(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
09 September 2022 (09.09.2022)

WIPO | PCT

(10) International Publication Number
WO 2022/185243 A1

(51) International Patent Classification:
A01N 57/20 (2006.01) *A01N 25/30* (2006.01)
A01P 13/00 (2006.01)

(21) International Application Number:
PCT/IB2022/051875

(22) International Filing Date:
03 March 2022 (03.03.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
202121009174 04 March 2021 (04.03.2021) IN

(71) Applicant: **UPL LIMITED** [IN/IN]; UPL House, 610 B/2, Bandra Village, off Western Express Highway, Bandra (East), Maharashtra, Mumbai 400051 (IN).

(72) Inventors: **MONDAL, Achintya**; UPL Limited, UPL House, 610 B/2, Bandra Village, Off Western Express Highway, Bandra (East), Maharashtra, Mumbai 400051 (IN). **BHOGE, Satish Ekanath**; UPL Limited, UPL House, 610 B/2, Bandra Village, Off Western Express Highway, Bandra (East), Maharashtra, Mumbai 400051 (IN).

(74) Agent: **MAJUMDAR, Subhatosh** et al.; S. Majumdar & Co., 5, Harish Mukherjee Road, West Bengal, Kolkata 700 025 (IN).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: PROCESS FOR PRODUCING A LIQUID HERBICIDAL COMPOSITION

(57) Abstract: The present invention relates to an improved process for producing a liquid herbicidal composition of single isomer of glufosinate salt and/or agronomically acceptable salts thereof.

WO 2022/185243 A1

PROCESS FOR PRODUCING A LIQUID HERBICIDAL COMPOSITION

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a process for producing a liquid herbicidal composition of glufosinate isomer or its salt. More particularly, the present invention relates to an improved process for producing a liquid herbicidal composition of L-glufosinate and/or agronomically acceptable salts thereof.

BACKGROUND OF THE INVENTION

Glufosinate is non-selective herbicide belonging to the group of organophosphate which has been widely used around the world. It is generally used in form of ammonium salt for total vegetation control and to control growth of weeds and grasses. Glufosinate is used as a racemic mixture of L- & D- glufosinate. However, it is well known that L-glufosinate i.e. (S)-2-amino-4-(hydroxy(methyl)phosphonoyl)butanoic acid) is much more potent than D-glufosinate.

Many patent and non-patent literature related to composition of L-glufosinate salt known in prior art, wherein a general process for preparation of composition comprising admixing the active ingredient with one or more adjuvants, such as diluents, extenders, carriers, surfactants, organic solvents, humectants, or conditioning agents, to provide a composition in the form of a finely-divided particulate solid, pellet, solution, dispersion, or emulsion are disclosed. Most of these formulations are in water. However, these prior arts are silent regarding stepwise procedure carried out for production of composition and the shortcomings faced during formulating the composition.

It is well known that glufosinate salt is readily soluble in water, however while producing liquid herbicide composition of L-glufosinate salt, the inventors of

present invention noticed that L-glufosinate salt on contact with water forms a rock-solid lump which has low solubility. This rock-solid lump formation makes the process for producing homogenous composition difficult and cumbersome. The inventors of the present invention have discussed these shortcomings in detail and have skilfully overcome it with an improved process for producing a liquid herbicidal composition of L-glufosinate salt.

OBJECT OF THE INVENTION

Accordingly, it is an object of the present invention to provide a simple and improved process for producing a liquid herbicidal composition of glufosinate isomer or its salt.

It is an object of the present invention to provide a simple and improved process for producing a liquid herbicidal composition of L-glufosinate or its salt.

It is another object of present invention to provide a process for producing a liquid herbicidal composition of L-glufosinate salt wherein the formation of rock-solid lump is avoided.

It is yet another object of present invention to provide a simple, cost-effective and industrially viable process for producing a liquid herbicidal composition of L-glufosinate salt.

SUMMARY OF THE INVENTION

According to an aspect of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises single isomer of glufosinate salt and at least one organic solvent or a liquid surfactant.

According to another aspect of present invention, there is provided an improved process for producing a liquid herbicidal composition of L-glufosinate salt comprising:

forming a dispersion in the absence of water wherein the dispersion comprises L-glufosinate salt and at least one organic solvent or a liquid surfactant; and

admixing the dispersion with water to obtain a liquid herbicidal composition which is free from rock-solid lumps.

According to another aspect of present invention, there is provided an improved process for producing a liquid herbicidal composition of single isomer of glufosinate salt by avoiding the formation of rock-solid lump comprising:

admixing water with a dispersion wherein the dispersion comprises single isomer glufosinate salt and at least one organic solvent or a liquid surfactant.

In an embodiment, the dispersion does not contain water.

According to another aspect of present invention, there is provided an improved process for producing a liquid herbicidal composition of L-glufosinate salt by avoiding the formation of rock-solid lump, said process comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate salt and at least one organic solvent or a liquid surfactant.

In an embodiment, the dispersion does not contain water.

DESCRIPTION OF THE FIGURES

Figure 1 shows graphical presentation of the rock-solid lump formed when the conventional approach was used for producing a liquid herbicidal composition.

DESCRIPTION OF THE INVENTION

Those skilled in art will be aware that invention described herein is subject to variations and modifications other than those specifically described. It is to be understood that the invention described herein includes all such variations and

modifications. The invention also includes all such steps, features, compositions and methods referred to or indicated in this specification, individually or collectively, and any and all combinations of any two or more said steps or features.

Definitions:

For convenience, before further description of the present invention, certain terms employed in the specification, examples are described here. These definitions should be read in light of the remainder of the disclosure and understood as by a person of skill in the art. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by a person of ordinary skill in the art. The terms used throughout this specification are defined as follows, unless otherwise limited in specific instances.

The terms used herein are defined as follows.

As used herein, “a,” “an,” “the,” and “at least one” do not denote a limitation of quantity and are intended to cover both the singular and plural, unless the context clearly indicates otherwise. For example, "an element" has the same meaning as “at least one element," unless the context clearly indicates otherwise. The terms first, second etc. as used herein are not meant to denote any particular ordering, but simply for convenience to denote a plurality of, for example, layers. As used herein, the terms “comprising” “including,” “having,” “containing,” “involving,” and the like are to be understood to be open-ended, i.e., to mean “including” but not limited to, unless otherwise noted. “About” or “approximately” as used herein is inclusive of the stated value and means within an acceptable range of deviation for the particular value as determined by one of ordinary skill in the art, considering the measurement in question and the error associated with measurement of the particular quantity (i.e., the limitations of the measurement system). For example, “about” can mean within one or more standard deviations, or within ± 10% or ± 5% of the stated value. The use of any and all examples, or exemplary language (e.g., “such as”), is intended merely to better illustrate the invention and does not pose a

limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention as used herein.

In any aspect or embodiment described hereinbelow, the phrase comprising may be replaced by the phrases "consisting of" or "consisting essentially of" or "consisting substantially of". In these aspects or embodiment, the composition described includes or comprises, or consists of, or consists essentially of, or consists substantially of the specific components recited therein, to the exclusion of other ingredients or excipients not specifically recited therein.

As used herein the term 'composition' is used interchangeably with the term 'formulation'.

The term 'room temperature' unless stated otherwise, essentially means temperature in range of 20-35 °C

The term 'dispersion' unless stated otherwise, essentially means system in which distributed particles of active ingredient are dispersed in a continuous phase of another material. The term 'dispersion' is used interchangeably with the term 'slurry'.

The term 'processing time' unless stated otherwise, essentially means the time required for completing a process of preparation of finished formulation from raw material.

Glufosinate has the chemical name 2-amino-4-[hydroxy(methyl)phosphoryl]butanoic acid. L-glufosinate, also known commercially as glufosinate-P, is an isomer of glufosinate.

Inventors of present invention found that even though racemic glufosinate salt is readily soluble in water, the same was not true for single isomer of glufosinate salt.

It was observed that while preparing soluble liquid formulation of L-glufosinate salt, when L-glufosinate salt is brought in contact with water the solubility of L-

glufosinate drastically reduces due to formation of rock-solid lump. This unpredicted decrease in solubility and formation of rock-solid lump not only increases the processing time required to obtain final product but also can damage the equipment used for preparing said formulation. Thus, making the large-scale production time consuming, cumbersome and hence, high-priced.

On further investigating, it was found that the formulation prepared using this rock-solid lump may lead to uneven distribution on plant surfaces thereby adversely impacting the bioavailability and efficiency of the formulation prepared. Hence, it was desirable to develop a process wherein during processing of formulation the solubility of L-glufosinate is not affected and the soluble liquid composition is prepared in shorter duration.

Inventors of present invention skilfully designed a process for producing a liquid herbicidal composition wherein the formation of rock-solid lump is avoided to a great extent, the processing is not only fast, but also reliable and inexpensive.

According to an aspect of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises single isomer of glufosinate salt and at least one organic solvent or a liquid surfactant.

In an embodiment, the dispersion is substantially free of water, or does not contain water.

In an embodiment, the process for producing a liquid herbicidal composition comprises forming a dispersion in the absence of water wherein the dispersion comprises single isomer of glufosinate salt and at least one organic solvent or a liquid surfactant.

In an embodiment of present invention, the dispersion comprises of single isomer of glufosinate salt and at least one organic solvent.

In an embodiment of the present invention, the single isomer of glufosinate salt is L-glufosinate salt or D-glufosinate salt.

The salt such as monosodium salt, disodium salt, monopotassium salt, dipotassium salt, calcium salt, ammonium salt, $-NH_3(CH_3)^+$ salt, $-NH_2(CH3)_2^+$ salt, $-NH(CH_3)_3^+$salt, $-NH(CH_3)_2(C_2H_4OH)^+$ salt, $-NH_2(CH_3)(C_2H_4OH)^+$ salt and the like can be used.

In an embodiment of the present invention, ammonium salt of L-glufosinate salt is used.

In an embodiment of present invention, the organic solvent used may be selected from but not limited to a water miscible polar/non-polar or a water immiscible polar/non-polar solvent, for example; alkyl esters of phthalic acid and trimellitic acid; aromatic hydrocarbons such as xylene, solvesso-100, solvesso-150, solvesso-200, alkyl benzenes; methylnaphthalene; mixtures of aromatics aliphatic or cycloaliphatic hydrocarbon such as hexanes and heptanes; phthalates; ketones such as cyclohexanone, 2-octanone or acetophenone, methyl isobutyl ketone, saturated or unsaturated cyclic ketones such as isophorone; chlorinated hydrocarbons; vegetable oils and modified vegetable oils; glycols and their derivatives; aliphatic alcohols, alkoxy aliphatic alcohols or mixtures of such two or more solvents.

Other solvents can be alkylene carbonates (like propylene carbonate), alkyl amides, and esters such as alkyl esters of monocarboxylic acids and dicarboxylic acid, esteramides, cyclic ethers such furan and its derivatives or mixtures thereof.

Preferably, vegetable oils such as castor oil and modified vegetable oils, glycols and their derivatives such as glycerin, propylene glycol, dipropylene glycol, polypropylene glycol, monoethylene glycol, diethylene glycol, polyethlene glycol 400, polyethlene glycol 300, polyethlene glycol 200, alkoxy aliphatic alcohols such as 1-methoxy-2-propanol, 2-butoxy ethanol, esters such as methyl ester of C_8-C_{20} fatty acids or mixture thereof.

More preferably, the organic solvent used is selected from group comprising of glycerine, propylene glycol, diethylene glycol, polyethlene glycol 400, polyethlene glycol 300, polyethlene glycol 200, 1-methoxy-2-propanol, 2-butoxy ethanol or mixture thereof.

In an embodiment of present invention, the organic solvent used is propylene glycol.

In another embodiment of present invention, the organic solvent used is polyethlene glycol 300.

In yet another embodiment of present invention, the organic solvent used is 2-butoxy ethanol.

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate ammonium salt and propylene glycol.

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate ammonium salt and 2-butoxy ethanol.

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate ammonium salt and PEG 300.

In another embodiment of present invention, more than one organic solvent is used.

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate ammonium salt, propylene glycol and 2-butoxy ethanol.

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate ammonium salt, propylene glycol, 2-butoxy ethanol and PEG 300.

In another embodiment of present invention, the dispersion comprises of a single isomer of glufosinate salt and a liquid surfactant.

In another embodiment of present invention, the liquid surfactant is selected from anionic, cationic or zwitterionic and/or non-ionic surfactants

The liquid surfactant is selected from the group comprising of alcohol ethoxylate, alkyl ether phosphate, alkyl aryl ether phosphate, sulfosuccinate and its derivatives, or mixtures thereof

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate ammonium salt and alkyl ether phosphate.

According to yet another embodiment of present invention, the process is carried out at temperature below 100°C, preferably at temperature of about 10°C to 50°C.

According to yet another embodiment of present invention, the processing time required for obtaining the liquid herbicidal composition is less than 2 hours, preferably less than 1.5 hours.

According to another embodiment of present invention, there is provided a liquid herbicidal composition comprising

a) single isomer of glufosinate salt;

b) at least one organic solvent; or a liquid surfactant; and

c) water

wherein the said liquid herbicidal composition is prepared through an improved process comprising admixing water with a dispersion; and wherein the dispersion comprises single isomer glufosinate salt; and at least one organic solvent or a liquid surfactant.

According to an embodiment of present invention, the liquid herbicidal composition comprises single isomer of glufosinate salt from about 1% to about 95% (by weight), preferably it is from about 5% to 50% (by weight) of the total weight of the liquid herbicidal composition.

According to an embodiment of present invention, the liquid herbicidal composition comprises organic solvent/s from about of 1% about 40% (by weight), preferably it is from about 1% to 30% (by weight) of the total weight of the liquid herbicidal composition.

According to an embodiment of present invention, liquid herbicidal composition comprises surfactant/s from about 1% to about 60% (by weight),preferably it is from about 10% to 50% (by weight) of the total weight of the liquid herbicidal composition.

According to yet another embodiment of present invention, there is provided a liquid herbicidal composition comprising

a) L-glufosinate ammonium salt;

b) at least one organic solvent; and

c) water

wherein the said liquid herbicidal composition is prepared through an improved process comprising admixing water with a dispersion; and wherein the dispersion comprises single isomer glufosinate salt and at least one organic solvent.

According to yet another embodiment of present invention, there is provided a liquid herbicidal composition comprising

a) L-glufosinate ammonium salt;
b) at least one organic solvent; and
c) water

wherein the said liquid herbicidal composition is prepared through an improved process comprising admixing water with a dispersion; and wherein the dispersion comprises single isomer glufosinate salt and at least one organic solvent selected from group comprising of glycerine, propylene glycol, diethylene glycol, polyethlene glycol 400, polyethlene glycol 300, polyethlene glycol 200, 1-methoxy-2-propanol, 2-butoxy ethanol.

According to another embodiment of present invention, there is provided a liquid herbicidal composition comprising

a) L-glufosinate ammonium salt;
b) a liquid surfactant; and
c) water

wherein the said liquid herbicidal composition is prepared through an improved process comprising admixing water with a dispersion; and wherein the dispersion comprises single isomer glufosinate salt and a liquid surfactant.

According to another embodiment of present invention, there is provided a liquid herbicidal composition comprising

a) L-glufosinate ammonium salt;
b) a liquid surfactant;
c) water

wherein the said liquid herbicidal composition is prepared through an improved process comprising admixing water with a dispersion; and wherein the dispersion comprises single isomer glufosinate salt and a liquid surfactant selected from the group comprising of alcohol ethoxylate, alkyl ether phosphate, alkyl aryl ether phosphate , sulfosuccinate and its derivatives, or mixtures thereof.

According to another aspect of present invention, there is provided an improved process for producing a liquid herbicidal composition comprising of single isomer of glufosinate salt by avoiding the formation of rock-solid lump, said process comprising:

admixing water with a dispersion wherein the dispersion comprises single isomer glufosinate salt and at least one organic solvent or a liquid surfactant.

In an embodiment, the dispersion is substantially free of water, or does not contain water.

In an embodiment of the present invention, the single isomer of glufosinate salt is L-glufosinate salt or D-glufosinate salt.

According to another aspect of the present invention, there is provided an improved process for producing a liquid herbicidal composition of L-glufosinate salt by avoiding the formation of rock-solid lump, said process comprising:

admixing water with a dispersion wherein the dispersion comprises L-glufosinate salt and at least one organic solvent or a liquid surfactant.

In an embodiment, the dispersion is substantially free of water, or does not contain water.

According to an embodiment of present invention, the L-glufosinate salt such as ammonium salt, monosodium salt, disodium salt, monopotassium salt, dipotassium salt, calcium salt or the likes are used.

In yet another embodiment of present invention, the L-glufosinate salt used is L-glufosinate ammonium salt.

According to an embodiment of present invention, the L-glufosinate salt is mixed with at least one organic solvent to get a dispersion, said dispersion is either added to water or water is added to the dispersion to obtain the desired liquid herbicidal composition.

According to an embodiment of present invention, the L-glufosinate salt is mixed with at least one liquid surfactant in the absence of water to get a dispersion, said dispersion is either added to water or water is added to the dispersion to obtain the desired liquid herbicidal composition.

In an embodiment, the dispersion is substantially free of water, or does not contain water.

The process of the present invention does not involve any direct contact of L-glufosinate salt with water and therefore the formation of rock-solid lump is avoided. This is done by preparing a dispersion of L-glufosinate salt with an organic solvent or liquid surfactant first in the absence of water and not contacting L-glufosinate salt with water in initial phase.

Furthermore, said dispersion is either added to water or water is added to the dispersion to obtain the desired liquid herbicidal composition.

This change in sequence of addition reduced the investments in time and equipment thus the cost of production on large scale is also reduced.

According to another aspect of the present invention, there is provided an improved process for producing a liquid herbicidal composition, said process comprising,

admixing water with a dispersion wherein the dispersion comprises D-glufosinate salt and at least one organic solvent or a liquid surfactant.

In an embodiment, the dispersion is substantially free of water, or does not contain water.

According to an embodiment of present invention, the D-glufosinate salt used is ammonium, potassium, calcium or sodium salt.

According to an embodiment of the present invention, liquid herbicidal composition further comprises a other active ingredients selected from various classes of pesticides including fungicides, insecticides, herbicides, plant regulators, defoliants, desiccants, biostimulants and nitrogen stabilizers, preferably with herbicides or mixtures thereof.

According to an embodiment of the present invention, the other active ingredient is herbicide.

The herbicide used, is selected from but not limited to, diphenyl ether herbicides such as oxyfluorfen, acifluorfen and its salts, lactofen and its salts, fomesafen and its salts; Pyrimidinyloxybenzoic analogue herbicides such as pyrithiobac sodium, bispyribac sodium; Organophosphrous based herbicides such as glyphosate and its salts, bilanafos and its salts, bialaphos and its salts; Bipyridinium herbicides such as paraquat and diquat and salts thereof; aryloxyalkanoic acid herbicides such as 2, 4-D and its salts and esters, MCPA, MCPB and their salts; aryloxyphenoxypropionic herbicides such as haloxyfop, isomers and esters, clodinafop and its esters; Pyridine herbicides such as triclopyr, picloram, aminopyralid and salts thereof,; Aromatic herbicides such as dicamba, 2,3,6-TBA, tricamba and their salts; Pyridinecarboxylic acid herbicides such as clopyralid; Imidazolinones selected from imazameth, imazamethabenz, imazamox, imazapic, imazapyr, imazaquin, imazethapyr; herbicides such as sulfonyl urea herbicides such as flazasulfuron, rimsulfuron, bensulfuron, ethoxysulfuron, mesosulfuron, oxasulfuron, pyrazosurfuron-ethyl and their salts; cyclohexanedioneoxime herbicides such as clethodim and its salts, chloroacetamide herbicide such as metolachlor and its salts and isomers, phenyl phthalimide herbicides such as flumioxazin and its salts, mesotrione, dinitroaniline herbicides such as oryzalin, pendimethalin, profluralin, trifluralin and its salts, bicyclic dicarboxylic acid herbicides such as endothal and its salts or mixtures of such herbicides.

According to another embodiment of present invention, liquid herbicidal composition comprises other active ingredient from about 1% to about 60% (by weight) of the total weight of the liquid herbicidal composition.

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein said dispersion comprises
single isomer of glufosinate salt;
at least one organic solvent or a liquid surfactant; and
another active ingredient selected from fungicides, insecticides, herbicides, plant regulators, defoliants, desiccants, biostimulants and nitrogen stabilizers, or mixtures thereof.

According to an embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein said dispersion comprises
single isomer of glufosinate salt;
at least one organic solvent or a liquid surfactant; and
another herbicide.

According to another embodiment of the present invention, there is provided an improved process for producing a liquid herbicidal composition comprising:

admixing water with a dispersion wherein said dispersion comprises
single isomer of glufosinate salt;
at least one organic solvent or a liquid surfactant; and
another herbicide selected from the group comprising of, but not limited to aryloxyalkanoic acid herbicides such as 2, 4-D and its salts and esters, MCPA, MCPB and their salts; or an organophosphrous based herbicides such as glyphosate and its salts, bialaphos and its salts and the likes.

According to an embodiment of the present invention, the composition prepared by present process may further comprise other agronomically suitable excipients such

as surfactants, solvent, fertilizer, pH modifiers, crystallization inhibitors, viscosity modifiers, suspending agents, spray droplet modifiers, pigments, antioxidants, foaming agents, light-blocking agents, compatibilizing agents, antifoam agents, sequestering agents, neutralizing agents, corrosion inhibitors, dyes, odorants, spreading agents, penetration aids, micronutrients, emollients, lubricants, sticking agents, dispersing agents, thickening agents, freezing point depressants, antimicrobial agents, and the like.

According to an embodiment of present invention, the dispersion comprising single isomer of glufosinate salt and at least one organic solvent may further comprise a surfactant.

The surfactants used in the process may be selected from anionic, cationic or zwitterionic and/or non-ionic surface-active compounds (surfactants) or combinations thereof.

Examples of anionic surfactants include: anionic derivatives of fatty alcohols having 10-24 carbon atoms in the form of ether carboxylates, sulfonates, sulfates, and phosphates, and their inorganic salts (e.g., alkali metal and alkaline earth metal salts) and organic salts (e.g., salts based on amine or alkanolamine); anionic derivatives of copolymers consisting of EO(ethylene oxide), PO (propylene oxide) and/or BO (butylene oxide) units, in the form of ether carboxylates, sulfonates, sulfates, and phosphates, and their inorganic salts (e.g., alkali metal and alkaline earth metal salts) and organic salts (e.g., salts based on amine or alkanolamine); derivatives of alkylene oxide adducts of alcohols, in the form of ether carboxylates, sulfonates, sulfates and phosphates, and their inorganic salts (e.g., alkali metal and alkaline earth metal salts) and organic salts (e.g., salts based on amine or alkanolamine); derivatives of fatty acid alkoxylates, in the form of ether carboxylates, sulfonates, sulfates and phosphates, and their inorganic salts (e.g., alkali metal and alkaline earth metal salts) and organic salts (e.g., salts based on amine or alkanolamine); alkyl ether phosphate, sulfosuccinate & its derivatives, sulfosuccinate half ester, alkyl sulfosuccinate mono ester and diester salts.

Examples of cationic or zwitterionic surfactants may be selected from alkylene oxide adducts of fatty amines, quaternary ammonium compounds having 8 to 22 carbon atoms (C_8-C_{22}), surface-active zwitterionic compounds such as taurides, betaines and sulfobetaines.

Examples of non-ionic surfactants are: alkylpolyglycosides, alkyl glucamide, alkyl amine oxides having C_8 to C_{20} carbon atoms, alcohol ethoxylate, , fatty acid methyl ester, sorbitan ester and ethoxylated sorbitan ester, ethoxylated alkylphenol, ethoxylated tristyrylphenol and alkyl amide, fatty alcohols having 10-24 carbon atoms with 0-60 EO and/or 0-20 PO and/or 0-15 BO in any order; fatty acid alkoxylates and triglyceride alkoxylates; fatty acid amide alkoxylates; alkylene oxide adducts of alkynediols; sugar derivatives such as amino sugars and amido sugars; polyacrylic and polymethacrylic derivatives; polyamides such as modified gelatins or derivatized polyaspartic acid; surfactant polyvinyl compounds such as modified PVP; polyol-based alkylene oxide adducts; polyglycerides and derivatives thereof.

In an aspect the present invention provides use of present composition prepared according to the present invention as herbicide to control harmful/undesired plants.

In an embodiment the present invention provides use of liquid composition comprising L-glufosinate or its salts and/or other herbicide optionally with other auxiliary ingredients to control harmful/undesired plants.

The abovementioned compositions provide effective weed control to keep agricultural crops free from undesired competing plants and thus to safeguard and/or increase the yields from the qualitative and quantitative point of view.

The compositions of the present invention maybe used to target weeds among the crops such corn, rice, wheat, barley, rye, oat, sorghum, cotton, soybean, peanut, buckwheat, beet, rapeseed, sunflower, sugar cane, tobacco, etc.; vegetables: solanaceous vegetables such as eggplant, tomato, pimento, pepper, potato, etc., cucurbit vegetables such as cucumber, pumpkin, zucchini, water melon, melon, squash, etc., cruciferous vegetables such as radish, white turnip, horseradish,

kohlrabi, Chinese cabbage, cabbage, leaf mustard, broccoli, cauliflower, etc., asteraceous vegetables such as burdock, crown daisy, artichoke, lettuce, etc, liliaceous vegetables such as green onion, onion, garlic, and asparagus, ammiaceous vegetables such as carrot, parsley, celery, parsnip, etc., chenopodiaceous vegetables such as spinach, Swiss chard, etc., lamiaceous vegetables such as Perilla frutescens, mint, basil, etc, strawberry, sweet potato, Dioscorea japonica, colocasia, etc., flowers, foliage plants, turf grasses, fruits: pome fruits such apple, pear, quince, etc, stone fleshy fruits such as peach, plum, nectarine, Prunus mume, cherry fruit, apricot, prune, etc., citrus fruits such as orange, lemon, rime, grapefruit, etc., nuts such as chestnuts, walnuts, hazelnuts, almond, pistachio, cashew nuts, macadamia nuts, etc. berries such as blueberry, cranberry, blackberry, raspberry, etc., grape, kaki fruit, olive, plum, banana, coffee, date palm, coconuts, etc. , tea, nut and vine crops, crops such as coconut, coffee, cocoa trees other than fruit trees; tea, mulberry, flowering plant, trees such as ash, birch, dogwood, Eucalyptus, Ginkgo biloba, lilac, maple, Quercus, poplar, Judas tree, Liquidambar formosana, plane tree, zelkova, Japanese arborvitae, fir wood, hemlock, juniper, Pinus, Picea, and Taxus cuspidate, etc.

The target weeds may be selected from Alopecurus myosuroides Huds. (blackgrass, ALOMY), Amaranthus palmeri (Palmer amaranth, AMAPA) Amaranthus viridis (slender amaranth, AMAVI), Avena fatua (wild oat, AVEFA), Brachiaria decumbens Stapf. or Urochloa decumbens (Stapf), Brachiaria brizantha or Urochloa brizantha, Brachiaria platyphylla (Groseb.) Nash or Urochloa platyphylla (broadleaf signalgrass, BRAPP), Brachiaria plantaginea. or Urochloa plantaginea (alexandergrass, BRAPL), Cenchrus echinatus (southern sandbur, CENEC), Digitaria horizontalis Willd. (Jamaican crabgrass, DIGHO), Digitaria insularis (sourgrass, TRCIN), Digitaria sanguinalis (large crabgrass, DIGSA), Echinochloa crus-galli (barnyardgrass, ECHCG), Echinochloa colonum (junglerice, ECHCO), Eleusine indica Gaertn. (goosegrass, ELEIN), Lolium multiflorum Lam. (Italian ryegrass, LOLMU), Panicum dichotomiflorum Michx. (fall panicum, PANDI), Panicum miliaceum L. (wild-proso millet, PANMI), Sesbania exaltata (hemp sesbania, SEBEX), Setaria faberi Herrm. (giant foxtail, SETFA), Setaria viridis

(green foxtail, SETVI), Sorghum halepense (Johnsongrass, SORHA), Sorghum bicolor, Moench ssp., Arundinaceum (shattercane, SORVU), Cyperus esculentus (yellow nutsedge, CYPES), Cyperus rotundus (purple nutsedge, CYPRO), Abutilon theophrasti (velvetleaf, ABUTH), Amaranthus species (pigweeds and amaranths, AMASS), Ambrosia artemisiifolia L. (common ragweed, AMBEL), Ambrosia psilostachya DC. (western ragweed, AMBPS), Ambrosia trifida (giant ragweed, AMBTR), Anoda cristata (spurred anoda, ANVCR), Asclepias syriaca (common milkweed, ASCSY), Bidens pilosa (hairy beggarticks, BIDPI), Borreria species (BOISS), Borreria alata or Spermacoce alata Aubl. or Spermacoce latifolia (broadleaf buttonweed, BOILF), Chenopodium album L. (common lambsquarters, CHEAL), Cirsium arvense (Canada thistle, CIRAR), Commelina benghalensis (tropical spiderwort, COMBE), Datura stramonium (jimsonweed, DATST), Daucus carota (wild carrot, DAUCA), Euphorbia heterophylla (wild poinsettia, EPHHL), Euphorbia hirta or Chamaesyce hirta (garden spurge, EPHHI), Euphorbia dentata Michx. (toothed spurge, EPHDE), Erigeron bonariensis or Conyza bonariensis (hairy fleabane, ERIBO), Erigeron canadensis or Conyza canadensis (horseweed, ERICA), Conyza sumatrensis (tall fleabane, ERIFL), Helianthus annuus (common sunflower, HELAN), Jacquemontia tamnifolia (smallflower morningglory, IAQTA), Ipomoea hederacea (ivyleaf morningglory, IPOHE), Ipomoea lacunosa (white morningglory, IPOLA), Lactuca serriola (prickly lettuce, LACSE), Portulaca oleracea (common purslane, POROL), Richardia species (pusley, RCHSS), Salsola tragus (Russian thistle, SASKR), Sida species (sida, SIDSS), Sida spinosa (prickly sida, SIDSP), Sinapis arvensis (wild mustard, SINAR), Solanum ptychanthum (eastern black nightshade, SOLPT), Tridax procumbens (coat buttons, TRQPR), Rumex dentatus (RUMDE)or Xanthium strumarium (common cocklebur, XANST).

In another embodiment the present invention provides a method of controlling undesired plants by applying the present compositions comprising L-glufosinate prepared according to the present invention.

In an embodiment, the composition of the present invention may be applied to the locus either simultaneously or sequentially, such that the herbicide may be applied in a tank mix or as a pre-mixed composition.

In an embodiment, the present invention may be applied either pre or post emergent.

The method of control of the present invention may be carried out by spraying the suggested tank mixes, or the individual herbicides may be formulated as a kit-of-parts containing various components that may be mixed as instructed prior to spraying.

According to an embodiment of the present invention, there is provided a kit comprising present liquid composition as an herbicide to control harmful plants.

The process for producing a liquid herbicidal composition according to the invention is ascertained by the experiments as exemplified below. These examples are merely illustrations and are not to be understood as limiting the scope and underlying principles of the invention in any way. Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art from the following examples and foregoing description.

Examples:

Example 1:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	25.77
Propylene Glycol	17
2-butoxy ethanol	6.0
Potassium chloride	0.5
Alkyl polyglucoside	12
Alkyl ether phosphate	12
Alkyl amine oxide	24

Water	Q.S.
Total	100

L-glufosinate ammonium, propylene glycol and 2-butoxy ethanol were mixed under slow agitation in formulation vessel to get a dispersion. To the dispersion was then added alkyl polyglucoside, alkyl ether phosphate, alkyl amine oxide and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 90 minutes at 20-35°C to get clear homogenous liquid herbicidal composition.

Example 2:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	13.7
Propylene Glycol	17
2-butoxy ethanol	6.0
Potassium chloride	0.5
Alkyl polyglucoside	15
Water	Q.S.
Total	100

L-glufosinate ammonium, propylene glycol and 2-butoxy ethanol were mixed under slow agitation at 20-35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion was then added alkyl polyglucoside and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 90 minutes at 20-35°C to get clear homogenous liquid herbicidal composition.

Example 3:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	Composition (% w/w)
L-glufosinate ammonium	13.7
Propylene Glycol	20
2-butoxy ethanol	4.5
Potassium chloride	0.5
Alkyl amine oxide	24
Water	Q.S.
Total	100

The composition was prepared according to process provided in Example 1 or 2.

Example 4:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	Composition (% w/w)
L-glufosinate ammonium	18.7
PEG 300	3.0
Propylene Glycol	17.0
2-butoxy ethanol	5.0
Potassium chloride	1.25
Alkyl polyglucoside	15
Water	Q.S.
Total	100

L-glufosinate ammonium and propylene glycol were mixed under slow agitation at 20-35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion was then added PEG 300, 2-butoxy ethanol , alkyl polyglucoside and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 90 minutes at 20-35°C to get clear homogenous liquid herbicidal composition.

Example 5:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	13.7
Propylene Glycol	20
2-butoxy ethanol	4.5
Potassium chloride	0.5
Alkyl ether phosphate	15
Water	Q.S.
Total	100

L-glufosinate ammonium and alkyl ether phosphate were mixed under slow agitation at 20-35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion was then added propylene glycol, 2-butoxy ethanol and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 90 minutes at 20-35°C to get clear homogenous liquid herbicidal composition.

Example 6:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	14.06
Propylene Glycol	17
2-butoxy ethanol	6.0
Potassium chloride	0.5
Alkyl polyglucoside	15
Water	Q.S.
Total	100

L-glufosinate ammonium, propylene glycol and 2-butoxy ethanol were mixed under slow agitation at 20°C for 10-30 minutes in formulation vessel to get a

dispersion. To the dispersion was then added alkyl polyglucoside and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 120 minutes at 20°C to get clear homogenous liquid herbicidal composition

Example 7:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	14.06
Propylene Glycol	20
Potassium chloride	0.5
Alkyl ether phosphate	15
Water	Q.S.
Total	100

Method A:

L-glufosinate ammonium and propylene glycol were mixed under slow agitation at 35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion was then added alkyl ether phosphate and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 120 minutes at 35°C to get clear homogenous liquid herbicidal composition.

Method B:

L-glufosinate ammonium and alkyl ether phosphate were mixed under slow agitation at 35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion was then added propylene glycol and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 120 minutes at 35°C to get clear homogenous liquid herbicidal composition.

Example 8:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	Composition (% w/w)
L-glufosinate ammonium	19.27
polyethlene glycol 300	3.0
Propylene Glycol	17
2-butoxy ethanol	5.0
Potassium chloride	1.25
Alkyl glucamide	20
Water	Q.S.
Total	100

L-glufosinate ammonium, polyethlene glycol 300, propylene glycol and 2-butoxy ethanol were mixed under slow agitation at 35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion was then added alkyl glucamide and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 120 minutes at 35°C to get clear homogenous liquid herbicidal composition.

Example 9:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	Composition (% w/w)
L-glufosinate ammonium	14.06
Propylene Glycol	17
2-butoxy ethanol	6
Potassium chloride	0.5
Alkyl polyglucoside	15
Water	Q.S.
Total	100

L-glufosinate ammonium, propylene glycol and 2-butoxy ethanol were mixed under slow agitation at 40°C for 10-30 minutes in formulation vessel to get a

dispersion. To the dispersion was then added alkyl polyglucoside and potassium chloride. To the resultant mixture water was added and the mixture is agitated for 60 minutes at 40°C to get clear homogenous liquid herbicidal composition

Example 10:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	14.06
Propylene Glycol	20
2-butoxy ethanol	4.50
Potassium chloride	0.5
Alkyl amine oxide	24
Water	Q.S.
Total	100

L-glufosinate ammonium, propylene glycol and 2-butoxy ethanol were mixed under slow agitation for 10-30 mins at 35°C to get a dispersion. To the dispersion was then added alkyl amine oxide and potassium chloride under agitation. To the resultant mixture water was added and the mixture is agitated for 120mins at 35°C to get clear homogenous liquid herbicidal composition

Example 11:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	19.27
Propylene Glycol	20
Water	Q.S.
Total	100

L-glufosinate ammonium and propylene glycol were mixed under slow agitation at 35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion

was then added water and the mixture is agitated for 120 minutes at 35°C to get clear homogenous liquid herbicidal composition.

Example 12:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**
L-glufosinate ammonium	26.04
Alkyl ether phosphate	25
Water	Q.S.
Total	100

L-glufosinate ammonium and alkyl ether phosphate were mixed under slow agitation at 20-35°C for 10-30 minutes in formulation vessel to get a dispersion. To the dispersion was then added water and the mixture is agitated for 120 minutes at 35°C to get clear homogenous liquid herbicidal composition.

Example 13 & 14:

A liquid herbicidal composition in accordance with present invention was prepared:

Ingredients	**Composition (% w/w)**	
	Example 13	Example 14
2,4-D amine salt	-	18
Glyphosate IPA salt	15	-
L-Glufosinate ammonium (Technical 96%)	14.2	18
Alkyl ether phosphate	15	15
Alkyl polyglucoside	8	10
C_{10} alkylamine oxide	10	10
C_{13}-C_{15} alkyl amine oxide	10	-
Propylene glycol	17	15
Potassium chloride	0.25	0.25

2-butoxy ethanol	10	10
Water	Q.S.	Q.S.
Total	100	100

L-glufosinate ammonium and alkyl ether phosphate were mixed under slow agitation in formulation vessel to get a dispersion. To the dispersion alkyl polyglucoside, alkyl amine oxide, propylene glycol, 2-butoxy ethanol and potassium chloride were added followed by addition of 2,4-D amine or Glyphosate IPA. To the resultant mixture water was added and the mixture required agitation for 100 minutes at 20-35°C to get clear homogenous liquid herbicidal composition.

Comparative Example 1:

In order to demonstrate the advantages of the inventive process, the formulation provided in Example 1 was prepared by using conventional process (US5491125). L-glufosinate ammonium was added to water under agitation in formulation vessel. At this stage, it was observed that rock-solid lump was formed and the solubility of L-glufosinate ammonium salt decreased drastically. To this mixture was then added propylene glycol, 2-butoxy ethanol, alkyl polyglucoside, alkyl ether phosphate, alkyl amine oxide and potassium chloride under agitation. The mixture required agitation for 200 minutes at 20-35°C to get clear homogenous liquid herbicidal composition.

Figure 1 depicts a photograph of the rock-solid lump obtained during the process.

It was observed that the processing time for production of composition is dependent on solubility of L-glufosinate salt. Usually when conventional process is followed, L-glufosinate salt is first contacted with water and the processing time for production of formulation is increased from 90 minutes to 200 minutes. The present invention mainly provides solution to these three problems namely,

1. Formation of rock-solid lump during formulating the finished product;

2. Long processing time required due to reduced solubility of rock-solid lump formed; and
3. Reduced bioavailability and efficiency of the formulation.

Claims:

1. A process for producing a liquid herbicidal composition comprising:

   admixing water with a dispersion wherein said dispersion comprises single isomer of glufosinate salt; and at least one organic solvent or a liquid surfactant.

2. The process as claimed in claim 1, wherein said dispersion is substantially free of water.

3. The process as claimed in claim 1, wherein said single isomer of glufosinate salt is L-glufosinate salt or D-glufosinate salt.

4. The process as claimed in claim 3, wherein said glufosinate salt used is selected from the group comprising of ammonium salt, monosodium salt, disodium salt, monopotassium salt, dipotassium salt or calcium salt.

5. The process as claimed in claim 1, wherein said dispersion comprises of single isomer of glufosinate salt and at least one organic solvent.

6. The process as claimed in claim 5, wherein said organic solvent is selected from a polar or a non-polar solvent.

7. The process as claimed in claim 5, wherein said organic solvent used is selected from the group comprising of glycerine, propylene glycol, diethylene glycol, polyethlene glycol 400, polyethlene glycol 300, polyethlene glycol 200, 1-methoxy-2-propanol, 2-butoxy ethanol or mixture thereof.

8. The process as claimed in claim 1, wherein said dispersion comprises of single isomer of glufosinate salt and a liquid surfactant.

9. The process as claimed in claim 8, wherein said liquid surfactant is selected from anionic, cationic, zwitterionic and/or non-ionic surfactants.

10. The process as claimed in claim 8, wherein said liquid surfactant is selected from the group comprising of alcohol ethoxylate, alkyl ether phosphate, alkyl aryl ether phosphate, sulfosuccinate and its derivatives, or mixtures thereof

11. The process as claimed in claim 1, wherein the process is carried out at temperature below 100°C.

12. The process as claimed in claim 1, wherein the processing time required for obtaining the liquid herbicidal composition is less than 2 hours.

13. The process as claimed in claim 1, wherein said composition further comprises another active ingredient/s selected from fungicides, insecticides, herbicides, plant regulators, defoliants, desiccants, biostimulants and nitrogen stabilizers, or mixtures thereof.

14. The process as claimed in claim 13, wherein said another active ingredient is a herbicide.

15. A process for producing a liquid herbicidal composition of L-glufosinate salt comprising:
forming a dispersion in the absence of water wherein the dispersion comprises L-glufosinate salt and at least one organic solvent or a liquid surfactant; and
admixing the dispersion with water to obtain a liquid herbicidal composition free from rock-solid lumps.

16. A liquid herbicidal composition comprising:
a) single isomer of glufosinate salt;
b) at least one organic solvent; or a liquid surfactant; and

c) water

wherein the said liquid herbicidal composition is prepared through the process as claimed in claim 1.

17. The composition as claimed in claim 16 wherein said single isomer of glufosinate salt is L-glufosinate salt or D-glufosinate salt.

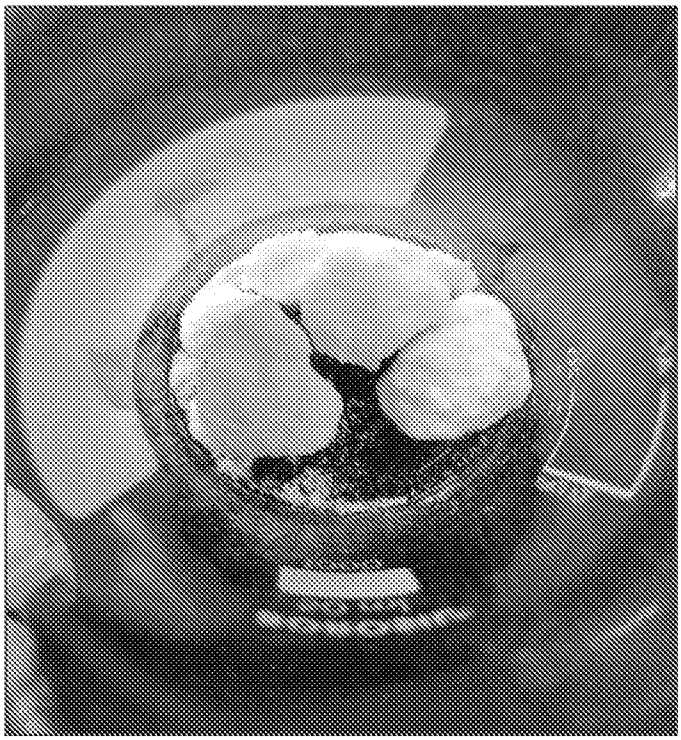


Figure 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2022/051875

A. CLASSIFICATION OF SUBJECT MATTER

A01N 57/20 (2006.01) A01P 13/00 (2006.01) A01N 25/30 (2006.01)

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)

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)

Databases: PATENTW, Espacenet, Google Search/Scholar/Patents, CAPlus, Registry, CASFORMULTNS, CABA, AGRICOLA, Internal IP Australia databases

IPC/CPC symbols: A01N (57/20, 25/30, 25/02, 25/04)

Keywords: L-glufosinate, organic solvent, surfactant, liquid herbicide, dispersion, soluble concentrate and like terms

Applicant/Inventor(s): UPL LTD, Achintya MONDAL, Satish Ekanath BHOGE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

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

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 April 2022	27 April 2022

Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Stefanie-Ann Zavras, PhD AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262832069

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/IB2022/051875**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 111771877 A (SHANXI ZHENCAOKANG BIOLOGICAL TECH CO LTD et al.) 16 October 2020 Example 22; claim 9	1-17
X	WO 2012/086617 A1 (MEIJI SEIKA PHARMA CO LTD et al.) 28 June 2012 Claims, page 3, examples	1-17
X	US 2020/0359630 A1 (BASF SE) 19 November 2020 Abstract, claims, para. [0023], [0078]-[0079]	1-17
X	CN 103719077 A (GAUNGXI TIANYUAN BIOCHEMISTRY) 16 April 2014 Embodiment 2 and 13	1-17
X	CN 107467061 A (ANHUI COSTAR BIO CHEMICAL CO LTD) 15 December 2017 Examples	1-17
X	US 5525578 A (LANGELÜDDEKE et al.) 11 June 1996 Example 4	1-17
X	US 2016/0120177 A1 (UPL LIMITED) 05 May 2016 Abstract; example 1; para. [0031], [0047]-[0049]	1-17
A	AGUIRRE, J.L. et al., 'Herbicidal effects of wood vinegar on nitrophilous plant communities', Food Energy Security. 2020, 00:e253, pp 1-18, DOI: 10.1002/fes3.253 Whole document	
A	MUNGKUNKAMCHAO, T. et al., 'Wood vinegar and fermented bioextracts: Natural products to enhance growth and yield of tomato (*Solanum lycopersicum* L.)', Scientia Horticulturae. 2013, Vol. 154, pp 66-72 whole document	
A	US EPA-Pesticides, 'Glufosinate' [retrieved from the internet on 22 April 2022] <URL: https://www3.epa.gov/pesticides/chem_search/cleared_reviews/csr_PC-128850_9-Jul-99_a.pdf> Published 9 July 1999 Background	
A	YUE, S. et al., 'Assessing the Efficacy-Risk of the Widely Used Chiral Glufosinate: Switch from the Racemate to the Single Enantiomer?', Environmental Science & Technology Letters. 2020, Vol. 7, pp. 143-148 Abstract and Figure 1	

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/IB2022/051875**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
CN 111771877 A	16 October 2020	CN 111771877 A	16 Oct 2020
WO 2012/086617 A1	28 June 2012	WO 2012086617 A1	28 Jun 2012
		CN 103269581 A	28 Aug 2013
		CN 103269581 B	10 Feb 2016
		JP WO2012086617 A1	22 May 2014
		JP 6016639 B2	26 Oct 2016
		KR 20130132924 A	05 Dec 2013
		KR 101927554 B1	10 Dec 2018
		TW 201306739 A	16 Feb 2013
		TW I561170 B	11 Dec 2016
US 2020/0359630 A1	19 November 2020	US 2020359630 A1	19 Nov 2020
		AR 112668 A1	27 Nov 2019
		BR 112020002680 A2	28 Jul 2020
		CA 3071292 A1	14 Feb 2019
		EP 3440939 A1	13 Feb 2019
		US 2022079157 A1	17 Mar 2022
		WO 2019030095 A2	14 Feb 2019
CN 103719077 A	16 April 2014	CN 103719077 A	16 Apr 2014
		CN 103719077 B	08 Jun 2016
CN 107467061 A	15 December 2017	CN 107467061 A	15 Dec 2017
US 5525578 A	11 June 1996	US 5525578 A	11 Jun 1996
		AU 6735890 A	13 Jun 1991
		AU 655576 B2	05 Jan 1995
		CA 2069114 A1	22 May 1991
		DE 3938564 A1	23 May 1991
		EP 0502014 A1	09 Sep 1992
		EP 0502014 B1	01 Feb 1995
		HU T61433 A	28 Jan 1993
		IE 904190 A1	22 May 1991
		IE 66519 B1	10 Jan 1996
		IL 96400 A	27 Nov 1995
		JP H05502444 A	28 Apr 1993
		MY 104597 A	30 Apr 1994

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/IB2022/051875**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
		PH 27232 A	04 May 1993
		PT 95934 A	13 Sep 1991
		PT 95934 B	30 Jan 1998
		WO 9107089 A1	30 May 1991
		ZA 909301 B	28 Aug 1991
US 2016/0120177 A1	05 May 2016	US 2016120177 A1	05 May 2016
		US 10506806 B2	17 Dec 2019
		MX 2015016568 A	16 Mar 2016
		PH 12015502571 A1	29 Feb 2016
		PH 12015502571 B1	29 Feb 2016
		WO 2014199293 A1	18 Dec 2014

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.