Untreated control @45 days after Application



Fig. 1

Untreated control @45 days after Application



Fig. 2

PRABHAKAR MANI PRATAP
of VUTTS & ASSOCIATES LLP
AGENT FOR THE APPLICANT
IN/PA No. 1217

Sulfentrazone +Pendimethalin + Chlorimuron ethyl @45 days after Application



Fig. 3

Sulfentrazone +Pendimethalin + Chlorimuron ethyl @45 days after Application



Fig. 4

PRABHAKAR MANI PRATAP
of VUTTS & ASSOCIATES LLP
AGENT FOR THE APPLICANT
IN/PA No. 1217

FORM 2
THE PATENTS ACT, 1970
(39 of 1970)
&
The Patent Rules, 2003
COMPLETE SPECIFICATION
[See Section 10 and Rule 13]

1. TITLE OF THE INVENTION

"BROAD SPECTRUM HERBICIDAL COMPOSITION AND RELATED METHODS THEREOF"

2. APPLICANT(S)

(a) **NAVIN NATH**
(b) an Indian Citizen,
(c) of C-2203, Mahindra Luminare, Sector 59, Gurugram 122011, Haryana, India

3. PREAMBLE TO THE DESCRIPTION

The following specification particularly describes the invention and the manner in which it is to be performed.

FIELD

The present disclosure relates to a field of herbicidal composition for agriculture and horticulture for controlling and management of weeds or unwanted vegetations in crops of useful plants. Particularly, the present disclosure relates to a synergistic herbicidal composition comprising active ingredients of compound (A) Sulfentrazone or salts thereof, compound (B) Pendimethalin or salts thereof, and compound (C) Chlorimuron ethyl or salts thereof, for the treatment and control of weeds in crops plants. The present invention further relates to a method of preparation of such synergistic herbicidal compositions and a method of using the same.

BACKGROUND

Poor control of unwanted vegetation or weeds are adversely impacting the crops in terms of productivity and quality. In order to achieve higher yield and quality of the crops, the crops' protection from weeds or other vegetation which inhibit crops must be take into account. Therefore, the researchers in the field of synthetic chemistry have produced a variety of chemicals and chemical formulations which are effective in the control of such unwanted growth of weeds.

New technologies for weed management have been incorporated in the agricultural land, however, the same has not been advantageous for selective weed control. Soybean crops are one of the crops which are susceptible to the growth of weeds or unwanted vegetations. Weed infestation causes a yield loss of target crop. To overcome this problem, many pre-emergent herbicides are available in the market, but most of them have their own limitation in terms of efficacy and specificity on certain types of weeds.

Most of the available pesticides have limited spectra to control and manage weeds. Various pesticidal compounds of different chemical classes are widely known as plant herbicides for application in various crops of cultivated plants. However, the formulation does not always satisfy the needs of agricultural practice in many incidents and aspects including tolerance, activity, specificity and cost.

The inventors(s) of the present disclosure have developed a mixture of herbicide for crops such as, but not being limited to soybean crops. The unique three-way combination controls a broad range of weeds of soybean for longer duration without causing any harmful effect to the crops.

At present, many herbicidal compositions have been deployed and used, but there are a variety of types of weeds to be controlled, and their development lasts for a long period of time. Thus, there is a need to further improvement and development for highly active and long-residual herbicidal composition having a broad herbicidal spectrum.

OBJECTS

One of the objects and advantage of present disclosure is to provide a synergistic herbicidal composition comprising herbicidally active ingredients, compound (A) Sulfentrazone or salts thereof, compound (B) Pendimethalin or salts thereof, and compound (C) Chlorimuron ethyl or salts thereof.

One of the objects and advantage of the present disclosure is to provide a synergistic herbicidal composition for comprehensive weed control on soybean as pre-emergent. Said unique three-way combination controls maximum weeds of soybean for longer duration.

One of the objects and advantage of the present disclosure is to provide a synergistic herbicidal composition having high persistence for longer duration which ensures the control of major weeds for a longer period (for example, not being limited to, at least for 45 to 60 days after application).

One of the objects and advantage of the present disclosure is to provide a method for preparing a synergistic herbicidal composition comprising at least two herbicidally active ingredients along with agriculturally acceptable additives.

One of the objects and advantage of present disclosure is to provide an herbicidal composition for comprehensive weed control on soybean as pre-emergent. The unique three-way combination controls maximum weeds of Soybean for longer duration.

One of the objects and advantage of the present disclosure is to provide a synergistic herbicidal composition which ensures no injuries to the crops such as yellowing, phyto-toxicity, plant deformations, decolorization etc.

One of the objects and advantage of the present disclosure is to provide a novel synergistic herbicidal composition that is suitable for increasing the harvest yield. (Due to excellence weed control).

SUMMARY

One aspect of the present disclosure relates to a synergistic herbicidal composition comprising herbicidally active ingredients comprising compound (A) Sulfentrazone or salts thereof, compound (B) Pendimethalin or salts thereof, and compound (C) Chlorimuron ethyl or salts thereof for controlling weeds or unwanted vegetations in crops.

In some examples, said synergistic herbicidal composition comprising at least two active ingredients along with agriculturally acceptable additives or carriers.

In some example, the synergistic herbicidal composition being made in the formulation, among others, but not being limited to a unique Water Dispersible Granule (WDG) formulation which ensures safe delivery and better utilization of active ingredients, a unique synergistic Suspension Concentrate (SC) formulation and a unique synergistic Wettable Powder (WP) formulation, a synergistic Soluble Granules (SG), a synergistic Suspo-Emulsion (SE), a synergistic Soluble Powder (SP). A formulation in the form of aqueous solutions, suspensions, also highly-concentrated aqueous, oily or other suspensions or dispersions, aqueous emulsions, aqueous microemulsions, aqueous suspo-emulsions (SE), oil dispersions (OD), emulsifiable concentrates (EC), soluble concentrates (SL), the liquid part(s) of a solid/liquid (KK) or liquid/liquid (KL) combi-pack, an oil miscible flowable concentrate (OF), an oil miscible liquid (OL), an oil-based soluble concentrate (SL), a spreading oil (SO), an oil-based ultra-low volume liquid (UL) or suspension (SU).

In some examples, the present disclosure relates to a synergistic herbicidal comprising compound (A) Sulfentrazone or salts thereof in an amount of 250 to 400 g.a.i./ha; compound (B)

Pendimethalin or salts thereof in an amount of 400 to 800 g.a.i./ha; compound (C) Chlorimuron ethyl or salts thereof in an amount 4 to 20 g.a.i./ha.

In some examples, the present disclosure relates to a synergistic herbicidal comprising compound (A) Sulfentrazone or salts thereof in an amount of 288-360 g.a.i./ha; compound (B) Pendimethalin or salts thereof in an amount of 540 to 677 g.a.i./ha; compound (C) Chlorimuron ethyl or salts thereof in an amount 7 to 9.37 g.a.i./ha.

In some examples, the present disclosure relates to a synergistic herbicidal composition, wherein the weight ratio of compound (A) to compound (B) to compound (C) is in a range of 10:15:0.1 to 25:50:5, preferably from 13:20:0.2 to 20:40:1.

In some examples, the present disclosure relates to a a synergistic herbicidal composition comprising compound (A) in an amount of 7% to 23 % w/w, compound (B) in an amount of 10% to 32 % w/w, and compound (C) in an amount of 0.05% to 0.80 % w/w of the total composition.

In some examples, further exemplary ranges for the amount of sulfentrazone in said composition may include 9% to 21 % w/w, the amount of pendimethalin in said composition may include 14 % to 30% w/w, and the amount of chlorimuron ethyl in said composition may include 0.1% to 0.6 % w/w of the total composition.

In some examples, preferably, the amount of sulfentrazone in said composition may include 9% to 16 % w/w, the amount of pendimethalin in said composition may include 14.5% to 20 % w/w, and the amount of chlorimuron ethyl in said composition may include 0.1% to 0.5% w/w of the total composition.

Said synergistic herbicidal composition comprising:

a) an effective amount of a compound (A) Sulfentrazone or salt(s) thereof in an amount of 7% to 23% w/w of the total composition;
b) an effective amount of a compound (B) Pendimethalin or salt(s) thereof in an amount of 10% to 32% w/w of the total composition;
c) an effective amount of a compound (C) Chlorimuron ethyl or salt(s) thereof in an amount of 0.05% to 0.8% w/w of the total composition;

d) one or more agriculturally acceptable additive(s) in an amount of 5% to 70% w/w of the total composition.

In some examples, said synergistic herbicidal composition of the combination which provides superior control and treatment of weeds compared to individual Sulfentrazone active, Pendimethalin active, and Chlorimuron ethyl active.

Any of the preferred lower weight ratio limits can be combined with any of the preferred upper weight ratio limits to define further suitable weight ratio ranges for the composition disclosed in the present disclosure.

In some examples, the herbicidal composition may be formulated as suspension concentrate (SC) or water dispersible granule (WG/WDG) or wettable powder (WP) or Suspo-Emulsion (SE) or Soluble Powder (SP) or the like.

In some examples, said synergistic herbicidal composition may further comprising agriculturally acceptable additives are selected from the group consisting of wetting agent(s), dispersing agent(s), anti-foaming agent(s), preservative(s), rheology modifier(s), adjuvant(s), filler(s), carrier(s) and/or mixture(s) thereof. Such composition may be produced in conventional manner, e.g. by mixing the active ingredients with at least one appropriate inert formulation adjuvant (for example, diluents, solvents, fillers and optionally other formulating ingredients such as surfactants, anti-freeze, stickers, thickeners and compounds that provide adjuvancy effects).

In some examples, the present disclosure relates to a method for preparing herbicidal composition, the process may comprise the step of mixing the active ingredients combination of Sulfentrazone, Pendimethalin, and Chlorimuron ethyl with extenders and/or surfactants or other formulating ingredients/additives. Said method is effectively control weeds infestation in useful crops, in particularly of a soybean crop, comprising the step of treating a field with a composition comprising Sulfentrazone, Pendimethalin, and Chlorimuron ethyl.

In some examples, the present disclosure relates to a method for preparing a wettable powder formulation. The method for preparing a wettable powder formulation comprising the following steps: blending and charging all the raw materials in a pre-mix blender to obtain a pre-mix;

grinding the blended pre-mix in an AC mill at a suitable feed rate to obtain a post blended pre-mix; milling and blending the post-blended pre-mix to obtain a final product.

In some examples, the herbicidal composition of the present disclosure controls a broad range of undesired plants such as annual weeds and perennial weeds. The compositions of the present disclosure are suitable for controlling a large number of harmful plants, including monocotyledonous weeds, in particular annual weeds such as gramineous weeds (grasses), including, but not being limited to *Echinochloa sp., Dinebra sp., Digiteria sp., Brachiaria sp., Panicum* sp *Eluseen sp., Digera sp.,Eragrotis sp. Setaria sp. Cenchrus* sp *Acalipha sp., Physallis sp., Commelina sp., Ephorbia sp., Abutilon sp., Cellesia sp.,Phyllanthus sp., Anotis sp., Amaranthus sp., Cucumis sp.* and *Ipomoea sp.*

The composition according to the disclosure is suitable for all methods of application conventionally used in agriculture, e.g. pre-emergence application. The composition according to the disclosure is suitable especially for controlling weeds in soybean. "Crops of useful plants" are to be understood as including those which have been made tolerant to herbicides or classes of herbicides as a result of conventional methods of breeding or genetic engineering.

The present disclosure further provides herbicidal compositions for the control of undesirable plant species in the presence of Soybean plants. Preferred herbicides for the control of undesirable plant species in the presence of Soybean plants include Diclosulam, Clomazone, Oxaziclomefone, Flumioxazin, Pyroxasulfone, Imazethapyr, and mixtures thereof.

Other aspects and advantages of the present disclosure will be apparent to those skilled in the art from the description and appended claims provided below.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The foregoing and other objects, features, and advantages of the present disclosure will be apparent from the following detailed description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is an illustration of the soybean field without treatment of herbicide;

Fig. 2 is an illustration of the soybean field without treatment of herbicide;

Fig. 3 is an illustration of the field experiment conducted on soybean weeds @45 days after application, treated with combination of Sulfentrazone, Pendimethalin and Chlorimuron ethyl of the present disclosure;

Fig. 4 is an illustration of the field experiment conducted on soybean weeds @45 days after application, treated with combination of Sulfentrazone, Pendimethalin and Chlorimuron ethyl of the present disclosure.

DETAILED DESCRIPTION

The following definitions provided herein for the terminologies used in the present disclosure are for illustrative purposes only and in no manner limit the scope of the present disclosure.

As used herein, the terms “comprise”, “comprising”, “includes”, “including”, “has”, “having”, “contains”, “containing”, “characterized by” or any other variation thereof, are intended to cover a non-exclusive inclusion, subject to any limitation explicitly indicated. For example, a composition, mixture, process or method which comprises a list of elements is not necessarily limited to only those elements but may include other elements not expressly listed or inherent to such composition, mixture, process or method.

Further, unless expressly stated to the contrary, “or” refers to an inclusive “or” and not to an exclusive “or”. For example, a condition A “or” B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present). It should also be noted that the term “or” is generally employed in its sense including “and/or” unless the content clearly dictates otherwise.

As used in the present disclosure, the singular forms “a”, “an” and “the” include plural referents unless the context clearly dictates otherwise. Thus, for example, the reference to “a surfactant” includes one or more of such surfactants. Furthermore, the indefinite articles “a” and “an” preceding an element or component of the present disclosure are intended to be non-restrictive regarding the number of instances (i.e., occurrences) of the element or component. Therefore “a” or “an” should be read to include one or at least one, and the singular word form of the element

or component also includes the plural unless the number is obviously meant to be singular. The singular forms “a” and “an”, “the” include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to a composition comprising “a compound” includes a mixture of two or more compounds.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one ordinary skilled in the art to which the disclosure pertains. Although other methods and materials similar, or equivalent, to those described herein may be used in the practice of the present disclosure, the preferred materials and methods are described herein.

Abbreviations

AE: Aerosol	SG: Water soluble granule
CS: Capsule suspension	SP: Water soluble powder
DP: Dustable powder	SU: Ultra-low volume (ULV) suspension
EC: Emulsifiable concentrate	ME: Micro-emulsion
EG: Emulsifiable granule	OD: Oil dispersion
EW: Oil-in water emulsion	UL: Ultra-low volume liquid
e.g.: Example	ULV: Ultra-low volume
GR: Granule	WDG/WG: Water dispersible granule
SC: Suspension concentrate	WP: Wettable powder
SE: Suspo-emulsion	WT: Water dispersible tablet

It is to be understood that all the above stated terminology used herein is/are for the purpose of describing various aspects, examples, only of the present disclosure and is not intended to be limiting.

It is to be understood that as used in the present disclosure, the term “composition” or “formulation” may be used interchangeably, unless stated otherwise, is meant to encompass, and are not limited to, compositions or formulations containing the combination of Sulfentrazone, Pendimethalin, and Chlorimuron ethyl.

The expression of various quantities in the terms of “g.a.i/ha” means the gram active ingredient per hectare.

The term “weeds” are defined as unwanted plants in crop fields which grow along with the desirable main crop.

The terms “pesticide” or “herbicide” is used herein to describe the active ingredients which kills, controls or otherwise adversely modifies the growth of undesired plants of weeds in crops or may surrounds the crop. A pesticidally effective dose or controlling dose is an amount of active ingredient(s) which causes an adversely modifying effect in the pathogens/weeds/insects such as deviations from natural development, killing, regulation, desiccation, retardation and the like.

The term “resistance” or “cross resistance” refers to the event occurs where weeds or pathogens is being resistance to the pesticides or a group of pesticides and becomes resistant after a period of time, to one or more other pesticide on a later stage.

The expression of various quantities in the terms of “% w/w” means the percentage by weight, relative to the weight of the total composition unless otherwise specified.

The terms “plants and vegetation” are used herein include germinant seeds, emerging seedlings, plants emerging from vegetative propagules and established vegetation.

The terms like “protecting a plant from weed/unwanted plants” includes preventative action and/or curative action to reduce the growth of the weed/unwanted plants which surrounds crops.

The term “crop plant” and “crops of useful plants” or “crop(s)” used herein refers to the plant or plant product that may be grown and harvested on a large scale for profit or subsistence.

Parts of plants of organs of plants, such as shoot, leaf, flower and root, examples which may be mentioned being leaves, needles, stems, trunks, flowers, fruit-bodies, fruits and seeds and also roots, tubers and rhizomes.

As used in the present disclosure, the term “additive(s)” or "auxiliary agent(s)" or “agriculturally acceptable carrier(s)” may be used interchangeably and refers to inert substances which are

commonly used as diluent, to provide stability or to increase the activity profile of the composition or formulation with or without having agrochemical activity or direct effect on the undesired growth of unwanted plants/weeds.

As used herein, the term “defoaming agent(s)” or “antifoam” refers to a chemical additive that reduces and hinders the formation of foam in the industrial process liquids, semi-solids, or solids. The terms defoaming agent and anti-foaming agent may be used interchangeably.

As used herein, the term “wetting agent (s)”, refers to a chemical additive used in herbicide formulations to reduce the surface tension of the spray solution, thereby enhancing the spreading and penetration of the herbicide on plant surfaces.

As used herein, the term “dispersing agent(s)”, refers to a chemical additive that help to distribute and stabilize solid particles within a liquid medium, preventing the particles from clumping together or settling.

As used herein, the term “filler” or “diluant”, refers to an inert substance added to materials, formulations, or mixtures to increase volume, improve properties, or modify physical characteristics without significantly affecting the primary function of the product. They typically used to enhance strength, durability, or bulk, while diluents are used to reduce concentration, viscosity, or to facilitate application or processing.

The term “Rheology modifier” refers to a chemical additive in pesticide that adjust the viscosity and flow properties of the spray solution, improving application and effectiveness.

The term “preservative” refers to a chemical additive used in pesticide formulations to prevent microbial growth, spoilage, and degradation of the active ingredients, thereby extending the shelf life and maintaining the effectiveness of the pesticide.

Unless otherwise specified, % refers to % weight; and % weight refers to % of the weight of the respective component with respect to the total weight of the composition.

As used herein, the term “locus" means a plant, plant parts, plant propagation material (preferably seed), soil, area, material or environment in which a pest is growing or may grow.

As used herein, the term the term “plant propagation material” is to be understood to denote all the generative parts of the plant such as seeds and vegetative plant material such as cuttings and tubers (e. g. potatoes), which may be used for the multiplication of the plant. Said term includes seeds, roots, fruits, tubers, bulbs, rhizomes, shoots, sprouts and other parts of plants, including seedlings and young plants, which are to be transplanted after germination or after emergence from soil. These young plants may also be protected before transplantation by a total or partial treatment by immersion or pouring. In a particular preferred embodiment, the term propagation material denotes seeds.

As used herein, the term “effective amount” means the amount of the active substances in the compositions to achieve an observable effect on growth, including the effects of necrosis, death, retardation, prevention, and removal, destruction, or otherwise diminishing the occurrence and activity of the target organism. The effective amount may vary for the various compositions used in the present disclosure. An effective amount of the compositions will also vary according to the prevailing conditions such as desired pesticidal effect and duration, weather, target species, locus, mode of application, and the like.

The term “Wettable Powder” as used in the present disclosure refers to a type of pesticide formulation where the active ingredient is blended with finely ground dry particles and other additives. These powders are designed to be mixed with water before application. When added to water, the powder forms a suspension that may be sprayed onto crops.

Parts of plants also include harvested plants and vegetative and generative propagation material, for example seedlings, tubers, rhizomes, cuttings, and seeds.

According to the present disclosure, it is possible to treat all plants and parts of plants. Plants are to be understood here as meaning all plants including useful plants and plant populations such as desired and undesired wild plants or crop plants (including naturally occurring crop plants). Crop plants may be plants which may be obtained by conventional breeding and optimization methods or by biotechnological and genetic engineering methods or combination of these methods, including the transgenic plants and including the plant cultivars which may or cannot be protected by plant breeders' certificates. Parts of plants are to be understood as meaning all above-ground and below-ground parts and organs of plants, such as

shoot, leaf, flower and root, examples which may be mentioned being leaves, needles, stems, trunks, flowers, fruit-bodies, fruits and seeds and also roots, tubers and rhizomes. Parts of plants also include harvested plants and vegetative and generative propagation material, for example seedlings, tubers, rhizomes, cuttings and seeds.

The treatment of the plants and parts of plants according to the present disclosure with the active compounds is carried out directly or by activity on their environment, habitat or storage area according to customary treatment methods, for example by dipping, spraying, evaporating, atomizing, broadcasting, brushing-on and, in the case of propagation material, in particular in the case of seeds, furthermore by one- or multi-layer coating.

A synergistic effect exists whenever the action of an active ingredient combination is greater than the sum of the actions of the individual components. The action to be expected “E” for a given active ingredient combination obeys the so-called COLBY formula and can be calculated as follows (COLBY, S.R. "Calculating synergistic and antagonistic responses of herbicide combination". Weeds, Vol. 15, pages 20-22; 1967):

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

X = % action by active ingredient (A) using p ppm of active ingredient
Y = % action by active ingredients (B+C) using q ppm of active ingredient.

Or:

X = % action by active ingredient (A+B) using p ppm of active ingredient
Y = % action by active ingredient (C) using q ppm of active ingredient.

Or:

X = % action by active ingredient (A+C) using p ppm of active ingredient
Y = % action by active ingredient (B) using q ppm of active ingredient.

According to COLBY, the expected (additive) action of active ingredients (A)+(B+C) or (A+B) + (C) or (A+C) + (B) using + m of active ingredient is:

$$E = X + Y - \frac{X \cdot Y}{100}$$

If the action actually observed (O) is greater than the expected action (E), then the action of the combination is super-additive, i.e., there is a synergistic effect. In mathematical terms, synergism corresponds to a positive value for the difference of (O-E). In the case of purely complementary addition of activities (expected activity), said difference (O-E) is zero. A negative value of said difference (O-E) signals a loss of activity compared to the expected activity.

Synergism can also be calculated by using the following formula:

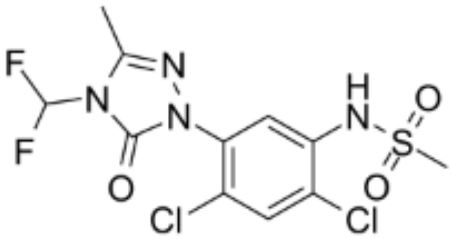
$$E \text{ (expected value)} = X + Y + Z - [(X Y) + (X Z) + (Y Z)/100] + [X Y Z/10000]$$

In one of the examples, said composition of present disclosure may control a broad range of unwanted plants/weeds *Echinochloa, Scirpus, Monochoria, Sagittaria, Cyperus, Ludwigia, Brachiaria, Setaria, Leptochloa, Cyperus, and Ipomoea* etc., which are responsible to cause 25% yield losses in soybean crops.

In some examples, the expression "composition" refers to the various mixtures or combination or formulations of sulfentrazone, pendimethalin, and chlorimuron ethyl for example in a single "ready-mix" form, "pre-mix" form, in a combined spray mixture composed from separate formulations of the single active ingredient components, such as a "tank-mix", and in a combined use of the single active ingredients when applied in a sequential manner, i.e. one after the other with a reasonably short period, such as a few hours or days. The order of applying the individual components of the combination of sulfentrazone, pendimethalin, and chlorimuron ethyl is not essential for working the present disclosure.

Said synergistic herbicidal composition comprising compound (A) Sulfentrazone or salts thereof, compound (B) pendimethalin of salts thereof, and compound (C) chlorimuron ethyl or salts thereof.

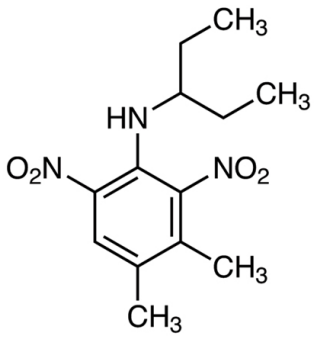
Wherein sulfentrazone being a compound (A) of Formula (I)



Formula (I)

is a chemical compound from the Aryl triazolinone herbicides and an herbicide with the formula $C_{11}H_{10}Cl_2F_2N_4O_3S$. Preferred IUPAC name of component sulfentrazone is N-[2,4-dichloro-5-[4-(difluoromethyl)-3-methyl-5-oxo-1,2,4-triazol-1-yl]phenyl]methanesulfonamide.

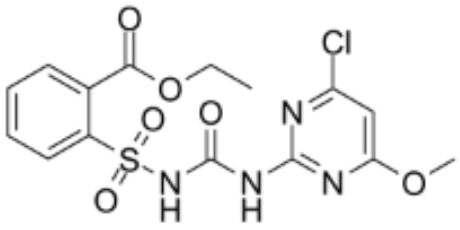
Wherein pendimethalin being a compound (B) of Formula (II)



Formula (II)

is a known organic compound and a member of the dinitroaniline class with the structural formula $C_{13}H_{19}N_3O_4$. The preferred IUPAC name of pendimethalin is 3,4-dimethyl-2,6-dinitro-N-pentan-3-ylaniline.

Wherein chlorimuron being a compound (C) of Formula (III)



Formula (III)

is a chemical compound and a member of sulfonylureas with the chemical formula $C_{13}H_{11}ClN_40_6S$. Preferred IUPAC name of chlorimuron ethyl is 2-[(4-chloro-6-methoxypyrimidin-2-yl) carbamoylsulfamoyl]benzoic acid.

In one of the examples, said synergistic herbicidal comprising compound (A) Sulfentrazone or salts thereof in an amount of 250 to 400 g.a.i./ha; compound (B) Pendimethalin or salts thereof in an amount of 400 to 800 g.a.i./ha; compound (C) Chlorimuron ethyl or salts thereof in an amount 4 to 20 g.a.i./ha.

In one of the examples, said synergistic herbicidal comprising compound (A) Sulfentrazone or salts thereof in an amount of 288-360 g.a.i./ha; compound (B) Pendimethalin or salts thereof in an amount of 540 to 677 g.a.i./ha; compound (C) Chlorimuron ethyl or salts thereof in an amount 7 to 9.37 g.a.i./ha.

In some examples, said synergistic herbicidal composition comprising compound (A), compound (B) and compound (C), wherein the weight ratio of compound (A) to compound (B) to compound (C) is in a range of 10:15:0.1 to 25:50:5, preferably from 13:20:0.2 to 20:40:1.

In some examples, said synergistic herbicidal composition comprising compound (A) in an amount of 7% to 23 % w/w, compound (B) in an amount of 10% to 32 % w/w, and compound (C) in an amount of 0.05% to 0.80 % w/w of the total composition. As an example, further exemplary ranges for the amount of sulfentrazone in said composition may include 9% to 21 % w/w, the amount of pendimethalin in said composition may include 14% to 30% w/w, and the amount of chlorimuron in said composition may include 0.1% to 0.6 % w/w of the total composition.

In some examples, preferably, the amount of sulfentrazone in said composition may include 9% to 16 % w/w, the amount of pendimethalin in said composition may include 14.5% to 20 % w/w, and the amount of chlorimuron ethyl in said composition may include 0.1% to 0.5% w/w of the total composition.

In some examples, said synergistic herbicidal composition comprising:

a) an effective amount of a compound (A) Sulfentrazone or salt(s) thereof in an amount of 7% to 23% w/w of the total composition;

b) an effective amount of a compound (B) Pendimethalin or salt(s) thereof in an amount of 10% to 32% w/w of the total composition;

c) an effective amount of a compound (C) Chlorimuron ethyl or salt(s) thereof in an amount of 0.05% to 0.8% w/w of the total composition;

d) one or more agriculturally acceptable additive(s) in an amount of 5% to 70% w/w of the total composition.

In some examples, said herbicidal composition of the present disclosure may be formulated in the forms given below: Wettable powder (WP), Water soluble granule (SG), Soluble concentrate (SL), Water soluble powder (SP), Water dispersible granule (WG or WDG), Water dispersible powder for slurry treatment (WS), Capsule suspension (CS), Water-soluble tablets (ST), an ultra-low volume (ULV) liquid (UL), an ultra-low volume (ULV) suspension (SU), Dispersible concentrate (DC), Powder for dry seed treatment (DS), Emulsifiable concentrate (EC), Emulsion, water in oil (EO), Emulsion, oil in water (EW), a water dispersible tablet (WT) Emulsion for seed treatment (ES), Flowable suspension/concentrate for seed treatment (FS), Granule/ soil applied (GR), Controlled (Slow or Fast) release granules (CR) Solution for seed treatment (LS), Micro-emulsion (ME), Oil dispersion (OD), Oil miscible Flowable concentrate (oil miscible suspension (OF), Oil miscible liquid (OL), Suspension concentrate (Flowable concentrate) (SC), Suspo-emulsion (SE).

In some examples, the composition may be is formulated as a water dispersible granule (WDG)/(WG), Water soluble granule (SG), Suspension concentrate (Flowable concentrate) (SC), Wettable powder (WP), Suspo-Emulsion (SE) or the like.

In some examples, said synergistic herbicidal composition comprising active ingredients further comprises one or more inactive excipient (s) including but not limited to wetting agent(s), dispersing agent(s), anti-foaming agent(s), preservative(s), rheology modifier(s), adjuvant(s), filler(s), carrier(s), liquid carrier(s) and/or mixture(s) thereof.

In some examples, said synergistic herbicidal composition comprising active ingredients further comprises one or more inactive excipient (s) including but not limited to wetting agent(s),

dispersing agent(s), anti-foaming agent(s), preservative(s), rheology modifier(s), adjuvant(s), filler(s), carrier(s), liquid carrier(s) and/or mixture(s) thereof.

In some examples, the dispersing agent may be selected from the group consisting of Sodium polyalkyl naphthalene sulfonate, Naphthalene Sulphonate formaldehyde condensate sodium salt, Sodium salt of methyl naphthalene sulfonate, Phenol sulfonic acid-formaldehyde, sodium ligno sulphonate, acrylate copolymer, phenol sulfonic acid-formaldehydepolycondensation as sodium salt, sodium polycarboxylate, acrylate copolymer, sodium methyl oleoyl taurate, propylene oxide co-polymer, and sodium lauryl sulphate and/or mixture(s) thereof.

In some examples, the anti-foaming agent may be selected from the group consisting of polydimethyl Siloxane, dimethyl polysiloxane, dimethyl siloxane, dimethylpolysiloxane and/or mixture(s) thereof.

In some examples, the rheology modifier may be selected from the group consisting of hydrophobic, hydrophilic fumed, precipitated silica particles, silicon dioxide, hydrogenated castor oil (trihydroxy stearin), Xanthan gum, castor oil organic derivatives and/or mixture(s) thereof.

In some examples, the filler and carrier may be selected from the group consisting of China Clay, River Sand, talc, calcium carbonate, kaolin, water, oil, and various organic solvents and/or mixture(s) thereof.

In some examples, said composition having certain weight ratios of compound (A) mixed with compound (B) and with compound (C) are able to give rise to synergistic activity. Therefore, in one of the examples, compound (A), compound (B) and compound (C) may present in the composition in amounts producing a synergistic effect.

Said synergistic activity is apparent from the fact that the herbicidal activity of the composition comprising compound (A), compound (B) and compound (C) is greater than the sum of the herbicidal activities of compound (A), compound (B) and compound (C). Said synergistic activity extends the range of action of compound (A), compound (B) and compound (C) in three ways. Firstly, the rates of application of compound (A), compound (B) and compound (C) are lowered whilst the action remains equally good, meaning that the active ingredients mixture still

achieves a high degree of weed control even where the three individual components have become totally ineffective in such a low application rate range. Secondly, there is a substantial broadening of the spectrum of weeds that may be comprehensibly controlled.

In order to facilitate a comprehensive understanding of the present disclosure, the following example(s) are presented primarily for the purpose of illustrating more specific details thereof. The scope of the present disclosure should not be deemed limited by the examples, but encompasses the entire subject matter defined in the claims. Thus, the present disclosure is not, however, limited to the example(s) provided herein.

Example 1: Composition of sulfentrazone, pendimethalin, and chlorimuron ethyl in the formulation of Wettable Powder (WP):

Table 1: Composition in Wettable Powder (WP) formulation:

S. No.	Ingredients	Function	Percentages w/w
1.	Sulfentrazone	Active ingredient	10.00%
2.	Pendimethalin	Active ingredient	15.00%
3.	Chlorimuron ethyl	Active ingredient	0.375%
4.	Precipitated Silica	Filler	5.00%
5.	Sodium Naphthalene Sulfonate	Wetting Agent	3.00%
6.	Sodium lignin sulfonate	Dispersing agent	4.00%
7.	China Clay	Filler	Q.S. to make 100%
	Total		**100%**

Preparation method steps:

The following method is finalized for preparation of herbicidal composition comprising sulfentrazone, pendimethalin and chlorimuron ethyl for Wettable Powder (WP) formulation in the laboratory. The ingredients in the process are mentioned in Table 1 while the lab process comprising the following steps:

Step-I: Blending

All the Raw material need to be charged in the Pre-Mix Blender and blended thoroughly to prepare a blended pre-mix.

Step-II: Milling and Grinding

The blended pre-mix need to be fed to the AC Mill at a suitable feed rate to obtain proper grinding.

Step-III: Blending

After milling, the pre-mix is to be fed to the post Blender and blended again.

Biological Examples:

A synergistic effect of the combination is always present when the herbicidal activity of the active compound combinations exceeds the total of the activities of the active herbicides when applied individually. So, the expected activities for three combinations of two active compounds were also calculated by using the Colby's formula (Colby, S.R. "Calculating synergistic and antagonistic responses of herbicide combination", Weeds, Vol. 15, pages 20-22; 1967).

Colby's formula:

The expected activity for a given combination of two active compounds (binary composition) can be calculated as follows:

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

X = % action by active ingredient (A) using p ppm of active ingredient
Y = % action by active ingredients (B+C) using q ppm of active ingredient.

Or:

X = % action by active ingredient (A+B) using p ppm of active ingredient
Y = % action by active ingredient (C) using q ppm of active ingredient.

Or:

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

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

According to COLBY, the expected (additive) action of active ingredients (A)+(B+C) or (A+B) + (C) or (A+C) + (B) using + m of active ingredient is:

$$E = X + Y - \frac{X \cdot Y}{100}$$

If the action actually observed (O) is greater than the expected action (E), then the action of the combination is super-additive, i.e., there is a synergistic effect. In mathematical terms, synergism corresponds to a positive value for the difference of (O-E). In the case of purely complementary addition of activities (expected activity), said difference (O-E) is zero. A negative value of said difference (O-E) signals a loss of activity compared to the expected activity.

FIELD AND SYNERGY STUDIES

Experiment 1: Synergistic herbicidal combination of sulfentrazone, pendimethalin, and chlorimuron ethyl effect on soybean crops:

1.	**Season**	Kharif
2.	**Location**	Indore, MP
3.	**Crop & Variety**	Soybean JS 2034
4.	**Design/Layout**	Randomized Block design (RBD)
5.	**Plot size**	20 sq meter
6.	**Number of treatments**	1
7.	**Number of replications**	3
8.	**Method of application**	Spray
9.	**Application time**	June
10.	**Spray volume**	580 + 360 +8 gm AI/ hectare
11.	**Observation time**	7 DAA, 15 DAA, 30 DAA, 45 DAA

Treatment details:

The herbicidal activity of the herbicides and composition(s) of the present disclosure were tested on various weeds/unwanted plants in soybean crop such as, but not being limited to *Echinochloa, Scirpus, Monochoria, Sagittaria, Cyperus, Ludwigia, Brachiaria, Setaria, Leptochloa, Cyperus, and Ipomoea, Echinochloa sp., Dinebra sp., Digiteria sp., Brachiaria sp., , Panicum* sp *Eluseen sp., Digera sp.,Eragrotis sp. Setaria sp. Cenchrus* sp *Acalipha sp., Physallis sp., Commelina sp., Ephorbia sp., Abutilon sp., Cellesia sp.,Phyllanthus sp., Anotis sp., Amaranthus sp., Cucumis sp., etc.* and others.

The Bio efficacy trials were conducted at various locations across India to produce independent experimental data. A total of 9 treatments were taken up in the season of Kharif at Multiple locations at Madhya Pradesh, India. The trials were conducted in in Randomized Block Design with 3 replicates per treatment under GAP (Good Agricultural Practice) practice. Spraying was done with battery operated backpack knapsack sprayer with 500 Litre of water per hectare as spray volume.

The trials were conducted in in Randomized Block Design with 3 replicates per treatment under GAP (Good Agricultural Practice) practice. Spraying was done with battery operated backpack knapsack sprayer with 500 Litre of water per hectare as spray volume.

The ternary composition of the present disclosure in wettable powder (WP) formulation, treatment was applied on soybean crops. One spray was given, and the mean results were recorded at 7 DAA, 15 DAA, 30 DAA and 45DAA respectively. The mortality % of weeds/unwanted vegetation is higher in case of the combination as compared to the individual active ingredients as per the below mentioned Table 2:

Table 2: Bio-efficacy of sulfentrazone, pendimethalin, and chlorimuron ethyl combination on different soybean weeds:

Bio-efficacy of sulfentrazone, pendimethalin, and chlorimuron ethyl combination on different Soybean weeds (% control over untreated)																			
					Application rate			Grassy (30DAA)		Broad(30DAA)		Total weed(30DAA)		Grassy (45DAA)		Broad(45DAA)		Total (45DAA)	
	Treatment	AI			Dose g a.i./ha			Observed Value (%)	Expected Value (%)	Observed Value (%)	Expected Value (%)	Observed Value (%)	Expected Value (%)	Observed Value (%)	Expected Value (%)	Observed Value (%)	Expected Value (%)	Observed Value (%)	Expected Value (%)
		(A)	(B)																
	T1	Pendimethalin			677			64		25		44.5		48		15		31.5	
	T2	Pendimethalin			540			54		15		34.5		42		10		26.0	
	T3	Sulfentrazone			360			40		58		49		25		44		34.5	
	T4	Sulfentrazone			288			34		50		42		15		38		26.5	
	T5	Chlorimuron ethyl			9.37			3		32		17.5		2		17		9.5	
	T6	Chlorimuron ethyl			7.5			2		22		12		1		14		7.5	
WP	T7	Pendimethalin	Sulfentrazone	Chlorimuron ethyl	677	360	9.4	100	77.51	100	78.58	100	76.65	95	61.78	89.12	60.49	92.06	58.9
	T8	Pendimethalin	Sulfentrazone	Chlorimuron ethyl	540	360	7.5	100	72.95	100	72.15	100	70.6	92.54	56.93	86.71	56.65	89.63	55.2
	T9	Pendimethalin	Sulfentrazone	Chlorimuron ethyl	540	288	7.5	80.66	70.24	84.66	66.85	82.66	66.56	75.78	51.25	80.31	52.01	78.05	49.7

The data record in Table 2 illustrates the herbicidally combination of sulfentrazone, pendimethalin, and chlorimuron ethyl when applied to the soybean field shows synergistic effect as compared to their solo application(s). The result obtained described synergistic effect when compared with the calculated expected response values (Colby's Method), as reproduced in above Table 2.

The Table 2 describes that treatments T7 to T9 of the combination of sulfentrazone, pendimethalin, and chlorimuron ethyl in wettable powder formulation (WP) shows enhanced efficacy and synergistic effect in suppressing and controls the Grassy and broad leaves, including, but not being limited to *Echinochloa Colona, Echinochloa Crusgalli, Leptochloa Chinensis, Cyperus difformis, Scripus sp, Monochoria sp, Marsilea quadrifoloa, Ludwigia, Alternanthera, Portulaca* in the soybean crop after 30 and 45 days applications (30 DAA and 45DAA) as compared to the solo application(s) of sulfentrazone active, pendimethalin active, and chlorimuron ethyl active.

Crop observations:

As shown in Fig. 1 to Fig. 4, the ternary combination of sulfentrazone, pendimethalin, and chlorimuron ethyl provides a synergistic effect in controlling weeds or unwanted vegetation, compared to untreated weeds in soybean crops.

Conclusion

The treatments T5 to T10, combination of sulfentrazone, pendimethalin, and chlorimuron ethyl in water soluble suspo-emulsion (SE) and wettable powder (WP) shows higher observed % value and were significantly superior to untreated and solo treatments of active ingredients Pendimethalin and Sulfentrazone indicating synergistic effect on broad array of weeds or unwanted vegetations *Echinochloa Colona, Echinochloa Crusgalli, Leptochloa Chinensis, Cyperus difformis, Scripus sp, Monochoria sp, Marsilea quadrifoloa, Ludwigia, Alternanthera, Portulaca* in the soybean crop.

Besides the actual synergistic action with respect to herbicidal activity, the herbicidal composition according to the present disclosure also have further surprising advantageous properties which may also be described, in a wider sense, as synergistic activity.

The examples herein and the various features and advantageous details thereof are explained with reference to the non-limiting embodiments in the description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

The present disclosure will so fully reveal the general nature of the examples herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the examples herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein may be practiced with modification within the spirit and scope of the embodiments as described herein.

Any discussion of documents, acts, materials, devices, articles and the like that has been included in the present disclosure is solely for the purpose of providing a context for the disclosure. It is not to be taken as an admission that any or all of these matters form a part of the prior art base or were common general knowledge in the field relevant to the disclosure as it existed anywhere before the priority date of the application.

The numerical values mentioned in the disclosure and the claims though might form a critical part of the present disclosure, any deviation from such numerical values shall still fall within the scope of the present disclosure if that deviation follows the same scientific principle as that of the present disclosure.

I CLAIM:

1. A synergistic herbicidal composition comprising:

e) an effective amount of a compound (A) sulfentrazone of formula (I) or salt(s) thereof in an amount of 7% to 23% w/w of the total composition;

f) an effective amount of a compound (B) pendimethalin formula (II) or salt(s) thereof in an amount of 10% to 32% w/w of the total composition;

g) an effective amount of a compound (C) chlorimuron ethyl formula (III) or salt(s) thereof in an amount of 0.05% to 0.8% w/w of the total composition;

h) one or more agriculturally acceptable additive(s) in an amount of 5% to 70%w/w of the total composition.

2. The composition as claimed in claim 1, wherein the composition is formulated as a dry flowable (DF) or a wettable powder (WP) or Water Dispersible Granule (WG) or Suspension Concentrate (SC) or Suspo-Emulsion (SE) or Emulsifiable Concentrates (EC), soluble Granule (SG) or directly sprayable or dilutable solutions, soluble powders, dusts, granules or microcapsules or the like.

3. The composition as claimed in claim 1, wherein the compound (A) sulfentrazone or salts thereof is present in an amount of 250 to 400 g.a.i./ha.

4. The composition as claimed in claim 1, wherein the compound (B) pendimethalin or salts thereof is present in an amount of 400 to 800 g.a.i./ha.

5. The composition as claimed in claim 1, wherein the compound (C) Chlorimuron ethyl or salts thereof is present in an amount of 4-20 g.a.i./ha.

6. The composition as claimed in claim 1, wherein the weight ratio of compound (A) to compound (B) to comound (C) is in a range of 10:15:0.1 to 25:50:5.

7. The composition as claimed in claim 1, wherein the agriculturally acceptable additives are selected from the group consisting of wetting agent, dispersing agent, anti-foaming agent,

preservative, rheology modifier, adjuvant, filler, formulating agent, carrier and/or mixture(s) thereof.

8. The composition as claimed in claim 7, wherein the wetting agent is selected from the group consisting of sodium alkylnaphthalene sulfonate formaldehyde, sodium lauryl sulfate, sodium napthaline sulphonate, polyalkoxylated butyl ether, polyoxyethylene fatty alcohol ethers, alkylated naphthalene sulphonate formaldehyde polymer, alkyl aryl sulphonate.

9. The composition as claimed in claim 7, wherein the dispersing agent is selected from the group consisting of Sodium polyalkyl naphthalene sulfonate, Napthalene Sulphonate formaldehyde condensate sodium salt, Sodium salt of methyl naphthalene sulfonate, Phenol sulfonic acid-formaldehyde, sodium ligno sulphonate, acrylate copolymer, phenol sulfonic acid-formaldehydepolycondensation as sodium salt, sodium polycarboxylate, acrylate copolymer, sodium methyl oleoyl taurate, propylene oxide co-polymer, and sodium lauryl sulphate and/or mixture(s) thereof.

10. The composition as claimed in claim 7, wherein the anti-foaming agent is selected from the group consisting of polydimethyl Siloxane, dimethyl polysiloxane, dimethyl siloxane, dimethylpolysiloxane and/or mixture(s) thereof.

11. The composition as claimed in claim 7, wherein the rheology modifier is selected from the group consisting of hydrophobic, hydrophilic fumed, precipitated silica particles, silicon dioxide, hydrogenated castor oil (trihydroxy stearin), Xantham gum, castor oil organic derivatives and/or mixture(s) thereof.

12. The composition as claimed in claim 7, wherein the filler and carrier are selected from the group consisting of China Clay, River Sand, talc, calcium carbonate, kaolin, water, oil, and various organic solvents and/or mixture(s) thereof.

13. The composition as claimed in claim 7, wherein the formulating agent selected from the group consisting of propylene glycol, silica acid, silicone, sodium alkylnaphthalene sulfonate formaldehyde condensate, sodium dialkyl naphathalene sulfonate, sodium

dioctyl sulfosuccinate, sodium lignosulfonate sulfomethylated, sodium naphthalene sulfonate, sodium polycarboxylate, sodium salt of alcohol ether sulfate, sodium salt of poly carboxylic acid, soluble starch, ethylene oxide-propylene oxide, tallow soap, xanthan gum and/or mixture(s) thereof.

14. A process for preparing a water dispersible granule formulation of the composition as claimed in claim 1, the process comprising the steps of:

a) mixing all ingredients according to a batch size using a ribbon blender-type mixer to form a homogeneous blend pre-mix;
b) milling the homogenous blend pre-mix using an air jet mill;
c) grinding the pre-mix in a post-blender to achieve the particle size i.e., below 10 micrometers to produce a fine powder;
d) blending the fine powder in a post-blender to prepare a milled material;
e) preparing a dough from the fine milled material in a dough-making machine;
f) extruding the dough using an extruder to form extruded granules;
g) drying the extruded granules using a fluid bed dryer at a temperature of 50°C.

15. A process for preparing a wettable powder formulation of the composition as claimed in claim 1, the process comprising the steps of:

a) blending and charging all raw materials in a pre-mix blender to obtain a blended pre-mix;
b) grinding the blended pre-mix in an AC mill;
c) milling and blending the post-blended pre-mix.

Dated this 6th day of September 2023.



PRABHAKAR MANI PRATAP
for VUTTS & ASSOCIATES LLP
AGENT FOR THE APPLICANT
IN/PA No. 1217

ABSTRACT

BROAD SPECTRUM HERBICIDAL COMPOSITION AND RELATED METHODS THEREOF

The disclosure relates to a novel synergistic ternary herbicidal composition comprising (A) Sulfentrazone, (B) Pendimethalin, and (C) Chlorimuron ethyl for the treatment and control of weeds in useful crops. The ternary herbicidal composition for management of unwanted vegetation. The present disclosure further relates to a method of preparation of such herbicidal composition and method of using the same.

Untreated control @45 days after Application



Fig. 1

Untreated control @45 days after Application



Fig. 2

PRABHAKAR MANI PRATAP
of VUTTS & ASSOCIATES LLP
AGENT FOR THE APPLICANT
IN/PA No. 1217

Sulfentrazone +Pendimethalin + Chlorimuron ethyl @45 days after Application



Fig. 3

Sulfentrazone +Pendimethalin + Chlorimuron ethyl @45 days after Application



Fig. 4

PRABHAKAR MANI PRATAP
of VUTTS & ASSOCIATES LLP
AGENT FOR THE APPLICANT
IN/PA No. 1217