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(54) Title: COMPOSITION

(57) Abstract: A composition comprising an agrochemical and a solvent, wherein the solvent has Hansen Solubility Parameters within the solubility sphere of dD = 19.1, dP = 10.0, dH = 7.4 and a HSP radius of 3; and has a water miscibility of 0.4 wt% or less at 25 °C.

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Composition

The present invention relates to compositions comprising an agrochemical and a solvent, together with methods of preparing and using the same.

The solubility of active ingredients, such as agrochemicals, in a solvent is limited on the basis of intrinsic molecular and crystallographic properties such as the enthalpy of fusion. To increase the solubility of an active ingredient the physicochemical interactions between the solute and the solvents must be maximised in order to provide dissolution energy as a driving force to keep the solute in solution. This is typically achieved by the matching of the polarity of the active ingredient to the polarity of a solvent, phenomenologically described as "like dissolves like".

As active ingredients are often intrinsically limited in their solubility identifying a solvent of matching polarity is of utmost importance. Furthermore, many other factors can affect the suitability of a solvent, in particular the solubility of the solvent in water and environmental or safety targets.

For example, *N*-methyl-2-pyrrolidone (NMP), is a well-known solvent of high polarity and thus has been used to dissolve active ingredients also with a high polarity. However, in practice a replacement to NMP is desired for environmental and regulatory reasons. Furthermore, NMP is water miscible and therefore should not be used as the sole solvent in an Emulsifiable Concentrate (EC).

Possible replacements for NMP with a similar polarity and a more favourable environmental profile have been cyrene [(1*S*,5*R*)-6,8-Dioxabicyclo[3.2.1]octan-4-one], or *γ*-Valerolactone [dihydro-5-methyl-2(3*H*)-furanone]. However, neither of these alternatives meet the requirement of low water-miscibility that is necessary in order to achieve stable emulsions for agrochemicals, especially after dilution in water.

Another important requirement of a commercially viable solvent is compatibility with other solvents to form mixtures with adjustable polarities and varying water miscibility.

The present invention addresses these technical problems.

There is therefore provided a composition comprising an agrochemical and a solvent, wherein the solvent has Hansen Solubility Parameters (HSP) within the solubility sphere of dD = 19.1, dP = 10.0, dH = 7.4 and a HSP radius of 3; and has a water miscibility of 0.4 wt% or less at 25 °C.

The use of a solvent as defined herein for agricultural applications has been found to have good dissolution properties while also exhibiting an improved environmental and safety profile. The compositions according to the invention also permit the preparation of stable emulsions upon dilution in water while avoiding crystallisation of the agrochemical.

The term 'agrochemical' and 'active ingredient' are used herein interchangeably.

The term 'water-immiscible' is defined herein as a component that has a water miscibility of 0.4 wt% or less at 25 °C. Conversely, a component is 'water-miscible' if it has a water miscibility of greater than 0.4 wt% at 25 °C.

Most agrochemical formulations are applied by diluting the concentrated product into water and spraying on to a field or crop. Typical dilution rates are 1 parts concentrate to 99 parts water (i.e., 1% dilution) and for a diluted EC, some or all of the solvent(s) will dissolve into the water during this process depending on the water miscibility of the solvent. For a water-immiscible solvent, most of the solvent will not dissolve and will leave a sufficient quantity of emulsion droplets to solubilise the active ingredient. Conversely, for a water-miscible solvent, most of the solvent will dissolve into the dilution water and remove the ability of the diluted formulation to solubilise the active ingredient. This will cause large crystals of active ingredient to form which may block the spray nozzles. This can also cause problems for the applicator with a non-uniform distribution of active ingredient and the need to clean and replace filters within the spray equipment.

Hansen Solubility Parameters (HSP) describe the affinity of a solute and a solvent. They are reported in $MPa^{0.5}$ and quantify the interactions in 3 parameters:

dD – the energy from dispersion forces between molecules;

dP – the energy from dipolar intermolecular forces between molecules; and

dH – the energy from hydrogen bonds between molecules.

In practice solvents are represented as points in a three-dimensional space called HSP space. The closer the HSP of a solvent and a solute are the more likely it is that it is an effective solvent. If a solute's HSP (HSP_{solute} = dD_2, dP_2, dH_2) is in a sphere of HSP radius r with a core of $HSP_{solvent}$ (dD_1, dP_1, dH_1), the solute's HSP distance, Ra, to the core is smaller than the HSP radius r and therefore the relation of Ra/r = RED is <1. Ra is calculated by $(Ra)^2$= $4(dD_2\text{-}dD_1)^2$ + $(dP_2\text{-}dP_1)^2$+$(dH_2\text{-}dH_1)^2$. The RED value of several potential solutes can therefore be used to judge potential suitability of a solvent.

Reference: *The three dimensional solubility parameter - key to paint component affinities: I. Solvents, plasticizers, polymers, and resins*; Hansen, Charles M.; Journal of paint technology; 1967; Volume: 39; Issue: 505.

References to 'radius' are to mean 'HSP radius' unless otherwise specified.

Herein, HSP details of agrochemicals have been obtained based on their chemical structures represented by SMILES strings by employing the in-built QSAR model for HSP predictions using BIOVIA COSMOquick 2022, Dassault Systems, 2021, Version 22.0.0. References: Hornig, M. & Klamt, A. COSMOfrag: *A Novel Tool for High-Throughput ADME Property Prediction and Similarity Screening Based on Quantum Chemistry*, J Chem Inf Model, 2005, 45, 1169-1177; Loschen, C. & Klamt, A. COSMOquick: *A Novel Interface for Fast σ-Profile Composition and Its Application to COSMO-RS Solvent Screening Using Multiple Reference Solvents*, Ind. & Eng. Chem. Res. 2012, 51, 14303.

HSP details of solvents have been obtained from the library within HSPiP 5th edition 5.4.06. RED values have been obtained using HSPiP 5th edition 5.4.06 referencing agrochemicals to the solvent of interest and the stated radius.

However, HSP parameters alone are not sufficient to find a technical solution to the problems above. It has been found that only the solvents described herein possess the combination of HSP parameters and levels of water-miscibility that can solvate difficult to formulate agrochemicals, such as those discussed below.

The solvent may comprise a substituted phenyl, preferably wherein the phenyl ring is substituted at two positions. Advantageously the solvent comprises a substituted benzaldehyde, such as an alkoxybenzaldehyde.

Preferably the solvent comprises methoxybenzaldehyde (anisaldehyde), preferably:
2-methoxybenzaldehyde (2-anisaldehyde, *ortho*-anisaldehyde) (dD=19.4, dP=11.9, dH=8.3); and/or
3-methoxybenzaldehyde (3-anisaldehyde, *meta*-anisaldehyde) (dD=18.9, dP=9.8, dH=6.4); and/or
4-methoxybenzaldehyde (4-anisaldehyde, *para*-anisaldehyde) (dD = 19.1, dP = 10.0, dH = 7.4).

Most preferably the solvent comprises 4-methoxybenzaldehyde (4-anisaldehyde, *para*-anisaldehyde).

The solvent may contain a blend of 4-methoxybenzaldehyde and 2-methoxybenzaldehyde, or a blend of 4-methoxybenzaldehyde and 3-methoxybenzaldehyde.

Advantageously, the solvent contains no or substantially no *N*-methylpyrrolidone (NMP).

By 'substantially no' we mean comprising less than 0.5% by weight.

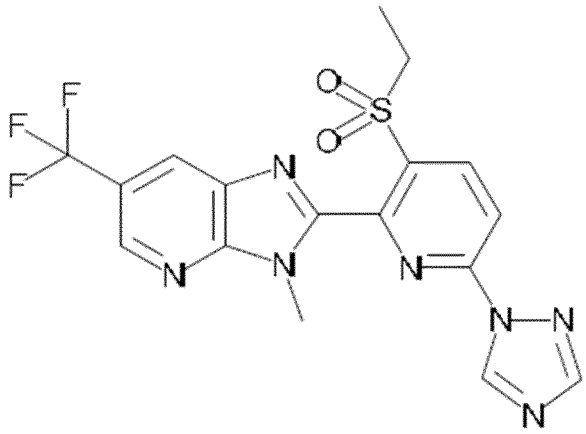
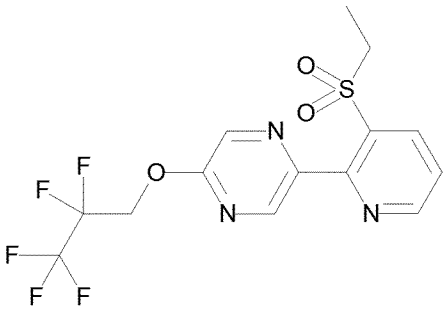
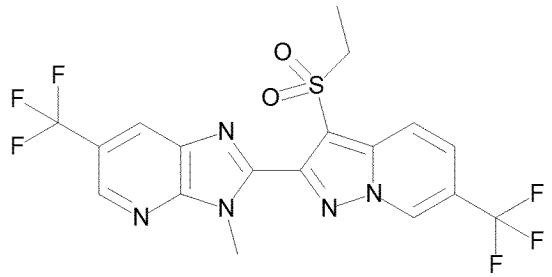
Preferably the agrochemical has Hansen Solubility Parameters within the solubility sphere of dD = 19.1, dP = 10.0, dH = 7.4 and a HSP radius of 6.

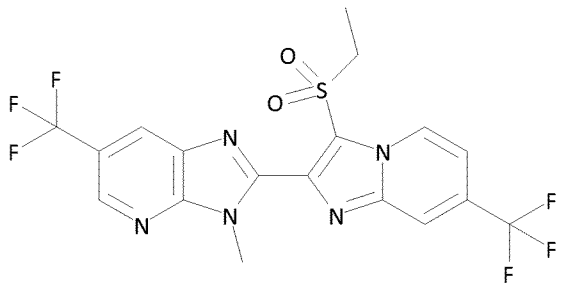
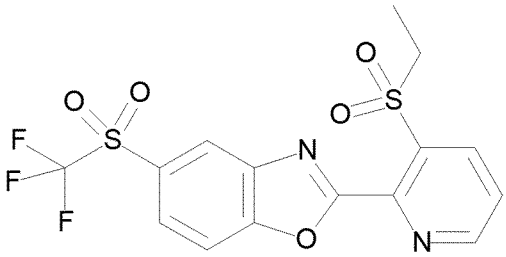
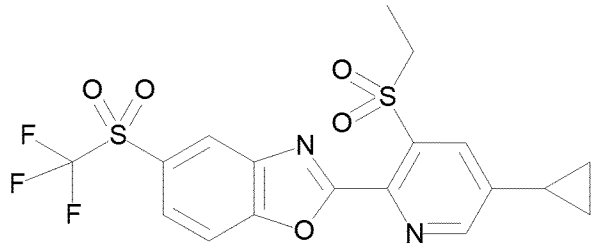
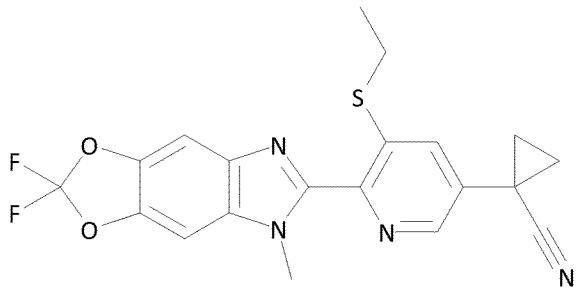
Advantageously the agrochemical is selected from one or more of the agrochemicals set out in Table A below. The HSP parameters of 4-methoxybenzaldehyde are provided for reference

and, as discussed above, if the RED value is below 1 the agrochemical is within the relevant solubility sphere.

Table A

Solvent	**dD**	**dP**	**dH**	**RED (r = 6)**
4-methoxybenzaldehyde	19.1	10	7.4	
AI				
Pyraclostrobin	19	8.2	7.3	0.3
Pinoxaden	18.7	8.4	6.6	0.33
Picoxystrobin	19.1	9	5.4	0.37
Lufenuron	19.6	8.6	9.1	0.4
Spiropidion	18.5	8.1	6.4	0.41
Pirimicarb	18.6	7.5	7.5	0.45
Butafenacil	19.1	9.7	10.1	0.45
Chlorothalonil	20.2	9.5	5.5	0.49
Napropamide	18.6	8.8	4.8	0.51
Clodinafop Propargyl	19.2	8.5	10.1	0.52
Acibenzolar-S-Methyl	19.9	7.9	5.5	0.54
Propiconazole	19	7.7	10.1	0.59
Rynaxypyr	19.5	8.4	10.6	0.61
Isocyloseram (Plinazolin®)	19.5	8.7	10.7	0.61
Pyroquilon	20.3	12.5	6.1	0.62
Azoxystrobin	19.1	8.5	10.9	0.63
Pydiflumetofen (Adepidyn®)	19.1	8.7	11	0.64
Benzovindiflupyr (Solatenol®)	19.8	9.3	11	0.65
Isopyrazam	19.1	11.0	11.2	0.65
Aclonifen	19.9	8.4	10.6	0.65
Cyproconazole	19.2	7.9	10.7	0.65

	19.5	11.7	11.1	0.69
Fomesafen Ph2	19.6	11.7	11.1	0.7
Metalaxyl	17.6	7.2	6.4	0.7
Difenoconazole	19.6	8.1	11.1	0.71
Sedaxane	19.4	9.2	11.7	0.74
Cyhalothrin	19.1	5.8	5.6	0.76
	19.2	11.4	11.8	0.77
Thiabendazole	20.3	9	11.4	0.8
Acetochlor	17.7	7.9	11	0.84
Cyprodinil	19.6	6.9	11.4	0.86
	19.7	12.2	12	0.87

	19.6	12.9	11.8	0.89
Phenetylarylamide (Tymirium ®)	20.1	12.8	11.6	0.9
Oxazosulfyl 	19.5	13.2	11.8	0.92
	19.6	13.9	11.3	0.93
Fludioxynil	20.3	12	12.1	0.94
	19.5	13.5	11.9	0.96
Imidacloprid	20	13.2	11.9	0.97

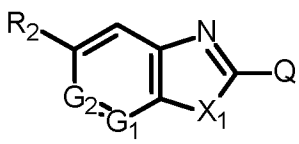
Advantageously the agrochemical is selected from one or more of Metalaxyl, Pirimicarb, Napropamide, Pyroquilon, Cyproconazole, Picoxystrobin, Clodinafop propargyl, Aclonifen, Acetochlor, Pyraclostrobin, Propiconazole, Butafenacil, Fomesafen, Lufenuron, Rynaxypyr, Chlorothalonil, Difenoconazole, Pydiflumetofen (Adepidyn®), azoxystrobin, pinoxaden,

Isocyloseram (Plinazolin®), Benzovindiflupyr (Solatenol®), Spiropidion, Phenetylarylamide (Tymirium®), sedaxane, and isopyrazam.

The agrochemical is preferably present in a quantity of least 2% by weight, preferably at least 5%, advantageously the agrochemical is present in a quantity of even greater than 10% by weight, such as greater than 20% by weight.

In a second aspect of the invention there is provided a composition comprising 4-methoxybenzaldehyde and one or more of:

- Pydiflumetofen (Adepidyn®)
- pinoxaden
- Isocyloseram (Plinazolin®)
- Benzovindiflupyr (Solatenol®)
- a compound of formula (I) below



(I),

wherein

R_2 is halogen, C_1-C_6haloalkyl, C_1-C_4haloalkylsulfanyl, C_1-C_4haloalkylsulfinyl, C_1-C_4haloalkylsulfonyl, C_1-C_6haloalkoxy, C_1-C_4haloalkylsulfonyloxy or C_3-C_6cycloalkyloxy;

X_1 is O or NR_5;

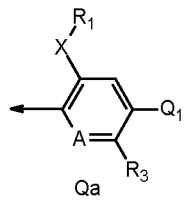
R_5 is C_1-C_4alkyl;

G_1 is N or CH;

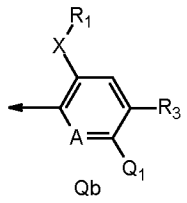
G_2 is C-R_{2a} or N;

R_{2a} is hydrogen or R_{2a} forms, together with R_2, the group -O-CF_2-O-

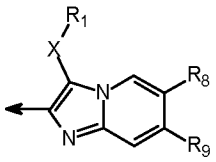
Q is a radical selected from the group consisting of formula Qa, Qb, Qc and Qd



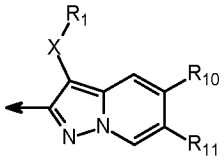
Qa



Qb



Qc



Qd

wherein the arrow denotes the point of attachment to the carbon atom of the bicyclic ring; and wherein A represents CH or N;

X is S, SO, SONH or SO_2;

R_1 is C_1-C_4alkyl or C_3-C_6cycloalkyl-C_1-C_4alkyl;

Q_1 is hydrogen, halogen, C_1-C_6haloalkyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkyl monosubstituted by cyano, C_1-C_6cyanoalkyl, C_1-C_6cyanoalkoxy, C_1-C_6haloalkoxy, -$N(R_4)_2$, -$N(R_4)COR_4$, -$N(R_4)CON(R_4)_2$, (oxazolidin-2-one)-3-yl, 2-pyridyloxy, N-linked pyrazolyl which is unsubstituted or is mono-substituted by chloro, cyano or trifluoromethyl, N-linked triazolyl or C-linked pyrimidinyl;

wherein each R_4 is independently hydrogen, C_1-C_4alkyl or C_3-C_6cycloalkyl; and

R_3 is hydrogen, halogen or C_1-C_4alkyl;

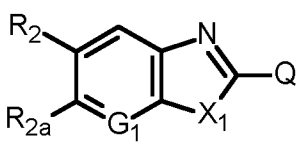
R_8, R_9, R_{10} and R_{11} are, independently from each other, hydrogen, halogen, C_1-C_4alkyl, C_1-C_6haloalkyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkyl monosubstituted by cyano, C_1-C_6cyanoalkyl, C_1-C_6cyanoalkoxy, cyano, C_1-C_4alkoxy, C_1-C_6haloalkoxy, -$N(R_6)_2$, or -$N(R_6)C(=O)R_7$;

wherein each R_6 is independently C_1-C_6alkyl, C_1-C_6haloalkyl or C_3-C_6cycloalkyl; and

R_7 is C_1-C_4alkyl;

or an agrochemically acceptable salt, stereoisomer, enantiomer, tautomer or N-oxide of a compound of formula I.

Preferably, the compound of formula I is represented by the compounds of formula Ia-1



(Ia-1),

wherein

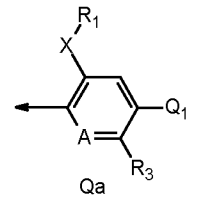
R_2 is C_1-C_2haloalkyl or C_1-C_2haloalkylsulfonyl; preferably R_2 is CF_3 or CF_3SO_2;

X_1 is O or NCH_3;

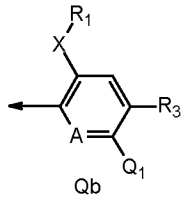
G_1 is N or CH;

R_{2a} is hydrogen or R_{2a} forms, together with R_2, the group -O-CF_2-O-

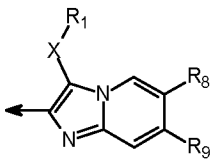
Q is a radical selected from the group consisting of formula Qa, Qb, Qc and Qd



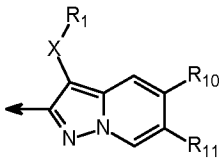
Qa



Qb



Qc



Qd

wherein the arrow denotes the point of attachment to the carbon atom of the bicyclic ring;

A is N;

X is S, SONH or SO_2;

R_1 is C_1-C_4alkyl; preferably R_1 is ethyl;

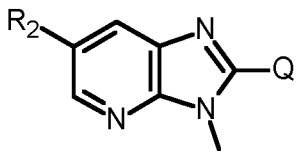
Q_1 is hydrogen, C_3-C_6cycloalkyl, C_3-C_6cycloalkyl monosubstituted by cyano, C_1-C_6cyanoalkyl, C_1-C_6cyanoalkoxy, N-linked pyrazolyl which is unsubstituted or is mono-substituted by chloro, cyano or trifluoromethyl, N-linked triazolyl or C-linked pyrimidinyl;

R_3 is hydrogen, halogen or C_1-C_4alkyl; preferably R_3 is hydrogen; and

R_8, R_9, R_{10} and R_{11} are, independently from each other, hydrogen or C_1-C_6haloalkyl; preferably R_8 and R_{10} are hydrogen and R_9 and R_{11} are CF_3;

or an agrochemically acceptable salt, stereoisomer, enantiomer, tautomer or N-oxide of a compound of formula Ia-1.

Also prefered is when the compound of formula I is represented by the compounds of formula Ia-2

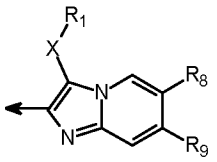


(Ia-2),

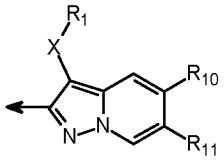
wherein

R_2 is C_1-C_2haloalkyl or C_1-C_2haloalkylsulfonyl; preferably R_2 is CF_3 or CF_3SO_2;

Q is a radical selected from the group consisting of formula Qc and Qd



Qc



Qd

wherein the arrow denotes the point of attachment to the carbon atom of the bicyclic ring;

X is S, SONH or SO_2;

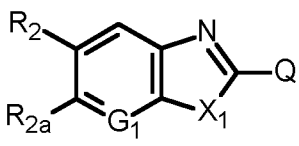
R_1 is C_1-C_4alkyl; preferably R_1 is ethyl;

R_8 and R_{10} are hydrogen; and

R_9 and R_{11} are hydrogen or C_1-C_4haloalkyl; preferably R_9 and R_{11} are CF_3;

or an agrochemically acceptable salt, stereoisomer, enantiomer, tautomer or N-oxide of a compound of formula I.

Further prefered the compound of formula I is represented by the compounds of formula Ia-3



(Ia-3),

wherein

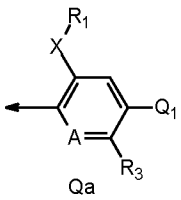
R_2 is C_1-C_2haloalkyl or C_1-C_2haloalkylsulfonyl; preferably R_2 is CF_3 or CF_3SO_2;

X_1 is O or NCH_3; preferably X_1 is O when G_1 is CH and X_1 is NCH_3 when G_1 is N;

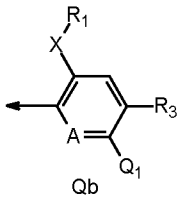
G_1 is N or CH; preferably G_1 is N when R_{2a} is hydrogen and G_1 is CH when R_{2a} forms, together with R_2, the group -O-CF_2-O-;

R_{2a} is hydrogen or R_{2a} forms, together with R_2, the group -O-CF_2-O-;

Q is a radical selected from the group consisting of formula Qa and Qb



Qa



Qb

wherein the arrow denotes the point of attachment to the carbon atom of the bicyclic ring;

A is N;

X is S, SONH or SO_2;

R_1 is C_1-C_4alkyl; preferably R_1 is ethyl;

Q_1 is hydrogen, C_3-C_6cycloalkyl, C_3-C_6cycloalkyl monosubstituted by cyano, C_1-C_6cyanoalkyl, C_1-C_6cyanoalkoxy, N-linked pyrazolyl which is unsubstituted or is mono-substituted by chloro, cyano or trifluoromethyl, N-linked triazolyl or C-linked pyrimidinyl; preferably Q_1 is hydrogen, cyanoisopropoxy, cyanoisopropyl, cyanocyclopropyl or N-linked pyrazolyl which is unsubstituted or is mono-substituted by chloro, cyano or trifluoromethyl, N-linked triazolyl or C-linked pyrimidinyl; and

R_3 is hydrogen;

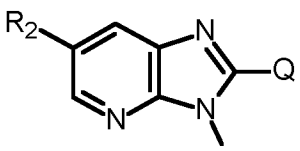
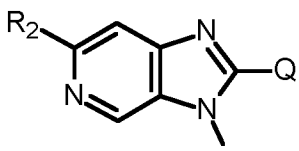
or an agrochemically acceptable salt, stereoisomer, enantiomer, tautomer or N-oxide of a compound of formula I.

Also preferred are compounds of formula Ia-3 wherein X_1 is O when G_1 is CH and wherein X_1 is NCH_3 when G_1 is N

Further preferred are compounds of formula Ia-3a, which are compounds of formula Ia-3 wherein Q is Qa, R_2 is CF_3, R_{2a} is hydrogen, X_1 is NCH_3, G_1 is N and Q_1 is hydrogen, cyanoisopropoxy, cyanoisopropyl, cyanocyclopropyl or, N-linked triazolyl.

Further preferred are compounds of formula Ia-3b, which are compounds of formula Ia-3 wherein Q is Qa, R_{2a} forms, together with R_2, the group -O-CF_2-O-, X_1 is O, G_1 is CH and Q_1 is hydrogen, cyanoisopropoxy, cyanoisopropyl, cyanocyclopropyl or, N-linked triazolyl.

Also prefered is when the compound of formula I is represented by the compounds of formula Ib-1 or Ib-2

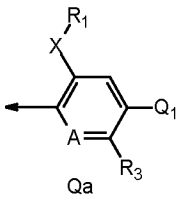
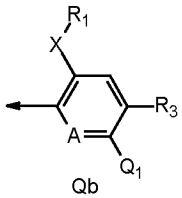

(I-b1) or

(I-b2),

wherein

R_2 is halogen, C_1-C_6haloalkyl, C_1-C_4haloalkylsulfanyl, C_1-C_4haloalkylsulfinyl, C_1-C_4haloalkylsulfonyl, C_1-C_6haloalkoxy, C_1-C_4haloalkylsulfonyloxy or C_3-C_6cycloalkyloxy;

R_5 is C_1-C_4alkyl;

Q is a radical selected from the group consisting of formula Qa and Qb


Qa

Qb

wherein the arrow denotes the point of attachment to the carbon atom of the bicyclic ring;

and wherein A represents CH or N;

X is S, SO, SONH or SO_2;

R_1 is C_1-C_4alkyl or C_3-C_6cycloalkyl-C_1-C_4alkyl;

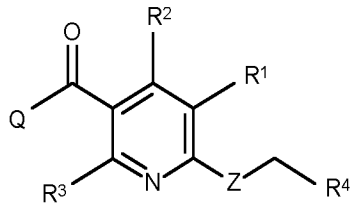
Q_1 is hydrogen, C_3-C_6cycloalkyl, C_3-C_6cycloalkyl monosubstituted by cyano, C_1-C_6cyanoalkyl, C_1-C_6cyanoalkoxy, N-linked pyrazolyl which is unsubstituted or is mono-substituted by chloro, cyano or trifluoromethyl, N-linked triazolyl or C-linked pyrimidinyl; preferably Q_1 is hydrogen, cyanoisopropoxy, cyanoisopropyl, cyanocyclopropyl or N-linked pyrazolyl which is unsubstituted or is mono-substituted by chloro, cyano or trifluoromethyl, N-linked triazolyl or C-linked pyrimidinyl; and

R_3 is hydrogen;

or an agrochemically acceptable salt, stereoisomer, enantiomer, tautomer or N-oxide of a compound of formula Ib-1 or Ib-2.

and

- compound of formula (II) below



(II)

wherein

R^1 is CN;

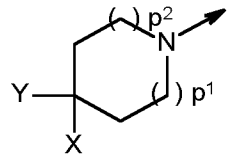
R^2 is H;

R^3 is C_1-C_2-alkyl, C_3-C_6-cycloalkyl, C_1-C_2-alkoxy-C_1-C_2-alkyl, or C_1-C_2-haloalkyl;

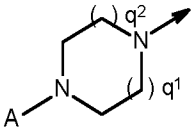
Z is a bond, or oxygen;

R^4 is phenyl substituted with 1 to 3 independently selected substituents R^5, or 5 or 6 membered monocyclic heteroaryl substituted with 1 to 3 independently selected substituents R^6;

Q is a cyclic amine represented by the formula IIa or a cyclic amine represented by the formula IIb,



(IIa)



(IIb)

wherein the arrow indicates the connection to the carbonyl group;

p^1 is 1 or 2 and indicates the number of methylene groups;

p^2 is 1 or 2 and indicates the number of methylene groups;

q^1 is 1 or 2 and indicates the number of methylene groups;

q^2 is 1 or 2 and indicates the number of methylene groups;

X is hydrogen, or halogen;

Y is R^aSO_2, $R^bR^cNSO_2$, $R^dSO_2N(C_1$-C_4-alkyl), 5 or 6 membered heteroaryl substituted with 1 to 3 independently selected substituents R^7, or 5 or 6 membered non-aromatic heterocyclic ring system in which one to three carbons are replaced independently by nitrogen, oxygen,

sulphur, or sulfonyl and substituted with 1 to 3 independently selected substituents from halogen, cyano, C_1-C_6-alkyl, C_1-C_6-haloalkyl and C_3-C_6-cycloalkyl;

A is C_1-C_6-alkyl, C_1-C_6-cyanoalkyl, C_3-C_6-cyanocycloalkyl, R^aSO_2, $R^bR^cNSO_2$, or 5 or 6 membered heteroaryl substituted with 1 to 3 independently selected substituents R^8;

R^a is C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_2-C_6-alkenyl, C_2-C_6-haloalkenyl, C_2-C_6-alkynyl, C_2-C_6-haloalkynyl, C_3-C_6-cycloalkyl, or C_3-C_6-halocycloalkyl;

R^b and R^c are independently selected from hydrogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_2-C_6-alkenyl, C_2-C_6-haloalkenyl, C_2-C_6-alkynyl, C_2-C_6-haloalkynyl, C_3-C_6-cycloalkyl and C_3-C_6-halocycloalkyl;

R^d is C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_2-C_6-alkenyl, C_2-C_6-haloalkenyl, C_2-C_6-alkynyl, C_2-C_6-haloalkynyl, C_3-C_6-cycloalkyl, or C_3-C_6-halocycloalkyl;

R^5 is independently selected from halogen, cyano, C_1-C_6-alkyl, C_1-C_6-haloalkylC_3-C_6-cycloalkyl, C_3-C_6-halocycloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, C_1-C_6-alkylsulfonyl, C_1-C_6-haloalkylsulfanyl and -O-$C_{1\text{-}2}$haloalkanediyl-O-; and

R^6, R^7 and R^8 are independently selected from halogen, cyano, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_2-C_6-alkenyl, C_2-C_6-haloalkenyl, C_2-C_6-alkynyl, C_2-C_6-haloalkynyl, C_3-C_6-cycloalkyl, C_3-C_6-halocycloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, C_1-C_6-alkylsulfonyl and C_1-C_6-haloalkylsulfanyl;

or an agrochemically acceptable salt, stereoisomer, enantiomer, tautomer and N-oxide of the compound of formula (II).

Synthesis of compounds of formula (II) are described in the prior art, in particular in applications PCT/JP2017/017241, PCT/EP2020/076134, PCT/EP2022/057816, PCT/EP2022/060093, PCT/EP2023/075142, PCT/EP2023/081407, and EP 23216968.0.

Preferably, when formula Q is a cyclic amine of formula IIa in a compound of formula I, p^1 and p^2 are each 2; R^3 is C_1-C_2-alkyl, C_3-C_4-cycloalkyl, C_1-C_2-alkoxy-C_1-C_2-alkyl, or C_1-C_2-haloalkyl; Z is a bond or oxygen; R^4 is phenyl substituted with 1 to 3 independently selected substituents from fluorine, bromine, chlorine, cyano, trifluoromethyl, methoxy, trifluoromethoxy, methylsulfonyl, trifluoromethylsulfonyl and O-CF_2-O-, or 5 or 6 membered monocyclic heteroaryl substituted with 1 to 3 independently selected substituents from fluorine, chlorine, cyano, methyl, trifluoromethyl, trifluoroethyl, cyclopropyl, methoxy, trifluoromethoxy, methylsulfonyl and trifluoromethylsulfonyl; X is hydrogen; Y is R^aSO_2,

$R^bR^cNSO_2$, R^dSO_2N(isopropyl), 5 or 6 membered heteroaryl substituted with 1 to 3 independently selected substituents from fluorine, chlorine, methyl and trifluoromethyl, or 5 or 6 membered non-aromatic heterocyclic ring system in which one to three carbons are replaced independently by nitrogen, oxygen, sulfur, or sulfonyl and substituted with 1 to 3 independently selected substituents from halogen, cyano, C_1-C_6-alkyl, C_1-C_6-haloalkyl and C_3-C_6-cycloalkyl; R^a is methyl, trifluoromethyl, or cyclopropyl; R^b and R^c are independently selected from hydrogen, methyl, ethyl, trifluoromethyl and cyclopropyl; and R^d is methyl or ethyl.

Preferably, when formula Q is a cyclic amine of formula IIa in a compound of formula I, p^1 and p^2 are each 2; R^3 is methyl, cyclopropyl, methoxymethyl, difluoromethyl, or trifluoromethyl; Z is a bond or oxygen; R^4 is phenyl substituted with 1 to 3 independently selected substituents from fluorine, bromine, chlorine, cyano, trifluoromethyl, methoxy, trifluoromethoxy, methylsulfonyl, trifluoromethylsulfonyl and O-CF_2-O-, or 5 or 6 membered monocyclic heteroaryl substituted with 1 to 3 independently selected substituents from fluorine, chlorine, cyano, methyl, trifluoromethyl, trifluoroethyl, cyclopropyl, methoxy, trifluoromethoxy, methylsulfonyl and trifluoromethylsulfonyl; X is hydrogen; Y is R^aSO_2, $R^bR^cNSO_2$, R^dSO_2N(isopropyl), 5 or 6 membered heteroaryl substituted with 1 to 3 independently selected substituents from fluorine, chlorine, methyl and trifluoromethyl, or 5 or 6 membered non-aromatic heterocyclic ring system in which one to three carbons are replaced independently by nitrogen, oxygen, sulfur, or sulfonyl and substituted with 1 to 3 independently selected substituents from halogen, cyano, C_1-C_3-alkyl, C_1-C_3-haloalkyl and C_3-C_4-cycloalkyl; R^a is methyl; R^b and R^c are independently selected from hydrogen, methyl, ethyl, and cyclopropyl; and R^d is methyl.

Preferably, when formula Q is a cyclic amine of formula IIa in a compound of formula I, p^1 and p^2 are each 2; R^3 is methyl, cyclopropyl, methoxymethyl, difluoromethyl, or trifluoromethyl; Z is a bond or oxygen; R^4 is phenyl substituted with 1 to 3 independently selected substituents from fluorine, bromine, chlorine, trifluoromethyl, and O-CF_2-O-, or 5 membered monocyclic heteroaryl substituted with trifluoroethyl; X is hydrogen; Y is $R^bR^cNSO_2$, R^dSO_2N(isopropyl), 5 membered heteroaryl substituted with methyl, or 5 membered non-aromatic heterocyclic ring system in which one to three carbons are replaced independently by nitrogen, and

sulfonyl, which ring is substituted with an ethyl; R^a is methyl; R^b and R^c are independently selected from hydrogen, methyl and ethyl; and R^d is methyl.

Preferably, when formula Q is a cyclic amine of formula IIb in a compound of formula I, q^1 and q^2 are each 2; R^3 is C_1-C_2-alkyl, C_3-C_4-cycloalkyl, methoxymethyl, trifluoromethyl or difluoromethyl; Z is a bond, or oxygen; R^4 is phenyl substituted with 1 to 3 independently selected substituents from fluorine, bromine, chlorine, cyano, trifluoromethyl, methoxy, trifluoromethoxy, methylsulfonyl, trifluoromethylsulfonyl and O-CF_2-O-, or 5 or 6 membered heteroaryl substituted with 1 to 3 independently selected substituents from fluorine, chlorine, cyano, methyl, trifluoromethyl, trifluoroethyl, cyclopropyl, methoxy, trifluoromethoxy, methylsulfonyl and trifluoromethylsulfonyl; A is $R^bR^cNSO_2$, $R^dSO_2N(C_1$-C_4-alkyl), or 5 or 6 membered heteroaryl substituted with 1 to 3 independently selected from fluorine, chlorine, methyl and trifluoromethyl; R^b and R^c are independently selected from hydrogen, methyl, ethyl and cyclopropyl; and R^d is C_1-C_2-alkyl.

Preferably, when formula Q is a cyclic amine of formula IIb in a compound of formula I, q^1 and q^2 are each 2; R^3 is trifluoromethyl or difluoromethyl; Z is oxygen; R^4 is phenyl substituted with 1 to 3 independently selected substituents from fluorine, bromine, chlorine, trifluoromethyl, methoxy, trifluoromethoxy, methylsulfonyl, trifluoromethylsulfonyl and O-CF_2-O-; A is $R^bR^cNSO_2$, R^dSO_2N(isopropyl), or 5 or 6 membered heteroaryl substituted with 1 to 3 independently selected from fluorine, chlorine, methyl and trifluoromethyl; and R^b and R^c are independently selected from hydrogen, methyl, and ethyl; and R^d is methyl.

Preferably the compound of formula II is selected from 6-cyclopropyl-2-[(2,2-difluoro-1,3-benzodioxol-5-yl)methoxy]-5-[4-(5-methyl-1,1-dioxo-1,2,5-thiadiazolidin-2-yl)piperidine-1-carbonyl]pyridine-3-carbonitrile; 2-[(2,2-difluoro-1,3-benzodioxol-5-yl)methoxy]-6-(difluoromethyl)-5-[4-(5-methyl-1,2,4-oxadiazol-3-yl)piperidine-1-carbonyl]pyridine-3-carbonitrile; 5-[4-(5-methyl-1,2,4-oxadiazol-3-yl)piperidine-1-carbonyl]-6-(trifluoromethyl)-2-[[4-(trifluoromethyl)phenyl]methoxy]pyridine-3-carbonitrile; 2-[(2,2-difluoro-1,3-benzodioxol-5-yl)methoxy]-5-[4-(1-methyl-1,2,4-triazol-3-yl)piperidine-1-carbonyl]-6-(trifluoromethyl)pyridine-3-carbonitrile; 5-[4-(5-methyl-1,2,4-oxadiazol-3-yl)piperidine-1-carbonyl]-2-[[1-(2,2,2-trifluoroethyl)pyrazol-4-yl]methoxy]-6-(trifluoromethyl)pyridine-3-

carbonitrile; 2-[(2,2-difluoro-1,3-benzodioxol-5-yl)methoxy]-5-[4-(5-methyl-1,2,4-oxadiazol-3-yl)piperidine-1-carbonyl]-6-(trifluoromethyl)pyridine-3-carbonitrile; 6-(difluoromethyl)-5-[4-(5-methyl-1,2,4-oxadiazol-3-yl)piperidine-1-carbonyl]-2-[(2,4,5-trifluorophenyl)methoxy]pyridine-3-carbonitrile; 1-[6-[(4-chloro-2-fluoro-phenyl)methoxy]-5-cyano-2-(difluoromethyl)pyridine-3-carbonyl]-N-ethyl-N-methyl-piperidine-4-sulfonamide; 1-[6-[(4-bromo-3-fluoro-phenyl)methoxy]-5-cyano-2-(difluoromethyl)pyridine-3-carbonyl]-N-ethyl-N-methyl-piperidine-4-sulfonamide; 1-[6-[(4-chloro-2-fluoro-phenyl)methoxy]-5-cyano-2-(methoxymethyl)pyridine-3-carbonyl]-N,N-dimethyl-piperidine-4-sulfonamide; N-[1-[1-[5-cyano-6-[(2,2-difluoro-1,3-benzodioxol-5-yl)methoxy]-2-(methoxymethyl)pyridine-3-carbonyl]-4-piperidyl]-1-methyl-ethyl]methanesulfonamide; 1-[5-cyano-6-(2,2-difluoro-1,3-benzodioxol-5-yl)-2-methyl-pyridine-3-carbonyl]-N-ethyl-N-methyl-piperidine-4-sulfonamide; 4-[5-cyano-6-[(2,2-difluoro-1,3-benzodioxol-5-yl)methoxy]-2-(difluoromethyl)pyridine-3-carbonyl]-N-ethyl-piperazine-1-sulfonamide; 6-(difluoromethyl)-5-[4-(5-methyl-1,2,4-oxadiazol-3-yl)piperidine-1-carbonyl]-2-[4-(trifluoromethyl)phenyl]pyridine-3-carbonitrile; and 5-[4-(5-methyl-1,2,4-oxadiazol-3-yl)piperidine-1-carbonyl]-6-(trifluoromethyl)-2-[4-(trifluoromethyl)phenyl]pyridine-3-carbonitrile.

Preferably wherein the one or more agrochemical is present in an amount of at least 2% by weight, such as at least 5% by weight, or even at least 10% by weight (e.g., from 5 to 50% by weight or from 10 to 55% by weight).

The compositions described herein may comprise a co-solvent. Preferably the co-solvent is selected from one or more of the solvents set out in Table B (trade names provided in parentheses).

Table B

dihydrolevoglucosenone (Cyrene)
Gamma-butyrolactone
N-methyl-pyrrolidinone (NMP)
Acetophenone

Mix of hydrocarbons, C10-C13, aromatics, <1% naphthalene (Solvesso 200 ND)
Ethyl lactate (Purasolv EL)
Benzyl alcohol
Triethyl phosphate (TEP, Levagard TEP-Z)
Me esters of C6-10 fatty acids, (Stepan C25)
Methyl benzoate
Propylene carbonate (Jeffsol AG-1555)
Dipropylene glycol dibenzoate (Benzoflex 9-88, Kalama K-Flex DP)
Benzyl acetate (Jeffsol AG 1705)
2-ethyl hexyl lactate ester (Agnique AE 3-2EH)
Dimethyl lactamide (DML, Agnique AMD 3L)
Glycerine Carbonate, 4-hydroxymethyl-1,3-dioxolan-2-one (Jeffsol GC)
Dimethyl amide ether (methyl-5-(dimethylamino)-2-methyl-5-oxopentanoate) (DV-SOLV 1059, Rhodiasolv Polarclean)
N,*N*-dimethyl 9-decenamide (Hallcomid 1025)
N-butyl pyrrolidone (Genagen NBP)
dimethyl 2-methylglutarate (Rhodiasolv Iris)
Dimethyl amide fatty acid (such as Hallcomid M-8-10, Hallcomid M-10, Hallcomid® M-12-14)

The composition may further comprise a co-formulant, such as a surfactant.

Surfactants are included as emulsifiers, dispersants, and wetting agents. The surfactants useful in the new compositions are known in the art and comprise, for example, salts of alkyl sulphates, such as diethanolammonium lauryl sulphate; salts of arylsulphonates, such as calcium dodecyl-benzenesulfonate; alkylphenol-alkylene oxide addition products, such as nonylphenol ethoxylate; alcohol-alkylene oxide addition products, such as tridecyl alcohol ethoxylate; soaps, such as sodium stearate; salts of alkylnaphthalenesulfonates, such as sodium dibutylnaphthalenesulfonate; dialkyl esters of sulfosuccinate salts, such as sodium di(2-ethylhexyl)sulfosuccinate; sorbitol esters, such as ethoxylated sorbitol hexaoleate; quaternary amines, such as lauryl trimethylammonium chloride; polyethylene glycol esters of

fatty acids, such as polyethylene glycol stearate; fatty alcohol alkoxylates which may be alkyl end-capped; block copolymers of ethylene oxide and propylene oxide; and salts of mono- and di-alkyl phosphate esters; alkylated polyvinylpyrrolidone, and also further substances described e.g. in "McCutcheon's Emulsifiers & Detergents", North American Edition, MC Publishing Co., 2018. It is also possible to use a mixture of one or more of these surfactants.

The compositions may also comprise additional co-formulants known in the art such as crystallisation inhibitors, viscosity-modifying substances, suspending agents, dyes, anti-oxidants, foaming agents, light absorbers, mixing aids, anti-foams, complexing agents, neutralising or pH-modifying substances and buffers, corrosion-inhibitors, fragrances, wetting agents, absorption improvers, micronutrients, plasticisers, glidants, lubricants, dispersants, thickeners, anti-freezes, microbiocides, and also liquid and solid fertilisers.

The composition is advantageously an emulsifiable concentrate (EC), a suspoemulsion (SE), emulsion in water (EW), microemulsion (ME), a capsule suspension (CS), or a mixed formulation of CS and a suspension concentrate (ZC), preferably the composition is an emulsifiable concentrate (EC).

Such formulations are diluted prior to use. Diluted formulations can be prepared, for example, with water, liquid fertilisers, micronutrients, biological organisms, oil, or solvents. For certain active ingredients requiring uptake into the leaf tissue, an EC is generally favourable and potentially increases biological performance by a factor of two. The present composition permits the preparation of EC for a range of active ingredients. The present composition also allows for the creation of specialized formulations for specific application techniques such as direct tree injection.

In a third aspect of the invention there is provided a method of preparing a composition as defined herein, comprising the dissolution of the agrochemical in the solvent.

In a fourth aspect of the invention there is provided the use of a composition as defined herein as a pesticide. The composition may be used in direct tree injection.

Unless otherwise stated, percentages are given as percentages by total weight and all embodiments and preferred features may be combined in any combination.

The invention is described by the following non-limiting Examples.

Examples

Example 1

The solubility of an agrochemical (AI1) within the structure of Formula I and with HSP parameters of dD = 19.5, dP = 13.6, dH = 11.2 was tested with a range of solvents in comparison to a solvent according to the invention (4-methoxybenzaldehyde) at both 5 °C and 25 °C. The solvents are listed in Table 1, together with their water-miscibility and whether or not the solvent is within the relevant HSP sphere.

Table 1

Solvent	**Compound (Trade Name)**	**Water miscibility of 0.4 wt% or less at 25 °C (WATER-IMMISCIBLE)**	**HSP sphere of dD = 19.1, dP = 10.0, dH = 7.4; HSP radius of 3**
Solvent 1	4-methoxybenzaldehyde	Yes	In
Solvent 2	3- methoxybenzaldehyde	Yes	In
Comparative solvent 1	butyrolactone	No	Out
Comparative solvent 2	acetophenone	No	Out
Comparative solvent 3	benzylalcohol	No	Out
Comparative solvent 4	dimethylamide ether type solvent (Rhodiasolv Polarclean)	No	Out
Comparative solvent 5	methylbenzoate	Yes	Out

Comparative solvent 6	Propylene carbonate (Jeffsol AG-1555)	No	Out
Comparative solvent 7	Ethyl lactate (Purasolv EL)	No	Out
Comparative solvent 8	dimethyl 2-methylglutarate (Rhodiasolv IRIS)	No	Out
Comparative solvent 9	propylene glycol	No	Out
Comparative solvent 10	N,N-dimethyl 9-decenamide (Hallcomid 1025)	Yes	Out
Comparative solvent 12	Isobornyl Acetate	Yes	Out
Comparative solvent 13	dipropylene glycol dibenzoate (Benzoflex 9-88)	Yes	Out
Comparative solvent 14	rape seed oil methyl ester (Agnique ME 18 RD-F)	Yes	Out
Comparative solvent 15	methyl oleate (AGNIQUE ME 181)	Yes	Out
Comparative solvent 16	Dimethyl lactamide (Agnique AMD 3L)	No	Out
Comparative solvent 17	glycerin carbonate (JEFFSOL GC)	No	Out
Comparative solvent 18	Triethyl Phosphate	No	Out
Comparative solvent 19	2-ethylhexyl-S-lactate Agnique AE 3-2EH	Yes	Out

Comparative solvent 20	benzylacetate	Yes	Out
Comparative solvent 21	RIBON, an adjuvant blend based on Tris (2-ethylhexyl) Phosphate	Yes	Out
Comparative solvent 22	cyclohexanedicarboxylic acid, dinonyl ester (Agnique AE 829)	Yes	Out
Comparative solvent 23	mixture of octanoic acid-decanoic acid- N,N-dimethylamide (HALLCOMID M-8-10)	Yes	Out
Comparative solvent 24	Methyl lactate (PURASOLV ML)	No	Out
Comparative solvent 25	Solvesso 200 ND	Yes	Out

The agrochemical (AI1) was added into the relevant solvent and the maximum concentration that was able to form a solution is shown in Table 2 below.

Table 2

	AI1 solubility at 5 °C (wt%)	**AI1 solubility at 25 °C (wt%)**
Solvent 1	5.6	10.7
Solvent 2	Not tested	9.5
Comparative solvent 1	7.5	11.5
Comparative solvent 2	-	10.2
Comparative solvent 3	4.1	9.2
Comparative solvent 4	2.8	6.8
Comparative solvent 5	4.7	6.7
Comparative solvent 6	4.0	6.7
Comparative solvent 7	3.8	5.8

Comparative solvent 8	2.8	4.2
Comparative solvent 9	2.3	3.8
Comparative solvent 10	1.8	3.3
Comparative solvent 12	0.7	1.4
Comparative solvent 13	0.7	0.8
Comparative solvent 14	0.3	0.6
Comparative solvent 15	0.2	0.4

It can be seen that Solvents 1 and 2 exhibit better solubility properties for the agrochemical when compared to Comparative Solvents 3 to 15, while Comparative Solvents 1 (butyrolactone) and 2 (acetophenone) are not water-immiscible and have an undesirable environmental profile.

Example 2

The following formulations as set out in Table 3 were prepared as emulsifiable concentrates (ECs), each having 5 wt% of active ingredient of Example 1.

Table 3

Compound	**EC 1**	**EC 2**
Active Ingredient (AI1)	5 g	5 g
Emulsogen EL360	6.1 g	5.33 g
Tween 80	0.9 g	-
Toximul 8320	-	6.67 g
Nansa EVM63/B	5.0 g	8.0 g
Comparative Solvent 16	27.26 mL	-
Comparative solvent 5	To 100 mL	-
Solvent 1	-	To 100 mL
	1.08 g/mL	*1.12 g/mL*

These emulsions were formed by diluting the emulsifiable concentrates at 1% by volume in hard water (500 ppm calcium carbonate) and soft water (20 ppm calcium carbonate) at 15 °C and 30 °C.

After formation, the stability of the emulsion is visually evaluated by assessing the amount of oil, cream, and sediment after standing for 1 hour, 2 hours, and 24 hours at the respective temperatures and water hardness. Crystallization of the active ingredient is also carefully monitored as a crystallization can induce nozzle blockage during spraying.

The results are summarized in the Table 4 below.

Table 4

		EC 1	**EC 2**
	After 1 h	0	trace
15°C	After 2 h	Trace (0.005 mL)	0.015 ml
Soft water	After 24h	0.025 mL (sediment) + small clear layer on the top	0.015 ml
	After 1 h	0	0
15°C	After 2 h	0.02 mL (phase separation)	0
Hard water	After 24h	0.12 mL (sediment) + small clear layer on the top	0
	After 1 h	Trace (0.005 mL)	trace
30°C	After 2 h	0.01 mL	trace
Soft water	After 24h	0.14 mL (sediment) + small clear layer on the top	0.017 ml
	After 1 h	0	0.04 ml
30°C	After 2 h	0.025mL (oil) micro crystals visible	0.2 ml oil + 0.15ml sediment

Hard water	After 24h	0.55 mL (oil) Large crystals visible in oil + clear layer on the top	0.75 ml oil

The results show that the emulsifiable concentrate 2 prepared with the Solvent 1 generates a more stable emulsion upon dilution in water and avoids crystallization of the agrochemical.

Example 3

The solubility methodology as set out in Example 1 was repeated for pydiflumetofen (AI2), azoxystrobin (AI3) and pinoxaden (AI4) to compare Solvent 1 with the most commercially relevant solvents. The solubility results in wt% of each active ingredient in these solvents at 5 °C and 25 °C are set out in Table 5 below.

Table 5

Solvent	**Pydiflumetofen**		**Azoxystrobin**		**Pinoxaden**	
Temperature	5°C	25°C	5°C	25°C	5°C	25°C
Solvent 1 (4-methoxybenzaldehyde)	12.3	20.3	11.8	20.6	17.4	29.8
Comparative Solvent 16 (AGNIQUE AMD 3L)	7.4	10.8	9.5	17.0	9.2	16.5
Comparative Solvent 23 (HALLCOMID M-8-10)	6.7	12.5	2.2	4.7	3.7	7.6
Comparative Solvent 24 (PURASOLV ML)	2.6	6.4	5.2	10.7	32.8	34.7
Comparative Solvent 25 (SOLVESSO 200 ND)	2.2	4.3	1.2	2.7	3.6	5.5

It can be seen that the leading available solvents are water-miscible and/or demonstrate an inferior technical performance compared to a solvent according to invention.

Example 4

The formulation as set out in Table 6 was prepared as emulsifiable concentrate at 5 wt% active ingredient Isocyloseram (AI5) (dD=19.5, dP=8.7, dH= 10.7).

Table 6

EC 3	
Component	**Quantity**
Isocyloseram	5 g
Emulsogen EL360	5.33 g
Toximul 8320	6.67 g
Nansa EVM63/B	8.0 g
4-methoxybenzaldehyde	To 100 mL
	1.12 g/mL

Emulsion stability of this emulsifiable concentrates is evaluated as per the methodology of Example 2.

The results are summarized in the Table 7 below and show a superior level of physical properties.

Table 7

	EC 3	
15°C Soft water	After 1 h	trace
	After 2 h	0.02 ml
	After 24h	0.1 ml
15°C Hard water	After 1 h	0
	After 2 h	0
	After 24h	0
30°C	After 1 h	trace
	After 2 h	trace

Soft water	After 24h	0.13 ml
30°C Hard water	After 1 h	trace
	After 2 h	Oil droplets on the edge
	After 24h	0.55 ml oil

Example 5

An agrochemical (AI6) within the structure of Formula II and with the HSP parameters of dD = 19.1, dP = 11.2 , dH = 9.5 was developed in different formulation types as per Table 8 and tested in a Translaminar test against *Tetranychus urticated* (mixed population) on French beans (*Phaseolus vulgaris*, variety: Fulvio; 14 days old; reduced to one leaf).

Formulation 'EC050 – 2' is a composition according to the invention.

Table 8

	EC050 – 1	**EC050 – 2**	**SC050**	**OD050**
AI6	5	5	5	5
Castor oil ethoxylate 36-37 EO (Emulsogen EL360)	-	5.33		5.6
Castor oil ethoxylate 35 EO (Agnique CSO35)	11	-	-	-
Copolymer Butanol PO/ EO (Toximul 8320)	-	6.67	-	-
Alkyl benzene sulfonate calcium salt (Nansa EVM 63/B)	4	8	-	5.6
Modified polyester non-ionic surfactant (Atlox 4914)	-	-	-	2
Solution of an acrylic graft copolymer in water and propylenglycol (Atlox 4913)	-	-	8	-

Naphthalenesulfonic acid, sodium salt condensed with formaldehyde (Morwet D-425)	-	-	2	-
Mixture of fatty acid polyethylene glycol esters (Alkamuls VO/2005)	-	-	-	2.8
1,2-Propylenglycol	-	-	3	-
Polydimethylsiloxane antifoam emulsion (SAG1572)	-	-	0.7	-
Silicon dioxide (Aerosil 200)	-	-	-	3
Xanthan gum (Rhodopol 23)	-	-	0.2	-
1,2-benzisothiazol-3(2H)-one (Proxel GXL)	-	-	0.25	-
Oleic acid methyl ester (Agnique ME 181-U)	-	-	-	10
4-methoxybenzaldehyde	-	To 100 mL	-	-
Mixture of octanoic acid-, decanoic acid-N,N-dimethylamide (Genagen 4166)	10	-	-	-
Cyclohexanone	20	-	-	-
Methylbenzoate	To 100 mL	-	-	-
Rape seed oil methyl ester (Agnique ME 18 RD-F)	-	-	-	To 100 mL
water	-	-	To 100 mL	-
	1.04 g/mL	*1.12 g/mL*	*1g/mL*	*0.94 g/mL*

The formulations were applied by using a Track Sprayer with a white nozzle Lechler LU-120-08 (filter 25/32M (red), medium droplets). The test was carried out on the whole plant as a curative application one day after infestation where the plants were sprayed in the track sprayer at a rate of 500 L/ha. During spraying, the leaves were kept horizontal using a metal grid. After the spray dried, the plants were placed in a greenhouse chamber (at 60% humidity, 14 h light, temperature of 22°C in the day and 20°C in the night) and were evaluated at 4, 7, and 11 days post-treatment.

The experiment was repeated four times and the percentage of mortality on mobile stages (nymphs and adults) was estimated and the number of mobiles was counted (50% of the area). The results are set out Table 9.

Table 9

	Rates (ppm)	Rates (g AI/ha)	**7 DAA** Ø AVERAGE estimated efficacy	**11 DAA** Ø AVERAGE estimated efficacy
EC050-2	84	42	97	100
	42	21	43	74
	21	10,5	48	71
	5,25	2,625	20	10
EC050-1	84	42	60	98
	42	21	45	56
	21	10,5	5	0
	5,25	2,625	0	0
OD050	84	42	95	100
	42	21	23	28
	21	10,5	0	3
	5,25	2,625	5	0
SC050	84	42	3	13

	42	21	0	3
	21	10,5	0	18
	5,25	2,625	0	13

The results show that the EC050 formulations 1 and 2 of the agrochemical show superior translaminar efficacy against mites compared to the OD050 and SC050 formulations. Notably, the EC050 formulation according to the invention further offers better mite control at lower rates without an adjuvant.

As can be seen, the compositions of the present invention demonstrate effective solubility of otherwise difficult to dissolve active ingredient and accordingly the formation of otherwise difficult to prepare EC formulations with improved efficacy.

The invention is defined by the claims.

Claims

1. A composition comprising an agrochemical and a solvent, wherein the solvent has Hansen Solubility Parameters within the solubility sphere of dD = 19.1, dP = 10.0, dH = 7.4 and a HSP radius of 3; and has a water miscibility of 0.4 wt% or less at 25 °C.

2. A composition according to claim 1, wherein the agrochemical has Hansen Solubility Parameters within the solubility sphere of dD = 19.1, dP = 10.0, dH = 7.4 and a HSP radius of 6.

3. A composition according to claim 1 or 2, wherein the solvent comprises a substituted phenyl.

4. A composition according to claim 3, wherein the solvent comprises a substituted benzaldehyde.

5. A composition according to claim 4, wherein the solvent comprises methoxybenzaldehyde, preferably 2-methoxybenzaldehyde and/or 3-methoxybenzaldehyde and/or 4-methoxybenzaldehyde.

6. A composition according to any of the preceding claims, wherein the solvent comprises no or substantially no N-methylpyrrolidone (NMP).

7. A composition according to any of the preceding claims, wherein the agrochemical is selected from one or more of Metalaxyl, Pirimicarb, Napropamide, Pyroquilon, Cyproconazole, Picoxystrobin, Clodinafop propargyl, Aclonifen, Acetochlor, Pyraclostrobin, Propiconazole, Butafenacil, Fomesafen, Lufenuron, Rynaxypyr, Chlorothalonil, Difenoconazole, Pydiflumetofen (Adepidyn®), azoxystrobin, pinoxaden, Isocyloseram (Plinazolin®), Benzovindiflupyr (Solatenol®), Spiropidion, Phenetylarylamide (Tymirium®), sedaxane, and isopyrazam .

8. A composition comprising 4-methoxybenzaldehyde and one or more of Pydiflumetofen (Adepidyn®), pinoxaden, and Isocyloseram (Plinazolin®).

9. A composition according to any of the preceding claims further comprising a co-formulant.

10. A composition according to any of the preceding claims further comprising a co-solvent.

11. A composition according to claim 10, wherein the co-solvent is selected from one or more of cyrene (dihydrolevoglucosenone), Gamma-butyrolactone, N-methyl-pyrrolidinone (NMP), Acetophenone, Solvesso 200 ND, Ethyl lactate (Purasolv EL), Benzyl alcohol, Triethyl phosphate (TEP, Levagard TEP-Z), Stepan C25, Methyl benzoate, Propylene carbonate (Jeffsol AG-1555), Dipropylene glycol dibenzoate (Benzoflex 9-88, Kalama K-Flex DP), Benzyl acetate (Jeffsol AG 1705), 2-ethyl hexyl lactate ester (Agnique AE 3-2EH), Dimethyl lactamide (DML, Agnique AMD 3L), Glycerine Carbonate, 4-hydroxymethyl-1,3-dioxolan-2-one (Jeffsol GC), Dimethyl amide ether (methyl-5-(dimethylamino)-2-methyl-5-oxopentanoate) (Rhodiasolv Polarclean), N,N-dimethyl 9-decanamide (Hallcomid 1025), N-butyl pyrrolidone, dimethyl 2-methylglutarate (Rhodiasolv Iris), and Dimethyl amide fatty acid (Hallcomid M810).

12. A composition according to any of the preceding claims, wherein the composition is an emulsifiable concentrate (EC), a suspoemulsion (SE), an emulsion in water (EW), a microemulsion (ME), a capsule suspension (CS), or a mixed formulation of CS and a suspension concentrate (ZC), preferably an emulsifiable concentrate (EC).

13. A method of preparing a composition according to any of the preceding claims, comprising the dissolution of the agrochemical in the solvent.

14. Use of a composition as defined in any of claims 1 to 12 as a pesticide.

15. Use of a composition according to claim 14 in direct tree injection.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/054647

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01N25/02 A01P3/00 A01P7/04
ADD.

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 practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2020/049493 A1 (PI INDUSTRIES LTD [IN]) 12 March 2020 (2020-03-12) claim 13	1-6,9, 12-14
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X	US 2016/227776 A1 (KAWAZU KEI [JP] ET AL) 11 August 2016 (2016-08-11) table 3	1-6,9-14

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 May 2024	17/05/2024

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	Lorusso, Patrizia

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/054647

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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X	"An emulsifiable concentrate having a benzaldehyde-based solvent system ED - Darl Kuhn", IP.COM, IP.COM INC., WEST HENRIETTA, NY, US, 1 March 2023 (2023-03-01), XP013195528, ISSN: 1533-0001 The whole document, in particular Table A	1-15
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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