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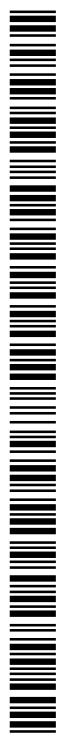
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(54) Title: A PROCESS OF CONTROLLING WEEDS

(57) Abstract: The present invention provides a process of controlling certain broadleaved weeds, by applying an herbicidally effective amount of a combination comprising Glufosinate and another active ingredient selected from aryloxy phenoxy propionic acid. Further, there is provided a process of controlling certain broadleaved weeds by applying herbicidally effective amount of a combination of Glufosinate and another active ingredient selected from aryloxy phenoxy propionic acid in broadleaved weeds wherein effective weed control could not be achieved by application of Glufosinate alone.



A PROCESS OF CONTROLLING WEEDS

FIELD OF THE INVENTION

The present invention relates to a process of controlling weeds. More specifically, the invention relates to a process of controlling broadleaved weeds which are tolerant to certain herbicides.

BACKGROUND AND THE PRIOR ART

Weed control is an important practice for crops growth. The losses caused by weeds in agricultural production environments include reduced crop quality, increased irrigation costs, increased harvesting costs, and reduced land value, injury to livestock, and crop damage from insects and pests harboured by the weeds. There are several mechanisms by which weeds cause damage to crops. Weeds may compete with crop plants for the nutrients essential for growth and development. Weeds may produce toxic or irritant chemicals that cause human or animal health problem. Some of the weed varieties also produce immense quantities of seed or vegetative reproductive parts or both that contaminate agricultural products and perpetuate the species in agricultural lands.

Broadleaved weeds such as *commelina benghalensis*, *Euphoria hirta* and *Portulaca oleracea* are common weeds of subtropical region and frequently occur with crops such as cotton, soybean and rice; and also at roadsides, pavements and orchards. These broadleaved weeds are troublesome in many ways. Primarily, they reduce crop yield by competing for water, light, soil nutrients, and space. Several cases of resistance to common herbicides has been observed in these broadleaved weeds and posed challenge for an effective control.

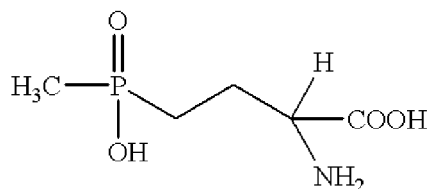
Commelina benghalensis (Benghal dayflower), also known as tropical spiderwort, is a noxious broadleaved weed that infests many agricultural crops throughout the

world (Holm et al. 1977). It produces aerial (above ground) and subterranean (below ground) flowers. This results in viable seed being produced both above and below ground. *Commelina benghalensis* also possesses the ability to root at the nodes and can be propagated from cut stems. Therefore, light cultivation can often break plant parts and increase the area of infestation. *Portulaca Oleracea*, also known as Purslane is an aggressive broadleaved weed and is considered a major problem in many crops throughout the world. Singh and Singh (1967) cite purslane as one of the ten most noxious weeds in the Upper Gangetic Plain of India and it is listed as a noxious weed by the state of Arizona (USDA, 2010). *Euphorbia hirta* is a pantropical broadleaved weed, possibly native to India. It is a hairy herb that grows in open grasslands, roadsides and pathways. *Euphorbia hirta* is distributed throughout the hotter parts of sub-tropical countries, often found in waste places along the roadsides.

Chemical herbicides have provided an effective way of controlling weeds over the years. Chemical herbicides can generally be applied pre-planting, pre-emergence and/or post-emergence. The use of chemical herbicides is sometimes the only practical and selective process of managing certain weeds. Herbicides control weeds by either stopping or changing the weed's normal growth patterns. It has been observed that weeds are capable of developing resistance to herbicides through genetic mutation and soon become tolerant to that particular herbicide. One of the frequently adopted practices to control tolerance is resistance management where two or more herbicide active substances with different mechanisms of actions are combined together and contribute the desired properties to control weed growth. The use of mixtures or sequences of herbicides with differing mechanism of actions are important especially to prevent or overcome resistance caused by single herbicides.

The combination of herbicides with a favourable profile of action allows the application rate to be reduced in comparison with the individual application of the herbicides to be combined and result into better control of weeds.

The chemical herbicide, such as Glufosinate (see Formula (I)) is an active compound (RS)-2-amino-4-[hydroxy(methyl)phosphinyl] butanoic acid, commercially available as monoammonium salt and is used as foliar herbicide (see DE-A-2717440, U.S. Pat. No. 4,168,963).

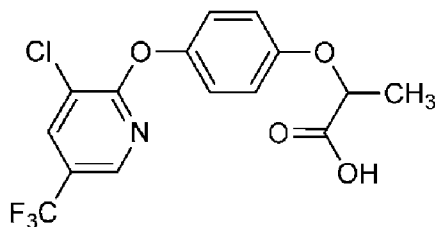


Formula I

Glufosinate ammonium is produced from phosphinic acid and is a non-selective herbicide. It can be used effectively on all broad-leaved and grass weeds. Glufosinate ammonium is used globally to control weeds on all edible & non-edible crops, fruits & berries and grasslands. It acts by inhibiting the enzyme glutamine synthetase. It is applied as foliar spray and as soil treatment. However, Glufosinate ammonium is non-selective herbicide but it is now demonstrated that some of the weed population cannot be controlled by Glufosinate when used alone. The problem of Glufosinate resistance is because of high selection pressure exerted by Glufosinate on a weed population over several years.

Certain aryloxyphenoxypropionic acids exhibit selective herbicidal activity against weeds. In these compounds, the aryloxy group may be phenoxy, pyridinyloxy or quinoxalinyloxy.

Aryloxyphenoxypropionate herbicides are known to inhibit acetyl CoA carboxylase (ACCase) enzyme of most of the grassy weeds whereas their effect is less known on dicotyledons. One such herbicidal aryloxyphenoxypropionic acid is Haloxyfop, {2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]-propanoic acid}, (shown as Formula II).



Formula II

Haloxyfop-P is an ester of aryloxyphenoxypropionic herbicides. Haloxyfop-P inhibits the biosynthesis of lipids through inhibition of ACCase enzymes. Haloxyfop-P can be provided in its acid form (as shown above) or as an agriculturally acceptable salt or ester thereof. Haloxyfop-P is a systemic herbicide, its residues "translocate", or travel throughout the plant, including within the edible parts. Haloxyfop-P-methyl which is a methyl ester of Haloxyfop-P which is having notable herbicidal activity. Exemplary uses of Haloxyfop-P-methyl ester include post-emergence control of annual and perennial grasses in sugar beet, fodder beet, oilseed rape, potatoes, leaf vegetables, onions, flax, sunflowers, soybeans, vines, strawberries, rice and other crops.

US Patent No. 7105470 discloses herbicidal compositions for tolerant or resistant soyabean crops for controlling harmful plants in soyabean crops by a process comprising treating area under cultivation through Glufosinate and large number of other herbicides in combination. However, there is no direct reference to the biological study or any data that can ascertain additive effect of the combination

of the present invention on certain specific broadleaved weeds of resistant soyabean crops which are tolerant to Glufosinate.

A variety of herbicides combinations have been hitherto developed to offer wider range of weed control. However, there still remains a need for improved solutions and process of use thereof that are effective in controlling broadleaved weeds especially which are developing resistance towards Glufosinate. The present invention meets these and other need in the art.

OBJECTIVES

An object of the present invention is to provide a process to control certain broadleaved weeds.

Another object of the present invention is to provide a process that effectively controls certain broadleaved weeds in both pre-emergent and post-emergent conditions.

Another object of the present invention is to provide a process that offers effective broadleaved weed control in arable as well as non-arable lands.

SUMMARY OF THE INVENTION

The present invention provides a process of controlling certain broadleaved weeds, by applying an herbicidally effective amount of a combination comprising:

- A) Glufosinate, ((RS)-2-Amino-4-(hydroxy(methyl)phosphonoyl) butanoic acid), its agriculturally acceptable salts, isomers, esters or derivatives thereof; and
- B) Haloxfop ((RS)-2-{4-[3-chloro-5-(trifluoromethyl)-2-pyridyloxy] phenoxy} propionic acid), its agriculturally acceptable salts, isomers, esters or derivatives thereof.

Further, there is provided a process of controlling certain broadleaved weeds by applying herbicidally effective amount of a combination of Glufosinate and Haloxyfop in broadleaved weeds wherein effective weed control could not be achieved by application of Glufosinate alone.

Further, there is provided a process of controlling certain broadleaved weeds comprising applying herbicidally effective amount of a combination of Glufosinate and Haloxyfop, wherein said broadleaved weed species are selected from the group of *Euphorbiaceae*, *Portulacaceae* and *Commelinaceae*; preferably from *Euphorbia*, *Portulaca* and *Commelina* genus respectively.

Further, there is provided a process of controlling certain broadleaved weeds by applying a composition comprising Glufosinate and Haloxyfop.

Further, there is provided a process of controlling certain broadleaved weeds comprising applying a composition comprising Glufosinate and Haloxyfop, wherein said broadleaved weed species are selected from the group of *Euphorbia hirta*, *Portulaca oleracea* and *Commelina bengalensis*.

DESCRIPTION OF THE INVENTION

Definitions:

The following terms have the indicated meanings when used herein:

As used herein, a herbicidally effective amount is an amount of active ingredient which causes an adversely modifying effect in targeted weeds. Such effects include deviations from natural development, killing, regulation, desiccation, retardation, and the like.

As used herein, post-emergence control of weeds means preventing, reducing, killing, or otherwise adversely modifying the development of the weeds with negligent adverse effect on the crop plants.

As used herein, applying an herbicide or herbicidal composition means delivering it directly to the targeted weeds or to the locus thereof or to the area where control of targeted weed is desired, but not directly on the trees, vines and nuts. Sprays or granules are directed under the vines or perennial crops, with foliar exposure of the vines and perennial crops being avoided.

As used herein, agriculturally acceptable salts, isomers, esters and derivatives of the compound of formula (I) or the compound of formula (II) refer to salts, isomers, esters and derivatives and can be hydrolyzed, oxidized, metabolized, or otherwise converted in plants or solid to the corresponding metabolite which, depending upon the pH, may be in the dissociated or undissociated form.

As used herein, the terms *_formulation:* and *_composition:* may be used interchangeably and refer to a mixture of two or more compounds, elements, molecules, etc. In some aspects the terms *_formulation:* and *_composition:* may be used to refer to a mixture of one or more active ingredients with a carrier or other excipients.

As used herein, the term *_expected value:* refer to the statistically predicted value as percentage control of weeds receiving treatment according to the present invention.

It has now been found that, surprisingly, process of applying the combination of a glutamine-synthase herbicide, Glufosinate with ACCase inhibitor herbicide, Haloxyfop surpasses the additional effect to be expected in principle on the *Commelina benghalensis*, *Euphorbia hirta* and *Portulaca oleracea* broadleaved

weeds, and thus offers a complete control. The combination of herbicidally effective amount of Glufosinate and Haloxyfop controls said broadleaved weeds that are failed to get controlled by the application of either of the compounds of said combination when used alone.

The present invention provides a process of controlling certain broadleaved weeds, by applying the herbicidally effective amount of a combination comprising:

- A) A broad-spectrum herbicide Glufosinate, which is (RS)-2-Amino-4-(hydroxy(methyl)phosphonyl) butanoic acid, its agriculturally acceptable salts, isomers, esters or derivatives thereof hereinafter, referred to as glufosinate; and
- B) Haloxyfop ((RS)-2-{4-[3-chloro-5-(trifluoromethyl)-2-pyridyloxy] phenoxy} propionic acid) its agriculturally acceptable salts, isomers, esters or derivatives thereof. (hereinafter, referred to as Haloxyfop).

According to another embodiment of the present invention, Glufosinate is applied alone or in combination at rates between 50g a.i./ha to about 2000g a.i./ha, preferably in the range of 20-1200g a.i./ha, more preferably in the range of 20-960g a.i./ha.

According to another embodiment of the present invention, Haloxyfop is applied alone or in combination at rates between 10g a.i./ha to about 300g a.i./ha, preferably in the range of 20-250g a.i./ha.

According to another embodiment of the present invention, the combination comprises from about 0.1% by weight to about 80% by weight of Glufosinate of the total amount of the active ingredients.

According to another embodiment of the present invention, the combination comprises from about 0.1% to about 70% by weight of Haloxyfop of the total amount of the active ingredients.

In another embodiment of the present invention, Glufosinate and Haloxyfop is used in a ratio from minimum of 9:1 to 1:9.

In an embodiment of the present invention, Glufosinate and Haloxyfop controls certain broadleaved weeds infestation at a locus by applying at said locus a herbicidally effective amount of Glufosinate and Haloxyfop.

In an embodiment of the present invention, herbicidally effective amount of Glufosinate and Haloxyfop controls certain broadleaved weeds when applied at the locus which is the vicinity of a desired plant/crop.

One of the preferred processes of control of certain broadleaved weeds according to the present invention involves the post-emergent control of weeds using herbicidally effective amount of Glufosinate and Haloxyfop.

In an embodiment of the present invention, herbicidally effective amount of Glufosinate and Haloxyfop in which Glufosinate is a broad spectrum, non-selective herbicide and Haloxyfop is used for selective control of certain weeds in arable and non-arable conditions.

In an embodiment of the present invention, the combination of Glufosinate and Haloxyfop in herbicidally effective amount exhibits good control of certain broadleaved weeds as compared to the control exhibited by Glufosinate and Haloxyfop used alone.

In an embodiment of the present invention, the combination of Glufosinate and Haloxyfop can be applied sequentially, with either component being applied first. Preferably the components are applied within 3 days and most preferably same day

of each other. Alternatively, and preferably, the Glufosinate and Haloxyfop are applied together as a single composition.

In an embodiment of the present invention, the combination employed in the practice of the present invention can be applied in a variety of ways known to those skilled in the art, at various concentrations. The combination is useful in controlling the growth of broadleaved weeds to the locus where control is desired.

In an embodiment of the invention, herbicidally effective amount of Glufosinate and Haloxyfop is effective in controlling broadleaved weeds from the *Portulaca* genus of family Portulacaceae.

In an embodiment of the invention, herbicidally effective amount of Glufosinate and Haloxyfop is effective in controlling broadleaved weeds selected from *Portulaca oleraceae* species.

In an embodiment of the invention, herbicidally effective amount of Glufosinate and Haloxyfop is effective in controlling broadleaved weeds from *Commelina* genus of Commelinaceae family.

In an embodiment of the invention, herbicidally effective amount of Glufosinate and Haloxyfop is effective in controlling broadleaved weeds selected from *commelina benghalensis* species.

In an embodiment of the invention, herbicidally effective amount of Glufosinate and Haloxyfop is effective in controlling broadleaved weeds selected from *Euphorbia* genus of Euphorbiaceae family.

In an embodiment of the invention, herbicidally effective amount of Glufosinate and Haloxyfop is effective in controlling broadleaved weeds selected from *euphorbia hirta* species.

In an embodiment, glufosinate is selected from its isomers, mixture of isomers, derivatives, or their lower alkyl esters thereof or salts thereof with acids or bases preferably the racemate or its salts as the active ingredient.

In another embodiment, the preferred salt is glufosinate ammonium.

In another embodiment, the preferred isomer is glufosinate P.

In an embodiment, haloxyfop is selected from its salts, its isomers, mixture of isomers, derivatives, or their lower alkyl esters thereof.

In another embodiment, the preferred isomer is haloxyfop-P.

In yet another embodiment, the preferred ester is methyl ester of haloxyfop.

In a preferred embodiment, the isomer is haloxyfop-P-methyl.

In an embodiment of the present invention, there is provided a process of controlling certain broadleaved weeds by applying a composition comprising Glufosinate and Haloxyfop.

In another embodiment, there is provided a process of controlling certain broadleaved weeds by applying herbicidally effective amount of the compositions comprising glufosinate, its agriculturally acceptable salts, isomers, esters or derivatives thereof; and haloxyfop, its agriculturally acceptable salts, isomers, esters or derivatives thereof and other suitable excipients wherein, said broadleaved weeds are selected from the family *Euphorbiaceae*, *Portulacaceae* and *Commelinaceae*.

According to another embodiment of the present invention, the composition comprises from about 1 g/L to about 800 g/L and preferably from about 10 g/L to about 500 g/L of Glufosinate of the total weight of the composition.

In a preferred embodiment of the present invention, the composition comprises from about 40 g/L to about 280 g/L of Glufosinate of the total weight of the composition.

In another preferred embodiment, glufosinate is applied at a rate of about 240g/ha to about 1500g/ha.

According to another embodiment of the present invention, the composition comprises from about 0.1 g/L to about 200 g/L and preferably from about 1 g/L to about 200 g/L of Haloxyfop of the total weight of the composition.

In a preferred embodiment of the present invention, the composition comprises from about 5 g/L to about 200 g/L of Haloxyfop of the total weight of the composition.

In another preferred embodiment, haloxyfop is applied at a rate of about 40g/ha to about 240g/ha.

In an embodiment of the present invention, the compositions and process of controlling certain broadleaved weeds herein are utilized to control certain broadleaved weeds that occur as undesirable vegetation includes, but is not limited to, those occurs in Glufosinate-tolerant soybeans, corn, or cotton; non-crop areas, including but not limited to pastures, grasslands, rangelands, fallowland, fencerows, parking areas, tank farms, storage areas, rights-of-way, utility areas, turf, forestry, aquatics, industrial vegetation management (IVM) and fallow-bed prior to

planting crops; perennial crops where the application contacts the undesirable vegetation but does not contact the crop foliage, such as tree and vine orchards, including but not limited to citrus, grapes, almond, apple, apricot, avocado, beechnut, brazil nut, butternut, cashew, cherry, chestnut, chinquapin, crab apple, date, feijoa, fig, filbert, hickory nut, kiwi, lemon, lime, loquat, macadamia nut, mandarin, mayhaw, nectarine, olive, oranges, peach, pear, pecan, persimmon, pistachio, plum, pome fruit, pomegranate, prune, quince, stone fruit, tree nuts and walnut; fruiting crops (e.g., blueberries, guava, papaya, strawberries, taro, blackberries and raspberries); and plantation crops (including, but not limited to, coffee, cocoa, rubber and palm oil).

The compositions of the present invention can be in any conventional agriculturally useful form, for example, in the form of a twin pack, or in a ready-to-use formulation, or in the form of a tank mix. Additionally, the active compounds can be supplied (either separately or pre-mixed) in any appropriate formulation type, for example emulsion concentrate (EC), a suspension concentrate (sq, a suspo-emulsion (SE), a capsule suspension (CS), a water dispersible granule (WG), an emulsifiable granule (EG), a water in oil emulsion (EO), an oil in water emulsion (EW), a micro-emulsion (ME), an oil dispersion (OD), an oil miscible flowable (OF), an oil miscible liquid (OL), a soluble concentrate (SL), an ultra-low volume suspension (SU), an ultra-low volume liquid (UL), a dispersible concentrate (DC), a wettable powder (WP) or any other technically feasible formulation in combination with agriculturally acceptable adjuvants.

In an embodiment of the invention, various adjuvants and carriers are added that facilitate dispersion of active substances in the formulation. The choice of formulation and mode of application for any given compound may affect its activity, and selection shall be made accordingly.

In an embodiment of the invention, various excipients are added that facilitate formulation of active substances in the desired form.

In another embodiment of the invention, these formulations can be applied to the areas where control is desired by conventional processes. Dust and liquid compositions, for example, can be applied by the use of power-dusters, broom and hand sprayers and spray dusters. The formulations can also be applied from airplanes as a dust or a spray or by rope wick applications. The formulations can also be applied by addition to irrigation water. This permits penetration of the formulations into the soil together with the irrigation water. Dust compositions, granular compositions or liquid formulations applied to the surface of the soil can be distributed below the surface of the soil by conventional means such as disking, dragging or mixing operations.

Further, other herbicidally active substances or compositions may be combined with the herbicidal composition of this invention. For example, the compositions may contain, in addition to Glufosinate and Haloxyfop, insecticides, fungicides, bactericides, acaricides or nematocides, in order to broaden the spectrum of activity.

In another embodiment, the composition comprising Glufosinate and Haloxyfop may further contain herbicide selected from ametryn, atrazine, simazine, alachlor, metolachlor, S-metolachlor, asulam, metribuzin, trifluralin, pendimethalin, tebuthiuron, diuron, hexazinone, amicarbazone, imazapic, trifloxysulfuron-sodium, iodosulfuron-methyl-sodium, halosulfuron-methyl, ethoxysulfuron, carfentrazone-ethyl, isoxaflutole, bicyclopyrone, mesotrione, picloram and salts and esters thereof, 2,4-D and salts thereof and esters thereof, dicamba and salts and esters thereof, clomazone, MSMA, paraquat or diquat.

In another embodiment, the composition comprising Glufosinate and Haloxypop may further contain fungicide selected from kresoxim-methyl, azoxystrobin, trifloxystrobin, fluoxastrobin, picoxystrobin, pyraclostrobin, dimoxystrobin, pyribencarb, metominostrobin, orysastrobin, enestrobin, pyraoxystrobin, pyrametostrobin, azaconazole, bitertanol, bromuconazole, cyproconazole, difenoconazole, diniconazole, epoxiconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, hexaconazole, imibenconazole, ipconazole, metconazole, myclobutanil, penconazole, propiconazole, prothioconazole, simeconazole, tebuconazole, tetraconazole, triadimenol, triticonazole, fenarimol, nuarimol, pyrifenoxy, imazalil, oxpoconazole fumarate, pefurazoate, prochloraz, triflumizole, metalaxyl, and metalaxyl-M.

Rates of application of the composition, or tank-mixed separately formulated active ingredients, will vary according to prevailing conditions such as targeted weeds, degree of infestation, weather conditions, soil conditions, crop species, mode of application, and application time. As one skilled in the art is aware, in herbicidal testing, a significant number of factors that are not readily controllable can affect the results of individual tests and render them non-reproducible. For example, the results may vary depending on environmental factors, such as amount of sunlight and water, soil type, pH of the soil, temperature, and humidity, among other factors. Also, the depth of planting, the application rate of individual and combined herbicides, the application rate of any antidote, and the ratio of the individual herbicides to one another and/or to an antidote, as well as the nature of crops or weeds being tested, can affect the results of the test. Results may vary from crop to crop within the crop varieties.

Inventors of the present invention succeeded in controlling certain broadleaved weeds selected from portulaca spp, commelina spp and euphorbia spp by applying

herbicidally effective amount of combination of Glufosinate and Haloxyfop. The process of controlling certain broadleaved weeds is ascertained by the experiments as exemplified below. These examples are merely illustrations and are not to be understood as limiting the scope and underlying principles of the invention in any way. Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art from the following examples and foregoing description.

POST EMERGENCE FIELD TRIAL TO OBSERVE EFFECTIVENESS OF
COMBINATION ON SELECTED WEEDS

SEASON-1

Post emergence field trials were conducted to observe effectiveness of the combination on commelina benghalensis, euphorbia hirta and portulaca oleracea. Field trials were conducted to observe effectiveness of Glufosinate and Haloxyfop-p-methyl combination in comparison to glufosinate or Haloxyfop-p-methyl alone. The study was conducted in two seasons to observe the variation. These three studies are presented below as:

- ¿ Season-I, 7DAT and 14DAT study of Haloxyfop-P-methyl, Glufosinate and Haloxyfop-P-methyl+ Glufosinate combination on Commelina benghalensis, Euphorbia hirta Portulaca Oleracea
- ¿ Season-2, 7DAT and 14DAT study of Haloxyfop-P-methyl, Glufosinate and Haloxyfop-P-methyl+ Glufosinate combination on Commelina benghalensis, Euphorbia hirta Portulaca Oleracea

EXAMPLE 1

Season-I, 7DAT and 14DAT study of Haloxyfop-P-methyl, Glufosinate and Haloxyfop-P-methyl+ Glufosinate combination on *Commelina benghalensis*, *Euphorbia hirta* *Portulaca Oleracea*.

Details of experiment:

- a) Treatments: 15 (Fifteen)
- b) Plot size: 100 sqm (2.74 X 36.49)
- c) Test Crop: Grape Orchard
- d) Variety: Thompson Seedless
- e) Time of application: Post-emergence directed spray
- f) Application volume: 500 L/Ha
- g) Observation days: 7, 14 days after application
- h) Season/Month: Rainy/August, 2015
- i) Treatment details: This study was performed on grapes orchard where grapes orchard was predominantly covered by weed plants such as *euphorbia hirta*, *commelina benghalensis* and *portulaca oleracea*. The average height of weeds was about 2-inch to 4-inch. For the study purpose, grape orchard was demarcated into three distinct regions. Each region was further divided into three zones such that observations were evaluated in the form of 3x3 matrix design. The intention of considering weed flora in three distinct regions was to evaluate individual herbicidal activity of Haloxyfop-P-methyl (control-I), individual herbicidal activity of Glufosinate (control-II) and the herbicidal activity of Haloxyfop-P-methyl and Glufosinate in combination. Also, the study was further intended to evaluate the efficiency of optimum dose of herbicidally active ingredients.

Effects of the combinations according to the invention are observed which exceed the formal total of the effects when applying the herbicides individually. If the data of the effects observed already exceed the formal total of the data of the experiments with individual applications, then they also exceed Colby's expected value (E^C), which is calculated by the formula:

$$E^C = A + B - (A \cdot B / 100)$$

A = % visual control by compound (a) at the rate of application of p kg/ha;

B = % visual control by compound (b) at the rate of application of q kg/ha; and

E^C = Expected % visual control caused by compounds (a) and (b) at a rate of application of p and q kg/ha

At suitable low dosages, the observed data of the experiments show an effect of the combinations above Colby's expected values.

Accordingly, weed plants were evaluated in one-week interval starting at 7 days after treatment (Table 1 to Table 9). The final evaluation is done two weeks (14 DAT) after treatment (Table 10 to Table 15), at which time-point, significant burn down effect was observed in the first region treated with the combination of Glufosinate and Haloxypop-P-methyl in comparison to the second and third region treated with control-I and control-II respectively.

The region that received control-I spray did not show any significant herbicidal activity. All the three weeds i.e. *euphorbia hirta*, *commelina benghalensis* and *portulaca oleracea* did not respond to control-I even at varied concentrations e.g. 140 g/ha, 200 g/ha and 260 g/ha of Haloxypop.

Similarly, another region received control-II spray with 560 g/ha, 835 g/ha and 1200 g/ha doses of Glufosinate. Control-II showed little better herbicidal activity on

targeted weeds wherein average 55% of *euphorbia hirta*, 65% of *commelina benghalensis* and 34% of *portulaca oleracea* got killed by control-II spray.

The region that received combination of Glufosinate and Haloxyfop-P-methyl showed significantly more burn down effect at all the varied concentrations with combinations of 140+560 g/ha, 140+835 g/ha, 140+1200 g/ha, 200+ 560 g/ha, 200+ 835 g/ha, 200+1200 g/ha, 260+560 g/ha, 260+835 g/ha, 260+1200 g/ha in all the selected weed classes.

Therefore, it was concluded that the combination of Glufosinate and Haloxyfop-P-methyl showed far more superior effect on *Euphorbia hirta*, *Commelina benghalensis* and *Portulaca oleracea* weeds than when treated alone with either of the two herbicides.

Table 1

DAT	7	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		40.00
Glufosinate @ 835 g ai/ha		60.00
Glufosinate @ 1200 g ai/ha		65.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	40.00	45.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	60.00	62.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	65.00	70.00

Table 2

DAT	7	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		55.00
Glufosinate @ 835 g ai/ha		65.00
Glufosinate @ 1200 g ai/ha		75.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	55.00	59.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	65.00	72.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	75.00	81.00

Table 3

DAT	7	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		25.00
Glufosinate @ 835 g ai/ha		35.00
Glufosinate @ 1200 g ai/ha		42.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	25.00	27.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	35.00	45.00

Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	42.00	52.00
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Table 4

DAT	7	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		2.00
Glufosinate @ 560 g ai/ha		40.00
Glufosinate @ 835 g ai/ha		60.00
Glufosinate @ 1200 g ai/ha		65.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	41.00	47.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	61.00	71.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	66.00	78.00

Table 5

DAT	7	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		55.00
Glufosinate @ 835 g ai/ha		65.00
Glufosinate @ 1200 g ai/ha		75.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	55.00	63.00

Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	65.00	78.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	75.00	86.00

Table 6

DAT	7	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		25.00
Glufosinate @ 835 g ai/ha		35.00
Glufosinate @ 1200 g ai/ha		42.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	25.00	30.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	35.00	36.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	42.00	45.00

Table 7

DAT	7	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 260 g ai/ha		5.00
Glufosinate @ 560 g ai/ha		40.00
Glufosinate @ 835 g ai/ha		60.00
Glufosinate @ 1200 g ai/ha		65.00

Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	43.00	48.00
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	62.00	69.00
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	67.00	81.00

Table 8

DAT	7	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^c)	Observed
Haloxfop-P-methyl @ 260 g ai/ha		2.00
Glufosinate @ 560 g ai/ha		55.00
Glufosinate @ 835 g ai/ha		65.00
Glufosinate @ 1200 g ai/ha		75.00
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	56.00	67.00
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	66.00	79.00
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	76.00	85.00

Table 9

DAT	7	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^c)	Observed
Haloxfop-P-methyl @ 260 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		25.00
Glufosinate @ 835 g ai/ha		35.00

Glufosinate @ 1200 g ai/ha		42.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	25.00	40.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	35.00	43.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	42.00	49.00

Table 10

DAT	14	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		65.00
Glufosinate @ 835 g ai/ha		70.00
Glufosinate @ 1200 g ai/ha		78.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	65.00	72.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	70.00	75.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	78.00	85.00

Table 11

DAT	14	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		5.00
Glufosinate @ 560 g ai/ha		67.00

Glufosinate @ 835 g ai/ha		70.00
Glufosinate @ 1200 g ai/ha		78.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	69.00	70.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	72.00	78.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	79.00	85.00

Table 12

DAT	14	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		3.00
Glufosinate @ 560 g ai/ha		65.00
Glufosinate @ 835 g ai/ha		70.00
Glufosinate @ 1200 g ai/ha		78.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	66.00	78.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	71.00	82.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	79.00	88.00

Table 13

DAT	14	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		10.00

Glufosinate @ 560 g ai/ha		67.00
Glufosinate @ 835 g ai/ha		70.00
Glufosinate @ 1200 g ai/ha		78.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	70.00	75.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	73.00	80.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	80.00	83.00

Table 14

DAT	14	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 260 g ai/ha		5.00
Glufosinate @ 560 g ai/ha		65.00
Glufosinate @ 835 g ai/ha		70.00
Glufosinate @ 1200 g ai/ha		78.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	67.00	75.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	72.00	85.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	79.00	90.00

Table 15

DAT	14	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^C)	Observed

Haloxypop-P-methyl @ 260 g ai/ha		12.00
Glufosinate @ 560 g ai/ha		67.00
Glufosinate @ 835 g ai/ha		70.00
Glufosinate @ 1200 g ai/ha		78.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	71.00	77.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	74.00	80.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	81.00	89.00

EXAMPLE 2

Season-2, 7DAT and 14DAT study of Haloxypop-P-methyl, Glufosinate and Haloxypop-P-methyl+ Glufosinate combination on Commelina benghalensis,

⌘ Euphorbia hirta Portulaca Oleracea

Details of experiment:

- a) Treatments: 15 (Fifteen)
- b) Plot size: 50 sqm
- c) Sprayer used: Battery operated Knapsack Sprayer
- ⌘ d) Nozzle Type: Flat Fan
- e) Test Crop: Grape Orchard
- f) Variety: Thompson Seedless
- g) Time of application: Post-emergence directed spray
- h) Application volume: 500 L/Ha
- ⌘ i) Observation days: 7, 14 days after application
- j) Season/Month: Winter/February, 2017

Treatment details: This study was performed on grapes orchard where grapes orchard was predominantly covered by weed plants such as *euphorbia hirta*, *commelina benghalensis* and *portulaca oleracea*. The average height of weeds was about 4-inch to 10-inch. For the study purpose, grape orchard was demarcated into three distinct regions. Each region was further divided into three zones such that observations were evaluated in the form of 3x3 matrix design. The intention of considering weed flora in three distinct regions was to evaluate individual herbicidal activity of Haloxyfop-P-methyl (control-I), individual herbicidal activity of Glufosinate (control-II) and the herbicidal activity of Haloxyfop-P-methyl and Glufosinate in combination. Also, the study was further intended to evaluate the efficiency of optimum dose of herbicidally active ingredients.

Weed plants were evaluated in one-week interval starting at 7 days after treatment (Table 18 to Table 24). The final evaluation is done two weeks (14 DAT) after treatment (Table 25 to Table 33), at which time-point, significant burn down effect was observed in the first region treated with the combination of Glufosinate and Haloxyfop-P-methyl in comparison to the second and third region treated with control-I and control-II respectively.

The region that received control-I spray did not show any significant herbicidal activity. All the three weeds i.e. *euphorbia hirta*, *commelina benghalensis* and *portulaca oleracea* showed very diminished response to control-I even at varied concentrations e.g. 140 g/ha, 200 g/ha and 260 g/ha of Haloxyfop.

Similarly, another region received control-II spray with 560 g/ha, 835 g/ha and 1200 g/ha doses of Glufosinate. Control-II showed little better herbicidal activity on targeted weeds wherein average 43% of *euphorbia hirta*, 32% of *commelina benghalensis* and 22% of *portulaca oleracea* got killed by control-II spray.

The region that received combination of Glufosinate and Haloxyfop-P-methyl showed significantly more burn down effect at all the varied concentrations with combinations of 140+560 g/ha, 140+835 g/ha, 140+1200 g/ha, 200+ 560 g/ha, 200+ 835 g/ha, 200+1200 g/ha, 260+560 g/ha, 260+835 g/ha, 260+1200 g/ha in all the selected weeds

Table 16

DAT	7	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		1.67
Glufosinate @ 560 g ai/ha		26.67
Glufosinate @ 835 g ai/ha		31.67
Glufosinate @ 1200 g ai/ha		36.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	27.89	48.33
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	32.81	46.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	37.72	60.00

Table 17

DAT	7	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		1.67
Glufosinate @ 560 g ai/ha		35.00

Glufosinate @ 835 g ai/ha		43.33
Glufosinate @ 1200 g ai/ha		51.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	36.08	43.33
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	44.28	50.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	52.47	61.67

Table 18

DAT	7	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		16.67
Glufosinate @ 835 g ai/ha		20.00
Glufosinate @ 1200 g ai/ha		28.33
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	16.67	23.33
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	20.00	26.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	28.33	35.00

Table 19

DAT	7	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		6.67

Glufosinate @ 560 g ai/ha		26.67
Glufosinate @ 835 g ai/ha		31.67
Glufosinate @ 1200 g ai/ha		36.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	31.56	40.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	36.22	45.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	40.89	50.00

Table 20

DAT	7	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		5.00
Glufosinate @ 560 g ai/ha		35.00
Glufosinate @ 835 g ai/ha		43.33
Glufosinate @ 1200 g ai/ha		51.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	38.25	48.33
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	46.17	48.33
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	54.08	56.67

Table 21

DAT	7	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		0.00
Glufosinate @ 560 g ai/ha		16.67
Glufosinate @ 835 g ai/ha		20.00
Glufosinate @ 1200 g ai/ha		28.33
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	16.67	21.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	20.00	31.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	28.33	38.33

Table 22

DAT	7	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 260 g ai/ha		10.00
Glufosinate @ 560 g ai/ha		26.67
Glufosinate @ 835 g ai/ha		31.67
Glufosinate @ 1200 g ai/ha		36.67
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	34.00	45.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	38.50	46.67

Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	43.00	60.00
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Table 23

DAT	7	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxfop-P-methyl @ 260 g ai/ha		6.67
Glufosinate @ 560 g ai/ha		35.00
Glufosinate @ 835 g ai/ha		43.33
Glufosinate @ 1200 g ai/ha		51.67
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	39.33	46.67
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	47.11	53.33
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	54.89	66.67

Table 24

DAT	7	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^C)	Observed
Haloxfop-P-methyl @ 260 g ai/ha		1.67
Glufosinate @ 560 g ai/ha		16.67
Glufosinate @ 835 g ai/ha		20.00
Glufosinate @ 1200 g ai/ha		28.33
Haloxfop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	18.06	25.00

Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	21.33	23.33
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	29.53	40.00

Table 25

DAT	14	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		8.33
Glufosinate @ 560 g ai/ha		53.33
Glufosinate @ 835 g ai/ha		58.33
Glufosinate @ 1200 g ai/ha		71.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	57.22	66.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	61.81	70.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	74.03	78.33

Table 26

DAT	14	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		6.67
Glufosinate @ 560 g ai/ha		60.00
Glufosinate @ 835 g ai/ha		68.33
Glufosinate @ 1200 g ai/ha		75.00

Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	62.67	66.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	70.44	73.33
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	76.67	85.00

Table 27

DAT	14	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 140 g ai/ha		1.67
Glufosinate @ 560 g ai/ha		60.00
Glufosinate @ 835 g ai/ha		60.00
Glufosinate @ 1200 g ai/ha		71.67
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 560 g ai/ha	60.67	65.00
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 835 g ai/ha	60.67	68.33
Haloxypop-P-methyl @ 140 g ai/ha + Glufosinate @ 1200 g ai/ha	72.14	73.33

Table 28

DAT	14	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^c)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		10.00
Glufosinate @ 560 g ai/ha		53.33
Glufosinate @ 835 g ai/ha		58.33

Glufosinate @ 1200 g ai/ha		71.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	58.00	61.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	62.50	66.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	74.50	80.00

Table 29

DAT	14	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		10.00
Glufosinate @ 560 g ai/ha		60.00
Glufosinate @ 835 g ai/ha		68.33
Glufosinate @ 1200 g ai/ha		75.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	64.00	75.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	71.50	83.33
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	77.50	86.67

Table 30

DAT	14	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 200 g ai/ha		1.67
Glufosinate @ 560 g ai/ha		60.00

Glufosinate @ 835 g ai/ha		60.00
Glufosinate @ 1200 g ai/ha		71.67
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 560 g ai/ha	60.67	68.33
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 835 g ai/ha	60.67	70.00
Haloxypop-P-methyl @ 200 g ai/ha + Glufosinate @ 1200 g ai/ha	72.14	78.33

Table 31

DAT	14	
Weed	<i>Commelina benghalensis</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 260 g ai/ha		10.00
Glufosinate @ 560 g ai/ha		53.33
Glufosinate @ 835 g ai/ha		58.33
Glufosinate @ 1200 g ai/ha		71.67
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	58.00	63.33
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	62.50	70.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	74.50	81.67

Table 32

DAT	14	
Weed	<i>Euphorbia hirta</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 260 g ai/ha		11.67

Glufosinate @ 560 g ai/ha		60.00
Glufosinate @ 835 g ai/ha		68.33
Glufosinate @ 1200 g ai/ha		75.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	64.67	70.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	72.03	81.67
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	77.92	86.67

Table 33

DAT	14	
Weed	<i>Portulaca oleracea</i>	
Doses	Expected (E ^C)	Observed
Haloxypop-P-methyl @ 260 g ai/ha		5.00
Glufosinate @ 560 g ai/ha		60.00
Glufosinate @ 835 g ai/ha		60.00
Glufosinate @ 1200 g ai/ha		71.67
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 560 g ai/ha	62.00	66.67
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 835 g ai/ha	62.00	70.00
Haloxypop-P-methyl @ 260 g ai/ha + Glufosinate @ 1200 g ai/ha	73.08	78.33

Therefore, it was concluded that the combination of Glufosinate and Haloxypop-P-methyl showed far more superior effect on *Euphorbia hirta*, *Commelina*

benghalensis and *Portulaca oleracea* weeds than when treated alone with either of the two herbicides.

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

CLAIMS

1. A process of controlling broadleaved weeds comprising applying an herbicidally effective amount of a combination comprising glufosinate, its agriculturally acceptable salts, isomers, esters or derivatives thereof; and haloxyfop, its agriculturally acceptable salts, isomers, esters or derivatives thereof.
2. A process according to claim 1 wherein said broadleaved weeds are selected from the family Euphorbiaceae, Portulacaceae and Commelinaceae.
3. A process according to claim 1 wherein said broadleaved weeds are selected from euphorbia hirta, portulaca oleraceae, and commelina bengalhensis.
4. A process according to claim 1, wherein said combination comprises glufosinate ammonium and haloxyfop-p-methyl.
5. A process according to claim 1 wherein glufosinate is applied at a rate of about 50g/ha to about 2000g/ha.
6. A process according to claim 1 wherein haloxyfop is applied at a rate of about 10g/ha to about 300g/ha.
7. A process according to claim 1 wherein, glufosinate and haloxyfop are applied to the locus of undesirable vegetation.
8. A process according to claim 1 wherein glufosinate and haloxyfop are applied to the locus of undesirable vegetation in crop/non crop habitat.
9. A process according to claim 1 wherein glufosinate and haloxyfop are applied for post-emergent control of said weeds.
10. A process according to claim 1 wherein glufosinate and haloxyfop are applied sequentially.
11. A process according to claim 1 wherein glufosinate and haloxyfop are applied together.

12. A process according to claim 1 wherein said combination further comprises other crop protection agents.
13. A process according to claim 1 wherein said combination further comprises adjuvants and other excipients conventionally used in agrochemical formulations.
14. A process of controlling broadleaved weeds comprising applying a composition comprising glufosinate, its agriculturally acceptable salts, isomers, esters or derivatives thereof; and haloxyfop, its agriculturally acceptable salts, isomers, esters or derivatives thereof.
15. A process according to claim 14, wherein glufosinate is applied at a rate of about 240g/ha to about 1500g/ha.
16. A process according to claim 14, wherein haloxyfop is applied at a rate of about 40g/ha to about 240g/ha.
17. A process according to claim 14, wherein said broadleaved weeds are selected from the family *Euphorbiaceae*, *Portulacaceae* and *Commelinaceae*.
18. A process according to claim 14 wherein, said broadleaved weeds are selected from *euphorbia hirta*, *portulaca oleraceae*, and *commelina bengalhensis*.
19. A process according to claim 14 wherein said composition comprises glufosinate ammonium and haloxyfop P-methyl.
20. A process according to claim 14 wherein said composition further comprises other crop protection agents.
21. A process according to claim 14 wherein said composition further comprises adjuvants and other excipients conventionally used in agrochemical formulations.

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/IB2017/055792

A. CLASSIFICATION OF SUBJECT MATTER

A01N 43/40 (2006.01) A01N 57/02 (2006.01) A01P 13/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPOQUE 5.2: Applicant/Inventor names (UPL Limited, S Bhoge, P Talati, J Shroff, V Shroff and like names); IPC/CPC marks (A01N57[02,20], A01N43/40, A01P13/00, A01N2300/00); Keywords (glufosinate, glufosinate-ammonium, haloxyfop, haloxyfop-p-methyl, broadleaf, flat, weed, euphorbia+, portulaca+, commelina+, spurge, pursley, purslane, day_flower and like terms, alternatives & truncations).

NEW STN: CAS Registry Numbers (51276-47-2, 77182-82-2, 69806-34-4, 72619-32-0); Keywords (broadleaf, flat, weed, euphorbia, portulaca, commelina, spurge, purslane, dayflower, glufosinate, glufosinate-ammonium, haloxyfop, haloxyfop-p-methyl and like terms, alternatives and truncations).

ONLINE DATABASES: Applicant/Inventor names (as above); Keywords (glufosinate, haloxyfop, glufosinate ammonium, haloxyfop-p-methyl, euphorbia, portulaca, commelina, broadleaf, flat weedand like terms and alternatives).

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 30 November 2017		Date of mailing of the international search report 30 November 2017	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au		Authorised officer Austin Smith AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262832381	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/IB2017/055792
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			

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Form PCT/ISA/210 (Family Annex)(July 2009)

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/IB2017/055792	
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INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/IB2017/055792	
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