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(54) **Title**: BED BUG CONTROL AND REPELLENCY

(57) **Abstract**: Control or repellency of bed bugs by bringing the bed bugs into contact with a bed bug control formulation containing at least one compound selected from the group consisting of alkyl ketones and cyclic ketones wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to 16 carbon atoms and method for achieving such control or repellency.

BED BUG CONTROL AND REPELLENCY

Field of the Invention

This application claims priority from US Provisional Application No. 61/214,766 filed April 28, 2009.

[0001] This invention relates to compositions and methods for the control or repellency of bed bugs

Background to the Invention

[0002] There have been a number of publications regarding various characteristics of bed bugs. See generally C. Johnson, The ecology of the bed-bug, *Cimex lectularius* L., 41 Journal of Hygiene 345-461 (1942); H. Levinson et al., Assembling and alerting scents produced by the bedbug, *Cimex lectularius* L., 27 Experientia: 102-103 (1971); H. Levinson et al., Action and composition of the alarm pheromone of the bedbug Cimex lectularius L., 61 Naturwissenschaften 684-685 (1974); H. Levinson et al., Structure of sensilla, olfactory perception, and behavior of the bedbug, *Cimex lectularius*, in response to its alarm pheromone, 20 Journal of Insect Physiology 1231-1248 (1974); K. Mellanby, The physiology and activity of the bed-bug (Cimex lectularius) in a natural infestation, 31 Parasitology 200-211 (1939); and H. Schmitz et al., The ability of Rhodnius prolixus (Hemiptera; Reduviidae) to approach a thermal source solely by its infrared radiation, 46 Journal of Insect Physiology 745-751 (2000).

[0003] Bed bugs feed on human blood. Thus, bed bugs are not merely unsightly, they leave ugly skin markings. However problematic this is for residential bedrooms, it is an even more serious problem for hotels and the like. With respect to such commercial bedrooms there is more opportunity for external infection sources to bring bed bugs to the site, and should there be an unknown infestation which causes biting of customers before it is dealt with, there is a severe risk of customer dissatisfaction and adverse publicity, likely leading to a long term significant reputation loss.

[0004] Recent data suggests bed bug infestations (*Cimex* species) of human domiciles are on the rise. At least 92 species of bed bugs have been identified globally, of which at least 16 species are in the North American continent. Generally, bed bugs are parasitic pests with its hosts including humans and various domesticated animals. It is believed that bed bug

infestations are becoming more problematic now at least in part because long acting, residual insecticides are no longer being used to keep bedbug populations in check. In addition, increased international travel and insecticide resistance have made bedbug infestations spread and control with insecticides very difficult. In terms of scale, such infestations are of particular concern for hoteliers, cruise ships, trains, daycare facilities, and the like because of the business reputation risk posed by bad press or bad reviews. Other problematic areas tend to include nursing homes, barracks, dorms, hospitals, and various other forms of high density housing. Nonetheless, single-family homes can likewise be impacted adversely.

[0005] There have been attempts to control bedbug infestation through applications of insecticidal chemicals to infected areas and materials (especially mattresses). This approach has some drawbacks. For example, it can expose those using a treated area or mattress too soon after application to odor or other undesired characteristics of the pesticidal chemical. Further, unless the chemicals are used regularly, without regard to whether an infestation is known to already exist (which procedure will significantly increase costs), those sleeping in an infected area can be bitten before one knows to begin treatment.

[0006] Bed bugs had nearly been eradicated by the widespread use of potent insecticides such as DDT. However, many of these strong insecticides have been banned from the United States and replaced with weaker insecticides such as pyrethroids. Many bed bugs have grown resistant to the weaker insecticides. In a study at the University of Kentucky bed bugs were randomly collected from across the United States. These "wild" bed bugs were up to several thousands of times more resistant to pyrethroids than were laboratory bed bugs. Another problem with current insecticide use is that the broad-spectrum insecticide sprays for cockroaches and ants that are no longer used had a collateral impact on bedbug infestations. Recently, a switch has been made to bait insecticides that have proven effective against cockroaches but have allowed bed bugs to escape the indirect treatment.

[0007] The number of bedbug infestations has risen significantly since the early 21st century. The National Pest Management Association has reported a 71% increase in bedbug calls between 2000 and 2005. The Steritech Group, a pest-management company based in Charlotte, North Carolina, claimed that 25% of the 700 hotels they surveyed between 2002 and 2006 needed bedbug treatment. In 2003, a brother and sister staying at a Motel 6 in

Chicago were awarded $372,000 in punitive damages after being bitten by bedbugs during their stay.

[0008] With the widespread use of DDT in the 1940s and 1950s, bed bugs all but disappeared from North America in the mid-twentieth century. Infestations remained common in many other parts of the world and in recent years have also begun to rebound in North America. Reappearance of bed bugs has presented new challenges for pest control without DDT and similarly banned agents.

[0009] Another reason for the increase in bed bugs is that pest control services more often nowadays use low toxicity gel-based pesticides for control of cockroaches, the most common pest in structures, instead of residual sprays. When residual sprays meant to kill other insects were commonly being used, they resulted in a collateral insecticidal effect on potential bedbug infestations; the gel-based insecticides primarily used nowadays do not have any effect on bed bugs, as they are incapable of feeding on these baits.

[0010] There is, therefore, a need for safe and effective chemicals to control or repel bed bugs and for safe and effective means to employ such chemicals for the control or repellency of bed bugs.

Summary of The Invention

[0011] Safe and effective control or repellency of bed bugs can be accomplished with the use of formulations containing at least one compound selected from alkyl ketones and cyclic ketones wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to 16 carbon atoms. The compounds may be present in any of their isomeric or enantiomeric forms or as mixtures of their isomers or enantiomers. Further aspects of this invention relate to the use of such formulations in various methods for the control or repellency of bed bugs. Among the various methods in which the formulations of this invention may be employed are (1) injecting the formulations into a mattress, either directly or in combination with other ingredients or solvents, (2) placing the formulations on an absorbent material and placing the absorbent material in a sachet and placing the sachet containing the formulation into a locus such as a mattress, hamper, suitcase, clothing bag, linen storage closet or any other enclosure where bed bugs may be present, (3) preparing

"dryer sheets" containing the formulations for placement in a locus such as a mattress, suitcase, clothing bag, hamper, clothing bag, linen storage closet, or any other enclosure where bed bugs are likely to be present, or in a pile of clean or soiled or dirty laundry, (4) placing the formulation into detergent or fabric softener compositions for controlling bed bugs during use of these compositions in cleaning clothes and sprays or in carpet or floor cleaner products the like to treat carpets and furniture, and (5) topical application of the formulation intended for use with humans or animals., such as in the form of a lotion, powder, spray or shampoo.

Detailed Disclosure of the Invention

[0012] Safe and effective control or repellency of bed bugs can be accomplished with the use of formulations containing at least one compound selected from alkyl ketones and cyclic ketones wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to 16 carbon atoms. Preferred are those alkyl ketones and cyclic ketones that contain from 12 to 16 carbon atoms and especially preferred are those alkyl ketones and cyclic ketones that contain from 13 to 16 carbon atoms. As examples of such active compounds for control or repellency of bed bugs there may be mentioned, for example, geranylacetone (6,10-dimethyl-5,9-undecadien-2-one), methyl undecyl ketone (2-tridecanone), geranylcyclopentanone and also known as apritone (2-(3,7-dimethylocta-2,6-dienyl)cyclopentan-1-one), methyl apritone (2-(3,7-dimethyl-2,6-nonadienyl)-cyclopentanone), velvione™ (5Z) cyclohexadec-5-ene-1-one, methyl dihydrojasmonate (methyl 3-oxo-2-pentylcyclopenteacetate), octenylcyclopentanone (2-(2-octen-1-yl)-cyclopentanone), methyl decyl ketone (2-dodecanone), nootkatone (4,4a-dimethyl-6-prop-1-en-2-yl-3,4,5,6,7,8-hexahydronaphthalen-2-one), alpha-ionone (4-(2,6,6-trimethyl-2-cyclohexenyl)-3-buten-2-one), beta ionone (4-(2,6,6-trimethyl-1-cyclohexenyl)-3-buten-2-one), alpha-isomethylionone (3-methyl-4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-3-buten-2-one), nectaryl™ (2-(2-(4-methyl-3-cyclohexen-1-yl) propyl) cyclopentanone), isobutylionone ((E)-5-Methyl-1-(2,6,6-trimethyl-1-cyclohex-2-enyl) hex-1-en-3-one), isolongifolen-9-one ((1R)-2,2,7,7-tetramethyltricyclo[6.2.1.01,6] undec-5-en-4-one) dimethylionone ((E)-2-methyl-1-(2,2,6-trimethyl-1-cyclohex-3-enyl)pent-1-en-3-one), isolongifolanone (2,2,7,7-tetramethyltricyclo [6.2.1.01,6]undecan-5-one), pseudoionone (6,10-dimethyl-3,5,9-undecatrien-2-one), 2-cyclopentylcyclopentanone, methyl nonyl ketone, 2-decen-2-one and l-carvone. Especially preferred are octenyl cyclopentanone, geranyl cyclopentanone, methyl apritone, methyl decyl ketone, velvione™ and other C_{15}-C_{16} cyclic ketones, methyl undecyl ketone and other C_{13}-C_{16} methyl ketones, geranylacetone, ionone, isolongifolenone, nootkatone, and methyl

dihydrojasmonate. The most preferred are apritone, methyl apritone, methyl undecyl ketone, velvione™ and other C_{15}-C_{16} cyclic ketones, and methyl dihydrojasmonate.

[0013] An embodiment of the invention comprises a method for control or repellency of bed bugs by bringing the bed bugs into contact with at least one repellent compound selected from the group consisting of an alkyl ketone and a cyclic ketone wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to 16 carbon atoms such that the bed bugs come into contact with the vapors of the compound(s). The compounds may be present in any of their isomeric or enantiomeric forms or as mixtures of their isomers or enantiomers Another embodiment of this invention comprises a method for control or repellency of bed bugs by placing into an area suspected of possibly containing bed bugs a formulation containing at least one compound selected from the group consisting of an alkyl ketone and a cyclic ketone wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to16 carbon atoms such that the bed bugs come into contact with the compound(s) or the vapors of the compound(s). Further embodiments of the invention comprise the aforesaid methods wherein the formulation is sprayed onto or injected into a mattress. Yet another embodiment of the invention comprises the aforesaid methods wherein the formulation is on an absorbent material located in a sachet placed into the suspected area such as a mattress, hamper, suitcase, clothing bag, linen storage closet, or other enclosure where bed bugs may be present. A still further embodiment of the invention comprises the aforesaid methods wherein the formulation is included in a detergent or fabric softener composition. An even still further embodiment of the invention comprises the aforesaid methods wherein the formulation is included in a form similar to a dryer type sheet which may be placed in a mattress, hamper, suitcase, clothing bag, linen storage closet, or in piles of clothes, including clean, dirty or soiled laundry. A still further embodiment of the invention wherein the formulation, preferably in the form of a spray or aerosol, is for application onto or into furniture, fabrics, clothing, footwear, carpets, or luggage (including in public or common areas such as hotels, airplane luggage compartments or other storage facilities to prevent cross contamination. The formulation may be incorporated into a treatment for protecting luggage, furniture, or goods for storage or transport. Dryer sheets are paper or cloth-like sheets generally about one square foot in area that are put into clothe dryers to eliminate static, soften fabrics and add fragrances. A similar dryer sheet type product may be

made using the compounds embodied in this invention in place of or in addition to the fragrance. The large surface area of the dryer type sheets will be ideal to promote rapid volatilization of the active ingredients into the areas where bed bugs may be present. Yet another embodiment of this invention comprises the use of said formulations in the aforesaid method wherein the formulation is in a powder form, or as a spray or aerosol, suitable for application to furniture or carpets. Additionally, the aforementioned compound(s) may be incorporated into various home cleaning products for use on carpets, floors, walls, closets, furniture, and the like, or in products intended for human and animal application such as lotions, powders, sprays and shampoos.

[0014] The active compound(s) of this invention, an alkyl ketone and a cyclic ketone wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to 18 carbon atoms, may be employed with any suitable carrier material. The compounds of the formulations of this invention may also be used in conjunction with fragrances, detergents, fabric softeners, as well as with other pesticides with which they may exhibit a synergistic or other beneficial effect.

[0015] As used herein, the term "carrier" refers to a material, which may be inorganic or organic and of synthetic or natural origin, with which the active compound is mixed or formulated to facilitate its application to a locus or other object to be treated, or its storage, transport and/or handling. In general, any material that may be customarily employed as a carrier in pesticidal formulations are suitable for use with the present invention. The pesticidal compositions provided herein may be employed alone or in the form of mixtures with such solid and/or liquid dispersible carrier vehicles. As used herein, "carriers" include conventional inert pesticide diluents or extenders of the type usable in conventional pesticide formulations or compositions, e.g., conventional pesticide dispersible carrier vehicles such as solutions, emulsions, suspensions, emulsifiable concentrates, spray powders, pastes, soluble powders, dusting agents, granules, foams, pastes, tablets, aerosols, natural and synthetic materials impregnated with active compounds, microcapsules, fumigating cartridges, fumigating cans and fumigating coils, as well as cold mist and warm mist formulations.

[0016] Examples of conventional carrier vehicles for use herein include, but are not limited to, aerosol propellants which are gaseous at normal temperatures and pressures, such as propane, butane, isobutene and carbon dioxide; inert dispersible liquid diluent carriers,

including inert organic solvents, such as aromatic hydrocarbons, e.g., benzene, toluene, xylene, alkyl naphthalenes, halogenated aromatic hydrocarbons, cycloalkanes, e.g., cyclohexane, paraffins, e.g., petroleum or mineral oil fractions, chlorinated aliphatic hydrocarbons, e.g., methylene chloride, chloroethylenes, alcohols, e.g., methanol, ethanol, propanol, butanol, ethylene or propylene glycol, as well as ethers and esters thereof, e.g., glycol monomethyl ether, amines, e.g., ethanolamine, amides, e.g., dimethyl formamide, sulfoxides, e.g., dimethyl sulfoxide, acetonitrile, ketones, e.g., acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, and/or water, as well as inert dispersible finely divided solid carriers such as ground natural minerals, e.g., kaolins, clays, vermiculite, alumina, silica, chalk, i.e., calcium carbonate, talc, attapulgite, montmorillonite, kieselguhr, and ground synthetic minerals, e.g., highly dispersed silicic acid, and silicates, e.g., alkali silicates

[0017] The formulations of this invention are formulated to provide a control or repellency effective surface concentration in the locus being treated of from about 1 mcg (microgram) to 5 mg (milligram) per sq inch, or in liquid solutions from 0.01% to 10%, or applied directly at full strength. Topical application may be in the range of from about 0.1% to 100%, more preferably at a concentration from 1% to 15%.

[0018] The utility and effectiveness of the invention is illustrated by, but not limited to, the following examples.

[0019] This test was undertaken employing unconcealed bugs. Two semicircular discs of filter paper, 9 cm in radius treated with 1 ml of solution to wet the entire surface, one treated with an acetone solution of the test compound and one only acetone treated were placed on the lid of a Petri dish. Five replicates of ten (10) bed bugs were release into the center of the lids of the Petri dish with a choice of the test compound treated or only acetone treated substrate. The distribution of bed bugs was recorded at ½, 1, 6 and 24 hours post-treatment. Paired t-tests were conducted for each treatment to ascertain whether or not there was a statistically significant difference in the number of bed bugs on the treated vs. untreated discs. The results for the test compounds were as set forth in the following Table wherein the values represent a ratio of the bed bugs in the treated portion of the disc to the total number of bed bugs on both the treated and untreated discs at the indicated time period.

Table

Chemical at 0.5% unless noted otherwise	0.5 hr	1 hr	6 hr	24 hr	Average
2-Octenylcyclopentanone	0.0%	0.0%	0.0%	0.0%	0.0%
2-Geranylcyclopentanone (Apritone)	0.0%	0.0%	0.0%	0.0%	0.0%
Methyl decyl ketone	0.0%	0.0%	0.0%	0.0%	0.0%
Methyl Apritone – at 0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Cyclohexadec-5-ene-1-one-at 0.1%	6.0%	6.0%	0.0%	0.0%	3.0%
Methyl dihydrojasmonate-at 0.2%	14.0%	4.0%	6.0%	8.0%	8.0%
Methyl jasmonate at 0.2%	20.0%	10.0%	10.0%	12.0%	13.0%
Nootkatone	0.0%	0.0%	0.0%	0.0%	0.0%
Geranylacetone	0.0%	0.0%	0.0%	0.0%	0.0%
Methyl undecyl ketone	0.0%	0.0%	0.0%	0.0%	0.0%
Isolongifolen-9-one	8.0%	4.0%	0.0%	2.0%	3.5%
Isobutylionone	0.0%	2.0%	6.0%	6.0%	3.5%
Alpha Ionone	0.0%	0.0%	0.0%	16.0%	4.0%
Alpha Isomethylionone	0.0%	0.0%	0.0%	16.0%	4.0%
Nectaryl	12.2%	4.1%	0.0%	0.0%	4.1%
Dimethylionone	10.0%	4.0%	4.0%	8.0%	6.5%
Isolongifolanone	10.0%	12.0%	2.0%	2.0%	6.5%
l-Carvone (1% Spearmint Oil containing 80% l-Carvone)	18.0%	16.0%	6.0%	20.0%	15.0%
2-Cyclopentylcyclopentanone	10.0%	10.0%	24.0%	30.0%	18.5%
Methyl nonyl ketone	14.3%	16.0%	20.0%	26.0%	19.1%
3-Decen-2-one	18.0%	16.0%	22.0%	24.0%	20.0%
2,3-Undecanedione	10.0%	40.0%	40.0%	10.0%	25.0%
Butyl levulinate at 0.2%	36.0%	32.0%	38.0%	40.0%	26.5%

[0020] While the exact mechanism of the superiority of the compounds of this invention containing from 12 to 16 carbon atoms relative to compounds of this invention having less than 12 carbon atoms or more than 16 carbon atoms is not known for sure it is thought to relate to the fit of the compounds with receptors or binding proteins of the bedbugs.

[0021] While the invention has been described herein with reference to the specific embodiments thereof, it will be appreciated that changes, modification and variations can be made without departing from the spirit and scope of the inventive concept disclosed herein. Accordingly, it is intended to embrace all such changes, modification and variations that fall with the spirit and scope of the appended claims.

Claims:

1. A method for control or repellency of bed bugs comprising bringing the bed bugs into direct contact or contact with vapors of a bed bug control formulation containing at least one compound selected from the group consisting of alkyl ketones and cyclic ketones wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to 16 carbon atoms.

2. A method according to claim 1 wherein the formulation contains a methyl ketone.

3. A method according to claim 1 wherein the formulation contains a cyclic ketone.

4. A method according to claim 1 wherein the formulation contains geranylacetone.

5. A method according to claim 1 wherein the formulation contains methyl undecyl ketone.

6. A method according to claim 1 wherein the formulation contains geranylcyclopentanone.

7. A method according to claim 1 wherein the formulation contains octenylcyclopantanone.

8. A method according to claim 1 wherein the formulation contains methyl decyl ketone.

9. A method according to claim 1 wherein the formulation contains nootkatone.

10. A method according to claim 1 wherein the formulation contains alpha-ionone.

11. A method according to claim 1 wherein the formulation contains nectaryl.

12. A method according to claim 1 wherein the formulation contains isolongifolen-9-one.

13. A method according to claim 1 wherein the formulation contains isolongifolanone.

14. A method according to claim 1 wherein the formulation is sprayed onto or injected into a mattress.

15. A method according to claim 1 wherein the formulation is on an absorbent material located in a sachet placed into the suspected area.

16. A method according to claim 15 wherein the sachet is placed in a locus selected from a mattress, hamper, suitcase, clothing bag, or linen storage closet.

17. A method according to claim 1 wherein the formulation is included in a detergent or fabric softener composition.

18. A method according to claim 1 wherein the formulation is included in a dryer type sheet.

19. A method according to claim 18 wherein the dryer type sheet is placed in a locus selected from a mattress, hamper, suitcase, clothing bag, and linen storage closet.

20. A method according to claim 18 wherein the dryer type sheet is placed in a pile of clean, soiled or dirty laundry.

21. A method according to claim 1 wherein the formulation is placed on or in a carpet or furniture.

22. A method according to claim 1 wherein the formulation is sprayed onto or placed in a fabric, furniture, clothing, footwear, carpet or luggage.

23. A method according to claim 1 wherein the formulation is incorporated into a

detergent, fabric softener, carpet or floor cleaner.

24. A method according to claim 1 wherein the formulation is incorporated into a treatment for protecting luggage, furniture, or goods for storage or transport.

25. A method according to claim 1 wherein the at least one compound is incorporated into a formulation for topical application to a human or animal.

26. A method according to claim 25 wherein the at least one compound is incorporated into a shampoo formulation.

27. A method according to claim 1 wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 12 to 16 carbon atoms.

28. A method for control or repellency of bed bugs comprising placing into an area suspected of possibly containing bed bugs a formulation containing at least one compound selected from the group consisting of alkyl ketones and cyclic ketones wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 10 to 16 carbon atoms so that bed bugs may be contacted with the vapor from the formulation so that direct contact with the liquid or formulated application method is not necessary.

AMENDED CLAIMS
received by the International Bureau on 23 August 2010 (23.08.10).

1. A method for control or repellency of bed bugs comprising bringing the bed bugs into direct contact or contact with vapors of a bed bug control formulation containing at least one compound selected from the group consisting geranylacetone (6,10-dimethyl-5,9-undecadien-2-one), methyl undecyl ketone (2-tridecanone), geranylcyclopentanone and also known as apritone (2-(3,7-dimethylocta-2,6-dienyl)cyclopentan-1-one), methyl apritone (2-(3,7-dimethyl-2,6-nonadienyl)-cyclopentanone), velvione™ (5Z) cyclohexadec-5-ene-1-one, methyl dihydrojasmonate (methyl 3-oxo-2-pentylcyclopenteacetate), octenylcyclopentanone (2-(2-octen-1-yl)-cyclopentanone), methyl decyl ketone (2-dodecanone), nootkatone (4,4a-dimethyl-6-prop-1-en-2-yl-3,4,5,6,7,8-hexahydronaphthalen-2-one), alpha-ionone (4-(2,6,6-trimethyl-2-cyclohexenyl)-3-buten-2-one), beta ionone (4-(2,6,6-trimethyl-1-cyclohexenyl)-3-buten-2-one), alpha-isomethylionone (3-methyl-4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-3-buten-2-one), nectaryl™ (2-(2-(4-methyl-3-cyclohexen-1-yl) propyl) cyclopentanone), isobutylionone ((E)-5-Methyl-1-(2,6,6-trimethyl-1-cyclohex-2-enyl) hex-1-en-3-one), dimethylionone ((E)-2-methyl-1-(2,2,6-trimethyl-1-cyclohex-3-enyl)pent-1-en-3-one), isolongifolanone (2,2,7,7-tetramethyltricyclo [6.2.1.01,6]undecan-5-one), pseudoionone (6,10-dimethyl-3,5,9-undecatrien-2-one), 2-cyclopentylcyclopentanone, methyl nonyl ketone, 2-decen-2-one and l-carvone.

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4. A method according to claim 1 wherein the formulation contains geranylacetone.

5. A method according to claim 1 wherein the formulation contains methyl undecyl ketone.

6. A method according to claim 1 wherein the formulation contains geranylcyclopentanone.

7. A method according to claim 1 wherein the formulation contains octenylcyclopantanone.

8. A method according to claim 1 wherein the formulation contains methyl decyl ketone.

9. A method according to claim 1 wherein the formulation contains nootkatone.

10. A method according to claim 1 wherein the formulation contains alpha-ionone.

11. A method according to claim 1 wherein the formulation contains nectaryl.

12.

13. A method according to claim 1 wherein the formulation contains isolongifolanone.

14. A method according to claim 1 wherein the formulation is sprayed onto or injected into a mattress.

15. A method according to claim 1 wherein the formulation is on an absorbent material located in a sachet placed into the suspected area.

16. A method according to claim 15 wherein the sachet is placed in a locus selected from a mattress, hamper, suitcase, clothing bag, or linen storage closet.

17. A method according to claim 1 wherein the formulation is included in a detergent or fabric softener composition.

18. A method according to claim 1 wherein the formulation is included in a dryer type sheet.

19. A method according to claim 18 wherein the dryer type sheet is placed in a locus selected from a mattress, hamper, suitcase, clothing bag, and linen storage closet.

20. A method according to claim 18 wherein the dryer type sheet is placed in a pile of clean, soiled or dirty laundry.

21. A method according to claim 1 wherein the formulation is placed on or in a carpet or furniture.

22. A method according to claim 1 wherein the formulation is sprayed onto or placed in a fabric, furniture, clothing, footwear, carpet or luggage.

23. A method according to claim 1 wherein the formulation is incorporated into a detergent, fabric softener, carpet or floor cleaner.

24. A method according to claim 1 wherein the formulation is incorporated into a treatment for protecting luggage, furniture, or goods for storage or transport.

25. A method according to claim 1 wherein the at least one compound is incorporated into a formulation for topical application to a human or animal.

26. A method according to claim 25 wherein the at least one compound is incorporated into a shampoo formulation.

27. A method according to claim 1 wherein the total number of carbon atoms in the alkyl ketones and cyclic ketones is from 12 to 16 carbon atoms.

28. A method for control or repellency of bed bugs comprising placing into an area suspected of possibly containing bed bugs a formulation containing at least one compound selected from the group consisting of geranylacetone (6,10-dimethyl-5,9-undecadien-2-one), methyl undecyl ketone (2-tridecanone), geranylcyclopentanone and also known as apritone (2-(3,7-dimethylocta-2,6-dienyl)cyclopentan-1-one), methyl apritone (2-(3,7-dimethyl-2,6-nonadienyl)-cyclopentanone), velvione™ (5Z) cyclohexadec-5-ene-1-

one, methyl dihydrojasmonate (methyl 3-oxo-2-pentylcyclopenteacetate), octenylcyclopentanone (2-(2-octen-1-yl)-cyclopentanone), methyl decyl ketone (2-dodecanone), nootkatone (4,4a-dimethyl-6-prop-1-en-2-yl-3,4,5,6,7,8-hexahydronaphthalen-2-one), alpha-ionone (4-(2,6,6-trimethyl-2-cyclohexenyl)-3-buten-2-one), beta ionone (4-(2,6,6-trimethyl-1-cyclohexenyl)-3-buten-2-one), alpha-isomethylionone (3-methyl-4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-3-buten-2-one), nectaryl™ (2-(2-(4-methyl-3-cyclohexen-1-yl) propyl) cyclopentanone), isobutylionone ((E)-5-Methyl-1-(2,6,6-trimethyl-1-cyclohex-2-enyl) hex-1-en-3-one), isolongifolen-9-one ((1R)-2,2,7,7-tetramethyltricyclo[6.2.1.01,6] undec-5-en-4-one), dimethylionone ((E)-2-methyl-1-(2,2,6-trimethyl-1-cyclohex-3-enyl)pent-1-en-3-one), isolongifolanone (2,2,7,7-tetramethyltricyclo [6.2.1.01,6]undecan-5-one), pseudoionone (6,10-dimethyl-3,5,9-undecatrien-2-one), 2-cyclopentylcyclopentanone, methyl nonyl ketone, 2-decen-2-one and l-carvone. so that bed bugs may be contacted with the vapor from the formulation so that direct contact with the liquid or formulated application method is not necessary.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 10/01198

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - IPC(8)-A01N 35/00 (2010.01)
USPC - 514/675, 690
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)
USPC-514/675, 690

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC-514/675, 690

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PUBWEST, USPC, Google Scholar, ketones, insecticide, pest, bed bug, arthropod, repellent, geranylcyclopentanone, ionone, nootkatone, isolongifolenone

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 7,378,557 B1 (Zhang et al) 27 May 2008 (27.05.2008) entire document esp. (col. 1, ln 5-13, col. 4, ln 4-7, 16, 24-25, 58, col. 5, ln 18-25), (Fig. 1, col. 2, ln 18-19).	1, 3, 12-17, 21-28 2, 4-11, 18-20
Y	US 7,288,573 B2 (Roe) 30 October 2007 (30.10.2007) entire document esp. (col. 1, ln 64 to col. 2, ln 1-18)	2, 5, 8
Y	US 2005/0187289 A1 (Dolan et al.) 25 August 2005 (25.08.2005) entire document esp. (para[0002], [0014]-[0016])	9
Y	US 2005/0245407 A1 (Ishihara et al.) 03 November 2005 (03. 11.2005) entire document esp. (para[0026],[0048]-[0051]) Table 12 para[0162]).	6,7, 10, 11
Y	US 2007/0111918 A1 (Caswell et al.) 17 May 2007 (17.05.2007) entire document esp.(para[0041], [0046], [0668])	4, 18-20
A	US 3,426,133 A (Shotton) 04 February 1969 (04.02.1969) entire document esp. (col. 1, ln 13-15), (col. 2, ln 35)	1-28
A	US 7,381,431 B2 (Baker et al.) 03 June 2008 (03.06.2008) entire document esp. (col. 3, ln 5-9)	1-28
A	US 4,548,764 A (Munteanu et al) 22 October 1985 (22.10.1985) entire document esp. (col. 13, ln	1-28

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 June 2010 (08.06.2010)	23 JUN 2010
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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