Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2935639 A1 2015/07/16

(21) 2 935 639

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) **Date de dépôt PCT/PCT Filing Date:** 2015/01/05
(87) **Date publication PCT/PCT Publication Date:** 2015/07/16
(85) **Entrée phase nationale/National Entry:** 2016/06/30
(86) **N° demande PCT/PCT Application No.:** EP 2015/050058
(87) **N° publication PCT/PCT Publication No.:** 2015/104242
(30) **Priorités/Priorities:** 2014/01/08 (US61/924,729); 2014/02/11 (EP14154658.0)

(51) **Cl.Int./Int.Cl.** ***A01N 43/50*** (2006.01), ***A01N 41/06*** (2006.01), ***A01N 43/653*** (2006.01), ***A01N 43/88*** (2006.01), ***A01P 13/00*** (2006.01)

(71) **Demandeur/Applicant:**
BASF AGROCHEMICAL PRODUCTS B.V., NL

(72) **Inventeurs/Inventors:**
ZAGAR, CYRILL, DE;
BEGLIOMINI, EDSON, SG;
BEOHAR, ABHISHEK, IN;
CHANDOLA, AJAY, IN;
GANIGER, SATISH, SG;
KANDRU, SUDHAKAR, DE;
...

(74) **Agent:** ROBIC

(54) **Titre : MELANGES HERBICIDES COMPRENANT DE L'IMAZETHAPYR, DE L'IMAZAMOX ET DU FOMESAFEN, UNE SULFENTRAZONE OU BENTAZONE**
(54) **Title: HERBICIAL MIXTURES COMPRISING IMAZETHAPYR, IMAZAMOX AND FOMESAFEN, SULFENTRAZONE OR BENTAZONE**

(57) **Abrégé/Abstract:**
The present invention relates to ternary herbicidally active compositions, which comprise a) 5- ethyl-2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]nicotinic acid (common name: imazethapyr) and 2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]-5-methoxymethylnicotinic acid (common name: imazamox) and b) at least one herbicide selected from the group consisting of 5-(2-chloro-a,a,a-trifluoro-p- tolyloxy)-N-mesyl-2-nitrobenzamide (common name: fomesafen), 2',4'-dichloro-5'-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1 H-1,2,4-triazoM - yl)methanesulfonanilide (common name: sulfentrazone) and 3-isopropyl-1 H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide (common name: bentazone).

CA 2935639 A1 2015/07/16

(21) **2 935 639**

(13) **A1**

(72) **Inventeurs(suite)/Inventors(continued):** OTURKAR, YOGESH, IN; RATHORE, YOGENDRA, IN; SANYAL, NILANJAN, IN

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 July 2015 (16.07.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/104242 A1

(51) International Patent Classification:
*A01N 41/06* (2006.01) *A01N 43/88* (2006.01)
*A01N 43/50* (2006.01) *A01P 13/00* (2006.01)
*A01N 43/653* (2006.01)

(21) International Application Number:
PCT/EP2015/050058

(22) International Filing Date:
5 January 2015 (05.01.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/924,729 8 January 2014 (08.01.2014) US
14154658.0 11 February 2014 (11.02.2014) EP

(71) Applicant: **BASF AGROCHEMICAL PRODUCTS B.V.** [NL/NL]; Groningensingel 1, NL-6835 Arnhem (NL).

(72) Inventor: **ZAGAR, Cyrill**; Carl-Bosch-Str. 38, 67056 Ludwigshafen (DE).

(74) Agent: **MAIWALD PATENTANWALTS GMBH**; Dr. Dirk Bühler, Postfach 33 05 23, 80065 München (DE).

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

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

**Published**:

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

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

WO 2015/104242 A1

**(54) Title**: HERBICIAL MIXTURES COMPRISING IMAZETHAPYR, IMAZAMOX AND FOMESAFEN, SULFENTRAZONE OR BENTAZONE

**(57) Abstract**: The present invention relates to ternary herbicidally active compositions, which comprise a) 5- ethyl-2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]nicotinic acid (common name: imazethapyr) and 2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]-5- methoxymethylnicotinic acid (common name: imazamox) and b) at least one herbicide selected from the group consisting of 5-(2-chloro-a,a,a-trifluoro-p- tolyloxy)-N-mesyl-2-nitrobenzamide (common name: fomesafen), 2',4'-dichloro-5'-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1 H-1,2,4-triazoM - yl)methanesulfonanilide (common name: sulfentrazone) and 3-isopropyl-1 H-2,1,3- benzothiadiazin-4(3H)-one 2,2-dioxide (common name: bentazone).

# Herbicial mixtures comprising imazethapyr, imazamox and fomesafen, sulfentrazone or bentazone

## Field of the invention

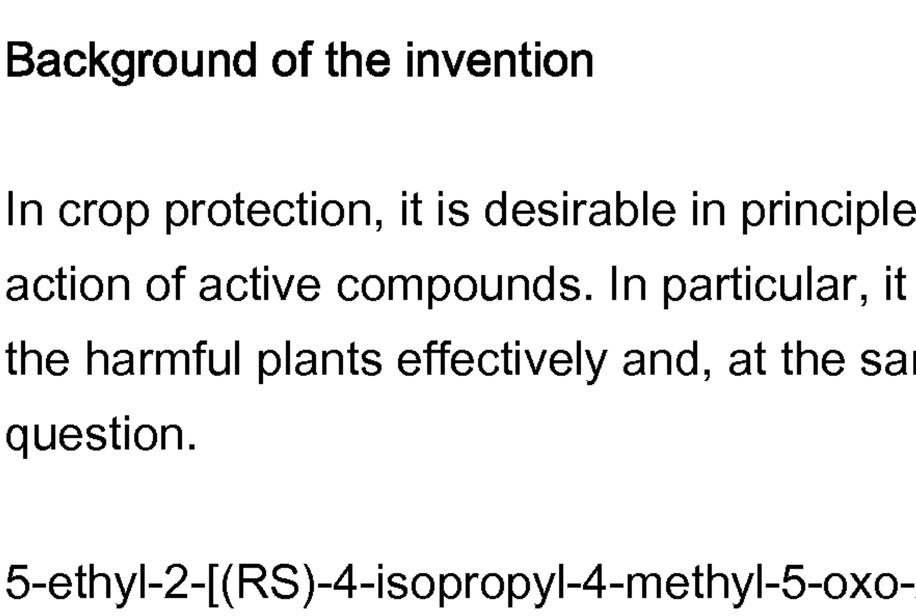
The present invention relates to ternary herbicidally active compositions, which comprise a) 5-ethyl-2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]nicotinic acid (common name: imazethapyr) and 2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]-5-methoxymethylnicotinic acid (common name: imazamox) and

b) at least one herbicide selected from the group consisting of 5-(2-chloro-α,α,α-trifluoro-p-tolyloxy)-N-mesyl-2-nitrobenzamide (common name: fomesafen), 2′,4′-dichloro-5′-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl)methanesulfonanilide (common name: sulfentrazone) and 3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide (common name: bentazone).

## Background of the invention

In crop protection, it is desirable in principle to increase the specificity and the reliability of the action of active compounds. In particular, it is desirable for the crop protection product to control the harmful plants effectively and, at the same time, to be tolerated by the useful plants in question.

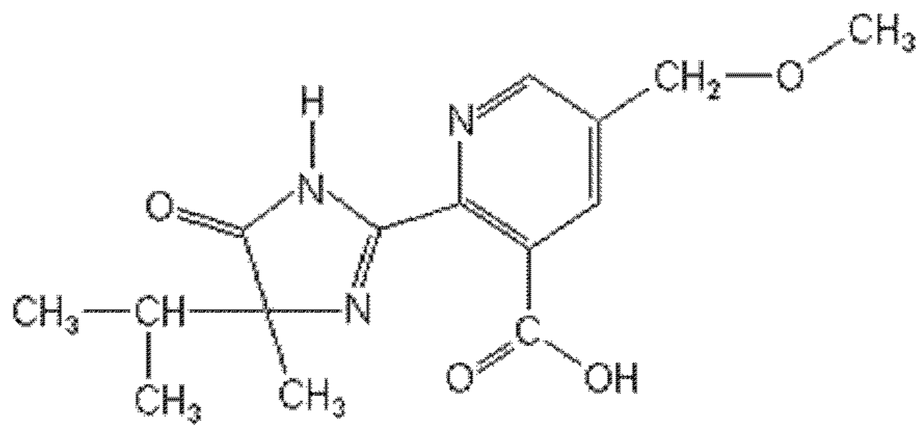
5-ethyl-2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]nicotinic acid (common name: imazethapyr; formula I) is an active compound from the group of imidazolinone herbicides, which are known e.g. from Shaner, D. L., O' Conner, S.L, The Imidazolinone Herbicides, CRC Press Inc., Boca Raton, Florida 1991 and also from The Compendium of Pesticide Common Names http://www.alanwood.net/pesticides/.




I

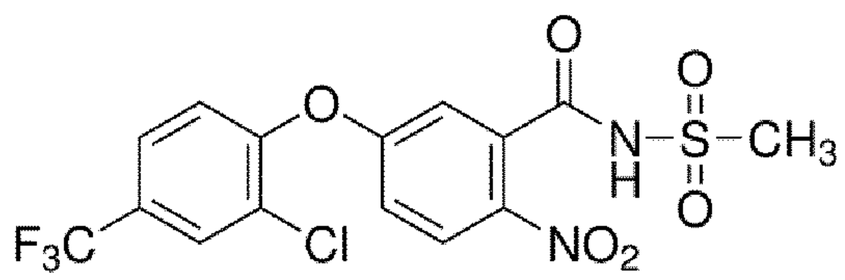
2-[(RS)-4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl]-5-methoxymethylnicotinic acid (common name: imazamox; formula II) is an active compound from the group of imidazolinone herbicides, which are known e.g. from Shaner, D. L. O' Conner, S.L The Imidazolinone Herbicides, CRC Press Inc., Boca Raton, Florida 1991 and also from The Compendium of Pesticide Common

Names http://www.alanwood.net/pesticides/.



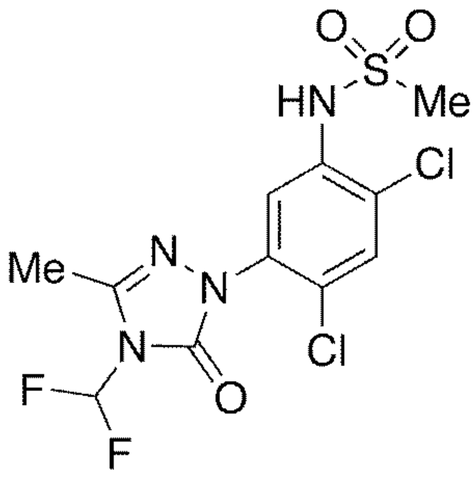
II

5-(2-chloro-α,α,α-trifluoro-p-tolyloxy)-N-mesyl-2-nitrobenzamide (common name: fomesafen, formula III) is an active compound that inhibits protoporphyrinogen IX oxidase (PPO).



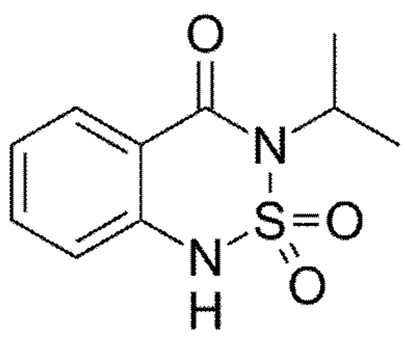
III

2′,4′-dichloro-5′-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl)methanesulfonanilide (common name: sulfentrazone, formula IV) is an active compound that inhibits protoporphyrinogen IX oxidase (PPO).



IV

3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide (common name: bentazone; formula V) is an active compound from the group of thiadiazine herbicides.



V

Herbicidal combinations of imazethapyr and imazamox are known to be highly effective as pre- and post-emergence herbicides; for example, such a combination is commercialized under the brand name Odyssey®. Still, in some cases such combinations do not provide a sufficient control of the relevant harmful plants and their activity at low application rates is not always satisfactory. Apart from that, their compatibility with certain dicotyledonous crop plants such as soybean, peanuts or other pulse or leguminous crops is not always satisfactory, i.e. in addition to the harmful plants, the crop plants are also damaged to an extent which is not acceptable.

Though it is in principle possible to spare crop plants by lowering the application rates, the extent of the control of harmful plants is naturally also reduced.

## Detailed description of the invention

It is an object of the present invention to provide herbicidal compositions, which show enhanced herbicide action against undesirable harmful plants, in particular against *Acalypha* species such as *Acalypha indica*, *Dinebra* species such as *Dinebra Arabica, Cynotis spec such as Cynotis axillaris, Parthenium spec such as Parthenium hysterophorus, Physalis spec such as Physalis minima, Digera spec such as Digera arvensis, Alopecurus myosuroides*, *Apera spicaventi*, *Ambrosia* spec. such as *Ambrosia artemisiifolia*, *Conyza* spec. such as *Conyza canadensis*, *Convolvulus* spec. such as *Convolvulus arvensis*, *Echinochloa* spec. such as *Echinochloa colonum and Echinochloa crus-galli, Rottboellia cochinchinensis, Digitaria spec. such as Digitaria sanguinalis, Eleusine indica, Saccharum spontaneum, Cynodon dactylon, Euphorbia hirta, Euphorbia geniculata, Commelina benghalensis, Commelina communis, Celosia argentea, Xanthium strumarium, Papaver rhoeas*, *Polygonum* spec. such as *Polygonum persicaria*, *Panicum* spec. such as *Panicum milaceum*, *Geranium* spec. such as *Geranium dissectum*, *Brassica* spec, *Avena fatua*, *Bromus* spec., *Echinocloa* spec., *Leptochloa* spec. such as *Leptochloa fusca, Lolium* spec., *Phalaris* spec. such as *Phalaris canariensis*, *Setaria* spec. such as *Setaria faberi*, *Sesbania* spec. such as *Sesbania exaltata*, , *Brachiaria* spec. such as *Brachiaria decumbens*, *Amaranthus* spec., *Chenopodium* spec., *Abutilon spec.* such as *Abutilon theophrasti*, *Galium aparine*, *Veronica* spec., or *Solanum* spec. and/or to improve their compatibility with crop plants, such as soybean, peanut, pea, bean, lentil, green gram, black gram, cluster bean, fenugreek, other pulse or leguminous crops, or crops which are tolerant to the action of acetohydroxyacid synthase inhibiting herbicides, such as for example Clearfield® wheat, Clearfield® barley, Clearfield® corn, Clearfield® lentil, Clearfield® oilseed rape or canola, Clearfield® rice, Cultivance® soybean and/or Clearfield® sunflower. The composition should also have a good pre-emergence herbicidal activity.

We consider this object to be achievable, by herbicidally active compositions comprising

a) the combination of imazethapyr, agriculturally acceptable salts thereof and imazamox, agriculturally acceptable salts thereof (collectively hereinafter also referred to as herbicide A); and
b) at least one herbicide B selected from the group of fomesafen, agriculturally acceptable salts thereof, sulfentrazone, agriculturally acceptable salts thereof and bentazone and agriculturally acceptable salts thereof.

The invention relates in particular to compositions in the form of herbicidally active compositions as defined above.

The invention furthermore relates to the use of compositions as defined herein for controlling undesirable vegetation in crops. When using the compositions of the invention for this purpose

the herbicide A and the at least one herbicide B can be applied simultaneously or in succession in crops, where undesirable vegetation may occur.

The invention furthermore relates to the use of compositions as defined herein for controlling undesirable vegetation in crops which, by genetic engineering or by breeding, are tolerant to one or more herbicides, e.g. acetohydroxyacid synthase inhibiting herbicides such as imazethapyr, and/or pathogens such as plant-pathogenous fungi, and/or to attack by insects; preferably tolerant to one or more herbicides that act as acetohydroxyacid synthase inhibitors.

The invention furthermore relates to a method for controlling undesirable vegetation, which comprises applying an herbicidal composition according to the present invention to the undesirable plants. Application can be done before, during and/or after, preferably during and/or after, the emergence of the undesirable plants. The herbicide A and the at least one herbicide B can be applied simultaneously or in succession.

The invention in particular relates to a method for controlling undesirable vegetation in crops, which comprises applying an herbicidal composition according to the present invention in crops where undesirable vegetation occurs or might occur.

The invention furthermore relates to a method for controlling undesirable vegetation, which comprises allowing a composition according to the present invention to act on plants, their habitat or on seed.

In the methods of the present invention it is immaterial whether the combination of herbicide A and the at least one herbicide B are formulated and applied jointly or separately, and, in the case of separate application, in which order the application takes place. It is only necessary, that the combination of herbicide A and the at least one herbicide B are applied in a time frame, which allows simultaneous action of the active ingredients on the plants.

In the methods of the present invention it is further immaterial whether the components of herbicide A, i.e. imazethapyr and imazamox and the at least one herbicide are formulated and applied jointly or separately, and, in the case of separate application, in which order the application takes place. It is only necessary, that the components of herbicide A and the at least one herbicide B are applied in a time frame, which allows simultaneous action of the active ingredients on the plants.

The invention also relates to an herbicide formulation, which comprises a herbicidally active composition as defined herein and at least one carrier material, including liquid and/or solid carrier materials.

It is believed that the compositions according to the invention have better herbicidal activity against harmful plants than would have been expected by the herbicidal activity of the individual

compounds. In other words, the joint action of the imazethapyr + imazamox combination and the at least one herbicide B results in an enhanced activity against harmful plants in the sense of a synergy effect (synergism). For this reason, the compositions can, based on the individual components, be used at lower application rates to achieve a herbicidal effect comparable to the individual components. The compositions of the invention also show an accelerated action on harmful plants, i.e. damaging of the harmful plants is achieved more quickly in comparison with application of the individual herbicides. Moreover, the compositions of the present invention provide good pre-emergence herbicidal activity, i.e. the compositions are particularly useful for combating/controlling harmful plants before their emergence. Apart from that, the compositions of the present invention show good crop compatibility, i.e. their use in crops leads to a reduced damage of the crop plants.

As used herein, the terms "controlling" and "combating" are synonyms.

As used herein, the terms "undesirable vegetation" and "harmful plants" are synonyms.

Where reference is made to imazethapyr, this includes the free base as well as agriculturally acceptable salts thereof.

Examples of agriculturally acceptable salts of imazethapyr include alkaline or earth alkaline metals or ammonium or organoammonium salts, for instance, sodium, potassium, ammonium and isopropyl ammonium. Particularly preferred is imazethapyr ammonium salt. Reference to a salt includes the anhydrous form as well as hydrated forms thereof.

Where reference is made to imazamox, this includes the free base as well as agriculturally acceptable salts thereof.

Examples of agriculturally acceptable salts of imazamox include alkaline or earth alkaline metals or ammonium or organoammonium salts, for instance, sodium, potassium, ammonium and isopropyl ammonium. Particularly preferred is imazamox ammonium salt. Reference to a salt includes the anhydrous form as well as hydrated forms thereof.

Where reference is made to fomesafen, this includes the free base as well as agriculturally acceptable salts thereof.

Examples of agriculturally acceptable salts of fomesafen include alkaline or earth alkaline metals or ammonium or organoammonium salts, for instance, sodium, potassium, ammonium and isopropyl ammonium. Particularly preferred is fomesafen sodium salt. Reference to a salt includes the anhydrous form as well as hydrated forms thereof.

Where reference is made to sulfentranzone, this includes the free base as well as agriculturally

acceptable salts thereof.

Examples of agriculturally acceptable salts of sulfentranzone include alkaline or earth alkaline metals or ammonium or organoammonium salts, for instance, sodium, potassium, ammonium and isopropyl ammonium. Reference to a salt includes the anhydrous form as well as hydrated forms thereof.

Where reference is made to bentazone, this includes the free base as well as agriculturally acceptable salts thereof.

Examples of agriculturally acceptable salts of bentazone include alkaline or earth alkaline metals or ammonium or organoammonium salts, for instance, lithium, sodium, potassium, magnesium, calcium, ammonium, methylammonium, dimethylammonium, methyltrioctylammonium and isopropyl ammonium as well as the diethanolamine and choline salts. Particularly preferred is bentazone sodium salt. Reference to a salt includes the anhydrous form as well as hydrated forms thereof.

The compositions of the invention comprise the imazethapyr + imazamox combination as a first component a).

As a second component b), the compositions of the invention comprise at least one herbicide B which is selected from the at least one herbicide B from the group of fomesafen, sulfentrazone or bentazone. In one embodiment a herbicide B is present, in another embodiment two herbicides B are present.

The herbicide B is selected from the group of fomesafen, sulfentrazone or bentazone.

Imazethapyr may be present in the form of its racemate or in the form of the pure R-or S-enantiomers (including salts as defined above). Particularly preferred is the racemate and/or R-imazethapyr.

Imazamox may be present in the form of its racemate or in the form of the pure R-or S-enantiomer (including salts as defined above). Particularly suitable is R-imazamox. Particularly preferred is the racemate.

In one embodiment the imazethapyr/imazamox combination is combined with fomesafen.

In another embodiment the imazethapyr/imazamox combination is combined with sulfentrazone.

In a further embodiment the imazethapyr/imazamox combination is combined with bentazone.

In the compositions of the present invention, imazethapyr and imazamox are present in a weight

ratio preferably in the range from 100:1 to 1:100, in particular in the range from 5:1 to 1:5, more preferably from 2:1 to 1:2 and even more preferably 1:1.

In the compositions of the present invention the relative weight ratio of herbicide A to herbicide B is preferably in the range from 20:1 to 1:100, in particular in the range from 10:1 to 1:40 and more preferably from 5:1 to 1:20. Accordingly, in the methods and uses of the invention, herbicide A and the at least one herbicide B are applied within these weight ratios.

In the composition comprising herbicide A and fomesafen the relative weight ratio of herbicide A to fomesafen is preferably in the range of 10:1 to 1:100, more preferably 5:1 to 1:20 and most preferably 1:1 to 1:10.

In the composition comprising herbicide A and sulfentrazone the relative weight ratio of herbicide A to sulfentrazone is preferably in the range of 20:1 to 1:20, more preferably 10:1 to 1:10 and most preferably 5:1 to 1:5.

In the composition comprising herbicide A and bentazone the relative weight ratio of herbicide A to bentazone is preferably in the range of 10:1 to 1:100, more preferably 3:1 to 1:30 or 1:1 to 1:20 and most preferably 1:3 to 1:15.

The compositions of the invention may also comprise, as a component c), one or more safeners. Safeners, also termed as herbicide safeners are organic compounds which in some cases lead to better crop plant compatibility when applied jointly with specifically acting herbicides. Some safeners are themselves herbicidally active. In these cases, the safeners act as antidote or antagonist in the crop plants and thus reduce or even prevent damage to the crop plants. However, in the compositions of the present invention, safeners are generally not required. Therefore, a preferred embodiment of the invention relates to compositions which contain no safener or virtually no safener (i.e. less than 1 % by weight, based on the total amount of herbicide A and herbicide B).

Suitable safeners, which can be used in the compositions according to the present invention are known in the art, e.g. from The Compendium of Pesticide Common Names (http://www.alanwood.net/pesticides/); Farm Chemicals Handbook 2000 Vol. 86, Meister Publishing Company, 2000; B. Hock, C. Fedtke, R. R. Schmidt, Herbizide, Georg Thieme Verlag, Stuttgart 1995; W. H. Ahrens, Herbicide Handbook, 7th Edition, Weed Science Society of America, 1994; and K. K. Hatzios, Herbicide Handbook, Supplement to 7th Edition, Weed Science Society of America, 1998.

Safeners include benoxacor, cloquintocet, cyometrinil, cyprosulfamide, dichlormid, dicyclonon, dietholate, fenchlorazole, fenclorim, flurazole, fluxofenim, furilazole, isoxadifen, mefenpyr, mephenate, naphthalic anhydride, 2,2,5-trimethyl-3-(dichloracetyl)-1,3-oxazolidine, 4-(dichloroacetyl)-1-oxa-4-azaspiro[4.5]decane and oxabetrinil, as well as thereof agriculturally

acceptable salts and, provided they have a carboxyl group, their agriculturally acceptable derivatives. 2,2,5-Trimethyl-3-(dichloroacetyl)-1,3-oxazolidine [CAS No. 52836-31-4] is also known under the name R-29148.4-(Dichloroacetyl)-1-oxa-4-azaspiro[4.5]decane [CAS No. 71526-07-03] is also known under the names AD-67 and MON 4660.

As safener, the compositions according to the invention particularly preferably comprise at least one of the compounds selected from the group of benoxacor, cloquintocet, cyprosulfamide, dichlormid, fenchlorazole, fenclorim, fluxofenim, furilazole, isoxadifen, mefenpyr, naphthalic anhydride, 2,2,5-trimethyl-3-(dichloroacetyl)-1,3-oxazolidine, and 4-(dichloroacetyl)-1-oxa-4-azaspiro[4.5]decane and oxabetrinil; and the agriculturally acceptable salt thereof and, in the case of compounds having a COOH group, an agriculturally acceptable derivative as defined below.

A preferred embodiment of the invention relates to compositions which contain no safener or virtually no safener (i.e. less than 1 % by weight, based on the total amount of herbicide A and the at least one herbicide B) is applied.

If the compounds of herbicidally active compounds mentioned as herbicides B and safeners (see below) have functional groups, which can be ionized, they can also be used in the form of their agriculturally acceptable salts. In general, the salts of those cations are suitable whose cations have no adverse effect on the action of the active compounds (”agriculturally acceptable”).

In general, the salts of those cations are suitable whose cations have no adverse effect on the action of the active compounds (”agriculturally acceptable”). Preferred cations are the ions of the alkali metals, preferably of lithium, sodium and potassium, of the alkaline earth metals, preferably of calcium and magnesium, and of the transition metals, preferably of manganese, copper, zinc and iron, furthermore ammonium and substituted ammonium (hereinafter also termed as organoammonium) in which one to four hydrogen atoms are replaced by C1-C4-alkyl, hydroxy-C1-C4-alkyl, C1-C4-alkoxy-C1-C4-alkyl, hydroxy-C1-C4-alkoxy-C1-C4-alkyl, phenyl or benzyl, preferably ammonium, methylammonium, isopropylammonium, dimethylammonium, diisopropylammonium, trimethylammonium, tetramethylammonium, tetraethylammonium, tetrabutylammonium, 2-hydroxyethylammonium, 2-(2-hydroxyethoxy)eth-1-ylammonium, di(2-hydroxyeth-1-yl)ammonium, benzyltrimethylammonium, benzyltriethylammonium, furthermore phosphonium ions, sulfonium ions, preferably tri(C1-C4-alkyl)sulfonium such as trimethylsulfonium, and sulfoxonium ions, preferably tri(C1-C4-alkyl)sulfoxonium.

In the compositions according to the invention, the compounds that carry a carboxyl group can also be employed in the form of agriculturally acceptable derivatives, for example as amides such as mono- or di-C1-C6-alkylamides or arylamides, as esters, for example as allyl esters, propargyl esters, C1-C10-alkyl esters or alkoxyalkyl esters, and also as thioesters, for example as C1-C10-alkyl thioesters. Preferred mono- and di-C1-C6-alkylamides are the methyl- and the

dimethylamides. Preferred arylamides are, for example, the anilidines and the 2-chloroanilides. Preferred alkyl esters are, for example, the methyl, ethyl, propyl, isopropyl, butyl, isobutyl, pentyl, mexyl (1-methylhexyl) or isooctyl (2-ethylhexyl) esters. Preferred C1-C4-alkoxy-C1-C4-alkyl esters are the straight-chain or branched C1-C4-alkoxyethyl esters, for example the methoxyethyl, ethoxyethyl or butoxyethyl esters. An example of the straight-chain or branched C1-C10-alkyl thioesters is the ethyl thioester. Preferred derivatives are the esters.

The compositions of the present invention are suitable for controlling a large number of harmful plants, including monocotyledonous weeds, in particular annual weeds such as gramineous weeds (grasses) including *Echinochloa* species such as barnyardgrass (*Echinochloa crusgalli var. crus-galli*) or *Echinochloa colonum*, *Leptochloa* species such as *Leptochloa fusca*, Digitaria species such as crabgrass (*Digitaria sanguinalis*), Setaria species such as green foxtail (*Setaria viridis*) and giant foxtail (*Setaria faberii*), Sorghum species such as johnsongrass (*Sorghum halepense Pers.*), Avena species such as wild oats (*Avena fatua*), *Cenchrus* species such as *Cenchrus echinatus*, *Bromus* species, *Lolium* species, *Phalaris* species such as *Phalaris canariensis*, *Eriochloa* species, *Panicum* species such as *Panicum miliaceum*, *Brachiaria* species such as *Brachiaria decumbens*, annual bluegrass (*Poa annua*), blackgrass (*Alopecurus myosuroides*), *Aegilops cylindrica*, *Agropyron repens*, *Apera spica-venti*, *Eleusine indica*, *Cynodon dactylon, Rottboellia cochinchinensis, Dinebra arabica, Saccharum spontaneum,* and the like.

The compositions of the present invention are particularly suitable for controlling the monocotyledonous weeds selected from *Echinochloa* species such as barnyardgrass (*Echinochloa crus-galli* ) or *Echinochloa colonum*, *Leptochloa* species such as *Leptochloa fusca*, *Phalaris* species such as *Phalaris canariensis,* Setaria species such as green foxtail (*Setaria viridis*), Digitaria species such as crabgrass (*Digitaria sanguinalis*), *Panicum* species such as *Panicum miliaceum and Brachiaria* species such as *Brachiaria decumbens, Dinebra species such as Dinebra arabica*

The compositions of the present invention are also suitable for controlling a large number of dicotyledonous weeds, in particular broad leaf weeds including *Acalypha* species such as *Acalypha indica*, *Polygonum* species such as wild buckwheat (*Polygonum convolvolus*) or *Polygonum persicaria*, *Amaranthus* species such as pigweed (*Amaranthus retroflexus*) *or (Amaranthus viridis), Chenopodium* species such as common lambsquarters (*Chenopodium album* L.), *Sida* species such as prickly sida (*Sida spinosa* L.), *Ambrosia* species such as common ragweed (*Ambrosia artemisiifolia*), *Acanthospermum* species, *Anthemis* species, *Atriplex* species, *Cirsium* species, *Convolvulus* species such as *Convolvulus arvensis*, *Conyza* species such as *Conyza canadensis*, *Cassia* species, *Commelina* species such as for example *Commelina communis* or *Commelina benghalensis*, *Datura* species, *Euphorbia* species such as for example *Euphorbia hirta* or *Euphorbia geniculata*, *Geranium* species such as *Geranium dissectum*, *Galinsoga* species, morningglory (*Ipomoea* species), *Lamium* species, *Malva* species, *Matricaria* species, *Sysimbrium* species, *Solanum* species, *Xanthium* species such as

for example *Xanthium strumiarium*, *Veronica* species, *Viola* species, common chickweed (*Stellaria media*), *Abutilon* species such as velvetleaf (*Abutilon theophrasti*), *Sespania* species such as Hemp sesbania (*Sesbania exaltata* Cory), *Anoda cristata*, *Bidens pilosa*, Brassica kaber, *Capsella bursa-pastoris*, *Centaurea cyanus*, *Galeopsis tetrahit*, *Galium aparine*, *Helianthus annuus*, *Desmodium tortuosum*, *Kochia scoparia*, *Mercurialis annua*, *Myosotis arvensis*, *Papaver rhoeas*, *Raphanus raphanistrum*, *Salsola kali*, *Sinapis arvensis*, *Sonchus arvensis*, *Thlaspi arvense*, *Tagetes minuta*, *Richardia brasiliensis*, *Rumex crispus*, *Rumex obtusifolius*, *Heracleaum sphondylium*, *Aethusa cynapium*, *Daucus carota*, *Equisetum arvense, Parthenium hysterophorus, Celosia argentea, Cynotis spec such as Cynotis axillaris, Parthenium spec such as Parthenium hysterophorus, Physalis spec such as Physalis minima, Digera spec such as Digera arvensis,* and the like.

In particular, the compositions of the present invention are suitable for controlling the dicotyledonous weeds selected from *Acalypha* species such as *Acalypha indica*, *Commelina* species such as *Commelina benghalensis* or *Commelina communis*, *Ambrosia* species such as common ragweed (*Ambrosia artemisiifolia*), *Geranium* species such as *Geranium dissectum*, *Abutilon* species such as velvetleaf (*Abutilon theophrasti*), *Sespania* species such as Hemp sesbania (*Sesbania exaltata*), *Conyza* species such as *Conyza canadensis, Convolvulus* species such as *Convolvulus arvensis, Polygonum* species such as *Polygonum persicaria, Parthenium spec such as Parthenium hysterophorus, Physalis spec such as Physalis minima, Digera spec such as Digera arvensis, Cynotis spec such as Cynotis axillaris.*

The herbicidal composition comprising imazethapyr, imazamox and bentazone is suitable for controlling *Acalypha* species such as *Acalypha indica*, *Commelina* species such as *Commelina benghalensis* or *Commelina communis, Ambrosia* spec. such as *Ambrosia artimisiifolia*, *Abutilon* spec. such as *Abutilon theophrasti*, *Echinochloa* spec. such as *Echinochloa crus-galli* or *Echinochloa colonum*, *Setaria* spec. such as *Setaria faberi*, *Digitaria* spec. such as *Digitaria sanguinalis*, *Conyza* spec. such as *Conyza canadensis*, *Phalaris* spec. such as *Phalaris canariensis*, *Leptochloa* spec, such as *Leptochloa fusca*, *Geranium* spec. such as *Geranium dissectum* and *Sesbania* species such as *Sesbania exalta*, *Parthenium spec such as Parthenium hysterophorus, Physalis spec such as Physalis minima, Digera spec such as Digera arvensis, Cynotis spec such as Cynotis axillaris, Dinebra spec. such as Dinebra arabica.*
The herbicidal composition comprising imazethapyr, imazamox and bentazone is particularly suitable for controlling *Acalypha* species such as *Acalypha indica*, *Commelina* species such as *Commelina benghalensis* or *Commelina communis, Echinochloa* spec. such as *Echinochloa crus-galli* or *Echinochloa colonum*, *Phalaris* spec. such as *Phalaris canariensis*, *Leptochloa* spec, such as *Leptochloa fusca*, *Geranium* spec. such as *Geranium dissectum* and *Sesbania* species such as *Sesbania exalta*, *Parthenium spec such as Parthenium hysterophorus, Physalis spec such as Physalis minima, Digera spec such as Digera arvensis, Cynotis spec such as Cynotis axillaris, Dinebra spec. such as Dinebra arabica.*

The herbicidal composition comprising imazethapyr, imazamox and fomesafen is particularly suitable for controlling *Acalypha* species such as *Acalypha indica*, *Commelina* species such as

*Commelina benghalensis* or *Commelina communis, Echinochloa* spec. such as *Echinochloa crus-galli* or *Echinochloa colonum*, *Phalaris* spec. such as *Phalaris* canariensis, *Leptochloa* spec. such as *Leptochloa fusca*, *Ambrosia* spec. such as *Ambrosia* artemisiifolia, *Geranium* spec. such as *Geranium dissectum*, *Sesbania* spec. such as *Sesbania exaltata*, *Conyza* spec. such as *Conyza Canadensis*, *convolvulus* spec. such as *Convolvulus arvensis* and *Polygonum* spec. such as *Polygonum persicaria*, *Parthenium spec such as Parthenium hysterophorus, Physalis spec such as Physalis minima, Digera spec such as Digera arvensis, Cynotis spec such as Cynotis axillaris, Dinebra spec. such as Dinebra arabica.*

The herbicidal composition comprising imazethapyr, imazamox and sulfentrazone is particularly suitable for controlling *Acalypha* species such as *Acalypha indica*, *Commelina* species such as *Commelina benghalensis* or *Commelina communis, Echinochloa* spec. such as *Echinochloa crus-galli* or *Echinochloa colonum*, *Setaria* spec. such as *Setaria faberi*, *Panicum* spec. such as *Panicum miliaceum*, *Phalaris* spec. such as *Phalaris* canariensis, *Leptochloa* spec. such as *Leptochloa* fusca, *Geranium* spec. such as Geranium dissectum, *Sesbania* spec. such as *Sesbania* exaltata, *Brachiaria* spec. such as *Brachiaria* decumbens, *Polygonum* spec. such as *Polygonum* persicaria, *Parthenium spec such as Parthenium hysterophorus, Physalis spec such as Physalis minima, Digera spec such as Digera arvensis, Cynotis spec such as Cynotis axillaris, Dinebra spec. such as Dinebra arabica.*

The compositions of the invention are suitable for controlling weeds selected from *Acalypha* spec., *Commelina* spec., *Echinochloa* spec., *Phalaris* spec, *Leptochloa* spec, *Echinochloa* spec., *Setaria* spec., *Digitaria* spec., *Panicum* spec., *Brachiaria* spec. *Ambrosia* spec., *Geranium* spec. *Abutilo*n spec., *Sesbania* spec., *Conyza* spec., *Convolvulu*s spec. and *Polygonum* spec, *Parthenium spec., Physalis spec., Digera spec., Dinebra spec, Cynotis spec*

The compositions of the invention are particular suitable for controlling weeds selected from *Acalypha* spec., *Commelina* spec., *Echinochloa* spec., *Phalaris* spec, *Leptochloa* spec, *Panicum* spec., *Brachiaria* spec. *Ambrosia* spec., *Geranium* spec. *Sesbania* spec., *Conyza* spec., *Convolvulu*s spec. and *Polygonum* spec. *Parthenium spec., Physalis spec., Digera spec., Dinebra spec, Cynotis spec*

The compositions of the present invention are in particular useful against annual and perennial grasses and broad-leaved weeds in post-emergence application.

The compositions of the present invention are also suitable for controlling a large number of annual and perennial sedge weeds including cyperus species such as purple nutsedge (*Cyperus rotundus* L.), yellow nutsedge (*Cyperus esculentus* L.), hime-kugu (*Cyperus brevifolius* H.), sedge weed (*Cyperus microiria* Steud), rice flatsedge (*Cyperus iria* L.), and the like.

The compositions according to the present invention are suitable for combat-ing/controlling common harmful plants in useful plants (i.e. in crops). The compositions of the present invention are generally suitable for combating/controlling undesired vegetation in

- Legumes (*Fabaceae*), including e.g. soybeans (*Glycine max.*), peanuts (*Arachis hypogaea*) and pulse crops such as peas including *Pisum sativum*, pigeon pea and cowpea, beans including broad beans (*Vicia faba*), *Vigna* spp., and *Phaseolus* spp. and lentils (*lens culinaris* var.).
- crops which are tolerant to the action of acetohydroxyacid synthase inhibiting herbicides, such as for example Clearfield® wheat, Clearfield® barley, Clearfield® corn, Clearfield® lentil, Clearfield® oilseed rape or canola, Clearfield® rice, Cultivance® soybean and/or Clearfield® sunflower.

The compositions of the present invention are in particular suitable for combat-ing/controlling undesired vegetation in soybean, peanut, pea, bean, lentil, green gram, black gram, cluster bean, fenugreek, other pulse or leguminous crops, or crops which are tolerant to the action of acetohydroxyacid synthase inhibiting herbicides, such as for example Clearfield® wheat, Clearfield® barley, Clearfield® corn, Clearfield® lentil, Clearfield® oilseed rape or canola, Clearfield® rice, Cultivance® soybean and/or Clearfield® sunflower.

The compositions of the present invention are most suitable for combating/controlling undesired vegetation in soybean, peanut, pea, bean, lentil, green gram, black gram, cluster bean, fenugreek, other pulse or leguminous crops, preferably soybean (*Glycine max.*).

If not stated otherwise, the compositions of the invention are suitable for application in any variety of the aforementioned crop plants.

The compositions according to the invention can also be used in crop plants which are tolerant to one or more herbicides owing to genetic engineering or breeding, which are resistant to one or more pathogens such as plant pathogenous fungi to genetic engineering or breeding, or which are resistant to attack by insects owing to genetic engineering or breeding. Suitable are for example pulse or leguminous crop plants, preferably soybean, peanut, pea, bean, green gram, black gram, cluster bean, fenugreek, or lentil which are tolerant to herbicidal AHAS inhibitors, such as, for example imazethapyr, or pulse or leguminous crop plants, preferably soybean, peanut, pea, bean, green gram, black gram, cluster bean, fenugreek, or lentil which, owing to introduction of the gene for Bt toxin by genetic modification, are resistant to attack by certain insects. Most suitable are soybeans which are tolerant to herbicidal AHAS inhibitors, such as, for example imazethapyr or soybean plants which, owing to introduction of the gene for Bt toxin by genetic modification, are resistant to attack by certain insects.

The compositions of the present invention can be applied in conventional manner by using techniques as skilled person is familiar with. Suitable techniques include spraying, atomizing, dusting, spreading or watering. The type of application depends on the intended purpose in a well known manner; in any case, they should ensure the finest possible distribution of the active ingredients according to the invention.

The compositions can be applied pre- or post-emergence, i.e. before, during and/or after emergence of the undesirable plants. Preferably, the compositions are applied post-emergence, in particular after the emergence of both the crop and the undesirable plants. When the compositions are used in crops, they can be applied after seeding and before or after the emergence of the crop plants. The compositions invention can, however, also be applied prior to seeding of the crop plants.

In any case the components of herbicide A and the at least one herbicide B can be applied simultaneously or in succession.

The compositions are applied to the plants mainly by spraying, in particular foliar spraying. Application can be carried out by customary spraying techniques using, for example, water as carrier and spray liquor rates of from about 10 to 2000 l/ha or 50 to 1000 l/ha (for example from 100 to 500 l/ha). Application of the herbicidal compositions by the low-volume and the ultra-low-volume method is possible, as is their application in the form of microgranules.

In the case of a post-emergence treatment of the plants, the herbicidal mixtures or compositions according to the invention are preferably applied by foliar application. Application may be effected, for example, by usual spraying techniques with water as the carrier, using amounts of spray mixture of approx. 20 to 1000 l/ha.

The required application rate of the composition of the pure active compounds, i.e. of herbicide A, herbicide B and optionally safener depends on the density of the undesired vegetation, on the development stage of the plants, on the climatic conditions of the location where the composition is used and on the application method. In general, the application rate of the composition (total amount of herbicide A, herbicide B and optional further actives) is from 1 to 5,000 g/ha, preferably from 5 to 1,500 g/ha of active substance.

The required application rates of imazethapyr are generally in the range from 1 g/ha to 200 g/ha and preferably in the range from 5 g/ha to 150 g/ha or from 10 g/ha to 100 g/ha of active substance.

The required application rates of imazamox are generally in the range from 1 g/ha to 200 g/ha and preferably in the range from 5 g/ha to 150 g/ha or from 10 g/ha to 100 g/ha of active substance.

The required application rates of the herbicide B (total amount of herbicide B) are generally in the range from 1 g/ha to 5,000 g/ha and preferably in the range from 5 g/ha to 3,000 g/ha or from 10 g/ha to 1,500 g/ha of active substance.

The required application rates of the safener, if applied, are generally in the range from 1 g/ha to 2,000 g/ha and preferably in the range from 2 g/ha to 2,000 g/ha or from 5 g/ha to 2,000 g/ha

of active substance.

The compositions of these embodiments are particularly suitable for controlling mono- and dicotyledonous weeds and sedge weeds, in particular *Acalypha* spec., *Physalis spec., Digera spec., Aegilops Cylindrica*, *Agropyron repens*, *Alopecurus myosuroides*, *Avena fatua*, *Brassica* spec., *Brachiaria* spec., *Bromus* spec., *Echinochloa* spec. such as for example *Echinochloa colonum*, *Lolium* spec., *Phalaris* spec., red rice, *Setaria* spec., *Sorghum* spec., *Abuthilon theoprasti*, *Amarantus* spec., *Brassica kaber*, *Capsella bursa-pastoris*, *Chenopodium* spec., *Cyperus* spec., *Euphorbia* spec. such as for example *Euphorbia hirta* or *Euphorbia geniculata*, *Geranium* sepc., *Ipomoea* spec., *Polygonum* spec., *Raphanus raphanistrum*, *Sinapis arevensis*, *Sysimbrium* spec., *Thlaspi arvense, Rottboellia cochinchinensis, Dinebra spec., Digitaria sanguinalis, Eleusine indica, Saccharum spontaneum, Cynodon dactylon, Commelina benghalensis, Commelina communis, Parthenium spec., Celosia argentea, Cynotis spp* and *Xanthium strumarium*.

The herbicidal composition comprising imazethapyr, imazamox and bentazone is suitable for controlling *Ambrosia* spec. such as *Ambrosia artimisiifolia*, *Abutilon* spec. such as *Abutilon theophrasti*, *Echinochloa* spec. such as *Echinochloa crus-galli*, *Setaria* spec. such as *Setaria faberi*, *Digitaria* spec. such as *Digitaria sanguinalis*, *Conyza* spec. such as *Conyza canadensis*, *Phalaris* spec. such as *Phalaris canariensis*, *Leptochloa* spec, such as *Leptochloa fusca*, *Geranium* spec. such as *Geranium dissectum* and *Sesbania* species such as *Sesbania exalta*.

The herbicidal composition comprising imazethapyr, imazamox and bentazone is particularly suitable for controlling *Phalaris* spec. such as *Phalaris canariensis*, *Leptochloa* spec, such as *Leptochloa fusca*, *Geranium* spec. such as *Geranium dissectum* and *Sesbania* species such as *Sesbania exalta*.

The herbicidal composition comprising imazethapyr, imazamox and fomesafen is particularly suitable for controlling *Phalaris* spec. such as *Phalaris* canariensis, *Leptochloa* spec. such as *Leptochloa fusca*, *Ambrosia* spec. such as *Ambrosia* artemisiifolia, *Geranium* spec. such as *Geranium dissectum*, *Sesbania* spec. such as *Sesbania exaltata*, *Conyza* spec. such as *Conyza Canadensis*, *convolvulus* spec. such as *Convolvulus arvensis* and *Polygonum* spec. such as *Polygonum persicaria*.

The herbicidal composition comprising imazethapyr, imazamox and sulfentrazone is particularly suitable for controlling Setaria spec. such as Setaria faberi, Panicum spec. such as Panicum miliaceum, *Phalaris* spec. such as *Phalaris* canariensis, *Leptochloa* spec. such as *Leptochloa* fusca, *Geranium* spec. such as Geranium dissectum, *Sesbania* spec. such as *Sesbania* exaltata, *Brachiaria* spec. such as *Brachiaria* decumbens, *Polygonum* spec. such as *Polygonum* persicaria.

The herbicidal composition comprising imazethapyr, imazamox and sulfentrazone is particularly

suitable for controlling *Phalaris* spec. such as *Phalaris* canariensis, *Leptochloa* spec. such as *Leptochloa* fusca, *Geranium* spec. such as *Geranium* dissectum, *Sesbania* spec. such as *Sesbania exaltata*, *Polygonum* spec. such as *Polygonum persicaria*, *Brachiaria* spec. such as *Brachiaria decumbens*, *Panicum* spec. such as *Panicum miliaceum*,.

The compositions of the invention are suitable for controlling weeds selected from *Phalaris* spec, *Leptochloa* spec, *Echinochloa* spec., *Setaria* spec., *Digitaria* spec., *Panicum* spec., *Brachiaria* spec. *Ambrosia* spec., *Geranium* spec. *Abutilo*n spec., *Sesbania* spec., *Conyza* spec., *Convolvulus* spec. and *Polygonum* spec..

The compositions of the invention are particular suitable for controlling weeds selected from *Phalaris* spec, *Leptochloa* spec, *Panicum* spec., *Brachiaria* spec. *Ambrosia* spec., *Geranium* spec. *Sesbania* spec., *Conyza* spec., *Convolvulus* spec. and *Polygonum* spec.

The compositions of these embodiments are in particular suitable for combating undesired vegetation in soybean, peanut, pea, bean, lentil, green gram, black gram, cluster bean, fenugreek, other pulse or leguminous crops, or crops which are tolerant to the action of acetohydroxyacid synthase inhibiting herbicides, such as for example Clearfield® wheat, Clearfield® barley, Clearfield® corn, Clearfield® lentil, Clearfield® oilseed rape or canola, Clearfield® rice, Cultivance® soybean and/or Clearfield® sunflower. The compositions of these embodiments are most suitable for combating undesired vegetation in soybean, peanut, pea, bean, lentil, green gram, black gram, cluster bean, fenugreek, other pulse or leguminous crops, preferably soybean.

If not stated otherwise, the compositions of this embodiment are suitable for application in any variety of the aforementioned crop plants.

In particular, the compositions of these embodiments are suitable for application in soybean, peanut, pea, bean, lentil, green gram, black gram, cluster bean, fenugreek, other pulse or leguminous crops, preferably soybean.

The present invention also relates to formulations of the compositions according to the present invention. The formulations contain, besides the composition, at least one organic or inorganic carrier material. The formulations may also contain, if desired, one or more surfactants and, if desired, one or more further auxiliaries customary for crop protection compositions.

The formulation may be in the form of a single package formulation containing both the herbicide A and the at least one herbicide B together with liquid and/or solid carrier materials, and, if desired, one or more surfactants and, if desired, one or more further auxiliaries customary for crop protection compositions. The formulation may be in the form of a two package formulation, wherein one package contains a formulation of the herbicide A while the other package contains a formulation of the at least one herbicide B and wherein both

formulations contain at least one carrier material, if desired, one or more surfactants and, if desired, one or more further auxiliaries customary for crop protection compositions. In the case of two package formulations the formulation containing the herbicide A and the formulation containing the herbicide B are mixed prior to application. In case the herbicide A itself is a two package formulation the composition is in the form of a three-pack formulation. Preferably the mixing is performed as a tank mix, i.e. the formulations are mixed immediately prior or upon dilution with water.

In the formulation of the present invention the active ingredients, i.e. imazethapyr, imazamox, herbicide B and optional further actives are present in suspended, emulsified or dissolved form. The formulation according to the invention can be in the form of aqueous solutions, powders, suspensions, also highly-concentrated aqueous, oily or other suspensions or dispersions, aqueous emulsions, aqueous microemulsions, aqueous suspoemulsions, oil dispersions, pastes, dusts, materials for spreading or granules.

Depending on the formulation type, they comprise one or more liquid or solid carriers, if appropriate surfactants (such as dispersants, protective colloids, emulsifiers, wetting agents and tackifiers), and if appropriate further auxiliaries which are customary for formulating crop protection products. The person skilled in the art is sufficiently familiar with the recipes for such formulations. Further auxiliaries include e.g. organic and inorganic thickeners, bactericides, antifreeze agents, antifoams, colorants and, for seed formulations, adhesives.

Suitable carriers include liquid and solid carriers. Liquid carriers include e.g. non-aqueous solvents such as cyclic and aromatic hydrocarbons, e.g. paraffins, tetrahydro-naphthalene, alkylated naphthalenes and their derivatives, alkylated benzenes and their derivatives, alcohols such as methanol, ethanol, propanol, butanol and cyclohexanol, ketones such as cyclohexanone, strongly polar solvents, e.g. amines such as N-methylpyrrolidone, and water as well as mixtures thereof. Solid carriers include e.g. mineral earths such as silicas, silica gels, silicates, talc, kaolin, limestone, lime, chalk, bole, loess, clay, dolomite, diatomaceous earth, calcium sulfate, magnesium sulfate, magnesium oxide, ground synthetic materials, fertilizers such as ammonium sulfate, ammonium phosphate, ammonium nitrate, ureas, and products of vegetable origin such as cereal meal, tree bark meal, wood meal and nutshell meal, cellulose powders, or other solid carriers.

Suitable surfactants (adjuvants, wetting agents, tackifiers, dispersants and also emulsifiers) are the alkali metal salts, alkaline earth metal salts and ammonium salts of aromatic sulfonic acids, for example lignosulfonic acids (e.g. BorrespersTM-types, Borregaard), phenolsulfonic acids, naphthalenesulfonic acids (Morwet types, Akzo Nobel) and dibutylnaphthalenesulfonic acid (Nekal® types, BASF SE), and of fatty acids, alkyl- and alkylarylsulfonates, alkyl sulfates, lauryl ether sulfates and fatty alcohol sulfates, and salts of sulfated hexa-, hepta- and octadecanols, and also of fatty alcohol glycol ethers, condensates of sulfonated naphthalene and its derivatives with formaldehyde, condensates of naphthalene or of the naphthalenesulfonic acids

with phenol and formaldehyde, polyoxyethylene octylphenol ether, ethoxylated isooctyl-, octyl- or nonylphenol, alkylphenyl or tributylphenyl polyglycol ether, alkylaryl polyether alcohols, isotridecyl alcohol, fatty alcohol/ethylene oxide condensates, ethoxylated castor oil, polyoxyethylene alkyl ethers or polyoxypropylene alkyl ethers, lauryl alcohol polyglycol ether acetate, sorbitol esters, lignosulfite waste liquors and proteins, denaturated proteins, polysaccharides (e.g. methylcellulose), hydrophobically modified starches, polyvinyl alcohol (Mowiol® types Clariant), polycarboxylates (BASF SE, Sokalan® types), polyalkoxylates, polyvinylamine (BASF SE, Lupamine® types), polyethyleneimine (BASF SE, Lupasol® types), polyvinylpyrrolidone and copolymers thereof.

Examples of thickeners (i.e. compounds which impart to the formulation modified flow properties, i.e. high viscosity in the state of rest and low viscosity in motion) are polysaccharides, such as xanthan gum (Kelzan® from Kelco), Rhodopol® 23 (Rhone Poulenc) or Veegum® (from R.T. Vanderbilt), and also organic and inorganic sheet minerals, such as Attaclay® (from Engelhardt).

Examples of antifoams are silicone emulsions (such as, for example, Silikon®· SRE, Wacker or Rhodorsil® from Rhodia), long-chain alcohols, fatty acids, salts of fatty acids, organofluorine compounds and mixtures thereof.

Bactericides can be added for stabilizing the aqueous herbicidal formulations. Examples of bactericides are bactericides based on diclorophen and benzyl alcohol hemiformal (Proxel® from ICI or Acticide® RS from Thor Chemie and Kathon® MK from Rohm & Haas), and also isothiazolinone derivates, such as alkylisothiazolinones and benzisothiazolinones (Acticide® MBS from Thor Chemie).

Examples of antifreeze agents are ethylene glycol, propylene glycol, urea or glycerol.

Examples of colorants are both sparingly water-soluble pigments and water-soluble dyes. Examples which may be mentioned are the dyes known under the names Rhodamin B, C.I. Pigment Red 112 and C.I. Solvent Red 1, and also pigment blue 15:4, pigment blue 15:3, pigment blue 15:2, pigment blue 15:1, pigment blue 80, pigment yellow 1, pigment yellow 13, pigment red 112, pigment red 48:2, pigment red 48:1, pigment red 57:1, pigment red 53:1, pigment orange 43, pigment orange 34, pigment orange 5, pigment green 36, pigment green 7, pigment white 6, pigment brown 25, basic violet 10, basic violet 49, acid red 51, acid red 52, acid red 14, acid blue 9, acid yellow 23, basic red 10, basic red 108.

Examples of adhesives are polyvinylpyrrolidone, polyvinyl acetate, polyvinyl alcohol and tylose.

To prepare emulsions, pastes or oil dispersions, the active the components, as such or dissolved in an oil or solvent, can be homogenized in water by means of wetting agent, tackifier, dispersant or emulsifier. Alternatively, it is possible to prepare concentrates consisting of active

substance, wetting agent, tackifier, dispersant or emulsifier and, if desired, solvent or oil, and these concentrates are suitable for dilution with water.

Powders, materials for spreading and dusts can be prepared by mixing or concomitant grinding of the active the components a) and b) and optionally safener c) with a solid carrier.

Granules, e.g. coated granules, impregnated granules and homogeneous granules, can be prepared by binding the active ingredients to solid carriers.

The formulations of the invention comprise a herbicidally effective amount of the composition of the present invention. The concentrations of the active the active ingredients in the formulations can be varied within wide ranges. In general, the formulations comprise from 1 to 98% by weight, preferably 10 to 60 % by weight, of active ingredients (sum of imazethapyr, imazamox, herbicide B and optionally further acitves). The active ingredients are employed in a purity of from 90% to 100%, preferably 95% to 100% (according to NMR spectrum).

The active compounds A and B as well as the compositions according to the invention can, for example, be formulated as follows:

1. Products for dilution with water

A Water-soluble concentrates

10 parts by weight of active compound (or composition) are dissolved in 90 parts by weight of water or a water-soluble solvent. As an alternative, wetters or other adjuvants are added. The active compound dissolves upon dilution with water. This gives a formulation with an active compound content of 10% by weight.

B Dispersible concentrates

20 parts by weight of active compound (or composition) are dissolved in 70 parts by weight of cyclohexanone with addition of 10 parts by weight of a dispersant, for example polyvinylpyrrolidone. Dilution with water gives a dispersion. The active compound content is 20% by weight.

C Emulsifiable concentrates

15 parts by weight of active compound (or composition) are dissolved in 75 parts by weight of an organic solvent (eg. alkylaromatics) with addition of calcium dodecyl-benzenesulfonate and castor oil ethoxylate (in each case 5 parts by weight). Dilution with water gives an emulsion. The formulation has an active compound content of 15% by weight.

D Emulsions

25 parts by weight of active compound (or composition) are dissolved in 35 parts by weight of an organic solvent (eg. alkylaromatics) with addition of calcium dodecyl-benzenesulfonate and

castor oil ethoxylate (in each case 5 parts by weight). This mixture is introduced into 30 parts by weight of water by means of an emulsifier (Ultraturrax) and made into a homogeneous emulsion. Dilution with water gives an emulsion. The formulation has an active compound content of 25% by weight.

E Suspensions

In an agitated ball mill, 20 parts by weight of active compound (or composition) are comminuted with addition of 10 parts by weight of dispersants and wetters and 70 parts by weight of water or an organic solvent to give a fine active compound suspension. Dilution with water gives a stable suspension of the active compound. The active compound content in the formulation is 20% by weight.

F Water-dispersible granules and water-soluble granules

50 parts by weight of active compound (or composition) are ground finely with addition of 50 parts by weight of dispersants and wetters and made into water-dispersible or water-soluble granules by means of technical appliances (for example extrusion, spray tower, fluidized bed). Dilution with water gives a stable dispersion or solution of the active compound. The formulation has an active compound content of 50% by weight.

G Water-dispersible powders and water-soluble powders

75 parts by weight of active compound (or composition) are ground in a rotor-stator mill with addition of 25 parts by weight of dispersants, wetters and silica gel. Dilution with water gives a stable dispersion or solution of the active compound. The active compound content of the formulation is 75% by weight.

H Gel formulations

In a ball mill, 20 parts by weight of active compound (or composition), 10 parts by weight of dispersant, 1 part by weight of gelling agent and 70 parts by weight of water or of an organic solvent are mixed to give a fine suspension. Dilution with water gives a stable suspension with active compound content of 20% by weight.

2. Products to be applied undiluted

I Dusts

5 parts by weight of active compound (or composition) are ground finely and mixed intimately with 95 parts by weight of finely divided kaolin. This gives a dusting powder with an active compound content of 5% by weight.

J Granules (GR, FG, GG, MG)

0.5 parts by weight of active compound (or composition) are ground finely and associated with 99.5 parts by weight of carriers. Current methods here are extrusion, spray-drying or the fluidized bed. This gives granules to be applied undiluted with an active compound content of

0.5% by weight.

K ULV solutions (UL)

10 parts by weight of active compound (or composition) are dissolved in 90 parts by weight of an organic solvent, for example xylene. This gives a product to be applied undiluted with an active compound content of 10% by weight.

Aqueous use forms can be prepared from emulsion concentrates, suspensions, pastes, wettable powders or water-dispersible granules by adding water.

It may furthermore be beneficial to apply the compositions of the invention alone or in combination with other herbicides, or else in the form of a mixture with other crop protection agents, for example together with agents for controlling pests or phytopathogenic fungi or bacteria. Also of interest is the miscibility with mineral salt solutions, which are employed for treating nutritional and trace element deficiencies. Other additives such as non-phytotoxic oils and oil concentrates may also be added.

Synergism can be described as an interaction where the combined effect of two or more compounds is greater than the sum of the individual effects of each of the compounds. The presence of a synergistic effect in terms of percent control, between two mixing partners (X and Y) can be calculated using the Colby equation (Colby, S. R., 1967, Calculating Synergistic and Antagonistic Responses in Herbicide Combinations, Weeds, 15, 21-22):

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

When the observed combined control effect is greater than the expected (calculated) combined control effect (E), then the combined effect is synergistic. The synergictic effect may also be present when the observed combined control effect is equal to the expected (calculates) combined control effect, especially when control values over 90 are calculated.

The following tests demonstrate the control efficacy of compounds, mixtures or compositions of this invention on specific weeds. However, the weed control afforded by the compounds, mixtures or compositions is not limited to these species.The analysis of synergism or antagonism between the mixtures or compositions was determined using Colby's equation. Analogously, the Colby's equation can be used to determine synergism of 3-way and higher mixtures:

$$E = X + Y + Z + \frac{XYZ}{10000} - \left[\frac{(XY) + (XZ) + (YZ)}{100}\right]$$

**Examples**

Products:

Imazethapyr – 70 % WG

Imazamox – 70 % WG

(Imazethapyr 35 + Imazamox 35 ) – 70 % WG

Bentazon -480 g /lit SC

Fomesafen - 240 g/lit SC

Sulfentrazone - 480 g/lit SC

Weeds in the study

| EPPO Code | Scientific Name |
|---|---|
| PHACA | Phalaris canariensis |
| LEFFA | Leptochloa fusca |
| AMBEL | Ambrosia artemisiifolia |
| GERDI | Geranium dissectum |
| ABUTH | Abutilon theophrasti |
| ECHCG | Echinochloa crus-galli |
| SETFA | Setaria faberi |
| DIGSA | Digitaria sanguinalis |
| SEBEX | Sesbania exaltata |
| ERICA | Conyza canadensis |
| CONAR | Convolvulus arvensis |
| POLPE | Polygonum persicaria |
| PANMI | Panicum miliaceum |
| BRADC | Brachiaria decumbens |

**Example 1: Post emergence treatment by the mixture of (Imazamox+Imazethapyr) + Bentazon**

| Application rate in g ai/ha | | | Herbicidal activity against | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PHACA | | LEFFA | | AMBEL | | GERDI | | ABUTH | |
| Imazethapyr | Imazamox | Bentazon | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated |
| 15 | -- | -- | 30 | -- | 45 | -- | 98 | -- | 65 | -- | 50 | -- |
| -- | 15 | -- | 65 | -- | 85 | -- | 98 | -- | 80 | -- | 95 | -- |
| -- | -- | 25 | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| (15+15) | | 25 | 85 | 76 | 98 | 92 | 100 | 100 | 98 | 93 | 98 | 98 |

| Application rate in g ai/ha | | | Herbicidal activity against | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ECHCG | | SETFA | | DIGSA | | SEBEX | | ERICA | |
| Imazethapyr | Imazamox | Bentazon | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated |
| 15 | -- | -- | 80 | -- | 90 | -- | 80 | -- | 0 | -- | 55 | -- |
| -- | 15 | -- | 98 | -- | 98 | -- | 98 | -- | 45 | -- | 60 | -- |
| -- | -- | 50 | 35 | -- | 10 | -- | 40 | -- | 40 | -- | 40 | -- |
| (15+15) | | 50 | 100 | 100 | 100 | 100 | 100 | 100 | 75 | 67 | 100 | 89 |

Example 2: Post emergence treatment by the mixture of (Imazamox+Imazethapyr) + Fomesafen

| Application rate in g ai/ha | | | Herbicidal activity against | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PHACA | | LEFFA | | GERDI | | CONAR | | POLPE | |
| Imazethapyr | Imazamox | Fomesafen | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated |
| 15 | -- | -- | 30 | -- | 45 | -- | 65 | -- | 65 | -- | 0 | -- |
| -- | 15 | -- | 65 | -- | 85 | -- | 80 | -- | 75 | -- | 95 | -- |
| -- | -- | 6 | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 20 | -- |
| (15+15) | | 6 | 90 | 76 | 98 | 92 | 100 | 93 | 95 | 91 | 98 | 96 |

| Application rate in g ai/ha | | | Herbicidal activity against | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | SEBEX | | ERICA | | GERDI | | AMBEL | |
| Imazethapyr | Imazamox | Fomesafen | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated |
| 15 | -- | -- | 0 | -- | 55 | -- | 65 | -- | 65 | -- |
| -- | 15 | -- | 45 | -- | 60 | -- | 95 | -- | 70 | -- |
| -- | -- | 10 | 80 | -- | 30 | -- | 70 | -- | 65 | -- |
| (15+15) | | 10 | 100 | 89 | 100 | 87 | 100 | 99 | 100 | 96 |

## Example 3: Post emergence treatment by the mixture of (Imazamox+Imazethapyr) + Sulfentrazone

| Application rate in g ai/ha | | | Herbicidal activity against | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PHACA | | SETFA | | PANMI | | LEFFA | | GERDI | |
| Imazethapyr | Imazamox | Sulfentrazone | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated | Found | Calculated |
| 15 | -- | -- | 30 | -- | 95 | -- | 70 | -- | 45 | -- | 65 | -- |
| -- | 15 | -- | 65 | -- | 98 | -- | 98 | -- | 85 | -- | 80 | -- |
| -- | -- | 6 | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| (15+15) | | 6 | 85 | 76 | 100 | 100 | 100 | 99 | 98 | 92 | 95 | 93 |

| Application rate in g ai/ha | | | Herbicidal activity against | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | BRADC | | SEBEX | | POLPE | |
| Imazethapyr | Imazamox | Sulfentrazone | Found | Calculated | Found | Calculated | Found | Calculated |
| 15 | -- | -- | 10 | -- | 0 | -- | 75 | -- |
| -- | 15 | -- | 35 | -- | 45 | -- | 95 | -- |
| -- | -- | 10 | 30 | -- | 80 | -- | 80 | -- |
| (15+15) | | 10 | 70 | 59 | 100 | 89 | 100 | 100 |

Further embodiments relate to:

1. Herbicidal compositions comprising:

a) a herbicide A, which is the combination of imazethapyr, or agriculturally acceptable salts thereof and imazamox, or agriculturally acceptable salts thereof, and

b) at least one herbicide B selected from the group consisting of fomesafen, or agriculturally acceptable salts thereof, sulfentrazone, or agriculturally acceptable salts thereof, and bentazone, or agriculturally acceptable salt thereof.

2. Compositions according embodiment 1, additionally containing a safener.

3. Compositions according embodiment 1, containing no safener.

4. Compositions according to any of the preceding embodiments, wherein the relative amount of imazethapyr to imazamox and herbicide B is in synergistically effective amounts.

5. Compositions according to any of the preceding embodiments, wherein the relative amount of the herbicide A to the at least one herbicide B is from 20:1 to 1:100, preferably from 10:1 to 1:40 and more preferably from 5:1 to 1:20.

6. The use of the compositions according to any of the preceding embodiments for controlling undesirable vegetation.

7. The use according to embodiment 6 for controlling undesirable vegetation in crop plants.

8. The use according to embodiment 7, wherein the crop plants are leguminous crops.

9. The use according to embodiment 8, wherein the crop plants are leguminous crops selected from soybean, green gram, black gram, peas, cluster beans, pulse crops, peanut.

10. The use according to embodiment 9, wherein the crop plant is soybean.

11. The use according to embodiment 7, wherein the crop plants are tolerant to acetohydroxyacid synthase inhibiting herbicides.

12. The use according to embodiment 11, wherein the crop plants tolerant to acetohydroxyacid synthase inhibiting herbicides are wheat, barley, canola, corn, lentils, oilseed rape, rice, soybean or sunflower.

13. A method for controlling undesirable vegetation, which comprises allowing a composition according to embodiments 1 to 5 to act on plants to be controlled or their habitat.

14. A method for controlling undesired vegetation as claimed in claim 13, which comprises applying the composition according to embodiments 1 to 5 before, during and/or after the emergence of the undesirable plants; the herbicide A and the at least one herbicide B being applied simultaneously or in succession.

15. An herbicide formulation comprising a composition according to any of the embodiments 1 to 5 and at least one solid or liquid carrier.

# CLAIMS

1. Herbicidal compositions comprising:
a) a herbicide A, which is the combination of imazethapyr, or agriculturally acceptable salts thereof and imazamox, or agriculturally acceptable salts thereof, and
b) at least one herbicide B selected from the group consisting of fomesafen, or agriculturally acceptable salts thereof, sulfentrazone, or agriculturally acceptable salts thereof, and bentazone, or agriculturally acceptable salt thereof.

2. Compositions as claimed in any of the preceding claims, wherein the relative amount of imazethapyr to imazamox and herbicide B is in synergistically effective amounts.

3. Compositions as claimed in any of the preceding claims, wherein the relative amount of the herbicide A to the at least one herbicide B is from 20:1 to 1:100, preferably from 10:1 to 1:40 and more preferably from 5:1 to 1:20.

4. The use of the compositions as claimed in any of the preceding claims for controlling undesirable vegetation.

5. The use of the compositions as claimed in claim 4 wherein the undesirable vegetation is monocotyledonous and/or dicotyledonous weeds.

6. The use of the composition as claimed in claim 4 or 5 wherein the undesirable vegetation are weeds selected from the group consisting of *Acalypha* spec., *Commelina* spec., *Dinebra* spec., *Cynotis spec., Parthenium spec., Physalis spec., Digera spec., Phalaris* spec, *Leptochloa* spec, *Echinochloa* spec., *Setaria* spec., *Digitaria* spec., *Panicum* spec., *Brachiaria* spec. *Ambrosia* spec., *Geranium* spec. *Abutilo*n spec., *Sesbania* spec., *Conyza* spec., *Convolvulu*s spec. and *Polygonum* spec.

7. The use as claimed in claims 4 to 6 for controlling undesirable vegetation in crop plants.

8. The use as claimed in claim 7, wherein the crop plants are leguminous crops.

9. The use as claimed in claim 8, wherein the crop plants are leguminous crops selected from soybean, green gram, black gram, peas, cluster beans, pulse crops, peanut.

10. The use as claimed in claim 9, wherein the crop plant is soybean.

11. The use as claimed in claims 7 to 10, wherein the crop plants are tolerant to acetohydroxyacid synthase inhibiting herbicides.

12. The use as claimed in claim 11, wherein the crop plants tolerant to acetohydroxyacid synthase inhibiting herbicides are wheat, barley, canola, corn, lentils, oilseed rape, rice, soybean or sunflower.

13. A method for controlling undesirable vegetation, which comprises allowing a composition as claimed in claims 1 to 3 to act on plants to be controlled or their habitat.

14. A method for controlling undesired vegetation as claimed in claim 13, which comprises applying the composition as claimed in claims 1 to 3 before, during and/or after the emergence of the undesirable plants; the herbicide A and the at least one herbicide B being applied simultaneously or in succession.

15. An herbicide formulation comprising a composition as claimed in any of claims 1 to 3 and at least one solid or liquid carrier.