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(54) Title: PESTICIDE COMPOSITIONS

(57) Abstract: Pesticide compositions are provided that comprise microcapsules that contain pirimiphos-methyl and (1) at least one plant essential oil selected from citronella, peppermint oil, d-limonene and abies sibirica or (2) at least one aromatic hydrocarbon solvent, wherein the pirimiphos-methyl is present in said composition in a pesticidally effective amount. The present invention also provides a method for controlling pests (such as mosquitoes and other disease vectors) which comprises applying the compositions of the invention to the target pests, to their locus or to a surface or substrate by brushing, rolling, spraying, spreading or dipping. By way of example, an IRS application of a surface such as a wall, ceiling or floor surface or the treatment of a substrate such as a bed net are contemplated by the method of the invention.

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PESTICIDE COMPOSITIONS

[0001] The field of the invention relates generally to pesticide compositions containing organophosphates and to methods for use thereof. More particularly, the compositions of this invention comprise pyrimidinyl phosphorothioate pesticides microencapsulated with at least one plant essential oil for use in controlling pests.

[0002] Many infectious diseases (e.g. malaria, dengue and yellow fever, lymphatic filariasis, and leishmaniasis) that are responsible for debilitating or even killing humans and animals in many countries, especially in tropical countries, are transmitted by insects. For example, the mosquito parasite, *Plasmodium falciparum*, accounts for greater than 25% of childhood mortality outside the neonatal period. In certain parts of Africa, malaria has been ranked first by the World Bank in terms of disability-adjusted life-years lost. Insufficiently developed and financed health services as well as drug resistance have hampered many medical efforts to improve the situation. More recently, efforts have been concentrated on controlling the transmitting insects.

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[0003] Many malaria vectors are endophilic, resting inside houses after taking a blood meal. These mosquitoes are particularly susceptible to control through indoor residual spraying (IRS). As its name implies, IRS involves coating the walls and other surfaces of a house with a residual insecticide. For several months, the insecticide will kill mosquitoes and other insects that come in contact with these surfaces. IRS does not directly prevent people from being bitten by mosquitoes. Rather, it usually kills mosquitoes after they have fed, if they come to rest on the sprayed surface. IRS thus prevents transmission of infection to other persons.

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[0004] To be effective, IRS must be applied to a very high proportion of households in an area (usually >70%). Although the community plays a passive role in IRS programs, cooperation with an IRS effort is a key to its success. Community participation for IRS often consists of cooperating with the spray teams by removing food and covering surfaces prior to spraying and refraining from covering the treated surfaces with new paint or plaster. However, community or individual householder opposition to IRS due to the smell, mess, possible chemical exposure, or sheer bother has become a serious problem in some areas.

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[0005] For many years, indoor residual applications of pyrethroid insecticides have been the main method for the control of malaria vectors. Due to the threat of increasing resistance in

5 vectors to such insecticides, alternative organophosphate insecticides are being developed and evaluated for their efficiency under field conditions. Pirimiphos-methyl is a fast acting pyrimidinyl phosphorothioate insecticide having the chemical structure of (Phosphorothioic acid, O-[2-(diethylamino)-6-methyl-4-pyrimidinyl] O,O-dimethyl ester) employing CAS nomenclature. A liquid product containing 50 weight percent pirimiphos-methyl is being sold
10 under the trademark Actellic® 50EC by Syngenta for use in grain, grain stores, and for fly control. Pirimiphos-methyl as Actellic also has been demonstrated to be highly effective against pyrethroid resistant mosquitoes. Furthermore, it has also been shown to be effective against some strains of insects with organophosphate resistance.

15 [0006] However, the current emulsifiable concentrate composition of pirimiphos-methyl (Actellic 50EC), although recommended for use in IRS by WHOPES, is not satisfactory in all respects because of its limited residual efficacy compared to that of pyrethroids and DDT. It has also been noted that during its use the product has a particularly strong unpleasant odour. That can lead to subsequent problems, especially with respect to community or individual householder
20 opposition to IRS. There therefore exists a further need for improved compositions, especially having good residual efficacy and having reduced odor.

[0007] Surprisingly, it has now been found that pesticide compositions comprising microcapsules that contain pirimiphos-methyl and certain hydrocarbon solvents or plant essential
25 oils have good residual efficacy and reduced odor relative to other pirimiphos-methyl formulations. The inventive compositions are very effective for combating or controlling disease vectors and also are suitable for use in IRS applications.

[0008] In accordance with the present invention, pesticide compositions are provided that
30 comprise microcapsules that contain pirimiphos-methyl and (1) at least one plant essential oil selected from citronella, peppermint oil, d-limonene and abies sibirica, (2) at least one single or mixed aromatic hydrocarbon solvent, or mixtures of (1) and (2), wherein the pirimiphos-methyl is present in said composition in a pesticidally effective amount.

35 [0009] The present invention also provides a method for controlling pests (such as mosquitoes and other disease vectors). In one embodiment, the method for controlling pests comprises applying the compositions of the invention to the target pests, to their locus or to a surface or substrate by brushing, rolling, spraying, spreading or dipping. By way of example, an IRS

5 application of a surface such as a wall, ceiling or floor surface is contemplated by the method of the invention. In another embodiment, it is contemplated to apply such compositions to a substrate such as a fabric material in the form of (or which can be used in the manufacture of) netting, clothing, bedding, curtains and tents.

10 [0010] In one embodiment, the pesticide composition is a liquid dispersion of such microcapsules and, more particularly, is an aqueous suspension of such microcapsules. Such aqueous microcapsule suspensions are also referred to as aqueous capsule suspensions (CS).

[0011] Suitable plant essential oils for use in the pesticidal compositions and pest control
15 methods of the present invention are oils suitable for IRS application, typically of high purity, and, in one embodiment, also are characterized by odor masking properties and solvency for or miscibility with pirimiphos-methyl. Suitable oils are generally composed of one or more plant essential oils such as those selected from citronella, peppermint oil, d-limonene and abies sibirica. These plant essential oil materials are known and used for other uses and can be prepared by a
20 skilled artisan by employing known methods and also are available commercially.

[0012] Suitable aromatic hydrocarbon solvents include, for example, a single or mixed hydrocarbon solvent comprising one or more members selected from the group consisting of C₈-C₁₁ aromatic hydrocarbons. Suitable commercially available mixtures include Solvesso 100 or
25 Solvesso 150 (manufactured by Exxon Mobil Co.)

[0013] The microcapsules that are suitable for use in the compositions and methods according to the invention contain a mixture comprising pirimiphos-methyl and (1) at least one plant essential oil selected from citronella, peppermint oil, d-limonene and abies sibirica or (2) at least one
30 aromatic hydrocarbon solvent, which mixture is contained within an encapsulating wall of polymeric material. Such microcapsules are prepared with any suitable technique known in the art.

[0014] For example, various processes for microencapsulating material have been previously
35 developed. These processes can be divided into three categories-physical methods, phase separation and interfacial reaction. In the physical methods category, microcapsule wall material and core particles are physically brought together and the wall material flows around the core particle to form the microcapsule. In the phase separation category, microcapsules are formed by

5 emulsifying or dispersing the core material in an immiscible continuous phase in which the wall material is dissolved and caused to physically separate from the continuous phase, such as by coacervation, and deposit around the core particles. In the interfacial reaction category, microcapsules are formed by emulsifying or dispersing the core material in an immiscible continuous phase and then an interfacial polymerization reaction is caused to take place at the
10 surface of the core particles.

[0015] In one embodiment, the concentration of the pirimiphos-methyl present in the microcapsules of the invention can vary from 0.1 to 95% by weight of the microcapsule. The concentration of the plant essential oil present in the microcapsules can vary from 0.1 to 90%. In
15 one embodiment of the invention, the concentration of the pirimiphos-methyl present is about 55% by weight of the microcapsule and the concentration of the plant essential oil is between 30-45% by weight of the microcapsule. In another embodiment of the invention, the concentration of the pirimiphos-methyl present is about 70% by weight of the microcapsule and the concentration of the plant essential oil is between 5-15% by weight of the microcapsule. In
20 general, suitable microcapsules are particles with diameters between 0.1 and 1000 μm .

[0016] In one aspect, suitable microcapsule polymeric wall materials are selected from the polyureas, aminoplasts, polyurethanes and polyamides.

25 [0017] In one embodiment, polyurea microcapsules containing pirimiphos-methyl are prepared as exemplified in U.S. Pat. No. 4,285,720, which involves the use of at least one polyisocyanate such as polymethylene polyphenylisocyanate (PMPPi) and/or tolylene diisocyanate (TDI) as the prepolymer. In the creation of polyurea microcapsules, the wall-forming reaction is initiated by heating the emulsion to an elevated temperature at which point the isocyanate polymers are
30 hydrolyzed at the interface to form amines, which in turn react with unhydrolyzed polymers to form the polyurea microcapsule wall.

[0018] In one embodiment, pirimiphos-methyl containing polyurea microcapsules are prepared which also contain: (i) 5 – 45% by weight, more particularly, 5 – 15% by weight of citronella; (ii)
35 5 – 45% by weight, more particularly, 5 – 15% by weight of peppermint oil; (iii) 5 – 45% by weight, more particularly, 5 – 15% by weight of d-limonene; or (iv) 5 – 45% by weight, more particularly, 5 – 15% by weight of abies sibirica.

5 [0019] Aqueous capsule suspensions (CS) in accordance with the invention are prepared with a polymerisation stage such that an aqueous dispersion of oil droplets is obtained, in which each oil droplet is encapsulated by a polymeric shell and contains pirimiphos-methyl and a plant essential oil carrier or diluent therefor. As noted above, the polymeric shell may be produced by either an interfacial polycondensation reaction or by a coacervation procedure. The CS compositions thus
10 obtained may provide for controlled release of pirimiphos-methyl and they may be used for IRS treatment.

[0020] It is, however, also possible to separate the microcapsules from the directly obtained capsule suspension by: (a) filtration or centrifugation and either to dry or convert them once more
15 into a suspension; or (b) by spray drying the microcapsules using known methods. The microcapsules which have been isolated from the suspension and dried are in the form of, for example, a flowable powder. The microcapsules can also be adsorbed on to a surface (such as a wall, ceiling or floor) or on to a substrate (such as a fabric material including, for example, polyester bed nets).

20 [0021] The suspensions of microcapsules obtainable in the process of this invention are directly ready for use. However, for transportation and storage they can be stabilised by the addition of further ingredients such as surface-active agents, thickeners, antifoams and antifreeze agents.

25 [0022] Accordingly, if it is desirable, the liquid compositions described herein can be compounded with, or have mixed therein, other known ingredients such as plasticizers, emulsifiers, surface active agents, stabilizers (including UV light protectants), fillers, antioxidants, fungicides, antimicrobials, antifoaming agents, drying adjuvants, levelling agents, pigments, or other compounding aids. Furthermore, thickeners or bodying agents may be added to
30 the liquid composition so as to control the viscosity of the composition and thereby achieve the proper flow properties for the particular application desired. Such materials are well known in the art.

[0023] Suitable wetting, emulsifying or dispersing agents, may be of the cationic, anionic or
35 non-ionic type. Suitable agents of the cationic type include, for example, quaternary ammonium compounds, for example, cetyltrimethyl ammonium bromide. Suitable agents of the anionic type include, for example, soaps, salts of aliphatic monoesters or sulphuric acid, for example, sodium lauryl sulphate, salts of sulphonated aromatic compounds, for example, sodium dodecylbenzene-

5 sulphonate, sodium, calcium or ammonium lignosulphonate, or butylnaphthalene sulphonate, and a mixture of the sodium salts of diisopropyl- and triisopropylnaphthalene sulphonates. Suitable agents of the non-ionic type include, for example, the condensation products of ethylene oxide with fatty alcohols such as oleyl alcohol or cetyl alcohol, or with alkyl phenols such as octyl phenol, nonyl phenol and octyl cresol. Other non-ionic agents are the partial esters derived from
10 long chain fatty acids and hexitol anhydrides, the condensation products of the said partial esters with ethylene oxide, and the lecithins.

[0024] Additional microencapsulated or non-microencapsulated active ingredients to be applied at a locus separately, sequentially in any order, or simultaneously with the microcapsules of the
15 invention may be employed for enhanced pesticidal effect and for pest resistance management reasons. Specific examples of suitable additional active ingredients include lambda cyhalothrin, α -cypermethrin, deltamethrin, permethrin, malathion, fenitrothion, bendiocarb, propoxur, cyfluthrin, and etofenprox.

20 [0025] Accordingly, in one embodiment, the pesticide compositions comprise a mixture of (a) microcapsules of pirimiphos-methyl and certain plant essential oils with (b) one or more such additional microencapsulated or non-microencapsulated active ingredients.

[0026] In another embodiment, a pesticide composition comprising microcapsules of pirimiphos-methyl and certain plant essential oils is provided or used with a separate pesticide composition
25 containing the additional active ingredient (e.g., a microencapsulated lambda cyhalothrin such as Icon 10 CS, Icon 2.5 CS or the like). These materials can be applied sequentially over a relatively short time period or can be combined with water in a treatment container or tank to form a final treatment composition for simultaneous application. Alternatively, the materials can
30 be applied separately as part of a more long term treatment regime.

[0027] In one embodiment, the pesticidal compositions which are to be used in the form of aqueous suspensions, dispersions or emulsions are generally supplied in the form of a concentrate containing a high proportion of the active ingredient or ingredients, the said concentrate to be
35 diluted with water before use. These concentrates are often required to withstand storage for prolonged periods and after such storage, to be capable of dilution with water to form aqueous preparations which remain homogenous for a sufficient time to enable them to be applied by spreading, brushing or by conventional spray equipment. The concentrates contain from 1 – 85%

5 by weight of the active ingredient (pirimiphos-methyl) or mixture of active ingredients. When diluted to form aqueous preparations, such dilute preparations may contain varying amounts of the active ingredient or ingredients depending on the purpose for which they are to be used. For example, for IRS purposes, an aqueous CS spray composition containing between 0.001% to 1% by weight of pirimiphos-methyl microencapsulated along with a suitable plant essential oil is
10 used alone or in admixture with other active ingredients.

[0028] In one aspect, target pests include insects belonging to the order Diptera (covering mosquitoes, gnats, black flies, tsetse flies and other biting flies), Hemiptera (covering bed bugs) and Siphonaptera (covering fleas). Among target pests there may also be mentioned, Dictyoptera
15 (covering cockroaches), Coleoptera (covering pests of stored grain), Lepidoptera (covering moths) and Arachnids (covering spiders, mites and ticks). The present invention is particularly suited for controlling flying pests such as mosquitoes including, for example, species of the *Anopheles gambiae* complex.

20 [0029] In one embodiment, the method for controlling such pests comprises applying a pesticidally effective amount of the compositions of the invention to the target pests, to their locus, or to a surface or substrate so as to provide effective residual pesticidal activity on the surface or substrate. Such application may be made by brushing, rolling, spraying, spreading or dipping the pesticidal composition of the invention. By way of example, an IRS application of a
25 surface such as a wall, ceiling or floor surface is contemplated by the method of the invention so as to provide effective residual pesticidal activity on the surface. In another embodiment, it is contemplated to apply such compositions for residual control of pests on a substrate such as a fabric material in the form of (or which can be used in the manufacture of) netting, clothing, bedding, curtains and tents.

30 [0030] Substrates including fabrics or netting to be treated may be made of natural fibres such as cotton, raffia, jute, flax, sisal, hessian, or wool, or synthetic fibres such as polyamide, polyester, polypropylene, polyacrylonitrile or the like. The polyesters are particularly suitable.

35 [0031] In this regard, in another embodiment, the present invention provides a method for combating or controlling pests in a dwelling which comprises applying a pesticidally effective amount of a composition comprising a microencapsulated mixture comprising pirimiphos-methyl and (1) at least one plant essential oil thereof selected from citronella, peppermint oil, d-limonene

5 and abies sibirica or (2) at least one aromatic hydrocarbon solvent, wherein the pirimiphos-methyl is present in said composition in a pesticidally effective amount, to a wall, ceiling or floor surface of such dwelling.

10 [0032] The method of the invention may be practised using liquid compositions such as aqueous compositions that comprise suspensions or dispersions of any suitable microcapsule containing a mixture of pirimiphos-methyl and (1) at least one plant essential oil selected from citronella, peppermint oil, d-limonene and abies sibirica, or (2) at least one aromatic hydrocarbon solvent which is effective against the pests to be controlled, particularly against disease vectors such as adult mosquitoes and flies.

15 [0033] Optimum rates of application for a particular composition comprising a microencapsulated mixture of pirimiphos-methyl and at least one plant essential oil, a particular target substrate or locus and a particular set of insect pressure conditions, can be determined easily and without undue experimentation by simple ranging studies carried out in or on target
20 substrates or pests. Determination of such optimum rates in treating target pests will achieve a target loading of the pirimiphos-methyl per square meter of a particular substrate being treated such as in an IRS or bed net application.

25 [0034] In one embodiment, the pirimiphos-methyl is applied in an amount of from 10 to 2000 mg a.i./m² to control such target pests.

[0035] The following examples describe specific embodiments within the scope of the invention. Other embodiments within the scope of the claims herein will be apparent to one skilled in the art from consideration of the specification or practice of the invention as disclosed herein. It is
30 intended that the specification, together with the examples, be considered exemplary only, with the scope and spirit of the invention being indicated by the claims which follow the examples. In the examples all percentages are given on a weight basis unless otherwise indicated.

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[0036] EXAMPLES

FORMULATION EXAMPLES

5 Comparative Example 1

Preparation of a 300 g/l Pyrimiphos-methyl Capsule Suspension (CS) Formulation

10 [0037] An 80% w/w solution of pirimiphos-methyl in Solvesso 100 (aromatic solvent, ex Exxon) was made by adding 32.39g of molten pirimiphos-methyl technical material (92.9%w/w pirimiphos-methyl) to 5.21g of Solvesso 100. To this was added 3.00g of Polyalkylene polyphenolisocyanate "PAPI" (Suprasec 5025, ex Huntsman) and 3.00g of toluene diisocyanate "TDI" technical material (80%w/w, ex Aldrich). This mixture is known as the oil phase.

15 [0038] An aqueous phase is prepared comprising 1.012g of Celvol 205 (88% hydrolysed polyvinylalcohol, ex Celanese Chemicals) dispersed via high shear mixing into 51.93g of deionised water. To this was added 0.51g of Synperonic A7 (C13/15 alcohol ethoxylate, 7 moles ethoxylation, ex Uniqema) whilst mixing. Continuing to mix, the oil phase is slowly added to the emulsion phase and mixing speed adjusted to give a median particle size between 5µm and 20µm.

20 [0039] The temperature of the reaction vessel was then raised to 60°C so as to initiate the wall formation reaction, and the temperature maintained, together with low shear mixing, for a period of 3 hours. 0.4g of 35% ammonia solution (ex Aldrich) was then added to quench any unreacted isocyanate and the mixture allowed to stir for a further 30 minutes. The mixture was allowed to cool to room temperature prior to adjustment to pH 7 using 1 M sulphuric acid.

25 [0040] Other surfactants such as Tergitol XD (20% solution) (alkoxylated alcohol) and Agnique NSC 11NP (Naphthalene Sulfonate Condensate, Na Salt) are suitable alternative surfactants.

Examples 2 - 5

30 [0041] The procedure of example 1 is repeated by replacing Solvesso 100 with equivalent amounts of a plant essential oil selected from citronella, peppermint oil, Abies sibirica and d-limonene.

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Table 1. Pyrimiphos-methyl/Essential Oil CS Formulations

Example	Active Ingredient	Essential Oil	A.i. Conc. g/l
2	pirimiphos-methyl	Citronella	300
3	pirimiphos-methyl	Peppermint oil	300
4	pirimiphos-methyl	Abies sibirica	300
5	pirimiphos-methyl	D-limonene	300

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BIOLOGICAL EXAMPLES

Example 6 – Residual Activity Against the Yellow Fever Mosquito *A. Aegypti* (laboratory susceptible strain)

10 Application details:

[0042] Products of examples 1 – 5 and Actellic EC50 (an EC formulation of pirimiphos-methyl) were diluted with water and applied to the unglazed side (porous) of a ceramic tile using a laboratory track sprayer at an application volume of 40mL/m² to deliver an a.i. loading of 1g ai/m². The treated tiles were stored under low light conditions at 25°C until required for bioassay.

15 Bioassays were undertaken at 1, 4, 8, 12, 18 and 24 weeks after treatment.

Bioassay methods:

[0043] Adult female mosquitoes were collected from the stock cultures 24 hours prior to the bioassay and stored under culture conditions. On the day of the assay, mosquitoes were

20 anaesthetised with carbon dioxide, placed in a Petri dish exposure chamber and clamped onto the treated surface. After exposure to the treated tile for 1 hour, an assessment of knockdown was made. The mosquitoes were then anaesthetised again, placed in a recovery cup and stored for 24 hours under culture conditions. Mortality was assessed at 24 hours. Three replicates of 10 mosquitoes were used for each treatment at each assessment interval.

25

Table 3. Percent mortality of adult *Aedes aegypti* exposed to treated tiles

	g ai/m ²	1WAT		4WAT		8WAT		12WAT		18WAT		24WAT	
		%KD	%mort	%KD	%mort	%KD	%mort	%KD	%mort	%KD	%mort	%KD	%mort
Ex. 1 (solvento 100)	1	0.0	96.7	0.0	80.0	0.0	73.3	13.3	100.0	3.3	96.7	0.0	10.0
Ex. 2	1	0.0	100.0	0.0	100.0	0.0	80.0	0.0	100.0	0.0	100.0	3.3	100.0
Ex. 3	1	0.0	100.0	0.0	100.0	0.0	50.0	0.0	100.0	6.7	100.0	0.0	96.7
Ex. 4	1	0.0	100.0	0.0	76.7	0.0	20.0	0.0	73.3	3.3	100.0	0.0	100.0
Ex. 5	1	0.0	100.0	3.3	100.0	6.7	93.3	0.0	100.0	0.0	100.0	0.0	100.0
Actellic EC50*	1	0.0	100.0	3.3	80.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	3.3
Control (water)	-	0.0	3.3	0.0	0.0	0.0	0.0	0.0	3.3	0.0	3.3	0.0	3.3

*Pyrimiphos-methyl (commercial standard)

[0044] The excellent residual knock down insecticidal action of the pirimiphos-methyl compositions of examples 1 – 5 according to the invention can be seen from the foregoing examples. It is further noted that these compositions had reduced odor relative to the other pirimiphos-methyl compositions (such as Actellic EC50, for example).

[0045] The foregoing description and examples are for the purpose of illustration only and does not limit the scope of protection which should be accorded this invention.

What is claimed is:

1. A pesticide composition comprising microcapsules that contain pirimiphos-methyl and (1) at least one plant essential oil selected from citronella, peppermint oil, d-limonene and abies sibirica or (2) at least one aromatic hydrocarbon solvent within an encapsulating wall of polymeric material; wherein the pirimiphos-methyl is present in said composition in a pesticidally effective amount.
2. The composition according to claim 1, which is a liquid dispersion of microcapsules.
3. The composition according to claim 2, which is an aqueous suspension of microcapsules.
4. The composition according to claim 1, wherein the plant essential oil is citronella.
5. The composition according to claim 1, wherein the plant essential oil is peppermint oil.
6. The composition according to claim 1, wherein the plant essential oil is d-limonene.
7. The composition according to claim 1, wherein the plant essential oil is abies sibirica.
8. The composition according to claim 1, wherein the aromatic hydrocarbon solvent comprises a single or mixed solvent comprising one or more members selected from the group consisting of a C₈-C₁₁ aromatic hydrocarbons.
9. The composition according to claim 1, wherein the polymeric material is selected from a polyurea, an aminoplast, a polyurethane and a polyamide.
10. The composition according to claim 9, wherein the polymeric material is a polyurea.
11. The composition according to claim 1, wherein the pirimiphos-methyl is present in the composition in an amount from 1 – 85% by weight.
12. The composition according to claim 11, wherein the pirimiphos-methyl is present in the composition in an amount from 0.001% to 1% by weight.

13. The composition according to claim 1, which comprises an additional active ingredient selected from lambda cyhalothrin, α -cypermethrin, deltamethrin, permethrin, malathion, fenitrothion, bendiocarb, propoxur, cyfluthrin, and etofenprox.
14. The composition according to claim 13, which comprises lambda cyhalothrin as additional active ingredient.
15. The composition according to claim 14, wherein the lambda cyhalothrin is microencapsulated.
16. A method for controlling pests which comprises applying a pesticide composition according to claim 1 to the pests, to their locus, or to a surface or substrate so as to provide effective residual pesticidal activity on the surface or substrate.
17. The method according to claim 16, wherein the pirimiphos-methyl is applied in an amount of from 10 to 2000 mg a.i./m².
18. The method according to claim 17, wherein the pirimiphos-methyl is applied in an amount of 1 g a.i./m².
19. The method according to claim 16, wherein the locus is a dwelling.
20. The method according to claim 19, wherein the composition is applied to a wall, ceiling or floor surface of such dwelling as part of an indoor residual spray application.
21. The method according to claim 16, wherein the pest is a disease vector.
22. The method according to claim 21, wherein the pest is a mosquito.
23. The method according to claim 16, wherein the substrate is a fabric material made from synthetic fibres selected from polyamide, polyester, polypropylene, and polyacrylonitrile.
24. The method according to claim 23, wherein fabric material is made from polyester fibres.

25. The method according claim 23, wherein the fabric material is in a form selected from netting, clothing, bedding, curtains and tents.
26. The method according to claim 25, wherein the fabric is a polyester open-meshed bed netting.
27. A microcapsule containing a mixture comprising pirimiphos-methyl and (1) at least one plant essential oil selected from citronella, peppermint oil, d-limonene and abies sibirica or (2) at least one aromatic hydrocarbon solvent, which mixture is contained within an encapsulating wall of polymeric material.
28. The microcapsule according to claim 26, wherein the plant essential oil is citronella.
29. The microcapsule according to claim 26, wherein the plant essential oil is peppermint oil.
30. The microcapsule according to claim 26, wherein the plant essential oil is d-limonene.
31. The microcapsule according to claim 26, wherein the plant essential oil is abies sibirica.
32. The microcapsule according to claim 26, wherein the polymeric material is selected from a polyurea, an aminoplast, a polyurethane and a polyamide.
33. The microcapsule according to claim 32, wherein the polymeric material is a polyurea.
34. The microcapsule of claim 27, wherein the concentration of pirimiphos-methyl is from 0.1 to 95% by weight of the microcapsule.
35. The microcapsule of claim 27 wherein the aromatic hydrocarbon solvent comprises a single or mixed solvent comprising one or more members selected from the group consisting a C₈-C₁₁ aromatic hydrocarbons.

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2008/002170

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01N25/28 A01N57/16 A01N27/00 A01N65/00 A01P7/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/036710 A (SYNGENTA LTD [GB]; BARNETT DAVID [GB]; SILVERTHORNE LESLEY ANNE [GB]) 5 April 2007 (2007-04-05) page 12; example 5 abstract	1-35
Y	UNITED STATES ENVIRONMENTAL PROTECTION AGENCY: "Oil of Citronella" EPA R.E.D FACTS, vol. epa-738-F-97-002, February 1997 (1997-02), pages 1-5, XP002499738 page 2	1-35



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
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- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
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Date of the actual completion of the international search

15 October 2008

Date of mailing of the international search report

17/11/2008

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INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2008/002170

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	BARNARD D R: "REPELLENCY OF ESSENTIAL OILS TO MOSQUITOES (DIPTERA: CULICIDAE)" JOURNAL OF MEDICAL ENTOMOLOGY, ENTOMOLOGICAL SOCIETY OF AMERICA, LANHAM, MD, US, vol. 36, no. 5, 1 September 1999 (1999-09-01), pages 625-629, XP009063018 ISSN: 0022-2585 abstract	1-35
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2008/002170

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