

PATENT SPECIFICATION

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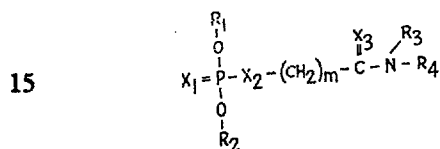
COMPLETE SPECIFICATION

Carbamylalkyl Phosphorodithioates

We, MONTECATINI SOCIETA GENERALE PER L'INDUSTRIA MINERARIA E CHIMICA, a body Corporate organised and existing under the laws of Italy, of 18 via Filippo Turati, Milan, Italy, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to carbamylalkyl phosphorodithioates.

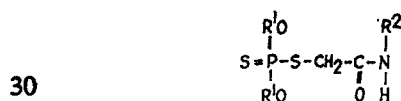
British Patent Specification No. 663,270 discloses phosphate esters having the general formula



in which R_1 and R_2 are alkyl, aralkyl or aryl radicals, R_3 and R_4 are hydrogen or alkyl, hydroxy, alkyl, aryl, or nitro-aryl radicals, X_1 , X_2 and X_3 are sulphur or oxygen and m is 1 to 4 inclusive.

20 It has now been found that certain substances falling within the general formula stated above have a particularly high parasiticide activity against animal parasites in all stages of their growth and, at the same time, a surprisingly low toxicity to warm blooded animals.

25 The invention provides carbamylalkyl-phosphorodithioates having the formula:

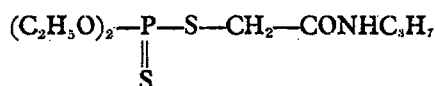


wherein R^1 is a methyl or ethyl group and R^2 is a methyl or isopropyl group and contains at least as many carbon atoms as R^1 .

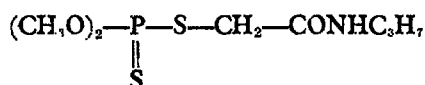
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More particularly the invention provides the following compounds:

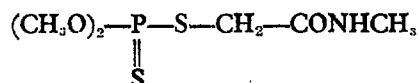
O,O-diethyl-S-(N-monoisopropyl)-carbamylmethyl-phosphorodithioate.



O,O-dimethyl-S-(N-monoisopropyl)-carbamylmethyl-phosphorodithioate.



O,O-dimethyl-S-(N-monomethyl)-carbamylmethyl-phosphorodithioate.



The invention further provides a process for preparing the carbamylalkyl-phosphorodithioates defined above, which process comprises reacting an alkali metal salt of an O,O-dialkyl phosphorodithioate with an N-methyl or N-isopropyl-alpha-halo-acetamide in the presence of a solvent for both reactants and at a temperature between 10 and 15° C. Highly pure compounds which require no further purification step can be obtained by this process.

The dialkylphosphorodithioate may be purified by preparing an aqueous solution of an alkali metal salt thereof and separating the undissolved oily phase therefrom, the remaining aqueous solution being used by condensation with the haloacetamide.

As a solvent, there may be used a mixture of water with one or more of the following water-miscible organic solvents: monohydric alcohols, ketones, dioxane, glycols, esters, and saturated aliphatic nitriles.

The invention further provides parasiticide

compositions comprising one or more phosphate esters as defined above, alone or in admixture with other active substances or with inert diluents.

The low toxicity and high parasitidal activity of the compounds in accordance with this invention compared with other compounds as illustrated by the following tables.

5

TABLE 1.
Relative toxicities of some N-amides

$\begin{array}{c} \text{C}_3\text{H}_7(\text{iso}) \\ \\ (\text{OCH}_3)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{S} \quad \text{O} \\ \\ \text{H} \end{array}$	Acute toxicity per os
(O,O-dimethyl-S - (N - isopropyl)-carbamylnmethyl-phosphorodithioate)	1
$\begin{array}{c} \text{CH}_3 \\ \\ (\text{OCH}_3)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{S} \quad \text{O} \\ \\ \text{CH}_3 \end{array}$	2.7
$\begin{array}{c} \text{CH}_3 \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{S} \quad \text{O} \\ \\ \text{CH}_3 \end{array}$	11
$\begin{array}{c} \text{CH}_3 \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{O} \quad \text{O} \\ \\ \text{CH}_3 \end{array}$	33
$\begin{array}{c} \text{C}_3\text{H}_7(\text{iso}) \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{S} \quad \text{O} \\ \\ \text{H} \end{array}$	4.2
$\begin{array}{c} \text{C}_3\text{H}_7(\text{iso}) \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{O} \quad \text{O} \\ \\ \text{H} \end{array}$	10
$\begin{array}{c} \text{CH}_3 \\ \\ (\text{OCH}_3)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{S} \quad \text{O} \\ \\ \text{H} \end{array}$	
(O,O - dimethyl-S-(N - monomethyl) - carbamylmethyl-phosphorodithioate)	1
$\begin{array}{c} \text{CH}_3 \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{S} \quad \text{O} \\ \\ \text{H} \end{array}$	22
$\begin{array}{c} \text{CH}_3 \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{O} \quad \text{S} \\ \\ \text{H} \end{array}$	47
$\begin{array}{c} \text{C}_2\text{H}_5 \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{S} \quad \text{O} \\ \\ \text{H} \end{array}$	8.4
$\begin{array}{c} \text{C}_2\text{H}_5 \\ \\ (\text{OC}_2\text{H}_5)_2\text{P}-\text{S}-\text{CH}_2-\text{C}-\text{N} \\ \quad \\ \text{O} \quad \text{O} \\ \\ \text{H} \end{array}$	15.5

TABLE 2
Results 2nd screening as compared with known compounds

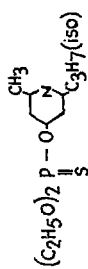
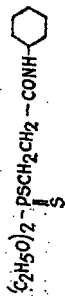
Compound	Activity						
	on flies			on aphides	on mites	Acute toxicity	
	topical	tarsal	on flies			per os	endovenous
1) Parathion	1	1	1	1	1	1	1
2) 	1/3	1/3	—	—	—	1/10.6	1/16.8
3) $(C_2H_5O)_2P(=S)-S-CH_2-CONHC_3H_7(iso)$	—	—	—	1/3	5	1/2.4	1/2.7
4) $(CH_3O)_2P(=S)-S-CH_2-CONH-CH_3$	1/3	1/4	1/4	1/4	1	1/22	1/18
5) $(CH_3O)_2P(=S)-S-CH_2-CONHC_3H_7(iso)$	1/10	1/20	1/20	1.5	10	1/10	1/14
6) $[CH_3(CH_2)_3O]_2P(=S)-SCH_2-CONH_2$	<1/1250	1/1800	1/1800	1/250	1/100	1/10.9	1/3.9
7) $(C_6H_5O)_2P(=S)SCH_2CONH_2$	<1/1250	<1/6250	<1/6250	1/300	1/100	1/134	1/211
8) 	<1/1250	<1/6250	<1/6250	1/100	1/250	1/500	1/61
9) 	1/1000	1/1800	1/1800	1/250	1/400	1/140	1/44

TABLE 3

Ratios of the biological activity of amides to their acute toxicity per os
in comparison with known compounds

Compound	on flies	on aphides	on mites
1) Parathion	1	1	1
2) $(C_2H_5O)_2P(=S)-O-C_6H_4-CH_3$ $C_3H_7(iso)$	3.5	—	—
3) $(C_2H_5O)_2P(=S)-CH_2-CONHC_3H_7(iso)$	—	0.8	12
4) $(CH_3O)_2P(=S)-S-CH_2CONH-CH_3$	5.5	5.5	22
5) $(CH_3O)_2P(=S)-S-CH_2-CONH-C_3H_7(iso)$	0.5	15	100
6) $[CH_3(CH_2)_3O]_2P(=S)-S-CH_2-CONH_2$	0.006	0.004	0.11
7) $(C_6H_5O)_2P(=S)-S-CH_2-CONH_2$	<0.021	<0.45	1.34
8) $(C_2H_5O)_2P(=S)-SCH_2CONH-$ 	~0.08	> 5	> 2
9) $(C_2H_5O)_2P(=S)-SCH_2CH_2-CONH-$ 	0.08	0.56	0.35

The following examples are given to illustrate the invention.

EXAMPLE 1.

- 5 1.58 kg of crude O,O-diethyl-hydrogen phosphorodithioate are dissolved in 2.5 litres of acetone (commercial grade), then 450 g of anhydrous Na_2CO_3 are added at a temperature not higher than 30° C., while stirring.
- 10 Stirring is continued for half an hour, then the solution is cooled to 10° C. 920 g N-isopropylchloroacetamide dissolved in 1000 cc acetone are added rapidly while cooling moderately to maintain the reaction mass at a temperature of about 10° C. After some
- 15 time a precipitate consisting of NaCl is formed; stirring is continued and the above temperature is maintained for 12 hours, then the acetone is distilled off at normal pressure

(about 65° C.). After distillation of the solvent is completed, the reaction mass is cooled and dipped into 6 litres of cold water. The oily phase is separated and shaken with a sodium bicarbonate solution if the pH is acidic, or with a carbon dioxide solution if the pH is alkaline, till the pH is 7. Finally, the mixture is allowed to separate completely and the oil is clarified by ~~filtration~~ through a pleated filter. 1950 g of crude O,O-diethyl-S-(N-monoisopropyl) - carbamylmethyl-phosphorodithioate are thus obtained. The product comes as a straw-coloured oil, D_4^{20} 1.1561 at 20° C., boiling point 152—155° C. at 0.1—0.2 mm Hg, refractive index n_D^{20} 1.5182, insoluble in water and soluble in numerous organic solvents like monohydric aliphatic alcohols such as ethanol and methanol,

20

25

30

35

34 filtration

aliphatic ether such as ethyl ether, ketones, and aromatic hydrocarbons of low molecular weight such as benzene and toluene.

EXAMPLE 2.

- 5 153 g of crude O,O-dimethyl - hydrogen-phosphorodithioate are dissolved in 250 cc acetone (commercial grade), then 35 g of anhydrous sodium carbonate are added at a temperature not higher than 30° C., while stirring. The solution is stirred for half an hour and then cooled to 10° C. 128 g isopropyl chloroacetamide dissolved in 300 cc acetone are then added rapidly while cooling the mass moderately to maintain the temperature at about 10° C. After some time, sodium chloride begins to form. The mixture is kept in agitation at said temperature for 12 hours, then the acetone is distilled off at normal pressure (65° C.). After distillation of the solvent is completed, the reaction mass is cooled and dipped into about 500 cc of cold water. A dense oily phase separates, which tends to crystallise. The oily-crystalline phase is shaken with a sodium bicarbonate solution if the pH is acidic or with a carbon dioxide solution if the pH is alkaline, till the pH is 7; then it is allowed to crystallise and the mixture is filtered by suction.
- 30 The O,O-dimethyl-S-(N - monoisopropyl)-carbamylmethyl-phosphorodithioate is in the form of crystals which are slightly yellow-coloured or colourless in the pure state, melt at 72—73° C., and are insoluble in water and propylene glycol, soluble in primary aliphatic alcohols and in ketones, scarcely soluble in ether, and soluble in dimethyl-acetamide.

EXAMPLE 3.

- 40 80 g of crude O,O-dimethyl - hydrogen-phosphorodithioate in 135 cc water are neutralised to pH 7 with about 31 g potassium carbonate. The mixture is filtered and the solids collected are washed twice with 70 cc water in total. The oil drops which settle in the filtrate are separated. The oily phase is discarded. The aqueous solution is transferred to a flask with 3 necks, provided with a good stirrer, and a solution of 38 g monoisopropyl-chloroacetamide in 35 cc acetone is added while stirring. The mass is stirred at 15° C. for at least 20 hours, then the flask is connected to a water jet suction pump and heated to 30° C. The mixture is kept at 30° C. under the maximum vacuum permitted by the apparatus (30—40 mm Hg) for about half an hour. Then it is cooled at about 5° C. for 1 hour and filtered by suction; the crystals collected are washed on the filter with a small amount of water.

- 60 By collecting also the crystals which separate from the mother liquors after 3 or 4 days, 60 g of O,O-dimethyl-S-(N-monoisopropyl)-carbamylmethyl-phosphorodithioate are obtained.

EXAMPLE 4.

525 g of crude O,O - dimethyl-hydrogen-phosphorodithioate are dissolved in about 1500 cc acetone (commercial grade), then about 173 g of anhydrous sodium carbonate are added at a temperature not higher than 30° C. while stirring. The solution is kept in agitation for half an hour and then cooled to 10° C. 300 g monomethylchloroacetamide dissolved in 400 cc acetone are added rapidly while cooling the mass moderately to maintain the temperature at about 10° C. After some time sodium chloride begins to form. The mixture is stirred at said temperature for 12 hours, then the acetone is distilled at normal pressure (65° C.). After distillation of the solvent is completed, the reaction mass is cooled and dipped into 500 cc of cold water. The oily phase thus separated is shaken with a sodium carbonate solution if the pH is acidic, or with a carbon dioxide solution if the pH is alkaline, till the pH is 7, and then allowed to separate completely. The oil obtained is clarified by filtration through a pleated filter. About 300 g of finished product are thus obtained.

The O,O-dimethyl-S-(N - monomethyl)-carbamylmethyl-phosphorodithioate comes as a straw-coloured oil having a specific gravity at 30° C. $d_4^{30} = 1.265$ and a refractive index $n_D^{30} = 1.53$. This product is insoluble in water and propylene glycol and soluble in primary aliphatic alcohols, ketones, ethyl ether, and dimethylacetamide.

EXAMPLE 5.

80 g of crude O,O - dimethyl - hydrogen-phosphorodithioate in 135 cc of water are neutralised to pH 7 with about 31 g potassium carbonate. The mixture is filtered and the filter is washed twice with a total of 70 cc water. The oil drops which settle in the filtrate are separated; the oily phase is discarded. The aqueous solution is transferred to a flask with 3 necks, provided with a good stirrer, and 30.5 g N-monomethylchloroacetamide in about 30 cc acetone are added. The mass is stirred at 15° C. for at least 20 hours, then the flask is connected to a water jet suction pump and heated to 30° C. The mixture is kept at 30° C. under a vacuum of 30—40 mm Hg for about half an hour. Then, the reaction mass is cooled and dipped into about 500 cc of cold water. The oily phase is separated and shaken with a sodium bicarbonate solution if the final pH is acidic, or with a carbon dioxide solution if the pH is alkaline, till the pH is 7. Finally, the mixture is allowed to separate completely and the oil obtained is clarified by filtration through pleated filters. 45—48 g of O,O - dimethyl-S-(N-monomethyl) - carbamylmethyl - phosphorodithioate are thus obtained.

As already said, the compounds of the present invention have proved as excellent para-

siticides. By the term "parasiticide" we mean herein an agent which is active for the control of animal parasites, such as for example:

Class of Arachnids:

- 5 Order of Mites: *Tetranychus telarius*,
Metatetranychus ulmi, etc.

Class of Insects:

- Order: Diptera: e.g. *Musca domestica*, *Culex pipiens*, *Dacus oleae* (olive fly)
10 Hemiptera: e.g. *Aphis fabae*, *Myzus persicae*, *Aphis pomi*, *Crysomphalus dictyospermi*
Coleoptera: e.g. *Calandra granaria*, *Tenebrio molitor*
15 Orthoptera: e.g. *Locusta migratoria-migratorioides*
Hymenoptera e.g. *Iridomyrmex humilis*
Lepidoptera: e.g. *Cydia pomonella*
20 Beetles: e.g. *Blatta orientalis*

- Formulations comprising O,O-diethyl-S-(N-monoisopropyl), O,O-dimethyl - S - (N-monoisopropyl) and O,O-dimethyl - S-(N-monomethyl) - carbamylmethyl - phosphorodithioates have proved experimentally to be effective for the control of various species of animal parasites, amongst which those belonging to the orders mentioned above, and in particular they present a special activity

against all mites, in all stages of their biological cycle. 30

The O,O - dimethyl-S-(N - monomethyl)-carbamyl-methyl - phosphorodithioate beside showing the same high general parasitocidal activity shown by the two 35 aforesaid compounds, proves to be especially active against *Musca domestica*, and has in particular a very low toxicity to warm-blooded animals, as it will be better demonstrated hereinafter. 40

The specific parasitocidal activity of the preferred compounds of this invention can be illustrated by the following examples in which said compounds are indicated for convenience as follows:— 45

— O,O-diethyl-S-(N - monoisopropyl) - carbamylmethyl-phosphorodithioate: I

— O,O - dimethyl-S - (N - monoisopropyl)-carbamylmethyl - phosphorodithioate: II

— O,O-dimethyl-S-(N - monomethyl) - carbamylmethyl-phosphorodithioate: III 50

1) Activity against *Tetranychus telarius*:

a) By nebulising a mixed population of mites in various stages of growth on bean plants under standardised conditions with suitably formulated aqueous dispersions of the compounds to be tested, the following average mortalities were obtained (at the twenty-fourth hour): 55

TABLE 4
Specific activity against *Tetranychus telarius*

Formulation based on compound	Concentration % active substance (A.S.)	% Mortality	% Mortality with equal doses of Parathion
I	0.001	100	80
	0.0005	95	35
	0.00025	90	—
	0.00010	65	—
II	0.001	100	80
	0.0005	89	35
	0.0001	90	—
III	0.02	100	—
	0.04	99	—
	0.001	90	80
	0.0005	35	35

By nebulising mite eggs, the following average mortalities were obtained (as measured 5 days after treatment):

TABLE 5

Activity against eggs of *Tetranychus telarius*

Formulation based on compound	Concentration % A.S.	% Mortality
I	0.125	100
	0.062	90
	0.031	50
II	0.125	100
	0.062	75
	0.031	10

- 5 c) A test carried out on eggs of *Tetranychus t.* laid within 3 days on apple-tree leaves, which are subsequently sprayed under standardised conditions as hereunder indicated, gave the following results:

TABLE 6

Activity against eggs of *Tetranychus telarius*

Formulation based on compound	Eggs not opened at concentrations of	
	0.1%	0.3%
I	95	98.5
II	58	78
III	23	44

10

2) Activity against *Aphis fabae*.

By nebulizing a population of aphides, apterous virginoparous females, on bean plants under standardised conditions with suitably

formulated aqueous dispersions of the compounds considered, the following average mortalities were obtained after 24 hours:

15

TABLE 7
Activity against *Aphis fabae*

Formulation based on compound	Concentration % A.S.	% Mortality	% Mortality with equal doses of Parathion
I	0.005	100	99
	0.004	100	—
	0.002	60	—
	0.001	25	65
II	0.005	100	99
	0.004	100	—
	0.001	85	65
	0.0005	10	5
III	0.01	100	100
	0.005	90	99
	0.004	75	90
	0.001	—	65

3) Activity against *Musca domestica*. ducts under examination to five days old 5
 a) By topical application, by means of a female flies, the following average per cent.
 microsyringe, of acetone solutions of the pro-mortalities were obtained after 20 hours:

TABLE 8
Activity against *Musca domestica*
(topical application)

Formulation based on compound	Micrograms A.S. per fly	% Mortality
I	1	100
	0.5	97
	0.4	81
II	0.4	100
	0.3	99
	0.2	75
III	0.1	100
	0.08	94
	0.06	65
	0.05	31

b) On tarsal absorption, after removal of the solvent, by introducing five days old female flies into a beaker previously treated with controlled amounts of benzene solutions of the active substances under examination, and leaving the flies in contact with these substances for 20 hours, the following mortalities were observed: 5

TABLE 9
Activity against *Musca domestica*
(tarsal absorption)

Formulation based on compound	g A.S./m ²	% Mortality, 20 h.
I	0.125	100
	0.025	100
	0.005	100
	0.001	45
II	0.01	100
	0.005	98
	0.001	45
III	0.001	100
	0.0005	95
	0.0002	55
	0.0001	10

- 10 4) Activity against *Acyrtosiphon onobrychis*. aphides with the following compounds in aqueous dispersion, the following results were obtained: 15
- By spraying under standardised conditions broad-bean plants infested by this kind of

TABLE 10
Activity against *Acyrtosiphon onobrychis*

Formulation based on compound	Concentration p.p.m. A.S.	% Mortality	DL ₅₀ p.p.m. A.S.
II	1.5	12.3	3
	2.0	30.5	
	2.6	39.0	
	3.6	67.7	
	4.6	73.4	
III	4	17.5	8
	8	49.5	
	15	77.4	
	30	97.3	

- 5) Activity against *Drosophila melanogaster*. The test was carried out by forming uniform deposits of the insecticides under examination through evaporation of the solvent of their solutions in Petri boxes. The results obtained by plotting the action lines for the compounds considered and for the comparison compounds are the following: 5

TABLE 11

Activity against *Drosophila melanogaster*.

Formulation based on compound	DL ₅₀ after 48 hours in gamma	Relative activity (Parathion = 1)
Parathion	0.55	1
O,O-diethyl-O-[2-(ethyl-mercapto)-ethyl]-thiophosphate	7.5	1/13.6
II	1.3	1/2.3
III	0.8	1/1.4

- 10 6) Activity against *Culex pipiens*. By dipping the third-aged larvae of these insects in suitably formulated aqueous dispersions of the compounds considered, the following average mortalities were obtained after 24 hours: 15

TABLE 12

Activity against *Culex pipiens*.

Formulation based on compound	A.S. p.p.m.	% Mortality
II	10	100
	5	86
	2	2
III	10	100
	5	98
	2	21

Moreover, substance I (O,O-diethyl-S-(N-monoisopropyl) - carbamylmethyl - phosphorodithioate) has proved as extraordinarily effective against the following parasites: 20

TABLE 13
Results of field tests.

Parasite	Concentration A.S. (p.p. Thousand)	% Mortality (after 26 hours)
Paratetranychus pilosus	0.18	100 (adults)
	0.14	100 (eggs)
Heliothrips haemor- roidalis (on snow-ball- tree)	0.1—0.2	100
Tingis pyri (on apple-tree)	0.1—0.2	100
Hyalopterous arun- dinis (on peach-tree)	0.16	95—100
Aphis pomi (on apple-tree)	0.2	100
Myrus cerasi	0.2	97

Determination of the acute toxicity (to warm-blooded animals) per os.

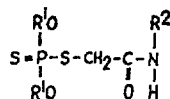
- 5 The acute toxicity per os was determined by gastric sounding and by administration of solutions of the product considered in
- dimethylacetamide to white mice size 18/20 g. The interference of the solvent with the toxic phenomena is to be considered as negligible.
- 10

TABLE 14
Acute toxicity per os.

Compound	D L (mm/kg)	Corresponding dose of	
		Parathion	Diazinone
I	19.54	8.2	—
II	82.22	8.2	86.5
III	180	8.2	86.5

What we claim is:—

1. Carbamylalkyl-phosphorodithioates having the formula:



wherein R¹ is a methyl or ethyl group and R² is a methyl or isopropyl group and contains at least as many carbon atoms as R¹.

2. O,O - Diethyl-S-(N - monoisopropyl)-carbamylmethyl-phosphorodithioate.

3. O,O - Dimethyl-S-(N - monoisopropyl)-carbamylmethyl-phosphorodithioate.

TABLE 13

Results of field tests.

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	0.14	100 (eggs)
Heliothrips haemor- roidalis (on snow-ball- tree)	0.1—0.2	100
Tingis pyri (on apple-tree)	0.1—0.2	100
Hyalopterous arun- dinis (on peach-tree)	0.16	95—100
Aphis pomi (on apple-tree)	0.2	100
Myrus cerasi	0.2	97

Determination of the acute toxicity (to warm-blooded animals) per os.

- 5 The acute toxicity per os was determined by gastric sounding and by administration of solutions of the product considered in

dimethylacetamide to white mice size 18/20 g. The interference of the solvent with the toxic phenomena is to be considered as negligible.

10

TABLE 14

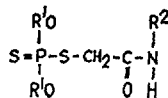
Acute toxicity per os.

Compound	D L (mm/kg)	Corresponding dose of	
		Parathion	Diazinone
I	19.54	8.2	—
II	82.22	8.2	86.5
III	180	8.2	86.5

What we claim is:—

1. Carbamylalkyl-phosphorodithioates having the formula:

15



wherein R¹ is a methyl or ethyl group and R² is a methyl or isopropyl group and contains at least as many carbon atoms as R¹.

2. O,O - Diethyl-S-(N - monoisopropyl)-carbamylmethyl-phosphorodithioate.

3. O,O - Dimethyl-S-(N - monoisopropyl)-carbamylmethyl-phosphorodithioate.

20



* C L M S *

4. O,O - Dimethyl - S - (N-monomethyl)-carbamylmethyl-phosphorodithioate.

5. A process for preparing the compounds defined in Claim 1 comprising reacting an alkali metal salt of an O,O-dialkylphosphorodithioate with an N-methyl or N-isopropyl-alpha-haloacetamide in the presence of a solvent for both reactants and at a temperature between 10 and 15° C.

10. 6. A process according to Claim 5, wherein the dialkylphosphorodithioate is purified by preparing an aqueous solution of an alkali metal salt thereof and separating the undissolved oily phase therefrom, the remaining aqueous solution being used for condensation with the haloacetamide.

20. 7. A process according to Claim 5 or Claim 6, wherein the solvent comprises water mixed with one or more of the following water-miscible organic solvents:—monohydric alcohols, ketones, dioxane, glycols, esters and saturated aliphatic nitriles.

8. A process for preparing the O,O-diethyl-

S - (N - monoisopropyl) - carbamylmethyl-phosphorodithioate substantially as herein described and illustrated by the foregoing Example 1. 25

9. A process for preparing the O,O-dimethyl - S-(N - monoisopropyl) - carbamylmethyl-phosphorodithioate substantially as herein described and illustrated by the foregoing Examples 2 and 3. 30

10. A process for preparing the O,O-dimethyl-S-(N-monomethyl) - carbamylmethyl-phosphorodithioate substantially as herein described and illustrated by the foregoing Examples 4 and 5. 35

11. Parasiticial compositions comprising one or more phosphate esters as claimed in any one of Claims 1 to 4 alone or in admixture with other active substances or with inert diluents. 40

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