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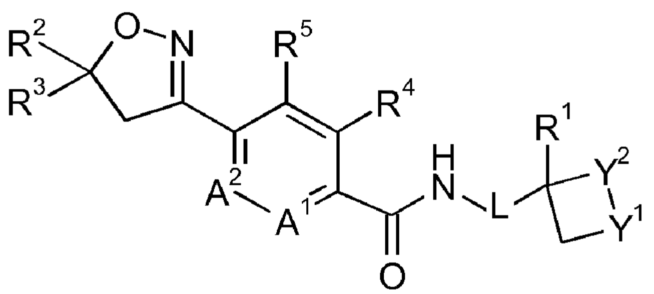
(54) **Title**: PESTICIDAL MIXTURES CONTAINING ISOXAZOLINE DERIVATIVES AND INSECTICIDE OR NEMATOICIDAL BIOLOGICAL AGENT



(I)

(57) **Abstract**: The present invention relates to pesticidal mixtures comprising a component A and a component B, wherein component A is a compound of formula (I) wherein A^1, A^2, R^1, R^2, R^3, R^4 and R^5 are as defined in claim 1 and one of Y^1 and Y^2 is S, SO or SO_2 and the other is CH_2 and component B is an insecticide or nematicidal biological agent as defined in claim 1. The present invention also relates to methods of using said mixtures for the control of pests.

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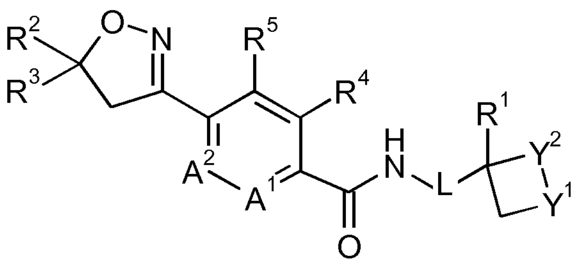
PESTICIDAL MIXTURES CONTAINING ISOXAZOLINE DERIVATIVES AND INSECTICIDE OR NEMATOICIDAL BIOLOGICAL AGENT

The present invention relates to mixtures of pesticidally active ingredients and to methods of using the mixtures in the field of agriculture.

WO 2009/080250 discloses that certain isoxazoline compounds have insecticidal activity.

The present invention provides pesticidal mixtures comprising a component A and a component B, wherein component A is a compound of formula I



(I)

wherein

one of Y^1 and Y^2 is S, SO or SO_2 and the other is CH_2;

L is a direct bond or methylene;

A^1 and A^2 are C-H, or one of A^1 and A^2 is C-H and the other is N;

R^1 is hydrogen or methyl;

R^2 is chlorodifluoromethyl or trifluoromethyl;

R^3 is 3,5-dibromo-phenyl, 3,5-dichloro-phenyl, 3,4-dichloro-phenyl, or 3,4,5-trichloro-phenyl;

R^4 is methyl;

R^5 is hydrogen;

or R^4 and R^5 together form a bridging 1,3-butadiene group;

and component B is a compound selected from

a) a pyrethroid including those selected from the group consisting of permethrin, cypermethrin, fenvalerate, esfenvalerate, deltamethrin, cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, bifenthrin, fenpropathrin, cyfluthrin, tefluthrin, ethofenprox, natural pyrethrin, tetramethrin, S-bioallethrin, fenfluthrin, prallethrin and 5-benzyl-3-furylmethyl-(E)-(1R,3S)-2,2-dimethyl-3-(2-oxothiolan-3-ylidenemethyl)cyclopropane carboxylate;

b) an organophosphate including those selected from the group consisting of sulprofos, acephate, methyl parathion, azinphos-methyl, demeton-s-methyl, heptenophos, thiometon, fenamiphos, monocrotophos, profenofos, triazophos, methamidophos, dimethoate, phosphamidon, malathion, chlorpyrifos, phosalone, terbufos, fensulfothion, fonofos, phorate, phoxim, pirimiphos-methyl, pirimiphos-ethyl, fenitrothion, fosthiazate and diazinon;

c) a carbamate including those selected from the group consisting of pirimicarb, triazamate, cloethocarb, carbofuran, furathiocarb, ethiofencarb, aldicarb, thiofurox, carbosulfan, bendiocarb, fenobucarb, propoxur, methomyl and oxamyl;

d) a benzoyl urea including those selected from the group consisting of diflubenzuron, triflumuron, hexaflumuron, flufenoxuron, lufenuron and chlorfluazuron;

e) an organic tin compound including those selected from the group consisting of cyhexatin, fenbutatin oxide and azocyclotin;

f) a pyrazole including those selected from the group consisting of tebufenpyrad and fenpyroximate;

g) a macrolide including those selected from the group consisting of abamectin, emamectin (e.g. emamectin benzoate), ivermectin, milbemycin, spinosad, azadirachtin and spinetoram;

h) an organochlorine compound including those selected from the group consisting of endosulfan (in particular alpha-endosulfan), benzene hexachloride, DDT, chlordane and dieldrin;

i) an amidine including those selected from the group consisting of chlordimeform and amitraz;

j) a fumigant agent including those selected from the group consisting of chloropicrin, dichloropropane, methyl bromide and metam;

k) a neonicotinoid compound including those selected from the group consisting of imidacloprid, thiacloprid, acetamiprid, nitenpyram, dinotefuran, thiamethoxam, clothianidin, nithiazine and flonicamid;

l) a diacylhydrazine including those selected from the group consisting of tebufenozide, chromafenozide and methoxyfenozide;

m) a diphenyl ether including those selected from the group consisting of diofenolan and pyriproxyfen;

n) indoxacarb;

o) chlorfenapyr;

p) pymetrozine;

q) spirotetramat, spirodiclofen and spiromesifen;

r) a diamide including those selected from the group consisting of flubendiamide, chlorantraniliprole (Rynaxypyr®) and cyantraniliprole;

s) sulfoxaflor;

t) metaflumizone;

u) fipronil and ethiprole;

v) pyrifluqinazon;

w) buprofezin.

x) diafenthiuron; and

y) 4-[(6-Chloro-pyridin-3-ylmethyl)-(2,2-difluoro-ethyl)-amino]-5H-furan-2-one .

In addition, component B may be a nematicidally active biological agent. The nematicidally active biological agent refers to any biological agent that has nematicidal activity. The biological agent can be any type known in the art including bacteria and fungi. The wording "nematicidally active" refers to having an effect on, such as reduction in damage caused by, agricultural-related nematodes. The nematicidally active biological agent can be a bacterium or a fungus. Preferably, the biological agent is a bacterium. Examples of nematicidally active bacteria include Bacillus firmus, Bacillus cereus, Bacillus subtilis, and Pasteuria penetrans, preferably Bacillus firmus, Bacillus subtilis, and Pasteuria penetrans. A suitable Bacillus firmus strain is strain CNCM I-1582 which is commercially available as BioNem^{TM}. A suitable Bacillus cereus strain is strain CNCM I-1562. Of both Bacillus strains more details can be found in US 6,406,690.

It has now been found, surprisingly, that the active ingredient mixture according to the invention not only delivers about the additive enhancement of the spectrum of action with respect to the pest to be controlled that was in principle to be expected but achieves a synergistic effect which can extend the range of action of the component A and of the component B in two ways. Firstly, the rates of application of the component A and of the component B are lowered whilst the action remains equally good. Secondly, the active ingredient mixture still achieves a high degree of pest control, sometimes even where the two individual components have become totally ineffective in such a low application rate range. This allows increased safety in use.

However, besides the actual synergistic action with respect to pest control, the pesticidal compositions according to the invention can have further surprising advantageous properties which can also be described, in a wider sense, as synergistic activity. Examples of such advantageous properties that may be mentioned are: a broadening of the spectrum of pest control to other pests, for example to resistant strains; a reduction in the rate of application of the active ingredients; adequate pest control with the aid of the compositions according to the invention, even at a rate of application at which the individual compounds are totally ineffective; advantageous behaviour during formulation and/or upon application, for example upon grinding, sieving, emulsifying, dissolving or dispensing; increased storage stability; improved stability to light; more advantageuos degradability; improved toxicological and/or ecotoxicological behaviour; improved characteristics of the useful plants including: emergence, crop yields, more developed root system, tillering increase, increase in plant height, bigger leaf blade, less dead basal leaves, stronger tillers, greener leaf colour, less fertilizers needed, less seeds needed, more productive tillers, earlier flowering, early grain maturity, less plant verse (lodging), increased shoot growth, improved plant vigor, and early germination; or any other advantages familiar to a person skilled in the art.

The compounds of formula I and their manufacturing processes are known from WO 2009/080250. The components B are known, e.g. from "The Pesticide Manual", Fifteenth Edition, Edited by Clive Tomlin, British Crop Protection Council. The compound under y) is known from DE 102006015467. Reference to the above components B includes reference to their salts and any usual derivatives, such as ester derivatives.

The combinations according to the invention may also comprise more than one of the active components B, if, for example, a broadening of the spectrum of pest control is desired. For instance, it may be advantageous in the agricultural practice to combine two or three components B with any of the compounds of formula I, or with any preferred member of the group of compounds of formula I. The mixtures of the invention may also comprise other active ingredients in addition to components A and B. In other embodiments the mixtures of the invention may include only components A and B as pesticidally active ingredients, e.g. no more than two pesticidally active ingredients.

In one preferred group of compounds of formula I Y^1 is S and Y^2 is CH_2.

In another preferred group of compounds of formula I Y^1 is SO and Y^2 is CH_2.

In another preferred group of compounds of formula I Y^1 is SO_2 and Y^2 is CH_2.

In another preferred group of compounds of formula I Y^2 is S and Y^1 is CH_2.

In another preferred group of compounds of formula I Y^2 is SO and Y^1 is CH_2.

In another preferred group of compounds of formula I Y^2 is SO_2 and Y^1 is CH_2.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is S and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO_2 and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is S and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; and R^4 is methyl; and R^4 and R^5 together form a bridging 1,3-butadiene group.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; and R^4 is methyl; and R^4 and R^5 together form a bridging 1,3-butadiene group.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO_2 and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; and R^4 is methyl; and R^4 and R^5 together form a bridging 1,3-butadiene group.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is S and the other is CH_2; A^1 is C-H; A^2 is N; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO and the other is CH_2; A^1 is C-H; A^2 is N; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO_2 and the other is CH_2; A^1 is C-H; A^2 is N; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is a direct bond; Y^1 is S, SO or SO_2; Y^2 is CH_2; A^1 is C-H; A^2 is C-H; R^1 is hydrogen; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is a direct bond; Y^1 is S, SO or SO_2; Y^2 is CH_2; A^1 is C-H; A^2 is C-H; R^1 is methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

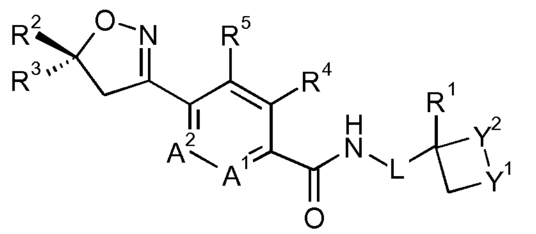
In yet another preferred group of compounds of formula I L is methylene; Y^1 is CH_2; Y^2 is S, SO or SO_2; A^1 is C-H; A^2 is C-H; R^1 is hydrogen; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

In yet another preferred group of compounds of formula I L is methylene; Y^1 is CH_2; Y^2 is S, SO or SO_2; A^1 is C-H; A^2 is C-H; R^1 is methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

Preferably when L is a direct bond Y^2 is CH_2 and Y^1 is S, SO or SO_2 and when L is methylene Y^2 is S, SO or SO_2 and Y^1 is CH_2.

Each substituent definition in each preferred group of compounds of formula I may be juxtaposed with any substituent definition in any other preferred group of compounds, in any combination.

Compounds of formula I include at least one chiral centre and may exist as compounds of formula I* or compounds of formula I**.



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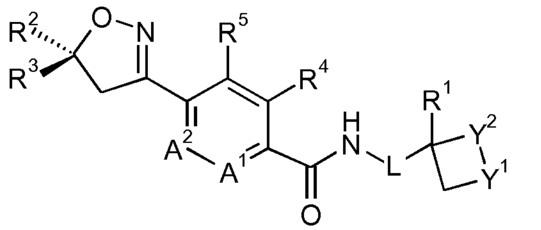
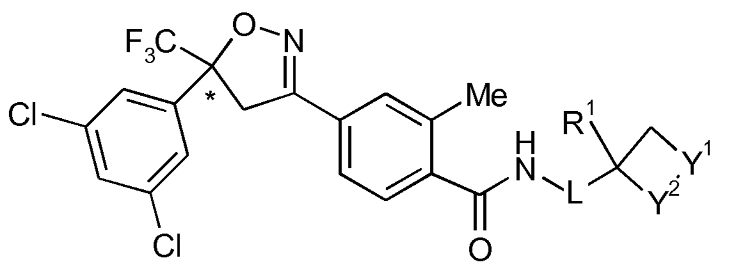


(I**)

Compounds of formula I** are more biologically active than compounds of formula I* (confirmed by X-ray analysis). Component A may be a mixture of compounds I* and I** in any ratio e.g. in a molar ratio of 1:99 to 99:1, e.g. 10:1 to 1:10, e.g. a substantially 50:50 molar ratio. Preferably component A is a racemic mixture of the compounds of formula I** and I* or is enantiomerically enriched for the compound of formula I**.For example, when component A is an enantiomerically enriched mixture of formula I**, the molar proportion of compound I** compared to the total amount of both enantiomers is for example greater than 50%, e.g. at least 55, 60, 65, 70, 75, 80, 85, 90, 95, 96, 97, 98, or at least 99%.

Preferred compounds of formula I are shown in the Table below.

Table A: Compounds of formula I(a)



(Ia)

The symbol * indicates the location of the chiral centre

Comp No.	Stereochemistry at *	L	R^1	Y^1	Y^2
1	racemic mixture	bond	CH_3	S	CH_2
2	racemic mixture	bond	CH_3	SO (cis)	CH_2

Comp No.	Stereochemistry at *	L	R^1	Y^1	Y^2
3	racemic mixture	bond	CH_3	SO (trans)	CH_2
4	racemic mixture	bond	CH_3	SO_2	CH_2
5	racemic mixture	bond	H	S	CH_2
6	racemic mixture	bond	H	SO (cis)	CH_2
7	racemic mixture	bond	H	SO (trans)	CH_2
8	racemic mixture	bond	H	SO_2	CH_2
9	racemic mixture	CH_2	CH_3	CH_2	S
10	racemic mixture	CH_2	CH_3	CH_2	SO (cis)
11	racemic mixture	CH_2	CH_3	CH_2	SO (trans)
12	racemic mixture	CH_2	CH_3	CH_2	SO_2
13	racemic mixture	CH_2	H	CH_2	S
14	racemic mixture	CH_2	H	CH_2	SO (cis)
15	racemic mixture	CH_2	H	CH_2	SO (trans)
16	racemic mixture	CH_2	H	CH_2	SO_2
19	S	bond	CH_3	S	CH_2
20	S	bond	CH_3	SO (cis)	CH_2
21	S	bond	CH_3	SO (trans)	CH_2
22	S	bond	CH_3	SO_2	CH_2
23	S	bond	H	S	CH_2
24	S	bond	H	SO (cis)	CH_2
25	S	bond	H	SO (trans)	CH_2
26	S	bond	H	SO_2	CH_2
27	S	CH_2	CH_3	CH_2	S
28	S	CH_2	CH_3	CH_2	SO (cis)
29	S	CH_2	CH_3	CH_2	SO (trans)
30	S	CH_2	CH_3	CH_2	SO_2
31	S	CH_2	H	CH_2	S
32	S	CH_2	H	CH_2	SO (cis)
33	S	CH_2	H	CH_2	SO (trans)
34	S	CH_2	H	CH_2	SO_2

The present invention includes all isomers of compounds of formula (I), salts and N-oxides thereof, including enantiomers, diastereomers and tautomers. Component A may be a mixture of any type of isomer of a compound of formula I, or may be substantially a single type of isomer. For example, where Y^1 or Y^2 is SO, component A may be a mixture of the cis and trans isomer in any ratio, e.g. in a molar ratio of 1:99 to 99:1, e.g. 10:1 to 1:10, e.g. a substantially 50:50 molar ratio. For example, in trans enriched mixtures of the compound of formula I, e.g. when Y^1 or Y^2 is SO, the molar proportion of the trans compound in the mixture compared to the total amount of both cis and trans is for example greater than 50%, e.g. at least 55, 60, 65, 70, 75, 80, 85, 90, 95, 96, 97, 98, or at least 99%. Likewise, in cis enriched mixtures of the compound of formula I (preferred), e.g. when Y^1 or Y^2 is SO, the molar proportion of the cis compound in the mixture compared to the total amount of both cis and trans is for example greater than 50%, e.g. at least 55, 60, 65, 70, 75, 80, 85, 90, 95, 96, 97, 98, or at least 99%. The compound of formula I may be enriched for the trans sulphoxide. Likewise, the compound of formula I may be enriched for the cis sulphoxide. Y^1 or Y^2 is SO for compounds 2, 3, 6, 7, 10, 11, 14, 15, 20, 21, 24, 25, 28, 29, 32 and 33in Table A. Each may be a mixture which is enriched for the cis or trans isomer respectively.

In one embodiment of the invention component B is a compound selected from

pymetrozine;

an organophosphate selected from the group consisting of sulprofos, acephate, methyl parathion, azinphos-methyl, demeton-s-methyl, heptenophos, thiometon, fenamiphos, monocrotophos, profenofos, triazophos, methamidophos, dimethoate, phosphamidon, malathion, chlorpyrifos, phosalone, terbufos, fensulfothion, fonofos, phorate, phoxim, pirimiphos-methyl, pirimiphos-ethyl, fenitrothion, fosthiazate and diazinon;

a pyrethroid selected from the group consisting of permethrin, cypermethrin, fenvalerate, esfenvalerate, deltamethrin, cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, bifenthrin, fenpropathrin, cyfluthrin, tefluthrin, ethofenprox, natural pyrethrin, tetramethrin, S-bioallethrin, fenfluthrin, prallethrin and 5-benzyl-3-furylmethyl-(E)-(1R,3S)-2,2-dimethyl-3-(2-oxothiolan-3-ylidenemethyl)cyclopropane carboxylate;

a macrolide selected from the group consisting of abamectin, emamectin benzoate, ivermectin, milbemycin, spinosad, azadirachtin and spinetoram;

a diamide selected from the group consisting of flubendiamide, chlorantraniliprole (Rynaxypyr®) and cyantraniliprole;

a neonicotinoid compound selected from the group consisting of imidacloprid, thiacloprid, acetamiprid, nitenpyram, dinotefuran, thiamethoxam, clothianidin, nithiazine and flonicamid;

spirotetramat, spirodiclofen and spiromesifen; and

sulfoxaflor, lufeneron, diafenthiuron, and fipronil.

Preferably component B is a compound selected from the group consisting of abamectin, chlorpyrifos, cyantraniliprole, emamectin, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid, chlorantraniliprole, flonicamid.

sulfoxaflor, lufeneron, diafenthiuron, flubendiamide, tefluthrin, and fipronil. More preferably component B is a compound selected from the group consisting of abamectin, chlorpyrifos, cyantraniliprole, emamectin, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid and flonicamid.

In one embodiment component B is a compound selected from the group consisting of abamectin, chlorpyrifos, cyantraniliprole, emamectin, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid and chlorantraniliprole. In another embodiment component B is a compound selected from the group consisting of abamectin, chlorpyrifos, cyantraniliprole, emamectin, lambda cyhalothrin, pymetrozine, spirotetramat, and thiamethoxam.

The invention also includes the following combinations:
A mixture of a compound from Table A and abamectin.
A mixture of a compound from Table A and chlorpyrifos.
A mixture of a compound from Table A and cyantraniliprole.
A mixture of a compound from Table A and emamectin.
A mixture of a compound from Table A and cyhalothrin.
A mixture of a compound from Table A and lambda cyhalothrin.
A mixture of a compound from Table A and gamma cyhalothrin.
A mixture of a compound from Table A and pymetrozine.
A mixture of a compound from Table A and spirotetramat.
A mixture of a compound from Table A and thiamethoxam.
A mixture of a compound from Table A and chlorantraniliprole.
A mixture of a compound from Table A and profenofos.
A mixture of a compound from Table A and acephate.
A mixture of a compound from Table A and azinphos-methyl.
A mixture of a compound from Table A and methamidophos.
A mixture of a compound from Table A and spinosad.
A mixture of a compound from Table A and spinetoram.
A mixture of a compound from Table A and flonicamid.
A mixture of a compound from Table A and indoxacarb.
A mixture of a compound from Table A and spirodiclofen.
A mixture of a compound from Table A and spiromesifen.

A mixture of a compound from Table A and sulfoxaflor.

A mixture of a compound from Table A and fipronil.

A mixture of a compound from Table A and imidacloprid.

A mixture of a compound from Table A and thiacloprid.

A mixture of a compound from Table A and acetamiprid.

A mixture of a compound from Table A and nitenpyram.

A mixture of a compound from Table A and dinotefuran.

A mixture of a compound from Table A and clothianidin.

A mixture of a compound from Table A and nithiazine.

A mixture of a compound from Table A and pyriproxyfen.

A mixture of a compound from Table A and buprofezin.

A mixture of a compound from Table A and pyrifluqinazon.

A mixture of a compound from Table A, thiamethoxam and cyantraniliprole.

A mixture of a compound from Table A, thiamethoxam and chlorantraniliprole.

A mixture of a compound from Table A and sulfoxaflor.

A mixture of a compound from Table A and Lufeneron.

A mixture of a compound from Table A and Diafenthiuron.

A mixture of a compound from Table A and Flubendiamide.

A mixture of a compound from Table A and Tefluthrin.

A mixture of a compound from Table A and Fipronil.

The present invention also relates to a method of controlling insects, acarines, nematodes or molluscs which comprises applying to a pest, to a locus of a pest, or to a plant susceptible to attack by a pest a combination of components A and B; seeds comprising a mixture of components A and B; and a method comprising coating a seed with a mixture of components A and B.

Components A and B may be provided and/or used in amounts such that they are capable of synergistic pest control. For example, For example, the present invention includes pesticidal mixtures comprising a component A and a component B in a synergistically effective amount; agricultural compositions comprising a mixture of component A and B in a synergistically effective amount; the use of a mixture of component A and B in a synergistically effective amount for combating animal pests; a method of combating animal pests which comprises contacting the animal pests, their habit, breeding ground,

food supply, plant, seed, soil, area, material or environment in which the animal pests are growing or may grow, or the materials, plants, seeds, soils, surfaces or spaces to be protected from animal attack or infestation with a mixture of component A and B in a synergistically effective amount; a method for protecting crops from attack or infestation by animal pests which comprises contacting a crop with a mixture of component A and B in a synergistically effective amount; a method for the protection of seeds from soil insects and of the seedlings' roots and shoots from soil and foliar insects comprising contacting the seeds before sowing and/or after pre-germination with a mixture of component A and B in a synergistically effective amount; seeds comprising, e.g. coated with, a mixture of component A and B in a synergistically effective amount; a method comprising coating a seed with a mixture of component A and B in a synergistically effective amount; a method of controlling insects, acarines, nematodes or molluscs which comprises applying to a pest, to a locus of a pest, or to a plant susceptible to attack by a pest a combination of components A and B in a synergistically effective amount.
Mixtures of A and B will normally be applied in an insecticidally, acaricidally, nematicidally or molluscicidally effective amount. In application components A and B may be applied simultaneously or separately.

The mixtures of the present invention can be used to control infestations of insect pests such as Lepidoptera, Diptera, Hemiptera, Thysanoptera, Orthoptera, Dictyoptera, Coleoptera, Siphonaptera, Hymenoptera and Isoptera and also other invertebrate pests, for example, acarine, nematode and mollusc pests. Insects, acarines, nematodes and molluscs are herein collectively referred to as pests. The pests which may be controlled by the use of the invention compounds include those pests associated with agriculture (which term includes the growing of crops for food and fiber products), horticulture and animal husbandry, companion animals, forestry and the storage of products of vegetable origin (such as fruit, grain and timber); those pests associated with the damage of man-made structures and the transmission of diseases of man and animals; and also nuisance pests (such as flies). The mixtures of the invention are particularly effective against insects, acarines and/or nematodes.

According to the invention “useful plants” typically comprise the following species of plants: grape vines; cereals, such as wheat, barley, rye or oats; beet, such as sugar beet or fodder beet; fruits, such as pomes, stone fruits or soft fruits, for example apples, pears, plums, peaches, almonds, cherries, strawberries, raspberries or blackberries; leguminous plants, such as beans, lentils, peas or soybeans; oil plants, such as rape, mustard, poppy, olives, sunflowers, coconut, castor oil plants, cocoa beans or groundnuts; cucumber plants, such as marrows, cucumbers or melons; fibre plants, such as cotton, flax, hemp or jute; citrus fruit, such as oranges, lemons, grapefruit or mandarins; vegetables, such as spinach, lettuce, asparagus, cabbages, carrots, onions, tomatoes, potatoes, cucurbits or paprika; lauraceae, such as avocados, cinnamon or camphor; maize; tobacco; nuts; coffee; sugar cane; tea; vines; hops; durian; bananas; natural rubber plants; turf or ornamentals, such as flowers, shrubs, broad-leaved trees or evergreens, for example conifers. This list does not represent any limitation.

The term "useful plants" is to be understood as including also useful plants that have been rendered tolerant to herbicides like bromoxynil or classes of herbicides (such as, for example, HPPD inhibitors, ALS inhibitors, for example primisulfuron, prosulfuron and trifloxysulfuron, EPSPS (5-enol-pyrovyl-shikimate-3-phosphate-synthase) inhibitors, GS (glutamine synthetase) inhibitors) as a result of conventional methods of breeding or genetic engineering. An example of a crop that has been rendered tolerant to imidazolinones, e.g. imazamox, by conventional methods of breeding (mutagenesis) is Clearfield® summer rape (Canola). Examples of crops that have been rendered tolerant to herbicides or classes of herbicides by genetic engineering methods include glyphosate- and glufosinate-resistant maize varieties commercially available under the trade names RoundupReady® , Herculex I® and LibertyLink®.

The term "useful plants" is to be understood as including also useful plants which have been so transformed by the use of recombinant DNA techniques that they are capable of synthesising one or more selectively acting toxins, such as are known, for example, from toxin-producing bacteria, especially those of the genus Bacillus.

Toxins that can be expressed by such transgenic plants include, for example, insecticidal proteins, for example insecticidal proteins from Bacillus cereus or Bacillus popliae; or insecticidal proteins from Bacillus thuringiensis, such as δ-endotoxins, e.g. CryIA(b), CryIA(c), CryIF, CryIF(a2), CryIIA(b), CryIIIA, CryIIIB(b1) or Cry9c, or vegetative insecticidal proteins (VIP), e.g. VIP1, VIP2, VIP3 or VIP3A; or insecticidal proteins of bacteria colonising nematodes, for example Photorhabdus spp. or Xenorhabdus spp., such as Photorhabdus luminescens, Xenorhabdus nematophilus; toxins produced by animals, such as scorpion toxins, arachnid toxins, wasp toxins and other insect-specific neurotoxins; toxins produced by fungi, such as Streptomycetes toxins, plant lectins, such as pea lectins, barley lectins or snowdrop lectins; agglutinins; proteinase inhibitors, such as trypsine inhibitors, serine protease inhibitors, patatin, cystatin, papain inhibitors; ribosome-inactivating proteins (RIP), such as ricin, maize-RIP, abrin, luffin, saporin or bryodin; steroid metabolism enzymes, such as 3-hydroxysteroidoxidase, ecdysteroid-UDP-glycosyl-transferase, cholesterol oxidases, ecdysone inhibitors, HMG-COA-reductase, ion channel blockers, such as blockers of sodium or calcium channels, juvenile hormone esterase, diuretic hormone receptors, stilbene synthase, bibenzyl synthase, chitinases and glucanases.

In the context of the present invention there are to be understood by δ-endotoxins, for example CryIA(b), CryIA(c), CryIF, CryIF(a2), CryIIA(b), CryIIIA, CryIIIB(b1) or Cry9c, or vegetative insecticidal proteins (VIP), for example VIP1, VIP2, VIP3 or VIP3A, expressly also hybrid toxins, truncated toxins and modified toxins. Hybrid toxins are produced recombinantly by a new combination of different domains of those proteins (see, for example, WO 02/15701). An example for a truncated toxin is a truncated CryIA(b), which is expressed in the Bt11 maize from Syngenta Seed SAS, as described below. In the case of modified toxins, one or more amino acids of the naturally occurring toxin are replaced. In such amino acid replacements, preferably non-naturally present protease recognition sequences are inserted into the toxin, such as, for example, in the case of CryIIIA055, a cathepsin-D-recognition sequence is inserted into a CryIIIA toxin (see WO 03/018810)

Examples of such toxins or transgenic plants capable of synthesising such toxins are disclosed, for example, in EP-A-0 374 753, WO 93/07278, WO 95/34656, EP-A-0 427 529, EP-A-451 878 and WO 03/052073.

The processes for the preparation of such transgenic plants are generally known to the person skilled in the art and are described, for example, in the publications mentioned above. CryI-type deoxyribonucleic acids and their preparation are known, for example, from WO 95/34656, EP-A-0 367 474, EP-A-0 401 979 and WO 90/13651.

The toxin contained in the transgenic plants imparts to the plants tolerance to harmful insects. Such insects can occur in any taxonomic group of insects, but are especially commonly found in the beetles (Coleoptera), two-winged insects (Diptera) and butterflies (Lepidoptera).

Transgenic plants containing one or more genes that code for an insecticidal resistance and express one or more toxins are known and some of them are commercially available. Examples of such plants are: YieldGard® (maize variety that expresses a CryIA(b) toxin); YieldGard Rootworm® (maize variety that expresses a CryIIIB(b1) toxin); YieldGard Plus® (maize variety that expresses a CryIA(b) and a CryIIIB(b1) toxin); Starlink® (maize variety that expresses a Cry9(c) toxin); Herculex I® (maize variety that expresses a CryIF(a2) toxin and the enzyme phosphinothricine N-acetyltransferase (PAT) to achieve tolerance to the herbicide glufosinate ammonium); NuCOTN 33B® (cotton variety that expresses a CryIA(c) toxin); Bollgard I® (cotton variety that expresses a CryIA(c) toxin); Bollgard II® (cotton variety that expresses a CryIA(c) and a CryIIA(b) toxin); VIPCOT® (cotton variety that expresses a VIP toxin); NewLeaf® (potato variety that expresses a CryIIIA toxin); NatureGard® and Protecta®.

Further examples of such transgenic crops are:

1. **Bt11 Maize** from Syngenta Seeds SAS, Chemin de l'Hobit 27, F-31 790 St. Sauveur, France, registration number C/FR/96/05/10. Genetically modified *Zea mays* which has been rendered resistant to attack by the European corn borer (*Ostrinia nubilalis* and *Sesamia nonagrioides*) by transgenic expression of a truncated CryIA(b) toxin. Bt11 maize also transgenically expresses the enzyme PAT to achieve tolerance to the herbicide glufosinate ammonium.

2. **Bt176 Maize** from Syngenta Seeds SAS, Chemin de l'Hobit 27, F-31 790 St. Sauveur, France, registration number C/FR/96/05/10. Genetically modified *Zea mays* which has been rendered resistant to attack by the European corn borer (*Ostrinia nubilalis* and *Sesamia nonagrioides*) by transgenic expression of a CryIA(b) toxin. Bt176 maize also transgenically expresses the enzyme PAT to achieve tolerance to the herbicide glufosinate ammonium.

3. **MIR604 Maize** from Syngenta Seeds SAS, Chemin de l'Hobit 27, F-31 790 St. Sauveur, France, registration number C/FR/96/05/10. Maize which has been rendered insect-resistant by transgenic expression of a modified CryIIIA toxin. This toxin is

Cry3A055 modified by insertion of a cathepsin-D-protease recognition sequence. The preparation of such transgenic maize plants is described in WO 03/018810.

4. **MON 863 Maize** from Monsanto Europe S.A. 270-272 Avenue de Tervuren, B-1150 Brussels, Belgium, registration number C/DE/02/9. MON *863* expresses a CryIIIB(b1) toxin and has resistance to certain Coleoptera insects.

5. **IPC 531 Cotton** from Monsanto Europe S.A. 270-272 Avenue de Tervuren, B-1150 Brussels, Belgium, registration number C/ES/96/02.

6. **1507 Maize** from Pioneer Overseas Corporation, Avenue Tedesco, 7 B-1160 Brussels, Belgium, registration number C/NL/00/10. Genetically modified maize for the expression of the protein Cry1F for achieving resistance to certain Lepidoptera insects and of the PAT protein for achieving tolerance to the herbicide glufosinate ammonium.

7. **NK603 × MON 810 Maize** from Monsanto Europe S.A. 270-272 Avenue de Tervuren, B-1150 Brussels, Belgium, registration number C/GB/02/M3/03. Consists of conventionally bred hybrid maize varieties by crossing the genetically modified varieties NK603 and MON 810. NK603 × MON 810 Maize transgenically expresses the protein CP4 EPSPS, obtained from *Agrobacterium sp.* strain CP4, which imparts tolerance to the herbicide Roundup® (contains glyphosate), and also a CryIA(b) toxin obtained from *Bacillus thuringiensis subsp. kurstaki* which brings about tolerance to certain Lepidoptera, include the European corn borer.

Transgenic crops of insect-resistant plants are also described in BATS (Zentrum für Biosicherheit und Nachhaltigkeit, Zentrum BATS, Clarastrasse 13, 4058 Basel, Switzerland) Report 2003, (http://bats.ch).

The term "useful plants" is to be understood as including also useful plants which have been so transformed by the use of recombinant DNA techniques that they are capable of synthesising antipathogenic substances having a selective action, such as, for example, the so-called "pathogenesis-related proteins" (PRPs, see e.g. EP-A-0 392 225). Examples of such antipathogenic substances and transgenic plants capable of synthesising such antipathogenic substances are known, for example, from EP-A-0 392 225, WO 95/33818, and EP-A-0 353 191. The methods of producing such transgenic plants are generally known to the person skilled in the art and are described, for example, in the publications mentioned above.

Antipathogenic substances which can be expressed by such transgenic plants include, for example, ion channel blockers, such as blockers for sodium and calcium channels, for example the viral KP1, KP4 or KP6 toxins; stilbene synthases; bibenzyl synthases; chitinases; glucanases; the so-called "pathogenesis-related proteins" (PRPs; see e.g. EP-A-0 392 225); antipathogenic substances produced by microorganisms, for example peptide antibiotics or heterocyclic antibiotics (see e.g. WO 95/33818) or protein or polypeptide factors involved in plant pathogen defence (so-called "plant disease resistance genes", as described in WO 03/000906).

Useful plants of elevated interest in connection with present invention are cereals; soybean; rice; oil seed rape; pome fruits; stone fruits; peanuts; coffee; tea; strawberries; turf; vines and vegetables, such as tomatoes, potatoes, cucurbits and lettuce.

The term “locus” of a useful plant as used herein is intended to embrace the place on which the useful plants are growing, where the plant propagation materials of the useful plants are sown or where the plant propagation materials of the useful plants will be placed into the soil. An example for such a locus is a field, on which crop plants are growing.

The term “plant propagation material” is understood to denote generative parts of a plant, such as seeds, which can be used for the multiplication of the latter, and vegetative material, such as cuttings or tubers, for example potatoes. There may be mentioned for example seeds (in the strict sense), roots, fruits, tubers, bulbs, rhizomes and parts of plants. Germinated plants and young plants which are to be transplanted after germination or after emergence from the soil, may also be mentioned. These young plants may be protected before transplantation by a total or partial treatment by immersion. Preferably “plant propagation material” is understood to denote seeds. Insecticides that are of particular interest for treating seeds include thiamethoxam, imidacloprid and clothianidin. Accordingly, in one embodiment component B is selected from thiamethoxam, imidacloprid and clothianidin.

A further aspect of the instant invention is a method of protecting natural substances of plant and/or animal origin, which have been taken from the natural life cycle, and/or their processed forms against attack of pests, which comprises applying to said natural substances of plant and/or animal origin or their processed forms a combination of components A and B in a synergistically effective amount.

According to the instant invention, the term “natural substances of plant origin, which have been taken from the natural life cycle” denotes plants or parts thereof which have been harvested from the natural life cycle and which are in the freshly harvested form. Examples of such natural substances of plant origin are stalks, leafs, tubers, seeds, fruits or grains. According to the instant invention, the term “processed form of a natural substance of plant origin” is understood to denote a form of a natural substance of plant origin that is the result of a modification process. Such modification processes can be used to transform the natural substance of plant origin in a more storable form of such a substance (a storage good). Examples of such modification processes are pre-drying, moistening, crushing, comminuting, grounding, compressing or roasting. Also falling under the definition of a processed form of a natural substance of plant origin is timber, whether in the form of crude timber, such as construction timber, electricity pylons and barriers, or in the form of finished articles, such as furniture or objects made from wood.

According to the instant invention, the term “natural substances of animal origin, which have been taken from the natural life cycle and/or their processed forms” is understood to denote material of animal origin such as skin, hides, leather, furs, hairs and the like.

A preferred embodiment is a method of protecting natural substances of plant origin, which have been taken from the natural life cycle, and/or their processed forms against attack of pests, which comprises applying to said natural substances of plant and/or animal origin or their processed forms a combination of components A and B in a synergistically effective amount.

A further preferred embodiment is a method of protecting fruits, preferably pomes, stone fruits, soft fruits and citrus fruits, which have been taken from the natural life cycle, and/or their processed forms, which comprises applying to said fruits and/or their processed forms a combination of components A and B in a synergistically effective amount.

The combinations according to the present invention are furthermore particularly effective against the following pests: *Myzus persicae* (aphid), *Aphis gossypii* (aphid), *Aphis fabae* (aphid), *Lygus* spp. (capsids), *Dysdercus* spp. (capsids), *Nilaparvata lugens* (planthopper), *Nephotettixc incticeps* (leafhopper), *Nezara* spp. (stinkbugs), *Euschistus* spp. (stinkbugs), *Leptocorisa* spp. (stinkbugs), *Frankliniella occidentalis* (thrip), Thrips spp. (thrips), *Leptinotarsa decemlineata* (Colorado potato beetle), *Anthonomus grandis* (boll weevil), *Aonidiella* spp. (scale insects), *Trialeurodes* spp. (white flies), *Bemisia tabaci* (white fly), *Ostrinia nubilalis* (European corn borer), *Spodoptera littoralis* (cotton leafworm), *Heliothis virescens* (tobacco budworm), *Helicoverpa armigera* (cotton bollworm), *Helicoverpa zea* (cotton bollworm), *Sylepta derogata* (cotton leaf roller), *Pieris brassicae* (white butterfly), *Plutella xylostella* (diamond back moth), *Agrotis* spp. (cutworms), *Chilo suppressalis* (rice stem borer), *Locusta_migratoria* (locust), *Chortiocetes terminifera* (locust), *Diabrotica* spp. (rootworms), *Panonychus ulmi* (European red mite), *Panonychus citri* (citrus red mite), *Tetranychus urticae* (two-spotted spider mite), *Tetranychus cinnabarinus* (carmine spider mite), *Phyllocoptruta oleivora* (citrus rust mite), *Polyphagotarsonemus latus* (broad mite), *Brevipalpus* spp. (flat mites), *Boophilus microplus* (cattle tick), *Dermacentor variabilis* (American dog tick), *Ctenocephalides felis* (cat flea), *Liriomyza* spp. (leafminer), *Musca domestica* (housefly), *Aedes aegypti* (mosquito), *Anopheles* spp. (mosquitoes), *Culex* spp. (mosquitoes), *Lucillia* spp. (blowflies), *Blattella germanica* (cockroach), *Periplaneta americana* (cockroach), *Blatta orientalis* (cockroach), termites of the Mastotermitidae (for example *Mastotermes* spp.), the Kalotermitidae (for example *Neotermes* spp.), the Rhinotermitidae (for example *Coptotermes formosanus*, *Reticulitermes flavipes*, *R. speratu*, *R. virginicus*, *R. hesperus*, and *R. santonensis*) and the Termitidae (for example *Globitermes sulfureus*), *Solenopsis geminata* (fire ant), *Monomorium pharaonis* (pharaoh's ant), *Damalinia* spp. and *Linognathus* spp. (biting and sucking lice), *Meloidogyne* spp. (root knot nematodes), *Globodera* spp. and *Heterodera* spp. (cyst nematodes), *Pratylenchus* spp. (lesion nematodes), *Rhodopholus* spp. (banana burrowing nematodes), *Tylenchulus* spp.(citrus nematodes), *Haemonchus contortus* (barber pole worm), *Caenorhabditis elegans*_(vinegar eelworm), *Trichostrongylus* spp. (gastro intestinal nematodes) and *Deroceras reticulatum* (slug).

The mixtures of the invention may be used for pest control on various plants, including soybean, corn, sugarcane, alfalfa, brassicas, oilseed rape (e.g. canola), potatoes (including sweet potatoes), cotton, rice, coffee, citrus, almonds, fruiting vegetables (e.g.

tomatoes, pepper, chili,eggplant, cucumber, squash etc.), tea, bulb vegetables (e.g. onion, leek etc.), grapes, pome fruit (e.g. apples, pears etc.), and stone fruit (e.g. pears, plums etc.).

The mixtures of the invention may be used on soybean to control, for example, *Elasmopalpus lignosellus*, *Diloboderus abderus*, *Diabrotica speciosa*, *Sternechus subsignatus*, *Formicidae*, *Agrotis ypsilon*, *Julus sspp.*, *Anticarsia gemmatalis*, *Megascelis ssp.*, *Procornitermes ssp.*, *Gryllotalpidae*, *Nezara viridula*, *Piezodorus spp., Acrosternum spp., Neomegalotomus spp., Cerotoma trifurcata*, *Popillia japonica*, *Edessa spp., Liogenys fuscus*, *Euchistus heros*, *stalk borer*, *Scaptocoris castanea*, *phyllophaga spp., Pseudoplusia includens*, *Spodoptera spp.*, *Bemisia tabaci*, *Agriotes spp.* The mixtures of the invention are preferably used on soybean to control *Diloboderus abderus*, *Diabrotica speciosa*, *Nezara viridula*, *Piezodorus spp., Acrosternum spp., Cerotoma trifurcata*, *Popillia japonica*, *Euchistus heros*, *phyllophaga spp., Agriotes sp*

The mixtures of the invention may be used on corn to control, for example, *Euchistus heros*, *Dichelops furcatus*, *Diloboderus abderus*, *Elasmopalpus lignosellus*, *Spodoptera frugiperda*, *Nezara viridula*, *Cerotoma trifurcata, Popillia japonica*, *Agrotis ypsilon*, *Diabrotica speciosa*, *Heteroptera*, *Procornitermes ssp.*, *Scaptocoris castanea*, *Formicidae*, *Julus ssp.*, *Dalbulus maidis*, *Diabrotica virgifera*, *Mocis latipes*, *Bemisia tabaci*, *heliothis spp., Tetranychus spp., thrips spp., phyllophaga spp., scaptocoris spp., Liogenys fuscus*, *Spodoptera spp., Ostrinia spp., Sesamia spp.,. Agriotes spp.* The mixtures of the invention are preferably used on corn to control *Euchistus heros, Dichelops furcatus, Diloboderus abderus, Nezara viridula, Cerotoma trifurcata, Popillia japonica, Diabrotica speciosa, Diabrotica virgifera, Tetranychus spp., thrips spp., phyllophaga spp., scaptocoris spp., Agriotes spp.*

The mixtures of the invention may be used on sugar cane to control, for example, *Sphenophorus spp.,* termites, *Mahanarva spp.*. The mixtures of the invention are preferably used on sugar cane to control termites, *Mahanarva spp.*

The mixtures of the invention may be used on alfalfa to control, for example, *Hypera brunneipennis, Hypera postica, Colias eurytheme, Collops spp., Empoasca solana, Epitrix, Geocoris spp., Lygus hesperus, Lygus lineolaris, Spissistilus spp., Spodoptera spp., Trichoplusia ni.* The mixtures of the invention are preferably used on alfalfa to control *Hypera brunneipennis, Hypera postica, Empoasca solana, Epitrix, Lygus hesperus, Lygus lineolaris, Trichoplusia ni.*

The mixtures of the invention may be used on brassicas to control, for example, *Plutella xylostella*, *Pieris spp., Mamestra spp., Plusia spp., Trichoplusia ni*, *Phyllotreta spp., Spodoptera spp., Empoasca solana*, *thrips spp., Spodoptera spp., Delia spp.* The mixtures of the invention are preferably used on brassicas to control Plutella xylostella *Pieris spp., Plusia spp., Trichoplusia ni*, *Phyllotreta spp., thrips sp*

The mixtures of the invention may be used on oil seed rape, e.g. canola, to control, for example*, Meligethes spp., Ceutorhynchus napi, Psylloides spp.*

The mixtures of the invention may be used on potatoes, including sweet potatoes, to control, for example, *Empoasca spp., Leptinotarsa spp., Diabrotica speciosa*, *Phthorimaea spp., Paratrioza spp., Maladera matrida*, *Agriotes spp.* The mixtures of the invention are preferably used on potatoes, including sweet potatoes, to control *Empoasca spp., Leptinotarsa spp., Diabrotica speciosa*, *Phthorimaea spp., Paratrioza spp., Agriotes spp.*

The mixtures of the invention may be used on cotton to control, for example, *Anthonomus grandis*, *Pectinophora spp., heliothis spp., Spodoptera spp., Tetranychus spp., Empoasca spp., thrips spp., Bemisia tabaci*, *Lygus spp., phyllophaga spp., Scaptocoris spp.* The mixtures of the invention are preferably used on cotton to control *Anthonomus grandis, Tetranychus spp., Empoasca spp., thrips spp., Lygus spp., phyllophaga spp., Scaptocoris spp.*

The mixtures of the invention may be used on rice to control, for example, *Leptocorisa spp., Cnaphalocrosis spp., Chilo spp., Scirpophaga spp., Lissorhoptrus spp., Oebalus pugnax*. The mixtures of the invention are preferably used on rice to control *Leptocorisa spp., Lissorhoptrus spp., Oebalus pugnax.*

The mixtures of the invention may be used on coffee to control, for example, *Hypothenemus Hampei*, *Perileucoptera Coffeella*, *Tetranychus spp.* The mixtures of the invention are preferably used on coffee to control *Hypothenemus Hampei, Perileucoptera Coffeella.*

The mixtures of the invention may be used on citrus to control, for example, *Panonychus citri, Phyllocoptruta oleivora*, *Brevipalpus spp., Diaphorina citri*, *Scirtothrips spp., thrips spp., Unaspis spp., Ceratitis capitata*, *Phyllocnistis spp.* The mixtures of the invention are preferably used on citrus to control *Panonychus citri, Phyllocoptruta oleivora, Brevipalpus spp., Diaphorina citri, Scirtothrips spp., thrips spp., Phyllocnistis spp.*

The mixtures of the invention may be used on almonds to control, for example, Amyelois transitella, Tetranychus spp.

The mixtures of the invention may be used on fruiting vegetable, including tomatoes, pepper, chili, eggplant, cucumber, squash etc, to control *thrips spp., Tetranychus spp., Polyphagotarsonemus spp., Aculops spp., Empoasca spp., Spodoptera spp., heliothis spp., Tuta absoluta*, *Liriomyza spp., Bemisia tabaci*, *Trialeurodes spp., Paratrioza spp., Frankliniella occidentalis*, *Frankliniella spp., Anthonomus spp., Phyllotreta spp., Amrasca spp., Epilachna spp., Halyomorpha spp., Scirtothrips spp., Leucinodes spp., Neoleucinodes spp.*. The mixtures of the invention are preferably used on fruiting vegetable, including tomatoes, pepper, chili, eggplant, cucumber, squash etc, to control, for example, *thrips spp., Tetranychus spp., Polyphagotarsonemus spp., Aculops spp., Empoasca spp., Spodoptera spp., heliothis spp., Tuta absoluta, Liriomyza spp., Paratrioza spp., Frankliniella occidentalis, Frankliniella spp., Amrasca spp., Scirtothrips spp., Leucinodes spp., Neoleucinodes spp.*

The mixtures of the invention may be used on tea to control, for example, *Pseudaulacaspis spp., Empoasca spp., Scirtothrips spp., Caloptilia theivora*. The mixtures of the invention are prefrerably used on tea to control *Empoasca spp., Scirtothrips spp.*

The mixtures of the invention may be used on bulb vegetables, including onion, leek etc to control, for example, *thrips spp., Spodoptera spp., heliothis spp.* The mixtures of the invention are preferably used on bulb vegetables, including onion, leek etc to control *thrips spp.*

The mixtures of the invention may be used on grapes to control, for example, *Empoasca spp., Lobesia spp., Frankliniella spp., thrips spp., Tetranychus spp., Rhipiphorothrips Cruentatus*, *Eotetranychus Willamettei*, *Erythroneura Elegantula*, *Scaphoides spp.*. The mixtures of the invention are preferably used on grapes to control *Frankliniella spp., thrips spp., Tetranychus spp., Rhipiphorothrips Cruentatus, Scaphoides spp.*

The mixtures of the invention may be used on pome fruit, including apples, pairs etc, to control, for example, *Cacopsylla spp., Psylla spp., Panonychus ulmi*, *Cydia pomonella*. The mixtures of the invention are preferably used on pome fruit, including apples, pairs etc, to control *Cacopsylla spp., Psylla spp., Panonychus ulmi.*

The mixtures of the invention may be used on stone fruit to control, for example, *Grapholita molesta*, *Scirtothrips spp., thrips spp., Frankliniella spp., Tetranychus spp.*

The mixtures of the invention are preferably used on stone fruit to control *Scirtothrips spp., thrips spp., Frankliniella spp., Tetranychus spp.*

The amount of a combination of the invention to be applied, will depend on various factors, such as the compounds employed; the subject of the treatment, such as, for example plants, soil or seeds; the type of treatment, such as, for example spraying, dusting or seed dressing; the purpose of the treatment, such as, for example prophylactic or therapeutic; the type of pest to be controlled or the application time.

The mixtures comprising a compound of formula I, e.g. those selected from table A, and one or more active ingredients as described above can be applied, for example, in a single "ready-mix" form, in a combined spray mixture composed from separate formulations of the single active ingredient components, such as a "tank-mix", and in a combined use of the single active ingredients when applied in a sequential manner, i.e. one after the other with a reasonably short period, such as a few hours or days. The order of applying the compounds of formula I selected from table A and the active ingredients as described above is not essential for working the present invention.

The synergistic activity of the combination is apparent from the fact that the pesticidal activity of the composition of A + B is greater than the sum of the pesticidal activities of A and B.

The method of the invention comprises applying to the useful plants, the locus thereof or propagation material thereof in admixture or separately, a synergistically effective aggregate amount of a component A and a component B.

Some of said combinations according to the invention have a systemic action and can be used as foliar, soil and seed treatment pesticides.

With the combinations according to the invention it is possible to inhibit or destroy the pests which occur in plants or in parts of plants (fruit, blossoms, leaves, stems, tubers, roots) in different useful plants, while at the same time the parts of plants which grow later are also protected from attack by pests.

The combinations of the present invention are of particular interest for controlling pests in various useful plants or their seeds, especially in field crops such as potatoes, tobacco and sugarbeets, and wheat, rye, barley, oats, rice, maize, lawns, cotton, soybeans, oil seed rape, pulse crops, sunflower, coffee, sugarcane, fruit and ornamentals in horticulture and viticulture, in vegetables such as cucumbers, beans and cucurbits.

The combinations according to the invention are applied by treating the pests, the useful plants, the locus thereof, the propagation material thereof, the natural substances of plant and/or animal origin, which have been taken from the natural life cycle, and/or their processed forms, or the industrial materials threatened by pests, attack with a combination of components A and B in a synergistically effective amount.

The combinations according to the invention may be applied before or after infection or contamination of the useful plants, the propagation material thereof, the natural substances of plant and/or animal origin, which have been taken from the natural life cycle, and/or their processed forms, or the industrial materials by the pests.

The combinations according to the invention can be used for controlling, i. e. containing or destroying, pests of the abovementioned type which occur on useful plants in agriculture, in horticulture and in forests, or on organs of useful plants, such as fruits, flowers, foliage, stalks, tubers or roots, and in some cases even on organs of useful plants which are formed at a later point in time remain protected against these pests.

When applied to the useful plants the compound of formula I is generally applied at a rate of 1 to 500 g a.i./ha in association with 1 to 2000 g a.i./ha, of a compound of component B, depending on the class of chemical employed as component B.

Generally for plant propagation material, such as seed treatment, application rates can vary from 0.001 to 10g / kg of seeds of active ingredients. When the combinations of the present invention are used for treating seed, rates of 0.001 to 5 g of a compound of formula I per kg of seed, preferably from 0.01 to 1g per kg of seed, and 0.001 to 5 g of a compound of component B, per kg of seed, preferably from 0.01 to 1g per kg of seed, are generally sufficient.

The weight ratio of A to B may generally be between 1000 : 1 and 1 : 1000. In other embodiments that weight ratio of A to B may be between 500 : 1 to 1 : 500, for example between 100 : 1 to 1 : 100, for example between 1 : 50 to 50 : 1, for example 1 : 20 to 20 : 1. Other embodiments of weight ratios of component (B) to component (A) range from 500: 1 to 1:250, with one embodiment being from 200:1 to 1:150, another embodiment being from 150:1 to 1:50 and another embodiment being from 50:1 to 1:10. Also of note are weight ratios of component (B) to component (A) which range from 450:1 to 1:300, with one embodiment being from 150:1 to 1:100, another embodiment being from 30:1 to 1:25 and another embodiment being from 10:1 to 1:10.

The invention also provides pesticidal mixtures comprising a combination of components A and B as mentioned above in a synergistically effective amount, together with an agriculturally acceptable carrier, and optionally a surfactant.

Spodoptera preferably means Spodoptera littoralis. Heliothis preferably means Heliothis virescens. Tetranychus preferably means Tetranychus urticae.

The compositions of the invention may be employed in any conventional form, for example in the form of a twin pack, a powder for dry seed treatment (DS), an emulsion for seed treatment (ES), a flowable concentrate for seed treatment (FS), a solution for seed treatment (LS), a water dispersible powder for seed treatment (WS), a capsule suspension for seed treatment (CF), a gel for seed treatment (GF), an emulsion concentrate (EC), a suspension concentrate (SC), a suspo-emulsion (SE), a capsule suspension (CS), a water dispersible granule (WG), an emulsifiable granule (EG), an emulsion, water in oil (EO), an emulsion, oil in water (EW), a micro-emulsion (ME), an oil dispersion (OD), an oil miscible flowable (OF), an oil miscible liquid (OL), a soluble concentrate (SL), an ultra-low volume suspension (SU), an ultra-low volume liquid (UL), a technical concentrate (TK), a dispersible concentrate (DC), a wettable powder (WP), a soluble granule (SG) or any technically feasible formulation in combination with agriculturally acceptable adjuvants.

Such compositions may be produced in conventional manner, e.g. by mixing the active ingredients with appropriate formulation inerts (diluents, solvents, fillers and optionally other formulating ingredients such as surfactants, biocides, anti-freeze, stickers, thickeners and compounds that provide adjuvancy effects). Also conventional slow release formulations may be employed where long lasting efficacy is intended. Particularly formulations to be applied in spraying forms, such as water dispersible concentrates (e.g. EC, SC, DC, OD, SE, EW, EO and the like), wettable powders and granules, may contain surfactants such as wetting and dispersing agents and other compounds that provide adjuvancy effects, e.g. the condensation product of formaldehyde with naphthalene sulphonate, an alkylarylsulphonate, a lignin sulphonate, a fatty alkyl sulphate, and ethoxylated alkylphenol and an ethoxylated fatty alcohol.

A seed dressing formulation is applied in a manner known per se to the seeds employing the combination of the invention and a diluent in suitable seed dressing formulation form, e.g. as an aqueous suspension or in a dry powder form having good adherence to the seeds. Such seed dressing formulations are known in the art. Seed dressing formulations may contain the single active ingredients or the combination of active ingredients in encapsulated form, e.g. as slow release capsules or microcapsules. A typical a tank-mix formulation for seed treatment application comprises 0.25 to 80%, especially 1 to 75 %, of the desired ingredients, and 99.75 to 20 %, especially 99 to 25 %, of a solid or liquid auxiliaries (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 40 %, especially 0.5 to 30 %, based on the tank-mix formulation. A typical pre-mix formulation for seed treatment application comprises 0.5 to 99.9 %, especially 1 to 95 %, of the desired ingredients, and 99.5 to 0.1 %, especially 99 to 5 %, of a solid or liquid adjuvant (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 50 %, especially 0.5 to 40 %, based on the pre-mix formulation.

In general, the formulations include from 0.01 to 90% by weight of active agent, from 0 to 20% agriculturally acceptable surfactant and 10 to 99.99% solid or liquid formulation inerts and adjuvant(s), the active agent consisting of at least the compound of formula I together with a compound of component B, and optionally other active agents, particularly microbiocides or conservatives or the like. Concentrated forms of compositions generally contain in between about 2 and 80%, preferably between about 5 and 70% by weight of active agent. Application forms of formulation may for example contain from 0.01 to 20% by weight, preferably from 0.01 to 5% by weight of active agent. Whereas commercial products will preferably be formulated as concentrates, the end user will normally employ diluted formulations.

Examples

A synergistic effect exists whenever the action of an active ingredient combination is greater than the sum of the actions of the individual components.

The action to be expected E for a given active ingredient combination obeys the so-called COLBY formula and can be calculated as follows (COLBY, S.R. "Calculating synergistic and antagonistic responses of herbicide combination". Weeds, Vol. 15, pages 20-22; 1967):

ppm = milligrams of active ingredient (= a.i.) per liter of spray mixture

X = % action by active ingredient A) using p ppm of active ingredient

Y = % action by active ingredient B) using q ppm of active ingredient.

According to COLBY, the expected (additive) action of active ingredients A)+B) using p+q ppm of active ingredient is $E = X + Y - \frac{X \cdot Y}{100}$

If the action actually observed (O) is greater than the expected action (E), then the action of the combination is super-additive, i.e. there is a synergistic effect. In mathematical terms the synergism factor SF corresponds to O/E. In the agricultural practice an SF of ≥ 1.2 indicates significant improvement over the purely complementary addition of activities (expected activity), while an SF of ≤ 0.9 in the practical application routine signals a loss of activity compared to the expected activity.

Tables 1 to 123 show mixtures and compositions of the present invention demonstrating control on a wide range of invertebrate pests, some with notable synergistic effect. As the percent of mortality cannot exceed 100 percent, the unexpected increase in insecticidal activity can be greatest only when the separate active ingredient components alone are at application rates providing considerably less than 100 percent control. Synergy may not be evident at low application rates where the individual active ingredient components alone have little activity. However, in some instances high activity was observed for combinations wherein individual active ingredient alone at the same application rate had essentially no activity. The synergism is remarkable.

Noteworthy are mixtures comprising A1 and abamectin, chlorpyrifos, cyantraniliprole, emamectin benzoate, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid or flonicamid; mixtures comprising A5 and abamectin, chlorpyrifos, cyantraniliprole, emamectin benzoate, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid or flonicamid; mixtures comprising A6 and abamectin, chlorpyrifos, cyantraniliprole, emamectin benzoate, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid or flonicamid; mixtures comprising A6 and A7 and abamectin, chlorpyrifos, cyantraniliprole, emamectin benzoate, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid or flonicamid; mixtures comprising A8 and abamectin, chlorpyrifos, cyantraniliprole, emamectin benzoate, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid or flonicamid.

Spodoptera littoralis (Egyptian cotton leaf worm)
(larvicide L1, feeding/contact)

Cotton leaf discs are placed on agar in Petri dishes and sprayed with test solutions in an application chamber. After drying, the leaf discs are infested with 10 L1 larvae. The samples are checked for mortality 5 days after treatment. 3 replicates per treatment were evaluated. Application rates are as indicated in the Tables. (1 PPM = 1 mg l^{-1})

Table 1

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A1	Abamectin	A1	Abamectin	MORTALITY	MORTALITY
0.4	0.4	20	10	28	33*
0.4	0.8	20	13	31	37*
0.4	1.6	20	40	52	47
0.8	0.4	50	10	55	50
0.8	0.8	50	13	57	53
0.8	1.6	50	40	70	90*

Table 2

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A1	Chlorpyriphos	A1	Chlorpyriphos	MORTALITY	MORTALITY
0.4	12.5	20	10	28	30*
0.4	25	20	17	33	37*
0.4	50	20	30	44	37
0.8	12.5	50	10	55	53
0.8	25	50	17	58	60*
0.8	50	50	30	65	80*

Table 3

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED

		AFTER 5 DAYS			
A1	Cyantraniliprole	A1	Cyantraniliprole	MORTALITY	MORTALITY
0.4	0.0125	37	23	51	40
0.4	0.025	37	27	54	40
0.4	0.05	37	40	62	90*
0.8	0.0125	67	23	74	83*
0.8	0.025	67	27	76	87*
0.8	0.05	67	40	80	93*

Table 4

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A1	Emamectin Benzoate	A1	Emamectin Benzoate	MORTALITY	MORTALITY
0.4	0.003125	37	20	49	37
0.4	0.00625	37	23	51	70*
0.4	0.0125	37	30	56	73*
0.8	0.003125	67	20	73	77*
0.8	0.00625	67	23	74	80*
0.8	0.0125	67	30	77	83*

Table 5

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A1	Lambda Cyhalothrin	A1	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.4	0.05	7	10	16	20*
0.4	0.1	7	13	19	30*
0.4	0.2	7	17	22	30*
0.8	0.05	27	10	34	40*
0.8	0.1	27	13	36	63*
0.8	0.2	27	17	39	67*

Table 6

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A1	Pymetrozine	A1	Pymetrozine	MORTALITY	MORTALITY
0.4	100	7	17	22	20
0.4	200	7	20	25	23
0.8	100	27	17	39	27
0.8	200	27	20	41	33

Table 7

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A1	Spirotetramat	A1	Spirotetramat	MORTALITY	MORTALITY
0.4	25	40	10	46	50*
0.4	50	40	17	50	57*
0.4	100	40	43	66	83*
0.8	25	47	10	52	57*
0.8	50	47	17	56	93*
0.8	100	47	43	70	97*

Table 8

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED

		AFTER 5 DAYS			
A1	Thiamethoxam	A1	Thiamethoxam	MORTALITY	MORTALITY
0.4	0.2	40	7	44	40
0.4	0.4	40	13	48	53*
0.4	0.8	40	30	58	60*
0.8	0.2	47	7	50	53*
0.8	0.4	47	13	54	57*
0.8	0.8	47	30	63	73*

Table 9

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Abamectin	A5	Abamectin	MORTALITY	MORTALITY
0.1	0.4	23	10	31	27
0.1	0.8	23	13	34	30
0.1	1.6	23	40	54	47
0.2	0.4	67	10	70	73*
0.2	0.8	67	13	71	73*
0.2	1.6	67	40	80	77

Table 10

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Chlorpyriphos	A5	Chlorpyriphos	MORTALITY	MORTALITY
0.1	12.5	23	10	31	30
0.1	25	23	17	36	43*
0.1	50	23	30	46	47*
0.2	12.5	67	10	70	67
0.2	25	67	17	72	73*
0.2	50	67	30	77	80*

Table 11

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Cyantraniliprole	A5	Cyantraniliprole	MORTALITY	MORTALITY
0.1	0.0125	30	23	46	47*
0.1	0.025	30	27	49	70*
0.1	0.05	30	40	58	77*
0.2	0.0125	50	23	62	63*
0.2	0.025	50	27	63	87*
0.2	0.05	50	40	70	97*

Table 12

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Emamectin Benzoate	A5	Emamectin Benzoate	MORTALITY	MORTALITY
0.1	0.003125	30	20	44	33
0.1	0.00625	30	23	46	50*
0.1	0.0125	30	30	51	50
0.2	0.003125	50	20	60	53
0.2	0.00625	50	23	62	53
0.2	0.0125	50	30	65	60

Table 13

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Lambda Cyhalothrin	A5	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.1	0.05	20	10	28	20
0.1	0.1	20	13	31	20
0.1	0.2	20	17	33	30
0.2	0.05	23	10	31	23
0.2	0.1	23	13	34	30
0.2	0.2	23	17	36	37*

Table 14

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Pymetrozine	A5	Pymetrozine	MORTALITY	MORTALITY
0.1	100	20	17	33	23
0.1	200	20	20	36	23
0.2	100	23	17	36	30
0.2	200	23	20	39	47*

Table 15

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Spirotetramat	A5	Spirotetramat	MORTALITY	MORTALITY
0.1	25	27	10	34	60*
0.1	50	27	17	39	60*
0.1	100	27	43	58	100*
0.2	25	47	10	52	67*
0.2	50	47	17	56	90*
0.2	100	47	43	70	100*

Table 16

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A5	Thiamethoxam	A5	Thiamethoxam	MORTALITY	MORTALITY
0.1	0.2	27	7	32	27
0.1	0.4	27	13	36	27
0.1	0.8	27	30	49	50*
0.2	0.2	47	7	50	53*
0.2	0.4	47	13	54	53
0.2	0.8	47	30	63	53

Table 17

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Abamectin	A6	Abamectin	MORTALITY	MORTALITY
0.05	0.4	7	7	13	7
0.1	0.4	20	7	25	20
0.2	0.4	50	7	53	50
0.05	0.8	7	10	16	10
0.1	0.8	20	10	28	23
0.2	0.8	50	10	55	50
0.05	1.6	7	20	25	20

0.1	1.6	20	20	36	27
0.2	1.6	50	20	60	60

Table 18

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Chlorpyriphos	A6	Chlorpyriphos	MORTALITY	MORTALITY
0.05	12.5	7	7	13	7
0.1	12.5	20	7	25	23
0.2	12.5	50	7	53	50
0.05	25	7	10	16	13
0.1	25	20	10	28	27
0.2	25	50	10	55	53
0.05	50	7	20	25	20
0.1	50	20	20	36	43*
0.2	50	50	20	60	63*

Table 19

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Cyantraniliprole	A6	Cyantraniliprole	MORTALITY	MORTALITY
0.05	0.0125	7	23	28	23
0.1	0.0125	17	23	36	37*
0.2	0.0125	47	23	59	77*
0.05	0.025	7	30	35	30
0.1	0.025	17	30	42	37
0.2	0.025	47	30	63	83*
0.05	0.05	7	50	53	67
0.1	0.05	17	50	58	70
0.2	0.05	47	50	73	83

Table 20

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Emamectin Benzoate	A6	Emamectin Benzoate	MORTALITY	MORTALITY
0.05	0.003125	7	20	25	20
0.1	0.003125	17	20	33	27
0.2	0.003125	47	20	57	80*
0.05	0.00625	7	23	28	27
0.1	0.00625	17	23	36	30
0.2	0.00625	47	23	59	83*
0.05	0.0125	7	27	32	27
0.1	0.0125	17	27	39	30
0.2	0.0125	47	27	61	90*

Table 21

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Lambda Cyhalothrin	A6	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.05	0.05	7	20	25	20
0.1	0.05	17	20	33	23
0.2	0.05	50	20	60	57
0.05	0.1	7	37	41	40
0.1	0.1	17	37	47	50*

0.2	0.1	50	37	68	67
0.05	0.2	7	57	60	57
0.1	0.2	17	57	64	70*
0.2	0.2	50	57	78	77

Table 22

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Pymetrozine	A6	Pymetrozine	MORTALITY	MORTALITY
0.05	100	7	7	13	10
0.1	100	17	7	22	20
0.2	100	50	7	53	50
0.05	200	7	17	22	17
0.1	200	17	17	31	20
0.2	200	50	17	58	60*

Table 23

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Spirotetramat	A6	Spirotetramat	MORTALITY	MORTALITY
0.05	25	7	23	28	23
0.1	25	13	23	34	27
0.2	25	40	23	54	90*
0.05	50	7	33	38	43*
0.1	50	13	33	42	63*
0.2	50	40	33	60	97*
0.05	100	7	67	69	70*
0.1	100	13	67	71	90
0.2	100	40	67	80	100*

Table 24

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A6	Thiamethoxam	A6	Thiamethoxam	MORTALITY	MORTALITY
0.05	0.2	7	10	16	13
0.1	0.2	13	10	22	23
0.2	0.2	40	10	46	40
0.05	0.4	7	13	19	13
0.1	0.4	13	13	25	33*
0.2	0.4	40	13	48	40
0.05	0.8	7	30	35	30
0.1	0.8	13	30	39	40*
0.2	0.8	40	30	58	43

Table 25

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Abamectin	A8	Abamectin	MORTALITY	MORTALITY
0.05	0.4	10	7	16	10
0.1	0.4	23	7	28	27
0.2	0.4	53	7	56	57*
0.05	0.8	10	10	19	13
0.1	0.8	23	10	31	27
0.2	0.8	53	10	58	57
0.05	1.6	10	20	28	20

0.1	1.6	23	20	39	30
0.2	1.6	53	20	63	57

Table 26

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Chlorpyriphos	A8	Chlorpyriphos	MORTALITY	MORTALITY
0.05	12.5	10	7	16	10
0.1	12.5	23	7	28	23
0.2	12.5	53	7	56	53
0.05	25	10	10	19	13
0.1	25	23	10	31	23
0.2	25	53	10	58	57
0.05	50	10	20	28	20
0.1	50	23	20	39	40*
0.2	50	53	20	63	60

Table 27

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Cyantraniliprole	A8	Cyantraniliprole	MORTALITY	MORTALITY
0.05	0.0125	20	23	39	27
0.1	0.0125	30	23	46	30
0.2	0.0125	50	23	62	80*
0.05	0.025	20	30	44	33
0.1	0.025	30	30	51	47
0.2	0.025	50	30	65	83*
0.05	0.05	20	50	60	53
0.1	0.05	30	50	65	57
0.2	0.05	50	50	75	100*

Table 28

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Emamectin Benzoate	A8	Emamectin Benzoate	MORTALITY	MORTALITY
0.05	0.003125	20	20	36	27
0.1	0.003125	30	20	44	30
0.2	0.003125	50	20	60	50
0.05	0.00625	20	23	39	27
0.1	0.00625	30	23	46	30
0.2	0.00625	50	23	62	63*
0.05	0.0125	20	27	41	33
0.1	0.0125	30	27	49	37
0.2	0.0125	50	27	63	83*

Table 29

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Lambda Cyhalothrin	A8	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.05	0.05	10	20	28	20
0.1	0.05	20	20	36	37*
0.2	0.05	53	20	63	53
0.05	0.1	10	37	43	37
0.1	0.1	20	37	49	40

0.2	0.1	53	37	70	60
0.05	0.2	10	57	61	57
0.1	0.2	20	57	65	60
0.2	0.2	53	57	80	73

Table 30

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Pymetrozine	A8	Pymetrozine	MORTALITY	MORTALITY
0.05	100	10	7	16	17*
0.1	100	20	7	25	20
0.2	100	53	7	56	53
0.05	200	10	17	25	20
0.1	200	20	17	33	30
0.2	200	53	17	61	57

Table 31

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Spirotetramat	A8	Spirotetramat	MORTALITY	MORTALITY
0.05	25	13	23	34	23
0.1	25	23	23	41	70*
0.2	25	40	23	54	90*
0.05	50	13	33	42	43*
0.1	50	23	33	49	87*
0.2	50	40	33	60	100*
0.05	100	13	67	71	77*
0.1	100	23	67	74	97*
0.2	100	40	67	80	100*

Table 32

PPM AI		AVERAGE DEAD IN % AFTER 5 DAYS		EXPECTED	OBSERVED
A8	Thiamethoxam	A8	Thiamethoxam	MORTALITY	MORTALITY
0.05	0.2	13	10	22	13
0.1	0.2	23	10	31	23
0.2	0.2	40	10	46	40
0.05	0.4	13	13	25	13
0.1	0.4	23	13	34	23
0.2	0.4	40	13	48	40
0.05	0.8	13	30	39	30
0.1	0.8	23	30	46	33
0.2	0.8	40	30	58	53

Heliothis virescens (Tobacco budworm):

(ovo-larvicide, feeding/contact)

30-35 fresh eggs (0-24 h old), deposited on filter paper, are placed in Petri dishes on top of a layer of artificial diet and 0.8 ml of diluted test solutions are pipetted onto them. After an incubation period of 7 days, samples are checked for egg and larval mortality. 3 replicates per treatment were evaluated. Application rates are as indicated in the Tables.

Table 33

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Abamectin	A1	Abamectin	MORTALITY	MORTALITY
0.2	0.025	17	3	19	30*
0.2	0.05	17	37	48	27
0.2	0.1	17	53	61	40
0.4	0.025	60	3	61	33
0.4	0.05	60	37	75	47
0.4	0.1	60	53	81	67
0.8	0.025	87	3	87	47
0.8	0.05	87	37	92	57
0.8	0.1	87	53	94	67

Table 34

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Chlorpyrifos	A1	Chlorpyrifos	MORTALITY	MORTALITY
0.2	50	0	0	0	30*
0.2	100	0	0	0	17*
0.2	200	0	30	30	63*
0.4	50	37	0	37	77*
0.4	100	37	0	37	70*
0.4	200	37	30	56	93*
0.8	50	67	0	67	77
0.8	100	67	0	67	90
0.8	200	67	30	77	97

Table 35

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Cyantraniliprole	A1	Cyantraniliprole	MORTALITY	MORTALITY
0.2	0.2	13	23	33	23
0.2	0.4	13	70	74	70
0.2	0.8	13	82	84	78
0.4	0.2	68	23	75	57
0.4	0.4	68	70	90	78
0.4	0.8	68	82	94	90
0.8	0.2	73	23	79	72
0.8	0.4	73	70	92	67
0.8	0.8	73	82	95	85

Table 36

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Emamectin benzoate	A1	Emamectin benzoate	MORTALITY	MORTALITY
0.2	0.0015	10	5	15	5
0.2	0.003	10	5	15	10
0.2	0.006	10	10	19	27*
0.4	0.0015	47	5	50	53*
0.4	0.003	47	5	50	70*
0.4	0.006	47	10	52	57*
0.8	0.0015	67	5	69	70*
0.8	0.003	67	5	69	73*
0.8	0.006	67	10	70	73*

Table 37

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Lambda Cyhalothrin	A1	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.2	0.05	24	33	49	80*
0.2	0.1	24	100	100	100
0.2	0.2	24	100	100	100
0.4	0.05	61	33	74	80*
0.4	0.1	61	100	100	100
0.4	0.2	61	100	100	100
0.8	0.05	72	33	81	73
0.8	0.1	72	100	100	100
0.8	0.2	72	100	100	100

Table 38

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Pymetrozine	A1	Pymetrozine	MORTALITY	MORTALITY
0.2	100	13	0	13	60*
0.2	200	13	40	48	53*
0.4	100	68	0	68	83*
0.4	200	68	40	81	73
0.8	100	73	0	73	82*
0.8	200	73	40	84	75

Table 39

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Spirotetramat	A1	Spirotetramat	MORTALITY	MORTALITY
0.2	100	13	78	81	60
0.2	200	13	100	100	-
0.4	100	68	78	93	78
0.4	200	68	100	100	100
0.8	100	73	78	94	83
0.8	200	73	100	100	100

Table 40

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A1	Thiamethoxam	A1	Thiamethoxam	MORTALITY	MORTALITY
0.2	100	13	78	81	72
0.2	200	13	80	83	73
0.4	100	68	78	93	88
0.4	200	68	80	94	87
0.8	100	73	78	94	90
0.8	200	73	80	95	63

Table 41

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A5	Abamectin	A5	Abamectin	MORTALITY	MORTALITY
0.025	0.025	3	3	6	37*

0.025	0.05	3	37	39	40*
0.025	0.1	3	53	54	63*
0.05	0.025	33	3	35	33
0.05	0.05	33	37	58	53
0.05	0.1	33	53	69	50
0.1	0.025	53	3	54	50
0.1	0.05	53	37	70	53
0.1	0.1	53	53	78	67

Table 42

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A5	Chlorpyrifos	A5	Chlorpyrifos	MORTALITY	MORTALITY
0.025	50	0	0	0	0
0.025	100	0	0	0	0
0.025	200	0	30	30	73*
0.05	50	7	0	7	43*
0.05	100	7	0	7	47*
0.05	200	7	30	35	87*
0.1	50	67	0	67	80*
0.1	100	67	0	67	90*
0.1	200	67	30	77	100*

Table 43

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A5	Cyantraniliprole	A5	Cyantraniliprole	MORTALITY	MORTALITY
0.025	0.2	12	23	32	20
0.025	0.4	12	63	67	62
0.025	0.8	12	72	75	90*
0.05	0.2	67	23	75	23
0.05	0.4	67	63	88	62
0.05	0.8	67	72	91	83
0.1	0.2	87	23	90	70
0.1	0.4	87	63	95	77
0.1	0.8	87	72	96	92

Table 44

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A5	Emamectin benzoate	A5	Emamectin benzoate	MORTALITY	MORTALITY
0.025	0.0015	3	5	8	2
0.025	0.003	3	5	8	15*
0.025	0.006	3	10	13	25*
0.05	0.0015	7	5	12	3
0.05	0.003	7	5	12	17*
0.05	0.006	7	10	16	27*
0.1	0.0015	30	5	34	67*
0.1	0.003	30	5	34	33
0.1	0.006	30	10	37	57*

Table 45

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED

		(LARVAE)			
A5	Lambda Cyhalothrin	A5	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.025	0.05	6	33	37	80*
0.025	0.1	6	100	100	100
0.025	0.2	6	100	100	100
0.05	0.05	27	33	51	70*
0.05	0.1	27	100	100	100
0.05	0.2	27	100	100	100
0.1	0.05	66	33	77	63
0.1	0.1	66	100	100	100
0.1	0.2	66	100	100	100

Table 46

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A5	Pymetrozine	A5	Pymetrozine	MORTALITY	MORTALITY
0.025	200	10	37	43	13
0.05	200	47	37	67	45
0.1	200	73	37	83	67

Table 47

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A5	Spirotetramat	A5	Spirotetramat	MORTALITY	MORTALITY
0.025	200	10	98	98	98
0.05	200	47	98	99	100*
0.1	200	73	98	99	100*

Table 48

PPM AI		AVERAGE DEAD IN % (LARVAE)		EXPECTED	OBSERVED
A5	Thiamethoxam	A5	Thiamethoxam	MORTALITY	MORTALITY
0.025	200	10	80	82	83*
0.05	200	47	80	89	85
0.1	200	73	80	95	82

Table 49

PPM AI		AVERAGE DEAD IN % (EGGS)		EXPECTED	OBSERVED
A1	Lambda Cyhalothrin	A1	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.2	0.05	0	0	0	3*
0.2	0.1	0	17	17	47*
0.2	0.2	0	50	50	73*
0.4	0.05	0	0	0	0
0.4	0.1	0	17	17	30*
0.4	0.2	0	50	50	80*
0.8	0.05	0	0	0	3*
0.8	0.1	0	17	17	50*
0.8	0.2	0	50	50	77*

Table 50

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED

		(EGGS)			
A1	Spirotetramat	A1	Spirotetramat	MORTALITY	MORTALITY
0.2	100	0	0	0	0
0.2	200	0	67	67	100*
0.4	100	0	0	0	0
0.4	200	0	67	67	67
0.8	100	0	0	0	0
0.8	200	0	67	67	67

Table 51

PPM AI		AVERAGE DEAD IN % (EGGS)		EXPECTED	OBSERVED
A1	Thiamethoxam	A1	Thiamethoxam	MORTALITY	MORTALITY
0.2	100	0	0	0	0
0.2	200	0	0	0	0
0.4	100	0	0	0	0
0.4	200	0	0	0	0
0.8	100	0	0	0	27*
0.8	200	0	0	0	33*

Table 52

PPM AI		AVERAGE DEAD IN % (EGGS)		EXPECTED	OBSERVED
A5	Lambda Cyhalothrin	A5	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.025	0.05	0	0	0	0
0.025	0.1	0	17	17	47*
0.025	0.2	0	50	50	77*
0.05	0.05	0	0	0	0
0.05	0.1	0	17	17	40*
0.05	0.2	0	50	50	77*
0.1	0.05	0	0	0	0
0.1	0.1	0	17	17	30*
0.1	0.2	0	50	50	40

Table 53

PPM AI		AVERAGE DEAD IN % (EGGS)		EXPECTED	OBSERVED
A5	Spirotetramat	A5	Spirotetramat	MORTALITY	MORTALITY
0.025	200	0	65	65	62
0.05	200	0	65	65	92*
0.1	200	0	65	65	87*

Table 54

PPM AI		AVERAGE DEAD IN % (EGGS)		EXPECTED	OBSERVED
A5	Thiamethoxam	A5	Thiamethoxam	MORTALITY	MORTALITY
0.025	200	0	0	0	0
0.05	200	0	0	0	0
0.1	200	0	0	0	77*

Single compound applications or combinations of A1 or A5 with Abamectin, Chlorpyrifos, Cyantraniliprole, Emamectin benzoate, or Pymetrozine were all inactive on eggs.

<u>Heliothis virescens</u> (Tobacco budworm)

Eggs (0-24 h old) are placed in 24-well microtiter plate on artificial diet and treated with test solutions (DMSO) by pipetting. After an incubation period of 4 days, samples are checked for larval mortality. Application rates are as indicated in the Tables.

Table 55

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A5	Flonicamid	SYN 545706	Flonicamid	MORTALITY	MORTALITY
3.2	100	98	0	98	95
1.6	50	90	15	92	98*
0.8	25	95	0	95	98*
0.4	12.5	90	0	90	75
0.2	6.25	35		35	10
1.6	100	90	0	90	95*
0.8	50	95	15	96	93
0.4	25	90	0	90	75
0.2	12.5	35	0	35	25
0.1	6.25	0		0	5*
0.8	100	95	0	95	85
0.4	50	90	15	92	93*
0.2	25	35	0	35	0
0.8	200	95	0	95	98*
0.4	100	90	0	90	93*
0.2	50	35	15	45	0
0.8	400	95	0	95	98*
0.4	200	90	0	90	90
0.2	100	35	0	35	0
0.1	50	0	15	15	0

Table 56

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A5	Imidacloprid	SYN 545706	Imidacloprid	MORTALITY	MORTALITY
3.2	50	96	85	99	93
1.6	25	91	75	98	95
0.8	12.5	88	0	88	85
0.4	6.25	78	0	78	80*
0.2	3.125	25		25	0
1.6	50	91	85	99	98
0.8	25	88	75	97	88
0.4	12.5	78	0	78	50
0.2	6.25	25	0	25	0
0.8	50	88	85	98	100*
0.4	25	78	75	94	95*
0.2	12.5	25	0	25	20
0.8	100	88	88	98	100
0.4	50	78	85	97	93
0.2	25	25	75	81	60
0.1	12.5	0	0	0	20*

0.8	200	88	100	100	100
0.4	100	78	88	97	98*
0.2	50	25	85	89	60
0.1	25	0	75	75	5

Table 57

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A5	Clothianidin	SYN 545706	Clothianidin	MORTALITY	MORTALITY
3.2	3	96	0	96	98*
1.6	1.5	91	0	91	93*
0.8	0.75	88	0	88	85
0.4	0.375	78	0	78	10
0.2	0.187	25		25	0
1.6	3	91	0	91	85
0.8	1.5	88	0	88	85
0.4	0.75	78	0	78	70
0.2	0.375	25	0	25	0
0.8	3	88	0	88	98*
0.4	1.5	78	0	78	88*
0.2	0.75	25	0	25	0
0.8	6	88	45	93	93
0.4	3	78	0	78	90*
0.2	1.5	25	0	25	0
0.8	12	88	80	98	90
0.4	6	78	45	88	90*
0.2	3	25	0	25	0

Table 58

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Abamectin	A6	Abamectin	MORTALITY	MORTALITY
3.2	1.6	95	78	99	95
1.6	0.8	95	68	98	85
0.8	0.4	85	45	92	75
0.4	0.2	65	0	65	85*
0.2	0.1	5		5	0
1.6	1.6	95	78	99	95
0.8	0.8	85	68	95	85
0.4	0.4	65	45	81	35
0.2	0.2	5	0	5	0
0.8	1.6	85	78	97	85
0.4	0.8	65	68	89	75
0.2	0.4	5	45	48	55*
0.8	3.2	85	100	100	100
0.4	1.6	65	78	92	90
0.2	0.8	5	68	69	60
0.1	0.4	0	45	45	35
0.8	6.4	85	100	100	100
0.4	3.2	65	100	100	100
0.2	1.6	5	78	79	60
0.1	0.8	0	68	68	75*
0.05	0.4		45	45	0

Table 59

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Emamectin benzoate	A6	Emamectin benzoate	MORTALITY	MORTALITY
3.2	0.006	100	0	100	95
1.6	0.003	90	0	90	90
0.8	0.0015	95	0	95	90
0.4	0.00075	70	0	70	45
0.2	0.000375	5		5	0
1.6	0.006	90	0	90	90
0.8	0.003	95	0	95	85
0.4	0.0015	70	0	70	40
0.2	0.00075	5	0	5	50*
0.8	0.006	95	0	95	90
0.4	0.003	70	0	70	60
0.2	0.0015	5	0	5	0
0.8	0.012	95	55	98	90
0.4	0.006	70	0	70	85*
0.2	0.003	5	0	5	0
0.8	0.024	95	93	100	90
0.4	0.012	70	55	87	80
0.2	0.006	5	0	5	0

Table 60

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Chlorpyrifos	A6	Chlorpyrifos	MORTALITY	MORTALITY
3.2	200	100	100	100	100
1.6	100	100	100	100	100
0.8	50	95	90	100	100
0.4	25	65	45	81	65
1.6	200	100	100	100	100
0.8	100	95	100	100	100
0.4	50	65	90	97	75
0.2	25	0	45	45	65*
0.8	200	95	100	100	95
0.4	100	65	100	100	100
0.2	50	0	90	90	85
0.1	25	0	45	45	0
0.8	400	95	100	100	100
0.4	200	65	100	100	100
0.2	100	0	100	100	100
0.1	50	0	90	90	80
0.05	25		45	45	25
0.8	800	95	100	100	100
0.4	400	65	100	100	100
0.2	200	0	100	100	100
0.1	100	0	100	100	100
0.05	50		90	90	85
0.025	25		45	45	0

Table 61

PPM AI	AVERAGE DEAD IN %	EXPECTED	OBSERVED

A6	Cyantraniliprole	A6	Cyantraniliprole	MORTALITY	MORTALITY
3.2	0.2	95	78	99	100*
1.6	0.1	95	45	97	90
0.8	0.05	85	0	85	90*
0.4	0.025	80	0	80	50
0.2	0.0125	65		65	0
1.6	0.2	95	78	99	90
0.8	0.1	85	45	92	90
0.4	0.05	80	0	80	85*
0.2	0.025	65	0	65	25
0.8	0.2	85	78	97	95
0.4	0.1	80	45	89	85
0.2	0.05	65	0	65	25
0.8	0.4	85	90	99	95
0.4	0.2	80	78	96	90
0.2	0.1	65	45	81	65
0.1	0.05	0	0	0	25*
0.8	0.8	85	100	100	100
0.4	0.4	80	90	98	90
0.2	0.2	65	78	92	85
0.1	0.1	0	45	45	65*

Table 62

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Lambda Cyhalothrin	A6	Lambda Cyhalothrin	MORTALITY	MORTALITY
3.2	0.05	100	0	100	95
1.6	0.025	95	0	95	90
0.8	0.0125	90	0	90	70
0.4	0.00625	85	0	85	65
0.2	0.0032	25		25	0
1.6	0.05	95	0	95	100*
0.8	0.025	90	0	90	85
0.4	0.0125	85	0	85	40
0.2	0.00625	25	0	25	0
0.8	0.05	90	0	90	85
0.4	0.025	85	0	85	85
0.2	0.0125	25	0	25	0
0.8	0.1	90	25	93	80
0.4	0.05	85	0	85	65
0.2	0.025	25	0	25	0
0.8	0.2	90	75	98	80
0.4	0.1	85	25	89	80
0.2	0.05	25	0	25	25

Table 63

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Pymetrozine	A6	Pymetrozine	MORTALITY	MORTALITY
3.2	200	98	0	98	93
1.6	100	90	0	90	90
0.8	50	75	0	75	90*
0.4	25	75	0	75	10

1.6	200	90	0	90	88
0.8	100	75	0	75	80*
0.4	50	75	0	75	85*
0.8	200	75	0	75	85*
0.4	100	75	0	75	85*
0.2	50	0	0	0	0
0.8	400	75	0	75	85*
0.4	200	75	0	75	80*
0.8	800	75	0	75	85*
0.4	400	75	0	75	85*

Table 64

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Spirotetramat	A6	Spirotetramat	MORTALITY	MORTALITY
3.2	50	98	0	98	95
1.6	25	90	0	90	93*
0.8	12.5	90	0	90	90
0.4	6.25	45	0	45	75*
0.2	3.125	0		0	25*
1.6	50	90	0	90	93*
0.8	25	90	0	90	88
0.4	12.5	45	0	45	25
0.8	50	90	0	90	85
0.4	25	45	0	45	80*
0.8	100	90	0	90	80
0.4	50	45	0	45	85*
0.2	25	0	0	0	0
0.1	12.5	0	0	0	25*
0.8	200	90	0	90	90
0.4	100	45	0	45	85*
0.2	50	0	0	0	0
0.1	25	0	0	0	25*

Table 65

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Thiamethoxam	A6	Thiamethoxam	MORTALITY	MORTALITY
3.2	50	95	0	95	95
1.6	25	95	0	95	90
0.8	12.5	85	0	85	85
0.4	6.25	70	0	70	45
0.2	3.125	35		35	10
1.6	50	95	0	95	90
0.8	25	85	0	85	90*
0.4	12.5	70	0	70	70
0.2	6.25	35	0	35	25
0.8	50	85	0	85	90*
0.4	25	70	0	70	90*
0.2	12.5	35	0	35	0
0.8	100	85	25	89	0
0.4	50	70	0	70	45
0.2	25	35	0	35	0
0.8	200	85	65	95	85
0.4	100	70	25	78	80*

0.2	50	35	0	35	0

Table 66

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Flonicamid	A6	Flonicamid	MORTALITY	MORTALITY
3.2	100	95	0	95	95
1.6	50	90	0	90	95*
0.8	25	75	0	75	85*
0.4	12.5	65	0	65	70*
0.2	6.25	25		25	50*
1.6	100	90	0	90	90
0.8	50	75	0	75	90*
0.4	25	65	0	65	55
0.2	12.5	25	0	25	0
0.8	100	75	0	75	85*
0.4	50	65	0	65	85*
0.2	25	25	0	25	0
0.8	200	75	0	75	85*
0.4	100	65	0	65	85*
0.2	50	25	0	25	0
0.8	400	75	0	75	75
0.4	200	65	0	65	80*
0.2	100	25	0	25	0

Table 67

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Imidacloprid	A6	Imidacloprid	MORTALITY	MORTALITY
3.2	50	100	50	100	100
1.6	25	95	20	96	93
0.8	12.5	85	0	85	45
0.4	6.25	85	0	85	0
1.6	50	95	50	98	95
0.8	25	85	20	88	88
0.4	12.5	85	0	85	25
0.8	50	85	50	93	90
0.4	25	85	20	88	75
0.8	100	85	95	99	93
0.4	50	85	50	93	93
0.2	25	0	20	20	0
0.1	12.5	0	0	0	5*
0.8	200	85	100	100	100
0.4	100	85	95	99	95
0.2	50	0	50	50	0
0.1	25	0	20	20	0

Table 68

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Clothianidin	A6	Clothianidin	MORTALITY	MORTALITY
3.2	3	100	3	100	98
1.6	1.5	95	0	95	95
0.8	0.75	80	0	80	83*
0.4	0.375	70	0	70	70

0.2	0.187	20		20	10
1.6	3	95	3	95	95
0.8	1.5	80	0	80	95*
0.4	0.75	70	0	70	65
0.2	0.375	20	0	20	0
0.8	3	80	3	81	80
0.4	1.5	70	0	70	80*
0.2	0.75	20	0	20	0
0.8	6	80	38	88	90*
0.4	3	70	3	71	75*
0.2	1.5	20	0	20	0
0.8	12	80	48	90	90
0.4	6	70	38	81	85*
0.2	3	20	3	22	0
0.1	1.5	0	0	0	10*

Table 69

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Abamectin	A8	Abamectin	MORTALITY	MORTALITY
3.2	1.6	100	78	100	95
1.6	0.8	90	68	97	90
0.8	0.4	90	45	95	90
0.4	0.2	85	0	85	55
0.2	0.1	65		65	0
1.6	1.6	90	78	98	85
0.8	0.8	90	68	97	80
0.4	0.4	85	45	92	60
0.2	0.2	65	0	65	50
0.8	1.6	90	78	98	90
0.4	0.8	85	68	95	75
0.2	0.4	65	45	81	50
0.1	0.2	0	0	0	40*
0.8	3.2	90	100	100	90
0.4	1.6	85	78	97	90
0.2	0.8	65	68	89	70
0.1	0.4	0	45	45	50*
0.8	6.4	90	100	100	100
0.4	3.2	85	100	100	95
0.2	1.6	65	78	92	85
0.1	0.8	0	68	68	40
0.05	0.4		45	45	0

Table 70

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Emamectin benzoate	A8	Emamectin benzoate	MORTALITY	MORTALITY
3.2	0.006	95	0	95	90
1.6	0.003	90	0	90	90
0.8	0.0015	90	0	90	90
0.4	0.00075	45	0	45	50*
1.6	0.006	90	0	90	85
0.8	0.003	90	0	90	75
0.4	0.0015	45	0	45	45

0.2	0.00075	0	0	0	10*
0.1	0.000375	0		0	10*
0.8	0.006	90	0	90	90
0.4	0.003	45	0	45	80*
0.8	0.012	90	55	96	85
0.4	0.006	45	0	45	75*
0.8	0.024	90	93	99	90
0.4	0.012	45	55	75	80*

Table 71

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Chlorpyrifos	A8	Chlorpyrifos	MORTALITY	MORTALITY
3.2	200	100	100	100	100
1.6	100	95	100	100	100
0.8	50	90	90	99	95
0.4	25	65	45	81	80
0.2	12.5	25		25	25
0.1	6.25	0		0	25*
1.6	200	95	100	100	100
0.8	100	90	100	100	100
0.4	50	65	90	97	70
0.2	25	25	45	59	50
0.8	200	90	100	100	100
0.4	100	65	100	100	100
0.2	50	25	90	93	90
0.1	25	0	45	45	25
0.8	400	90	100	100	100
0.4	200	65	100	100	100
0.2	100	25	100	100	100
0.1	50	0	90	90	100*
0.05	25		45	45	0
0.8	800	90	100	100	100
0.4	400	65	100	100	100
0.2	200	25	100	100	0
0.1	100	0	100	100	100
0.05	50		90	90	65
0.025	25		45	45	0

Table 72

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Cyantraniliprole	A8	Cyantraniliprole	MORTALITY	MORTALITY
3.2	0.2	95	78	99	95
1.6	0.1	90	45	95	90
0.8	0.05	80	0	80	85*
0.4	0.025	65	0	65	65
0.2	0.0125	50		50	0
1.6	0.2	90	78	98	95
0.8	0.1	80	45	89	85
0.4	0.05	65	0	65	65
0.2	0.025	50	0	50	80*
0.8	0.2	80	78	96	90
0.4	0.1	65	45	81	80
0.2	0.05	50	0	50	0

0.8	0.4	80	90	98	90
0.4	0.2	65	78	92	80
0.2	0.1	50	45	73	25
0.1	0.05	0	0	0	65*
0.8	0.8	80	100	100	90
0.4	0.4	65	90	97	85
0.2	0.2	50	78	89	80
0.1	0.1	0	45	45	60*

Table 73

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Lambda Cyhalothrin	A8	Lambda Cyhalothrin	MORTALITY	MORTALITY
3.2	0.05	95	0	95	100*
1.6	0.025	90	0	90	95*
0.8	0.0125	85	0	85	90*
0.4	0.00625	75	0	75	75
0.2	0.0032	35		35	0
1.6	0.05	90	0	90	90
0.8	0.025	85	0	85	80
0.4	0.0125	75	0	75	25
0.2	0.00625	35	0	35	25
0.8	0.05	85	0	85	90*
0.4	0.025	75	0	75	75
0.2	0.0125	35	0	35	40*
0.8	0.1	85	25	89	85
0.4	0.05	75	0	75	80*
0.2	0.025	35	0	35	0
0.8	0.2	85	75	96	75
0.4	0.1	75	25	81	50
0.2	0.05	35	0	35	0

Table 74

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Pymetrozine	A8	Pymetrozine	MORTALITY	MORTALITY
3.2	200	93	0	93	93
1.6	100	90	0	90	90
0.8	50	85	0	85	75
0.4	25	65	0	65	55
0.2	12.5	50		50	0
1.6	200	90	0	90	90
0.8	100	85	0	85	85
0.4	50	65	0	65	60
0.2	25	50	0	50	0
0.8	200	85	0	85	90*
0.4	100	65	0	65	85*
0.2	50	50	0	50	0
0.8	400	85	0	85	85
0.4	200	65	0	65	80*
0.2	100	50	0	50	0
0.8	800	85	0	85	85
0.4	400	65	0	65	75*
0.2	200	50	0	50	0

0.1	100	0	0	0	25*

Table 75

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Spirotetramat	A8	Spirotetramat	MORTALITY	MORTALITY
3.2	50	100	0	100	98
1.6	25	93	0	93	93
0.8	12.5	90	0	90	85
0.4	6.25	25	0	25	0
1.6	50	93	0	93	90
0.8	25	90	0	90	90
0.4	12.5	25	0	25	45*
0.8	50	90	0	90	90
0.4	25	25	0	25	90*
0.8	100	90	0	90	88
0.4	50	25	0	25	85*
0.8	200	90	0	90	90
0.4	100	25	0	25	80*

Table 76

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Thiamethoxam	A8	Thiamethoxam	MORTALITY	MORTALITY
3.2	50	95	0	95	100*
1.6	25	90	0	90	90
0.8	12.5	90	0	90	85
0.4	6.25	75	0	75	40
0.2	3.125	55		55	10
0.1	1.563	0		0	0
1.6	50	90	0	90	90
0.8	25	90	0	90	85
0.4	12.5	75	0	75	90*
0.2	6.25	55	0	55	50
0.8	50	90	0	90	90
0.4	25	75	0	75	75
0.2	12.5	55	0	55	0
0.025	1.563			0	0
0.8	100	90	25	93	85
0.4	50	75	0	75	85*
0.2	25	55	0	55	0
0.8	200	90	65	97	95
0.4	100	75	25	81	80
0.2	50	55	0	55	0
0.1	25	0	0	0	40*

Table 77

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Flonicamid	A8	Flonicamid	MORTALITY	MORTALITY
3.2	100	95	0	95	93
1.6	50	93	0	93	90
0.8	25	85	0	85	85
0.4	12.5	60	0	60	50
1.6	100	93	0	93	93

0.8	50	85	0	85	90*
0.4	25	60	0	60	70*
0.8	100	85	0	85	95*
0.4	50	60	0	60	93*
0.8	200	85	0	85	98*
0.4	100	60	0	60	90*
0.8	400	85	0	85	93*
0.4	200	60	0	60	85*

Table 78

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Imidacloprid	A8	Imidacloprid	MORTALITY	MORTALITY
3.2	50	100	50	100	95
1.6	25	95	20	96	93
0.8	12.5	90	0	90	70
0.4	6.25	60	0	60	60
1.6	50	95	50	98	93
0.8	25	90	20	92	88
0.4	12.5	60	0	60	30
0.8	50	90	50	95	93
0.4	25	60	20	68	85*
0.2	12.5	0	0	0	20*
0.8	100	90	95	100	98
0.4	50	60	50	80	90*
0.2	25	0	20	20	10
0.1	12.5	0	0	0	15*
0.8	200	90	100	100	100
0.4	100	60	95	98	85
0.2	50	0	50	50	35
0.1	25	0	20	20	25*

Table 79

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Clothianidin	A8	Clothianidin	MORTALITY	MORTALITY
3.2	3	98	3	98	100*
1.6	1.5	95	0	95	95
0.8	0.75	98	0	98	93
0.4	0.375	60	0	60	65*
1.6	3	95	3	95	93
0.8	1.5	98	0	98	95
0.4	0.75	60	0	60	60
0.8	3	98	3	98	93
0.4	1.5	60	0	60	85*
0.2	0.75	0	0	0	10*
0.8	6	98	38	98	93
0.4	3	60	3	61	95*
0.2	1.5	0	0	0	20*
0.1	0.75	0	0	0	45*
0.8	12	98	48	99	95

Tetranychus urticae (Two spotted spider mite)

(contact/feeding activity)

Bean plants are infested with mite populations of mixed ages. 1 day after infestation, plants are treated in a spray chamber with diluted test solutions. 1 and 8 days later, samples are checked for adult mortality. 2 replicates per treatment were evaluated. Application rates are as indicated in the Tables.

Table 80

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Abamectin	A1	Abamectin	MORTALITY	MORTALITY
1.6	0.0015	0	0	0	0
1.6	0.003	0	0	0	0
1.6	0.006	0	0	0	10*
3.125	0.0015	0	0	0	0
3.125	0.003	0	0	0	20*
3.125	0.006	0	0	0	25*
6.25	0.0015	40	0	40	25
6.25	0.003	40	0	40	10
6.25	0.006	40	0	40	30

Table 81

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Chlorpyrifos	A1	Chlorpyrifos	MORTALITY	MORTALITY
1.6	50	0	0	0	30*
1.6	100	0	60	60	100*
1.6	200	0	88	88	100*
3.125	50	20	0	20	75*
3.125	100	40	60	76	95*
3.125	200	40	88	93	100*
6.25	50	50	0	50	70*
6.25	100	80	60	92	100*
6.25	200	80	88	98	95

Table 82

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Cyantraniliprole	A1	Cyantraniliprole	MORTALITY	MORTALITY
1.6	100	0	0	0	30*
1.6	200	0	10	10	55*
3.125	100	20	0	20	60*
3.125	200	20	10	28	65*
6.25	100	50	0	50	85*
6.25	200	50	10	55	80*

Table 83

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Emamectin benzoate	A1	Emamectin benzoate	MORTALITY	MORTALITY
1.6	0.0125	0	0	0	0
1.6	0.025	0	8	8	0
1.6	0.05	0	0	0	10*

3.125	0.0125	45	0	45	40
3.125	0.025	45	8	49	50*
3.125	0.05	45	0	45	45
6.25	0.0125	80	0	80	90*
6.25	0.025	80	8	82	95*
6.25	0.05	80	0	80	100*

Table 84

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Lambda Cyhalothrin	A1	Lambda Cyhalothrin	MORTALITY	MORTALITY
1.6	3.125	0	25	25	15
1.6	6.25	0	55	55	50
1.6	12.5	0	88	88	100*
3.125	3.125	10	25	33	80*
3.125	6.25	10	55	60	100*
3.125	12.5	10	88	89	95*
6.25	3.125	80	25	85	95*
6.25	6.25	80	55	91	100*
6.25	12.5	80	88	98	100*

Table 85

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Pymetrozine	A1	Pymetrozine	MORTALITY	MORTALITY
1.6	200	0	5	5	0
3.125	200	40	5	43	40
6.25	200	80	5	81	80

Table 86

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Spirotetramat	A1	Spirotetramat	MORTALITY	MORTALITY
1.6	0.1	0	13	13	10
1.6	0.2	0	18	18	35*
1.6	0.4	0	23	23	35*
3.125	0.1	15	13	26	20
3.125	0.2	15	18	30	10
3.125	0.4	15	23	35	25
6.25	0.1	75	13	78	90*
6.25	0.2	75	18	80	95*
6.25	0.4	75	23	81	85*

Table 87

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A1	Thiamethoxam	A1	Thiamethoxam	MORTALITY	MORTALITY
1.6	200	0	0	0	35
3.125	200	40	0	40	15
6.25	200	80	0	80	100

Table 88

PPM AI	AVERAGE DEAD IN %	EXPECTED	OBSERVED

		AFTER 1 DAY			
A5	Abamectin	A5	Abamectin	MORTALITY	MORTALITY
0.4	0.0015	0	0	0	0
0.4	0.003	0	0	0	10*
0.4	0.006	0	0	0	20*
0.8	0.0015	20	0	20	0
0.8	0.003	20	0	20	0
0.8	0.006	20	0	20	25*
1.6	0.0015	80	0	80	15
1.6	0.003	80	0	80	45
1.6	0.006	80	0	80	30

Table 89

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A5	Chlorpyrifos	A5	Chlorpyrifos	MORTALITY	MORTALITY
0.4	50	0	0	0	10
0.4	100	0	60	60	60
0.4	200	0	88	88	100*
0.8	50	30	0	30	40*
0.8	100	0	60	60	100*
0.8	200	0	88	88	95*
1.6	50	30	0	30	80*
1.6	100	75	60	90	95*
1.6	200	75	88	97	95

Table 90

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A5	Cyantraniliprole	A5	Cyantraniliprole	MORTALITY	MORTALITY
0.4	100	0	0	0	70*
0.4	200	0	10	10	70*
0.8	100	30	0	30	50*
0.8	200	30	10	37	60*
1.6	100	30	0	30	55*
1.6	200	30	10	37	80*

Table 91

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A5	Emamectin benzoate	A5	Emamectin benzoate	MORTALITY	MORTALITY
0.4	0.0125	0	0	0	0
0.4	0.025	0	8	8	0
0.4	0.05	0	0	0	20*
0.8	0.0125	15	0	15	20*
0.8	0.025	15	8	22	30*
0.8	0.05	15	0	15	25*
1.6	0.0125	65	0	65	40
1.6	0.025	65	8	68	55
1.6	0.05	65	0	65	85*

Table 92

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED

		AFTER 1 DAY			
A5	Lambda Cyhalothrin	A5	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.4	3.125	10	25	33	15
0.4	6.25	10	55	60	60
0.4	12.5	10	88	89	95*
0.8	3.125	35	25	51	80*
0.8	6.25	35	55	71	80*
0.8	12.5	35	88	92	100*
1.6	3.125	75	25	81	45
1.6	6.25	75	55	89	75
1.6	12.5	75	88	97	100*

Table 93

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A5	Pymetrozine	A5	Pymetrozine	MORTALITY	MORTALITY
0.4	200	0	5	5	0
0.8	200	0	5	5	35*
1.6	200	75	5	76	70

Table 94

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A5	Spirotetramat	A5	Spirotetramat	MORTALITY	MORTALITY
0.4	0.1	0	13	13	10
0.4	0.2	0	18	18	10
0.4	0.4	0	23	23	15
0.8	0.1	0	13	13	10
0.8	0.2	0	18	18	25*
0.8	0.4	0	23	23	40*
1.6	0.1	10	13	22	10
1.6	0.2	10	18	26	35*
1.6	0.4	10	23	31	25

Table 95

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A5	Thiamethoxam	A5	Thiamethoxam	MORTALITY	MORTALITY
0.4	200	0	0	0	0
0.8	200	0	0	0	40*
1.6	200	75	0	75	65

Table 96

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A6	Lambda Cyhalothrin	A6	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.2	3.125	3	70	71	100*
0.2	6.25	3	90	90	100*
0.2	12.5	3	83	84	100*
0.4	3.125	20	70	76	100*
0.4	6.25	20	90	92	100*
0.4	12.5	20	83	86	100*
0.8	3.125	85	70	96	90

0.8	6.25	85	90	99	100*
0.8	12.5	85	83	97	100*

Table 97

PPM AI		AVERAGE DEAD IN % AFTER 1 DAY		EXPECTED	OBSERVED
A8	Lambda Cyhalothrin	A8	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.4	3.125	38	70	81	95*
0.4	6.25	38	90	94	100*
0.4	12.5	38	83	89	100*
0.8	3.125	35	70	81	90*
0.8	6.25	35	90	94	85
0.8	12.5	35	83	89	85
1.5	3.125	100	70	100	90
1.5	6.25	100	90	100	95
1.5	12.5	100	83	100	95

Table 98

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Abamectin	A1	Abamectin	MORTALITY	MORTALITY
1.5	0.0015	30	25	48	35
1.5	0.003	30	20	44	30
1.5	0.006	30	25	48	35
3.125	0.0015	45	25	59	70*
3.125	0.003	45	20	56	75*
3.125	0.006	45	25	59	75*
6.25	0.0015	65	25	74	100*
6.25	0.003	65	20	72	100*
6.25	0.006	65	25	74	100*

Table 99

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Chlorpyrifos	A1	Chlorpyrifos	MORTALITY	MORTALITY
1.5	50	30	0	30	65*
1.5	100	10	20	28	80*
1.5	200	10	63	67	75*
3.125	50	85	0	85	100*
3.125	100	60	20	68	95*
3.125	200	60	63	85	95*
6.25	50	90	0	90	95*
6.25	100	90	20	92	100*
6.25	200	90	63	96	100*

Table 100

PPM AI		AVERAE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Cyantraniliprole	A1	Cyantraniliprole	MORTALITY	MORTALITY
1.5	100	30	35	55	75*
1.5	200	30	25	48	85*
3.125	100	85	35	90	100*
3.125	200	85	25	89	80
6.25	100	90	35	94	95*

6.25	200	90	25	93	100*

Table 101

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Emamectin benzoate	A1	Emamectin benzoate	MORTALITY	MORTALITY
1.5	0.0125	30	5	34	40*
1.5	0.025	30	23	46	40
1.5	0.05	30	38	57	80*
3.125	0.0125	85	5	86	100*
3.125	0.025	85	23	88	100*
3.125	0.05	85	38	91	95*
6.25	0.0125	95	5	95	100*
6.25	0.025	95	23	96	100*
6.25	0.05	95	38	97	100*

Table 102

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Lambda Cyhalothrin	A1	Lambda Cyhalothrin	MORTALITY	MORTALITY
1.5	3.125	10	20	28	20
1.5	6.25	10	85	87	80
1.5	12.5	10	98	98	100*
3.125	3.125	45	20	56	95*
3.125	6.25	45	85	92	100*
3.125	12.5	45	98	99	100*
6.25	3.125	85	20	88	95*
6.25	6.25	85	85	98	100*
6.25	12.5	85	98	100	100

Table 103

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Pymetrozine	A1	Pymetrozine	MORTALITY	MORTALITY
1.5	200	10	0	10	50*
3.125	200	60	0	60	60
6.25	200	90	0	90	95*

Table 104

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Spirotetramat	A1	Spirotetramat	MORTALITY	MORTALITY
1.5	0.1	0	10	10	5
1.5	0.2	0	33	33	65*
1.5	0.4	0	38	38	75*
3.125	0.1	90	10	91	95*
3.125	0.2	90	33	93	100*
3.125	0.4	90	38	94	100*
6.25	0.1	100	10	100	100
6.25	0.2	100	33	100	100
6.25	0.4	100	38	100	100

Table 105

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A1	Thiamethoxam	A1	Thiamethoxam	MORTALITY	MORTALITY
1.5	200	10	5	15	35*
3.125	200	60	5	62	70*
6.25	200	90	5	91	100*

Table 106

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Abamectin	A5	Abamectin	MORTALITY	MORTALITY
0.4	0.0015	45	25	59	30
0.4	0.003	45	20	56	35
0.4	0.006	45	25	59	40
0.8	0.0015	80	25	85	35
0.8	0.003	80	20	84	55
0.8	0.006	80	25	85	75
1.5	0.0015	100	25	100	100
1.5	0.003	100	20	100	95
1.5	0.006	100	25	100	100

Table 107

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Chlorpyrifos	A5	Chlorpyrifos	MORTALITY	MORTALITY
0.4	50	25	0	25	55*
0.4	100	0	20	20	40*
0.4	200	0	63	63	65*
0.8	50	65	0	65	75*
0.8	100	25	20	40	80*
0.8	200	25	63	72	85*
1.5	50	100	0	100	100
1.5	100	100	20	100	100
1.5	200	100	63	100	100

Table 108

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Cyantraniliprole	A5	Cyantraniliprole	MORTALITY	MORTALITY
0.4	100	25	35	51	100*
0.4	200	25	25	44	90*
0.8	100	65	35	77	80*
0.8	200	65	25	74	85*
1.5	100	100	35	100	100
1.5	200	100	25	100	100

Table 109

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Emamectin benzoate	A5	Emamectin benzoate	MORTALITY	MORTALITY
0.4	0.0125	15	5	19	5
0.4	0.025	15	23	35	10
0.4	0.05	15	38	47	25

0.8	0.0125	55	5	57	85*
0.8	0.025	55	23	65	95*
0.8	0.05	55	38	72	80*
1.5	0.0125	100	5	100	100
1.5	0.025	100	23	100	100
1.5	0.05	100	38	100	100

Table 110

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Lambda Cyhalothrin	A5	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.4	3.125	0	20	20	10
0.4	6.25	0	85	85	60
0.4	12.5	0	98	98	100
0.8	3.125	40	20	52	30
0.8	6.25	40	85	91	50
0.8	12.5	40	98	99	100*
1.5	3.125	100	20	100	100
1.5	6.25	100	85	100	100
1.5	12.5	100	98	100	100

Table 111

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Pymetrozine	A5	Pymetrozine	MORTALITY	MORTALITY
0.4	200	0	0	0	15*
0.8	200	25	0	25	35*
1.5	200	100	0	100	100

Table 112

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Spirotetramat	A5	Spirotetramat	MORTALITY	MORTALITY
0.4	0.1	0	10	10	0
0.4	0.2	0	33	33	0
0.4	0.4	0	38	38	35
0.8	0.1	35	10	42	95*
0.8	0.2	35	33	56	95*
0.8	0.4	35	38	60	100*
1.5	0.1	100	10	100	100
1.5	0.2	100	33	100	100
1.5	0.4	100	38	100	100

Table 113

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A5	Thiamethoxam	A5	Thiamethoxam	MORTALITY	MORTALITY
0.4	200	0	5	5	0
0.8	200	25	5	29	40*
1.5	200	100	5	100	100

Table 114

PPM AI	AVERAGE DEAD IN %	EXPECTED	OBSERVED

		AFTER 8 DAYS			
A6	Lambda Cyhalothrin	A6	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.2	3.125	3	75	76	100*
0.2	6.25	3	90	90	100*
0.2	12.5	3	90	90	100*
0.4	3.125	60	75	90	100*
0.4	6.25	60	90	96	100*
0.4	12.5	60	90	96	100*
0.8	3.125	85	75	96	100*
0.8	6.25	85	90	99	100*
0.8	12.5	85	90	99	100*

Table 115

PPM AI		AVERAGE DEAD IN % AFTER 8 DAYS		EXPECTED	OBSERVED
A8	Lambda Cyhalothrin	A8	Lambda Cyhalothrin	MORTALITY	MORTALITY
0.4	3.125	55	75	89	100*
0.4	6.25	55	90	96	100*
0.4	12.5	55	90	96	100*
0.8	3.125	38	75	85	100*
0.8	6.25	38	90	94	100*
0.8	12.5	38	90	94	100*
1.5	3.125	100	75	100	100
1.5	6.25	100	90	100	100
1.5	12.5	100	90	100	100

<u>*Tetranychus urticae*</u> (Two-spotted spider mite)

Bean leaf discs on agar in 24-well microtiter plates are sprayed with test solutions (DMSO). After drying, the leaf discs are infested with mite populations of mixed ages. 8 days later, discs are checked for mixed population mortality. Application rates are as indicated in the Tables.

Table 116

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Abamectin	A6	Abamectin	MORTALITY	MORTALITY
0.4	0.1	90	85	99	100*
0.4	0.05	90	85	99	100*
0.4	0.025	90	0	90	100*
0.4	0.0125	90	0	90	100*
0.4	0.006	90	0	90	90
0.4	0.003	90	0	90	100*
0.4	0.0015	90	0	90	100*
0.4	0.0008	90	0	90	100*
0.4	0.0004	90	0	90	100*
0.4	0.0002	90	0	90	100*
0.2	0.1	0	85	85	95*
0.2	0.05	0	85	85	100*
0.2	0.025	0	0	0	90*
0.2	0.0125	0	0	0	90*

0.2	0.006	0	0	0	80*
0.2	0.003	0	0	0	90*
0.2	0.0015	0	0	0	90*
0.2	0.0008	0	0	0	90*
0.2	0.0004	0	0	0	70*
0.2	0.0002	0	0	0	75*
0.1	0.1	0	85	85	90*
0.1	0.05	0	85	85	80
0.05	0.1	0	85	85	45
0.05	0.05	0	85	85	40

Table 117

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Emamectin	A6	Emamectin	MORTALITY	MORTALITY
0.8	0.8	100	95	100	95
0.4	0.4	75	93	98	85
0.2	0.2	25	75	81	65
0.1	0.1	0	70	70	65
0.4	0.8	75	95	99	100*
0.2	0.4	25	93	94	95*
0.1	0.2	0	75	75	75
0.05	0.1	0	70	70	25
0.2	0.8	25	95	96	100*
0.1	0.4	0	93	93	100*
0.05	0.2	0	75	75	60
0.025	0.1	0	70	70	25
0.2	1.6	25	95	96	100*
0.1	0.8	0	95	95	100*
0.05	0.4	0	93	93	75
0.025	0.2	0	75	75	90*
0.0125	0.1		70	70	65
0.2	3.2	25	100	100	100
0.1	1.6	0	95	95	100*
0.05	0.8	0	95	95	95
0.025	0.4	0	93	93	90
0.0125	0.2		75	75	60
0.00625	0.1		70	70	0

Table 118

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Thiamethoxam	A6	Thiamethoxam	MORTALITY	MORTALITY
0.8	200	95	0	95	100*
0.4	100	90	38	94	100*
0.2	50	0	13	13	65*
0.1	25	25	0	25	0
0.4	200	90	0	90	85
0.2	100	0	38	38	65*
0.1	50	25	13	34	0
0.2	200	0	0	0	80*
0.1	100	25	38	53	25
0.05	50	0	13	13	0
0.025	25	0	0	0	25*
0.2	400	0	0	0	70*

0.1	200	25	0	25	30*
0.05	100	0	38	38	25
0.025	50	0	13	13	0
0.2	800	0	13	13	65*
0.1	400	25	0	25	25
0.05	200	0	0	0	0
0.025	100	0	38	38	25
0.0125	50		13	13	0

Table 119

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A6	Imidacloprid	A6	Imidacloprid	MORTALITY	MORTALITY
0.8	200	100	0	100	95
0.4	100	95	25	96	50
0.2	50	50	0	50	0
0.1	25	50	0	50	50
0.05	12.5	25		25	25
0.4	200	95	0	95	80
0.2	100	50	25	63	0
0.1	50	50	0	50	0
0.05	25	25	0	25	0
0.2	200	50	0	50	80*
0.1	100	50	25	63	25
0.05	50	25	0	25	0
0.2	400	50	13	56	70*
0.1	200	50	0	50	65*
0.05	100	25	25	44	0
0.025	50	0	0	0	60*
0.0125	25		0	0	25*
0.2	800	50	25	63	70*
0.1	400	50	13	56	25
0.05	200	25	0	25	0
0.025	100	0	25	25	50*

Table 120

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Abamectin	A8	Abamectin	MORTALITY	MORTALITY
0.4	0.1	80	80	96	90
0.4	0.05	80	70	94	90
0.4	0.025	80	0	80	100*
0.4	0.0125	80	0	80	100*
0.4	0.006	80	0	80	100*
0.4	0.003	80	0	80	100*
0.4	0.0015	80	0	80	100*
0.4	0.0008	80	0	80	100*
0.4	0.0004	80	0	80	100*
0.4	0.0002	80	0	80	100*
0.2	0.1	0	80	80	80
0.2	0.05	0	70	70	85*
0.2	0.025	0	0	0	80*
0.2	0.0125	0	0	0	100*
0.2	0.006	0	0	0	100*
0.2	0.003	0	0	0	90*

0.2	0.0015	0	0	0	90*
0.2	0.0008	0	0	0	90*
0.2	0.0004	0	0	0	90*
0.2	0.0002	0	0	0	90*
0.1	0.1	0	80	80	95*
0.1	0.05	0	70	70	80*
0.05	0.1	0	80	80	55
0.05	0.05	0	70	70	0

Table 121

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Emamectin	A8	Emamectin	MORTALITY	MORTALITY
0.8	0.8	100	95	100	90
0.4	0.4	65	93	97	90
0.2	0.2	50	75	88	30
0.1	0.1	50	70	85	0
0.4	0.8	65	95	98	95
0.2	0.4	50	93	96	95
0.1	0.2	50	75	88	25
0.05	0.1	0	70	70	0
0.2	0.8	50	95	98	95
0.1	0.4	50	93	96	95
0.05	0.2	0	75	75	85*
0.025	0.1	0	70	70	0
0.2	1.6	50	95	98	100*
0.1	0.8	50	95	98	95
0.05	0.4	0	93	93	100*
0.025	0.2	0	75	75	95*
0.0125	0.1		70	70	65
0.2	3.2	50	100	100	100
0.1	1.6	50	95	98	95
0.05	0.8	0	95	95	100*
0.025	0.4	0	93	93	100*
0.0125	0.2		75	75	80*
0.00625	0.1		70	70	0

Table 122

PPM AI		AVERAGE DEAD IN %		EXPECTED	OBSERVED
A8	Thiamethoxam	A8	Thiamethoxam	MORTALITY	MORTALITY
0.8	200	100	0	100	90
0.4	100	85	38	91	85
0.2	50	55	13	61	80*
0.1	25	50	0	50	0
0.4	200	85	0	85	65
0.2	100	55	38	72	25
0.1	50	50	13	56	0
0.2	200	55	0	55	65*
0.1	100	50	38	69	0
0.05	50	0	13	13	0
0.025	25	0	0	0	40*
0.2	400	55	0	55	90*
0.1	200	50	0	50	25
0.05	100	0	38	38	0

0.025	50	0	13	13	25*
0.2	800	55	13	61	0
0.1	400	50	0	50	0
0.025	100	0	38	38	0
0.0125	50		13	13	0

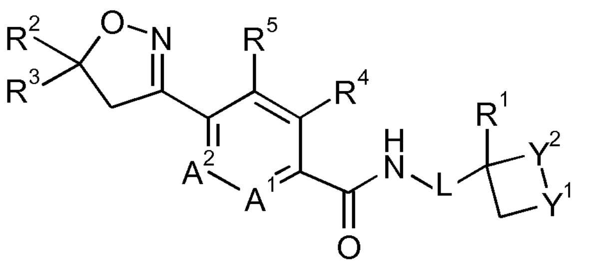
Table 123

PPM AI		AVERAGE DEAD IN %		EXPECTED MORTALITY	OBSERVED MORTALITY
A8	Imidacloprid	A8	Imidacloprid		
0.8	200	90	0	90	100*
0.4	100	85	25	89	85
0.2	50	80	0	80	0
0.1	25	65	0	65	50
0.05	12.5	25		25	0
0.4	200	85	0	85	80
0.2	100	80	25	85	60
0.1	50	65	0	65	25
0.05	25	25	0	25	50*
0.2	200	80	0	80	75
0.1	100	65	25	74	60
0.05	50	25	0	25	25
0.2	400	80	13	83	85*
0.1	200	65	0	65	65
0.05	100	25	25	44	0
0.025	50	0	0	0	50*
0.0125	25		0	0	50*
0.2	800	80	25	85	50
0.1	400	65	13	69	50
0.05	200	25	0	25	0
0.025	100	0	25	25	50*
0.0125	50		0	0	25*

Unless otherwise indicated, the compounds were formulated as follows: Compound A1 EC, Compound A5 EC, Abamectin EC, Chlorpyrifos ME, Cyantraniliprole SC, Emamectin benzoate SG, Lambda-Cyhalothrin EC, Pymetrozine WP, Spirotetramat OD, Thiamethoxam WG. Data is not shown for experiments where there was no insect mortality.

Claims

1. A pesticidal mixture comprising a component A and a component B, wherein component A is a compound of formula I



(I)

wherein

one of Y^1 and Y^2 is S, SO or SO_2 and the other is CH_2;

L is a direct bond or methylene;

A^1 and A^2 are C-H, or one of A^1 and A^2 is C-H and the other is N;

R^1 is hydrogen or methyl;

R^2 is chlorodifluoromethyl or trifluoromethyl;

R^3 is 3,5-dibromo-phenyl, 3,5-dichloro-phenyl, 3,4-dichloro-phenyl, or 3,4,5-trichloro-phenyl;

R^4 is methyl;

R^5 is hydrogen;

or R^4 and R^5 together form a bridging 1,3-butadiene group;

and component B is a compound selected from

a) a pyrethroid including those selected from the group consisting of permethrin, cypermethrin, fenvalerate, esfenvalerate, deltamethrin, cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, bifenthrin, fenpropathrin, cyfluthrin, tefluthrin, ethofenprox, natural pyrethrin, tetramethrin, S-bioallethrin, fenfluthrin, prallethrin and 5-benzyl-3-furylmethyl-(E)-(1R,3S)-2,2-dimethyl-3-(2-oxothiolan-3-ylidenemethyl)cyclopropane carboxylate;

b) an organophosphate including those selected from the group consisting of sulprofos, acephate, methyl parathion, azinphos-methyl, demeton-s-methyl, heptenophos, thiometon, fenamiphos, monocrotophos, profenofos, triazophos, methamidophos, dimethoate, phosphamidon, malathion, chlorpyrifos, phosalone, terbufos, fensulfothion, fonofos, phorate, phoxim, pirimiphos-methyl, pirimiphos-ethyl, fenitrothion, fosthiazate and diazinon;

c) a carbamate including those selected from the group consisting of pirimicarb, triazamate, cloethocarb, carbofuran, furathiocarb, ethiofencarb, aldicarb, thiofurox, carbosulfan, bendiocarb, fenobucarb, propoxur, methomyl and oxamyl;

d) a benzoyl urea including those selected from the group consisting of diflubenzuron, triflumuron, hexaflumuron, flufenoxuron, lufenuron and chlorfluazuron;

e) an organic tin compound including those selected from the group consisting of cyhexatin, fenbutatin oxide and azocyclotin;

f) a pyrazole including those selected from the group consisting of tebufenpyrad and fenpyroximate;

g) a macrolide including those selected from the group consisting of abamectin, emamectin, ivermectin, milbemycin, spinosad, azadirachtin and spinetoram;

h) an organochlorine compound including those selected from the group consisting of endosulfan, benzene hexachloride, DDT, chlordane and dieldrin;

i) an amidine including those selected from the group consisting of chlordimeform and amitraz;

j) a fumigant agent including those selected from the group consisting of chloropicrin, dichloropropane, methyl bromide and metam;

k) a neonicotinoid compound including those selected from the group consisting of imidacloprid, thiacloprid, acetamiprid, nitenpyram, dinotefuran, thiamethoxam, clothianidin, nithiazine and flonicamid;

l) a diacylhydrazine including those selected from the group consisting of tebufenozide, chromafenozide and methoxyfenozide;

m) a diphenyl ether including those selected from the group consisting of diofenolan and pyriproxyfen;

n) Indoxacarb;

o) chlorfenapyr;

p) pymetrozine;

q) spirotetramat, spirodiclofen and spiromesifen;

r) a diamide including those selected from the group consisting of flubendiamide, chlorantraniliprole (Rynaxypyr®) and cyantraniliprole;

s) sulfoxaflor;

t) metaflumizone;

u) fipronil and ethiprole;

v) pyrifluqinazon;

w) buprofezin;

x) diafenthiuron;

y) 4-[(6-Chloro-pyridin-3-ylmethyl)-(2,2-difluoro-ethyl)-amino]-5H-furan-2-one; and

z) Bacillus firmus, Bacillus cereus, Bacillus subtilis, and Pasteuria penetrans.

2. A pesticidal mixture according to claim 1, wherein in the compound of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is S and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

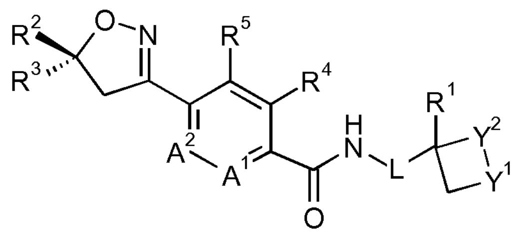
3. A pesticidal mixture according to claim 1, wherein in the compound of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

4. A pesticidal mixture according to claim 3, wherein the molar proportion of the cis SO compounds of formula I compared to the total amount of cis SO and trans SO compounds of formula I is greater than 50%.

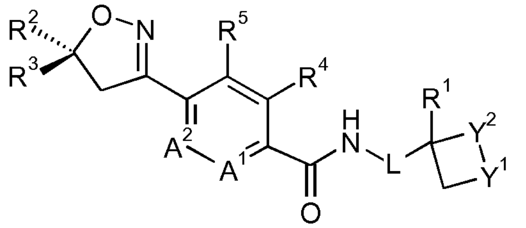
5. A pesticidal mixture according to claim 1, wherein in the compound of formula I L is a direct bond or methylene; one of Y^1 and Y^2 is SO_2 and the other is CH_2; A^1 and A^2 are C-H; R^1 is hydrogen or methyl; R^2 is trifluoromethyl; R^3 is 3,5-dichloro-phenyl; R^4 is methyl; and R^5 is hydrogen.

6. A pesticidal mixture according to any one of claims 1 to 5, wherein when L is a direct bond Y^2 is CH_2 and Y^1 is S, SO or SO_2, and wherein when L is methylene Y^2 is S, SO or SO_2 and Y^1 is CH_2.

7. A pesticidal mixture according to any one of claims 1 to 6, wherein component A is a mixture of compounds I* and I**



(I*)



(I**)

wherein the molar proportion of compound I** compared to the total amount of both enantiomers is greater than 50%.

8. A pesticidal mixture according to any one of claims 1 to 7, wherein component B is a compound selected from

a) a pyrethroid selected from the group consisting of permethrin, cypermethrin, fenvalerate, esfenvalerate, deltamethrin, cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, bifenthrin, fenpropathrin, cyfluthrin, tefluthrin, ethofenprox, natural pyrethrin, tetramethrin, S-bioallethrin, fenfluthrin, prallethrin and 5-benzyl-3-furylmethyl-(E)-(1R,3S)-2,2-dimethyl-3-(2-oxothiolan-3-ylidenemethyl)cyclopropane carboxylate;

b) an organophosphate selected from the group consisting of sulprofos, acephate, methyl parathion, azinphos-methyl, demeton-s-methyl, heptenophos, thiometon, fenamiphos, monocrotophos, profenofos, triazophos, methamidophos, dimethoate, phosphamidon, malathion, chlorpyrifos, phosalone, terbufos, fensulfothion, fonofos, phorate, phoxim, pirimiphos-methyl, pirimiphos-ethyl, fenitrothion, fosthiazate and diazinon;

c) a carbamate selected from the group consisting of pirimicarb, triazamate, cloethocarb, carbofuran, furathiocarb, ethiofencarb, aldicarb, thiofurox, carbosulfan, bendiocarb, fenobucarb, propoxur, methomyl and oxamyl;

d) a benzoyl urea selected from the group consisting of diflubenzuron, triflumuron, hexaflumuron, flufenoxuron, lufenuron and chlorfluazuron;

e) an organic tin compound selected from the group consisting of cyhexatin, fenbutatin oxide and azocyclotin;

f) a pyrazole selected from the group consisting of tebufenpyrad and fenpyroximate;

g) a macrolide selected from the group consisting of abamectin, emamectin, ivermectin, milbemycin, spinosad, azadirachtin and spinetoram;

h) an organochlorine compound selected from the group consisting of endosulfan, benzene hexachloride, DDT, chlordane and dieldrin;

i) an amidine selected from the group consisting of chlordimeform and amitraz;

j) a fumigant agent selected from the group consisting of chloropicrin, dichloropropane, methyl bromide and metam;

k) a neonicotinoid compound selected from the group consisting of imidacloprid, thiacloprid, acetamiprid, nitenpyram, dinotefuran, thiamethoxam, clothianidin, nithiazine and flonicamid;

l) a diacylhydrazine, selected from the group consisting of tebufenozide, chromafenozide and methoxyfenozide;

m) a diphenyl ether selected from the group consisting of diofenolan and pyriproxyfen;

n) Indoxacarb;

o) chlorfenapyr;

p) pymetrozine;

q) spirotetramat, spirodiclofen and spiromesifen;

r) a diamide selected from the group consisting of flubendiamide, chlorantraniliprole and cyantraniliprole;

s) sulfoxaflor;

t) metaflumizone;

u) fipronil and ethiprole;

v) pyrifluqinazon;

w) buprofezin;

x) diafenthiuron;

y) 4-[(6-Chloro-pyridin-3-ylmethyl)-(2,2-difluoro-ethyl)-amino]-5H-furan-2-one; and

z) Bacillus firmus, Bacillus cereus, Bacillus subtilis, and Pasteuria penetrans.

9. A pesticidal mixture according to any one of claims 1 to 7, wherein component B is a compound selected from

pymetrozine;

an organophosphate selected from the group consisting of sulprofos, acephate, methyl parathion, azinphos-methyl, demeton-s-methyl, heptenophos, thiometon, fenamiphos, monocrotophos, profenofos, triazophos, methamidophos, dimethoate, phosphamidon, malathion, chlorpyrifos, phosalone, terbufos, fensulfothion, fonofos, phorate, phoxim, pirimiphos-methyl, pirimiphos-ethyl, fenitrothion, fosthiazate and diazinon;

a pyrethroid selected from the group consisting of permethrin, cypermethrin, fenvalerate, esfenvalerate, deltamethrin, cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, bifenthrin, fenpropathrin, cyfluthrin, tefluthrin, ethofenprox, natural pyrethrin, tetramethrin, S-bioallethrin, fenfluthrin, prallethrin and 5-benzyl-3-furylmethyl-(E)-(1R,3S)-2,2-dimethyl-3-(2-oxothiolan-3-ylidenemethyl)cyclopropane carboxylate;

a macrolide selected from the group consisting of abamectin, emamectin, ivermectin, milbemycin, spinosad, azadirachtin and spinetoram;

a diamide selected from the group consisting of flubendiamide, chlorantraniliprole and cyantraniliprole;

a neonicotinoid compound selected from the group consisting of imidacloprid, thiacloprid, acetamiprid, nitenpyram, dinotefuran, thiamethoxam, clothianidin, nithiazine and flonicamid;

spirotetramat, spirodiclofen and spiromesifen; and

sulfoxaflor, lufeneron, diafenthiuron, and fipronil.

10. A pesticidal mixture according to any one of claims 1 to 7, wherein component B is a compound selected from the group consisting of abamectin, chlorpyrifos, cyantraniliprole, emamectin, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid, chlorantraniliprole, flonicamid. Sulfoxaflor, Lufeneron, Diafenthiuron, Flubendiamide, Tefluthrin, and Fipronil

11. A pesticidal mixture according to any one of claims 1 to 7, wherein component B is a compound selected from the group consisting of abamectin, chlorpyrifos, cyantraniliprole, emamectin, lambda cyhalothrin, pymetrozine, spirotetramat, thiamethoxam, clothianidin, imidacloprid and flonicamid.

12. A pesticidal mixture according to any one of claims 1 to 11, wherein the mixture comprises an agricultural acceptable carrier and optionally a surfactant.

13. A pesticidal mixture according to any one of claims 1 to 12, wherein the weight ratio of A to B is 1000:1 to 1:1000.

14. A method of controlling insects, acarines, nematodes or molluscs which comprises applying to a pest, to a locus of a pest, or to a plant susceptible to attack by a pest a combination of components A and B, wherein components A and B are as defined in any one of claims 1 to 13.

15. A seed comprising a mixture as defined in any one of claims 1 to 13.

16. A method comprising coating a seed with a mixture as defined in any one of claims 1 to 13.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/051511

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01N43/80 A01N43/40 A01N43/56 A01N43/90 A01N43/707
A01N47/06 A01N51/00 A01N53/00 A01N57/16 A01P5/00
A01P7/02 A01P7/04 A01P9/00

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, CHEM ABS Data, 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 2009/080250 A2 (SYNGENTA PARTICIPATIONS AG [CH]; RENOLD PETER [CH]; ZAMBACH WERNER [CH) 2 July 2009 (2009-07-02) cited in the application page 1, lines 3-6; claim 1 page 38, line 27 - page 39, line 2 page 39 - page 41 page 38, line 27 - page 40, line 16 -----	1-16

☐ 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

"E" earlier document 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
25 July 2011	03/08/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Sawicki, Marcin

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2011/051511

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009080250 A2	02-07-2009	AR 069702 A1	10-02-2010
		AU 2008340691 A1	02-07-2009
		CA 2709246 A1	02-07-2009
		CN 101910161 A	08-12-2010
		DO P2010000196 A	15-09-2010
		EA 201001008 A1	28-02-2011
		EC SP10010304 A	30-07-2010
		EP 2238132 A2	13-10-2010
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		KR 20100112588 A	19-10-2010
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