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Insect attractant composition

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Abstract

An insect attractant composition comprising α-pinene, anisyl alcohol, butyl salicylate, D-limonene, cineole and phenylacetaldehyde.

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COMPLETE SPECIFICATION

Standard Patent

Applicant:

Ag Biotech Australia Pty Ltd

Invention Title:

INSECT ATTRACTANT COMPOSITION

The following statement is a full description of this invention, including the best method for performing it known to me/us:

ATTRACTANTS FOR MOTHS

Technical Field

The present invention is concerned with attractants for insects.

Background Art

It has long been appreciated that it would be desirable to attract insect pests to a locus, where action may be taken either to kill the pest or to otherwise reduce its numbers. This strategy is referred to as an "attract-and-kill" strategy. Pheromone attractants have been previously used in attract-and-kill strategies, however complications associated with variation in sex ratios, multiple mating, female competition, immigration of mated females and male responsiveness to pheromones make the effectiveness of this strategy uncertain (Gregg & Wilson 1991). Nevertheless, in cotton, the attract-and-kill approach using pheromones has led to significant reductions in boll weevil populations in the United States of America (Smith et al. 1994) and in pink bollworm populations in Egypt (Mafra-Neto and Habib 1996). Attract-and-kill methods using crude bait such as molasses were commonly used for *Helicoverpa zea* in the United States of America before the development of synthetic insecticides (for example, Ditman 1937). It is nevertheless a considerable disadvantage that pheromone attractants attract only male moths, and crude preparations have limited effectiveness.

Dissemination of selective pathogens of pest moth species is potentially another means for control. In such a technique, moths would be lured to a trap, contaminated with the pathogen, and then released. This might be particularly valuable with the new generation of genetically modified organisms which kill the hosts quickly, without the normal increase in inoculum which accompanies an epidemic. However, success of such a technique relies upon having available an effective

attractant for such pests.

A further means of reducing pest moth numbers which has been proposed is the use of trap cropping. Trap cropping is becoming widely used in the cotton industry, with the most common trap crops being chick peas in spring and pigeon peas in summer and autumn. *Helicoverpa* females are attracted to an area of trap crop where they remain and oviposit. The trap crop is then destroyed and the insect eggs are destroyed along with it. While this technique to date has relied upon the natural attractiveness of the crop, if an effective attractant for female pest moths were available the efficacy of this technique may be greatly increased.

Summary of the Invention

It will therefore be appreciated that there is a substantial need for an effective attractant of pest moth species, which attracts females as well as males.

According to one aspect the present invention provides an insect attractant composition comprising α-pinene, anisyl alcohol, butyl salicylate, D-limonene, cineole and phenylacetaldehyde.

In a further aspect the invention relates to a method of attracting insects to a particular location comprising applying a composition comprising α-pinene, anisyl alcohol, butyl salicylate, D-limonene, cineole and phenylacetaldehyde to that location.

In a further aspect the present invention provides a method of killing insects comprising attracting insects to a particular location by applying a composition comprising α-pinene, anisyl alcohol, butyl salicylate, D-limonene, cineole and phenylacetaldehyde to that location and killing said insects.

In a further aspect the invention comprises a bait or lure incorporating a composition comprising α-pinene, anisyl alcohol, butyl salicylate, D-limonene,

cineole and phenylacetaldehyde for use in attracting insects.

Detailed Description of Embodiments of the Invention

The compositions of the invention comprise α-pinene, anisyl alcohol, butyl salicylate, D-limonene, cineole and phenylacetaldehyde. Typically the composition comprises 1 to 50g/L α-pinene, 1 to 50mL/L anisyl alcohol, 1 to 100mL/L butyl salicylate, 0.5 to 20g/L D-limonene, 1 to 50g/L cineole and 1 to 100g/L phenylacetaldehyde.

In an embodiment the composition comprises 3 to 20g/L α-pinene, 3 to 20mL/L anisyl alcohol, 3 to 50mL/L butyl salicylate, 1 to 10g/L D-limonene, 3 to 20g/L cineole and 3 to 50g/L phenylacetaldehyde.

In an embodiment the composition comprises 5 to 8g/L α-pinene, 5 to 8mL/L anisyl alcohol, 8 to 12mL/L butyl salicylate, 1 to 3g/L D-limonene, 5 to 8g/L cineole and 8 to 12g/L phenylacetaldehyde.

As will be well understood by the person skilled in the the compounds referred to herein are known by various synomyms. For example, cineole (CAS number [470-82-6]) is variously known as 1,8 cineol, 1,8 cineole, eucalyptol, limonene oxide and so. It's IUPAC name is 1,3,3-trimeythyl-2-oxabicyclo[2,2,2]octane. Anisyl alchol (CAS number [105-13-5] is also know as 4-methoxybenzenemethanol, 4-methoxybenzyl alcohol, p-methoxybenzylalcohol, anise alcohol and anisic alcohol. Phenylacetaldehyde (or 2-phenylacetaldehyde) has been allocated CAS number [122-78-1] and may also be called hyacinthin or phenylethanal. The bicyclic terpene α-pinene (CAS number [80-56-8] has the systematic name (1S,5S)-2,6,6-trimethylbicyclo[3.1.1]hept-2-ene. D-limonene (CAS number [5989-27-5] has the systemic name (4R)-1-methyl-4-(1-methylethenyl)cyclohexene. The compound known by the common name n-butyl salicylate is the butyl ester of 2-hydroxybenzoic acid and bears CAS number [2052-14-4].

In an embodiment the method of attracting insects is used to attract insects from the Order *Lepidoptera*, and more particularly insects from the Family *Noctuidae, Plutellidae* and *Pyralidae*. Equally the insects may be of the Order *Diptera* or *Hemiptera*.

The compositions of the present invention typically include an inert carrier. Volatile compounds such as those of the invention may be formulated in a variety of inert carriers, the nature of which would be recognised by the person skilled in the art. They may be formulated in liquid or solid form, where appropriate, in a manner well understood by the person skilled in the art. Suitable liquid carriers include but are not limited to polyols, esters, methylene chloride, alcohol (such as C_1 - C_4alcohol), vegetable oil or SIRENE base. Suitable vegetable oils include olive oil, sesame oil, peanut oil, canola oil, cottonseed oil, corn oil, soybean oil, mineral oil, as well as methylated forms of these oils, or mixtures thereof. Aromatic and linear hydrocarbon solvents may also be included. The active ingredient mixture may also be incorporated in a solid substrate, such as clays, diatomaceous earth, silica, polyvinyl chloride, polystyrene, polyurethanes, ureaformaldehyde condensates, and starches. Other useful solid support matrices include expanded vermiculite and paraffinic or bees wax. Mixtures of carriers are envisaged in the present invention and, for example, an aqueous/oil mixture in which the plant volatiles are dissolved in a miscible vegetable oil for subsequent admixture with a solution of sucrose in water (sucrose being included as a feeding stimulant) are envisaged. Additionally, a small quantity of glycerol may be added to such a formulation as a humectant and a small quantity of polyvinyl alcohol added to form a skin over the droplets, with the aim of slowing desiccation.

Such formulations may include a variety of optional components or adjuvants, including but not

limited to feeding stimulants, food sources, insect toxicants and other insect attractants such as insect pheromones. Yet other components which may be included in the formulation include humectants, preservatives, thickeners, antimicrobial agents, antioxidants, emulsifiers, film forming polymers and mixtures thereof. Additives which retard or slow the volatilization of the active mixture are also envisaged. Humectants may include polyols, sugar fractions (such as molasses), glycols and hygroscopic salts. Antioxidants which protect the vegetable oils and reduce polymerization of phenyl acetaldehyde are preferred. Film forming polymers include gum rosin, latex, polyvinyl pyrrolidone, polyvinyl alcohol, polyvinyl chloride, polyethylene, polyvinyl acetate and mixtures thereof. Additional optional additives include shellac, methyl methacrylate, and mixtures thereof.

In an embodiment feeding stimulants for the adult insects or moths are included in the attractant composition and function to induce the target insets to contact and/or ingest the bait, particularly when formulated with an insecticide to effect control. Without being limited thereto, feeding stimulants such as fructose, fucose, glucose, and particularly sucrose, are preferred.

The invention further relates to a method of attracting insects to a particular location, comprising the step of applying an attractant composition as described above to that location.

The location may be a trap crop, wherein the method comprises locating the attractant composition within or adjacent the trap crop. Alternatively, the location may be a trap for a moth pest, wherein the method comprises applying the attractant composition to the trap, such as by locating an amount of the composition within a depot in the trap.

The attractant composition may be formulated in a

manner known *per se* for spraying, as would be well understood by the person skilled in the art, and this is a convenient means for applying the composition to a trap crop. The components of the composition may also be applied separately or released by an attractant disseminator if desired.

Insect toxicants may also be included in the composition of the invention.

Typically the toxicant is a pyrethroid or a carbamate. Preferred insect intoxicants include bifenthrin, carbaryl, methomyl, acephate, thiodicarb, cyfluthrin, malathion, chlorpyrifos, emamectin benzoate, abamectin, spinosad, endosulfan and diamide insecticides such as chlorantraniprole and flubendiamide, and mixtures thereof. Bacterial and viral pathogens may also be included, as well as insect growth regulators or compounds eliciting behavior modification or disrupting physiological functions. These may include, for instance, pigments and/or dyes which may mark, attract, modify various insect behaviors, or which may be toxic. Combination of the insecticide with the attractant composition of this invention allows the use of significantly lower concentrations of insecticides to kill the adults under field conditions than would be used to control the insect pests with a normal commercial broadcast application of the same insecticides.

The attractant compositions may be used in a number of ways, including monitoring or controlling insect populations. In one preferred embodiment, the compositions may be placed within traps to monitor population changes. Precise monitoring will enable growers to reduce the number of insecticide applications when populations are low. In other embodiments, the attractants may be used to control pest populations by employing large numbers of traps (trap-out strategy).

It is envisioned that the attractants may be used in conjunction with any type of appropriate trap or

attractant disseminator as known in the art. The attractant can be applied or disseminated using a variety of convention techniques, such as in an exposed solution, impregnated into a wicking material or other substrate, or incorporated in a deodorant dispenser. Further, the components of the attractant may be combined in a single dispenser provided within a single trap, or provided separately in a plurality of dispensers, all within a single trap. The attractant can be applied to the device undiluted, or formulated in an inert carrier. Volatilization can be controlled or retarded by inclusion of components as described above. Controlled, slow release over an extended period of time may also be effected by placement within vials covered with a permeable septum or cap, by encapsulation using conventional techniques, or absorption into a porous substrate.

One of ordinary skill will appreciate that the rate of release of the active ingredient mixture of the present invention may be varied by manipulation of the size of the reservoir and permeability of the matrix. The support or other delivery mechanisms of the present invention preferably provides release or volatilization of the active ingredient mixture of the invention for at least one week.

Application scenarios and methods of using the attractant composition of the present invention also include separate application of a feeding stimulant (such as molasses or sucrose solutions), combined with an insecticide, to plants by known methods, with the placement of the attractant composition in a manner which will attract moth pests to the feeding stimulant-insecticide mixture. Placement may include location in a strip in the same field which is upwind of the strip of the feeding stimulant-insecticide mixture. Another placement may involve a small area treated with the attractant composition in the centre of a larger area

treated with the feeding stimulant-insecticide mixture. The attractant composition of the present invention may be applied in or on granules, plastic dispensers or wicks, for example, and may be applied parallel to sprays of a feeding stimulant-insecticide mixture. Cross-wind application may offer greater control of the insect population because of an increase in the area with effective volatile concentrations, and the foraging and ovipositing behavior in which the moths fly upwind within the plant canopy. Single point application of the attractant composition may also be used effectively, depending on the existing wind conditions.

Plants which may be protected from insect pests include but are not limited to agronomically important crops such as cotton field corn, field peas, lupins, chick peas, sunflowers, sorghum, soybeans and vegetables, including seed corn, sweet corn, cole crops, melons, beans and tomatoes.

In the practice of any of the above-described embodiment, an attractant is used as a trap or bait or is otherwise applied to the locus of or in the vicinity of infestation in an amount effective to attract the target insect. Factors such as population density, precipitation, temperature, wind velocity, and release rate will influence the actual number of insects trapped.

Embodiments will be described in the following Example:

Example

A blend in accordance with the invention, a commercial blend and a formulation containing only butyl salicylate were compared with a blank (no volatile) treatment on cotton on a property near Oakey, Queensland, Australia as shown in Table 1.

Treatment No.	Product	Active Concentration	Application Volume (mL/30 m of row)
1. Commercial blend (comparative)	PF3 + z-3-hexenyl salicylate + Lannate L (methomyl)	See below 10.4 mL/L 5.0 g/L	300
2.	PF3 + butyl salicylate + anisyl alcohol + Lannate L (methomyl)	See below 10.4 mL/L 5.2 mL/L 5.0 g/L	300
3. (comparative)	Butyl salicylate + Lannate L (methomyl)	See below 10.4 mL/L 5.0 g/L	300
4. (blank)	Lannate L (methomyl)	See below 5.0 g/L	300

Table 1

Formulations trialed near Oakey, Queensland, Australia

PF3 = consists of the following plant volatiles:

alpha-pinene (5.68 g/L)

d-limonene (1.88 g/L)

cineole (5.07 g/L)

phenylacetaldehyde (9.08 g/L)

Excipient ingredients common to all treatments included canola oil as a carrier for volatiles, sucrose as a feeding stimulant, xanthan gum (thickener), anti-oxidants, emulsifying agents and blue dye as a marker. All treatments also contained methomyl 0.5% a.i. as the insecticide to kill the moths.

Formulations were applied at the rate of 500 ml per 50m of row, and were shaken from a plastic bottle so that the material formed pools on the foliage of the treated row.

Dead moths were collected early in the morning from the rows adjacent to the treated row, for three days after treatment, and identified to species level. Mean numbers of *H. armigera* (Ha), *H. punctigera* (Hp) and other pest and non-pest species, including small lepidopterans collected for 3 days are given in Table 2.

Treatment No.	Total Ha	Total Hp	Other pests	Other nonpests	Small leps	% target
4	28.8 (5.7)	0.3 (0.3)	0.3 (0.3)	0.5 (0.5)	0.5 (0.5)	96.8 (2.4)
3	44.5 (12.4)	0.5 (0.5)	0.5 (0.5)	0.3 (0.3)	0.3 (0.3)	98.3 (1.0)
1	63.3 (8.1)	0.3 (0.3)	1.5 (0.9)	4.8 (1.4)	12.3 (5.8)	79.0 (4.9)
2	137.6 (23.2)	3.3 (1.3)	4.8 (0.5)	3.0 (0.4)	15.3 (2.6)	85.5 (1.7)

Table 2.

Means and standard errors (in brackets) for all treatments on all three days. % target figures are calculated as (*H. armigera* + *H. punctigera)*/total of all moths collected.

Under conditions of high *H. armigera* moth numbers, the blend 2 in accordance with the invention was significantly more attractive to *Helicoverpa* spp. moths and other noctuid moth pests than the commercial blend. The addition of butyl salicylate to the blank resulted in a trend for increased attractiveness to *Helicoverpa* spp., however differences were not significant.

Industrial Applicability

The present invention is useful in the control of insect pests.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

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The contents of the following documents are incorporated herein by reference:

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Claims:

1. An insect attractant composition comprising α-pinene, anisyl alcohol, butyl salicylate, D-limonene, cineole and phenylacetaldehyde.

2. A composition as claimed in claim 1 further comprising an insect feeding stimulant.

3. A composition as claimed in either one of claims 1 or 3 further comprising an insect toxicant.

4. A composition as claimed in any one of claims 1 to 3 further comprising an inert carrier.

5. A composition as claimed in claim 4 comprising to 50g/L α-pinene, 1 to 50mL/L anisyl alcohol, 1 to 100mL/L butyl salicylate, 0.5 to 20g/L D-limonene, 1 to 50g/L cineole and 1 to 100g/L phenylacetaldehyde.

6. A composition as claimed in claim 5 comprising 3 to 20g/L α-pinene, 3 to 20mL/L anisyl alcohol, 3 to 50mL/L butyl salicylate, 1 to 10g/L D-limonene, 3 to 20g/L cineole and 3 to 50g/L phenylacetaldehyde

7. A composition as claimed in claim 6 comprising 5 to 8g/L α-pinene, 5 to 8mL/L anisyl alcohol, 8 to 12mL/L butyl salicylate, 1 to 3g/L D-limonene, 5 to 8g/L cineole and 8 to 12g/L phenylacetaldehyde.

8. A method of attracting insects to a particular location comprising applying a composition as claimed in any one of claims 1 to 7 to that location.

9. A method as claimed in claim 8 wherein the insect is from the Order *Lepidoptera*.

10. A method as claimed in claim 9 wherein the insect is from the Family *Noctuidae, Plutellidae* or *Pyralidae.*

11. A method as claimed in claim 8 wherein the insect is from the Order *Diptera* or *Hemiptera*.

12. A bait or lure incorporating a composition as claimed in any one of claims 1 to 7 for use in attracting insects.

13. A method of killing insects comprising attracting insects by applying a composition as claimed in any one of claims 1 to 7 and killing the insects.

14. A method as claimed in claim 13 comprising applying a toxicant to the insects once they have been attracted to the location or to the location to which the insects are to be attracted.

15. An insect attractant composition as claimed in claim 1, a method as claimed in claim 8 or 13, or a bait as claimed in claim 12, substantially as hereinbefore described with reference to any one of the Examples.