

PATENT SPECIFICATION

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 WILHELM STENDEL and JURGEN SCHRAMM



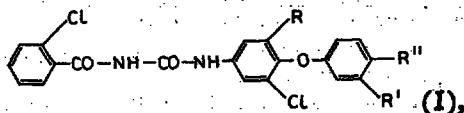
(54) NOVEL BENZOYLUREIDO-DIPHENYL ETHERS, AND
 THEIR USE AS INSECTICIDES

(71) We, BAYER AKTIENGESELLSCHAFT, a body corporate organised under the laws of Germany, of Leverkusen, Germany, 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:—

The present invention relates to certain new benzoylureido-diphenyl ethers, to a process for their preparation and their use as insecticides.

It is already known that certain benzoylureas, such as, for example, N - (2,6 - dichlorobenzoyl) - N - (4 - chlorophenyl) - urea, possess insecticidal properties (see German Offenlegungsschrift (German Published Specification) 2,123,236).

The present invention provides, as new compounds, the benzoylureido-diphenyl ethers of the general formula



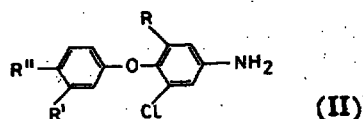
in which

R and R' are different from one another and are each hydrogen or chlorine, and R'' is nitro or cyano.

The compounds of the formula (I) have been found to possess strong insecticidal properties.

The present invention also provides a process for the preparation of a benzoylureido-diphenyl ether of the formula (I) in which

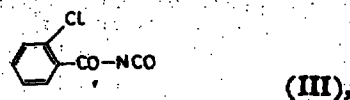
(a) a phenoxyaniline of the general formula



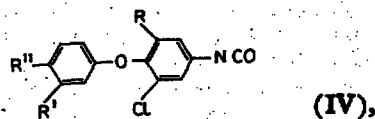
in which

R, R' and R'' have the above-mentioned meanings,

is reacted with 2-chlorobenzoylisocyanate of the formula

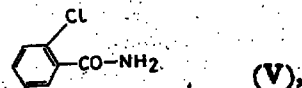


if appropriate in the presence of a solvent, or (b) a 4 - isocyanato - diphenyl ether of the general formula



in which

R, R' and R'' have the above-mentioned meanings, is reacted with 2-chlorobenzamide of the formula

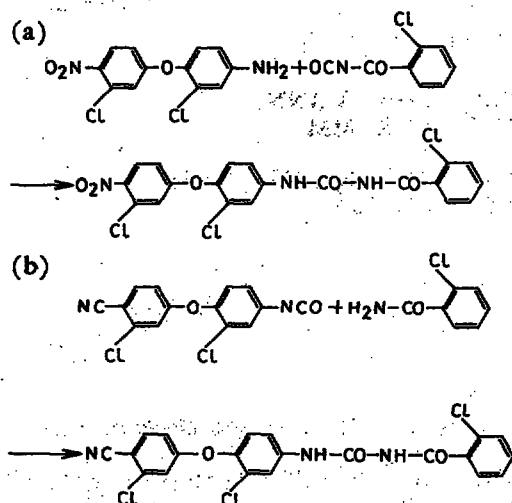


if appropriate in the presence of a solvent.

Surprisingly, the benzoylureido-diphenyl ethers according to the invention have a substantially better insecticidal action than the nearest compounds, previously known from the state of the art, which have an analogous

structure and the same type of action. The compounds according to the invention thus represent a genuine enrichment of the art.

- If, using process variant (a), 3-chloro-4-(3'-chloro-4'-nitrophenoxy)-aniline and 2-chlorobenzoylisocyanate are used as the starting materials, and using process variant (b), 3-chloro-4-(3'-chloro-4'-cyano-phenoxy)-phenylisocyanate and 2-chlorobenzamide are used as the starting materials, the courses of the reactions can be represented by the following equations:



- 2-Chlorobenzoylisocyanate (III), to be used as a starting material, is known from the literature and can be prepared according to generally customary processes [see A. J. Speziale *et al.*, J. Org. Chem. 30(12), pages 4,306-4,307 (1965)], as can 2-chlorobenzamide (V) (see Beilsteins Handbuch der organischen Chemie (Beilstein's Handbook of Organic Chemistry), volume 9, page 336). The phenoxyanilines (II) can be prepared in accordance with generally customary processes, for example from alkali metal aminophenolates and aromatic nitrohalogeno compounds in a solvent, for example dimethylsulphoxide, and the aminophenoxy-benzonitriles can be prepared likewise (see Jürgen Schramm *et al.*, Justus Liebigs Annalen der Chemie 1970, 740, 169-179). The amino group can be converted into the isocyanate group in accordance with generally customary processes, for example by reaction with phosgene.

- The following may be mentioned as examples of the phenoxyanilines (II) and 4-isocyanato-diphenyl ethers (IV) to be used as starting materials: 3-chloro-4-(3'-chloro-4'-nitro- or 3'-chloro-4'-cyanophenoxy)-aniline, 3,5-dichloro-4-(4'-nitro- or 4'-cyanophenoxy)-aniline, as well as 2,6-dichloro-4-isocyanato-4'-nitro-diphenyl ether, 2,6-dichloro-4-isocyanato-4'-cyano-diphenyl ether, 2-chloro-4-isocyanato-3'-chloro-4'-nitro-diphenyl ether and 2-chloro-4-

isocyanato-3'-chloro-4'-cyano-diphenyl ether.

The process variants for the preparation of the compounds according to the invention are preferably carried out in the presence of suitable solvents and diluents. Practically all inert organic solvents can be used for this purpose, especially aliphatic and aromatic optionally chlorinated hydrocarbons, such as benzene, toluene, xylene, benzine, methylene chloride, chloroform, carbon tetrachloride and chlorobenzene; ethers, for example diethyl ether, dibutyl ether and dioxan; ketones, for example acetone, methyl ethyl ketone, methyl isopropyl ketone and methyl isobutyl ketone; and nitriles, such as acetonitrile and propionitrile.

The reaction temperature can be varied within a fairly wide range. In general, the reaction is carried out at between 0° and 120°C, preferably at from 70° to 85°C.

In general, the reaction is allowed to take place under normal pressure.

To carry out the process, the reactants are preferably employed in equimolar amounts. An excess of one or other reactant produces no essential advantages.

The 4-isocyanato-diphenyl ethers (IV) to be employed in process variant (b) can be employed as such or, without intermediate isolation, in the form of the reaction mixture obtained from the reaction of amine with phosgene. This reaction mixture in one of the above-mentioned solvents, is treated with 2-chlorobenzamide. The reaction is carried out under the desired conditions and the product which separates out is isolated in the usual manner by filtration, washing and, if appropriate, recrystallisation.

The compounds are obtained in a crystalline form of sharp melting point.

As already mentioned, the benzoylureido-diphenyl ethers according to the invention are distinguished by an excellent insecticidal activity. They are not only active against plant pests but also, in the veterinary medicine field, against animal parasites (ectoparasites), such as parasitic fly larvae.

For this reason, the compounds according to the invention can be employed successfully in plant protection against biting and sucking insects, and as pesticides in the veterinary field.

To the sucking insects there belong, in the main, aphids (*Aphididae*) such as the green peach aphid (*Myzus persicae*), the bean aphid (*Doralis fabae*), the bird cherry aphid (*Rhopalosiphum padi*), the pea aphid (*Macrosiphum pisi*) and the potato aphid (*Macrosiphum solanifolii*), the currant gall aphid (*Cryptomyzus korschelti*), the rosy apple aphid (*Sappaphis mali*), the mealy plum aphid (*Hyalopterus arundinis*) and the cherry black-fly (*Myzus cerasi*); in addition scales and mealybugs (*Coccinea*), for example

the oleander scale (*Aspidiotus hederae*) and the soft scale (*Lecanium hesperidum*) as well as the grape mealybug (*Pseudococcus maritimus*); thrips (*Thysanoptera*), such as *Hercinothrips femoralis*, and bugs, for example the beet bug (*Piesma quadrata*), the red cotton bug (*Dysdercus intermedius*), the bed bug (*Cimex lectularius*), the assassin bug (*Rhodnius prolixus*) and Chagas' bug (*Triatoma infestans*) and, further cicadas, such as *Euscelis bilobatus* and *Nephotettix bipunctatus*.

In the case of the biting insects, above all there should be mentioned butterfly and moth caterpillars (*Lepidoptera*) such as the diamond-back moth (*Plutella maculipennis*), the gipsy moth (*Lymantria dispar*), the brown-tail moth (*Euproctis chrysorrhoea*) and tent caterpillar (*Malacosoma neustria*); further, the cabbage moth (*Mamestra brassicae*) and the cutworm (*Agrotis segetum*), the large white butterfly (*Pieris brassicae*) the small winter moth (*Cheimatobia brumata*), the green oak tortrix moth (*Tortrix viridana*), the fall armyworm (*Laphygma frugiperda*) and cotton worm (*Prodenia litura*), the ermine moth (*Hyponomeuta padella*), the Mediterranean flour moth (*Ephesia kuehniella*) and the greater wax moth (*Galleria mellonella*).

Also to be classed with the biting insects are beetles (*Coleoptera*), for example the granary weevil (*Sitophilus granarius* = *Calandra granaria*), the Colorado beetle (*Leptinotarsa decemlineata*), the dock beetle (*Gastrophysa viridula*), the mustard beetle (*Phaedon cochleariae*), the blossom beetle (*Meligethes aeneus*), the raspberry beetle (*Byturus tomentosus*), the bean weevil (*Bruchidius* = *Acanthoscelides obtectus*), the leather beetle (*Dermestes frischi*), the khapra beetle (*Trogoderma granarium*), the flour beetle (*Tribolium castaneum*), the northern corn billbug (*Calandra* or *Sitophilus zeamais*), the drugstore beetle (*Stegobium paniceum*), the yellow mealworm (*Tenebrio molitor*) and the saw-toothed grain beetle (*Oryzaephilus surinamensis*), but also species living in the soil, for example wireworms (*Agriotes spec.*) and larvae of the cockchafer (*Melolontha melolontha*); cockroaches, such as the German cockroach (*Blattella germanica*), American cockroach (*Periplaneta americana*), Madeira cockroach (*Leucophaea* or *Rhyparobia maderae*), oriental cockroach (*Blatta orientalis*), the giant cockroach (*Blaberus giganteus*) and the black giant cockroach (*Blaberus fuscus*) as well as *Henschoutedenia flexivitta*; further, *Orthoptera*, for example the house cricket (*Gryllus domesticus*); termites such as the eastern subterranean termite (*Reticulitermes flavipes*) and *Hymenoptera* such as ants, for example the garden ant (*Lasius niger*).

The *Diptera* comprise essentially the flies, such as the vinegar fly (*Drosophila melanogaster*), the Mediterranean fruit fly (*Ceratitis*

capitata), the house fly (*Musca domestica*), the little house fly (*Fannia canicularis*), the black blow fly (*Pormia regina*) and bluebottle fly (*Calliphora erythrocephala*) as well as the stable fly (*Stomoxys calcitrans*); further, gnats, for example mosquitoes such the yellow fever mosquito (*Aedes aegypti*), the northern house mosquito (*Culex pipiens*) and the malaria mosquito (*Anopheles stephensi*).

The active compounds according to the present invention can be converted into the usual formulations, such as solutions, emulsions, suspensions, powders, pastes and granulates. These may be produced in known manner, for example by mixing the active compounds with extenders, that is, liquid or solid or liquefied gaseous diluents or carriers, optionally with the use of surface-active agents, that is, emulsifying agents and/or dispersing agents and/or foam-forming agents. In the case of the use of water as an extender, organic solvents can, for example, also be used as auxiliary solvents.

As liquid diluents or carriers, there are preferably used aromatic hydrocarbons, such as xylenes, toluene, benzene or alkyl naphthalenes, chlorinated aromatic or aliphatic hydrocarbons, such as chlorobenzenes, chloroethylenes or methylene chloride, aliphatic hydrocarbons, such as cyclohexane or paraffins, for example mineral oil fractions, alcohols such as butanol or glycol as well as their ethers and esters, ketones, such as acetone, methyl ethyl ketone, methyl isobutyl ketone or cyclohexanone, or strongly polar solvents, such as dimethyl formamide, dimethyl sulphoxide or acetonitrile, as well as water.

By liquefied gaseous diluents or carriers are meant liquids which would be gaseous at normal temperatures and pressures, for example aerosol propellants, such as halogenated hydrocarbons, for example Freon (trade mark).

As solid diluents or carriers, there are preferably used ground natural minerals, such as kaolins, clays, talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth or ground synthetic minerals, such as highly-dispersed silicic acid, alumina or silicates.

Preferred examples of emulsifying and foam-forming agents include non-ionic and anionic emulsifiers, such as polyoxyethylene-fatty acid esters, polyoxyethylene-fatty alcohol ethers, for example alkylaryl polyglycol ethers, alkyl sulphonates, alkyl sulphates and aryl sulphonates as well as albumin hydrolyzation products; and preferred examples of dispersing agents include lignin sulphite waste liquors and methyl cellulose.

The active compounds according to the invention can be employed in the formulations as mixtures with other active compounds.

The formulations in general contain from 0.1 to 95 per cent by weight of active compound, preferably from 0.5 to 90 per cent.

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85

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95

100

105

110

115

120

125

130

The active compounds can be employed as such, in the form of their formulations or as the use forms prepared therefrom, such as ready-to-use solutions, emulsions, foams, suspensions, powders, pastes, soluble powders, dusting agents and granules. They may be used in the customary manner, for example by squirting, spraying, atomising, dusting, scattering, fumigating, gassing, watering, dressing or encrusting.

The active-compound concentrations in the ready-to-use preparations can be varied within fairly wide ranges. In general, they are between 0.0001 and 10%, preferably between 0.01 and 1%, by weight.

The active compounds can also be used with good success in the ultra-low-volume (ULV) method, where it is possible to apply formulations of up to 95% active compound or even to use the active compound by itself.

The present invention also provides an insecticidal composition containing as active ingredient a compound of the present invention in admixture with a solid or liquefied gaseous diluent or carrier or in admixture with a liquid diluent or carrier containing a surface-active agent.

The present invention also provides a method of combating insects which comprises applying to the insects or an insect habitat a compound of the present invention alone or in the form of a composition containing as active ingredient a compound of the present invention in admixture with a diluent or carrier.

The present invention further provides crops protected from damage by insects by being grown in areas in which immediately

prior to and/or during the time of the growing a compound of the present invention was applied alone or in admixture with a diluent or carrier. It will be seen that the usual methods of providing a harvested crop may be improved by the present invention.

The pesticidal activity of the compounds of this invention is illustrated by the following biotest Examples.

Example A.

Plutella test

Solvent: 3 parts by weight of dimethylformamide

Emulsifier: 1 part by weight of alkylaryl polyglycol ether

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

Cabbage leaves (*Brassica oleracea*) were sprayed with the preparation of the active compound until dew moist and were then infested with caterpillars of the diamond-back moth (*Plutella maculipennis*).

After the specified periods of time, the degree of destruction was determined as a percentage: 100% means that all the caterpillars were killed whereas 0% means that none of the caterpillars were killed.

The active compounds, the concentrations of the active compounds, the evaluation times and the results can be seen from the following table:

TABLE A

Plutella test

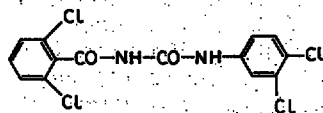
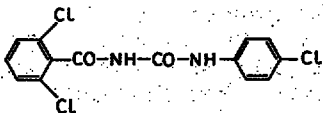
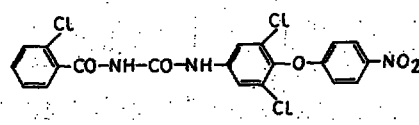
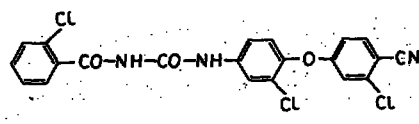
Active compound	Active compound concentration in %	Degree of destruction in % after 8 days
 (Known)	0.1 0.01 0.001	100 100 15
 (Known)	0.1 0.01	65 0

TABLE A

Plutella test

Active compound	Active compound concentration in %	Degree of destruction in % after 8 days
 (1)	0.1	100
	0.01	100
	0.001	100
 (2)	0.1	100
	0.01	100
	0.001	100

Example B.

Test with parasitic fly larvae

Solvent: 35 parts by weight of ethylene polyglycol monomethyl ether

34 parts by weight of nonylphenol polyglycol ether

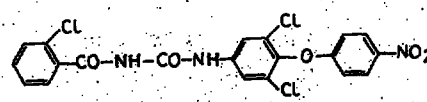
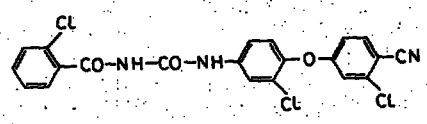
To produce a suitable preparation of active compound, 30 parts by weight of the active substance in question were mixed with the stated amount of solvent which contained the above-mentioned proportion of emulsifier and the concentrate thus obtained was diluted with water to the desired concentration.

About 20 fly larvae (*Lucilia cuprina*) were introduced into a test tube which contained approx. 2 cm³ of horse muscle. 0.5 ml of the preparation of active compound was applied to this horse meat. After 24 hours, the degree of destruction in % was determined. 100% means that all the larvae had been killed and 0% means that no larvae had been killed.

The active compounds investigated, the concentrations of the active compounds used and the results obtained can be seen from the table which follows:

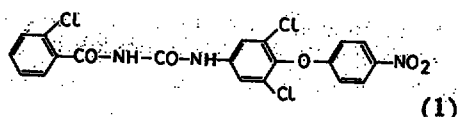
TABLE B

Test with parasitic fly larvae/*Lucilia cuprina* res.

Active compound	Active compound concentration in ppm	Degree of destruction in %
 (1)	1,000	100
 (2)	1,000	100

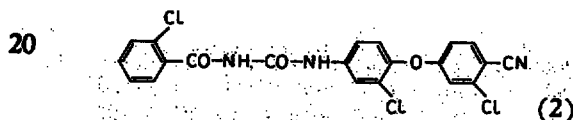
The process of this invention is illustrated by the following preparative Examples.

Example 1.



- 5 A solution of 5.5 g (0.03 mole) of 2-chlorobenzoylisocyanate in 50 ml of toluene was added dropwise at 80°C to 9 g (0.03 mole) of 3,5 - dichloro - 4 - (4' - nitrophenoxy) - aniline in 150 ml of toluene. The batch was stirred for 1 hour at 80°C and after cooling the product which had precipitated was filtered off and was washed first with toluene and then with petroleum ether. After drying, 10 g (69% of theory) of analytically pure 4 - nitro - 2',6' - dichloro - 4' - [N - (N' - (o - chlorobenzoyl)) - ureido] - diphenyl ether of melting point 184°C were obtained.

Example 2.

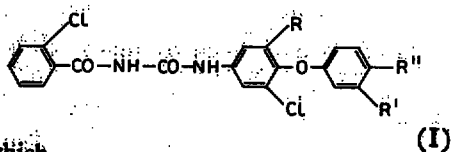


- 20 A solution of 7.3 g (0.04 mole) of 2-chlorobenzoylisocyanate in 50 ml of toluene was added dropwise at 80°C to a solution of 10.2 g (0.04 mole) of 3 - chloro - 4 - (3' - chloro - 4' - cyano - phenoxy) - aniline in 100 ml of toluene. The batch was stirred for 1 hour at 80°C and the substance which separated out was filtered off after cooling the reaction mixture to 20°C, and was washed with toluene and petroleum ether. After drying, 12 g (65% of theory) of 3 - chloro - 4 - cyano - 2' - chloro - 4' - [N - (N' - (o - chlorobenzoyl)) - ureido] - diphenyl ether of melting point 209°C were obtained.

35 The above compounds could also be obtained from the corresponding 4 - isocyanato-diphenyl ethers by reaction with 2-chlorobenzamide.

WHAT WE CLAIM IS:—

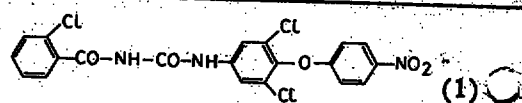
- 40 1. Benzoylureidodiphenyl ethers of the general formula



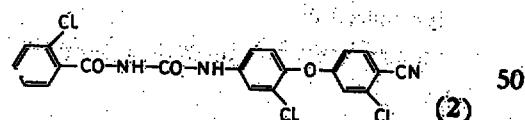
in which

- 45 R and R' are different from one another and are each hydrogen or chlorine; and R'' is nitro or cyano.

2. The compound of the formula

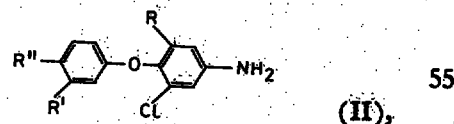


3. The compound of the formula



4. A process for the preparation of a benzoylureidodiphenyl ether according to claim 1, 2 or 3, in which

(a) a phenoxyaniline of the general formula

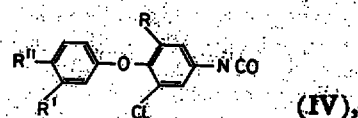


in which

R, R' and R'' have the meaning stated in claim 1, is reacted with 2-chlorobenzoylisocyanate of the formula

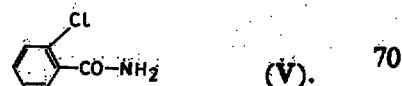


or (b) a 4 - isocyanato - diphenyl ether of the general formula



in which

R, R' and R'' have the meanings stated in claim 1, is reacted with 2-chlorobenzamide of the formula



5. A process according to claim 4(a) in which the phenoxyaniline (II) is one that is hereinbefore referred to.

6. A process according to claim 4(b) in which the 4 - isocyanato - diphenyl ether (IV) is one that is hereinbefore referred to.

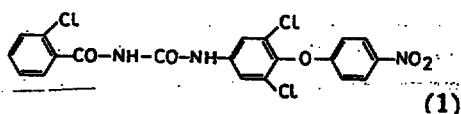
7. A process according to claim 4, 5 or 6, in which the reaction is effected in the presence of a diluent or solvent.

8. A process according to any of claims 4 to 7, in which the reaction is effected at between 0°C and 120°C.

9. A process according to claim 8, in which the reaction is effected at between 70°C and 80°C.

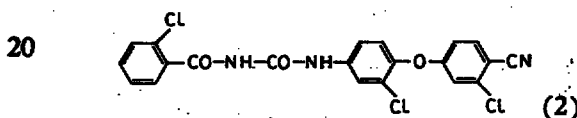
The process of this invention is illustrated by the following preparative Examples.

Example 1.



- 5 A solution of 5.5 g (0.03 mole) of 2-chlorobenzoylisocyanate in 50 ml of toluene was added dropwise at 80°C to 9 g (0.03 mole) of 3,5-dichloro-4-(4'-nitrophenoxy)-aniline in 150 ml of toluene. The batch was stirred for 1 hour at 80°C and after cooling the product which had precipitated was filtered off and was washed first with toluene and then with petroleum ether. After drying, 10 g (69% of theory) of analytically pure 4-nitro-2',6'-dichloro-4'-[N-(N'-(o-chlorobenzoyl))-ureido]-diphenyl ether of melting point 184°C were obtained.

Example 2.

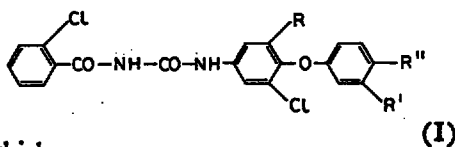


- 20 A solution of 7.3 g (0.04 mole) of 2-chlorobenzoylisocyanate in 50 ml of toluene was added dropwise at 80°C to a solution of 10.2 g (0.04 mole) of 3-chloro-4-(3'-chloro-4'-cyano-phenoxy)-aniline in 100 ml of toluene. The batch was stirred for 1 hour at 80°C and the substance which separated out was filtered off after cooling the reaction mixture to 20°C, and was washed with toluene and petroleum ether. After drying, 12 g (65% of theory) of 3-chloro-4-[N-(N'-(o-chlorobenzoyl))-ureido]-diphenyl ether of melting point 209°C were obtained.

- 30 The above compounds could also be obtained from the corresponding 4-isocyanato-diphenyl ethers by reaction with 2-chlorobenzamide.

WHAT WE CLAIM IS:—

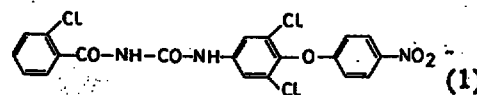
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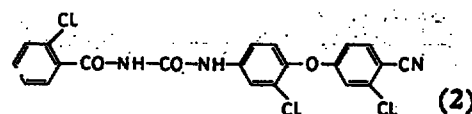
in which

- 45 R and R' are different from one another and are each hydrogen or chlorine, and R'' is nitro or cyano.

2. The compound of the formula

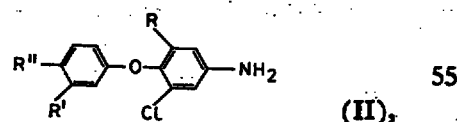


3. The compound of the formula



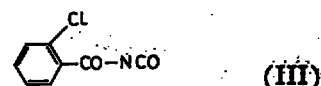
4. A process for the preparation of a benzoylureidodiphenyl ether according to claim 1, 2 or 3, in which

- (a) a phenoxyaniline of the general formula

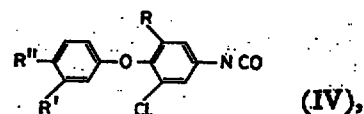


in which

- R, R' and R'' have the meaning stated in claim 1, is reacted with 2-chlorobenzoylisocyanate of the formula

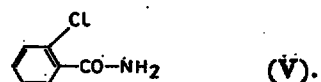


- or (b) a 4-isocyanato-diphenyl ether of the general formula



in which

- R, R' and R'' have the meanings stated in claim 1, is reacted with 2-chlorobenzamide of the formula



5. A process according to claim 4(a) in which the phenoxyaniline (II) is one that is hereinbefore referred to.

6. A process according to claim 4(b) in which the 4-isocyanato-diphenyl ether (IV) is one that is hereinbefore referred to.

7. A process according to claim 4, 5 or 6, in which the reaction is effected in the presence of a diluent or solvent.

8. A process according to any of claims 4 to 7, in which the reaction is effected at between 0°C and 120°C.

9. A process according to claim 8, in which the reaction is effected at between 70°C and 80°C.





10. A process according to any of claims 4 to 9, in which the reactants are employed in submolar amounts.
- 5 11. A process for the preparation of a compound according to claim 1, substantially as hereinbefore described in Example 1 or 2.
12. Compounds according to claim 1, whenever prepared by a process according to any of claims 4 to 11.
- 10 13. An insecticidal composition containing as active ingredient a compound according to any of claims 1 to 3 and 12 in admixture with a solid or liquefied gaseous diluent or carrier or in admixture with a liquid diluent or carrier containing a surface-active agent.
- 15 14. A composition according to claim 12 containing from 0.1 to 95% of the active compound, by weight.
- 20 15. A composition according to claim 13 containing from 0.5 to 90% of the active compound, by weight.
- 25 16. A method of combating insects which comprises applying to the insects or an insect habitat a compound according to any of claims 1 to 3 and 12 alone or in the form of a composition containing as active ingredient a compound according to any of claims 1 to 3 and 12 in admixture with a diluent or carrier.
17. A method according to claim 16 in which a composition is used containing from 0.0001 to 10% of the active compound, by weight.
18. A method according to claim 17 in which a composition is used containing from 0.01 to 1% of the active compound, by weight.
19. A method according to any of claims 16 to 18 in which the active compound is one of those hereinbefore mentioned in Example A or B.
20. Crops protected from damage by insects by being grown in areas in which immediately prior to and/or during the time of the growing a compound according to any of claims 1 to 3 and 12 was applied alone or in admixture with a diluent or carrier.
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