

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

(19) World Intellectual Property

Organization

International Bureau

(43) International Publication Date

19 December 2024 (19.12.2024)



(10) International Publication Number

WO 2024/257004 A1

(51) International Patent Classification:

A01N 43/54 (2006.01) A01P 13/02 (2006.01)

(21) International Application Number:

PCT/IB2024/055786

(22) International Filing Date:

13 June 2024 (13.06.2024)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

202311041072 16 June 2023 (16.06.2023) IN

(71) Applicants: **UPL MAURITIUS LIMITED** [MU/MU]; 6th Floor, Suite 157B, Harbor Front Building, President John Kennedy Street, Port Louis (MU). **UPL EUROPE SUPPLY CHAIN GMBH** [—/CH]; Suurstoffi 37, 6343 Rotkreuz/Risch (CH).

(72) Inventors: **NETO, Ayrton Berger**; R. José Geraldo Ferreira, 105 - Notre Dame, 13092-807 Campinas - SP (BR). **LEAL, Jéssica Ferreira Lourenco**; R. José Geraldo Ferreira, 105 - Notre Dame, 13092-807 Campinas - SP (BR). **FERREIRA, Flavia Megda**; R. José Geraldo Ferreira, 105 - Notre Dame, 13092-807 Campinas - SP (BR). **KORIA-MA, Rodrigo**; R. José Geraldo Ferreira, 105 - Notre Dame, 13092-807 Campinas - SP (BR).

(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).

(54) Title: METHOD OF CONTROLLING WEEDS

(57) Abstract: The present invention provides an effective herbicidal combination, its use and a method for controlling broad-spectrum weeds. The present invention provides a herbicidal combination comprising saflufenacil and triclopyr for effective such that the application amount of the saflufenacil is substantially reduced by at least 80% of the standard application amount of said herbicide, and at least 70% control of undesired weeds is obtained.

WO 2024/257004 A1

METHOD OF CONTROLLING WEEDS

Technical field

[0001] The present invention provides an effective herbicidal combination, it uses and a method for controlling broad-spectrum and resistant variety of weeds.

5 **Background of the invention**

[0002] Weeds are the most problematic organisms in agricultural areas, costing >US\$25 billion per year in crop yield reductions, and an additional US\$7 billion on herbicide control. An unfortunate outcome of the excessive reliance on herbicides is the evolution of herbicide resistance in weeds, as a once susceptible population is no longer controlled
10 by a particular herbicide.

[0003] Herbicides represent one of the external factors and form a group of synthetic-plus some bio-chemicals used to suppress or kill unwanted vegetation and are a major component of pesticides. They assist in management and restoration of areas invaded by invasive species. Herbicides are a major technological tool and responsible, in part,
15 for an agricultural revolution and increase in food production in the last few decades. However, at present this technology faces radical changes in effectiveness under field conditions that lead to failure of weed control operations due to continued development of weed tolerance/resistance and evolution and limitations in the herbicide industry.

[0004] A herbicide-resistant weed is a weed species that has developed the ability to
20 survive application of a herbicide which previously controlled it. The intensive and continuous use of the same herbicide(s) over the last few decades has resulted in the evolution of herbicide-resistant weeds. For instance, growth rate, reproductive capacity, genetic variability, and stress tolerance are all high in *Amaranthus* species. These traits give them a large capacity to evolve resistance to herbicides, which makes it difficult to
25 control these species. Slender amaranth (*Amaranthus viridis* L.) is widely spread over tropical and subtropical regions in more than 80 countries. These species, as well as other *Amaranthus* species, are the most abundant weeds in Brazilian south and centre-west regions. In 2010, this weed was reported with multiple resistance to the acetolactate synthase (ALS) and photosystem II inhibiting herbicides in cotton in the states of Bahia

and Mato Grosso, Brazil, and in 2015, *Amaranthus palmeri* was found with resistance to glyphosate and ALS-inhibiting herbicides in soybean in the state of Mato Grosso, Brazil.

[0005] Saflufenacil, a protoporphyrinogen oxidase (PPO) inhibitor herbicide is known for the control of broadleaf weeds, especially weeds that have developed resistance to glyphosate and paraquat and is also used as a harvest aid desiccant in oilseed crops.

[0006] Few studies reported that the addition of adjuvants greatly improved efficacy of saflufenacil to control broad leaf weeds. However, if saflufenacil is to be applied post emergence in annual crops, addition of adjuvants may cause injury. It has been reported that addition of an adjuvant to saflufenacil applied POST emergence caused 99% injury to corn (*Zea mays* L.) at three-leaf stage and reduced yield upto 59% (Jhala. A *et al.*, Weed Technology 27, April–June 2013).

[0007] Further, it is believed that PPO inhibitors can cause toxicity especially in PPO-generating organs such as the liver, in mammals and occasionally induce hepatocellular tumours because of hepatotoxicity. PPO catalyzes the oxidation of protoporphyrinogen (PP)IX to PPIX during heme biosynthesis in both plants and mammals. In mammals, the inhibition of PPO blocks the production of hemoglobin and erythrocytes, resulting in anaemia. Since the molecular mechanism of heme biosynthesis is common to all mammals, the possibility that PPO inhibitors are hepatotoxic and/or cause anaemia in humans must be considered, especially when such toxicity is observed in rodents and other mammals (*J Pestic Sci.* 2021 Nov 20; 46(4): 333–341).

[0008] Therefore, there is a need in the art to overcome issues relating to the effective control of broad spectrum as well as herbicide resistant weeds. There is also an unmet need in the art to provide the application of a PPO inhibitor, namely saflufenacil in safe amounts and to obtain efficient weed control.

Object of the invention

[0009] It is an object of the present invention to provide a herbicidal combination for controlling a broad spectrum of weeds, including resistant weeds.

[0010] It is another object of the present invention to provide a synergistic herbicidal combination comprising a protoporphyrinogen oxidase (PPO) inhibitor as one of the

herbicides, wherein the PPO inhibitor herbicide is applied at a lower application amount compared to standard application amounts conventionally applied for weed control.

[0011] It is another object of the present invention to provide a method of controlling resistant weeds.

5 **[0012]** It is yet another object of the present invention to provide a method of controlling weeds by applying a reduced amount of the protoporphyrinogen oxidase (PPO) inhibitor herbicide compared to the standard application amount.

Summary of the invention

[0013] The present invention provides an effective herbicidal combination comprising
10 protoporphyrinogen oxidase (PPO) inhibitor herbicides, and at least one herbicide and a method for controlling a broad spectrum of weeds, including resistant weeds.

[0014] In an aspect, the present invention provides a herbicidal combination for effective broad spectrum control of weeds, the combination comprising;

15 (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins,

wherein the application amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide.

[0015] In an aspect, the present invention provides a herbicidal combination for effective
20 broad spectrum control of weeds, the combination comprising;

(i) at least one herbicide from the group comprising N-phenyl-imides, and

(ii) at least one herbicide from the group comprising pyridyloxy-carboxylates,

wherein the application amount of the N-phenyl-imide herbicide is reduced by at least 80% of the standard application amount of said herbicide.

25 **[0016]** In another aspect, the present invention provides a synergistic combination comprising saflufenacil and triclopyr for effective, broad-spectrum control of weeds, wherein the application amount of saflufenacil is substantially reduced by at least 80% of the standard application amount of said herbicide.

[0017] In an aspect, the present invention provides at least 70% control of undesired weeds by application of the present herbicidal combination.

[0018] In another aspect, the present invention provides a synergistic herbicidal combination comprising saflufenacil and triclopyr for effective, broad-spectrum control of weeds, wherein the application amount of saflufenacil is substantially reduced by at least 80% of the standard application amount of said herbicide, and wherein at least 70% control of undesired weeds is obtained.

[0019] In an aspect, the present invention provides a herbicidal composition for effective control of weeds comprising;

- 10 (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides,
- (ii) at least one herbicide from the group comprising synthetic auxins, and
- (iii) agrochemically acceptable excipients,

wherein the application amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard amount of said herbicide applied.

[0020] In an aspect, the present invention provides a method for effectively controlling weeds comprising applying a herbicidal combination to a locus of a crop comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
- 20 (ii) at least one herbicide from the group comprising synthetic auxins,

wherein the application amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide.

[0021] In an aspect, the present invention provides a method for controlling weeds comprising applying a herbicidal combination to a locus of a crop, the combination comprising;

- 25 (i) at least one herbicide from the group comprising N-phenyl-imides, and
- (ii) at least one herbicide from the group comprising pyridyloxy-carboxylates,
- wherein the application amount of the N-phenyl-imide herbicide is reduced by at least 80% of the standard application amount of said herbicide.

[0022] In an aspect, the present invention provides a method for controlling weeds comprising applying a herbicidal combination to a locus of a crop, the method comprising saflufenacil and triclopyr, wherein the application amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide.

5 [0023] In an aspect, the present invention provides a method for controlling weeds such that at least 70% control of undesired weeds is obtained by applying the present herbicidal combination.

[0024] In an aspect, the present invention provides a method for controlling weeds comprising applying a herbicidal combination to a locus of a crop, the method comprising saflufenacil and triclopyr, wherein the application amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide and wherein at least 70% control of undesired weeds is obtained by applying the present herbicidal combination.

10 [0025] In yet another aspect, the present invention provides a method for controlling weeds selected from the group comprising *Bidens pilosa*, *Digitaria horizontalis*, *Amaranthus viridis*, *Amaranthus hybridus*, *Conyza sp.*, *Conyza bonariensis*, *Conyza sumatrensis*, *Conyza canadensis*, *Sida rhombifolia*, *Euphorbia heterophylla*, *Commelina benghalensis*, *Ipomoea grandiflora*, *Borreria latifolia* and *Borreria verticillate*.

[0026] In an aspect, the present invention provides use of a herbicidal combination for effectively controlling weeds, the combination comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins,

wherein the application amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide.

25 [0027] In an aspect, the present invention provides use of a herbicidal combination for effectively controlling weeds, the combination comprising;

(i) at least one herbicide from the group comprising N-phenyl-imides, and

(ii) at least one herbicide from the group comprising pyridyloxy-carboxylates,

wherein the application amount of the N-phenyl-imide herbicide is reduced by at least 80% of the standard application amount of said herbicide.

[0028] In an aspect, the present invention provides use of a synergistic and efficient herbicidal combination comprising saflufenacil and triclopyr for efficient weed control, wherein the application amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide.

[0029] In another aspect, the present invention provides use of the herbicidal combination comprising saflufenacil and triclopyr for synergistic and broad-spectrum control of weeds belonging to *Conyza* sp., *Bidens* spp, *Digitaria* spp, *Amaranthus* spp., *Sida* spp., *Euphorbia* spp., *Commelina* spp., *Ipomea* spp. and *Borreira* spp.

[0030] In another aspect, the present invention provides use of a herbicidal combination comprising saflufenacil and triclopyr, wherein at least 70% control of undesired weeds is obtained.

[0031] In yet another aspect, the present invention provides a kit of parts comprising saflufenacil and triclopyr, wherein the application amount of saflufenacil is reduced by at least 80% of the standard amount of said herbicide applied.

Detailed description of the invention

[0032] 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.

[0033] 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.

[0034] “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 $\pm 10\%$ or $\pm 5\%$ of the stated value.

[0035] 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.

[0036] The use of the terms “a”, “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.

[0037] 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.

[0038] “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 $\pm 10\%$ or $\pm 5\%$ of the stated value.

[0039] The use of any and all examples, or exemplary language (e.g., “such as”), is intended merely to better illustrate the disclosure and does not pose a limitation on the scope of the disclosure unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the disclosure as used herein.

[0040] While the disclosure 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 disclosure. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the essential scope thereof. Therefore, it is intended that the disclosure is not limited to the particular embodiment disclosed as the best mode contemplated for carrying out this disclosure, but that the disclosure will include all embodiments falling within the scope of the appended claims.

[0041] The expression of various quantities in terms of “%” or “% w/v” means the percentage by weight of the total solution or composition unless otherwise specified.

[0042] The term ‘herbicide’ as used herein denotes a compound which controls or modifies the growth of undesired weeds/plants.

[0043] 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/weeds. Controlling effects include

all deviation from natural development, for example: killing, retardation, leaf burn, albinism, dwarfism, etc.

[0044] The term “plants” refer to all physical parts of a plant, including seeds, seedlings, saplings, roots, tubers, stems, stalks, foliage and fruits.

5 **[0045]** The term “crop” shall include a multitude of desired crop plants or an individual crop plant growing at a locus.

[0046] As used herein, the term ‘pre-emergence’ refers to the time point before seedlings emerge from the ground. When any herbicide is applied at pre-emergence stage, it prevents establishment of the germinated weed seedlings.

10 **[0047]** As used herein, the term ‘post-emergence’ refers to the time point after seedlings emerge from the ground. When any herbicide is applied at post-emergence stage, it prevents growth of the germinated weed seedlings.

[0048] The terms “plants” and “vegetation” include, but are not limited to, germinant seeds, emerging seedlings, plants emerging from vegetative propagules, and established
15 vegetation.

[0049] The terms “undesirable vegetation”, “harmful plants”, “unwanted plants”, “weeds” and “weed species”, as used herein, are synonyms.

[0050] The term “control” provides a weed, includes control of the weed, as well as protecting a plant, a portion of the plant, or a plant seed from attack or invasion by
20 said weed.

[0051] The term “locus” as used herein shall denote the vicinity of a desired crop in which weed control, typically selective weed control is desired. The locus includes the vicinity of desired crop plants wherein the weed infestation has either emerged or is yet to emerge.

25 **[0052]** The term ‘standard application amount’ refers to the amount of a pesticide applied in field conventionally as a practice.

[0053] Each of the aspects described above may have one or more embodiments.

[0054] Each of the embodiments described hereinafter may apply to one or all of the aspects described hereinabove. These embodiments are intended to be read as being
30 preferred features of one or all of the aspects described hereinabove. Each of the

embodiments described hereinafter applies to each of the aspects described hereinabove individually.

[0055] In an embodiment, the present invention provides preferred combinations, compositions and methods thereof. The methods of the invention include a method of
5 controlling weeds by applying to a locus of a crop, a combination or the composition, or a method of increasing yield in a crop by application of the combination or composition, or a method of improving the plant health by application at the locus of the plant the combination or the composition. The embodiments described herein describe the preferred embodiments of all these possible combinations, compositions and methods
10 of the invention.

[0056] In view of the above, it will be seen that the several advantages of the disclosure are achieved, and other advantageous results are attained. Although the present disclosure has been disclosed in full, it will be understood that numerous additional modifications and variations could be made thereto without departing from the scope of
15 the disclosure. The embodiments may be combined together for better understanding of the disclosure, without departing from the scope of the disclosure.

[0057] 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
20 disclosure. One or more embodiments of the disclosure can be combined together to exhibit the teaching of the invention, without departing from the scope of the disclosure.

[0058] The present invention provides an effective herbicidal combination and a method for controlling broad spectrum of weeds, including resistant weeds. The present inventors have provided an effective herbicidal combination comprising a systemic herbicide such
25 as a synthetic auxin and a protoporphyrinogen oxidase (PPO) inhibitor herbicide, wherein the PPO inhibitor is applied at lower amounts compared to its standard dosage. Accordingly, the present inventors have provided a herbicidal combination comprising a systemic herbicide such as triclopyr and saflufenacil for the control of a broad spectrum of weeds, including resistant weeds. The present inventors have provided weed control

at a lower application amount of saflufenacil. Thus, the present invention also provides use of a PPO inhibitor herbicide at a substantially reduced dosage.

5 [0059] Accordingly, the present invention provides use of a PPO inhibitor herbicide at a substantially reduced application amount by at least about 80% of the standard application amount.

[0060] In another embodiment, the present invention also provides a herbicidal composition comprising a PPO inhibitor herbicide, wherein the PPO inhibitor herbicide is used at an application amount that is reduced by at least about 80% of the standard's dosage.

10 [0061] In an embodiment, the standard application amount of saflufenacil is 25 g ai/ha or greater than 30 g ai/ha.

[0062] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide,
15 wherein the amount of the PPO inhibitor herbicide is reduced by at least 80%.

[0063] In an embodiment, the second herbicide is selected from the group comprising acetyl coenzyme A Carboxylase (ACC'ase) inhibitors, acetolactate synthase (ALS) inhibitors, microtubule assembly inhibitors, auxin mimics or synthetic auxins, glutamine synthetase inhibitors, photosynthesis inhibitors – Photosystem II (PSII) inhibitors, very-long-chain fatty
20 acid (VLCFA) inhibitors, 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, 4-hydroxyphenyl pyruvate dioxygenase (HPPD) inhibitors, phytoene desaturase inhibitors and cellulose synthesis inhibitors.

[0064] According to an embodiment, the second herbicide can be selected from the group of: chlorophenoxyacetic acid (4-CPA); 4-CPB 4-(4-chlorophenoxy)butanoic acid; 4-
25 CPP 2-(4-Chlorophenoxy)propionic acid; 2,4-D (2,4-Dichlorophenoxyacetic acid); 2,4-D choline salt, 2,4-D esters and amines, 2,4-DB; 3,4-DA; 3,4-DB; 2,4-DEB; 2,4-DEP; 3,4-DP; (2,3,6-Trichlorobenzoic acid) 2,3,6-TBA; 2,4,5-T; 2,4,5-TB; acetochlor, acifluorfen, aclonifen, acrolein, alachlor, allidochlor, alloxydim, allyl alcohol, alorac, ametrudione, ametryn, amibuzin, amicarbazone, amidosulfuron, aminocyclopyrachlor, aminopyralid, amiprofos-
30 methyl, amitrole, ammonium sulfamate, anilofos, anisuron, asulam, atraton, atrazine,

azafenidin, azimsulfuron, aziprotryne, barban, BCPC, beflubutamid, benazolin, bencarbazon, benfluralin, benfuresate, bensulfuron-methyl, bensulide, benthiocarb, bentazon-sodium, benzadox, benzfendizone, benzipram, benzobicyclon, benzofenap, benzofluor, benzoylprop, benzthiazuron, bialaphos, bicyclopyrone, bifenox, bilanafos, 5 bispyribac-sodium, borax, bromacil, bromobonil, bromobutide, bromofenoxim, bromoxynil, brompyrazon, butachlor, butafenacil, butamifos, butenachlor, buthidazole, buthiuron, butralin, butroxydim, buturon, butylate, cacodylic acid, cafenstrole, calcium chlorate, calcium cyanamide, cambendichlor, carbasulam, carbetamide, carboxazole chlorprocarb, carfentrazone-ethyl, 2-chloro-N-N-diethylacetamide (CDEA), 2-chloroethyl (3- 10 chlorophenyl)carbamate (CEPC), chlomethoxyfen, chloramben, chloranocryl, chlorazine, chlorbromuron, chlorbufam, chloreturon, chlorfenac, chlorfenprop, chlorflurazole, chlorflurenol, chloridazon, chlorimuron, chlornitrofen, chloropon, chlorotoluron, chloroxuron, chloroxynil, chlorpropham, chlorsulfuron, chlorthal, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, cisanilide, clethodim, clodinate, clomazone, clomeprop, cloprop, 15 cloproxydim, clopyralid, , copper sulfate, 1-Chloro-N'-(3,4-dichlorophenyl)-N,N-dimethylformamidine (CPMF), 2-chloro-1-methylethyl (3-chlorophenyl)carbamate (CPPC), credazine, cresol, cumyluron, cyanatryn, calcium acid methanearsonate (CMA), cyanazine, cycloate, cyclopyrimorate, cyclosulfamuron, cycloxydim, cycluron, cyperquat, cyprazine, cyprazole, cypromid, daimuron, dalapon, dazomet, delachlor, desmedipham, desmetryn, 20 di-allate, dicamba, dichlobenil, dichloralurea, dichlormate, dichlorprop, dichlorprop-P, diethamquat, diethatyl, difenopenten, difenoxuron, difenzoquat, diflufenican, diflufenzopyr, dimefuron, dimepiperate, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimexano, dimidazon, dinitramine, dinofenate, dinoprop, dinosam, dinoseb, dinoterb, diphenamid, dipropetryn, diquat, disul, dithiopyr, diuron, (O-(2,4-Dichlorophenyl) O-Methyl 25 Isopropylphosphoramidothioate) DMPA, 4,6-Dinitro-o-cresol (DNOC), Disodium methyl arsonate (DSMA), ethyl bis(2-ethylhexyl)phosphinate (EBEP), eglinazine, endothal, epronaz, EPTC, erbon, esprocarb, ethalfuralin, ethbenzamide, ethametsulfuron, ethidimuron, ethiolate, ethobenzamid, etobenzamid, ethofumesate, ethoxyfen, ethoxysulfuron, etinofen, etnipromid, etobenzanid, EXD, fenasulam, fenoprop, fenoxaprop, fenoxaprop-P-ethyl, 30 fenoxaprop-P-ethyl-isoxadifen-ethyl, fenoxasulfone, fenteracol, fenthiaprop, fentrazamide,

fenuron, ferrous sulfate, flamprop, flamprop-M, flazasulfuron, fluazolate, flucarbazone, flucetosulfuron, fluchloralin, flufenacet, flufenican, flufenpyr-ethyl, flumezin, flumiclorac-pentyl, flumioxazin, flumipropyn, fluometuron, fluorodifen, fluoroglycofen, fluoromidine, fluoronitrofen, fluothiuron, flupoxam, flupropacil, flupropanate, flupyrsulfuron, fluridone, 5 fluorochloridone, fluoroxyppy, fluoroxyppy-meptyl, flurtamone, fluthiacet, fomesafen, foramsulfuron, fosamine, fumiclorac, furyloxyfen, glufosinate, glufosinate-ammonium, L-glufosinate, L-glufosinate ammonium, glufosinate-P-ammonium, glyphosate salts and esters, halauxifen, halauxifen-methyl, halosafen, halosulfuron-methyl, haloxydine, hexachloroacetone, hexaflurate, hexazinone, imazamethabenz, imazamox, imazapic, 10 imazapyr, imazaquin, imazosulfuron, cloransulam-methyl, indanofan, indaziflam, iodobonil, iodomethane, iodosulfuron, iodosulfuron-ethyl-sodium, iofensulfuron, ioxynil, ipazine, ipfencarbazone, iprymidam, isocarbamid, isocil, isomethiozin, isonoruron, isopolinate, isopropalin, isoproturon, isouron, isoxaben, isoxachlortole, isoxaflutole, karbutilate, ketospiradox, lactofen, lenacil, linuron, MCPA (2-methyl-4-chlorophenoxyacetic acid) esters and amines, MCPA-thioethyl, MCPB 2,4-MCPB, 4-(4-chloro-o-tolyloxy)butyric acid, 15 mecoprop, mecoprop-P, medinoterb, mefenacet, mefluidide, mesoprazine, mesosulfuron, mesotrione, metam, metamitron, metazachlor, metazosulfuron, metflurazon, methabenzthiazuron, methalpropalin, methazole, methiobencarb, methiozolin, methiuron, methometon, methoprotryne, methyl bromide, methyl isothiocyanate, methylodymron, 20 metobenzuron, metobromuron, metolachlor, metoxuron, metribuzin, metsulfuron, metsulfuron-methyl, molinate, monalide, monisouron, monochloroacetic acid, monolinuron, monuron, morfamquat, monosodium methanearsonate (MSMA), naproanilide, napropamide, naptalam, neburon, nicosulfuron, nipyraclufen, nitralin, nitrofen, nitrofluorfen, norflurazon, noruron, phenoxy herbicides, orbencarb, ortho-dichlorobenzene, orthosulfamuron, oryzalin, 25 oxadiargyl, oxadiazon, oxapyrazon, oxasulfuron, oxaziclomefone, oxyfluorfen, paraflufen-ethyl, parafluron, paraquat, pebulate, pelargonic acid, pendimethalin, pentachlorophenol, pentanochlor, pentoxazone, perfluidone, pethoxamid, phenisopham, phenmedipham, phenmedipham-ethyl, phenobenzuron, phenylmercury acetate, picloram, picolinafen, pinoxaden, piperophos, potassium arsenite, potassium azide, potassium cyanate, 30 pretilachlor, primisulfuron-methyl, procyazine, prodiamine, profluzol, profluralin,

profoxydim, proglinazine, prohexadione-calcium, prometon, prometryn, pronamide, propachlor, propanil, propazine, propham, propisochlor, propoxycarbazone, propyrisulfuron, propyzamide, prosulfalin, prosulfocarb, prosulfuron, proxan, prynachlor, pydanon, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazosulfuron-ethyl, pyrazoxyfen, pyribenzoxim, pyributicarb, pyriclor, pyridafof, pyridate, pyriftalid, pyriminobac, pyrimisulfan, pyrithiobac-sodium, pyroxasulfone, quinclorac, quinmerac, quinochlor, quinonamid, rhodethanil, rimsulfuron, saflufenacil, S-metolachlor, sebuthylazine, secbumeton, sethoxydim, siduron, simazine, simeton, simetryn, Sodium Methanearsonate (SMA), sodium arsenite, sodium azide, sodium chlorate, sulcotrione, sulfallate, sulfometuron, sulfosate, sulfosulfuron, sulfuric acid, sulglycapin, sweep, trichloroacetic acid (TCA), tebutam, tebuthiuron, tefuryltrione, tembotrione, tepraloxym, terbacil, terbucarb, terbutryn, terbuthylazine, terbutryn, tetrafluoron, thenylchlor, thiazafluoron, thiazopyr, thidiazimin, thidiazuron, thien carbazole-methyl, thifensulfuron, thifensulfurn-methyl, thiobencarb, tiocarbamil, tioclorim, topramezone, tralkoxydim, triafamone, tri-allate, triasulfuron, triaziflam, tribenuron, tribenuron-methyl, tricamba, triclopyr choline salt, triclopyr esters and salts, tridiphane, trietazine, trifloxysulfuron, trifluralin, triflusulfuron, trifopsime, trihydroxytriazine, trimeturon, tripropindan, tritac tritosulfuron, vernolate, xylachlor and salts, esters, optically active isomers or a combination thereof.

[0065] In a preferred embodiment, the second herbicide is selected from synthetic auxins.

[0066] In a preferred embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
- (ii) at least one herbicide from the group comprising synthetic auxins,

wherein the application amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide.

[0067] In a preferred embodiment, the protoporphyrinogen oxidase (PPO) inhibitor herbicides comprise N-phenyl-imides.

[0068] In another preferred embodiment, the synthetic auxin herbicides comprise pyridyloxy-carboxylates.

[0069] In an embodiment, the present invention provides a herbicidal combination for effective broad spectrum control of weeds, the combination comprising;

- (i) at least one herbicide from the group comprising N-phenyl-imides, and
- (ii) at least one herbicide from the group comprising pyridyloxy-carboxylates,

5 wherein the application amount of N-phenyl-imides is reduced by at least 80% of the standard application amount of said herbicide.

[0070] In an embodiment, the present invention provides N-phenyl-imides comprising saflufenacil, butafenacil, epyrifenacil, tiafenacil, flumioxazin, pentoxazone, trifludimoxazin, flumiclorac-pentyl and cinidon-ethyl or salts thereof.

10 [0071] In a preferred embodiment, the N-phenyl-imides comprises saflufenacil or its salts.

[0072] In an embodiment, the pyridyloxy-carboxylates comprise fluroxypyr or triclopyr or salts thereof.

[0073] In a preferred embodiment, the pyridyloxy-carboxylate comprises triclopyr or salts thereof.

15 [0074] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
- (ii) at least one herbicide from the group comprising synthetic auxins,

20 wherein the application amount of synthetic auxins is reduced by at least 80% of the standard application amount of said herbicide.

[0075] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein the application amount of saflufenacil is reduced by at least 80% of the standard
25 application amount of said herbicide.

[0076] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein at least 70% control of undesired weeds is obtained.

30 [0077] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds,

wherein the application amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide and wherein at least 70% control of undesired weeds is obtained.

5 [0078] In another aspect, the present invention provides a synergistic combination comprising saflufenacil and triclopyr for the effective broad-spectrum control of weeds.

[0079] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide, wherein the amount of the PPO inhibitor is not more than 30 g ai/ha.

10 [0080] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide, wherein the amount of the PPO inhibitor is not more than 20 g ai/ha.

[0081] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide, wherein the amount of the PPO inhibitor is not more than 10 g ai/ha.

15 [0082] In a preferred embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide, wherein the amount of the PPO inhibitor is 7 g ai/ha.

[0083] In another preferred embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide, wherein the amount of the PPO inhibitor is 5 g ai/ha.

20 [0084] In yet another preferred embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide, wherein the amount of the PPO inhibitor is 1.75 g ai/ha.

[0085] In yet another preferred embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and a second herbicide, wherein the amount of the PPO inhibitor is ranging from 1 to 7 g ai/ha.

5 [0086] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
- (ii) at least one herbicide from the group comprising synthetic auxins,

10 wherein the amount of the PPO inhibitor herbicide is not more than 30 g ai/ha.

[0087] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
- (ii) at least one herbicide from the group comprising synthetic auxins,

15 wherein the amount of the PPO inhibitor herbicide is not more than 20 g ai/ha.

[0088] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
- (ii) at least one herbicide from the group comprising synthetic auxins,

20 wherein the amount of the PPO inhibitor herbicide is not more than 10 g ai/ha.

[0089] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
- (ii) at least one herbicide from the group comprising synthetic auxins,

25 wherein the amount of the PPO inhibitor herbicide is 7 g ai/ha.

[0090] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

30

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins,

wherein the amount of the PPO inhibitor herbicide is 5 g ai/ha.

5 **[0091]** In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins,

10 wherein the amount of the PPO inhibitor herbicide is 1.75 g ai/ha.

[0092] In an embodiment, the present invention provides a herbicidal combination for effective control of weeds, the combination comprising;

(iii) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

15 (iv) at least one herbicide from the group comprising synthetic auxins,

wherein the amount of the PPO inhibitor herbicide is ranging from 1 to 7 g ai/ha.

[0093] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is not more than 30 g ai/ha.

20 **[0094]** In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is not more than 20 g ai/ha.

[0095] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds,
25 wherein the amount of saflufenacil is not more than 10 g ai/ha.

[0096] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is 1 to 7 g ai/ha.

[0097] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is 7 g ai/ha.

5 [0098] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is 5 g ai/ha.

[0099] In an embodiment, the present invention provides a herbicidal combination comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is 1.75 g ai/ha.

10 [0100] In an embodiment, the present invention provides a herbicidal combination for the broad-spectrum control of weeds belonging to *Conyza* spp., *Bidens* spp, *Digitaria* spp, *Amaranthus* spp., *Sida* spp., *Euphorbia* spp., *Commelina* spp., *Ipomea* spp. and *Borreria* spp.

15 [0101] In an embodiment, the present invention provides a herbicidal combination for the broad-spectrum control of weeds belonging to *Bidens pilosa*, *Digitaria horizontalis*, *Amaranthus viridis*, *Amaranthus hybridus*, *Conyza* sp., *Conyza bonariensis*, *Conyza sumatrensis* *Conyza canadensis* *Sida rhombifolia*, *Euphorbia heterophylla*, *Commelina benghalensis*, *Ipomoea grandiflora*, *Borreria latifolia* and *Borreria verticillate*.

20 [0102] According to some embodiments of the invention, the weed species of interest is selected from the group consisting of Examples of weed species which can be targeted (mitigated) according to the present teachings include, but are not limited to, *Amaranthus* species *A. albus*, *A. blitoides*, *A. hybridus*, *A. palmeri*, *A. powellii*, *A. retroflexus*, *A. rudis*, *A. spinosus*, *A. tuberculatus*, and *A. viridis*; *Ambrosia* species - *A. trifida*, *A. artemisifolia*; *Lolium* species *L. multiflorum*, *L. rigidum*, *L. perenne*; *Digitaria* species *D. insularis*;
25 *Euphorbia* species -*E. heterophylla*; *Kochia* species, *K. scoparia*; *Sorghum* species -*S. halepense*; *Conyza* species, *C. bonariensis*, *C. canadensis*, *C. sumatrensis*; *Chloris* species -*C. truncate*; *Echinochola* species - *E. colona*, *E. crus-galli*; *Eleusine* species -*E. indica*; *Poa* species, *P. annua*; *Plantago* species *P. lanceolata*; *Avena* species, *A. fatua*; *Chenopodium* species - *C. album*; *Setaria* species - *S. viridis*, *Abutilon theophrasti*, *Ipomoea*
30 species, *Sesbania*, species, *Cassia* species, *Sida* species, *Brachiaria* species, *Sporobolus*

species - S. pyramidalis, S. natalensis, S. jacquemontii, S. fertilis, S. africanus S. indicus and Solanum species. Additional weedy plant species found in cultivated areas include *Alopecurus myosuroides, Avenasterilis, Avena sterilis ludoviciana, Brachiaria plantaginea, Bromus diandrus, Bromus rigidus, Cynosurus echinatus, Digitaria ciliaris, Digitaria ischaemum, Digitaria sanguinalis, Echinochloa oryzicola, Echinochloa aphyllpogon, Eriochloa apunctata, Hordeum glaucum, Hordeum leporinum, Ischaemum rugosum, Leptochloachinensis, Lolium persicum, Phalaris minor, Phalarisparadoxa, Rottboelliaexalta, Setaria faberi, Setaria viridisvar, robusta-alba schreiber, Setariaviridisvar, robusta - purpurea, Snowdenia polystachea, Sorghum Sudanese, Alismaplantago-aquatica, Amaranthus lividus, Amaranthus quitensis, Ammania auriculata, Ammaniacoccinea, Anthemiscotula, Aperaspica-venti, Bacopa rotundifolia, Biden pilosa, Bidens subalternans, Brassica tournefortii, Bromus tectorum, Camelina microcarpa, Chrysanthemum coronarium, Cuscuta campestris, Cyperus dijformis, Damasonium minus, Descurainia sophia, Diplotaxis tenuifolia, Echium plantagineum, Elatine triandra var, pedicellata, Euphorbia heterophylla, Fallopia convolvulus, Fimbristylis miliacea, Galeopsis tetrahit, Galium spurium, Helianthus annuus, Iva xanthifolia, Ixophorus unisetus, Ipomoea indica, Ipomoea purpurea, Ipomoea sepiaria, Ipomoea aquatic, Ipomoea triloba, Lactuca serriola, Limnocharis flava, Limnophila erecta, Limnophila sessiliflora, Lindemia dubia, Lindernia dubia var, major, Lindemia micrantha, Lindernia procumbens, Mesembryanthemum crystallinum, Monochoria korsakowii, Monochoria vaginalis, Neslia paniculata, Papaver rhoeas, Parthenium hysterophorus, Pentzia suj fruticosa, Phalaris minor, Raphanus raphanistrum, Raphanus sativus, Rapistrum rugosum, Rotala indica var, uliginosa, Sagittaria guyanensis, Sagittaria montevidensis, Sagittaria pygmaea, Salsola iberica, Scirpus juncoides var, ohwianus, Scirpus mucronatus, Setaria lutescens, Sida spinosa, Sinapis arvensis, Sisymbrium orientale, Sisymbrium thellungii, Solanum ptycanthum, Sonchus asper, Sonchu soleraceus, Sorghum bicolor, Stellaria media, Thlaspiarvense, Xanthium strumarium, Arctotheca calendula, Conyza spp, Conyza sumatrensis, Crassocephalum crepidiodes, Cuphea carthagenensis, Epilobium adenocaulon, Erigeron philadelphicus, Landoltia punctata, Lepidiumvirginicum, Monochoria korsakowii, Solanum americanum, Solanum nigrum, Vulpiabromoides, Youngia japonica, Hydrilla verticillata, Carduus nutans, Carduus*

pycnocephalus, Centaurea solstitialis, Cirsiumarvense, Commelina diffusa, Convolvulus arvensis, Daucus carota, Digitaria ischaemum, Echinochloa crus-pavonis, Fimbristylis miliacea, Galeopsis tetrahit, Galium spurium, Limnophila erecta, Matricaria perforate, Papaver rhoeas, Ranunculus acris, Soliva sessilis, Sphenoclea zeylanica, Stellaria media,
5 *Nassella trichotoma, Stipa neesiana, Agrostis stolonifera, Polygonum aviculare, Alopecurus japonicus, Beckmannia syzigachne, Bromus tectorum, Chloris inflata, Echinochloa erecta, Portulaca oleracea, and Senecio vulgaris.*

[0103] The combination of the present disclosure maybe applied simultaneously as a tank mix or a premix formulation or may be applied sequentially. The application may
10 be made to the soil before emergence of the plants, either pre-planting or post-planting. The application may be made to the soil after emergence of the plants. The application may be made as a foliar spray at different timings during crop development, with either one or more applications early or late post-emergence. Herbicidal compositions according to the invention can also be incorporated into the soil before, during or after sowing
15 seeds of a crop. These combinations as described above may be applied to the locus of the weeds, in an herbicidally effective amount.

[0104] The combinations of the present disclosure may be developed as a pre-mix composition or a kit of parts such that individual actives may be mixed before applying.

[0105] The herbicidal compositions of the present disclosure can be in any conventional
20 agriculturally useful form, for example, in the form of a ready-to-use formulation, or in the form of a tank mix.

[0106] In an embodiment, the present invention provides a herbicidal composition for effective control of weeds, the composition comprising a herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, a second herbicide,
25 and an agriculturally acceptable excipient, wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide.

[0107] In a preferred embodiment, the present invention provides a herbicide composition for effective control of weeds, the composition comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase
30 (PPO) inhibitor herbicides,

- (ii) at least one herbicide from the group comprising synthetic auxins, and
- (iii) an agriculturally acceptable excipient,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide.

5 **[0108]** In a preferred embodiment, the present invention provides a herbicide composition comprising saflufenacil, triclopyr, and an agriculturally acceptable excipient for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide.

10 **[0109]** In an embodiment, the present invention provides a herbicidal composition comprising saflufenacil and triclopyr for the effective broad spectrum control of weeds, wherein at least 70% control of undesired weeds is obtained.

15 **[0110]** In a preferred embodiment, the present invention provides a herbicide composition comprising saflufenacil, triclopyr an agriculturally acceptable excipient for the effective broad spectrum control of weeds, wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide and at least 70% control of undesired weeds is obtained.

20 **[0111]** In an embodiment, the composition of the present invention may contain agriculturally acceptable adjuvants, carriers, diluents, emulsifiers, fillers, anti-foaming agents, thickening agents, anti-freezing agents, freezing agents etc. The compositions may be either solid or liquids. They can be solids, such as, for example, dusts, granules, water-dispersible granules, microcapsules or wettable powders, or liquids, such as, for example, emulsifiable concentrates, solutions, oil dispersion, emulsions or suspensions, ZC formulations. The agriculturally acceptable excipient is any or a combination of a surfactant, a preservative, a coloring agent, a pH adjusting agent, anti-foaming agent and
25 a solvent. However, it should be appreciated that any other agriculturally acceptable excipients, as known to a person skilled in the art, may be used to serve its intended purpose.

[0112] In an embodiment, the agriculturally acceptable excipients are present in an amount ranging from 0.01% to 90% by weight of the composition.

[0113] In an embodiment, the liquid herbicidal composition is formulated as an oil dispersion (OD), a dispersible concentrate (DC), an emulsifiable concentrate (EC), or a soluble concentrate (SL).

[0114] In an embodiment, the agriculturally acceptable excipient is any or a combination of a surfactant, a preservative, a coloring agent, a pH adjusting agent, anti-foaming agent and a solvent. However, it should be appreciated that any other agriculturally acceptable excipients, as known to a person skilled in the art, may be used to serve its intended purpose. In an embodiment, the agriculturally acceptable excipients are present in an amount ranging from 5% to 99% by weight of the composition.

[0115] According to an embodiment, the composition comprises one or more adjuvants comprising surfactants (emulsifier), crop oil, fertilizers, dispersing agents, compatibility agents, foaming activators, foam suppressants, correctives, and spray colorants (dyes).

[0116] Suitable agricultural adjuvants and carriers may include, but are not limited to, crop oil concentrates; methylated seed oils, emulsified methylated seed oil, nonylphenol ethoxylate; benzylcocoalkyldimethyl quaternary ammonium salt; blend of petroleum hydrocarbon, alkyl esters, organic acid, and anionic surfactant; C₉-C₁₁ alkylpolyglycoside; phosphated alcohol ethoxylate; natural primary alcohol (C₁₂-C₁₆) ethoxylate; di-sec-butylphenol EO-PO block copolymer; polysiloxane-methyl cap; nonylphenol ethoxylate, urea ammonium nitrate; tridecyl alcohol (synthetic) ethoxylate (8EO); tallow amine ethoxylate ; PEG(400) dioleate-99, alkyl sulfates, such as diethanolammonium lauryl sulfate; alkylarylsulfonate salts, such as calcium dodecylbenzenesulfonate; alkylphenol-alkylene oxide addition products, such as nonylphenol-C18 ethoxylate; alcohol-alkylene oxide addition products, such as tridecyl alcohol-C₁₆ ethoxylate; soaps, such as sodium stearate; alkyl-naphthalene-sulfonate salts, such as sodium dibutylnaphthalenesulfonate; dialkyl esters of sulfosuccinate salts, such as sodium di(2-ethylhexyl)sulfosuccinate; sorbitol esters, such as sorbitol oleate; quaternary amines, such as lauryl trimethylammonium chloride; polyethylene glycol esters of fatty acids, such as polyethylene glycol stearate; block copolymers of ethylene oxide and propylene oxide; salts of mono and dialkyl phosphate esters; vegetable or seed oils such as soybean oil, rapeseed/canola oil, olive oil, castor oil, sunflower seed oil, coconut oil, corn oil,

cottonseed oil, linseed oil, palm oil, peanut oil, safflower oil, sesame oil, tung oil and the like; and esters of the above vegetable oils, and in certain embodiments, methyl esters.

[0117] The herbicidal combinations of the present invention maybe used to target weeds among the crops such as corn, rice, wheat, barley, rye, oat, sorghum, cotton, soybean, peanut, buckwheat, beet, rapeseed, sunflower, sugar cane, tobacco, etc.; vegetables: solanaceous vegetables such as eggplant, tomato, pimento, pepper, potato, etc., cucurbit vegetables such as cucumber, pumpkin, zucchini, water melon, melon, squash, etc., cruciferous vegetables such as radish, white turnip, horseradish, kohlrabi, Chinese cabbage, cabbage, leaf mustard, broccoli, cauliflower, etc., asteraceous vegetables such as burdock, crown daisy, artichoke, lettuce, etc, liliaceous vegetables such as green onion, onion, garlic, and asparagus, ammiaceous vegetables such as carrot, parsley, celery, parsnip, etc., chenopodiaceous vegetables such as spinach, Swiss chard, etc., lamiaceous vegetables such as *Perilla frutescens*, mint, basil, etc, strawberry, sweet potato, *Dioscorea japonica*, colocasia, etc., flowers, foliage plants, turf grasses, fruits: pome fruits such apple, pear, quince, etc, stone fleshy fruits such as peach, plum, nectarine, Prunus mume, cherry fruit, apricot, prune, etc., citrus fruits such as orange, lemon, rime, grapefruit, etc., nuts such as chestnuts, walnuts, hazelnuts, almond, pistachio, cashew nuts, macadamia nuts, etc. berries such as blueberry, cranberry, blackberry, raspberry, etc., vines, kaki fruit, olive, plum, banana, oil palm, coffee, date palm, coconuts, etc. , trees other than fruit trees; tea, mulberry, flowering plant, trees such as ash, birch, dogwood, Eucalyptus, Ginkgo biloba, lilac, maple, Quercus, poplar, Judas tree, Liquidambar formosana, plane tree, zelkova, Japanese arborvitae, fir wood, hemlock, juniper, Pinus, Picea, and Taxus cuspidate, etc.

[0118] The present invention also provides a composition comprising saflufenacil and triclopyr, wherein the composition administers not more than 1-30 g/Ha of saflufenacil to a locus of a crop.

[0119] The present invention also provides a composition comprising saflufenacil and triclopyr, wherein the composition administers not more than 1-20 g/Ha of saflufenacil to a locus of a crop.

[0120] The present invention also provides a composition comprising saflufenacil and triclopyr, wherein the composition administers not more than 1-10 g/Ha of saflufenacil to a locus of a crop.

5 [0121] The present invention also provides a composition comprising saflufenacil and triclopyr, wherein the composition administers not more than 1-7 g/Ha of saflufenacil to a locus of a crop.

[0122] The present invention also provides a composition comprising saflufenacil and triclopyr, wherein the composition administers not more than 1-5 g/Ha of saflufenacil to a locus of a crop.

10 [0123] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying a herbicidal combination to a locus, the combination comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and at least one herbicide, wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard
15 application amount of said herbicide applied.

[0124] In a preferred embodiment, the present invention provides a method for effectively controlling weeds comprising applying a herbicidal combination to a locus, the combination comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase
20 (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins,
wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

25 [0125] In another preferred embodiment, the present invention provides a method for controlling weeds comprising applying a herbicidal combination to a locus, the combination comprising;

(i) at least one herbicide from the group comprising N-phenyl-imides, and

(ii) at least one herbicide from the group comprising pyridyloxy-carboxylates,

30 wherein the amount of the N-phenyl-imides herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0126] In an embodiment, the present invention provides a method for controlling weeds comprising applying a herbicidal combination to a locus comprising saflufenacil and triclopyr, wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied and wherein the at least 70% control of weeds is obtained.

[0127] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount ranging from 1 to 30 g ai/ha, and
- (ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 150 to 800 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0128] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount ranging from 1 to 10 g ai/ha, and
- (ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 150 to 800 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0129] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount ranging from 1 to 7 g ai/ha, and
- (ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 150 to 800 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0130] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount ranging from 1 to 7 g ai/ha, and
- (ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0131] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount of 7 g ai/ha, and
- (ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0132] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (iii) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount of 5 g ai/ha, and
- (iv) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0133] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount of 3.5 g ai/ha, and
- (ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

10 [0134] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount of 1.75 g ai/ha, and
- 15 (ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard application amount of said herbicide applied.

[0135] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount ranging from 1 to 10 g ai/ha, and
- (ii) triclopyr in an amount ranging from 150 to 800 g ai/ha,

25 wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0136] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount ranging from 1 to 7 g ai/ha,
- 30 (ii) triclopyr in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0137] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount ranging from 1 to 5 g ai/ha,
- (ii) triclopyr in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0138] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount ranging from 1 to 4 g ai/ha,
- (ii) triclopyr in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0139] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount of 7 g ai/ha,
- (ii) triclopyr in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0140] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (iii) saflufenacil in an amount of 5 g ai/ha,
- (iv) triclopyr in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0141] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

(v) saflufenacil in an amount of 3.5 g ai/ha,

(vi) triclopyr in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0142] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

(i) saflufenacil in an amount ranging of 1.75 g ai/ha,

(ii) triclopyr in an amount ranging from 200 to 500 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0143] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

(i) saflufenacil in an amount of 7 g ai/ha,

(ii) triclopyr in an amount of 240 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0144] In an aspect, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

(i) saflufenacil in an amount of 3.5 g ai/ha,

(ii) triclopyr in an amount of 240 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0145] In an aspect, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount ranging of 1.75 g ai/ha,
- (ii) triclopyr in an amount of 240 g ai/ha,

5 wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0146] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- 10 (i) saflufenacil in an amount of 7 g ai/ha,
- (ii) triclopyr in an amount of 360 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0147] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- 15 (i) saflufenacil in an amount of 3.5 g ai/ha,
- (ii) triclopyr in an amount of 360 g ai/ha,

20 wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0148] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

- 25 (i) saflufenacil in an amount ranging of 1.75 g ai/ha,
- (ii) triclopyr in an amount of 360 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0149] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination

comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one other herbicide to obtain at least 60% control of weeds.

[0150] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination
5 comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one other herbicide to obtain at least 70% control of weeds.

[0151] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination
10 comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one other herbicide to obtain at least 80% control of weeds.

[0152] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination
comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one other herbicide to obtain at least 90% control of weeds.

[0153] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination
15 comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one herbicide from the group comprising synthetic auxins to obtain at least 60% control of weeds.

[0154] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination
20 comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one herbicide from the group comprising synthetic auxins to obtain at least 70% control of weeds.

[0155] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination
25 comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one herbicide from the group comprising synthetic auxins to obtain at least 80% control of weeds.

[0156] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) and at least one herbicide from the group comprising synthetic auxins to obtain
5 at least 90% control of weeds.

[0157] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising saflufenacil and triclopyr, wherein at least 60% control of weeds is obtained.

[0158] In an embodiment, the present invention provides a method for effectively
10 controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising saflufenacil and triclopyr, wherein at least 70% control of weeds is obtained.

[0159] In an embodiment, the present invention provides a method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising saflufenacil and triclopyr, wherein at least 80% control of weeds is obtained.

[0160] In an embodiment, the present invention provides a method for effectively
15 controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising saflufenacil and triclopyr, wherein at least 90% control of weeds is obtained.

[0161] In an embodiment, the present invention provides use of a herbicidal combination for effective control of weeds, the combination comprising;

20 (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins,

wherein the amount of the PPO inhibitor is not more than 30 g ai/ha.

[0162] In an embodiment, the present invention provides use of a herbicidal combination
25 for effective control of weeds, the combination comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins,

wherein the amount of the PPO inhibitor is not more than 20 g ai/ha.

[0163] In an embodiment, the present invention provides use of a herbicidal combination for effective control of weeds, the combination comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

5 (ii) at least one herbicide from the group comprising synthetic auxins, wherein the amount of the PPO inhibitor is not more than 10 g ai/ha.

[0164] In an embodiment, the present invention provides use of a herbicidal combination for effective control of weeds, the combination comprising;

10 (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins, wherein the amount of the PPO inhibitor is not more than 7 g ai/ha.

[0165] In an embodiment, the present invention provides use of a herbicidal combination for effective control of weeds, the combination comprising;

15 (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins, wherein the amount of the PPO inhibitor is 3.5 g ai/ha.

[0166] In an embodiment, the present invention provides use of a herbicidal combination
20 for effective control of weeds, the combination comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and

(ii) at least one herbicide from the group comprising synthetic auxins, wherein the amount of the PPO inhibitor is 1.75 g ai/ha.

25 **[0167]** In an embodiment, the present invention provides the use of saflufenacil as a herbicide in an amount not more than 30 g/Ha.

[0168] In another embodiment, the present invention provides the use of saflufenacil as a herbicide in an amount not more than 1 to 30 g/Ha.

30 **[0169]** In another embodiment, the present invention provides the use of saflufenacil as a herbicide in an amount not more than 1 to 7 g/Ha.

[0170] In a preferred embodiment, the present invention provides a kit of parts comprising saflufenacil and triclopyr, wherein the amount of saflufenacil applied is reduced by at least 80% of the standard amount of said herbicide applied.

[0171] In view of the above, it will be seen that the several advantages of the disclosure are achieved, and other advantageous results are attained. Although the present disclosure has been disclosed in full, it will be understood that numerous additional modifications and variations could be made thereto without departing from the scope of the disclosure. The embodiments may be combined together for better understanding of the disclosure, without departing from the scope of the disclosure.

[0172] 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 combined together to exhibit the teaching of the invention, without departing from the scope of the disclosure.

[0173] The invention shall now be described with reference to the following specific examples. It should be noted that the examples appended below illustrate rather than limit the invention and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the present invention.

[0174] The invention is summarized in the embodiments below:

[0175] In an embodiment, the present invention provides a method for effectively controlling *Amaranthus viridis* comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount of 7 g ai/ha,
- (ii) triclopyr in an amount of 240 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0176] In an embodiment, the present invention provides a method for effectively controlling *Amaranthus viridis* comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount of 3.5 g ai/ha,

(ii) triclopyr in an amount of 240 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

5 [0177] In an embodiment, the present invention provides a method for effectively controlling *Amaranthus viridis* comprising applying to a locus of a crop a herbicidal combination comprising;

(i) saflufenacil in an amount of 1.75 g ai/ha,

(ii) triclopyr in an amount of 240 g ai/ha,

10 wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0178] In an embodiment, the present invention provides a method for effectively controlling *Bidens pilosa* comprising applying to a locus of a crop a herbicidal combination comprising;

(i) saflufenacil in an amount of 7 g ai/ha,

15 (ii) triclopyr in an amount of 240 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0179] In an embodiment, the present invention provides a method for effectively controlling *Bidens pilosa* comprising applying to a locus of a crop a herbicidal combination comprising;

(i) saflufenacil in an amount of 3.5 g ai/ha,

(ii) triclopyr in an amount of 240 g ai/ha,

20 wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

25 [0180] In an embodiment, the present invention provides a method for effectively controlling *Bidens pilosa* comprising applying to a locus of a crop a herbicidal combination comprising;

(i) saflufenacil in an amount of 1.75 g ai/ha,

(ii) triclopyr in an amount of 240 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0181] In an embodiment, the present invention provides a method for effectively controlling *Amaranthus hybridus* comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount of 7 g ai/ha,
- (ii) triclopyr in an amount of 360 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0182] In an embodiment, the present invention provides a method for effectively controlling *Euphorbia heterophylla* comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount of 7 g ai/ha,
- (ii) triclopyr in an amount of 360 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

[0183] In an embodiment, the present invention provides a method for effectively controlling *Conyza sp.* comprising applying to a locus of a crop a herbicidal combination comprising;

- (i) saflufenacil in an amount of 7 g ai/ha,
- (ii) triclopyr in an amount of 240 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard application amount of said herbicide applied.

Examples

[0184] The synergy of the combination was also evaluated, and the well-established method of Colby's calculation was used to determine the synergy. A frequently used method for improving the use profile of an agricultural is the combination of an active compound with one or more other active compounds which contribute to the desired additional properties. However, when two or more active compounds are applied in

combination, it is not uncommon for phenomena of physical and biological incompatibility to occur, for example insufficient stability of a joint formulation, decomposition of an active compound or antagonism of the active compounds. What is desired are, in contrast, active compound combinations having a favorable activity profile, high stability and, if possible, synergistically enhanced activity, thus permitting the application rate to be reduced, compared with the individual application of the active compounds to be combined.

[0185] Chemical mixtures can have an antagonistic effect when mixed, where the results are less than expected when the chemicals are combined. There can also be an additive effect, where the resultant mixture gives results expected from the sum of its components. Finally, there can be a synergistic effect where the results are greater than expected. A synergistic result is rare and typically only observed in results from high concentrations. In the heavily regulated agricultural industry, high concentrations are not desirable in the environment. Therefore, when a synergistic effect is achieved at low doses, the resultant mixture is indeed a rare and unexpected finding.

[0186] A synergistic effect of an agricultural is always present when the anti-phytopathogenic activity of the active compound combinations exceeds the total of the activities of the active compounds when applied individually. The expected activity for a given combination of two active compounds can be calculated according to S. R. Colby (“Calculating Synergistic and Antagonistic Responses of Herbicidal combinations”, Weeds 15, (1967), 20-22).

[0187] This effectiveness of all treatments as measured by percent reduction in weed growth was also evaluated according to Colby’s equation as below.

If,

X is the percent weed inhibition of growth by saflufenacil (A) at an application rate,

Y is the percent weed inhibition of growth by triclopyr (B) at an application rate, and

E is the expected growth as a percent of control with saflufenacil and triclopyr when applying the active compounds, A and B at specific application rates as defined below.

Then,

$$\text{Colby's equation } E = X + Y - XY/100$$

5 **[0188]** If the actual/observed weed control efficacy of the combinations of the present disclosure exceeds the calculated value, then the activity of the combination is super additive, i.e. a synergistic effect exists. In this case, the efficacy which was observed must be greater than the value for the expected efficacy calculated from the abovementioned formula.

10 **Example 1**

[0189] Trials were carried out for evaluating the effect of herbicidal combinations on target weeds. The application effect of the herbicides according to the invention on the growth of herbicide resistant undesirable plants was demonstrated by the following greenhouse experiments. Evaluation for the damage on undesired vegetation caused by the present combinations was carried out using a scale from 0 to 100%, compared to the untreated control plants. Here, 0 means no damage and 100 means complete destruction of the plants. The percentage control was calculated from the observed percent weed coverage data. In the following experiments, the herbicidal activity for the individual herbicidal compositions (solo and combination applications) was assessed after treatment.

Example 2: Evaluation of % weed control of *Amaranthus viridis*

[0190] Post emergence weed control of *A. viridis* was determined at 14 DAA (14 days after application) of the treatments as set out in Table 1(a). The colby calculations indicating the synergy of the combination is depicted in Table 1(b).

25 Table 1 (a): Treatments and % weed control of *A. viridis*

Treatment no.	Treatment	Active amount g ai/ha	Dose rate ml-g/ha	% weed control 14 DAA
1.	Untreated	0	0	0
2.	Triclopyr	240	500	85

3.	Saflufenacil	7	10	65
4.	Saflufenacil	3.5	5	60
5.	Saflufenacil	1.75	2.5	50
6.	Triclopyr + Saflufenacil	240 + 7	500 + 10	99.6
7.	Triclopyr + Saflufenacil	240 + 3.5	500 + 5	99.4
8.	Triclopyr + Saflufenacil	240 + 1.75	500 + 2.5	99.1

Table 1 (b): Colby Calculations

Treatment no.	Treatment	Dose rate ml-g/ha	14 DAA	
			Observed control (%)	Expected control (%)
1.	Untreated	0	0	-
2.	Triclopyr	500	85	-
3.	Saflufenacil	10	65	--
4.	Saflufenacil	5	60	-
5.	Saflufenacil	2.5	50	
6.	Triclopyr + Saflufenacil	500 + 10	99.6	94.75
7.	Triclopyr + Saflufenacil	500 + 5	99.4	94
8.	Triclopyr + Saflufenacil	500 + 2.5	99.1	92.5

The combination of triclopyr and saflufenacil was observed to be synergistic at the application amounts defined above.

Example 3: Evaluation of % weed control of *Bidens pilosa*

[0191] Post emergence weed control of *B. pilosa* was determined at 14 DAA and 28 DAA of the treatments as set out in Table 2(a). The Colby calculations indicating the synergy of the combination is depicted in Table 2(b).

Table 2 (a): Treatments and % weed control of *B. pilosa*

Treatment no.	Treatment	Active amount g ai/ha	Dose rate ml-g/ha	% weed control	
				14 DAA	28 DAA
1.	Untreated	0	0	0	0
2.	Triclopyr	240	500	35	35.6
3.	Saflufenacil	7	10	55	32.5
4.	Saflufenacil	3.5	5	48.8	31.9
5.	Saflufenacil	1.75	2.5	56.3	28.8
6.	Triclopyr + Saflufenacil	240 + 7	500 + 10	100	100
7.	Triclopyr + Saflufenacil	240 + 3.5	500 + 5	93.1	100
8.	Triclopyr + Saflufenacil	240 + 1.75	500 + 2.5	89.4	81.3

Table 2 (b): Colby Calculations

Treatment no.	Treatment	Dose rate ml-g/ha	14 DAA		28 DAA	
			Observed control %	Expected control %	Observed control %	Expected control %
1.	Untreated	0	0	-	0	-
2.	Triclopyr	500	35	-	35.6	-
3.	Saflufenacil	10	55	-	32.5	-
4.	Saflufenacil	5	48.8	-	31.9	-
5.	Saflufenacil	2.5	56.3	-	28.8	-
6.	Triclopyr + Saflufenacil	500 + 10	100	70.75	100	56.53
7.	Triclopyr + Saflufenacil	500 + 5	93.1	66.72	100	56.14

8.	Triclopyr + Saflufenacil	500 + 2.5	89.4	71.6	81.3	54.14
----	-----------------------------	--------------	------	------	------	-------

The combination of triclopyr and saflufenacil was observed to be synergistic at the application amounts defined above.

Example 4: Evaluation of % weed control of *Amaranthus hybridus*

5 [0192] Post emergence weed control of *A. hybridus* was determined at 14 DAA and 28 DAA of the treatments as set out in Table 3(a). The Colby calculations indicating the synergy of the combination is depicted in Table 3(b).

Table 3 (a): Treatments and % weed control of *A. hybridus*

Treatment no.	Treatment	Active amount g ai/ha	Dose rate ml-g/ha	% weed control	
				14 DAA	28 DAA
1.	Untreated	0	0	0	0
2.	Triclopyr	360	750	58.1	53.8
3.	Saflufenacil	7	10	90.6	76.3
4.	Triclopyr + Saflufenacil	360 + 7	750 + 10	100	100

10 Table 3 (b) Colby Calculations

Treatment no.	Treatment	Dose rate ml-g/ha	14 DAA		28 DAA	
			Observed control %	Expected control %	Observed control %	Expected control %
1.	Untreated	0	0	-	0	-
2.	Triclopyr	750	58.1	-	53.8	-
3.	Saflufenacil	10	90.6	-	76.3	-
4.	Triclopyr + Saflufenacil	750 + 10	100	96.06	100	89.05

Example 5: Evaluation of % weed control of *Euphorbia heterophylla*

[0193] Post emergence weed control of *E. heterophylla* was determined at 28 DAA of the treatments as set out in Table 4. The colby calculations indicating the synergy of the combination is also depicted.

5 **Table 4: Treatments, % weed control and Colby Calculations**

Treatment no.	Treatment	Active amount g ai/ha	Dose rate ml-g/ha	28 DAA		
				Observed control (%)	Expected control (%)	Difference (%)
1.	Untreated	0	0	0	0	-
2.	Triclopyr	360	750	68.8	-	-
3.	Saflufenacil	7	10	45.6	-	-
4.	Triclopyr + Saflufenacil	360 + 7	750 + 10	100	83.02	17.02

Example 4: Evaluation of % weed control of *Coryza sp.*

[0194] Post emergence weed control of *Coryza sp.* was determined at 14 DAA and 28 DAA of the treatments as set out in Table 5(a). The colby calculations indicating the synergy of the combination is depicted in Table 5(b).

10 Table 5 (a): Treatments and % weed control of *Coryza sp.*

Treatment no.	Treatment	Active amount g ai/ha	% weed control		
			14 DAA	21 DAA	28 DAA
1.	Untreated	0	0	0	0
2.	Triclopyr	240	38	40	45
3.	Saflufenacil	7	55	38	33
4.	Triclopyr + Saflufenacil	240 + 7	75	70	66

Table 5 (b): Treatments and % weed control of *Conyza sp.*

Trt. no.	Treatment	14 DAA		21 DAA		28 DAA	
		Observed control (%)	Expected control (%)	Observed control (%)	Expected control (%)	Observed control (%)	Expected control (%)
1.	Untreated	0	-	0	-	0	-
2.	Triclopyr	38	-	40	-	45	-
3.	Saflufenacil	55	-	38	-	33	-
4.	Triclopyr + Saflufenacil	75	72.1	70	62.8	66	63.15

[0195] It is evident from Examples 2 to 5, that the present combination provides for the synergistic control of weeds at lower amounts of saflufenacil. Additionally, the herbicidal effect is exerted efficiently on tolerant weeds and satisfies the need for a broad spectrum weed control.

We claim,

1. A herbicidal combination for effective control of weeds comprising;
5 (i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides, and
(ii) at least one herbicide from the group comprising synthetic auxins,
wherein the application amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard amount of said herbicide applied.
- 10 2. The combination as claimed in claim 1, wherein the protoporphyrinogen oxidase (PPO) inhibitor herbicide comprises N-phenyl-imides selected from the group comprising saflufenacil, butafenacil, epyrifenacil, tiafenacil, flumioxazin, pentoxazone, trifludimoxazin, flumiclorac-pentyl and cinidon-ethyl or salts thereof.
- 15 3. The combination as claimed in claim 1, wherein the synthetic auxin comprises pyridyloxy-carboxylate selected from fluroxypyr or triclopyr or salts thereof.
4. The combination as claimed in claim 1, wherein the application amount of the PPO inhibitor is ranging from 1 to 10 g ai/ha.
- 20 5. The combination as claimed in claim 1, wherein the application amount of the PPO inhibitor is ranging from 1 to 7 g ai/ha.
6. The combination as claimed in claim 1, wherein the application amount of saflufenacil ranging from 1 to 7 g ai/ha.
- 25 7. The combination as claimed in claim 1, wherein the application amount of the synthetic auxins is ranging from 150 to 800 g ai/ha.

8. The combination as claimed in claim 1, wherein the application amount of triclopyr is ranging from 150 to 800 g ai/ha.
9. The combination as claimed in claim 1, wherein the application of the combination provides at least 70% control of undesired weeds.

5

10. A method for effectively controlling weeds comprising applying to a locus of a crop a herbicidal combination comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides in an amount ranging from 1 to 10 g ai/ha, and

10

(ii) at least one herbicide from the group comprising synthetic auxins in an amount ranging from 150 to 800 g ai/ha,

wherein the amount of the PPO inhibitor is reduced by at least 80% of the standard amount of said herbicide applied.

15

11. The method as claimed in claim 10, the method comprising applying a herbicidal combination comprising;

(i) saflufenacil in an amount ranging from 1 to 10 g ai/ha, and

(ii) triclopyr in an amount ranging from 150 to 800 g ai/ha,

wherein the amount of saflufenacil is reduced by at least 80% of the standard amount of said herbicide applied.

20

12. The method as claimed in claim 10, the method comprising applying a herbicidal combination comprising;

(i) saflufenacil in an amount ranging from 1 to 7 g ai/ha, and

(ii) triclopyr in an amount ranging from 200 to 500 g ai/ha,

25

wherein the amount of saflufenacil is reduced by at least 80% of the standard amount of said herbicide applied.

13. The method as claimed in claim 10, wherein the weed are selected from the group comprising *Bidens pilosa*, *Digitaria horizontalis*, *Amaranthus viridis*, *Amaranthus hybridus*, *Conyza sp.*, *Conyza bonariensis*, *Conyza sumatrensis* *Conyza*

canadensis Sida rhombifolia, Euphorbia heterophylla, Commelina benghalensis, Ipomoea grandiflora, Borreria latifolia and Borreria verticillate.

14. A herbicidal composition for effective control of weeds comprising;

(i) at least one herbicide from the group comprising protoporphyrinogen oxidase (PPO) inhibitor herbicides,

(ii) at least one herbicide from the group comprising synthetic auxins, and

(iii) agrochemically acceptable excipients,

wherein the amount of the PPO inhibitor herbicide is reduced by at least 80% of the standard amount of said herbicide applied.

15. A kit of parts comprising saflufenacil and triclopyr, wherein the amount of saflufenacil applied is reduced by at least 80% of the standard amount of said herbicide applied.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/055786

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A01N43/54 A01P13/02
 ADD.
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
A01N A01P
 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 105 265 440 A (GUANGDONG ZHONGXUN AGRI TECH) 27 January 2016 (2016-01-27) claim 1 -----	1-3,9-14
X	CN 108 782 563 B (UNIV YANGZHOU) 25 June 2021 (2021-06-25) examples 2-4 3.2 Herbicide dosage setting -----	1-12,14
X	US 2002/004457 A1 (NEVILL DAVID JOHN [CH] ET AL) 10 January 2002 (2002-01-10) paragraphs [0046], [0047] -----	1-3, 9-12,14
X	US 2020/315173 A1 (JIN YOSHINOBU [JP]) 8 October 2020 (2020-10-08) paragraphs [0120], [0121], [0127], [0134], [0151], [0159], [0166], [0701] paragraph [0704] -----	1-3,9-14
	-/-	

Further documents are listed in the continuation of Box C. 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 "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 13 August 2024	Date of mailing of the international search report 04/09/2024
--	---

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Beligny, Samuel
--	--

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/055786

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2023/067621 A1 (UPL LTD [IN]) 27 April 2023 (2023-04-27) page 182 -----	1-3,9-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2024/055786

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 105265440	A	27-01-2016	NONE

CN 108782563	B	25-06-2021	NONE

US 2002004457	A1	10-01-2002	AR 021121 A1 12-06-2002
			AT E240650 T1 15-06-2003
			AU 760278 B2 08-05-2003
			BR 9915141 A 07-08-2001
			CA 2347774 A1 18-05-2000
			CN 1332608 A 23-01-2002
			CZ 20011594 A3 12-12-2001
			DE 69908172 T2 15-01-2004
			DK 1128729 T3 29-09-2003
			EP 1128729 A1 05-09-2001
			ES 2200595 T3 01-03-2004
			JP 2002529379 A 10-09-2002
			KR 20010086009 A 07-09-2001
			MX 219218 B 20-02-2004
			PL 347628 A1 22-04-2002
			PT 1128729 E 30-09-2003
			US 2002004457 A1 10-01-2002
			WO 0027203 A1 18-05-2000
			ZA 200103193 B 19-04-2002

US 2020315173	A1	08-10-2020	AU 2017319643 A1 25-06-2020
			BR 112020012211 A2 24-11-2020
			CA 3086453 A1 08-03-2018
			US 2020315173 A1 08-10-2020
			WO 2018043764 A2 08-03-2018

WO 2023067621	A1	27-04-2023	AR 127389 A1 17-01-2024
			AU 2022369503 A1 02-05-2024
			CA 3235261 A1 27-04-2023
			CO 2024004617 A2 30-05-2024
			WO 2023067621 A1 27-04-2023
