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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 June 2024 (27.06.2024)

WIPO | PCT

(10) International Publication Number
WO 2024/134474 A1

(51) International Patent Classification:
A01N 43/80 (2006.01) *A01N 43/707* (2006.01)
A01N 25/14 (2006.01) *A01P 13/00* (2006.01)
A01N 25/30 (2006.01)

(21) International Application Number:
PCT/IB2023/062909

(22) International Filing Date:
19 December 2023 (19.12.2023)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
202221073941 20 December 2022 (20.12.2022) IN

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(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, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, 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, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, 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, ME, 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))*

WO 2024/134474 A1

(54) Title: STABLE AGROCHEMICAL COMPOSITION

(57) Abstract: The present disclosure relates to a stable agrochemical composition and in particular, a stable herbicidal composition of an isoxazoline herbicide and a triazinone herbicide. The present disclosure also relates to a process for preparation of the agrochemical composition and to a method for controlling weeds using the agrochemical composition thereof.

STABLE AGROCHEMICAL COMPOSITION

FIELD OF THE DISCLOSURE:

The present disclosure relates to a stable agrochemical composition and in particular, a stable agrochemical composition comprising an isoxazoline herbicide and a triazinone herbicide; as well as a process for preparation of the same thereof. The present invention also relates to a method of controlling weeds using present agrochemical composition.

BACKGROUND OF THE DISCLOSURE:

Herbicides play an important role in agricultural practices across the world in removal of unwanted plants/weeds contaminating the yielding land. Formulations containing herbicides have been used for decades for weed control. To enable efficient elimination or control of unwanted plants/weeds in agricultural and other applications, it is desirable to use effective herbicidal combinations.

Pyroxasulfone is an isoxazoline herbicide belonging to the group of pyrazolium. Pyroxasulfone is chemically known as 3-[5-(difluoromethoxy)-1-methyl-3-(trifluoromethyl)pyrazol-4-ylmethylsulfonyl]-4,5-dihydro-5,5-dimethyl-1,2-oxazole. It is a pre-emergence herbicide that inhibits the biosynthesis of very long-chain fatty acids (VLCFA). It can be used to effectively control grass and broad-leaved weeds in corn, soybean, and wheat fields.

Metribuzin, also known as 4-amino-6-tert-butyl-3-methylsulfanyl-1,2,4-triazin-5-one, is a triazinone herbicide used both pre- and post-emergence in crops including soybean, potatoes, tomatoes and sugar cane to control grasses and broad-leaved weeds. It acts by inhibiting photosynthesis in susceptible plant by binding to a protein of the photosystem II complex. It is known for its efficiency and relatively low toxicity. Metribuzin is slightly soluble in water and in several organic solvents.

A water dispersible granular (WDG) formulation is a solid formulation that generally incorporates the active ingredient into a granule which disperses or dissolves quickly when added to water in the spray tank to give a fine particle suspension. WDG formulations provide a system for delivering active ingredients to their target and allow the production of highly concentrated formulations which are wettable and readily disintegrate on contact with water. These types of formulations present advantages in terms of storage as well as in terms of handling and toxicity.

Rapid disintegration is important for the efficient dispersion of WDG formulations in water and is also an important index for evaluating the performance of WDG formulations. When hydrophobic agrochemicals are formulated as a WDG, disintegration of the WDG becomes the major concern. Although WDG formulations are optimized to improve disintegration properties, there has been limited research into the factors influencing the disintegration performance of WDGs, especially when the active ingredient is a hydrophobic agrochemical. Other than disintegration, an important aspect associated with the preparation of a WDG is attrition. In particular, granules with low resistance to attrition and abrasion are prone to dusting as they fail to withstand handling and shipping and turn to dust. While the rates of dusting and attrition are much better in WDG than other solid formulations such as a wettable powder (WP), controlling the attrition rate and dusting remains very important when a hydrophobic active ingredient is incorporated in the granules in a very small quantity.

Retaining the integrity of a WDG formulation including a reduced amount of active ingredient(s) is highly desirable in order to ensure a sufficient quantity of active ingredient(s) is present to provide the required dose rate, otherwise, the WDG formulation will become ineffective. Moreover, dusting exposes the operator/formulator to harmful chemicals and poses health hazards. There thus remains a need to develop WDG formulations which address the challenges

associated with dusting and attrition as well as performance challenges of dispersibility, suspensibility and foaming.

OBJECTIVES OF THE DISCLOSURE:

A primary objective of the present disclosure is to provide a stable agrochemical composition comprising an isoxazoline herbicide and a triazinone herbicide, with improved suspensibility, controlled foam, improved dispersibility and/or controlled attrition.

Yet another objective of the present disclosure is to provide a stable agrochemical composition comprising an isoxazoline herbicide in combination with a triazinone herbicide in the form of water dispersible granules.

Still another object of the present disclosure is to provide a method of controlling weeds using present agrochemical composition comprising an isoxazoline herbicide and a triazinone herbicide.

SUMMARY OF THE DISCLOSURE:

In an aspect, the present disclosure provides a herbicidal composition comprising:

(a) at least one isoxazoline herbicide;
(b) at least one triazinone herbicide; and
(c) at least one anionic surfactant.

In another aspect, the present disclosure provides a herbicidal composition comprising:

(a) at least one isoxazoline herbicide;
(b) at least one triazinone herbicide; and
(c) at least two anionic surfactants.

In another aspect, the weight ratio of two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

In yet another aspect, the present disclosure provides a process of preparing a herbicidal composition, the process comprising:

(a) combining at least one isoxazoline herbicide, at least one triazinone herbicide, at least two anionic surfactants, and optionally at least one agrochemically acceptable excipient to provide a blend;

(b) mixing and homogenizing the blend obtained in step (a); and

(c) granulating the mixed and homogenized blend to obtain the herbicidal composition.

In another aspect, the present disclosure provides use of a herbicidal composition for controlling weeds, the composition comprising:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least two anionic surfactants.

In another aspect, the present disclosure provides a method of controlling weeds comprising applying to the plant or a locus thereof an effective amount of a herbicidal composition comprising:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least two anionic surfactants.

DETAILED DESCRIPTION OF THE DISCLOSURE:

The present disclosure now will be described hereinafter with reference to the accompanying examples, in which embodiments of the disclosure are shown. This description is not intended to be a detailed catalogue of all the different ways in which the disclosure may be implemented, or all the features that may be added to the instant disclosure. For example, features illustrated with respect to one

embodiment may be incorporated into other embodiments, and features illustrated with respect to a particular embodiment may be deleted from that embodiment. Thus, the disclosure contemplates that in some embodiments of the disclosure, any feature or combination of features set forth herein can be excluded or omitted. In addition, numerous variations and additions to the various embodiments suggested herein will be apparent to those skilled in the art in light of the instant disclosure, which do not depart from the instant disclosure. Hence, the following descriptions are intended to illustrate some particular embodiments of the disclosure, and not to exhaustively specify all permutations, combinations and variations thereof.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the disclosure, suitable methods and materials are described herein.

Recitation of ranges of values are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. The endpoints of all ranges are included within the range and independently combinable. As used herein, all numerical values or numerical ranges include integers within such ranges and fractions of the values or the integers within ranges unless the context clearly indicates otherwise. Thus, for example, reference to a range of 90-100%, includes 91%, 92%, 93%, 94%, 95%, 95%, 97%, etc., as well as 91.1%, 91.2%, 91.3%, 91.4%, 91.5%, etc., 92.1%, 92.2%, 92.3%, 92.4%, 92.5%, etc., and so forth. All methods described herein can be performed in a suitable order unless otherwise indicated herein or otherwise clearly contradicted by context.

The use of the terms “a”, and “an”, and “the” and similar referents (especially in the context of the following claims) are to be construed to cover both the singular

and the plural, unless otherwise indicated herein or clearly contradicted by context. 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.

The terms "comprising", "having", "including", and "containing" are to be construed as open-ended terms (i.e., meaning "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.

While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made, and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention is not limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

"Alkyl" means a straight or branched chain saturated aliphatic hydrocarbon having the specified number of carbon atoms, specifically 1 to 12 carbon atoms, more specifically 1 to 6 carbon atoms. Alkyl groups include, for example, groups having from 1 to 50 carbon atoms (C_1 to C_{50} alkyl).

"Aryl" means a cyclic moiety in which all ring members are carbon and at least one ring is aromatic, the moiety having the specified number of carbon atoms, specifically 6 to 24 carbon atoms, more specifically 6 to 12 carbon atoms. More than one ring may be present, and any additional rings may be independently aromatic, saturated or partially unsaturated, and may be fused, pendant, spirocyclic or a combination thereof.

The term "control" as it relates to a pest, includes the killing of the pest, as well as protecting a plant, a portion of the plant, or a plant seed from attack or invasion by said pest.

The term "suspensibility" refers to the ability of particles to be suspended in a diluent (e.g., water) without settling.

The expression of various quantities in terms of "%" or "% w/w" means the percentage by weight of the total solution or composition unless otherwise specified.

The term "herbicide" as used herein denotes a compound which controls or modifies the growth of undesired weeds.

The term "herbicidally effective amount" indicates the quantity of such a compound or combination of such compounds which is capable of controlling or modifying effect on the growth of harmful plants/undesired vegetation. Controlling effects include all deviation from natural development, for example: killing, retardation, leaf burn, albinism, dwarfing etc.

The term “plants” refers to all physical parts of a plant, including seeds, seedlings, saplings, roots, tubers, stems, stalks, foliage and fruits.

The term “locus” refers to an area of planted crops or a location where the weeds occurs or grows or can occur or grow and is intended to include soil, medium of growth other than soil.

As used throughout the disclosure, the isoxazoline herbicide or other active ingredients for example the triazinone herbicide, include their salts, esters, ethers, polymorphs including solvates and hydrates. A salt includes salts that retain the biological effectiveness and properties of the active ingredient, and which are not biologically or otherwise undesirable, and include derivatives of the disclosed compounds in which the parent compound is modified by making inorganic and organic, non-toxic, acid or base addition salts thereof. The salts can be synthesized from the parent compound by conventional chemical methods.

A “solvate” means the herbicide or its pharmaceutically acceptable salt, wherein molecules of a suitable solvent are incorporated in the crystal lattice. A suitable solvent is physiologically tolerable at the dosage administered. Examples of suitable solvents are ethanol, water and the like. When water is the solvent, the molecule is referred to as a “hydrate”. The formation of solvates will vary depending on the compound and the solvate. In general, solvates are formed by dissolving the compound in the appropriate solvent and isolating the solvate by cooling or using an antisolvent. The solvate is typically dried or azeotroped under ambient conditions. In an aspect, the solvate is a hydrate.

While developing a granular formulation of an isoxazoline herbicide and a triazinone herbicide, it was surprisingly found that the integrity of water dispersible granules can be maintained using a combination of two anionic surfactants. The combination of two anionic surfactants in a particular ratio not only facilitates granule formation but also provides quick disintegration of the actives when the

granule is dispersed in water for field application. The selected combination of the anionic surfactants in a selective weight ratio is found to successfully retain the integrity of the actives in the formulation which results in greater suspensibility and dispersibility.

In an embodiment, the present disclosure provides a stable agrochemical composition.

Accordingly, in an embodiment of the present disclosure, a herbicidal composition comprises:

(a) at least one isoxazoline herbicide;
(b) at least one triazinone herbicide; and
(c) at least one anionic surfactant.

Accordingly, in an embodiment of the present disclosure, a herbicidal composition comprises:

(a) at least one isoxazoline herbicide;
(b) at least one triazinone herbicide; and
(c) at least two anionic surfactants.

Accordingly, in an embodiment of the present disclosure, a herbicidal composition comprises:

(a) at least one isoxazoline herbicide;
(b) at least one triazinone herbicide;
(c) at least two anionic surfactants; and
(d) at least one agrochemically acceptable excipient.

According to an embodiment of the present disclosure, the isoxazoline herbicide is selected from the group comprising pyroxasulfone, fenoxasulfone, or combinations thereof.

According to preferred embodiment, the isoxazoline herbicide of the herbicidal composition is pyroxasulfone.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 70% w/w isoxazoline herbicide, based on total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 50% w/w isoxazoline herbicide, based on total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 30% w/w isoxazoline herbicide, based on total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises about 26.4% w/w pyroxasulfone of total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 20% w/w isoxazoline herbicide, based on total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises from about 11.98% w/w to about 13.52% w/w pyroxasulfone of total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises about 13.2% w/w pyroxasulfone of total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the triazinone herbicide is selected from the group comprising metribuzin, metamitron, ametridione, amibuzin, ethiozin, hexazinone, isomethiozin, or combinations thereof.

According to an embodiment, the triazinone herbicide of the herbicidal composition is metribuzin.

According to an embodiment, the triazinone herbicide of the herbicidal composition is metamitron.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 70% w/w triazinone herbicide, based on total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 1% w/w to about 50% w/w triazinone herbicide, based on total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises about 44% w/w metribuzin of total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 1% w/w to about 30% w/w triazinone herbicide, based on total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises from about 19.74% w/w to about 22.26% w/w metribuzin of total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises about 22% w/w metribuzin of total weight of the herbicidal composition.

Accordingly, in an embodiment of the present disclosure, the herbicidal composition comprises:

(a) pyroxasulfone;

(b) metribuzin; and

(c) at least one anionic surfactant.

Accordingly, in an embodiment of the present disclosure, the herbicidal composition comprises:

(a) pyroxasulfone;

(b) metribuzin; and

(c) at least two anionic surfactant.

Accordingly, in an embodiment of the present disclosure, the herbicidal composition comprises:

(a) pyroxasulfone;

(b) metamitron; and

(c) at least one anionic surfactant.

Accordingly, in an embodiment of the present disclosure, the herbicidal composition comprises:

(a) pyroxasulfone;

(b) metamitron; and

(c) at least two anionic surfactant.

In an embodiment, the herbicidal composition further comprises at least three anionic surfactants.

According to an embodiment of the present disclosure, the anionic surfactants are selected from the group comprising substituted, polymeric alkyl or aryl sulfonate such as a sodium alkyl naphthalene sulfonate, sodium naphthalene sulfonate, a sodium alkyl naphthalene sulfonate formaldehyde condensate, calcium

lignosulfonate, sodium lignosulfonate, ammonium lignosulfonate, sodium diisopropylnaphthalene sulfonate, sodium salt of an aryl sulfonic acid methylene linked condensate, a sodium alkyl naphthalene sulfonate-formaldehyde condensate, or combinations thereof.

In an embodiment of the present disclosure, the anionic surfactants comprise, consist essentially of, or consist of, sodium lignosulfonate and alkyl naphthalene sulfonate.

According to an embodiment of the present disclosure, the anionic surfactants comprise, consist essentially of, or consist of alkyl naphthalene sulfonate and sodium alkylnaphthalenesulfonate formaldehyde condensate.

In an embodiment of the present disclosure, the anionic surfactants comprise, consist essentially of, or consist of sodium lignosulfonate and sodium diisopropylnaphthalene sulfonate.

In another embodiment of the present disclosure, the composition comprises three anionic surfactants.

According to an embodiment of the present disclosure, the three anionic surfactants comprise, consist essentially of, or consist of sodium diisopropylnaphthalene sulfonate, sodium alkyl naphthalene sulfonate-formaldehyde condensate, sodium lignosulfonate, or combinations thereof.

According to an embodiment of the present disclosure, the three anionic surfactants comprise, consist essentially of, or consist of an alkyl naphthalene sulfonate of sodium salt, a sodium salt of arylsulfonic acid methylene linked condensate, and sodium lignosulfonate.

In an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 30% w/w anionic surfactant, based on total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 25% w/w anionic surfactant, based on total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises from about 0.1% w/w to about 20% w/w anionic surfactant, based on total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises from about 0.5% w/w to about 5% w/w, preferably about 3% w/w sodium diisopropylnaphthalene sulfonate of total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises from about 0.6% w/w to about 10% w/w, preferably about 6% w/w sodium alkyl naphthalene sulfonate formaldehyde-condensate of total weight of the herbicidal composition.

In a preferred embodiment, the herbicidal composition comprises from about 0.1% w/w to about 5% w/w, preferably about 3% w/w sodium lignosulfonate of total weight of the herbicidal composition.

According to an embodiment of the present disclosure, the herbicidal composition comprises:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least two anionic surfactants;

wherein a weight ratio of the two anionic surfactants ranges from about 0.5:100 to about 100:0.5.

In another embodiment, the weight ratio of the two anionic surfactants ranges from about 1:100 to about 100:1, from about 10:100 to about 100:10, from about 20:100 to about 100:20, from about 30:100 to about 100:30, from about 40:100 to about 100:40, from about 50:100 to about 100:50, from about 60:100 to about 100:60, from about 70:100 to about 100:70, from about 80:100 to about 100:80, from about 90:100 to about 100:90, or combinations thereof.

Unless otherwise indicated, the ratios disclosed throughout the specification are weight ratios.

According to an embodiment of the present disclosure, the herbicidal composition comprises:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least two anionic surfactants;

wherein a weight ratio of the two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

In an embodiment of the disclosure, the herbicidal composition comprises pyroxasulfone, metribuzin and at least two anionic surfactants, wherein the weight ratio of the two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

In an embodiment of the disclosure, the herbicidal composition comprises pyroxasulfone, metamitron, and at least two anionic surfactants, wherein the weight ratio of the two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin and at least two anionic surfactants, wherein the weight ratio of sodium diisopropylenenaphthalene sulfonate and sodium alkyl napthalene sulfonate-formaldehyde condenesate is about 1:2.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin and at least two anionic surfactants, wherein the weight ratio of sodium diisopropylenenaphthalene sulfonate and sodium lignosulfonate is about 1:1.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin and at least two anionic surfactants, wherein the weight ratio of sodium alkyl napthalene sulfonate-formaldehyde condensate and sodium lignosulfonate is about 2:1.

According to an embodiment of the present disclosure, the herbicidal composition comprises:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least three anionic surfactants;

wherein a weight ratio of the three anionic surfactants ranges from about 1:100:100 to about 100:1:1.

In an embodiment of the disclosure, the stable agrochemical composition comprises pyroxasulfone, metribuzin, and three anionic surfactants, wherein ratio of the three anionic surfactants is from about 1:10:10 to about 10:1:1.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin and at least three anionic surfactants, wherein the weight ratio of sodium diisopropylenenaphthalene sulfonate and sodium alkyl napthalene sulfonate-formaldehyde condensate and sodium lignosulfonate is about 1:2:1.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin and at least three anionic surfactants, wherein the weight ratio of sodium diisopropylenenaphthalene sulfonate and sodium lignosulfonate and sodium alkyl napthalene sulfonate-formaldehyde condensate is about 1:1:2.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin and at least three anionic surfactants, wherein the weight ratio of sodium alkyl napthalene sulfonate-formaldehyde condensate and sodium diisopropylenenaphthalene sulfonate and sodium lignosulfonate is about 1:0.5:0.5.

In an embodiment, the two anionic surfactants are present in a weight ratio from about 0.5:10 to about 10:0.5 and the three anionic surfactants are present in a weight ratio from about 1:10:10 to about 10:1:1.

According to an embodiment of the disclosure, the stable agrochemical composition comprises pyroxasulfone, metribuzin, wherein pyroxasulfone and metribuzin are present in a weight ratio from about 1:25 to about 25:1.

According to an embodiment of the disclosure, the stable agrochemical composition comprises pyroxasulfone, metribuzin, wherein pyroxasulfone and metribuzin are present in a weight ratio from about 1:10 to about 10:1.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin, wherein pyroxasulfone and metribuzin are present in a weight ratio of about 1:1.66.

In a preferred embodiment, the herbicidal composition comprises pyroxasulfone, metribuzin, wherein pyroxasulfone and metribuzin are present in a weight ratio of about 1:1.64.

According to an embodiment of the present disclosure, the composition further comprises at least one disintegrating agent.

According to an embodiment of the present disclosure, the herbicidal composition comprises:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide;
(c) at least two anionic surfactants; and
(d) at least one disintegrating agent.

According to an embodiment of the present disclosure, the herbicidal composition comprises:
(a) at least one isoxazoline herbicide;
(b) at least one triazinone herbicide;
(c) at least three anionic surfactants; and
(d) at least one disintegrating agent.

In another embodiment, the disintegrating agents are considered important agrochemically acceptable excipients, which facilitate the disintegration (breaking) of the water-dispersible granule when it comes in contact with a diluent. The disintegrants used in agrochemical formulations are ammonium salts such as ammonium sulfate, ammonium phosphate, ammonium nitrate; and mineral clays such as kaolinite, talc, and gypsum, or combinations thereof.

According to an embodiment of the present disclosure, the organic salts comprise salts or derivatives of a lactate, an oxalate, an acetate, a sorbate, pyrrolidone, or combinations thereof. In another aspect, the disintegrant comprises or consists of sodium acetate, sodium citrate, or combinations thereof.

According to an embodiment of the present disclosure, the inorganic salts comprise ammonium sulfate, sodium sulfate, ammonium phosphate, sodium phosphate, sodium dihydrogen phosphate, copper sulfate, ferric sulfate, ferric chloride, magnesium oxide, sodium silicate, or combinations thereof.

According to an embodiment of the present disclosure, the natural polymers based on sugar and starch comprise lactose, maltose, dextrose, mannose, or combinations thereof.

According to an embodiment of the present disclosure, the mineral clays comprise kaolin, bentonite, zeolite, gypsum, or combinations thereof.

According to an embodiment of the present disclosure, the disintegrant comprises ammonium sulfate, lactose, maltose, sodium sulfate, ammonium bicarbonate, ammonium phosphate, sodium bicarbonate, magnesium sulfate, hydrogen carbonate, sodium chloride, sodium citrate, kaolin, gypsum, calcium carbonate, sodium dihydrogen carbonate, sodium dihydrogen phosphate, ammonium citrate, sodium acetate bentonite, aluminium chloride, citric acid, succinic acid, or combinations thereof.

In an embodiment, the composition further comprises at least one disintegrating agent selected from ammonium sulfate.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises from about 0.01% w/w to about 30% w/w disintegrant based on total weight of the agrochemical composition.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises from about 0.1% w/w to about 30% w/w disintegrant based on total weight of the agrochemical composition.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises from about 0.1% w/w to about 20% disintegrant based on total weight of the agrochemical composition.

In a preferred embodiment, the herbicidal composition comprises about 17.6% w/w ammonium sulfate of total weight of the herbicidal composition.

In an embodiment the disintegrant comprises water-soluble salts of lignin sulfonate, for example the sodium, potassium, magnesium, calcium or ammonium salts of

lignin sulfonate. In an embodiment the disintegrant is sodium salt of lignin sulfonate, i.e., sodium lignosulfonate.

According to an embodiment of the present disclosure, the stable agrochemical composition of the present disclosure is formulated as a solid composition. The solid composition comprises, but is not limited to, dust, powder, granules, pellets, tablets, dry flowable, wettable powder, water effervescent granules, water dispersible granules (WDG), water emulsifiable granules, or combinations thereof.

In an embodiment, the stable agrochemical composition of the present disclosure is a water dispersible granules (WDG).

In an embodiment, the stable agrochemical composition of the present disclosure further comprises at least one agrochemically acceptable excipient(s) is selected from the group comprising surfactant(s) (for wetting and dispersion), binder(s), antifoam agent(s), diluent(s), non-ionic surfactant(s), filler(s), colorant(s), anticaking agent(s), pH-regulating agent(s), preservative(s), biocide(s), other formulation aid(s), or combinations thereof.

In an embodiment, among agrochemically acceptable excipient(s), the performance of a disintegrant can be altered significantly when mixed with various excipients. Water wetting or the granule surface and diffusion of the water to the inner space of WDGs have been identified as steps necessary in the disintegration process. Therefore, the choice of disintegrant and surfactant becomes essential for WDGs to achieve sufficient disintegration. Generally, disintegrants are hygroscopic in nature and if they absorb moisture from the air, there is a potential to impair the stability of the WDG formulation. Thus, the choice of agrochemically acceptable excipient(s) is crucial in order to develop a stable composition.

In an embodiment, the non-ionic surfactant(s) may be selected from fatty acid glycol ester surfactants, polyalkoxylated triglyceride surfactants, alkoxylated fatty

alcohol surfactants, and sorbitan fatty acid ester surfactants, polyalkoxylated alkylphenol surfactants, polyalkoxylated alkarylphenol surfactants, amine oxide surfactants, alkanolamide surfactants, glycoside surfactants, ethylene/propylene block copolymers, or combinations thereof.

In an embodiment, the filler(s) may be selected from insoluble fillers and/or soluble fillers. Non-limiting examples of the fillers include silica, amorphous silica, fumed diatomaceous earth, kaolin, clay, bentonite, or combinations thereof.

In an embodiment, the antifoam- agent(s) may be selected from silicones, long-chain alcohols, and salts of fatty acids, or combinations thereof.

In an embodiment, the colorant(s) (for example red, blue and green) include pigments, which are sparingly soluble in water, and dyes, which are water-soluble. Examples include inorganic coloring agents (for example iron oxide, titanium oxide, and iron hexacyanoferrate) and organic coloring agents (for example alizarin, azo, and/or phthalocyanine-based coloring agents), or combinations thereof.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises from about 0.1% w/w to about 50%, preferably from about 0.1% w/w to about 30% w/w agrochemically acceptable excipients based on total weight of the agrochemical composition.

According to further embodiment, the stable agrochemical composition comprises from about 0.1% w/w to about 70% w/w at least one isoxazoline herbicide and from about 0.1% w/w to about 70% w/w at least one triazinone herbicide, based on total weight of the stable agrochemical composition.

In a preferred embodiment, the composition comprises from about 0.1% w/w to about 30% w/w isoxazoline herbicide and from about 1% w/w to about 50% w/w triazinone herbicide of total weight of the composition.

According to an embodiment of the present disclosure, a stable agrochemical composition comprising:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide;

(c) at least two anionic surfactants; and

(d) at least one agrochemically acceptable excipient;

wherein a weight ratio of the two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

In one embodiment, the present invention provides a water dispersible granular (WDG) composition comprising:

(a) at least one 22sooxazoline herbicide;

(b) at least one triazinone herbicide;

(c) at least two anionic surfactants; and

(d) at least one agrochemically acceptable excipient;

wherein a weight ratio of the two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

In a preferred embodiment, the present invention provides a water dispersible granular (WDG) composition comprising:

(a) pyroxasulfone;

(b) metribuzin;

(c) sodium diisopropylenenaphthalene sulfonate, sodium alkyl napthalene sulfonate-formaldehyde condensate, sodium lignosulfonate; and

(d) at least one agrochemically acceptable excipient.

In an embodiment, the composition further comprises ammonium sulfate.

In one embodiment, there is provided a water dispersible granular formulation comprising pyroxasulfone in an amount of about 12.75% w/w and metribuzin in an amount of about 21% w/w of total weight of the composition.

According to an embodiment, the stable agrochemical composition comprises:
from about 0.1% w/w to about 50% w/w at least one isoxazoline herbicide;
from about 0.1% w/w to about 50% w/w at least one triazinone herbicide; and
from about 0.1% w/w to about 30% w/w at least two anionic surfactants based on total weight of the agrochemical composition.

According to an embodiment, the stable agrochemical composition comprises:
from about 0.1% w/w to about 50% w/w at least one isoxazoline herbicide;
from about 0.1% w/w to about 50% w/w at least one triazinone herbicide; and
from about 0.1% w/w to about 30% w/w at least two anionic surfactants, based on total weight of the stable agrochemical composition,
wherein a weight ratio of the anionic surfactants ranges from about 0.5:10 to about 10:0.5.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises:
from about 0.1% w/w to about 50% w/w pyroxasulfone;
from about 0.1% w/w to about 50% w/w metribuzin; and
from about 0.1% w/w to about 10% w/w sodium diisopropylnaphthalene sulfonate and from about 0.1% w/w to about 15% w/w sodium alkyl naphthalene sulfonate-formaldehyde condensate of total weight of the composition;
wherein the weight ratio of sodium diisopropylnaphthalene sulfonate and sodium alkyl naphthalene sulfonate-formaldehyde condensate ranges from about 0.5:10 to about 10:0.5.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises:
from about 0.1% w/w to about 50% w/w pyroxasulfone;
from about 0.1% w/w to about 50% w/w metribuzin;
from about 0.1% w/w to about 10% w/w sodium diisopropylnaphthalene sulfonate and from about 0.1% w/w to about 10% w/w sodium alkyl naphthalene sulfonate-formaldehyde condensate of total weight of the composition.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises:
from about 0.1% w/w to about 50% w/w pyroxasulfone;
from about 0.1% w/w to about 50% w/w metribuzin;
from about 0.1% w/w to about 10% w/w sodium diisopropylnaphthalene sulfonate and from about 0.1% w/w to about 10% w/w sodium alkyl naphthalene sulfonate-formaldehyde condensate; and
at least one agrochemically acceptable excipient of total weight of the composition.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises:
from about 0.1% w/w to about 50% w/w pyroxasulfone;
from about 0.1% w/w to about 50% w/w metribuzin;
from about 0.1% to about 10% sodium diisopropylnaphthalene sulfonate, from about 0.1% w/w to about 10% w/w sodium alkyl naphthalene sulfonate-formaldehyde condensate and from about 0.1% w/w to about 20% w/w sodium lignosulfonate of total weight of the composition.

According to an embodiment of the present disclosure, the stable agrochemical composition comprises:
from about 0.1% w/w to about 50% w/w pyroxasulfone;
from about 0.1% w/w to about 50% w/w metribuzin;

from about 0.1% w/w to about 10% w/w sodium diisopropylnaphthalene sulfonate, from about 0.1% w/w to about 10% w/w sodium alkyl naphthalene sulfonate-formaldehyde condensate, and from about 0.1% w/w to about 20% w/w sodium lignosulfonate; and

optionally from about 1% w/w to about 80% w/w ammonium sulfate.

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In another aspect the present invention provides a process for the preparation of the present stable agrochemical compositions.

According to an embodiment of the present disclosure, the process of preparing a herbicidal composition comprises:

(a) mixing at least one isoxazoline herbicide, at least one triazinone herbicide, at least two anionic surfactants, and optionally at least one agrochemically acceptable excipient to obtain a premix powder;

(b) milling the premix powder and preparing a dough using water; and

(c) preparing granules from the dough to obtain the herbicidal composition.

According to an embodiment, the ratio of the two anionic surfactants used in the composition ranges from about 0.5:10 to about 10:0.5.

According to an embodiment of the present disclosure, the process of preparing a herbicidal composition comprises:

(a) mixing at least one isoxazoline herbicide, at least one triazinone herbicide, at least three anionic surfactants, and optionally at least one agrochemically acceptable excipient to obtain a premix powder;

(b) Milling the premix powder and preparing a blend using water; and

(c) preparing granules from the blend to obtain the herbicidal composition.

According to an embodiment of the present disclosure, the preparing of the granules from the blend comprises granulating the blend.

According to an embodiment of the present disclosure, the process comprises:

(a) mixing pyroxasulfone, metribuzin, at least two anionic surfactants, and optionally at least one agrochemically acceptable excipient to obtain a premix powder;

(b) milling the premix powder and preparing a dough using water;

(c) preparing granules from the dough; and

(d) drying the granules to obtain the herbicidal composition.

According to an embodiment of the present disclosure, the process comprises:

(a) mixing pyroxasulfone, metribuzin, sodium diisopropylnaphthalene sulfonate and sodium alkyl naphthalene sulfonate-formaldehyde condensate, and optionally at least one agrochemically acceptable excipient to obtain a premix powder;

(b) milling the premix powder and preparing a dough using water;

(c) preparing the granules from the dough; and

(d) drying the granules to obtain the herbicidal composition.

In an embodiment, the ratio of sodium diisopropylnaphthalene sulfonate and sodium alkyl naphthalene sulfonate-formaldehyde condensate is from about 0.5:10 to about 10:0.5.

According to an embodiment of the present disclosure, the process comprises:

(a) combining pyroxasulfone, metribuzin, sodium diisopropylnaphthalene sulfonate, sodium alkyl naphthalene sulfonate-formaldehyde condensate, sodium lignosulfonate, ammonium sulfate and optionally at least one agrochemically acceptable excipient to obtain to obtain premix powder;

(b) milling the premix powder and preparing a dough using water

(c) preparing the granules from the dough and

(d) drying the granules to obtain the agrochemical composition.

In an embodiment, the weight ratio of sodium diisopropylnaphthalene sulfonate and sodium alkyl naphthalene sulfonate-formaldehyde condensate ranges from about 0.5:10 to about 10:0.5.

According to an embodiment of the present disclosure, the combining of the above ingredients to obtain a premix or blend is performed using a suitable blender such as ribbon blender, V-blender, and high intensity plough shear mixer. According to an embodiment of the present disclosure, the grinding of the blend may be performed in any suitable device such as air jet mill, air classifier mill, hammer mill, and/or pin disc mill. Jet mills are shear or pulverizing machines in which the particles to be milled are accelerated by gas flows and pulverized by collision. There are a number of different types of jet mill designs, such as double counterflow (opposing jet) and spiral (pancake) fluid energy mills.

According to an embodiment of the present disclosure, the formation of water dispersible granules is performed by a process including, for example, extrusion, pan granulation, fluidised bed spray granulation, spray drying, or combinations thereof.

According to an embodiment of the present disclosure, the drying of the granules may be performed in any suitable drying equipment such as a fluidised bed drier, a tray drier, and/or a Rotocone vacuum drier.

According to an embodiment, the temperature at which the granules are dried is not necessarily limited as long as the temperature is not greater than about 50°C to about 100°C. According to an embodiment, the drying of the granules is performed at a temperature in the range from about 50°C to about 70°C.

According to an embodiment, the drying process preferably removes as much water as possible from the granules in order to reduce weight and to provide good stability to the granules while still in a dry flowable state. Preferably, the amount of water

retained in the granules is less than about 2% following complete drying. More preferably, the amount of water retained in the granules is less than about 0.5% following complete drying.

According to an embodiment of the present disclosure, the dried granules are subjected to sieving to remove undersized and oversized granules.

According to an embodiment of the present disclosure, processing time of granules is from about 30 minutes to about 1 hour.

According to an embodiment of the present disclosure, the suspensibility of the granules is at least about 80% w/w. According to an embodiment of the present disclosure, the suspensibility of the granules is at least about 85% w/w. According to an embodiment of the present disclosure, the suspensibility of the granules is at least about 90% w/w.

According to an embodiment of the present disclosure, the dispersibility of the granules is at least about 80% w/w. According to an embodiment of the present disclosure, dispersibility of the granules is at least about 85% w/w. According to an embodiment of the present disclosure, dispersibility of the granules is at least about 90% w/w.

According to an embodiment of the present disclosure, the moisture content of the granules is less than or equal to about 2%. According to an embodiment of the present disclosure, the moisture content of the granules is less than or equal to about 1%. According to an embodiment of the present disclosure, the moisture content of the granules is less than or equal to about 0.5%.

The physical stability of the compositions/formulation is performed according to the Collaborative International Pesticides Analytical Council (CIPAC) Standard method.

In an embodiment of the present disclosure, the pH of the stable solid agrochemical composition is adjusted as needed to a pH of about 5 to about 7.

The process of the disclosure considerably reduces the amount of oversized and undersized material which must be recycled. Consequently, the granule composition is essentially dust free.

According to an embodiment, the present invention provides use of a herbicidal composition comprising at least one isoxazoline herbicide, at least one triazinone herbicide and at least two anionic surfactants, for controlling weeds.

In an embodiment, the present invention provides use of an herbicidal composition for controlling weeds, the composition comprising:
from about 0.1% w/w to about 50% w/w at least one isoxazoline herbicide;
from about 0.1% w/w to about 50% w/w at least one triazinone herbicide; and
from about 0.1% w/w to about 30% w/w at least two anionic surfactants,
based on total weight of the herbicidal composition;
wherein the weight ratio of the two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

In an embodiment the present invention provides use of a herbicidal composition for controlling weeds, the composition comprising:
from about 0.1% w/w to about 50% w/w pyroxasulfone;
from about 0.1% w/w to about 50% w/w metribuzin; and
from about 0.1% w/w to about 30% w/w at least two anionic surfactants,
based on total weight of the herbicidal composition,
wherein the weight ratio of the two anionic surfactants ranges from about 0.5:10 to about 10:0.5.

According to an embodiment of the present disclosure, a method of controlling weeds comprises applying to a plant or a locus thereof, a herbicidal composition comprising:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least two anionic surfactants.

According to an embodiment of the present disclosure, the weight ratio of two anionic surfactants ranges from about 0.5:1 to about 5:1.

According to an embodiment of the present disclosure, a method of controlling weeds comprises applying to a plant or a locus thereof, a herbicidal composition comprising:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least three anionic surfactants.

According to an embodiment of the present disclosure, a method of controlling weeds comprises applying to a plant or a locus thereof, a herbicidal composition comprising:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and

(c) at least two anionic surfactants.

According to an embodiment, the weight ratio of the two anionic surfactant ranges from about 0.5:1 to about 5:1.

According to an embodiment of the present disclosure, a method of controlling weeds comprises applying to a plant or a locus thereof, a herbicidal composition comprising:

(a) at least one isoxazoline herbicide;

(b) at least one triazinone herbicide; and
(c) at least three anionic surfactants.

According to an embodiment of the present disclosure, the isoxazoline herbicide comprises or consists of pyroxasulfone; and the triazinone herbicide comprises or consists of metribuzin.

According to an embodiment of the present disclosure, a method of controlling weeds comprises applying to a plant or a locus thereof a herbicidal composition comprising:
(a) pyroxasulfone;
(b) metribuzin; and
(c) at least two anionic surfactants.

According to an embodiment of the present disclosure, a method of controlling weeds comprises applying to a plant or a locus thereof a herbicidal composition comprising:
(a) pyroxasulfone;
(b) metribuzin; and
(c) at least three anionic surfactants.

According to an embodiment of the present disclosure, the various components of the herbicidal composition can be used individually or already partially or completely mixed with one at least one other to prepare the composition according to the disclosure. It is also possible for them to be packaged and used further as composition such as a kit of parts.

According to an embodiment of the present disclosure, there is provided a kit comprising:
at least one isoxazoline herbicide;
at least one triazinone herbicide;

at least two anionic surfactants; and
at least one agrochemically acceptable excipient;
and optionally further comprises:
instructions for use.

According to an embodiment of the present disclosure, there is provided a kit comprising pyroxasulfone, metribuzin and at least two anionic surfactants.

According to an embodiment of the present disclosure, there is provided a kit comprising pyroxasulfone, metribuzin and at least three anionic surfactants.

In one embodiment of the disclosure, the kits may include one or more, including all, components that may be used to prepare the herbicidal granular composition, e.g., kits may include active ingredients and/or anionic surfactants. One or more of the components may already be combined together or pre-formulated. In those embodiments where more than two components are provided in a kit, the components may already be combined together and as such are packaged in a single container such as a vial, bottle, can, pouch, bag or canister.

It will be understood that the specification and examples are illustrative but not limiting of the present disclosure and that other embodiments within the spirit and scope of the disclosure will suggest themselves to those skilled in the art. Other embodiments can be practiced that are also within the scope of the present disclosure. The following examples illustrate the disclosure, but by no means intend to limit the scope of the disclosure.

In another embodiment, alternative or multiple embodiments of the disclosure disclosed herein are not to be construed as limitations. Each embodiment can be referred to and claimed individually or in any combination with other embodiments of the disclosure. One or more embodiments of the disclosure can be included in, or deleted from, the disclosure for reasons of convenience and/or patentability.

The disclosure will now be described in more details with reference to the following examples. While the foregoing written description of the disclosure enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific embodiment, method, and examples herein. The disclosure should therefore not be limited by the above-described embodiment, method, and following examples, but by all embodiments and methods within the scope and spirit of the disclosure.

EXAMPLES:

Example 1: Water-dispersible granular (WDG) formulation

The herbicidal composition of the present invention was formulated as a water-dispersible granular (WDG) formulation.

Sr. No	Ingredients	Amount (% w/w)
1	Pyroxasulfone	26.4
2	Metribuzin	44
3	Sodium diisopropylenenaphthalene sulfonate	3
4	Sodium alkyl napthalene sulfonate-formaldehyde condensate	6
5	Sodium lignosulfonate	3
6	Ammonium sulfate	Q.S.
Total		100

Process:

Pyroxasulfone, sodium diisopropyl naphthalene sulfonate, sodium alkyl naphthalene sulfonate-formaldehyde condensate were combined with sodium

lignosulfonate, and ammonium sulfate in the aforementioned quantities and blended in a ribbon blender for about 20 to about 30 minutes to obtain a blend. The blend was further ground in an air jet mill to obtain a ground mixture. The ground mixture was further blended for about 40 to about 50 minutes to obtain a homogeneous mixture. A water spray was applied to the homogeneous mixture to prepare a dough. Granules were then prepared by extrusion in a granulator having sieve size of about 0.8 to about 1.2 mm aperture. The extruded granules were dried on fluid bed dryer at a temperature between about 50°C to about 70°C. The dried granules were passed through a sieve to obtain uniform sized granules.

Example 2: Water-dispersible granular (WDG) formulation

The herbicidal composition of the present invention was formulated as a water-dispersible granular (WDG) formulation.

Sr. No	**Ingredients**	**Amount (% w/w)**
1	Pyroxasulfone	11.98 to 13.52
2	Metribuzin	19.74 to 22.26
3	Sodium diisopropylnaphthalene sulfonate	0.5 to 5
4	Sodium alkyl napthalene sulfonate-formaldehyde condensate	0.6 to 10
5	Sodium lignosulfonate	0.1 to 5
6	Ammonium sulfate	Q.S.
Total		100

Example 3: Stability study

The herbicidal composition of Example 1 (WDG) was analysed for stability studies. This composition was tested for stability based on various parameters in ambient

conditions, i.e., just after preparation of granules at room temperature and also in accelerated heat stability (AHS) conditions, i.e., storage at about 54°C for about 2 weeks. The stability results in ambient condition and AHS conditions are presented in Table 1.

Table 1: Stability study

Sr. No	Parameters	Stability	
		Ambient	14 days AHS
1	Appearance	Brown Colored Granules	Brown Colored Granules
2	Pyroxasulfone (%/ w/w) Active	26.2	26.13
3	Metribuzin (% w/w) Active	42.5	42.42
4	Pyroxasulfone (% /w/w) Active Suspension	97.91	96.8
5	Metribuzin (% w/w) Active Suspension	98.9	97.12
6	LOD (15 Min for 105°C)	1.04	1.13
7	Wet Sieve Test % w/w (Pass through 200 BSS)	99.8	99.71
8	Dispersibility (Strokes)	10	10
9	pH	5.66	5.61
10	Foam	16	20

It is evident from the Table 1 that the herbicidal composition is stable at tested storage conditions. The suspensibility of pyroxasulfone in the water dispersible granule composition was greater than about 85% in ambient conditions and greater than about 75% in AHS conditions.

Similarly, suspensibility of metribuzin was also observed to be greater than about 85% in ambient conditions and greater than about 75% in AHS conditions. The moisture content in composition was less than about 2%. Also, the number of inversions was found to be less than about 20 in the composition at ambient condition as well as in AHS condition.

Example 4: Stability study

The following composition (WDG) was prepared by the process analogous to the process of Example 1.

Sr. No	Ingredients	Amount (% w/w)
1	Pyroxasulfone	13.2
2	Metribuzin	22
3	Sodium diisopropylenenaphthalene sulfonate	3
4	Naphthalene-formaldehyde condensate sodium	6
5	Sodium lignosulfonate	3
6	Ammonium sulfate	Q.S.
Total		100

The herbicidal composition (WDG) was analysed for stability studies. This composition was tested for stability based on various parameters in ambient conditions, i.e., just after preparation of granules at room temperature and also in accelerated heat stability (AHS) conditions, i.e., storage at about 54°C for about 2 weeks. The stability results in ambient condition and AHS conditions are presented in Table 2.

Table 2: Stability data

Sr. No	Parameters	Stability		
		Ambient	14 days AHS	18 Months
1	Appearance	Brown Colored Granules	Brown Colored Granules	Brown Colored Granules
2	Pyroxasulfone (% w/w) Active	13.59	13.56	12.81
3	Metribuzin (% w/w) Active	21.39	21.23	21.26
4	Pyroxasulfone (% w/w) Active Suspension	95.39	94.88	87.1
5	Metribuzin (% w/w) Active Suspension	98.08	97.69	94.3
6	LOD (15 Min for 105°C)	1.31	1.4	1.31
7	Wet Sieve Test % w/w (Pass through 200 BSS)	99.8	99.6	99.78
8	Dispersibility (Strokes)	10	10	10
9	pH	5.36	5.21	5.36
10	Foam	15	20	15

Example 5: Bio efficacy data

The compositions comprising pyroxasulfone and metribuzin were tested for their ability to control weeds in order to evaluate the efficacy of the compositions. The overall effectiveness of the compositions was compared with an untreated check (control). The details of the trials are outlined below.

Trial details:

- Target weeds: *PHAMI- Phalaris minor*
- Crop: Winter wheat
- Water Volume: 400 to 500 L/Ha

- Application description: 0 to 3 DAS
- Observations: 30 days and 45 days after application (DAA).

The results of the trial are shown in Table 3.

Sr. No.	**Treatment**	**% Control (*PHAMI- Phalaris minor*)**				
		A.I rate (g/ha)	**Formulation (ml or g/ha)**	**30 DAA**	**45 DAA**	**Phytotoxicity**
1	Untreated check	-	-	0	0	-
2	Pyroxasulfone + metribuzin (33.75% WG)	337.5	1000	88	88	NA
3	Pyroxasulfone + metribuzin (33.75% WG)	405	1200	92	92	

No phytotoxicity was observed during the trials. Thus, it is evident that the present composition comprising pyroxasulfone and metribuzin clearly exhibits good control of the targeted weeds as compared to untreated check.

Claims:

1. A herbicidal composition comprising:
   (a) at least one isoxazoline herbicide;
   (b) at least one triazinone herbicide;
   (c) at least two anionic surfactants; and
   (d) at least one agrochemically acceptable excipient.

2. The composition as claimed in claim 1, wherein the isoxazoline herbicide is selected from the group comprising pyroxasulfone, fenoxasulfone, or combinations thereof.

3. The composition as claimed in claim 1, wherein the triazinone herbicide is selected from the group comprising metribuzin, metamitron, ametridione, amibuzin, ethiozin, hexazinone, isomethiozin, or combinations thereof.

4. The composition as claimed in claim 1, wherein the composition further comprises at least three anionic surfactants.

5. The composition as claimed in claim 4, wherein the anionic surfactants are selected from the group comprising sodium diisopropylnaphthalene sulfonate, sodium alkyl naphthalene sulfonate-formaldehyde condensate, sodium lignosulfonate, or combinations thereof.

6. The composition as claimed in claim 5, wherein the two anionic surfactants are present in a weight ratio from about 0.5:10 to about 10:0.5 and the three anionic surfactants are present in a weight ratio from about 1:10:10 to about 10:1:1.

7. The composition as claimed in claim 1, wherein the composition further comprises at least one disintegrating agent selected from ammonium sulfate.

8. The composition as claimed in claim 1, wherein the agrochemically acceptable excipient is selected from the group comprising surfactant(s), binder(s), antifoam agent(s), diluent(s), non-ionic surfactant(s), filler(s), colorant(s), anticaking agent(s), pH-regulating agent(s), preservative(s), biocide(s), other formulation aid(s), or combinations thereof.

9. The composition as claimed in claim 1, wherein the composition comprises from about 0.1% w/w to about 30% w/w isoxazoline herbicide and from about 1% w/w to about 50% w/w triazinone herbicide of total weight of the composition.

10. The composition as claimed in claim 1, wherein the composition comprises from about 0.1% w/w to about 30% w/w anionic surfactants of total weight of the composition.

11. The composition as claimed in claim 1, wherein the composition is in a form of a water-dispersible granule.

12. A water-dispersible granular composition comprising:
    (a) pyroxasulfone;
    (b) metribuzin;
    (c) at least two anionic surfactants;
    (d) optionally at least one disintegrating agent; and
    (e) at least one agrochemically acceptable excipient.

13. A process for preparing a herbicidal composition, the process comprising:
    (a) mixing at least one isoxazoline herbicide, at least one triazinone herbicide, at least two anionic surfactants, and at least one agrochemically acceptable excipient to obtain a premix powder;
    (b) milling the premix powder and preparing a dough using water; and
    (c) preparing granules from the dough to obtain the herbicidal composition.

14. Use of a herbicidal composition for controlling weeds, the composition comprising:
    (a) at least one isoxazoline herbicide;
    (b) at least one triazinone herbicide;
    (c) at least two anionic surfactants; and
    (d) at least one agrochemically acceptable excipient.

15. A method for controlling weeds by applying an effective amount of a herbicidal composition to a plant or a locus thereof, the composition comprising:
    (a) at least one isoxazoline herbicide;
    (b) at least one triazinone herbicide;
    (c) at least two anionic surfactants; and
    (d) at least one agrochemically acceptable excipient.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2023/062909

A. CLASSIFICATION OF SUBJECT MATTER

A01N 43/80 (2006.01) A01N 25/14 (2006.01) A01N 25/30 (2006.01) A01N 43/707 (2006.01) A01P 13/00 (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: PATENW, Espacenet, Google Scholar/Patents/Search, CAPLUS, REGISTRY, CASFORMLTNS, CABA, AGRICOLA

IPC/CPC symbols: A01N (43/80, 43/707, 25/30)

Key words: Isoxazoline herbicide, pyroxasulfone, fenoxasulfone, triazinone herbicide, metribuzin, metamitron, ametridione, amibuzin, ethiozin, hexazinone, isomethiozin, sodium diisopropylnaphthalene sulfonate, sodium alkyl naphthalene sulfonate-formaldehyde condensate, sodium lignosulfonate, ammonium sulfate and like terms

Applicant/Inventor(s): UPL LIMITED; SAINI, Anil; MUKHERJEE, Dev Varta; SHIRSAT, Rajan Ramakant

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
12 February 2024	12 February 2024
Name and mailing address of the ISA/AU	**Authorised officer**
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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/IB2023/062909**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	CN 106259360 A (JIANGSU ROTAM CHEMISTRY CO LTD) 04 January 2017 Example 8; claims 11-15 Example 8; claims 11-15	1-3 and 8-15 4-7
Y	US 2019/0045788 A1 (VALENT U.S.A., CORPORATION) 14 February 2019 Tables 1 and 2; claims 11-18	4-7
A	WO 2017/125786 A1 (UPL LIMITED) 27 July 2017 Examples 18A and 18B	
A	CN 106962361 A (SHANDONG RUNBO BIOLOGICAL TECH CO LTD) 21 July 2017 Examples	
A	WO 2022/167964 A1 (UPL LIMITED) 11 August 2022 pp. 17, 19, 21 and 33; Examples 1, 2 and 6; Tables 2, 3 and 7	
A	WO 2022/249203 A1 (UPL LIMIITED) 01 December 2022 Example 12	
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P,X	US 2023/0014559 A1 (VALENT U.S.A. LLC) 19 January 2023 Table 7, Formulation Z; para. [0169]-[0171]; claim 16	1-15

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/IB2023/062909**

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.

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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/IB2023/062909**

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End of Annex

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