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- (54) Benævnelse: **ANVENDELSE AF ALS-INHIBITORHERBICIDER TIL BEKÆMPELSE AF UØNSKET VEGETATION I OMRÅDER MED ALS-INHIBITORHERBICIDTOLERANTE BETA VULGARIS-PLANTER**
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WO-A1-98/02527
WO-A1-2012/049266
WO-A1-2012/049268
TAN S ET AL: "IMIDAZOLINONE-TOLERANT CROPS: HISTORY, CURRENT STATUS AND FUTURE", PEST MANAGEMENT SCIENCE, WILEY & SONS, BOGNOR REGIS; GB, vol. 61, no. 3, 1 January 2005 (2005-01-01), pages 246-257, XP009058795, ISSN: 1526-498X, DOI: 10.1002/PS.993 cited in the application
SIBONY MOSHE ET AL: "Molecular basis for multiple resistance to acetolactate synthase-inhibiting herbicides and atrazine in Amaranthus blitoides (prostrate pigweed)", PLANTA, SPRINGER VERLAG, DE, vol. 216, no. 6, 1 April 2003 (2003-04-01) , pages 1022-1027, XP002631640, ISSN: 0032-0935, DOI: 10.1007/S00425-002-0955-6 [retrieved on 2002-12-18]

DESCRIPTION

[0001] The present invention relates to the technical field of crop protection by using ALS (acetolactate synthase; also known as AHAS (acetohydroxyacid synthase; EC 2.2.1.6; formerly EC 4.1.3.18)) inhibitor herbicides against unwanted vegetation in areas of growing *Beta vulgaris* plants, preferably sugar beet, that are tolerant against ALS inhibitor herbicides by comprising mutations in the endogenous ALS gene thereby encoding an ALS polypeptide having an amino acid that is different from the naturally occurring tryptophan (i.e. the tryptophan of the wild-type ALS protein) at position 569 and having an amino acid that is different from the naturally occurring proline (i.e. the proline of the wild-type ALS protein) at position 188.

[0002] Thus, the mutated sugar beet plants used in the context of the present invention comprise mutations in the ALS gene where the tryptophan at position 569 in the encoded ALS enzyme (corresponding to position 574 in the *Arabidopsis thaliana* ALS enzyme) is substituted by another amino acid (preferably by leucine), and a mutation in the ALS gene where the proline at position 188 in the encoded ALS enzyme (corresponding to position 197 in *Arabidopsis thaliana* ALS enzyme) is substituted by another amino acid (preferably by serine).

[0003] Cultivated forms of *Beta vulgaris* (as defined in Ford-Lloyd (2005) Sources of genetic variation, Genus *Beta*. In: Biancardi E, Campbell LG, Skaracis GN, De Biaggi M (eds) Genetics and Breeding of Sugar Beet. Science Publishers, Enfield (NH), USA, pp25-33) are important agricultural crops in temperate and subtropical regions. For example, about 20 % of the world sugar production is based on sugar beet. Because beet seedlings and juvenile plants during their first 6-8 weeks of their life are susceptible for strong competition caused by fast growing weeds, which outcompete the young crop plants, reliable weed control measures are imperative in these crop areas.

[0004] Since more than 40 years, herbicides are the preferred tools to control weeds in sugar beet (*Beta vulgaris* subsp. *vulgaris* var. *altissima*). The products used for this purpose, namely phenmedipham, desmediphan, ethofumesate, and metamitron allow to suppress weeds in sugar beet fields without damaging the crop. Nevertheless, under adverse environmental conditions the efficacy of these products leaves room for improvements, especially if noxious weeds like *Chenopodium album*, *Amaranthus retroflexus* and/or *Fallopia convolvulus* germinate over an extended period of time.

[0005] The ALS/AHAS enzyme is present in bacteria, fungi, and plants and from various organisms protein isolates have been obtained and their corresponding amino acid/nucleic acid sequences as well as their biochemical characteristics have been determined/characterized (for review, see at Umbarger, H.E., Annu. Rev. Biochem. (1978), 47, 533-606; Chiman, D.M. et al., Biochim. Biophys. Acta (1998), 1385, 401-419; Duggleby, R.G., and Pang, S.S., J. Biochem. Mol. Biol. (2000), 33, 1-36; Duggleby, R.G. (Structure and Properties of Acetohydroxyacid Synthase in Thiamine: Catalytic Mechanisms in Normal and

Disease States, Vol 11, Marcel The use of herbicidal compounds belonging to the class of ALS inhibitors, like (a) sulfonylurea herbicides (Beyer E.M et al. (1988), Sulfonylureas in Herbicides: Chemistry, Degradation, and Mode of Action; Marcel Dekker, New York, 1988, 117-189), (b) sulfonylaminocarbonyltriazolinone herbicides (Pontzen, R., Pflanz.-Nachrichten Bayer, 2002, 55, 37-52), (c) imidazolinone herbicides (Shaner, D.L., et al., Plant Physiol., 1984, 76, 545-546; Shaner, D.L., and O'Connor, S.L. (Eds.) The Imidazolinone Herbicides, CRC Press, Boca Rato, FL, 1991), (d) triazolopyrimidine herbicides (Kleschick, W.A. et al., Agric. Food Chem., 1992,40, 1083-1085), and (e) pyrimidinyl(thio)benzoate herbicides (Shimizu, T.J., Pestic. Sci.,1997, 22, 245-256; Shimizu, T. et al., Acetolactate Synthase Inhibitors in Herbicide Classes in Development, Böger, P., Wakabayashi. K., Hirai, K., (Eds.), Springer Verlag, Berlin, 2002, 1-41) for the control of unwanted vegetation in various crop cultures is well known in agriculture.

[0006] A broad variety of ALS/AHAS inhibitor herbicides enable a farmer to control a wide range of weed species independently of their growth stages, but these highly efficient herbicides cannot be used in *Beta vulgaris*, preferably sugar beet, because *Beta vulgaris*, especially conventional sugar beet plants/ commercial sugar beet varieties are highly susceptible against / affected by these ALS inhibitor herbicides. Nevertheless, these ALS inhibitor herbicides show an excellent herbicidal activity against broadleaf and grass weed species. The first herbicides based on ALS inhibitors were developed for their use in agriculture already 30 years ago. Nowadays, active ingredients of this class exhibit a strong weed control and are widely used in maize and cereals as well as in dicot crops, except *Beta vulgaris*, preferably sugar beet.

[0007] By now, there is only one commercially available product based on a sulfonylurea herbicide, i.e. Debut® (component (A) 50% triflurosulfuron-methyl + component (B) a specific formulation compound, i.e. a specific adjuvant) which can be used in sugar beet in post emergent application, but it requires the application at a very early leaf stage of the weeds to be treated and also show severe gaps in the treatment of serious weeds growing in sugar beet plantings. This sulfonylurea is not tolerated by but degraded in the sugar beet plants.

[0008] Another, more reliable and more flexible way to obtain *Beta vulgaris*, preferably sugar beet plants that stand an ALS inhibitor herbicide treatment is to generate mutants that are sufficiently tolerant to agronomically useful/necessary quantities of ALS inhibitor herbicides in order to control serious unwanted vegetation in *Beta vulgaris*, preferably sugar beet plantings.

[0009] Since ALS inhibitor herbicides were introduced into agriculture it was observed that susceptible plant species, including naturally occurring weeds, occasionally develop spontaneous tolerance to this class of herbicides. Single base pair substitutions at specific sites of the ALS gene usually lead to more or less resistant ALS enzyme variants which show different levels of inhibition by the ALS inhibitor herbicides.

[0010] Plants conferring mutant ALS alleles therefore show different levels of tolerance to ALS inhibitor herbicides, depending on the chemical structure of the ALS inhibitor herbicide and the

site of the point mutation(s) in the ALS gene and the hereby encoded ALS protein.

[0011] Several mutants (naturally occurring in weeds but also artificially induced in crops by either mutation or transgenic approaches) of the ALS conferring tolerance to one or more chemicals defined under the above given ALS inhibitor herbicide classes / groups are known at various parts of the enzyme (i.e. in the α -, β -, and γ -domain of the ALS h are known and have been identified in various organisms, including plants (US Patent No. 5,378,824; Duggleby, R.G. et al., (2008), *Plant Physiol. and Biochem.*, pp 309-324; Siyuan, T. et al. (2005), *Pest Management Sci.*, 61, pp 246-257; Jung, S. (2004) *Biochem J.*, pp 53-61; Kolkman, J.M. (2004), *Theor. Appl. Genet.*, 109, pp 1147-1159; Duggleby, R.G. et al (2003), *Eur. J. Biochem.*, 270, pp 2895-2904; Pang, S.S., et al. (2003), *J. Biol. Chem.*, pp 7639-7644); Yadav, N. et al., (1986), *Proc. Natl. Acad. Sci.*, 83, pp 4418-4422), Jander G. et al. (2003), *Plant Physiol.*, 131, pp. 139-146); Tranel, P.J., and Wright, T.R. (2002), *Weed Science*, 50, pp 700-712); Chang, A.K., and Duggleby, R.G. (1998), *Biochem J.*, 333, pp. 765-777).

[0012] Crop plants conferring mutant ALS alleles do show different levels of tolerance to ALS inhibitor herbicides, depending on the chemical structure of the ALS inhibitor herbicide and the site of the point mutation in the ALS gene.

[0013] For example, Hattori et al. (1995), *Mol. Gen. Genet.* 246: 419-425, describes a single mutation in the Trp 557 codon in a *Brassica napus* cell line (according to the numbering of the *Arabidopsis thaliana* sequence that is used in the literature in order to compare all ALS/AHAS mutants this refers to position "574") - which equals position 569 of the sugar beet ALS polypeptide sequence. These authors observed resistance to several members of sub-classes of ALS inhibitor herbicides, like sulfonylureas, imidazolinones and triazolopyrimidines.

[0014] EP-A-0360750 describes the production of ALS inhibitor herbicide tolerant plants by producing an increased amount of the attacked ALS inside the plant. Such plants show an increased tolerance against certain sulfonylureas, like chlorsulfuron, sulfometuron-methyl, and triasulfuron.

[0015] US 5,198,599 describes sulfonylurea and imidazolinone tolerant plants that have been obtained via a selection process and which show a tolerance against chlorsulfuron, bensulfuron, chlorimuron, thifensulfuron and sulfometuron.

[0016] Furthermore, US 5,013,659, US 5,141,870, and US 5,378,824 describe the production of transgenic sugar beet plants by introducing a modified yeast ALS gene into such sugar beet plants.

[0017] In addition, Saunders et al. (*Crop Science*, 1992, 32, 1357-1360) disclose sulfonylurea tolerant sugar beet plants that were obtained via somaclonal cell selection but these authors neither showed up any biological data concerning the level of tolerance of such plants against ALS inhibitor herbicide treatment nor did they demonstrate genetically stable mutants obtained from cultures in which these mutations have been generated.

[0018] Tan et al. report in Pest Manag. Sci. 2005, 61, 246-257 on weed control in certain imidazolinone-tolerant crops.

[0019] Stougaard et al. (1990), J. Cell Biochem., Suppl. 14E, 310 describe the isolation of ALS mutants in a tetraploid sugar beet cell culture. Two different ALS genes (ALS I and ALS II) were isolated which differed at amino acid position 37 only. Mutant 1 contained in its ALS I gene 2 mutations, while mutant 2 contained 3 mutations in its ALS II gene. After the mutations were separated to resolve which mutation would confer resistance against an ALS inhibitor, it was revealed that ALS synthesized from a recombinant *E. coli* was herbicide resistant if it contained a point mutation in the Trp 574 codon (according to the numbering of the *Arabidopsis thaliana* sequence that is used in the literature in order to compare all ALS mutants) - which equals position 569 of the beet ALS amino acid sequence, leading to a replacement of the amino acid "Trp" by the amino acid "Leu". Stougaard et al did not show in sugar beet that the mutation at position 569 of any of the sugar beet ALS genes is sufficient in order to obtain an agronomically acceptable level of tolerance to ALS inhibitor herbicides. Moreover, Stougaard et al did not regenerate or handle sugar beet plants comprising a mutation, including Trp - > Leu mutation at position 569 of sugar beet ALS.

[0020] Knowing this, Stougaard et al. constructed plant transformation vectors containing different ALS genes for use in plant transformation. However, up to now, no further data - especially not concerning the effects of the application of ALS inhibitor herbicides to plants and/or agricultural areas comprising this mutation in *Beta vulgaris* plants have been disclosed by these or other authors either in genetically engineered or mutant plants over more than 20 years, thereafter.

[0021] Additionally, beet mutants were described conferring a point mutation in the Ala 122 codon which led to a certain tolerance to the ALS inhibitor herbicide subclass of imidazolinones (WO 98/02526) but which is not sufficient for weed control in agricultural application schemes. No cross-tolerance to other ALS inhibitor herbicide classes was described by employing this mutant. Furthermore, beet plants conferring a second point mutation in the Pro 197 codon showed a moderate tolerance to ALS inhibitor herbicides belonging to members of the subclass of sulfonylurea herbicides. Also double mutants of these two were described (WO 98/02527). However, none of these mutants were used for the market introduction of beet varieties because the level of herbicide tolerance to ALS inhibitor herbicides was not sufficiently high in these mutants to be exploited agronomically.

[0022] WO 2012/049268 discloses a method for the manufacture of sugar beet plant resistant to several ALS inhibitors, including to foramsulfuron, which comprises the steps of exposing to foramsulfuron calli obtained from explants of *B. vulgaris*, and regenerating plants from the few spontaneous mutants that can grow in the presence of this herbicide. Said method yielded plants having a mutation in the ALS gene, where the tryptophan at position 569 of the encoded ALS enzyme (corresponding to the 574 position of the *Arabidopsis thaliana* ALS enzyme) is substituted by a leucine. WO 2012/049266 relates to the use of ALS inhibitor herbicides for

control of unwanted vegetation in ALS inhibitor herbicide tolerant *Beta vulgaris* plants having a mutation in the ALS gene, where the tryptophan at position 569 of the encoded ALS enzyme.

[0023] WO 2008/124495 discloses ALS double and triple mutants. According to WO 2009/046334, specific mutations in the ALS gene were provided. However, agronomically exploitable *Beta vulgaris* mutants containing such mutations according to WO 2009/046334 and also showing a sufficient tolerance to any kind of ALS inhibitor herbicides of various ALS inhibitor herbicide classes have not been obtained/described by now.

[0024] All these sugar beet mutants do not show a reliable tolerance and/or do not show satisfactory tolerance against various classes of the ALS inhibitor herbicides, and - even worse - they do not show a tolerance level that is sufficient and useful at agronomic application rates against any kind of ALS inhibitor herbicides.

[0025] As it relates to the compounds known acting as ALS inhibitor herbicides, these can be grouped in several classes.

[0026] Compounds from the group of the (sulfon)amides are already known as herbicidally active compounds for controlling unwanted vegetation; see, for example, EP 239414, US 4,288,244, DE 3303388, US 5,457,085, US 3,120,434, US 3,480,671, EP 206251, EP 205271, US 2,556,664, US 3,534,098, EP 053011, US 4,385,927, EP 348737, DE 2822155, US 3,894,078, GB 869169, EP 447004, DE 1039779, HU 176582, US 3,442,945, DE 2305495, DE 2648008, DE 2328340, DE 1014380, HU 53483, US 4,802,907, GB 1040541, US 2,903,478, US 3,177,061, US 2,695,225, DE 1567151, GB 574995, DE 1031571, US 3,175,897, JP 1098331, US 2,913,327, WO 83/00329, JP 80127302, DE 1300947, DE 2135768, US 3,175,887, US 3,836,524, JP 85067463, US 3,582,314, US 5,333,0821, EP 131258, US 4,746,353, US 4,420,325, US 4,394,506, US 4,127,405, US 4,479,821, US 5,009,699, EP 136061, EP 324569, EP 184385, WO 02/30921, WO 92/15576, WO 95/29899, US 4,668,277, EP 305939, WO 96/41537, WO 95/10507, EP 007677, CN 01080116, US 4,789,393, EP 971902, US 5,209,771, EP 084020, EP 120814, EP 087780, WO 88/04297, EP 5828924, WO 02/36595, US 5,476,936, WO 2009/053058 and the literature cited in the publications mentioned above.

[0027] Compounds from the group of the imidazolinones are already known as herbicidally active compounds for controlling unwanted vegetation; see, for example Proc. South. Weed Sci. Soc. 1992. 45, 341, Proc. South. Weed Sci. Soc. Annu. Mtg. 36th, 1983, 29, Weed Sci. Soc. Annu. Mtg. 36th, 1983, 90-91, Weed Sci. Soc. Mtg., 1984, 18, Modern Agrochemicals, 2004, 14-15.

[0028] Compounds from the group of the pyrimidinyl(thio)benzoates are already known as herbicidally active compounds for controlling unwanted vegetation; see, for example US 4,906,285, EP 658549, US 5,118,339, WO 91/05781, US 4,932,999, and EP 315889.

[0029] Compounds from the group of the sulfonanilides are already known as herbicidally active compounds for controlling unwanted vegetation; see, for example WO 93/09099, WO 2006/008159, and WO 2005/096818.

[0030] To the extent the material incorporated by reference contradicts or is inconsistent with this specification, the specification will supersede any such material.

[0031] In view of the fact that, for example, sugar beet accounts for about 20% of the world sugar production, it would be highly desirable to have available a weed control system that enables the efficient control of highly potent and serious weeds. It would thus be highly desirable to use one or more ALS inhibitor herbicides for control of unwanted vegetation in Beta vulgaris plants, preferably sugar beet plants which are tolerant to such ALS inhibitor herbicides.

[0032] This problem was solved according to present invention.

[0033] The present invention relates to the use of one or more ALS inhibitor herbicide(s) belonging to one or various ALS inhibitor herbicide class(es) for controlling unwanted vegetation in Beta vulgaris, preferably in sugar beet, growing areas in which the Beta vulgaris plant, preferably a sugar beet plant, comprises a mutation of tryptophan at position 569 in the ALS enzyme and a mutation of proline at position 188 in the ALS enzyme, as well as optionally one or several further mutations, preferably one or several further mutations in the ALS gene, preferably a mutation causing a further amino acid substitution in the ALS gene.

[0034] Seeds of sugar beet plants comprising such mutations and which are preferably employed according to present invention have been deposited with the NCIMB, Aberdeen, UK, under Number NCIMB 42050 on September 7, 2012 (Bayer CropScience AG being co-depositor).

[0035] More preferably, the present invention relates to the use of one or more ALS inhibitor herbicide(s) in the above mentioned mutated Beta vulgaris plants, preferably in the above described mutated sugar beet plants, wherein the ALS inhibitor herbicide(s) belong to:

the group of the (sulfon)amides (group (A)) consisting of:

the subgroup (A1) of the sulfonylureas, consisting of:

amidosulfuron [CAS RN 120923-37-7] (= A1-1) ;

azimsulfuron [CAS RN 120162-55-2] (= A1-2);

bensulfuron-methyl [CAS RN 83055-99-6] (= A1-3);

chlorimuron-ethyl [CAS RN 90982-32-4] (= A1-4);

chlorsulfuron [CAS RN 64902-72-3] (= A1-5);

cinosulfuron [CAS RN 94593-91-6] (= A1-6);

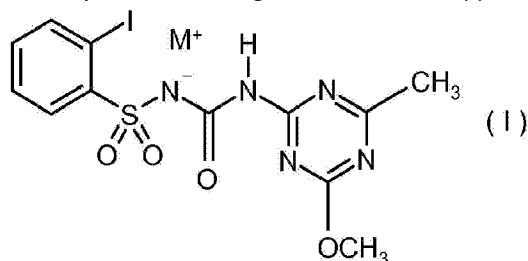
cyclosulfamuron [CAS RN 136849-15-5] (= A1-7);

ethametsulfuron-methyl [CAS RN 97780-06-8] (= A1-8);

ethoxysulfuron [CAS RN 126801-58-9] (= A1-9);

flazasulfuron [CAS RN 104040-78-0] (= A1-10);

flucetosulfuron [CAS RN 412928-75-7] (= A1-11);
 flupyrsulfuron-methyl-sodium [CAS RN 144740-54-5] (= A1-12);
 foramsulfuron [CAS RN 173159-57-4] (= A1-13);
 halosulfuron-methyl [CAS RN 100784-20-1] (= A1-14);
 imazosulfuron [CAS RN 122548-33-8] (= A1-15);
 iodosulfuron-methyl-sodium [CAS RN 144550-36-7] (= A1-16);
 mesosulfuron-methyl [CAS RN 208465-21-8] (= A1-17);
 metsulfuron-methyl [CAS RN 74223-64-6] (= A1-18);
 monosulfuron [CAS RN 155860-63-2] (= A1-19);
 nicosulfuron [CAS RN 111991-09-4] (= A1-20);
 orthosulfamuron [CAS RN 213464-77-8] (= A1-21);
 oxasulfuron [CAS RN 144651-06-9] (= A1-22);
 primisulfuron-methyl [CAS RN 86209-51-0] (= A1-23);
 prosulfuron [CAS RN 94125-34-5] (= A1-24);
 pyrazosulfuron-ethyl [CAS RN 93697-74-6] (= A1-25);
 rimsulfuron [CAS RN 122931-48-0] (= A1-26);
 sulfometuron-methyl [CAS RN 74222-97-2] (= A1-27);
 sulfosulfuron [CAS RN 141776-32-1] (= A1-28);
 thifensulfuron-methyl [CAS RN 79277-27-3] (= A1-29);
 triasulfuron [CAS RN 82097-50-5] (= A1-30);
 tribenuron-methyl [CAS RN 101200-48-0] (= A1-31);
 trifloxysulfuron [CAS RN 145099-21-4] (sodium) (= A1-32);
 triflusulfuron-methyl [CAS RN 126535-15-7] (= A1-33);
 tritosulfuron [CAS RN 142469-14-5] (= A1-34);
 NC-330 [CAS RN 104770-29-8] (= A1-35);
 NC-620 [CAS RN 868680-84-6] (= A1-36);
 TH-547 [CAS RN 570415-88-2] (= A1-37);
 monosulfuron-methyl [CAS RN 175076-90-1] (= A1-38);
 2-iodo-N-[(4-methoxy-6-methyl-1,3,5-triazinyl)carbamoyl]benzene-sulfonamide (= A1-39);
 a compound of the general formula (I)



where M^+ denotes the respective salt of the compound (I), i.e.

its lithium salt (= A1-40); its sodium salt (= A1-41); its potassium salt

(= A1-42); its magnesium salt (= A1-43); its calcium (= A1-44); its ammonium salt (= A1-45); its methylammonium salt (= A1-46); its dimethylammonium salt (= A1-47); its tetramethylammonium salt

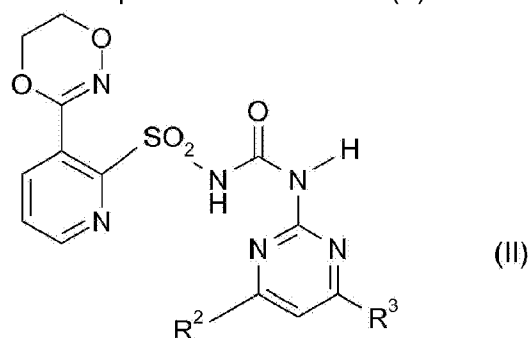
(= A1-48); its ethylammonium salt (= A1-49); its diethylammonium salt (= A1-50); its tetraethylammonium salt (= A1-51); its propylammonium salt (=A1-52); its tetrapropylammonium salt (= A1-53); its isopropylammonium salt (= A1-54); its diisopropylammonium salt

(= A1-55); its butylammonium salt (= A1-56); its tetrabutylammonium salt (= A1-57); its (2-hydroxyeth-1-yl)ammonium salt (= A1-58); its bis-N,N-(2-hydroxyeth-1-yl)ammonium salt (= A1-59); its tris-N,N,N-(2-hydroxyeth-1-yl)ammonium salt (= A1-60); its 1-phenylethylammonium salt (= A1-61); its 2-phenylethylammonium salt (= A1-62); its trimethylsulfonium salt (= A1-63); its trimethyloxonium salt (= A1-64); its pyridinium salt (= A1-65); its 2-methylpyridinium salt (= A1-66); its 4-methylpyridinium salt (= A1-67); its 2,4-dimethylpyridinium salt

(= A1-68); its 2,6-dimethylpyridinium salt (= A1-69); its piperidinium salt (= A1-70); its imidazolium salt (= A1-71); its morpholinium salt

(= A1-72); its 1,5-diazabicyclo[4.3.0]non-7-enium salt (= A1-73); its 1,8-diazabicyclo[5.4.0]undec-7-enium salt (= A1-74);

or a compound of the formula (II) or salts thereof

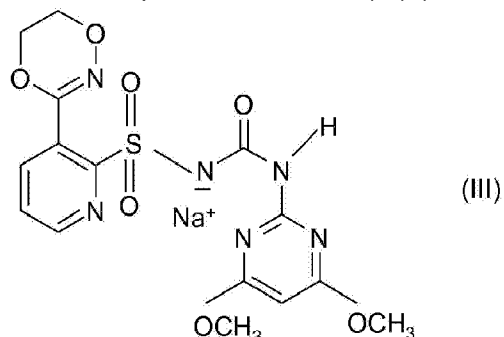


with R^2 , and R^3 having the meaning as defined in the below table

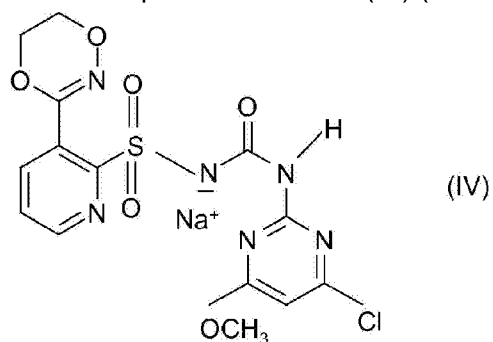
Compound	R^2	R^3
A1-75	OCH ₃	OC ₂ H ₅
A1-76	OCH ₃	CH ₃
A1-77	OCH ₃	C ₂ H ₅
A1-78	OCH ₃	CF ₃
A1-79	OCH ₃	OCF ₂ H
A1-80	OCH ₃	NHCH ₃
A1-81	OCH ₃	N(CH ₃) ₂
A1-82	OCH ₃	Cl
A1-83	OCH ₃	OCH ₃
A1-84	OC ₂ H ₅	OC ₂ H ₅
A1-85	OC ₂ H ₅	CH ₃

Compound	R ²	R ³
A1-86	OC ₂ H ₅	C ₂ H ₅

or the compound of formula (III) (= A1-87), i.e. the sodium salt of compound (A1-83)



or the compound of formula (IV) (=A1-88), i.e. the sodium salt of compound (A1-82)



the subgroup of the sulfonylaminocarbonyltriazolinones (subgroup ((A2)), consisting of:

flucarbazone-sodium [CAS RN 181274-17-9] (= A2-1);

propoxycarbazone-sodium [CAS RN 181274-15-7] (= A2-2);

thiencarbazone-methyl [CAS RN 317815-83-1] (= A2-3);

the subgroup of the triazolopyrimidines (subgroup (A3)), consisting of:

cloransulam-methyl [147150-35-4] (= A3-1);

diclosulam [CAS RN 145701-21-9] (= A3-2);

florasulam [CAS RN 145701-23-1] (= A3-3);

flumetsulam [CAS RN 98967-40-9] (= A3-4);

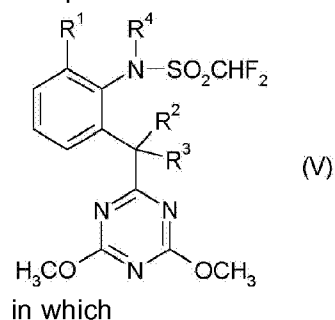
metosulam [CAS RN 139528-85-1] (= A3-5);

penoxsulam [CAS RN 219714-96-2] (= A3-6);

pyroxsulam [CAS RN 422556-08-9] (= A3-7);

the subgroup of the sulfonanilides (subgroup (A4)), consisting of:

compounds or salts thereof from the group described by the general formula (V):

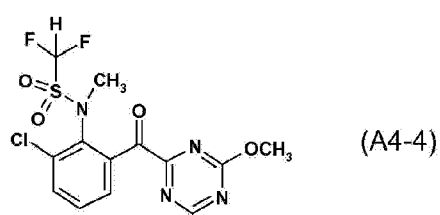
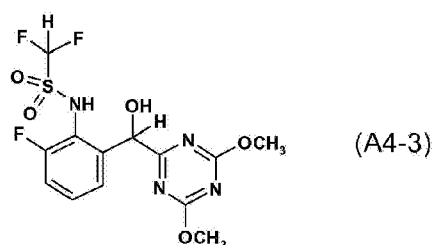
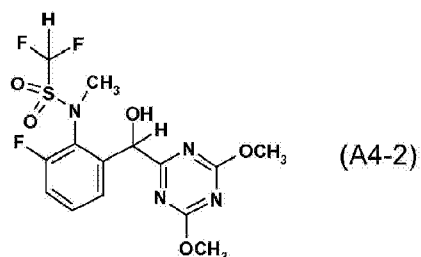
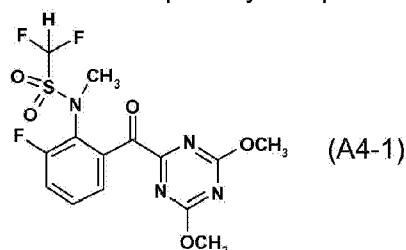


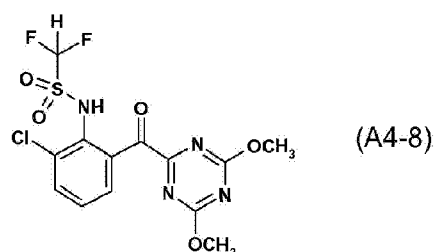
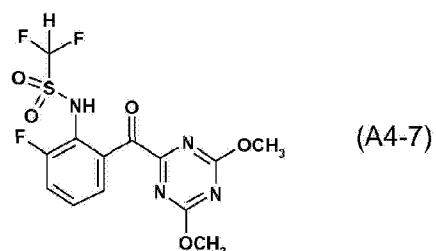
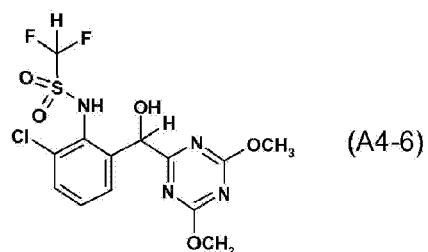
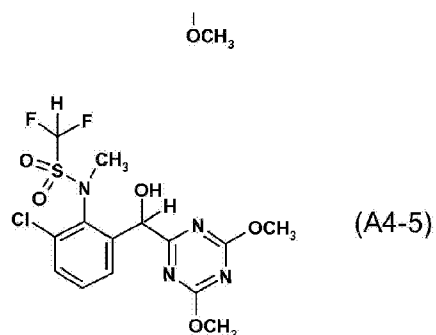
R¹ is halogen, preferably fluorine or chlorine,

R² is hydrogen and R³ is hydroxyl or R² and R³ together with the carbon atom to which they are attached are a carbonyl group C=O and

R⁴ is hydrogen or methyl;

and more especially compounds of the below given chemical structure (A4-1) to (A4-8)





the group of the imidazolinones (group (B1)), consisting of:

imazamethabenzmethyl [CAS RN 81405-85-8] (= B1-1);

imazamox [CAS RN 114311-32-9] (= B1-2);

imazapic [CAS RN 104098-48-8] (= B1-3);

imazapyr [CAS RN 81334-34-1] (= B1-4);

imazaquin [CAS RN 81335-37-7] (= B1-5);

imazethapyr [CAS RN 81335-77-5] (= B1-6);

SYP-298 [CAS RN 557064-77-4] (= B1-7);

SYP-300 [CAS RN 374718-10-2] (= B1-8);

the group of the pyrimidinyl(thio)benzoates (group (C)), consisting of:

the subgroup of the pyrimidinyloxybenzoic acids (subgroup (C1)) consisting of:

bispyribac-sodium [CAS RN 125401-92-5] (= C1-1);

pyribenzoxim [CAS RN 168088-61-7] (= C1-2);

pyriminobac-methyl [CAS RN 136191-64-5] (= C1-3);

pyribambenz-isopropyl [CAS RN 420138-41-6] (= C1-4);

pyribambenz-propyl [CAS RN 420138-40-5] (= C1-5);

the subgroup of the pyrimidinylthiobenzoic acids (subgroup (C2)), consisting of:

pyriftalid [CAS RN 135186-78-6] (= C2-1);

pyrithiobac-sodium [CAS RN 123343-16-8] (= C2-2).

[0036] In this context, "tolerance" or "tolerant" means that the application of one or more ALS inhibitor herbicide(s) belonging to any of the above defined groups (A), (B), (C) does not show any apparent effect(s) concerning the physiological functions/phytotoxicity when applied to the respective *Beta vulgaris* plant, especially sugar beet containing an ALS polypeptide comprising mutations at positions 569 and 188 and whereas the application of the same amount of the respective ALS inhibitor herbicide(s) on non-tolerant *Beta vulgaris* plants leads to significant negative effects concerning plant growth, its physiological functions or shows phytotoxic symptoms. Quality and quantity of the observed effects may depend on the chemical composition of the respective ALS inhibitor herbicide(s) applied, dose rate and timing of the application as well growth conditions/stage of the treated plants.

[0037] Unless otherwise indicated, the term "at least" preceding a series of elements is to be understood to refer to every element in the series. Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments of the invention described herein.

[0038] Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integer or step. The word "comprise" and its variations on the one side and the word "contain" and its analogous variations on the other side can be used interchangeably throughout this specification and the corresponding claims without a preference given to any of them.

[0039] When used herein, the term "transgenic" or "genetically modified" means that a gene - which can be of the same or a different species - has been introduced via an appropriate biological carrier, like *Agrobacterium tumefaciens* or by any other physical means, like protoplast transformation or particle bombardment, into a plant and which gene is able to be expressed in the new host environment, namely the genetically modified organism (GMO).

[0040] In accordance to the before definition, the term "non-transgenic" or "non-genetically modified" means exactly the contrary, i.e. that no introduction of the respective gene has occurred via an appropriate biological carrier or by any other physical means. However, a mutated gene can be transferred through pollination, either naturally or via a breeding process to produce another non-transgenic plant concerning this specific gene.

[0041] An "endogenous" gene means a gene of a plant which has not been introduced into the plant by genetic engineering techniques.

[0042] An "amino acid different from tryptophan" (indicated by "Trp" in the three letter code or "W" in the equivalently used one letter code) includes any naturally-occurring amino acid different from tryptophan. These naturally-occurring amino acids include alanine (A), arginine (R), asparagine (N), aspartate (D), cysteine (C), glutamine (Q), glutamate (E), glycine (G), histidine (H), isoleucine (I), leucine (L), lysine (K), methionine (M), phenylalanine (F), proline (P), serine (S), threonine (T), tyrosine (Y) or valine (V).

[0043] However, preferably, the amino acid different from tryptophan (belonging to the group of neutral-polar amino acids) at position 569 of the ALS protein is an amino acid with physico-chemical properties different from tryptophan, i.e. belonging to any of the amino acids showing neutral-nonpolar, acidic, or basic properties. More preferably, the amino acid different from tryptophan is selected from the group consisting of alanine, glycine, isoleucine, leucine, methionine, phenylalanine, proline, valine, and arginine. Even more preferably, said amino acid is a neutral-nonpolar amino acid such as alanine, glycine, isoleucine, leucine, methionine, phenylalanine, proline or valine. Particularly preferred said amino acid is alanine, glycine, isoleucine, leucine, valine. Even more preferred said amino acid is glycine or leucine. Most preferably, it is leucine.

[0044] The "CAS RN" stated in square brackets behind the names (common names) mentioned under groups A to C corresponds to the "chemical abstract service registry number", a customary reference number which allows the substances named to be classified unambiguously, since the "CAS RN" distinguishes, inter alia, between isomers including stereoisomers.

[0045] ALS inhibitor herbicides which are preferably used for control of unwanted vegetation in *Beta vulgaris*, preferably sugar beet, growing areas in which *Beta vulgaris*, preferably sugar beet plants, contain an ALS protein encoded by an endogenous ALS gene comprising an amino acid different from tryptophan at position 569 and an amino acid different from proline at

position 188, and thereby providing tolerance against the ALS inhibitor herbicide(s) according to this invention belonging to group (A) are:

amidosulfuron [CAS RN 120923-37-7] (= A1-1);

chlorimuron-ethyl [CAS RN 90982-32-4] (= A1-4);

ethametsulfuron-methyl [CAS RN 97780-06-8] (= A1-8);

ethoxysulfuron [CAS RN 126801-58-9] (= A1-9);

flupyrsulfuron-methyl-sodium [CAS RN 144740-54-5] (= A1-12);

foramsulfuron [CAS RN 173159-57-4] (= A1-13);

iodosulfuron-methyl-sodium [CAS RN 144550-36-7] (= A1-16);

mesosulfuron-methyl [CAS RN 208465-21-8] (= A1-17);

metsulfuron-methyl [CAS RN 74223-64-6] (= A1-18);

monosulfuron [CAS RN 155860-63-2] (= A1-19);

nicosulfuron [CAS RN 111991-09-4] (= A1-20);

sulfosulfuron [CAS RN 141776-32-1] (= A1-28);

thifensulfuron-methyl [CAS RN 79277-27-3] (= A1-29);

tribenuron-methyl [CAS RN 101200-48-0] (= A1-31);

2-iodo-N-[(4-methoxy-6-methyl-1,3,5-triazinyl)carbamoyl]benzene-sulfonamide

(= A1-39);

2-iodo-N-[(4-methoxy-6-methyl-1,3,5-triazinyl)carbamoyl]benzene-sulfonamide sodium salt (= A1-41);

(A1-83) or its sodium salt (=A1-87);

propoxycarbazone-sodium [CAS RN 181274-15-7] (= A2-2);

thiencarbazone-methyl [CAS RN 317815-83-1] (= A2-3);

florasulam [CAS RN 145701-23-1] (= A3-3);

metosulam [CAS RN 139528-85-1] (= A3-5);

pyroxsulam [CAS RN 422556-08-9] (= A3-7)

(A4-1);

(A4-2); and

(A4-3).

[0046] ALS inhibitor herbicides which are especially preferably used for control of unwanted vegetation in *Beta vulgaris* (preferably sugar beet) growing areas in which the *Beta vulgaris* (preferably sugar beet) plants contain an ALS protein encoded by an endogenous ALS gene comprising an amino acid different from tryptophan at position 569 and an amino acid different from proline at position 188, and thereby providing tolerance against the ALS inhibitor herbicide(s) according to this invention belonging to group (A) are:

amidosulfuron [CAS RN 120923-37-7] (= A1-1);

foramsulfuron [CAS RN 173159-57-4] (= A1-13);

iodosulfuron-methyl-sodium [CAS RN 144550-36-7] (= A1-16);

2-iodo-N-[(4-methoxy-6-methyl-1,3,5-triazinyl)carbamoyl]benzene-sulfonamide (= A1-39);

2-iodo-N-[(4-methoxy-6-methyl-1,3,5-triazinyl)carbamoyl]benzene-sulfonamide sodium salt A1-41;

A1-83 or its sodium salt (=A1-87);

thiencarbazone-methyl [CAS RN 317815-83-1] (= A2-3).

[0047] Another ALS inhibitor herbicide which is preferably used for control of unwanted vegetation in *Beta vulgaris* (preferably sugar beet) growing areas in which the *Beta vulgaris* (preferably sugar beet) plants contain an ALS protein encoded by an endogenous ALS gene comprising an amino acid different from tryptophan at position 569 and an amino acid different from proline at position 188, and thereby providing tolerance against the ALS inhibitor herbicide(s) according to this invention belonging to group (B) is:

imazamox [CAS RN 114311-32-9] (= B1-2).

[0048] Another ALS inhibitor herbicide which is preferably used for control of unwanted vegetation in *Beta vulgaris* (preferably sugar beet) growing areas in which the *Beta vulgaris* (preferably sugar beet) plants contain an ALS protein encoded by an endogenous ALS gene comprising an amino acid different from tryptophan at position 569 and an amino acid different from proline at position 188, and thereby providing tolerance against the ALS inhibitor herbicide(s) according to this invention belonging to group (C) is:

bispyribac-sodium [CAS RN 125401-92-5] (= C1-1).

[0049] It is to be further understood that concerning all above defined ALS inhibitor herbicides

and where not already specified by the respective CAS RN, all use forms, such as acids, and salts can be applied according to the invention.

[0050] Additionally, the ALS inhibitor herbicide(s) to be used according to the invention may comprise further components, for example agrochemically active compounds of a different type of mode of action and/or the formulation auxiliaries and/or additives customary in crop protection, or may be used together with these.

[0051] In a preferred embodiment, the herbicide combinations to be used according to the invention comprise effective amounts of the ALS inhibitor herbicide(s) belonging to groups (A), (B) and/or (C) and/or have synergistic actions. The synergistic actions can be observed, for example, when applying one or more ALS inhibitor herbicide(s) belonging to groups (A), (B), and/or (C) together, for example as a coformulation or as a tank mix; however, they can also be observed when the active compounds are applied at different times (splitting). It is also possible to apply the herbicides or the herbicide combinations in a plurality of portions (sequential application), for example pre-emergence applications followed by post-emergence applications or early post-emergence applications followed by medium or late post-emergence applications. Preference is given here to the joint or almost simultaneous application of the ALS-inhibitor herbicides belonging to groups (A), (B) and/or (C) of the combination in question.

[0052] The synergistic effects permit a reduction of the application rates of the individual ALS inhibitor herbicides, a higher efficacy at the same application rate, the control of species which were as yet uncontrolled (gaps), control of species which are tolerant or resistant to individual ALS inhibitor herbicides or to a number of ALS inhibitor herbicides, an extension of the period of application and/or a reduction in the number of individual applications required and - as a result for the user - weed control systems which are more advantageous economically and ecologically.

[0053] The herbicides to be used according to this invention are all acetolactate synthase (ALS) inhibitor herbicides (which might alternatively and interchangeably also be named as "ALS inhibiting herbicides") and thus inhibit protein biosynthesis in plants.

[0054] The application rate of the ALS inhibitor herbicides belonging to groups (A), (B) or (C) (as defined above) can vary within a wide range, for example between 0.001 g and 1500 g of ai/ha (ai/ha means here and below "active substance per hectare" = based on 100% pure active compound). Applied at application rates of from 0.001 g to 1500 g of ai/ha, the herbicides belonging to classes A, B and C according to this invention, preferably the compounds A1-1; A1-4; A1-8; A1-9; A1-12; A1-13; A1-16; A1-17; A1-18; A1-19; A1-20; A1-28; A1-29; A1-31; A1-39; A1-41; A1-83; A1-87; A2-2; A2-3; A3-3; A3-5; A3-7, A4-3, control, when used by the pre- and post-emergence method, a relatively wide spectrum of harmful plants, for example of annual and perennial mono- or dicotyledonous weeds, and also of unwanted crop plants (together also defined as "unwanted vegetation") .

[0055] In many applications according to the invention, the application rates are generally

lower, for example in the range of from 0.001 g to 1000 g of ai/ha, preferably from 0.1 g to 500 g of ai/ha, particularly preferably from 0.5 g to 250 g of ai/ha, and even more preferably 1.0 g to 200 g of ai/ha. In cases where the application of several ALS inhibitor herbicides is conducted, the quantity represents the total quantity of all of the applied ALS inhibitor herbicides.

[0056] For example, the combinations according to the invention of ALS inhibitor herbicides (belonging to groups (A), (B) and/or (C)) allow the activity to be enhanced synergistically in a manner which, by far and in an unexpected manner, exceeds the activities which can be achieved using the individual ALS inhibitor herbicides (belonging to groups (A), (B) and/or (C)).

[0057] For combinations of ALS inhibitor herbicides, the preferred conditions are illustrated below.

[0058] Of particular interest according to present invention is the use of herbicidal compositions for control of unwanted vegetation in *Beta vulgaris* plants, preferably in sugar beet plants having a content of the following ALS inhibitor herbicides:

(A1-1) + (A1-4); (A1-1) + (A1-8); (A1-1) + (A1-9); (A1-1) + (A1-12);

(A1-1) + (A1-13); (A1-1) + (A1-16); (A1-1) + (A1-17); (A1-1) + (A1-18);

(A1-1) + (A1-19); (A1-1) + (A1-20); (A1-1) + (A1-28); (A1-1) + (A1-29);

(A1-1) + (A1-31); (A1-1) + (A1-39); (A1-1) + (A1-41); (A1-1) + (A1-83);

(A1-1) + (A1-87); (A1-1) + (A2-2); (A1-1) + (A2-3); (A1-1) + (A3-3);

(A1-1) + (A3-5); (A1-1) + (A3-7); (A1-1) + (A4-1); (A1-1) + (A4-2); (A1-1) + (A4-3);

(A1-4) + (A1-8); (A1-4) + (A1-9); (A1-4) + (A1-12); (A1-4) + (A1-13);

(A1-4) + (A1-16); (A1-4) + (A1-17); (A1-4) + (A1-18); (A1-4) + (A1-19);

(A1-4) + (A1-20); (A1-4) + (A1-28); (A1-4) + (A1-29); (A1-4) + (A1-31);

(A1-4) + (A1-39); (A1-4) + (A1-41); (A1-4) + (A1-83); (A1-4) + (A1-87);

(A1-4) + (A2-2); (A1-4) + (A2-3); (A1-4) + (A3-3); (A1-4) + (A3-5);

(A1-4) + (A3-7); (A1-4) + (A4-1); (A1-4) + (A4-2); (A1-4) + (A4-3);

(A1-8) + (A1-9); (A1-8) + (A1-12); (A1-8) + (A1-13); (A1-8) + (A1-16);

(A1-8) + (A1-17); (A1-8) + (A1-18); (A1-8) + (A1-19); (A1-8) + (A1-20);

(A1-8) + (A1-28); (A1-8) + (A1-29); (A1-8) + (A1-31); (A1-8) + (A1-39);

(A1-8) + (A1-41); (A1-8) + (A1-83); (A1-8) + (A1-87); (A1-8) + (A2-2);

(A1-8) + (A2-3); (A1-8) + (A3-3); (A1-8) + (A3-5); (A1-8) + (A3-7);
 (A1-8) + (A4-1); (A1-8) + (A4-2); (A1-8) + (A4-3);
 (A1-9) + (A1-12); (A1-9) + (A1-13); (A1-9) + (A1-16); (A1-9) + (A1-17);
 (A1-9) + (A1-18); (A1-9) + (A1-19); (A1-9) + (A1-20); (A1-9) + (A1-28);
 (A1-9) + (A1-29); (A1-9) + (A1-31); (A1-9) + (A1-39); (A1-9) + (A1-41);
 (A1-9) + (A1-83); (A1-9) + (A1-87); (A1-9) + (A2-2); (A1-9) + (A2-3);
 (A1-9) + (A3-3); (A1-9) + (A3-5); (A1-9) + (A3-7); (A1-9) + (A4-1);
 (A1-9) + (A4-2); (A1-9) + (A4-3);
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 (A1-13) + (A3-7); (A1-13) + (A4-1); (A1-13) + (A4-2); (A1-13) + (A4-3);
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 (A1-16) + (A1-28); (A1-16) + (A1-29); (A1-16) + (A1-31); (A1-16) + (A1-39);
 (A1-16) + (A1-41); (A1-16) + (A1-83); (A1-16) + (A1-87); (A1-16) + (A2-2);
 (A1-16) + (A2-3); (A1-16) + (A3-3); (A1-16) + (A3-5); (A1-16) + (A3-7);
 (A1-16) + (A4-1); (A1-16) + (A4-2); (A1-16) + (A4-3);
 (A1-17) + (A1-18); (A1-17) + (A1-19); (A1-17) + (A1-20); (A1-17) + (A1-28);
 (A1-17) + (A1-29); (A1-17) + (A1-31); (A1-17) + (A1-39); (A1-17) + (A1-41);
 (A1-17) + (A1-83); (A1-17) + (A1-87); (A1-17) + (A2-2); (A1-17) + (A2-3);
 (A1-17) + (A3-3); (A1-17) + (A3-5); (A1-17) + (A3-7); (A1-17) + (A4-1);

(A1-17) + (A4-2); (A1-17) + (A4-3);
 (A1-18) + (A1-19); (A1-18) +(A1-20); (A1-18) + (A1-28); (A1-18) + (A1-29);
 (A1-18) + (A1-31); (A1-18) + (A1-39); (A1-18) +(A1-41); (A1-18) + (A1-83);
 (A1-18) + (A1-87); (A1-18) + (A2-2); (A1-18) + (A2-3); (A1-18) + (A3-3);
 (A1-18) + (A3-5); (A1-18) + (A3-7); (A1-18) + (A4-1); (A1-18) + (A4-2);
 (A1-18) + (A4-3);
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 (A1-28) + (A1-83); (A1-28) + (A1-87); (A1-28) + (A2-2); (A1-28) + (A2-3);
 (A1-28) + (A3-3); (A1-28) + (A3-5); (A1-28) + (A3-7); (A1-28) + (A4-1);
 (A1-28) + (A4-2); (A1-28) + (A4-3);
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 (A1-29) + (A3-5); (A1-29) + (A3-7); (A1-29) + (A4-1); (A1-29) + (A4-2); (A1-29) + (A4-3);
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 (A1-31) + (A2-2); (A1-31) + (A2-3); (A1-31) + (A3-3); (A1-31) + (A3-5);
 (A1-31) + (A3-7); (A1-31) + (A4-1); (A1-31) + (A4-2); (A1-31) + (A4-3);
 (A1-39) + (A1-41); (A1-39) + (A1-83); (A1-39) + (A1-87); (A1-39) + (A2-2);
 (A1-39) + (A2-3); (A1-39) + (A3-3); (A1-39) + (A3-5); (A1-39) + (A3-7);

(A1-39) + (A4-1); (A1-39) + (A4-2); (A1-39) + (A4-3);
 (A1-41) + (A1-83); (A1-41) + (A1-87); (A1-41) + (A2-2); (A1-41) + (A2-3);
 (A1-41) + (A3-3); (A1-41) + (A3-5); (A1-41) + (A3-7); (A1-41) + (A4-1);
 (A1-41) + (A4-2); (A1-41) + (A4-3);
 (A1-83) + (A2-2); (A1-83) + (A2-3); (A1-83) + (A3-3); (A1-83) + (A3-5);
 (A1-83) + (A3-7); (A1-83) + (A4-1); (A1-83) + (A4-2); (A1-83) + (A4-3);
 (A1-87) + (A2-2); (A1-87) + (A2-3); (A1-87) + (A3-3); (A1-87) + (A3-5);
 (A1-87) + (A3-7); (A1-87) + (A4-1); (A1-87) + (A4-2); (A1-87) + (A4-3);
 (A2-2) + (A2-3); (A2-2) + (A3-3); (A2-2) + (A3-5); (A2-2) + (A3-7);
 (A2-2) + (A4-1); (A2-2) + (A4-2); (A2-2) + (A4-3);
 (A2-3) + (A3-3); (A2-3) + (A3-5); (A2-3) + (A3-7);
 (A2-3) + (A4-1); (A2-3) + (A4-2); (A2-3) + (A4-3);
 (A3-3) + (A3-5); (A3-3) + (A3-7);
 (A3-3) + (A4-1); (A3-3) + (A4-2); (A3-3) + (A4-3);
 (A3-5) + (A3-7); (A3-5) + (A4-1); (A3-5) + (A4-2); (A3-5) + (A4-3);
 (A3-7) + (A4-1); (A3-7) + (A4-2); (A3-7) + (A4-3);
 (A-1) + (A4-2); (A4-1) + (A4-3); and
 (A4-2) + (A4-3);

[0059] Additionally, the ALS inhibitor herbicides to be used according to the invention may comprise further components, for example agrochemically active compounds of a different type of mode of action and/or the formulation auxiliaries and/or additives customary in crop protection, or may be used together with these.

[0060] The ALS inhibitor herbicide(s) to be used according to the invention or combinations of various such ALS inhibitor herbicides may furthermore comprise various agrochemically active compounds, for example from the group of the safeners, fungicides, insecticides, or from the group of the formulation auxiliaries and additives customary in crop protection.

[0061] In a further embodiment, the invention relates to the use of effective amounts of ALS inhibitor herbicide(s) (i.e. members of the groups (A), (B) and/or (C)) and non-ALS inhibitor

herbicides (i.e. herbicides showing a mode of action that is different to the inhibition of the ALS enzyme [acetohydroxyacid synthase; EC 2.2.1.6] (group D herbicides) in order obtain synergistic effect for the control of unwanted vegetation. Such synergistic actions can be observed, for example, when applying one or more ALS inhibitor herbicides (i.e. members of the groups (A), (B), and/or (C)) and one or more non-ALS inhibitor herbicides (group D herbicides) together, for example as a coformulation or as a tank mix; however, they can also be observed when the active compounds are applied at different times (splitting). It is also possible to apply the ALS inhibitor herbicides and non-ALS inhibitor herbicides in a plurality of portions (sequential application), for example pre-emergence applications followed by post-emergence applications or early post-emergence applications followed by medium or late post-emergence applications. Preference is given here to the joint or almost simultaneous application of the herbicides ((A), (B) and/or (C)) and (D) of the combination in question.

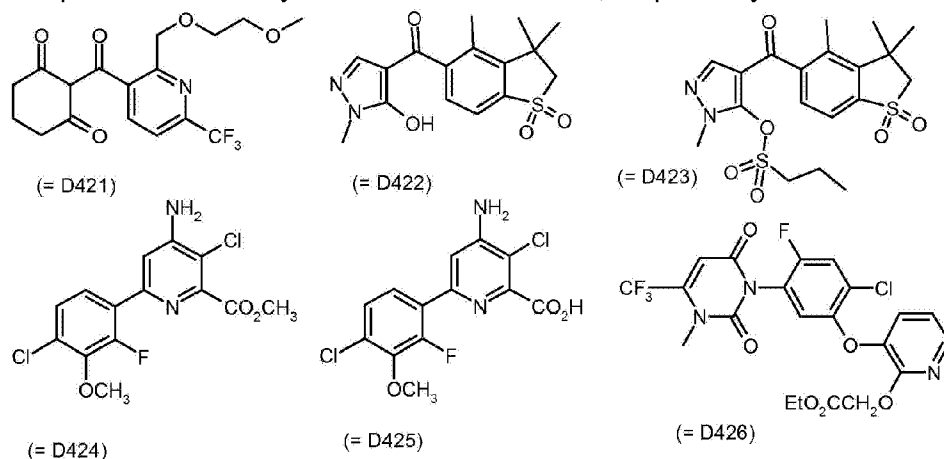
[0062] Suitable partner herbicides to be applied together with ALS inhibitor herbicides are, for example, the following herbicides which differ structurally from the herbicides belonging to the groups (A), (B), and (C) as defined above, preferably herbicidally active compounds whose action is based on inhibition of, for example, acetyl coenzyme A carboxylase, PS I, PS II, HPPDO, phytoene desaturase, protoporphyrinogen oxidase, glutamine synthetase, cellulose biosynthesis, 5-enolpyruvylshikimate 3-phosphate synthetase, as described, for example, in Weed Research 26, 441-445 (1986), or "The Pesticide Manual", 14th edition, The British Crop Protection Council, 2007, or 15th edition 2010, or in the corresponding "e-Pesticide Manual", Version 5 (2010), in each case published by the British Crop Protection Council, (hereinbelow in short also "PM"), and in the literature cited therein. Lists of common names are also available in "The Compendium of Pesticide Common Names" on the internet. Herbicides known from the literature (in brackets behind the common name hereinafter also classified by the indicators D1 to D426), which can be combined with ALS-inhibitor herbicides of groups (A), (B) and/or (C) and to be used according to present invention are, for example, the active compounds listed below: (note: the herbicides are referred to either by the "common name" in accordance with the International Organization for Standardization (ISO) or by the chemical name, together where appropriate with a customary code number, and in each case include all use forms, such as acids, salts, esters and isomers, such as stereoisomers and optical isomers, in particular the commercial form or the commercial forms, unless the context indicates otherwise. The citation given is of one use form and in some cases of two or more use forms):

acetochlor (= D1), acibenzolar (= D2), acibenzolar-S-methyl (= D3), acifluorfen (= D4), acifluorfen-sodium (= D5), aclonifen (= D6), alachlor (= D7), allidochlor (= D8), alloxydim (= D9), alloxydim-sodium (= D10), ametryn (= D11), amicarbazone (= D12), amidochlor (= D13), aminocyclopyrachlor (= D14), aminopyralid (= D15), amitrole (= D16), ammonium sulfamate (= D17), ancymidol (= D18), anilofos (= D19), asulam (= D20), atrazine (= D21), azafenidin (= D22), aziprotryn (= D23), beflubutamid (= D24), benazolin (= D25), benazolin-ethyl (= D26), bencarbazone (= D27), benfluralin (= D28), benfuresate (= D29), bensulide (= D30), bentazone (= D31), benzfendizone (= D32), benzobicyclon (= D33), benzofenap (= D34), benzofluor (= D35), benzoylprop (= D36), bicyclopyrone (= D37), bifenox (= D38), bilanafos (= D39), bilanafos-sodium (= D40), bromacil (= D41), bromobutide (= D42), bromofenoxim (= D43),

bromoxynil (= D44), bromuron (= D45), buminafos (= D46), busoxinone (= D47), butachlor (= D48), butafenacil (= D49), butamifos (= D50), butenachlor (= D51), butralin (= D52), butoxydim (= D53), butylate (= D54), cafenstrole (= D55), carbetamide (= D56), carfentrazone (= D57), carfentrazone-ethyl (= D58), chlomethoxyfen (= D59), chloramben (= D60), chlorazifop (= D61), chlorazifop-butyl (= D62), chlorbromuron (= D63), chlorbufam (= D64), chlorfenac (= D65), chlorfenac-sodium (= D66), chlorfenprop (= D67), chlorflurenol (= D68), chlorflurenol-methyl (= D69), chloridazon (= D70), chlormequat-chloride (= D71), chlornitrofen (= D72), chlorophthalim (= D73), chlorthal-dimethyl (= D74), chlorotoluron (= D75), cinidon (= D76), cinidon-ethyl (= D77), cinmethylin (= D78), clethodim (= D79), clodinafop (= D80), clodinafop-propargyl (= D81), clofencet (= D82), clomazone (= D83), clomeprop (= D84), cloprop (= D85), clopyralid (= D86), cloransulam (= D87), cloransulam-methyl (= D88), cumyluron (= D89), cyanamide (= D90), cyanazine (= D91), cyclanilide (= D92), cycloate (= D93), cycloxydim (= D94), cycluron (= D95), cyhalofop (= D96), cyhalofop-butyl (= D97), cyperquat (= D98), cyprazine (= D99), cyprazole (= D100), 2,4-D (= D101), 2,4-DB (= D102), daimuron/dymron (= D103), dalapon (= D104), daminozide (= D105), dazomet (= D106), n-decanol (= D107), desmedipham (= D108), desmetryn (= D109), detosyl-pyrazolate (= D110), diallate (= D111), dicamba (= D112), dichlobenil(= D113), dichlorprop (= D114), dichlorprop-P (= D115), diclofop (= D116), diclofop-methyl (= D117), diclofop-P-methyl (= D118), diethatyl (= D119), diethatyl-ethyl (= D120), difenoxuron (= D121), difenzoquat (= D122), diflufenican (= D123), diflufenzopyr (= D124), diflufenzopyr-sodium (= D125), dimefuron (= D126), dikegulac-sodium (= D127), dimefuron (= D128), dimepiperate (= D129), dimethachlor (= D130), dimethametryn (= D131), dimethenamid (= D132), dimethenamid-P (= D133), dimethipin (= D134), dimetrasulfuron (= D135), dinitramine (= D136), dinoseb (= D137), dinoterb (= D138), diphenamid(=D139), dipropetryn (= D140), diquat (= D141), diquat-dibromide (= D142), dithiopyr (= D143), diuron (= D144), DNOC (= D145), eglinazine-ethyl (= D146), endothal (= D147), EPTC (= D148), esprocarb (= D149), ethalfluralin (= D150), ethephon (= D151), ethidimuron (= D152), ethiozin (= D153), ethofumesate (= D154), ethoxyfen (= D155), ethoxyfen-ethyl (= D156), etobenzanid (= D157), F-5331 (= 2-Chlor-4-fluor-5-[4-(3-fluorpropyl)-4,5-dihydro-5-oxo-1H-tetrazol-1-yl]-phenyl]-ethansulfonamid) (= D158), F-7967 (= 3-[7-Chlor-5-fluor-2-(trifluormethyl)-1H-benzimidazol-4-yl]-1-methyl-6-(trifluormethyl)pyrimidin-2,4(1H,3H)-dion) (= D159), fenoprop (=D160), fenoxaprop (=D161), fenoxaprop-P (= D162), fenoxaprop-ethyl (= D163), fenoxaprop-P-ethyl (= D164), fenoxasulfone (= D165), fentrazamide (= D166), fenuron (= D167), flamprop (= D168), flamprop-M-isopropyl (= D169), flamprop-M-methyl (= D170), fluazifop (= D171), fluazifop-P (= D172), fluazifop-butyl (= D173), fluazifop-P-butyl (= D174), fluazolate (= D175), fluchloralin (= D176), flufenacet (thiafluamide) (= D177), flufenpyr (= D178), flufenpyr-ethyl (= D179), flumetralin (= D180), flumiclorac (= D181), flumiclorac-pentyl (= D182), flumioxazin (= D183), flumipropyn (= D184), fluometuron (= D185), fluorodifen (= D186), fluoroglycofen (= D187), fluoroglycofen-ethyl (= D188), flupoxam (= D189), flupropacil (= D190), flupropanate (= D191), flurenol (= D192), flurenol-butyl (= D193), fluridone (= D194), flurochloridone (= D195), fluoxypyr (= D196), fluoxypyr-meptyl (= D197), flurprimidol (= D198), flurtamone (= D199), fluthiacet (= D200), fluthiacet-methyl (= D201), fluthiamide (= D202), fomesafen (= 203), forchlorfenuron (= D204), fosamine (= D205), furyloxyfen (= D206), gibberellic acid (= D207), glufosinate (= D208), glufosinate-ammonium (= D209), glufosinate-P (= D210), glufosinate-P-ammonium (= D211), glufosinate-P-sodium (=

D212), glyphosate (= D213), glyphosate-isopropylammonium (= D214), H-9201 (=O-(2,4-Dimethyl-6-nitrophenyl)-O-ethyl-isopropylphosphoramidothioat) (= D215), halosafen (= D216), haloxyfop (= D217), haloxyfop-P (= D218), haloxyfop-ethoxyethyl (= D219), haloxyfop-P-ethoxyethyl (= D220), haloxyfop-methyl (= D221), haloxyfop-P-methyl (= D222), hexazinone (= D223), HW-02 (= 1-(Dimethoxyphosphoryl)-ethyl(2,4-dichlorphenoxy)acetate) (= D224), inabenfide (= D225), indanofan (= D226), indaziflam (= D227), indol-3-acetic acid (IAA) (= D228), 4-indol-3-ylbutyric acid (IBA) (= D229), ioxynil (= D230), ipfencarbazone (= D231), isocarbamid (= D232), isopropalin (= D233), isoproturon (= D234), isouron (= D235), isoxaben (= D236), isoxachlortole (= D237), isoxaflutole (= D238), isoxapyrifop (= D239), KUH-043 (= 3-((5-(Difluormethyl)-1-methyl-3-(trifluormethyl)-1H-pyrazol-4-yl)methyl)sulfonyl)-5,5-dimethyl-4,5-dihydro-1,2-oxazol) (= D240), karbutilate (= D241), ketospiradox (= D242), lactofen (= D243), lenacil (= D244), linuron (= D245), male ic hydrazide (= D246), MCPA (= D247), MCPB (= D248), MCPB-methyl, -ethyl and -sodium (= D249), mecoprop (= D250), mecoprop-sodium (= D251), mecoprop-butotyl (= D252), mecoprop-P-butotyl (= D253), mecoprop-P-dimethylammonium (= D254), mecoprop-P-2-ethylhexyl (= D255), mecoprop-P-potassium (= D256), mefenacet (= D257), mefluidide (= D258), mepiquat-chloride (= D259), mesotrione (= D260), methabenzthiazuron (= D261), metam (= D262), metamifop (= D263), metamitron (= D264), metazachlor (= D265), metazole (= D266), methiopyrsulfuron (= D267), methiozolin (= D268), methoxyphenone (= D269), methyldymron (= D270), 1-methylcyclopropen (= D271), methylisothiocyanat (= D272), metobenzuron (= D273), metobromuron (= D274), metolachlor (= D275), S-metolachlor (= D-276), metoxuron (= D277), metribuzin (= D278), molinate (= D279), monalide (= D280), monocarbamide (=D281), monocarbamide-dihydrogensulfate (= D282), monolinuron (= D283), monosulfuron-ester (= D284), monuron (= D285), MT-128 (= 6-Chlor-N-[(2E)-3-chlorprop-2-en-1-yl]-5-methyl-N-phenylpyridazin-3-amine) (= D286), MT-5950 (=N-[3-Chlor-4-(1-methylethyl)-phenyl]-2-methylpentanamide) (= D287), NGGC-011 (= D288), naproanilide (= D289), napropamide (= D290), naptalam (= D291), NC-310 (= 4-(2,4-Dichlorobenzoyl)-1-methyl-5-benzyloxy-pyrazole) (= D292), neburon (= D293), nipyraclufen (= D294), nitralin (= D295), nitrofen (= D296), nitrophenolat-sodium (isomer mixture) (= D297), nitrofluorfen (= D298), nonanoic acid (= D299), norflurazon (= D300), orbencarb (= D301), oryzalin (= D302), oxadiargyl (= D303), oxadiazon (= D304), oxaziclomefone (= D305), oxyfluorfen (= D306), paclobutrazol (= D307), paraquat (= D308), paraquat-dichloride (= D309), pelargonic acid (nonanoic acid) (= D310), pendimethalin (= D311), pendralin (= D312), pentanochlor (= D313), pentoxazone (= D314), perfluidone (= D315), pethoxamid (= D317), phenisopham (= D318), phenmedipham (= D319), phenmedipham-ethyl (= D320), picloram (= D321), picolinafen (= D322), pinoxaden (= D323), piperophos (= D324), pirifenop (= D325), pirifenop-butyl (= D326), pretilachlor (= D327), probenazole (= D328), profluazol (= D329), procyzazine (= D330), prodiamine (= D331), prifluraline (= D332), profoxydim (= D333), prohexadione (= D334), prohexadione-calcium (= D335), prohydrojasmon (= D336), prometon (= D337), prometryn (= D338), propachlor (= D339), propanil (= D340), propaquizafop (= D341), propazine (= D342), propham (= D343), propisochlor (= D344), propyzamide (= D345), prosulfalin (= D346), prosulfocarb (= D347), prynachlor (= D348), pyraclonil (= D349), pyraflufen (= D350), pyraflufen-ethyl (= D351), pyrasulfotole (= D352), pyrazolynate (pyrazolate) (= D353), pyrazoxyfen (= D354), pyribambenz (= D355), pyributicarb (= D356), pyridafol (= D357), pyridate (= D358), pyriminobac (= D359), pyrimisulfan (= D360),

pyroxasulfone (= D361), quinclorac (= D362), quinmerac (= D363), quinclamine (= D364), quizalofop (= D365), quizalofop-ethyl (= D366), quizalofop-P (= D367), quizalofop-P-ethyl (= D368), quizalofop-P-tefuryl (= D369), saflufenacil (= D370), secbumeton (= D371), sethoxydim (= D372), siduron (= D373), simazine (= D374), simetryn (= D375), SN-106279 (= Methyl-(2R)-2-({7-[2-chlor-4-(trifluormethyl)phenoxy]-2-naphthyl}oxy)-propanoate) (= D376), sulcotrione (= D377), sulfallate (CDEC) (= D378), sulfentrazone (= D379), sulfosate (glyphosate-trimesium) (= D380), SYN-523 (= D381), SYP-249 (= 1-Ethoxy-3-methyl-1-oxobut-3-en-2-yl-5-[2-chlor-4-(trifluormethyl)phenoxy]-2-nitrobenzoate) (= D382), tebutam (= D383), tebuthiuron (= D384), tecnazene (= D385), tefuryltrione (= D386), tembotrione (= D387), tepraloxymid (= D388), terbacil (= D389), terbucarb (= D390), terbuchlor (= D391), terbumeton (= D392), terbuthylazine (= D393), terbutryn (= D394), thenylchlor (= D395), thiafluamide (= D396), thiazafluron (= D397), thiazopyr (= D398), thidiazimin (= D399), thidiazuron (= D400), thiobencarb (= D401), tiocarbazil (= D402), topramezone (= D403), tralkoxydim (= D404), triallate (= D405), triaziflam (= D406), triazofenamide (= D407), trichloroacetic acid (TCA) (= D408), triclopyr (= D409), tridiphane (= D410), trietazine (= D411), trifluralin (= D412), trimeturon (= D413), trinexapac (= D414), trinexapac-ethyl (= D415), tsitodef (= D416), uniconazole (= D417), uniconazole-P (= D418), vernolate (= D419), ZJ-0862 (= 3,4-Dichlor-N-{2-[(4,6-dimethoxypyrimidin-2-yl)oxy]benzyl}aniline) (= D420), and the below compounds defined by their chemical structure, respectively:



[0063] Preferred herbicides which differ structurally and via their mode of action from the ALS inhibitor herbicides belonging to the groups (A), (B), and (C) as defined above and to be applied according to the present invention for control of unwanted vegetation in ALS inhibitor herbicide tolerant *Beta vulgaris* plants, preferably sugar beet plants comprising mutations in the ALS gene thereby encoding an ALS polypeptide having an amino acid that is different from the naturally occurring tryptophan at position 569 and having an amino acid that is different from the naturally occurring proline at position 188, preferably the tryptophan of the wild-type ALS protein is substituted by a leucine at position 569 and/or the proline of the wild-type ALS protein is substituted by a serine at position 188, are those belonging to the group of:

chloridazon (= D70), clethodim (= D79), clodinafop (= D80), clodinafop-propargyl (= D81), clopyralid (= D86), cycloxydim (= D94), desmedipham (= D108), dimethenamid (= D132), dimethenamid-P (= D133), ethofumesate (= D154), fenoxaprop (= D161), fenoxaprop-P (=

D162), fenoxaprop-ethyl (= D163), fenoxaprop-P-ethyl (=D164), fluazifop (=D171), fluazifop-P (=D172), fluazifop-butyl(=D173), fluazifop-P-butyl (= D174), glufosinate (= D208), glufosinate-ammonium (= D209), glufosinate-P (=D210), glufosinate-P-ammonium (= D21 1), glufosinate-P-sodium (= D212), glyphosate (= D213), glyphosate-isopropylammonium (= D214), haloxyfop (= D217), haloxyfop-P (= D218), haloxyfop-ethoxyethyl (= D219), haloxyfop-P-ethoxyethyl (= D220), haloxyfop-methyl (= D221), haloxyfop-P-methyl (= D222), lenacil (= D244), metamiltron (= D264), phenmedipham (= D319), phenmedipham-ethyl (= D320), propaquizafop (= D341), quinmerac (= D363), quizalofop (= D365), quizalofop-ethyl (= D366), quizalofop-P (= D367), quizalofop-P-ethyl (= D368), quizalofop-P-tefuryl (= D369), sethoxydim (= D372).

[0064] Even more preferred further herbicides which differ from the ALS inhibitor herbicides belonging to the groups (A), (B), and (C) as defined above and to be applied according to the invention in connection with ALS inhibitor herbicides belonging to the groups (A), (B), and (C) are those belonging to the group of:

desmedipham (= D108), ethofumesate (= D154), glufosinate (= D208), glufosinate-ammonium (= D209), glufosinate-P (= D210), glufosinate-P-ammonium (= D211), glufosinate-P-sodium (= D212), glyphosate (= D213), glyphosate-isopropylammonium (= D214), lenacil (= D244), metamiltron (= D264), phenmedipham (= D319), phenmedipham-ethyl (= D320).

[0065] Mixtures containing ALS inhibitor herbicides and non-ALS inhibitor herbicides, compositions comprising mixtures of one or more ALS inhibitor herbicide(s) (compounds belonging to one or more of groups (A), (B) and (C)) and non-ALS inhibitor herbicide(s) (group (D) members; as defined above) that are of very particular interest in order to be used according to present invention for control of unwanted vegetation are.:

(A1-1) + (D108); (A1-1) + (D154); (A1-1) + (D208); (A1-1) + (D209);

(A1-1) + (D210); (A1-1) + (D212); (A1-1) + (D213); (A1-1) + (D214);

(A1-1) + (D244); (A1-1) + (D264); (A1-1) + (D319); (A1-1) + (D320).

(A1-13) + (D108); (A1-13) + (D154); (A1-13) + (D208); (A1-13) + (D209);

(A1-13) + (D210); (A1-13) + (D212); (A1-13) + (D213); (A1-13) + (D214);

(A1-13) + (D244); (A1-13) + (D264); (A1-13) + (D319); (A1-13) + (D320).

(A1-16) + (D108); (A1-16) + (D154); (A1-16) + (D208); (A1-16) + (D209);

(A1-16) + (D210); (A1-16) + (D212); (A1-16) + (D213); (A1-16) + (D214);

(A1-16) + (D244); (A1-16) + (D264); (A1-16) + (D319); (A1-16) + (D320).

(A1-39) + (D108); (A1-39) + (D154); (A1-39) + (D208); (A1-39) + (D209);

(A1-39) + (D210); (A1-39) + (D212); (A1-39) + (D213); (A1-39) + (D214);

(A1-39) + (D244); (A1-39) + (D264); (A1-39) + (D319); (A1-39) + (D320).

(A1-41) + (D108); (A1-41) + (D154); (A1-41) + (D208); (A1-41) + (D209);
 (A1-41) + (D210); (A1-41) + (D212); (A1-41) + (D213); (A1-41) + (D214);
 (A1-41) + (D244); (A1-41) + (D264); (A1-41) + (D319); (A1-41) + (D320).
 (A1-83) + (D108); (A1-83) + (D154); (A1-83) + (D208); (A1-83) + (D209);
 (A1-83) + (D210); (A1-83) + (D212); (A1-83) + (D213); (A1-83) + (D214);
 (A1-83) + (D244); (A1-83) + (D264); (A1-83) + (D319); (A1-83) + (D320).
 (A1-87) + (D108); (A1-87) + (D154); (A1-87) + (D208); (A1-87) + (D209);
 (A1-87) + (D210); (A1-87) + (D212); (A1-87) + (D213); (A1-87) + (D214);
 (A1-87) + (D244); (A1-87) + (D264); (A1-87) + (D319); (A1-87) + (D320).
 (A2-3) + (D108); (A2-3) + (D154); (A2-3) + (D208); (A2-3) + (D209);
 (A2-3) + (D210); (A2-3) + (D212); (A2-3) + (D213); (A2-3) + (D214);
 (A2-3) + (D244); (A2-3) + (D264); (A2-3) + (D319); (A2-3) + (D320).
 (B1-2) + (D108); (B1-2) + (D154); (B1-2) + (D208); (B1-2) + (D209);
 (B1-2) + (D210); (B1-2) + (D212); (B1-2) + (D213); (B1-2) + (D214);
 (B1-2) + (D244); (B1-2) + (D264); (B1-2) + (D319); (B1-2) + (D320).
 (C1-1) + (D108); (C1-1) + (D154); (C1-1) + (D208); (C1-1) + (D209);
 (C1-1) + (D210); (C1-1) + (D212); (C1-1) + (D213); (C1-1) + (D214);
 (C1-1) + (D244); (C1-1) + (D264); (C1-1) + (D319); (C1-1) + (D320).

[0066] The application of ALS inhibitor herbicides also act efficiently on perennial weeds which produce shoots from rhizomes, root stocks and other perennial organs and which are difficult to control. Here, the substances can be applied, for example, by the pre-sowing method, the pre-emergence method or the post-emergence method, for example jointly or separately. Preference is given, for example, to application by the post-emergence method, in particular to the emerged harmful plants.

[0067] Specific examples may be mentioned of some representatives of the monocotyledonous and dicotyledonous weed flora which can be controlled by the ALS inhibitor herbicides, without the enumeration being restricted to certain species.

[0068] Examples of weed species on which the application according to present invention act

efficiently are, from amongst the monocotyledonous weed species, *Avena* spp., *Alopecurus* spp., *Apera* spp., *Brachiaria* spp., *Bromus* spp., *Digitaria* spp., *Lolium* spp., *Echinochloa* spp., *Panicum* spp., *Phalaris* spp., *Poa* spp., *Setaria* spp. and also *Cyperus* species from the annual group, and, among the perennial species, *Agropyron*, *Cynodon*, *Imperata* and *Sorghum* and also perennial *Cyperus* species.

[0069] In the case of the dicotyledonous weed species, the spectrum of action extends to genera such as, for example, *Abutilon* spp., *Amaranthus* spp., *Chenopodium* spp., *Chrysanthemum* spp., *Galium* spp., *Ipomoea* spp., *Kochia* spp., *Lamium* spp., *Matricaria* spp., *Pharbitis* spp., *Polygonum* spp., *Sida* spp., *Sinapis* spp., *Solanum* spp., *Stellaria* spp., *Veronica* spp. and *Viola* spp., *Xanthium* spp., among the annuals, and *Convolvulus*, *Cirsium*, *Rumex* and *Artemisia* in the case of the perennial weeds.

[0070] It is preferred that the *Beta vulgaris* plant, preferably sugar beet plant, to which one or more ALS inhibitor herbicide(s) alone or in combination with one or more herbicide(s) that do(es) not belong to the class of ALS inhibitor herbicides are applied for control of unwanted vegetation in *Beta vulgaris*, preferably in sugar beet, growing areas in which *Beta vulgaris* plants, preferably sugar beet, comprise mutations in the ALS gene thereby encoding an ALS polypeptide having an amino acid that is different from the naturally occurring tryptophan at position 569 and having an amino acid that is different from the naturally occurring proline at position 188, is orthoploid or anorthoploid. Herein, an orthoploid plant may preferably be haploid, diploid, tetraploid, hexaploid, octaploid, decaploid or dodecaploid, while an anorthoploid plant may preferably be triploid or pentaploid.

[0071] As used herein unless clearly indicated otherwise, the term "plant" intended to mean a plant at any developmental stage.

[0072] It might be, that - depending on the respective genetic background - *Beta vulgaris* plants of the same genetic background in which such mutation is only heterozygously present, the herbicide tolerant *Beta vulgaris* plants which are homozygous for the non-transgenic mutation of the endogenous ALS gene reveal a better agronomical level of ALS inhibitor herbicide tolerance.

[0073] In this context "homozygous" indicates that a plant of the present invention has two copies of the same allele on different DNA strands, in particular at the ALS gene locus.

[0074] Accordingly, when used herein the term "heterozygous" or "heterozygously" means that a plant of the present invention has different alleles at a particular locus, in particular at the ALS gene locus.

[0075] Therefore, the present invention relates to the use of one or more ALS inhibitor herbicide(s) alone or in combination with one or more non-ALS inhibitor herbicide(s) for weed control in *Beta vulgaris*, preferably in sugar beet, growing areas in which the *Beta vulgaris* plants, preferably sugar beet plants, comprise mutations in the codon of an endogenous ALS

gene encoding an ALS protein containing (i) an amino acid that is different from tryptophan at position 569, preferably the tryptophan of the wild-type ALS protein is substituted by a leucine at position 569, and (ii) an amino acid that is different from proline at position 188, preferably the proline of the wild-type ALS protein is substituted by a serine at position 188. These mutations of the endogeneous ALS gene can be heterozygously present, and can preferably be the only two mutations of the ALS gene. More preferably, the respective mutations can be homozygously present, and most preferably, the respective mutation is homozygously present as the only two mutations of the endogenous ALS gene.

[0076] Owing to their herbicidal and plant growth-regulatory properties, ALS inhibitor herbicides belonging to one or more of the groups (A), (B), and (C) either alone or in combination with non-ALS inhibitor herbicides can be employed for controlling harmful plants in known *Beta vulgaris*, preferably sugar beet plants but also in tolerant or genetically modified crop plants that do already exist or need still to be developed. In general, the transgenic plants are distinguished by specific advantageous properties, in addition to tolerances to the ALS inhibitor herbicides according to the invention, for example, by tolerances to non-ALS inhibitor herbicides, resistances to plant diseases or the causative organisms of plant diseases such as certain insects or microorganisms, such as fungi, bacteria or viruses. Other specific characteristics relate, for example, to the harvested material with regard to quantity, quality, storability, composition and specific constituents. Thus, transgenic plants are known whose starch content is increased, or whose starch quality is altered, or those where the harvested material has a different fatty acid composition.

[0077] Conventional methods of generating novel plants which have modified properties in comparison to plants occurring to date consist, for example, in traditional breeding methods and the generation of mutants. Alternatively, novel plants with altered properties can be generated with the aid of recombinant methods (see, for example, EP-A-0221044, EP-A-0131624). For example, the following have been described in several cases:

- the modification, by recombinant technology, of crop plants with the aim of modifying the starch synthesized in the plants (for example WO 92/11376, WO 92/14827, WO 91/19806),
- transgenic crop plants which exhibit tolerance to non-ALS inhibitor herbicides,
- transgenic crop plants with the capability of producing *Bacillus thuringiensis* toxins (Bt toxins), which make the plants resistant to certain pests (EP-A-0142924, EP-A-0193259),
- transgenic crop plants with a modified fatty acid composition (WO 91/13972).

[0078] A large number of techniques in molecular biology are known in principle with the aid of which novel transgenic plants with modified properties can be generated; see, for example, Sambrook et al., 1989, *Molecular Cloning, A Laboratory Manual*, 2nd Edition, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY; or Winnacker "Gene und Klone", VCH Weinheim 2nd Edition 1996 or Christou, "Trends in Plant Science" 1 (1996) 423-431).

[0079] To carry out such recombinant manipulations, nucleic acid molecules which allow mutagenesis or sequence changes by recombination of DNA sequences can be introduced into plasmids. For example, the abovementioned standard methods allow base exchanges to be carried out, subsequences to be removed, or natural or synthetic sequences to be added. To connect the DNA fragments to each other, adapters or linkers may be added to the fragments.

[0080] For example, the generation of plant cells with a reduced activity of a gene product can be achieved by expressing at least one corresponding antisense RNA, a sense RNA for achieving a cosuppression effect or by expressing at least one suitably constructed ribozyme which specifically cleaves transcripts of the abovementioned gene product.

[0081] To this end, it is possible to use DNA molecules which encompass the entire coding sequence of a gene product inclusive of any flanking sequences which may be present, and also DNA molecules which only encompass portions of the coding sequence, it being necessary for these portions to be long enough to have an antisense effect in the cells. The use of DNA sequences which have a high degree of homology to the coding sequences of a gene product, but are not completely identical to them, is also possible.

[0082] When expressing nucleic acid molecules in plants, the protein synthesized can be localized in any desired compartment of the plant cell. However, to achieve localization in a particular compartment, it is possible, for example, to link the coding region with DNA sequences which ensure localization in a particular compartment. Such sequences are known to those skilled in the art (see, for example, Braun et al., EMBO J. 11 (1992), 3219-3227; Wolter et al., Proc. Natl. Acad. Sci. USA 85 (1988), 846-850; Sonnewald et al., Plant J. 1 (1991), 95-106).

[0083] The transgenic plant cells can be regenerated by known techniques to give rise to entire plants. Thus, transgenic *Beta vulgaris* plants, preferably sugar beet plants can be obtained whose properties are altered by overexpression, suppression or inhibition of homologous (= natural) genes or gene sequences or the expression of heterologous (= foreign) genes or gene sequences.

[0084] The present invention furthermore provides a method for controlling unwanted vegetation in the above-mentioned mutated *Beta vulgaris* plants, preferably in sugar beet, which comprises applying one or more ALS inhibitor herbicides belonging to groups (A), (B) and/or (C) to the plants (for example harmful plants, such as monocotyledonous or dicotyledonous weeds or unwanted crop plants), the seed (seeds or vegetative propagation organs, such as tubers or shoot parts) or to the area in which the plants grow (for example the area under cultivation), for example together or separately.

[0085] The present invention furthermore provides a method for controlling unwanted vegetation in said *Beta vulgaris* plants, preferably in sugar beet, which comprises applying one

or more ALS inhibitor herbicide(s) belonging to groups (A), (B) and/or (C) alone or in combination with non-ALS inhibitor herbicides belonging to class (D) compound according to the invention to the plants (for example harmful plants, such as monocotyledonous or dicotyledonous weeds or unwanted crop plants), the seed (seeds or vegetative propagation organs, such as tubers or shoot parts) or to the area in which the plants grow (for example the area under cultivation), for example together or separately. One or more non-ALS inhibitor herbicides may be applied in combination with one or more ALS inhibitor herbicide(s) before, after or simultaneously with the ALS inhibitor herbicide(s) to the plants, the seed or the area in which the plants grow (for example the area under cultivation).

[0086] "Unwanted plants" or "unwanted vegetation" are to be understood as meaning all plants which grow in locations where they are unwanted. This can, for example, be harmful plants (for example monocotyledonous or dicotyledonous weeds or unwanted crop plants).

[0087] Attached Sequences (SEQ.ID.NOs: 1 to 8)

SEQ.ID.NOs: 1 and 7 represent wild-type nucleic acid sequences of sugar beet.

SEQ.ID.NOs: 2 and 8 represent the ALS protein sequences encoded by the SEQ.ID.NOs: 1 and 7, respectively.

SEQ.ID.NO:3 represents the nucleic acid sequence of a mutated ALS gene encoding sugar beet ALS protein comprising a Trp→ Leu mutation.

SEQ.ID.NO:4 represents the Trp→ Leu mutated ALS protein at position 569 which is encoded by nucleic acid sequence SEQ.ID.NO:3.

SEQ.ID.NO:5 represents the nucleic acid sequence of a mutated ALS gene encoding sugar beet ALS protein comprising a Pro→ Ser mutation.

SEQ.ID.NO:6 represents the Pro→ Ser mutated ALS protein at position 188 which is encoded by nucleic acid sequence SEQ.ID.NO:5.

[0088] Preferably, (one allele of) the ALS gene of a Beta vulgaris plant, preferably a sugar beet plant used in the context of the present invention corresponds to SEQ.ID.NO:3 or SEQ.ID.NO:5.

[0089] Preferably, a Beta vulgaris plant, preferably a sugar beet plant used in the context of the present comprises SEQ.ID.NO:3 (in one allele) and/or SEQ.ID.NO:5 (in the second allele), more preferably, a Beta vulgaris plant, preferably a sugar beet plant used in the context of the present comprises SEQ.ID.NO:3 in one allele and SEQ.ID.NO:5 in the second allele.

[0090] Alternatively, a Beta vulgaris plant, preferably a sugar beet plant used in the context of the present invention comprises SEQ.ID.NO:3 (or SEQ.ID.NO:4) and/or SEQ.ID.NO:5 (or

SEQ.ID.NO:6).

[0091] Alternatively, a *Beta vulgaris* plant, preferably a sugar beet plant used in the context of the present invention comprises SEQ.ID.NO:3 (in one allele) and either SEQ.ID.NO:1, or SEQ.ID.NO:7 (in the second allele).

[0092] Such mutated sugar beet plants are resistant to one or several ALS inhibitor(s) used, such as a sulfonylurea (e.g. foramsulfuron) and advantageously additionally to other ALS inhibitor(s), preferably selected from the group consisting of iodossulfuron, amidosulfuron and thienncarbazone-methyl.

[0093] In a preferred embodiment according to the present invention relates to a use according to the present invention (as defined hereinbefore) and a corresponding method (as defined hereinbefore), wherein the *Beta vulgaris* plants correspond to the deposit under NCIMB 42050.

[0094] The herbicide combinations to be used according to the invention can be prepared by known processes, for example as mixed formulations of the individual components, if appropriate with further active compounds, additives and/or customary formulation auxiliaries, which combinations are then applied in a customary manner diluted with water, or as tank mixes by joint dilution of the components, formulated separately or formulated partially separately, with water. Also possible is the split application of the separately formulated or partially separately formulated individual components.

[0095] It is also possible to apply ALS inhibitor herbicides or the combination comprising ALS inhibitor herbicide(s) and non-ALS inhibitor herbicide(s) in a plurality of portions (sequential application) using, for example, pre-emergence applications followed by post-emergence applications or using early post-emergence applications followed by medium or late post-emergence applications. Preference is given here to the joint or almost simultaneous application of the active compounds of the combination in question.

[0096] The herbicides belonging to any of the above defined groups (A), (B), (C) and (D) and to be applied according to present invention can be converted jointly or separately into customary formulations, such as solutions, emulsions suspensions, powders, foams, pastes, granules, aerosols, natural and synthetic materials impregnated with active compound and microencapsulations in polymeric materials. The formulations may comprise the customary auxiliaries and additives.

[0097] These formulations are produced in a known manner, for example by mixing the active compounds with extenders, that is liquid solvents, pressurized liquefied gases and/or solid carriers, if appropriate with the use of surfactants, that is emulsifiers and/or dispersants, and/or foam formers.

[0098] If the extender used is water, it is also possible to use, for example, organic solvents as

auxiliary solvents. Suitable liquid solvents are essentially: aromatics, such as xylene, toluene, alkylnaphthalenes, chlorinated aromatics or chlorinated aliphatic hydrocarbons, such as chlorobenzenes, chloroethylenes, or methylene chloride, aliphatic hydrocarbons, such as cyclohexane or paraffins, for example mineral oil fractions, mineral and vegetable oils, alcohols, such as butanol or glycol, and ethers and esters thereof, ketones, such as acetone, methyl ethyl ketone, methyl isobutyl ketone or cyclohexanone, strongly polar solvents, such as dimethylformamide or dimethyl sulfoxide, and also water.

[0099] Suitable solid carriers are: for example ammonium salts and ground natural minerals, such as kaolins, clays, talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth, and ground synthetic minerals, such as finely divided silica, alumina and silicates; suitable solid carriers for granules are: for example crushed and fractionated natural rocks, such as calcite, marble, pumice, sepiolite and dolomite, and also synthetic granules of inorganic and organic meals, and granules of organic material, such as sawdust, coconut shells, corn cobs and tobacco stalks; suitable emulsifiers and/or foam formers are: for example nonionic and anionic emulsifiers, such as polyoxyethylene fatty acid esters, polyoxyethylene fatty alcohol ethers, for example alkylaryl polyglycol ethers, alkylsulfonates, alkyl sulfates, arylsulfonates and also protein hydrolysates; suitable dispersants are: for example lignosulfite waste liquors and methylcellulose.

[0100] Tackifiers such as carboxymethylcellulose and natural and synthetic polymers in the form of powders, granules or latices, such as gum arabic, polyvinyl alcohol and polyvinyl acetate, and also natural phospholipids, such as cephalins and lecithins and synthetic phospholipids, can be used in the formulations. Other possible additives are mineral and vegetable oils.

[0101] The herbicidal action of the herbicide combinations to be used according to the invention can be improved, for example, by surfactants, preferably by wetting agents from the group of the fatty alcohol polyglycol ethers. The fatty alcohol polyglycol ethers preferably comprise 10 - 18 carbon atoms in the fatty alcohol radical and 2 - 20 ethylene oxide units in the polyglycol ether moiety. The fatty alcohol polyglycol ethers may be present in nonionic form, or ionic form, for example in the form of fatty alcohol polyglycol ether sulfates, which may be used, for example, as alkali metal salts (for example sodium salts and potassium salts) or ammonium salts, or even as alkaline earth metal salts, such as magnesium salts, such as C₁₂/C₁₄-fatty alcohol diglycol ether sulfate sodium (Genapol® LRO, Clariant GmbH); see, for example, EP-A-0476555, EP-A-0048436, EP-A-0336151 or US-A-4,400,196 and also Proc. EWRS Symp. "Factors Affecting Herbicidal Activity and Selectivity", 227 - 232 (1988). Nonionic fatty alcohol polyglycol ethers are, for example, (C₁₀-C₁₈)-, preferably (C₁₀-C₁₄)-fatty alcohol polyglycol ethers (for example isotridecyl alcohol polyglycol ethers) which comprise, for example, 2 - 20, preferably 3 - 15, ethylene oxide units, for example those from the Genapol® X-series, such as Genapol® X-030, Genapol® X-060, Genapol® X-080 or Genapol® X-150 (all from Clariant GmbH).

[0102] The present invention further comprises the combination of ALS inhibitor herbicides

belonging to any of the groups (A), (B), and (C) according to present invention with the wetting agents mentioned above from the group of the fatty alcohol polyglycol ethers which preferably contain 10 - 18 carbon atoms in the fatty alcohol radical and 2 - 20 ethylene oxide units in the polyglycol ether moiety and which may be present in nonionic or ionic form (for example as fatty alcohol polyglycol ether sulfates). Preference is given to C₁₂/C₁₄-fatty alcohol diglycol ether sulfate sodium (Genapol® LRO, Clariant GmbH) and isotridecyl alcohol polyglycol ether having 3 - 15 ethylene oxide units, for example from the Genapol® X-series, such as Genapol® X-030, Genapol® X-060, Genapol® X-080 and Genapol® X-150 (all from Clariant GmbH). Furthermore, it is known that fatty alcohol polyglycol ethers, such as nonionic or ionic fatty alcohol polyglycol ethers (for example fatty alcohol polyglycol ether sulfates) are also suitable for use as penetrants and activity enhancers for a number of other herbicides (see, for example, EP-A-0502014).

[0103] Furthermore, it is known that fatty alcohol polyglycol ethers, such as nonionic or ionic fatty alcohol polyglycol ethers (for example fatty alcohol polyglycol ether sulfates) are also suitable for use as penetrants and activity enhancers for a number of other herbicides (see, for example, EP-A-0502014).

[0104] The herbicidal action of the herbicide combinations according to the invention can also be enhanced by using vegetable oils. The term vegetable oils is to be understood as meaning oils of oleaginous plant species, such as soybean oil, rapeseed oil, corn oil, sunflower oil, cottonseed oil, linseed oil, coconut oil, palm oil, thistle oil or castor oil, in particular rapeseed oil, and also their transesterification products, for example alkyl esters, such as rapeseed oil methyl ester or rapeseed oil ethyl ester.

[0105] The vegetable oils are preferably esters of C₁₀-C₂₂-, preferably C₁₂-C₂₀-, fatty acids. The C₁₀-C₂₂-fatty acid esters are, for example, esters of unsaturated or saturated C₁₀-C₂₂-fatty acids, in particular those having an even number of carbon atoms, for example erucic acid, lauric acid, palmitic acid and in particular C₁₈-fatty acids, such as stearic acid, oleic acid, linoleic acid or linolenic acid.

[0106] Examples of C₁₀-C₂₂-fatty acid esters are esters obtained by reacting glycerol or glycol with the C₁₀-C₂₂-fatty acids contained, for example, in oils of oleaginous plant species, or C₁-C₂₀-alkyl-C₁₀-C₂₂-fatty acid esters which can be obtained, for example, by transesterification of the aforementioned glycerol- or glycol-C₁₀-C₂₂-fatty acid esters with C₁-C₂₀-alcohols (for example methanol, ethanol, propanol or butanol). The transesterification can be carried out by known methods as described, for example, in Römpp Chemie Lexikon, 9th edition, Volume 2, page 1343, Thieme Verlag Stuttgart.

[0107] Preferred C₁-C₂₀-alkyl-C₁₀-C₂₂-fatty acid esters are methyl esters, ethyl esters, propyl esters, butyl esters, 2-ethylhexyl esters and dodecyl esters. Preferred glycol- and glycerol-C₁₀-C₂₂-fatty acid esters are the uniform or mixed glycol esters and glycerol esters of C₁₀-C₂₂-fatty

acids, in particular fatty acids having an even number of carbon atoms, for example erucic acid, lauric acid, palmitic acid and, in particular, C₁₈-fatty acids, such as stearic acid, oleic acid, linoleic acid or linolenic acid.

[0108] In the herbicidal compositions to be used according to the invention, the vegetable oils can be present, for example, in the form of commercially available oil-containing formulation additives, in particular those based on rapeseed oil, such as Hasten® (Victorian Chemical Company, Australia, hereinbelow referred to as Hasten, main ingredient: rapeseed oil ethyl ester), Actirob®B (Novance, France, hereinbelow referred to as ActirobB, main ingredient: rapeseed oil methyl ester), Rako-Binol® (Bayer AG, Germany, hereinbelow referred to as Rako-Binol, main ingredient: rapeseed oil), Renol® (Stefes, Germany, hereinbelow referred to as Renol, vegetable oil ingredient: rapeseed oil methyl ester) or Stefes Mero® (Stefes, Germany, hereinbelow referred to as Mero, main ingredient: rapeseed oil methyl ester).

[0109] In a further embodiment, herbicidal combinations to be used according to present invention can be formulated with the vegetable oils mentioned above, such as rapeseed oil, preferably in the form of commercially available oil-containing formulation additives, in particular those based on rapeseed oil, such as Hasten® (Victorian Chemical Company, Australia, hereinbelow referred to as Hasten, main ingredient: rapeseed oil ethyl ester), Actirob®B (Novance, France, hereinbelow referred to as ActirobB, main ingredient: rapeseed oil methyl ester), Rako-Binol® (Bayer AG, Germany, hereinbelow referred to as Rako-Binol, main ingredient: rapeseed oil), Renol® (Stefes, Germany, hereinbelow referred to as Renol, vegetable oil ingredient: rapeseed oil methyl ester) or Stefes Mero® (Stefes, Germany, hereinbelow referred to as Mero, main ingredient: rapeseed oil methyl ester).

[0110] It is possible to use colorants, such as inorganic pigments, for example iron oxide, titanium oxide, Prussian Blue, and organic dyes, such as alizarin dyes, azo dyes and metal phthalocyanine dyes, and trace nutrients such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc.

[0111] The formulations to be used according to present invention generally comprise from 0.1 to 95% by weight of active compounds, preferably from 0.5 to 90% by weight.

[0112] As such or in their formulations, the ALS inhibitor herbicides belonging to any of the above defined groups (A), (B), and (C) can also be used as a mixture with other agrochemically active compounds, such as known non-ALS inhibitor herbicides, for controlling unwanted vegetation, for example for controlling weeds or for controlling unwanted crop plants, finished formulations or tank mixes, for example, being possible.

[0113] The use of a mixture of ALS inhibitor herbicides belonging to any of the above defined groups (A), (B), and (C) with other known active compounds, such as fungicides, insecticides, acaricides, nematocides, safeners, bird repellants, plant nutrients and soil structure improvers is likewise possible.

[0114] The ALS inhibitor herbicides belonging to any of the above defined groups (A), (B), (C) can be used as such, in the form of their formulations or in the use forms prepared therefrom by further dilution, such as ready-to-use solutions, suspensions, emulsions, powders, pastes and granules. Application is carried out in a customary manner, for example by watering, spraying, atomizing, broadcasting.

[0115] According to the invention, one or more of the ALS inhibitor herbicides belonging to any of the above defined groups (A), (B), and (C) can be applied either alone or in combination with one or more non-ALS inhibitor herbicides belonging to group (D) to the plants (for example harmful plants, such as monocotyledonous or dicotyledonous weeds or unwanted crop plants), the seed (for example grains, seeds or vegetative propagation organs, such as tubers or shoot parts with buds) or the area under cultivation (for example the soil), preferably to the green plants and parts of plants and, if appropriate, additionally the soil. One possible use is the joint application of the active compounds in the form of tank mixes, where the optimally formulated concentrated formulations of the individual active compounds are, together, mixed in a tank with water, and the spray liquor obtained is applied.

Biological examples

[0116] Selection for obtaining ALS inhibitor tolerant *Beta vulgaris* plants for use in the context of the present invention The making, selection and propagation of the respective ALS inhibitor herbicide tolerant *Beta vulgaris* mutants and their progenies that were used in all the biological examples disclosed subsequently is described in detail in the European Patent Application 12196858.0 (Bayer CropScience AG being co-applicant) having the title "Method to develop herbicide-resistant sugar beet plants" which was filed on 13.12.2012 at the European Patent Office and which subsequently was published as part of WO 2014/091021 A1. Therefore, these respective techniques concerning the preparation of such ALS inhibitor herbicide tolerant *Beta vulgaris* mutants, especially sugar beet mutants comprising mutations in the endogenous ALS gene encoding an ALS polypeptide containing an amino acid that is different from tryptophan at position 569 and an amino acid that is different from proline at position 188 are described herein only in brief and the content of the above cited European Patent Application 12196858.0 is referenced in its entirety.

[0117] A suitable method for producing a sugar beet mutant being resistant to one or more inhibitor(s) of the acetohydroxyacid synthase enzyme (ALS) for use in the context of the present invention preferably comprises the steps of:

- obtaining protoplasts from stomatal guard cells isolated from a sugar beet plant;
- applying to an *in vitro* culture of the said protoplasts a composition comprising one or more ALS inhibitor(s) at a concentration that is lethal to more than 99.9% of the *in vitro* cultured cells (yet allowing some mutants to escape); and
- regenerating sugar beet plants from the surviving cells of the said *in vitro* cultured cells,

wherein the said stomatal guard cells protoplasts are pre selected for their capacity to regenerate into a sugar beet plant and/or wherein the said ALS inhibitor(s) is/are applied to more than 2 000 000 of the said protoplasts, said method preferably comprising the sub-steps of isolating stomatal guard cells protoplasts from sugar beet plants of different genotypes and measuring for each genotype the proportion of the said protoplasts that is growing when the said protoplasts are put in culture.

[0118] It can be stated that this method is very useful to develop plants having evolved mutations causing a resistance to an herbicide, especially since this method does not involve the use of foreign DNA and/or the introduction of DNA vectors encoding genetic elements already known to confer resistance to ALS inhibitors.

Example 1 Selection of sugar beet genotypes (lines) for well-regenerating protoplasts

[0119] Because mutated sugar beet were successfully generated in the art (e.g. WO 98/02527) upon the addition of ALS herbicide to calli being explants from wild-type sugar beet, firstly the sugar beet genotype (line) derived from the line of WO 98/02527 was selected and protoplasts from their stomatal guard cells isolated therefrom. Several millions of these protoplasts were isolated as described in WO 95/10178, placed in culture medium comprising alginate, and treated with MS culture medium comprising 10^{-9} to 10^{-6} mol/l foramsulfuron.

[0120] By using the approach as described in WO 98/02527 and WO 95/10178 several sugar beet plant genotypes were compared for their capacity of regeneration from stomatal guard cells protoplasts. As a result, a genotype was selected having more than 0.25% of stomatal guard cells protoplasts that are able to grow *in vitro*.

Example 2 Herbicide treatment of protoplasts

[0121] Subsequently, the same approach as described in WO 98/02527 and WO 95/10178 was applied, but relying on well growing stomatal guard cells protoplasts (as identified in Example 1; other sugar beet plants having a high proportion of growing stomatal guard cell protoplasts).

[0122] By treating about 68 millions of well-growing stomatal guard cell protoplasts with an ALS herbicide composition comprising up to 10^{-6} M foramsulfuron, a total of 46 calli were obtained.

[0123] One regenerated plant showed a mutation in the ALS gene: a mutation in the codon for tryptophan at position 569 (corresponding to tryptophan at position 574 in *Arabidopsis thaliana*). The two alleles of the ALS genes of this mutant are encoded by SEQ.ID.NO:3 and SEQ.ID.NO:7. Other grown calli were sequenced and have mutations in the ALS gene,

(including mutations at other positions) but did not regenerate into a plant.

[0124] Obtained seeds, containing the tryptophan to leucin mutation at position 569 and the proline to serine mutation at position 188 of the ALS protein encoded by the endogenous sugar beet ALS gene have been deposited with the NCIMB, Aberdeen, UK, under Number NCIMB 42050 (Bayer CropScience AG being co-depositor).

Example 3 ALS inhibitor treatment of sugar beets

[0125] The behaviour of regenerated sugar beet plants having the mutated SEQ.ID.NO:3 (heterozygote for this mutation) and a wild-type sugar beet commercial variety was compared.

[0126] The (heterozygote) mutated variety showed good resistance to foramsulfuron (12.5 g/ha; up to 3 applications), even when the herbicide has been combined with an organic compound (25 g/ha rapeseed oil methyl ester) to boost its effect.

[0127] As expected, the wild-type plant was very sensitive to foramsulfuron, even after the first application.

[0128] The same experiment was performed using amidosulfuron (15 g /ha), and yielded the same level of resistance in the mutated plants.

[0129] On the other hand, the wild-type plants were very sensitive to amidosulfuron, especially when combined with the organic compound, and/or after several applications of amidosulfuron.

[0130] The same experiment was performed using iodosulfuron (3.5 g/ha), and demonstrated a good level of resistance in the mutated plants when iodosulfuron was added, but this resistance declined when iodosulfuron is applied together with the organic compound.

[0131] As expected, the wild-type plant was very sensitive to iodosulfuron even after one application and without the organic compound.

[0132] The same experiment was performed using 7.5 g/ha thien carbazone-methyl, and yielded about the same level of resistance as for iodosulfuron in the mutated plants.

[0133] The wild-type plant was very sensitive to thien carbazone-methyl at all the tested concentrations and regardless of the addition of the organic compound.

[0134] It can be concluded that, by comparison to the wild-type, the mutated sugar beet plant comprising SEQ.ID.NO:3 (deposited under the Budapest Treaty NCIMB 42051) offers the best resistance against foramsulfuron.

[0135] It can further be concluded that this (heterozygote) mutated plant has further acquired

some (although partial) resistance towards other ALS inhibitors, including towards inhibitors belonging to other chemical classes.

Example 4 ALS inhibitor treatment of sugar beets having further mutations in the ALS gene

[0136] Subsequently, a mutated sugar beet plant was developed comprising SEQ.ID.NO:3 and SEQ.ID.NO:5 (on two different alleles). Such resulting dual mutant has been deposited under the Budapest Treaty under NCIMB 42050. A plant comprising both SEQ.ID.NO:3 and SEQ.ID.NO:5 can be generated by relying on several techniques, including, for instance, a subsequent mutagenesis step applied to the single mutant NCIMB 42051.

[0137] Then the resistance of this dual mutant plant (a mutation in one allele at amino acid 569 and a mutation in the other allele at amino acid 188) was compared with with the single mutant (a mutation at position 569) sugar beet.

[0138] The dual mutant plant line at least keeps all the resistance features as in Example 3, and has also acquired a good resistance (compatible with field application) towards thien carbazon-methyl and towards amidosulfuron treatments, even when put in composition with organic compounds.

[0139] Therefore, this dual mutant plant displays improved, synergistic, resistance towards several ALS inhibitors by comparison to the resistance attributed to the single mutant plant (at position 569 in the ALS gene).

Example 5 Greenhouse trials: ALS inhibitor treatment of different sugar beets in direct comparison

[0140] Mutated sugar beet plants comprising SEQ.ID.NO:3 and SEQ.ID.NO:5 (on two different alleles) for use in the context of the present invention (as described in Example 4 above, "Line A") were treated with different ALS inhibitors in direct comparison with sugar beet plants where the tryptophan at position 569 of the encoded ALS enzyme is substituted by a leucine ("Line B"), with sugar beet plants described in WO 98/02527 where the proline at position 188 of the encoded ALS enzyme is substituted by a serine ("Line C"), and a traditional variety (wild-type) sugar beet plant not having a mutation at positions 569 and 188 ("Line WT").

[0141] Several groups of seeds of the four different mentioned sugar beet plants were sown separately in the greenhouse and grew up to stage BBCH 14 for *Beta vulgaris* L. *ssp. vulgaris* (i.e. 4 leaves (the second pair) unfolded) according to the BBCH monograph "Growth stages of mono- and dicotyledonous plants", 2nd edition, 2001, ed. Uwe Meier, Federal Biological Research Centre for Agriculture and Forestry (Biologische Bundesanstalt für Land und

Forstwirtschaft). Subsequently, the resulting separate groups of sugar beet plants were each individually treated with an ALS inhibitor (ALS-in) in the amounts (g/ha) indicated in Table 1.

[0142] On day 14 after application of the respective ALS inhibitor, the damage (i.e. the phytotoxicity) for each group of sugar beet plants was rated on a stratified scale from 0% (i.e. no damage, no phytotoxicity) to 100% (i.e. the plants were completely killed). The average rating for each group of plants is also shown in Table 1.

Table 1:

ALS-in	ALS-in g/ha	Line A	Line B	Line C	Line WT
Foramsulfuron	13	26.9%	45.6%	77.5%	80.0%
Iodosulfuron-methyl-Na	3.5	22.5%	38.8%	80.0%	82.5%
Amidosulfuron	15	6.3%	37.5%	51.9%	73.1%
Thiencarbazone-methyl	7.5	8.1%	35.6%	37.5%	84.4%
Bisbyribac-Na	50	17.5%	38.1%	71.7%	80.0%
Metosulam	15	13.1%	40.6%	69.4%	79.4%

[0143] According to the data shown in Table 1, it can clearly be demonstrated that the sugar beet plants of "Line A" were markedly more tolerant to the application of various ALS inhibitor herbicides, i.e. tolerance has been demonstrated to representative ALS inhibitor herbicides, whereas the conventional variety, i.e. the wild-type ("Line WT"), was significantly damaged under identical conditions.

[0144] Additionally, typical early phenotypes of each sugar beet plants were inspected after treatment with a mixture comprising thiencarbazone-methyl and foramsulfuron. A representative early phenotype of each Line is shown in Figure 1 (Fig. 1).

[0145] Fig. 1 also demonstrates that the sugar beet plants particularly suitable for use in the context of the present invention ("Line A") show superior ALS inhibitor herbicide resistance, i.e. superior growth and less phytotoxic effects were observed in comparison to the other early phenotypes of "Line B", "Line C" and "Line WT".

SEQUENCE LISTING

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<120> Use of ALS inhibitors for resistant sugar beet mutants

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<160> 8

<170> PatentIn version 3.5

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Ser Arg Trp Arg Glu Glu Leu Gly Glu Gln Lys Lys Glu Phe Pro Leu

liability in this regard.

Patent documents cited in the description

- [US5378824A](#) [0011] [0016]
- [EP0360750A](#) [0014]
- [US5198599A](#) [0015]
- [US5013659A](#) [0016]
- [US5141870A](#) [0016]
- [WO9802526A](#) [0021]
- [WO9802527A](#) [0021] [0119] [0119] [0120] [0121] [0140]
- [WO2012049268A](#) [0022]
- [WO2012049266A](#) [0022]
- [WO2008124495A](#) [0023]
- [WO2009046334A](#) [0023] [0023]
- [EP239414A](#) [0026]
- [US4288244A](#) [0026]
- [DE3303388](#) [0026]
- [US5457085A](#) [0026]
- [US3120434A](#) [0026]
- [US3480671A](#) [0026]
- [EP206251A](#) [0026]
- [EP205271A](#) [0026]
- [US2556664A](#) [0026]
- [US3534098A](#) [0026]
- [EP053011A](#) [0026]
- [US4385927A](#) [0026]
- [EP348737A](#) [0026]
- [DE2822155](#) [0026]
- [US3894078A](#) [0026]
- [GB869169A](#) [0026]
- [EP447004A](#) [0026]
- [DE1039779](#) [0026]
- [HU176582](#) [0026]
- [US3442945A](#) [0026]
- [DE2305495](#) [0026]
- [DE2648008](#) [0026]
- [DE2328340](#) [0026]
- [DE1014380](#) [0026]
- [HU53483](#) [0026]
- [US4802907A](#) [0026]
- [GB1040541A](#) [0026]

- [US2903478A \[0026\]](#)
- [US3177061A \[0026\]](#)
- [US2695225A \[0026\]](#)
- [DE1567151 \[0026\]](#)
- [GB574995A \[0026\]](#)
- [DE1031571 \[0026\]](#)
- [US3175897A \[0026\]](#)
- [JP1098331A \[0026\]](#)
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- [US4746353A \[0026\]](#)
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- [US5009699A \[0026\]](#)
- [EP136061A \[0026\]](#)
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- [WO0230921A \[0026\]](#)
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- [WO9641537A \[0026\]](#)
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- [EP007677A \[0026\]](#)
- [CN01080116 \[0026\]](#)
- [US4789393A \[0026\]](#)
- [EP971902A \[0026\]](#)
- [US5209771A \[0026\]](#)
- [EP084020A \[0026\]](#)
- [EP120814A \[0026\]](#)
- [EP087780A \[0026\]](#)
- [WO8804297A \[0026\]](#)

- [EP5828924A \[0026\]](#)
- [WO0236595A \[0026\]](#)
- [US5476936A \[0026\]](#)
- [WO2009053058A \[0026\]](#)
- [US4906285A \[0028\]](#)
- [EP658549A \[0028\]](#)
- [US5118339A \[0028\]](#)
- [WO9105781A \[0028\]](#)
- [US4932999A \[0028\]](#)
- [EP315889A \[0028\]](#)
- [WO9309099A \[0029\]](#)
- [WO2006008159A \[0029\]](#)
- [WO2005096818A \[0029\]](#)
- [EP0221044A \[0077\]](#)
- [EP0131624A \[0077\]](#)
- [WO9211376A \[0077\]](#)
- [WO9214827A \[0077\]](#)
- [WO9119806A \[0077\]](#)
- [EP0142924A \[0077\]](#)
- [EP0193259A \[0077\]](#)
- [WO9113972A \[0077\]](#)
- [EP0476555A \[0101\]](#)
- [EP0048436A \[0101\]](#)
- [EP0336151A \[0101\]](#)
- [US4400196A \[0101\]](#)
- [EP0502014A \[0102\] \[0103\]](#)
- [EP12196858A \[0116\] \[0116\]](#)
- [WO2014091021A1 \[0116\]](#)
- [WO9510178A \[0119\] \[0120\] \[0121\]](#)

Non-patent literature cited in the description

- Genetics and Breeding of Sugar Beet Science Publishers 25-33 [0003]
- **UMBARGER, H.E.** Annu. Rev. Biochem., 1978, vol. 47, 533-606 [0005]
- **CHIMAN, D.M. et al.** Biochim. Biophys. Acta, 1998, vol. 1385, 401-419 [0005]
- **DUGGLEBY, R.G. PANG, S.S.J.** Biochem. Mol. Biol., 2000, vol. 33, 1-36 [0005]
- **DUGGLEBY, R.G.** Structure and Properties of Acetohydroxyacid Synthase in Thiamine: Catalytic Mechanisms Normal and Disease States, vol. 11, [0005]
- **BEYER E.M et al.** Sulfonylureas in Herbicides: Chemistry, Degradation, and Mode of Action Marcel Dekker 1988 0000117-189 [0005]

- **PONTZEN, R.** Pflanz.-Nachrichten Bayer, 2002, vol. 55, 37-52 [0005]
- **SHANER, D.L. et al.** Plant Physiol., 1984, vol. 76, 545-546 [0005]
- The Imidazolinone Herbicides CRC Press 19910000 [0005]
- **KLESCHICK, W.A. et al.** Agric. Food Chem., 1992, vol. 40, 1083-1085 [0005]
- **SHIMIZU, T.J.** Pestic. Sci., 1997, vol. 22, 245-256 [0005]
- Acetolactate Synthase Inhibitors **SHIMIZU, T. et al.** Herbicide Classes in Development Springer Verlag 200200001-41 [0005]
- **DUGGLEBY, R.G. et al.** Plant Physiol. and Biochem., 2008, 309-324 [0011]
- **SIYUAN, T. et al.** Pest Management Sci., 2005, vol. 61, 246-257 [0011]
- **JUNG, S.** Biochem J., 2004, 53-61 [0011]
- **KOLKMAN, J.M.** Theor. Appl. Genet., 2004, vol. 109, 1147-1159 [0011]
- **DUGGLEBY, R.G. et al.** Eur. J. Biochem., 2003, vol. 270, 2895-2904 [0011]
- **PANG, S.S. et al.** J. Biol. Chem., 2003, 7639-7644 [0011]
- **YADAV, N. et al.** Proc. Natl. Acad. Sci., 1986, vol. 83, 4418-4422 [0011]
- **JANDER G. et al.** Plant Physiol., 2003, vol. 131, 139-146 [0011]
- **TRANEL, P.J. WRIGHT, T.R.** Weed Science, 2002, vol. 50, 700-712 [0011]
- **CHANG, A.K. DUGGLEBY, R.G.** Biochem J., 1998, vol. 333, 765-777 [0011]
- **HATTORI et al.** Mol. Gen. Genet., 1995, vol. 246, 419-425 [0013]
- **SAUNDERS et al.** Crop Science, 1992, vol. 32, 1357-1360 [0017]
- **TAN et al.** Pest Manag. Sci., 2005, vol. 61, 246-257 [0018]
- **STOUGAARD et al.** J. Cell Biochem., 1990, vol. 14E, 310- [0019]
- Proc. South. Weed Sci. Soc., 1992, vol. 45, 341- [0027]
- Proc. South. Weed Sci. Soc. Annu. Mtg. 36th, 1983, 29- [0027]
- Weed Sci. Soc. Annu. Mtg. 36th, 1983, 90-91 [0027]
- Weed Sci. Soc. Mtg., 1984, 18- [0027]
- Modern Agrochemicals, 2004, 14-15 [0027]
- CHEMICAL ABSTRACTS, 120923-37-7 [0035] [0045] [0046]
- CHEMICAL ABSTRACTS, 120162-55-2 [0035]
- CHEMICAL ABSTRACTS, 83055-99-6 [0035]
- CHEMICAL ABSTRACTS, 90982-32-4 [0035] [0045]
- CHEMICAL ABSTRACTS, 64902-72-3 [0035]
- CHEMICAL ABSTRACTS, 94593-91-6 [0035]
- CHEMICAL ABSTRACTS, 136849-15-5 [0035]
- CHEMICAL ABSTRACTS, 97780-06-8 [0035] [0045]
- CHEMICAL ABSTRACTS, 126801-58-9 [0035] [0045]
- CHEMICAL ABSTRACTS, 104040-78-0 [0035]
- CHEMICAL ABSTRACTS, 412928-75-7 [0035]
- CHEMICAL ABSTRACTS, 144740-54-5 [0035] [0045]
- CHEMICAL ABSTRACTS, 173159-57-4 [0035] [0045] [0046]
- CHEMICAL ABSTRACTS, 100784-20-1 [0035]
- CHEMICAL ABSTRACTS, 122548-33-8 [0035]
- CHEMICAL ABSTRACTS, 144550-36-7 [0035] [0045] [0046]
- CHEMICAL ABSTRACTS, 208465-21-8 [0035] [0045]
- CHEMICAL ABSTRACTS, 74223-64-6 [0035] [0045]

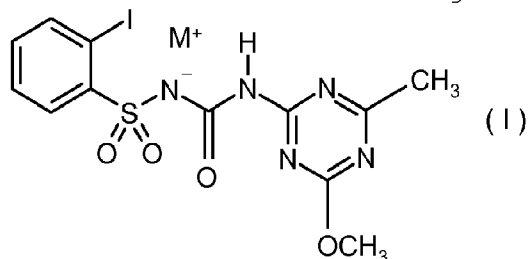
- CHEMICAL ABSTRACTS, 155860-63-2 [0035] [0045]
- CHEMICAL ABSTRACTS, 111991-09-4 [0035] [0045]
- CHEMICAL ABSTRACTS, 213464-77-8 [0035]
- CHEMICAL ABSTRACTS, 144651-06-9 [0035]
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- CHEMICAL ABSTRACTS, 94125-34-5 [0035]
- CHEMICAL ABSTRACTS, 93697-74-6 [0035]
- CHEMICAL ABSTRACTS, 122931-48-0 [0035]
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- CHEMICAL ABSTRACTS, 141776-32-1 [0035] [0045]
- CHEMICAL ABSTRACTS, 79277-27-3 [0035] [0045]
- CHEMICAL ABSTRACTS, 82097-50-5 [0035]
- CHEMICAL ABSTRACTS, 101200-48-0 [0035] [0045]
- CHEMICAL ABSTRACTS, 145099-21-4 [0035]
- CHEMICAL ABSTRACTS, 126535-15-7 [0035]
- CHEMICAL ABSTRACTS, 142469-14-5 [0035]
- CHEMICAL ABSTRACTS, 104770-29-8 [0035]
- CHEMICAL ABSTRACTS, 868680-84-6 [0035]
- CHEMICAL ABSTRACTS, 570415-88-2 [0035]
- CHEMICAL ABSTRACTS, 175076-90-1 [0035]
- CHEMICAL ABSTRACTS, 181274-17-9 [0035]
- CHEMICAL ABSTRACTS, 181274-15-7 [0035] [0045]
- CHEMICAL ABSTRACTS, 317815-83-1 [0035] [0045] [0046]
- CHEMICAL ABSTRACTS, 145701-21-9 [0035]
- CHEMICAL ABSTRACTS, 145701-23-1 [0035] [0045]
- CHEMICAL ABSTRACTS, 98967-40-9 [0035]
- CHEMICAL ABSTRACTS, 139528-85-1 [0035] [0045]
- CHEMICAL ABSTRACTS, 219714-96-2 [0035]
- CHEMICAL ABSTRACTS, 422556-08-9 [0035] [0045]
- CHEMICAL ABSTRACTS, 81405-85-8 [0035]
- CHEMICAL ABSTRACTS, 114311-32-9 [0035] [0047]
- CHEMICAL ABSTRACTS, 104098-48-8 [0035]
- CHEMICAL ABSTRACTS, 81334-34-1 [0035]
- CHEMICAL ABSTRACTS, 81335-37-7 [0035]
- CHEMICAL ABSTRACTS, 81335-77-5 [0035]
- CHEMICAL ABSTRACTS, 557064-77-4 [0035]
- CHEMICAL ABSTRACTS, 374718-10-2 [0035]
- CHEMICAL ABSTRACTS, 125401-92-5 [0035] [0048]
- CHEMICAL ABSTRACTS, 168088-61-7 [0035]
- CHEMICAL ABSTRACTS, 136191-64-5 [0035]
- CHEMICAL ABSTRACTS, 420138-41-6 [0035]
- CHEMICAL ABSTRACTS, 420138-40-5 [0035]
- CHEMICAL ABSTRACTS, 135186-78-6 [0035]
- CHEMICAL ABSTRACTS, 123343-16-8 [0035]

- Weed Research, 1986, vol. 26, 441-445 [0062]
- The Pesticide ManualThe British Crop Protection Council20070000 [0062]
- e-Pesticide ManualBritish Crop Protection Council20100000 [0062]
- **SAMBROOK et al.**Molecular Cloning, A Laboratory ManualCold Spring Harbor Laboratory Press19890000 [0078]
- **WINNACKER**Gene und KloneVCH19960000 [0078]
- **CHRISTOUT**Trends in Plant Science, 1996, vol. 1, 423-431 [0078]
- **BRAUN et al.**EMBO J., 1992, vol. 11, 3219-3227 [0082]
- **WOLTER et al.**Proc. Natl. Acad. Sci. USA, 1988, vol. 85, 846-850 [0082]
- **SONNEWALD et al.**Plant J., 1991, vol. 1, 95-106 [0082]
- Factors Affecting Herbicidal Activity and SelectivityProc. EWRS Symp., 1988, 227-232 [0101]
- Römpp Chemie LexikonThieme Verlagvol. 2, 1343- [0106]
- Growth stages of mono-and dicotyledonous plantsFederal Biological Research Centre for Agriculture and Forestry (Biologische Bundesanstalt für Land und Forstwirtschaft)20010000 [0141]

Patentkrav

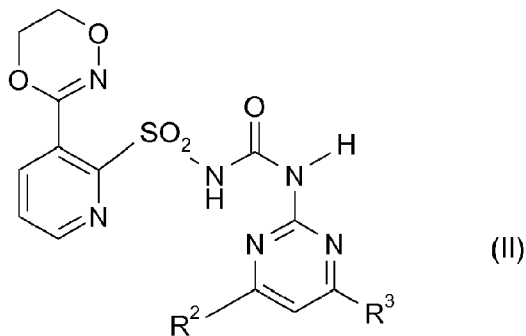
1. Anvendelse af et eller flere ALS-inhibitorherbicide(r) til bekæmpelse af uønsket vegetation i Beta vulgaris-bevoksede områder, hvor Beta vulgaris-planter omfatter mutationer i ALS-genet, der koder for et ALS-polypeptid, der indeholder en aminosyre, der er forskellig fra tryptofan, i position 569 og en aminosyre, der er forskellig fra prolin i position 188.
2. Anvendelse af et eller flere ALS-inhibitorherbicide(r) ifølge krav 1, hvor ALS-inhibitorherbicide(r)-herbicide(r) tilhører:
- gruppen af (sulfon)amider (gruppe (A)), der består af:
- undergruppen (A1) af sulfonylurinstoffer, der består af:
- amidosulfuron [CAS RN 120923-37-7] (=A1-1);
 - azimsulfuron [CAS RN 120162-55-2] (= A1-2);
 - bensulfuron-methyl [CAS RN 83055-99-6] (= A1-3);
 - chlorimuron-ethyl [CAS RN 90982-32-4] (= A1-4);
 - chlorsulfuron [CAS RN 64902-72-3] (= A1-5);
 - cinosulfuron [CAS RN 94593-91-6] (= A1-6);
 - cyclosulfamuron [CAS RN 136849-15-5] (= A1-7);
 - ethametsulfuron-methyl [CAS RN 97780-06-8] (= A1-8);
 - ethoxysulfuron [CAS RN 126801-58-9] (= A1-9);
 - flazasulfuron [CAS RN 104040-78-0] (=A1-10);
 - flucetosulfuron [CAS RN 412928-75-7] (= A1-11);
 - flupyrsulfuron-methyl-natrium [CAS RN 144740-54-5] (= A1-12);
 - foramsulfuron [CAS RN 173159-57-4] (= A1-13);
 - halosulfuron-methyl [CAS RN 100784-20-1] (=A1-14);
 - imazosulfuron [CAS RN 122548-33-8] (= A1-15);
 - iodosulfuron-methyl-natrium [CAS RN 144550-36-7] (= A1-16);
 - mesosulfuron-methyl [CAS RN 208465-21-8] (= A1-17);
 - metsulfuron-methyl [CAS RN 74223-64-6] (= A1-18);
 - monosulfuron [CAS RN 155860-63-2] (=A1-19);
 - nicosulfuron [CAS RN 111991-09-4] (= A1-20);
 - orthosulfamuron [CAS RN 213464-77-8] (= A1-21);
 - oxasulfuron [CAS RN 144651-06-9] (= A1-22);
 - primisulfuron-methyl [CAS RN 86209-51-0] (= A1-23);
 - prosulfuron [CAS RN 94125-34-5] (= A1-24);

- pyrazosulfuron-ethyl [CAS RN 93697-74-6] (= A1-25);
rimsulfuron [CAS RN 122931-48-0] (= A1-26);
sulfometuron-methyl [CAS RN 74222-97-2] (= A1-27);
sulfosulfuron [CAS RN 141776-32-1] (= A1-28);
5 thifensulfuron-methyl [CAS RN 79277-27-3] (= A1-29);
triasulfuron [CAS RN 82097-50-5] (= A1-30);
tribenuron-methyl [CAS RN 101200-48-0] (=A1-31);
trifloxysulfuron [CAS RN 145099-21-4] (natrium) (= A1-32);
triflusulfuron-methyl [CAS RN 126535-15-7] (= A1-33);
10 tritosulfuron [CAS RN 142469-14-5] (= A1-34);
NC-330 [CAS RN 104770-29-8] (= A1-35);
NC-620 [CAS RN 868680-84-6] (= A1-36);
TH-547 [CAS RN 570415-88-2] (= A1-37);
monosulfuron-methyl [CAS RN 175076-90-1] (=A1-38);
15 2-iod-N-[(4-methoxy-6-methyl-1,3,5-
triazinyl)carbamoyl]benzensulfonamid (=A1-39);
en forbindelse med den generelle formel (I)



- hvor M⁺ angiver det respektive salt af forbindelsen (I), det vil
20 sige
dens lithiumsalt (= A1-40); dens natriumsalt (= A1-41); dens
kaliumsalt
(= A1-42); dens magnesiumsalt (= A1-43); dens calciumsalt (= A1-
44); dens ammoniumsalt (= A1-45); dens methylammoniumsalt (= A1-
25 46); dens dimethylammoniumsalt (= A1-47); dens
tetramethylammoniumsalt (= A1-48); dens ethylammoniumsalt
(= A1-49); dens diethylammoniumsalt (= A1-50); dens
tetraethylammoniumsalt (= A1-51); dens propylammoniumsalt (=A1-
52); dens tetrapropylammoniumsalt (= A1-53); dens
30 isopropylammoniumsalt (= A1-54); dens diisopropylammoniumsalt
(=A1-55); dens butylammoniumsalt (= A1-56); dens
tetrabutylammoniumsalt (= A1-57); dens (2-hydroxyeth-1-yl)-
ammoniumsalt (= A1-58); dens bis-N,N-(2-hydroxyeth-1-yl)-
ammoniumsalt (= A1-59); dens tris-N,N,N-(2-hydroxyeth-1-yl)-

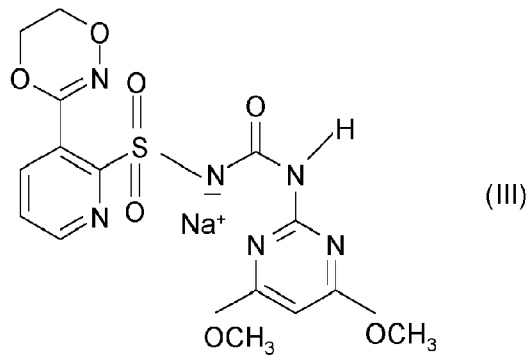
ammoniumsalt (= A1-60); dens 1-phenylethylammoniumsalt (= A1-61); dens 2-phenylethylammoniumsalt (= A1-62); dens trimethylsulfoniumsalt (= A1-63); dens trimethyloxoniumsalt (= A1-64); dens pyridiniumsalt (= A1-65); dens 2-methylpyridiniumsalt (= A1-66); dens 4-methylpyridiniumsalt (= A1-67); dens 2,4-dimethylpyridiniumsalt (= A1-68); dens 2,6-dimethylpyridiniumsalt (= A1-69); dens piperidiniumsalt (= A1-70); dens imidazoliumsalt (= A1-71); dens morpholiniumsalt (= A1-72); dens 1,5-diazabicyclo[4.3.0]non-7-eniumsalt (= A1-73); dens 1,8-diazabicyclo[5.4.0]undec-7-eniumsalt (= A1-74); eller en forbindelse med formel (II) eller salte deraf



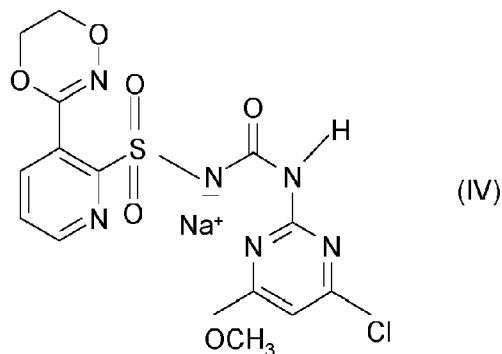
hvor R² og R³ har betydningen som vist i tabellen nedenfor:

Forbindelse	R ²	R ³
A1-75	OCH ₃	OC ₂ H ₅
A1-76	OCH ₃	CH ₃
A1-77	OCH ₃	C ₂ H ₅
A1-78	OCH ₃	CF ₃
A1-79	OCH ₃	OCF ₂ H
A1-80	OCH ₃	NHCH ₃
A1-81	OCH ₃	N(CH ₃) ₂
A1-82	OCH ₃	Cl
A1-83	OCH ₃	OCH ₃
A1-84	OC ₂ H ₅	OC ₂ H ₅
A1-85	OC ₂ H ₅	CH ₃
A1-86	OC ₂ H ₅	C ₂ H ₅

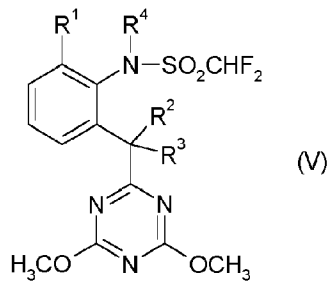
15 eller forbindelsen med formel (III) (= A1-87), det vil sige natriumsaltet af forbindelse (A1-83)



eller forbindelsen med formel (IV) (=A1-88), det vil sige natriumsaltet of forbindelse (A1-82)



- 5 undergruppen af sulfonaminocarbonyltriazolinoner (undergruppe (A2)), der består af:
- flucarbazon-natrium [CAS RN 181274-17-9] (= A2-1);
 - propoxycarbazon-natrium [CAS RN 181274-15-7] (= A2-2);
 - thiencarbazon-methyl [CAS RN 317815-83-1] (= A2-3);
- 10 undergruppen af triazolopyrimidiner (undergruppe (A3)), der består af:
- cloransulam-methyl [147150-35-4] (= A3-1);
 - diclosulam [CAS RN 145701-21-9] (= A3-2);
 - florasulam [CAS RN 145701-23-1] (= A3-3);
 - 15 flumetsulam [CAS RN 98967-40-9] (= A3-4);
 - metosulam [CAS RN 139528-85-1] (= A3-5);
 - penoxsulam [CAS RN 219714-96-2] (= A3-6);
 - pyroxsulam [CAS RN 422556-08-9] (= A3-7);
- undergruppen af sulfonanilider (undergruppe (A4)), der består
- 20 af:
- forbindelser eller salte deraf fra gruppen beskrevet ved den generelle formel (V):



hvor

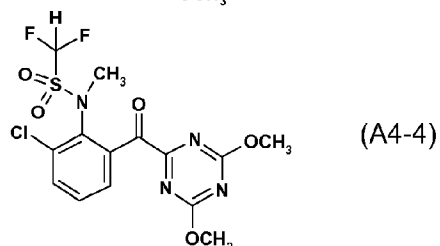
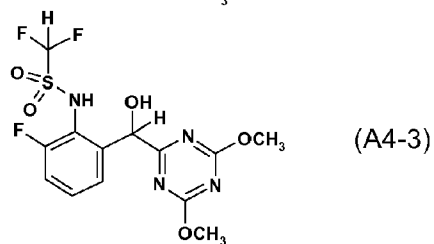
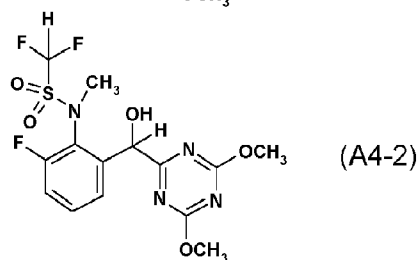
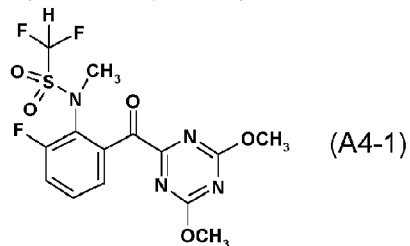
R¹ er halogen, fortrinsvis fluor eller chlor,

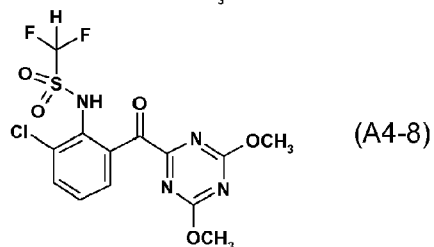
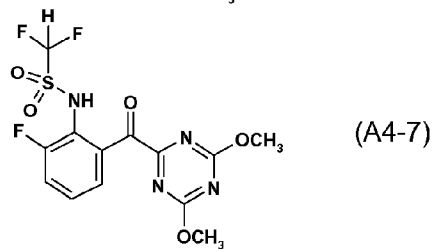
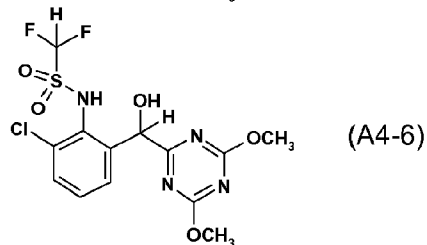
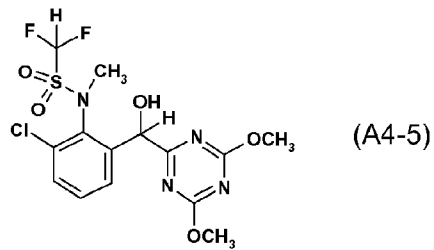
R² er hydrogen, og R³ er hydroxyl, eller

5 R² og R³ sammen med carbonatomet, hvortil de er bundet, er en carbonylgruppe C=O, og

R⁴ er hydrogen eller methyl;

og mere fortrinsvis forbindelser med den kemiske struktur (A4-1) til (A4-8) nedenfor:





gruppen af imidazolinoner (gruppe (B1)), der består af:

imazamethabenzmethyl [CAS RN 81405-85-8] (= B1-1);

imazamox [CAS RN 114311-32-9] (= B1-2);

5 imazapic [CAS RN 104098-48-8] (= B1-3);

imazapyr [CAS RN 81334-34-1] (= B1-4);

imazaquin [CAS RN 81335-37-7] (= B1-5);

imazethapyr [CAS RN 81335-77-5] (= B1-6);

SYP-298 [CAS RN 557064-77-4] (= B1-7);

10 SYP-300 [CAS RN 374718-10-2] (= B1-8);

gruppen af pyrimidinyl(thio)benzoater (gruppe (C)), der består af:

undergruppen af pyrimidinyl(oxy)benzoesyre (undergruppe (C1)), der består af:

15 bispyribac-natrium [CAS RN 125401-92-5] (= C1-1);

pyribenzoxim [CAS RN 168088-61-7] (= C1-2);

pyriminobac-methyl [CAS RN 136191-64-5] (= C1-3);

pyribambenz-isopropyl [CAS RN 420138-41-6] (= C1-4);

pyribambenz-propyl [CAS RN 420138-40-5] (= C1-5);

undergruppen af pyrimidinylthiobenzoesyre (undergruppe (C2)),
der består af:

pyrifthalid [CAS RN 135186-78-6] (= C2-1);
pyrithiobac-natrium [CAS RN 123343-16-8] (= C2-2).

5

3. Anvendelse af et eller flere ALS-inhibitorherbicid(er)
ifølge krav 1 eller 2, hvor ALS-inhibitorherbicidet/
herbiciderne tilhører gruppen, der består af:

- amidoflurofen [CAS RN 120923-37-7] (= A1-1) ;
10 chlorimuron-ethyl [CAS RN 90982-32-4] (= A1-4);
ethametsulfuron-methyl [CAS RN 97780-06-8] (= A1-8);
ethoxysulfuron [CAS RN 126801-58-9] (= A1-9);
flupyriflurofen-methyl-natrium [CAS RN 144740-54-5] (= A1-12);
foramsulfuron [CAS RN 173159-57-4] (=A1-13);
15 iodosulfuron-methyl-natrium [CAS RN 144550-36-7] (= A1-16);
mesosulfuron-methyl [CAS RN 208465-21-8] (= A1-17);
metsulfuron-methyl [CAS RN 74223-64-6] (= A1-18);
monosulfuron [CAS RN 155860-63-2] (= A1-19);
nicosulfuron [CAS RN 111991-09-4] (= A1-20);
20 sulfosulfuron [CAS RN 141776-32-1] (= A1-28);
thifensulfuron-methyl [CAS RN 79277-27-3] (= A1-29);
tribenuron-methyl [CAS RN 101200-48-0] (= A1-31);
2-iod-N-[(4-methoxy-6-methyl-1,3,5-
triazinyl)carbonyl]benzensulfonamid (= A1-39);
25 2-iod-N-[(4-methoxy-6-methyl-1,3,5-
triazinyl)carbonyl]benzensulfonamid-natriumsalt (= A1-41);
(A1-83) eller dens natriumsalt (=A1-87);
propoxycarbazon-natrium [CAS RN 181274-15-7] (= A2-2);
thiencarbazon-methyl [CAS RN 317815-83-1] (= A2-3);
30 florasulam [CAS RN 145701-23-1] (= A3-3);
metosulam [CAS RN 139528-85-1] (= A3-5);
pyroxsulam [CAS RN 422556-08-9] (= A3-7)
(A4-1);
(A4-2);
35 (A4-3);
imazamox [CAS RN 114311-32-9] (= B1-2); og
bispyribac-natrium [CAS RN 125401-92-5] (= C1-1).

4. Anvendelse af et eller flere ALS-inhibitorherbicid(er) ifølge krav 1 eller 2, hvor ALS-inhibitorherbicidet/-herbiciderne tilhører gruppen, der består af:
- amidoflurofen [CAS RN 120923-37-7] (= A1-1) ;
- 5 foramsulfuron [CAS RN 173159-57-4] (=A1-13);
- iodoflurofen-methyl-natrium [CAS RN 144550-36-7] (= A1-16);
- 2-iod-N-[(4-methoxy-6-methyl-1,3,5-triazinyl)carbonyl]benzensulfonamid (= A1-39);
- 2-iod-N-[(4-methoxy-6-methyl-1,3,5-triazinyl)carbonyl]benzensulfonamid-natriumsalt (= A1-41);
- 10 A1-83 eller dens natriumsalt (=A1-87);
- thiencarbazon-methyl [CAS RN 317815-83-1] (= A2-3);
- imazamox [CAS RN 114311-32-9] (= B1-2);
- bispyribac-natrium [CAS RN 125401-92-5] (= C1-1).
- 15
5. Anvendelse af et eller flere ALS-inhibitorherbicid(er) ifølge et hvilket som helst af kravene 1 til 4, hvor aminosyren i ALS-proteinet i position 569 er leucin.
- 20
6. Anvendelse af et eller flere ALS-inhibitorherbicid(er) ifølge et hvilket som helst af kravene 1 til 5 i kombination med ikke-ALS-inhibitorherbicider (det vil sige herbicider, der fremviser en virkningsmekanisme, der er forskellig fra inhibering af ALS-enzymet [acetohydroxysyresyntase; EC 2.2.1.6]
- 25 gruppe D-herbicider), og hvor ikke-ALS-inhibitorherbicidet/herbiciderne er valgt fra gruppen, der består af:
- chloridazon, clethodim, clodinafop, clodinafop-propargyl, clopyralid, cycloxydim, desmedipham, dimethenamid,
- 30 dimethenamid-P, ethofumesat, fenoxaprop, fenoxaprop-P, fenoxaprop-ethyl, fenoxaprop-P-ethyl, fluazifop, fluazifop-P, fluazifop-butyl, fluazifop-P-butyl, glufosinat, glufosinat-ammonium, glufosinat-P, glufosinat-P-ammonium, glufosinat-P-natrium, glyphosat, glyphosat-isopropylammonium, haloxyfop,
- 35 haloxyfop-P, haloxyfop-ethoxyethyl, haloxyfop-P-ethoxyethyl, haloxyfop-methyl, haloxyfop-P-methyl, lenacil, met amitron, phenmedipham, phenmedipham-ethyl, propaquizafop, quinmerac, quizalofop, quizalofop-ethyl, quizalofop-P, quizalofop-P-ethyl,

quizalofop-P-tefuryl, sethoxydim.

7. Anvendelse af et eller flere ALS-inhibitorherbicid(er) ifølge krav 6, hvor ikke-ALS-inhibitorherbicidet/herbiciderne er valgt fra gruppen, der består af:

desmedipham, ethofumesat, glufosinat, glufosinat-ammonium, glufosinat-P, glufosinat-P-ammonium, glufosinat-P-natrium, glyphosat, glyphosat-isopropylammonium, lenacil, met amitron, phenmedipham, phenmedipham-ethyl.

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8. Anvendelse ifølge et hvilket som helst af kravene 1 til 7, hvor Beta vulgaris-planterne svarer til deponeringen under NCIMB 42050.

15 9. Fremgangsmåde til bekæmpelse af uønsket vegetation i områder bevokset med Beta vulgaris-planter, der er kendetegnet ved:

(a) tilstedeværelse af Beta vulgaris-planter, der omfatter en mutation i et endogent ALS-gen, der koder for et ALS-protein, der indeholder en aminosyre, der er forskellig fra tryptofan, i position 569 og en aminosyre, der er forskellig fra prolin, i position 188,

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(b) påføring af et eller flere ALS-inhibitorherbicid(er) alene eller i kombination med et eller flere herbicid(er), der ikke tilhører klassen af ALS-inhibitorherbicider (ikke-ALS-inhibitorherbicider), og

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(c) hvor påføringen af de respektive herbicider som defineret under (b)

(i) finder sted samlet eller samtidig eller

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(ii) finder sted på forskellige tidspunkter og/eller i et antal portioner (sekventiel påføring), ved før-emergens-påføringer efterfulgt af efter-emergens-påføringer eller tidlige efter-emergens-påføringer efterfulgt af middel eller sen efter-emergens-påføringer.

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10. Fremgangsmåde ifølge krav 9 til bekæmpelse af uønsket vegetation, hvor ALS-inhibitorherbicidet/-herbiciderne er valgt fra grupperne som defineret i krav 2.

11. Fremgangsmåde ifølge krav 9 eller 10, hvor ALS-inhibitorherbicidet/-herbiciderne er valgt fra grupperne som defineret i krav 3.

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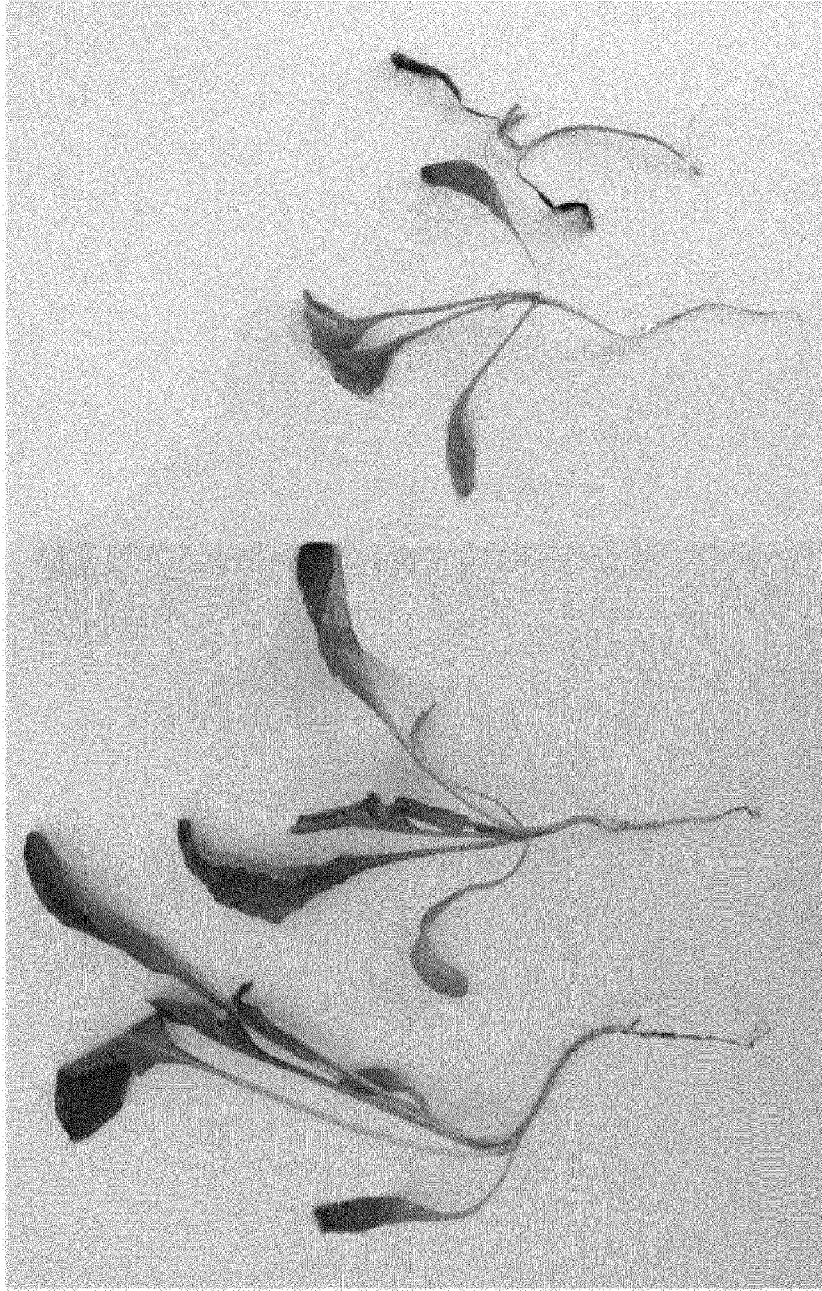
12. Fremgangsmåde ifølge et hvilket som helst af kravene 9 til 11, hvor ikke-ALS-inhibitorherbicidet/-herbiciderne er valgt fra gruppen, der består af:

chloridazon, clethodim, clodinafop, clodinafop-propargyl,
10 clopyralid, cycloxydim, desmedipham, dimethenamid,
dimethenamid-P, ethofumesat, fenoxaprop, fenoxaprop-P,
fenoxaprop-ethyl, fenoxaprop-P-ethyl, fluazifop, fluazifop-P,
fluazifop-butyl, fluazifop-P-butyl, glufosinat, glufosinat-
15 ammonium, glufosinat-P, glufosinat-P-ammonium, glufosinat-P-
natrium, glyphosat, glyphosat-isopropylammonium, haloxyfop,
haloxyfop-P, haloxyfop-ethoxyethyl, haloxyfop-P-ethoxyethyl,
haloxyfop-methyl, haloxyfop-P-methyl, lenacil, metamitron,
phenmedipham, phenmedipham-ethyl, propaquizafop, quinmerac,
20 quizalofop, quizalofop-ethyl, quizalofop-P, quizalofop-P-ethyl,
quizalofop-P-tefuryl, sethoxydim.

13. Fremgangsmåde ifølge et hvilket som helst af kravene 9 til 12, hvor Beta vulgaris-planterne svarer til deponeringen under NCIMB 42050.

DRAWINGS

Fig. 1



Line WT

Line C

Line B

Line A