Composition

The present invention relates to a composition for controlling plant growth, and to the preparation and use said composition.

There is a need for herbicidal compositions suitable for application on rice paddy fields. However, direct application formulations such as suspension concentrates (SC), oil dispersions (OD) or granules (GR) may settle on the bed of the paddy field and/or clump causing localised phytotoxicity. Such compositional forms also require a strict level of water of at least 5 cm before and after application.

Aqueous emulsions (EW) have benefits in that they are simple to manufacture and have good chemical stability and can be applied to the paddy water directly or upon dilution and the spontaneous emulsion of the oil droplets containing the active ingredient(s) will lead to the droplets floating or rising to float and dispersing across the surface of the field with no sedimentation.

However, EW formulations, particularly concentrated EW formulations, typically have high viscosities, which are undesirable from an direct, splash application into the field and are aesthetically less pleasing for the end user, while low viscosity compositions struggle to achieve sufficient concentration of the oil phase, and by extension the active ingredient(s).

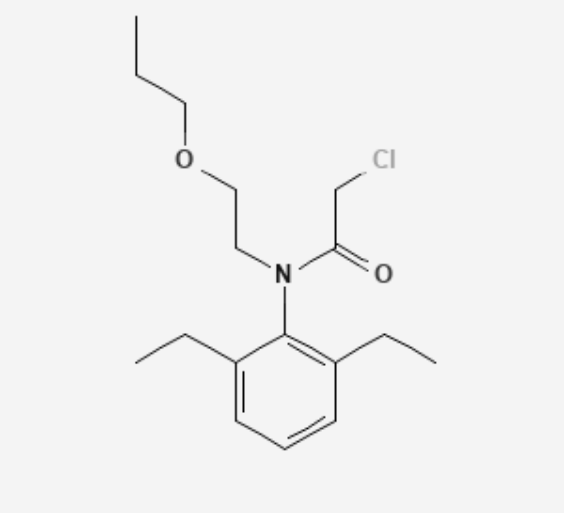
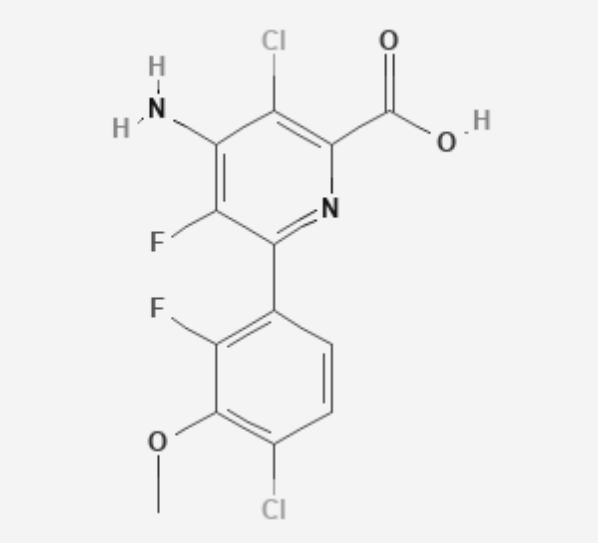
There is therefore provided in a first aspect of the present invention a composition comprising Pretilachlor, Florpyrauxifen and one or more surfactants, wherein the composition has a viscosity of less than 600 cps (centipoise). Preferably the composition is an aqueous emulsion (EW).

Advantageously, the composition may have a viscosity of less than 500 cps, 450 cps, 400 cps, or even 350 cps.

The viscosity is measured with a Brookfield viscometer using the spindle 2 and with a rotating speed of 30 rpm.

The structures of the active ingredients are set out in Table 1.

Table 1

Pretilachlor	
Florpyrauxifen	

Advantageously, the oil:aqueous phase ratio (ϕ) is 1.1:1 or higher, such as 1.2:1 or higher, 1.3:1 or higher, 1.4:1 or higher, most preferably preferably 1.5:1 or higher. The higher ratio of the compositions allows a more concentrated composition to be prepared.

Pretilachlor may preferably be present in an amount of from 10 to 50% by weight, such as from 12 to 45%, from 15 to 42%, 20 to 40%, or even from 25 to 35%.

Florpyrauxifen may preferably be present in an amount of from 0.01 to 10% by weight, such as from 0.05 to 8%, from 0.09 to 7%, preferably from 0.1 to 5% by weight, or even from 0.5 to 1.5% by weight.

The one or more surfactants that are suitable for the present composition according to the invention include tristyrylphenol ethoxylates, for example Soprophor TS-10 (RhonePoulenc S. A.) or BSU (Rhodia Geronazzo Spa), EO/PO/EO block copolymers, for example Pluronic F-108, Pluronic F-38, PluronicP-105 (BASF Wyandotte Corp.) and/or sodium salts of sulfonated naphthalenesulfonic acid-formaldehyde condensation products, for example Morwet D-425 (Witco Chem. Corp.) or Orotan SN (Rohm and Haas, France S. A.), lignosulfonates, PO/EO butanol copolymers, for example Atlox G-5000, block copolymers of polyhydroxystearic acid and polyalkylene glycols, for example Atlox 4912 or 4914 (American Hoechst), or partially hydrolyse or fully hydrolysed polyvinyl acetate, for example Mowiol 18-88 or Mowiol 4-88 (Hoechst AG).

Particularly preferably, the one or more surfactants are selected from the group comprising: polyalkylene glycols (e.g., Atlox 4914), butyl polyalkylene oxide block copolymers (e.g. Toximul 8320), Ethoxylated sorbitol esters (e.g., Polyoxyethylene (8) sorbitan monolaurate 'Tween 22'), polyoxyethylene tridecyl phosphate esters (e.g., Rhodalfac RS610E) and anionic acrylic copolymers (e.g., Zephrym PD3315).

The one or more surfactants are present in a total amount of from 1 to 10% by weight, such as from 2 to 8%, from 2.5 to 7%, or even from 2.8 to 6%.

In a particularly preferred embodiment, the one or more surfactants comprise Atlox 4914, Tween 20 and Toximul 8320.

Advantageously the composition may contain xanthan gum. Surprisingly and counter-intuitively, it has been found that xanthan gum acts as a thinning agent in context of the present invention and serves to reduce the viscosity. It may also aid in the formation of fine droplets upon application.

The xanthan gum is preferably present in a non-zero quantity but in an amount of less than 0.2% by weight, such as less than 0.1%, less than 0.05%, less than 0.01% or even less than 0.005% (e.g., from 0.00001 to 0.005% by weight).

Advantageously the composition comprises an adjuvant in order to improve the efficacy of the composition. Preferably the adjuvant comprises an alkyl methyl ester. The alkyl chain length may be from 1 to 30 carbons, such as from 5 to 25 carbons, for even from 10 to 20 carbons, such as C_{18} methyl Oleate Ester ('Agnique ME 181').

It was also found that the presence of the adjuvant helps in the formation of fine droplets, such as those with a D_{95} of less than 2.5 microns.

It is possible to include a solvent. Any solvent that is substantially insoluble in water is suitable as the hydrophobic solvent, for example aromatic solvents selected from the classes of toluenes, xylenes, alkylbenzenes and alkylnaphthalenes, and also saturated and unsaturated hydrocarbons, aryl-alkyl ketones, esters, fatty acid methyl esters, rapeseed oil, C1-C6 alkyl esters, especially rapeseed oil methyl ester and rapeseed oil ethyl ester, esters of acetic acid or benzoic acid, amides of alkanecarboxylic acids, linear or cyclic acetates, alkylpyrrolidones, alkylcaprolactones and also alkyl carbonates or mixtures of those solvents.

For effective dispersal on the field, it is advantageous for the density of the oil phase to be less than 1g/ml. Solvents with a low density are therefore preferred.

Oil phase stabilisers that are suitable for the composition according to the invention include the following polymers, copolymers and oligomers or mixtures thereof, selected from the classes of the polystyrenes, water-insoluble poly(n-alkylene) glycols wherein $n > 2$, polypropylene glycols, polyvinyl acetates and polyvinyl acetate-copolyethylenes.

The oil phase stabilisers may be:
1) Polymers of monoolefins and diolefins.
2) Mixtures of the polymers mentioned under 1), mixtures of different types of polyethylene (for example LDPE/HDPE).
3) Copolymers of monoolefins and diolefin with one another or with other vinyl monomers.
3a) Hydrocarbon resins (for example C5-C9) including hydrogenated modifications thereof.
4) Polystyrene, poly(p-methylstyrene), poly (α-methylstyrene).
5) Copolymers of styrene or a-methylstyrene with dienes or acrylic derivatives.
6) Graft copolymers of styrene or methylstyrene.
7) Halogenated polymers.
8) Polymer derivatives of a-unsaturated acids and derivatives thereof.
9) Copolymers of the monomers mentioned under 8) with one another or with other unsaturated monomers, for example acrylonitrile/butadiene copolymers, acrylonitrile/alkyl

acrylate copolymers, acrylonitrile/alkoxyalkyl acrylate or acrylonitrile/vinyl halide copolymers or acrylonitrile/alkyl methacrylate/butadiene terpolymers.

10) Polymers derived from unsaturated alcohols and amines or their acyl and acetal derivatives; and copolymers thereof with the olefins mentioned under 1).

11) Homopolymers and copolymers of cyclic ethers.

12) Polyacetals such as polyoxymethylene and polyoxymethylenes which contain ethylene oxides as comonomer.

13) Polyphenylene oxides and sulphides.

14) Polyurethanes derived from polyethers, polyesters and polybutadienes which have terminal hydroxyl groups on the one hand and aliphatic or aromatic polyisocyanates on the other hand.

15) Polyamides and copolyamides derived from diamines, dicarboxylic acids and from aminocarboxylic acids of the corresponding lactams.

16) Polyureas, polyimides and polyamide imides and polybenzimidazoles.

17) Polyesters derived from dicarboxylic acids and diols and/or from hydroxycarboxylic acids and lactones thereof.

17a) Polyesters derived from aliphatic dicarboxylic acids and diols and/or oligo ethers and having the general formula

$-(O-X-O-C(=O)-Y-C(O=))_z$

wherein $X=-(CH_2)_n-$ wherein n = 2 to 12 or

$X = [-(CH_2)_n-O-(CH_2)n]_r$ wherein n = 2 to 4 and r = 2 to 10,

$Y =-(CH_2)_m-$ wherein m = 0 to 12, and z = 5 to 100 and copolymers thereof.

18) Polycarbonates and polyester carbonates.

19) Polysulphones, polyether sulfones and polyether ketones.

20) Polyethers of diglycidyl compounds, including diglycidyl ethers and diols.

21) Natural polymers, such as rubber, and chemically modified homologous derivatives of natural polymers, for example cellulose acetates, cellulose propionates and cellulose butyrates, or cellulose ethers, for example methyl cellulose (degree of substitution > 2.5); and also resins and derivatives thereof.

22) Mixtures of the afore-mentioned polymers.

23) Mineral oils, fatty acid alkyl esters or rapeseed oil C_{1-6} alkyl esters.

The molecular weight of the polymer of the oil phase stabilisers that are suitable for the composition according to the invention, determined, for example, by light-scattering measurements or by measurement of the osmotic pressure, can be up to 1 000 000 and is usually from 1000 to 1 000 000 Daltons, preferably from 1000 to 100 000 Daltons. In the case

of compounds that are extremely hydrophobic and therefore of extremely low solubility in water, for example alkanes and fatty acid alkyl esters, the Mw can also be less than 1000.

The oil phase stabilisers are used in the composition according to the invention in a concentration of from 0.5 to 10 % by weight, preferably from 1 to 5 % by weight, based on the complete formulation. In the case of compounds that are extremely hydrophobic and therefore of extremely low solubility in water, for example alkanes and fatty acid alkyl esters, and that have a low molecular weight, the concentration of the oil phase stabilisers can be up to 25 %.

In addition, there may also be added to the formulations according to the invention substances that lower the melting point of the emulsions, that is to say that prevent the formulation from freezing at low temperatures (anti-freezing agents).

Such substances are usually water-soluble salts that are suitable for lowering the freezing point of the aqueous phase of the emulsion according to the invention, for example sodium chloride, potassium chloride, ammonium chloride, ammonium nitrate and sodium nitrate and mixtures thereof. Also suitable are water-soluble glycols, for example ethylene glycol, propylene glycol, diethylene glycol, glycerol and mixtures thereof. The salts and the glycols are, in each case, preferably used in a concentration of from 0.5 to 10 % by weight, based on the complete formulation of the emulsion.

The emulsions according to the invention may additionally comprise, as adjuvants, preservatives that inhibit the growth of micro-organisms such as bacteria and fungi (for example Acticide LG) or formaldehyde. Such adjuvants can be used in an amount of from 0.1 to 0.5 % by weight of the complete formulation.

In a second aspect of the invention, there is provided a method of preparing a composition as defined herein. The organic phase comprising Pretilachlor and Florpyrauxifen may be emulsified in the aqueous phase by means of a suitable stirrer, for example a YSTRALO X 40/32 emulsifier, having stirring speeds of from 3000 to 6000 rpm. Depending on the formulation used and the speed, an emulsion is obtained having particle sizes in the preferred range of 1-10 micrometres.

In a third aspect of the invention there is provided a method of controlling undesired plant growth comprising applying a herbicidally effective amount of a composition as described herein to the plants or to the locus thereof. Whereas the commercial products will preferably

be formulated as concentrates, the end user will normally dilute the compositions with water. Advantageously, the compositions are applied to a paddy field.

In a fourth aspect of the invention there is provided the use of xanthan gum to reduce the viscosity of an agrochemical composition, preferably wherein the agrochemical composition is an aqueous emulsion. Advantageously, the xanthan gum will be used in the quantities and form described above.

In a fifth aspect of the invention, there is provided the combination of an unmanned aerial vehicle and a composition as described herein.

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

The following compositions were prepared.

Table 2

Composition % w/w	**1**	**2**	**3**
Pretilachlor	30.1	30.2	30.3
Florpyrauxifen	1.002	1.007	1.01
Pluronic F108 *Surfactant*	1.543	-	-
Morwet D425 *Surfactant*	0.36	-	-
Span 20 *Surfactant*	0.08	-	-
Tween 22 *Surfactant*	2	-	-
Atlox 4914	-	2.05	-

Surfactant			
Tween 20 *Surfactant*	-	1.13	-
Toximul 8320 *Surfactant*	-	0.82	0.9
Zephrym PD3315 *Surfactant*	-	-	4.595
pH reducer	0.08	0.1	0.1
Biocide	0.087	0.087	0.087
Agnique ME181 *Adjuvant*	27.306	28.627	28.577
Propylene glycol *Antifreeze*	4.81	4.81	3.51
Xanthan gum	0.002	0.002	0.002
Preservative	0.11	0.217	0.219
Antifoam	0.02	0.02	0.02
Water	Remainder	Remainder	Remainder

Physical Properties

The viscosity of the compositions are:
Composition 1: 580 cps;
Composition 2: 300 cps; and
Composition 3: 385 cps.

Measured with Brookfield viscometer using the spindle 2 and with a rotating speed of 30 rpm.

Figure 1 shows the shear rate sweep at 25 °C for Composition 2 and indicates shear thinning behaviour, which is particularly advantageous for direct splash application.

Effect of Xanthan Gum

Figure 2 shows ***Left***, Composition 2 with 20 ppm Xanthan added before emulsification; ***Middle***, Composition 2 without Xanthan gum; ***Right***, Composition 2 with 20 ppm xanthan added post emulsification step.

It can be seen that the addition of Xanthan gum unexpectedly leads to an improved and reduced viscosity in comparison to the absence of the gum.

Efficacy

The herbicidal activity of the compositions were tested with splash or foliar application against *Echinochloa crus-galli* (ECHCG). Composition 2 was tested against a commercially available herbicide Topshot™ (containing active ingredients penoxsulam and cyhalofop).

The results are shown in Table 3.

Table 3

Treatment	**Application rate (g ai/ha)**	**Method**	**Efficacy (%)**
Comp. 2	543	Splash	99
Comp. 2	620		99
Comp. 2	1,028		100
Comp. 2	1,240		100
TOPSHOT™	90	Foliar	88

The compositions according to the invention can also be seen to have an improved performance relative to commercial compositions in efficacy against a significant weed.

The invention is defined by the claims.

Claims

1. A composition comprising Pretilachlor, Florpyrauxifen and one or more surfactants, wherein the composition has a viscosity of less than 600 cps.

2. A composition according to claim 1, wherein the composition is an aqueous emulsion (EW).

3. A composition according to claim 1, wherein the oil:aqueous phase ratio (ϕ) is 1.1:1 or higher, preferably 1.5:1 or higher.

4. A composition according to any of the preceding claims, wherein the Pretilachlor is present in an amount of from 20 to 40% by weight.

5. A composition according to any of the preceding claims, wherein the Florpyrauxifen is present in an amount of from 0.1 to 5% by weight.

6. A composition according to any of the preceding claims, wherein the one or more surfactants are selected from the group comprising: polyalkylene glycols, butyl polyalkylene oxide block copolymers, Ethoxylated sorbitol esters, polyoxyethylene tridecyl phosphate esters and anionic acrylic copolymers.

7. A composition according to any of the preceding claims comprising xanthan gum, preferably in an amount of less than 0.2% by weight.

8. A composition according to any of the preceding claims comprising an adjuvant, preferably an adjuvant comprising an alkyl methyl ester.

9. A method of preparing a composition according to any of the preceding claims.

10. A method of controlling undesired plant growth comprising applying a herbicidally effective amount of a composition according to any of claims 1 to 8 to the plants or to the locus thereof.

11. A method according to claim 10, wherein the composition is applied to a paddy field.

12. Use of xanthan gum to reduce the viscosity of an agrochemical composition, preferably wherein the agrochemical composition is an aqueous emulsion.