The invention relates to herbicidal agents comprising an effective amount of flufenacet and the further herbicides aclonifen and diflufenican. Said herbicidal agents have an improved range of application.
(54) Title: HERBICIDAL AGENTS CONTAINING FLUFENACET

(54) Bezeichnung: HERBIZIDE MITTEL ENTHALTEND FLUFENACET

(57) Abstract: The invention relates to herbicidal agents comprising an effective amount of flufenacet and the further herbicides acetonilid and difluifenac. Said herbicidal agents have an improved range of application.

Description

Herbicidal agents containing flufenacet

The invention is in the technical field of the crop protection agents which can be used against harmful plants, for example in crop plants, and which, as active compounds in the herbicidal compositions, comprise a combination of flufenacet and a plurality of further herbicides.

The herbicidally active compound flufenacet (manufacturer: Bayer CropScience) belongs to the group of the heteroaryloxyacetamides, and mixtures of this group with other herbicides are known from the literature: for example (e.g.) US 5945397 B, US 5593942 B, US 5811373 B, US 6967188 B. US 5858920 B describes, inter alia, heteroaryloxyacetamides in mixtures with individual active compounds such as, for example, the herbicide aclonifen, however, without any experimental data for the synergistic effect.

The herbicidal active compound flufenacet is characterized by a broad activity against mono- and dicotyledonous harmful plants and is employed, for example, by the presowing method, the pre-emergence method or the post-emergence method in sown and/or planted agricultural or horticultural crop plants and also on non-crop land (for example in cereals such as wheat, barley, rye, oats, triticale, rice, corn, millet, sugar beet, sugar cane, oilseed rape, cotton, sunflowers, soybeans, potatoes, tomatoes, beans, flax, pasture grass, fruit plantations, plantation crops, greens and lawns and also squares of residential areas or industrial sites, rail tracks).

As individual active compound, flufenacet is commercially available, for example, under the trade names Cadou®, Drago®, Define® and Tiara®. In addition to the use of the
individual compound, mixtures of flufenacet with other herbicides are also known from the literature (e.g. US 5985797 B, US 5912206 B, US 6492301 B, US 6864217 B, US 6486096 B; US 2003/0069138 A, WO 2002/058472 A, US 6365550 B, US 2003/0060367 A, US 6878675 B, US 6071858 B, WO 2007/112834 A) and commercially available: mixtures with metribuzin (e.g. Axiom®, Bastille®, Artist®, Domain®, Plateen®, Fedor®, Draeda®), with isoxaflutole (e.g. Epic®, Cadou Star®), with metosulam (e.g. Diplôme®, Terano®), with diflufenican (e.g. Herold®, Liberator®), with 2,4-D (e.g. Drago 3.4®), with atrazine (e.g. Aspect®), with pendimethalin (e.g. Crystal®, Malibu Pack®), with atrazine and metribuzin (e.g. Axiom AT®) and with diflufenican and flurtamone (e.g. Baccara FORTE®).

In spite of the good activity of flufenacet as individual active compound and in the mixtures already known, there is still a need for improving the application profile of this active compound in specific areas of use. There are various reasons for this, such as, for example, further increase of efficacy in specific areas of application, enhancement of crop plant compatibility, as a reaction to novel production techniques in individual crops and/or to the increasing occurrence of herbicide-resistant harmful plants (e.g. in cereals, rice and corn, but also in potatoes, sunflowers, peas, carrots and fennel), for example with target-site resistance (abbreviation: TSR; where the weed populations comprise biotypes having a target-site-specific resistance, i.e. the binding site at the site of action is modified as a result of natural mutations in the gene sequence so that the active compounds are no longer able to bind, or bind in an unsatisfactory manner, and are therefore no longer able to act) and enhanced metabolic resistance (abbreviation: EMR; where the weed populations comprise biotypes having a metabolic resistance, i.e. the plants are capable of metabolizing the active compounds more quickly via enzyme complexes, that means the active compounds are degraded more rapidly in the plant). According to the Herbicide Resistance Action Committee (abbreviation: HRAC; a committee of the research-conducting industry), resistances to approved active compounds are classified according to their mode of action (MoA): e.g. HRAC group A = acetylcoenzyme-A carboxylase inhibitors (MoA: ACCase) or HRAC group B =
acetolactate synthase inhibitors (MoA: ALS). These improvements of the application profile may be of importance both individually and in combination with one another.

One way of improving the application profile of a herbicide may be to combine the active compound with one or more other suitable active compounds. However, in the combined application of a plurality of active compounds, there are frequently phenomena of physical and biological incompatibility, for example lack of stability of a coformulation, decomposition of an active compound and/or antagonism of the active compounds. What is desired, however, are combinations of active compounds having a favorable activity profile, high stability and ideally a synergistically enhanced activity which allows the application rate to be reduced compared to the individual application of the active compounds to be combined. Likewise, desirable are combinations of active compounds which increase crop plant compatibility in general and/or can be used for specific production techniques. These include, for example, a reduction of sowing depth which, for crop compatibility reasons, can frequently not be used. In this manner, in general a more rapid emergence of the crop is achieved, their risk of emergence diseases (such as, for example, Pythium and Rhizoctonia) is reduced, and winter survival and stocking are improved. This also applies to late sowing which would otherwise not be possible owing to the crop compatibility risk.

It was an object of the present invention to improve the application profile of the herbicidal active compound flufenacet with respect to:

- a more simple application method which reduces the costs for the user and would thus be more environmentally compatible.

- an improvement in application flexibility of the active compounds from pre-emergence to post-emergence of the crop and weed plants.

- an improvement and application flexibility of the reliability of action on soils with different soil properties (e.g. soil type, soil humidity).

- an improvement of the reliability of action to resistant weed plant species which would allow a novel option for an effective resistance management;
where the object mentioned last was of particular importance.

This object was achieved by providing herbicidal compositions comprising flufenacet and the further herbicides aclonifen and diflufenican.

Accordingly, the invention provides herbicidal compositions comprising, as sole herbicidally active constituents:

A) flufenacet (component A),
B) aclonifen (component B) and
C) diflufenican (component C).

The active compounds (herbicidally active constituents) referred to in the present description by their common names are known, for example, from "The Pesticide Manual", 14th edition 2006/2007, or from the corresponding "The e-Pesticide Manual", version 4.0 (2006-07), each published by the British Crop Protection Council and the Royal Soc. of Chemistry, and from "The Compendium of Pesticide Common Names" on the Internet (website: http://www.alanwood.net/pesticides/).

Together, the herbicidally active constituents component A, B and C are hereinbelow referred to as "(individual) active compounds", "(individual) herbicides" or as "herbicide components", and they are known, as individual compounds or as mixture, for example from "The Pesticide Manual", 14th edition (see above), where they have the following entry numbers (abbreviation: "PM #." with the respective sequential entry number):

- component A: flufenacet (PM #381), syn. thiafluamide, for example N-(4-fluorophenyl)-N-(1-methylethyl)-2-[[5-(trifluoromethyl)-1,3,4-thiadiazol-2-yl]oxy]acetamide;
- component B: aclonifen (PM #9), e.g. 2-chloro-6-nitro-3-phenoxybenzenamine;
- component C: diflufenican (PM #258), e.g. N-(2,4-difluorophenyl)-2-[3-(trifluoromethyl)phenoxy]-3-pyridinecarboxamide.
If the short form of the common name of an active ingredient is used in the context of this description, this - if applicable - therefore refers in each case to all common derivatives, such as the esters and salts, and isomers, especially optical isomers, more particularly the commercial form or forms. If an ester or salt is referred to by the common name, this therefore also refers in each case to all other common derivatives, such as other esters and salts, the free acids and neutral compounds, and isomers, especially optical isomers, especially the commercial form or forms. The stated chemical compound names identify at least one of the compounds embraced by the common name, frequently a preferred compound.

If the abbreviation "AS/ha" is used in the present description, it means "active substance per hectare", based on 100% active compound. All percentages in the description are percent by weight (abbreviation: "% by weight") and, unless defined otherwise, refer to the relative weight of the respective component based on the total weight of the herbicidal composition (for example as formulation).

The herbicidal compositions according to the invention comprise a herbicidally effective amount of components A, B and C and may comprise further constituents, for example agrochemically active compounds from the group of the insecticides, fungicides and safeners, and/or formulation auxiliaries and/or additives customary in crop protection, or be used together with these.

In a preferred embodiment, the herbicidal compositions according to the invention have, as an improvement of the application profile, synergistic effects. These synergistic effects can be observed, for example, when applying the herbicide components together; however, they can frequently also be observed when the components are applied at different times (splitting). It is also possible to apply the individual 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 active compounds of the herbicidal compositions according to the invention.

5 The synergistic effects permit a reduction of the application rates of the individual active compounds, a higher efficacy at the same application rate, the control of species which are as yet uncovered (gaps), 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.

10 The application rate of the herbicide components and their derivatives in the herbicidal composition may vary within wide ranges. Applied at application rates of from 21 to 7500 g of AS/ha by the pre- and post-emergence method, the herbicide components control a relatively broad spectrum of annual and perennial broad-leaved weeds, weed grasses and Cyperaceae.

The application rates of the herbicide components in the herbicidal composition, with respect to one another, are present in the weight ratio stated below:

(range component A) : (range component B) : (range component C)

generally (1 - 2000) : (1 - 100) : (1 - 500),
preferably (1 - 40) : (1 - 25) : (1 - 30),
particularly preferably (1 - 10) : (1 - 10) : (1 - 8).

The application rates of the respective herbicide components in the herbicidal composition are:

- component A: generally 10 - 2000 g of AS/ha, preferably 30 - 400 g of AS/ha, particularly preferably 50 - 300 g of AS/ha of flufenacet;
- component B: generally 10 - 5000 g of AS/ha, preferably 80 - 3000 g of AS/ha, particularly preferably 80 - 1000 g of AS/ha of aclonifen;
- component C: generally 1 - 500 g of AS/ha, preferably 10 - 300 g of AS/ha, particularly preferably 30 - 200 g of AS/ha of diflufenican.

Correspondingly, the application rates mentioned above may be used to calculate the percentages by weight (% by weight) of the herbicide components based on the total weight of the herbicidal compositions, which may additionally also comprise other components.

The herbicidal compositions according to the invention have excellent herbicidal activity against a broad spectrum of economically important monocotyledonous and dicotyledonous harmful plants, such as broad-leaved weeds, weed grasses or Cyperaceae, including species which are resistant to herbicidal active compounds such as glyphosate, glufosinate, atrazine, photosynthesis inhibitors, imidazolinone herbicides, sulfonylureas, (hetero)aryloxyaryloxyalkylcarboxylic acids or phenoxyalkylcarboxylic acids ('fops'), cyclohexanedione oximes ('dims') or auxin inhibitors. The active compounds also act efficiently on perennial weeds which produce shoots from rhizomes, root stocks or 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.

Specific examples of some representatives of the monocotyledonous and dicotyledonous weed flora which can be controlled by the herbicidal compositions according to the invention are as follows, though the enumeration is not intended to impose a restriction to particular species.

Examples of weed species on which the herbicidal compositions 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., Leptochloa spp., Fimbristylis spp., Panicum spp., Phalaris spp., Poa spp., Setaria spp. and also Cyperus species from the annual group, and, from amongst the perennial
species, Agropyron, Cynodon, Imperata and Sorghum and also perennial Cyperus species.


If the inventive herbicidal compositions are applied to the soil surface before germination, either the weed seedlings are prevented completely from emerging or the weeds grow until they have reached the cotyledon stage, but then stop growing, and eventually, after two to four weeks have elapsed, die completely.

If the herbicidal compositions according to the invention are applied post-emergence to the green parts of the plants, growth likewise stops drastically a very short time after the treatment, and the weed plants remain in the growth stage at the point of time of application, or they die completely after a certain time, so that in this manner competition by the weeds, which is harmful to the crop plants, is eliminated very early and in a sustained manner. In the case of rice, the herbicidal compositions according to the invention can also be applied into the water, and they are then taken up via soil, shoot and roots.

The herbicidal compositions according to the invention are distinguished by a rapidly commencing and long-lasting herbicidal action. In general, the rainfastness of the active compounds in the compositions according to the invention is favorable. A particular advantage is that the effective dosages of components A, B and C used in the compositions according to the invention can be adjusted to such a low level that their
soil action is optimally low. This does not only allow them to be employed in sensitive crops in the first place, but ground water contaminations are also virtually avoided. The combination according to the invention of active compounds allows the necessary application rate of the active compounds to be reduced considerably.

When the components A, B and C are applied jointly in the compositions according to the invention, there are, in a preferred embodiment, as improvement of the application profile, superadditive (= synergistic) effects. Here, the activity in the combinations is higher than the expected sum of the activities of the individual herbicides employed.

The synergistic effects allow higher efficacy and/or longer persistency; the control of a wider spectrum of broad-leaved weeds, weed grasses and Cyperaceae, in some cases with only one or a few applications; a more rapid onset of the herbicidal action; the control of species which are as yet uncovered (gaps); the control of, for example, species which are tolerant or resistant to individual herbicides or to a number of herbicides; an extension of the period of application and/or a reduction in the number of individual applications required or a reduction of the total application rate and – as a result for the user – weed control systems which are more advantageous economically and ecologically.

The abovementioned properties and advantages are necessary for practical weed control to keep agricultural/forestry/horticultural crops, green land/meadows or crops for generating energy (biogas, bioethanol) free of unwanted competing plants, and thus to ensure and/or increase yield levels from the qualitative and quantitative angle. These novel combinations in the herbicidal compositions according to the invention markedly exceed the technical state of the art with a view to the properties described.

Even though the herbicidal compositions according to the invention have an outstanding herbicidal activity toward mono- and dicotyledonous harmful plants, the crop plants are damaged only to a minor degree, if at all.
Furthermore, some of the compositions according to the invention can have growth-regulating properties with respect to the crop plants. They intervene in the plants' own metabolism with regulatory effect, and can thus be used for the targeted influencing of plant ingredients and to facilitate harvesting, such as e.g. by triggering desiccation and stunted growth. Furthermore, they are also suitable for the general control and inhibition of unwanted vegetative growth without killing the plants in the process. Inhibition of vegetative growth is very important for many mono- and dicotyledonous crops, since this can reduce or completely prevent harvesting losses caused by lodging.

Owing to their improved application profile, the compositions according to the invention can also be employed for controlling harmful plants in known plant crops or in tolerant or genetically modified crop and energy plants still to be developed. In general, transgenic plants (GMOs) are characterized by particular advantageous properties, for example by resistances to certain pesticides, in particular certain herbicides (such as resistances against components A, B and C in the compositions according to the invention), for example by resistances to harmful insects, plant diseases or pathogens of plant diseases, such as certain microorganisms such as fungi, bacteria or viruses. Other specific characteristics relate, for example, to the harvested material with regard to quantity, quality, storability, and the composition of 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, or increased vitamin content or energetic properties. Further special properties may be tolerance or resistance to abiotic stress factors, for example heat, cold, drought, salinity and ultraviolet radiation. In the same manner, owing to their herbicidal and other properties, the compositions according to the invention can also be used for controlling harmful plants in crops of known plants or plants still to be developed by mutant selection, and also crossbreeds of mutagenic and transgenic plants.

Conventional ways of producing novel plants which have modified properties in comparison to plants which have occurred 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 0221044 A, EP 0131624 A). For example, in several cases the following have been described: genetic modifications of crop plants for the purpose of modifying the starch synthesized in the plants (for example WO 92/011376 A, WO 92/014827 A, WO 91/019806 A); transgenic crop plants which are resistant to certain herbicides of the glufosinate type (cf., for example, EP 0242236 A, EP 0242246 A) or glyphosate (WO 92/000377 A) or of the sulfonylurea type (EP 0257993 A, US 5,013,659) or to combinations or mixtures of these herbicides through "gene stacking", such as transgenic crop plants e.g. corn or soybean with the tradename or the name Optimum™ GAT™ (glyphosate ALS tolerant); transgenic crop plants, for example cotton, with the capability of producing Bacillus thuringiensis toxins (Bt toxins) which make the plants resistant to certain pests (EP 0142924 A, EP 0193259 A); transgenic crop plants having a modified fatty acid composition (WO 91/013972 A); genetically modified crop plants having novel constituents or secondary compounds, for example novel phytoalexins providing increased resistance to disease (EP 0309862 A, EP 0464461 A); genetically modified plants having reduced photorespiration, which provide higher yields and have higher stress tolerance (EP 0305398 A); transgenic crop plants producing pharmaceutically or diagnostically important proteins ("molecular pharming"); transgenic crop plants distinguished by higher yields or better quality; transgenic crop plants distinguished by a combination, for example of the novel properties mentioned above ("gene stacking").

Numerous molecular biology techniques which can be used to produce novel transgenic plants with modified properties are known in principle; see, for example, I. Potrykus and G. Spangenberg (eds.) Gene Transfer to Plants, Springer Lab Manual (1995), Springer Verlag Berlin, Heidelberg. or Christou, "Trends in Plant Science" 1 (1996) 423-431. To carry out such recombinant manipulations, nucleic acid molecules which allow mutagenesis or a sequence change by recombination of DNA sequences can be introduced into plasmids. With the aid of standard methods, it is possible, for example,
to undertake base exchanges, remove parts of sequences or add natural or synthetic
sequences. For the joining of the DNA fragments to one another, adaptors or linkers
can be attached to the fragments; see, for example, Sambrook et al., 1989, Molecular
Spring Harbor, NY; or Winnacker "Gene und Klone" [Genes and Clones], VCH

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.

To this end, it is possible firstly 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. It is also possible to use DNA sequences which have a high degree of
homology to the coding sequences of a gene product, but are not completely identical.

When expressing nucleic acid molecules in plants, the protein synthesized may be
localized in any desired compartment of the plant cell. However, to achieve localization
in a particular compartment, it is possible, for example, to join the coding region to 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),
al., Plant J. 1 (1991), 95-106). The nucleic acid molecules can also be expressed in the
organelles of the plant cells.

The transgenic plant cells can be regenerated by known techniques to give rise to entire
plants. In principle, the transgenic plants can be plants of any desired plant species, i.e.
not only monocotyledonous, but also dicotyledonous, plants. Thus, transgenic plants
can be obtained whose properties are altered by overexpression, suppression or
inhibition of homologous (= natural) genes or gene sequences or expression of
heterologous (= foreign) genes or gene sequences.

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The present invention furthermore also provides a method for controlling unwanted
vegetation (for example harmful plants), preferably in crop plants such as cereals (for
example durum wheat and common wheat, barley, rye, oats, crossbreeds thereof such
as triticale, planted or sown rice under 'upland' or 'paddy' conditions, corn, millet such
as, for example, sorghum), sugar beet, sugar cane, oilseed rape, cotton, sunflowers,
soybeans, potatoes, tomatoes, beans such as, for example, bush beans and broad
beans, flax, pasture grass, fruit plantations, plantation crops, greens and lawns, and
also squares of residential areas or industrial sites, rail tracks, particularly preferably in
monocotyledonous crops such as cereals, for example wheat, barley, rye, oats,
crossbreeds thereof such as triticale, rice, corn and millet and also dicotyledonous crops
such as sunflowers, soybeans, potatoes, tomatoes, peas, carrots and fennel where the
components A, B and C of the herbicidal compositions according to the invention are
applied jointly or separately to the plants, for example harmful plants, plant parts, plant
seeds or the area on which the plants grow, for example the area under cultivation, for
example by the pre-emergence method (very early to late), post-emergence method or
pre-emergence and post-emergence method.

The invention also provides the use of the herbicidal compositions according to the
invention comprising the components A, B and C for controlling harmful plants,
preferably in crop plants, preferably in the crop plants mentioned above. The invention
also provides the use of the herbicidal compositions according to the invention
comprising the components A, B and C for controlling herbicide-resistant harmful plants
(for example TSR and EMR resistances in the case of ALS and ACCase), preferably in
crop plants, preferably in the crop plants mentioned above.
The invention also provides the method with the herbicidal compositions according to the invention comprising the components A, B and C for the selective control of harmful plants in crop plants, preferably in the crop plants mentioned above, and its use.

The invention also provides the method for controlling unwanted vegetation with the herbicidal compositions according to the invention comprising the components A, B and C, and its use in crop plants which have been modified by genetic engineering (transgenic) or obtained by mutation selection, and which are resistant to growth regulators such as, for example, 2,4 D, dicamba, or against herbicides which inhibit essential plant enzymes, for example acetolactate synthases (ALS), EPSP synthases, glutamine synthases (GS) or hydroxyphenylpyruvate dioxygenases (HPPD), or respectively to herbicides from the group of the sulfonylureas, glyphosates, glufosinates or benzoilisoxazoles and analogous active compounds, or to any combinations of these active compounds. The herbicidal compositions according to the invention can be used with particular preference in transgenic crop plants which are resistant to a combination of glyphosates and glufosinates, glyphosates and sulfonylureas or imidazolinones. Very particularly preferably, the herbicidal compositions according to the invention can be used in transgenic crop plants such as, for example, corn or soybean with the tradename or the name Optimum™ GAT™ (glyphosate ALS tolerant).

The invention also provides the use of the herbicidal compositions according to the invention comprising the components A, B and C for controlling harmful plants, preferably in crop plants, preferably in the crop plants mentioned above.

The herbicidal compositions according to the invention can also be used non-selectively for controlling unwanted vegetation, for example in plantation crops, at the wayside, on squares, industrial sites or railway installations; or selectively for controlling unwanted vegetation in crops for energy generation (biogas, bioethanol).
The herbicidal compositions according to the invention can be present both as mixed formulations of components A, B and C and, if appropriate, with further agrochemical active compounds, additives and/or customary formulation auxiliaries which are then applied in a customary manner diluted with water, or can be prepared as so-called tank mixes by joint dilution of the separately formulated or partially separately formulated components with water. In certain cases, the mixed formulations can be diluted with other liquids or solids, or else be applied in undiluted form.

The components A, B and C or their subcombinations can be formulated in various ways, depending on the prevailing biological and/or chemico-physical parameters. Examples of general formulation options are: wettable powders (WP), water-soluble concentrates, emulsifiable concentrates (EC), aqueous solutions (SL), emulsions (EW), such as oil-in-water and water-in-oil emulsions, sprayable solutions or emulsions, suspension concentrates (SC), dispersions, oil dispersions (OD), suspomulsions (SE), dusts (DP), seed-dressing products, granules for soil application or spreading (GR) or water-dispersible granules (WG), ultra-low volume formulations, microcapsule dispersions or wax dispersions.


The formulation auxiliaries required, such as inert materials, surfactants, solvents and further additives, are likewise known and are described, for example, in: Watkins, "Handbook of Insecticide Dust Diluents and Carriers", 2nd ed., Darland Books, Caldwell N.J.; H.v. Olphen, "Introduction to Clay Colloid Chemistry"; 2nd ed., J. Wiley & Sons, N.Y.; Marsden, "Solvents Guide", 2nd ed., Interscience, N.Y. 1950; McCutcheon's
Based on these formulations, it is also possible to prepare combinations with other agrochemical active compounds such as fungicides, insecticides and also safeners, fertilizers and/or growth regulators, for example in the form of a ready mix or as tank mix.

Wettable powders (sprayable powders) are products which are uniformly dispersible in water and which, besides the active compounds and in addition to one or more diluents or inert substances, also comprise ionic and/or nonionic surfactants (wetting agents, dispersants), for example polyoxyethylated alkylphenols, polyethoxylated fatty alcohols or fatty amines, propylene oxide/ethylene oxide copolymers, alkanesulfonates or alkylbenzenesulfonates or alkylnaphthalenesulfonates, sodium lignosulfonate, sodium 2,2′-dinaphthylmethane-6,6′-disulfonate, sodium dibutylnaphthalenesulfonate or else sodium oleoylmethyltaurate.

Emulsifiable concentrates are prepared by dissolving the active compounds in an organic solvent or solvent mixture, for example butanol, cyclohexanone, dimethylformamide, acetophenone, xylene or else higher-boiling aromatics or hydrocarbons with addition of one or more ionic and/or nonionic surfactants (emulsifiers). Examples of emulsifiers which may be used are: calcium alkylaryl sulfonates such as calcium dodecylbenzenesulfonate, or nonionic emulsifiers such as fatty acid polyglycol esters, alkylaryl polyglycol ethers, fatty alcohol polyglycol ethers, propylene oxide-ethylene oxide copolymers, alkyl polyethers, sorbitan fatty acid esters, polyoxyethylene sorbitan fatty acid esters or polyoxyethylene sorbitol esters.
Dustable powders are obtained by grinding the active compound with finely distributed solid substances, for example talc, natural clays such as kaolin, bentonite and pyrophyllite, or diatomaceous earth.

Suspension concentrates are water-based suspensions of active compounds. They may be prepared, for example, by wet grinding by means of commercially available bead mills and optional addition of further surfactants as have, for example, already been listed above for the other formulation types. In addition to the suspended active compound or active compounds, other active compounds may also be present in the formulation in dissolved form.

Oil dispersions are oil-based suspensions of active compounds, where oil is to be understood as meaning any organic liquid, for example vegetable oils, aromatic or aliphatic solvents, or fatty acid alkyl esters. They can be prepared, for example, by wet grinding by means of commercially available bead mills and, if appropriate, addition of further surfactants (wetting agents, dispersants) as have already been mentioned, for example, above in the case of the other formulation types. In addition to the suspended active compound or active compounds, other active compounds may also be present in the formulation in dissolved form.

Emulsions, for example oil-in-water emulsions (EW), can be prepared, for example, by means of stirrers, colloid mills and/or static mixers from mixtures of water and water-immiscible organic solvents and, if appropriate, further surfactants as have already been mentioned, for example, above in the case of the other formulation types. Here, the active compounds are present in dissolved form.

Granules can be prepared either by spraying the active compound onto adsorptive, granulated inert material or by applying active compound concentrates to the surface of carriers such as sand, kaolinites, chalk or granulated inert material with the aid of binders, for example polyvinyl alcohol, sodium polyacrylate or else mineral oils. Suitable
active compounds can also be granulated in the manner customary for the preparation of fertilizer granules - if desired as a mixture with fertilizers. Water-dispersible granules are produced generally by the customary processes such as spray-drying, fluidized bed granulation, pan granulation, mixing with high-speed mixers and extrusion without solid inert material. For the production of pan granules, fluidized bed granules, extruder granules and spray granules, see, for example, processes in "Spray-Drying Handbook" 3rd ed. 1979, G. Goodwin Ltd., London; J.E. Browning, "Agglomeration", Chemical and Engineering 1967, pages 147 ff.; "Perry's Chemical Engineer's Handbook", 5th ed., McGraw-Hill, New York 1973, pp. 8-57.


The agrochemical formulations generally comprise from 0.1 to 99% by weight, in particular from 2 to 95% by weight, of active compounds of the herbicide components, the following concentrations being customary, depending on the type of formulation: In wettable powders, the active compound concentration is, for example, about 10 to 95% by weight, the remainder to 100% by weight consisting of customary formulation constituents. In the case of emulsifiable concentrates, the active compound concentration can be, for example, from 5 to 80% by weight. In most cases, formulations in the form of dusts comprise from 5 to 20% by weight of active compound, sprayable solutions comprise about 0.2 to 25% by weight of active compound. In the case of granules such as dispersible granules, the active compound content depends partially on whether the active compound is present in liquid or solid form and on which granulation auxiliaries and fillers are used. In water-dispersible granules, the content is generally between 10 and 90% by weight.

In addition, the active compound formulations mentioned optionally comprise the respective customary adhesives, wetting agents, dispersants, emulsifiers,
preservatives, antifreeze agents and solvents, fillers, colorants and carriers, antifoams, evaporation inhibitors and pH- or viscosity-modifying agents.

The herbicidal action of the herbicide combinations according to the invention can be improved, for example, by surfactants, for example 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 or phosphates, which are 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 2 - 20, preferably 3 - 15, ethylene oxide units, for example from the Genapol® X series, such as Genapol® X-030, Genapol® X-060, Genapol® X-080 or Genapol® X-150 (all from Clariant GmbH).

The present invention further comprises the combination of components A, B and C 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 sodium C₁₂/C₁₄-fatty alcohol diglycol ether sulfate (Genapol® LRO, Clariant GmbH) and isotridecyl alcohol polyglycol ethers 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). It is
also 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 as penetrants and activity enhancers for a number of other herbicides, including herbicides from the group of the imidazolinones (see, for example, EP-A-0502014).

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.

The vegetable oils are preferably esters of C_{10}-C_{22}^{*}, preferably C_{12}-C_{20}^{*}, fatty acids. The C_{10}-C_{22}^{*}-fatty acid esters are, for example, esters of unsaturated or saturated C_{10}-C_{22}^{*}-fatty acids having, in particular, an even number of carbon atoms, for example erucic acid, lauric acid, palmitic acid and in particular C_{18}-fatty acids such as stearic acid, oleic acid, linoleic acid or linolenic acid.

Examples of C_{10}-C_{22}^{*}-fatty acid esters are esters which are obtained by reacting glycerol or glycol with the C_{10}-C_{22}^{*}-fatty acids present, for example, in oils of oleaginous plant species, or C_{1}-C_{20}^{*}-alkyl C_{10}-C_{22}^{*}-fatty acid esters which can be obtained, for example, by transesterification of the glycerol or glycol C_{10}-C_{22}^{*}-fatty acid esters mentioned above with C_{1}-C_{20}^{*}-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.

Preferred C_{1}-C_{20}^{*}-alkyl-C_{10}-C_{22}^{*}-fatty acid esters are methyl esters, ethyl esters, propyl esters, butyl esters, 2-ethylhexyl esters and dodecyl esters. Preferred glycol and glycerol C_{10}-C_{22}^{*}-fatty acid esters are the uniform or mixed glycol esters and glycerol esters of C_{10}-C_{22}^{*}-fatty acids, in particular fatty acids having an even number of carbon
atoms, for example erucic acid, lauric acid, palmitic acid and in particular C<sub>18</sub>-fatty acids such as stearic acid, oleic acid, linoleic acid or linolenic acid.

In the herbicidal compositions 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).

In a further embodiment, the present invention embraces combinations of the components A, B and C 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®, Actirob®B, Rako-Binol®, Renol® or Stefes Mero®.

For application, the formulations in commercial form are, if appropriate, diluted in a customary manner, for example in the case of wettable powders, emulsifiable concentrates, dispersions and water-dispersible granules with water. Dust-type preparations, granules for soil application or granules for scattering and sprayable formulations are not normally diluted further with other inert substances prior to application.

The active compounds can be applied to the plants, plant parts, plant seeds or area under cultivation (soil), preferably on the green plants and plant parts, and optionally additionally to the soil.
One means of application is the co-deployment of the active compounds in the form of tank-mixes, by mixing the optimally formulated concentrated formulations of the individual active compounds together in the tank with water and deploying the spray liquor obtained.

A joint herbicidal formulation of the herbicidal compositions according to the invention comprising the components A, B and C has the advantage that it can be applied more easily since the quantities of the components are already adjusted to the correct ratio to one another. Moreover, the auxiliaries in the formulation can be optimized to one another.

A. General formulation examples

a) A dust is obtained by mixing 10 parts by weight of an active compound/active compound mixture and 90 parts by weight of talc as inert substance and comminuting the mixture in a hammer mill.

b) A wettable powder which is readily disperseable in water is obtained by mixing 25 parts by weight of an active compound/active compound mixture, 64 parts by weight of kaolin-containing clay as inert substance, 10 parts by weight of potassium lignosulphonate and 1 part by weight of sodium oleylmethyltaurate as wetting agent and dispersant, and grinding the mixture in a pinned-disk mill.

c) A suspension concentrate which is readily disperseable in water is obtained by mixing 20 parts by weight of an active compound/active compound mixture with 5 parts by weight of tristyrlylphenol polyglycol ether (Soprobor BSU), 1 part by weight of sodium lignosulfonate (Vanisperse CB) and 74 parts by weight of water, and grinding the mixture in a ball mill to a fineness of below 5 microns.
d) An oil dispersion which is readily dispersible in water is obtained by mixing 20 parts by weight of an active compound/active compound mixture with 6 parts by weight of alkylphenol polyglycol ether (Triton® X 207), 3 parts by weight of isotridecanol polyglycol ether (8 EO) and 71 parts by weight of paraffinic mineral oil (boiling range for example approx. 255 to 277°C), and grinding the mixture in a ball mill to a fineness of below 5 microns.

e) An emulsifiable concentrate is obtained from 15 parts by weight of an active compound/active compound mixture, 75 parts by weight of cyclohexanone as solvent and 10 parts by weight of oxyethylated nonylphenol as emulsifier.

f) Water-dispersible granules are obtained by mixing 75 parts by weight of an active compound/active compound mixture, 10 parts by weight of calcium lignosulfonate, 5 parts by weight of sodium laurylsulfate, 3 parts by weight of polyvinyl alcohol and 7 parts by weight of kaolin, grinding the mixture in a pinned-disk mill, and granulating the powder in a fluidized bed by spray application of water as a granulating liquid.

g) Water-dispersible granules are also obtained by homogenizing and precommuting, in a colloid mill, 25 parts by weight of an active compound/active compound mixture, 5 parts by weight of sodium 2,2'-dinaphthylmethane-6,6'-disulfonate, 2 parts by weight of sodium oleoylmethyltaurate, 1 part by weight of polyvinyl alcohol, 17 parts by weight of calcium carbonate and 50 parts by weight of water, then grinding the mixture in a bead mill and atomizing and drying the resulting suspension in a spray tower by means of a one-phase nozzle.
B. Biological examples

a) Description of the methods

Greenhouse trials

In the standard implementation of the test, seeds of various broad-leaved weed and weed grass biotypes (origins) were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures of the prior art or the components applied individually. Application of the active compounds or active compound combinations formulated as WG, WP, EC or otherwise was carried out at the appropriate growth stages of the plants. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned to the greenhouses.

About 3 weeks after the application, the soil action or/and foliar action was assessed visually according to a scale of 0-100% in comparison to an untreated comparative group: 0% = no noticable effect compared to the untreated comparative group; 100% = full effect compared to the untreated comparative group.

(Notes: the term "seeds" also includes vegetative propagation forms such as, for example, rhizome pieces; abbreviations used: h light = hours of illumination, g of AS/ha = grams of active substance per hectare, l/ha = liter per hectare, S = sensitive, R = resistant)
1. Pre-emergence action against weeds: seeds of various broad-leaved weed and weed grass biotypes (origins) were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at BBCH stage 00-10 of the seeds/plants on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned to the greenhouses and fertilized and watered as required.

2. Post-emergence action against weeds: seeds of various broad-leaved weed and weed grass biotypes (origins) were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at various BBCH stages between 11-25 of the seeds/plants, i.e. generally between two to three weeks after the start of the cultivation, on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned to the greenhouses and fertilized and watered as required.

3. Selective pre-emergence action: seeds of various crop species (origins) were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at BBCH stage 00-10 of the seeds/plants on a laboratory track sprayer with spray liquors comprising the
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4. Selective post-emergence action: seeds of various crop species (origins) were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at various BBCH stages 11-32 of the seeds/plants, i.e. generally between two to four weeks after the start of the cultivation, on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned to the greenhouses and fertilized and watered as required. The pots were cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C).

5. Pre-emergence and post-emergence action against weeds under various cultivation conditions: seeds of various broad-leaved weed and weed grass biotypes (origins) were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at various BBCH stages 00-25 of the seeds/plants on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned to the greenhouses and fertilized and watered as required. The pots were cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C). Irrigation was
varied according to the issue. Here, the individual comparative groups were provided with gradually differing amounts of water in a range from above the PWP (permanent wilting point) up to the level of maximum field capacity.

6. Pre-emergence and post-emergence action against weeds under various irrigation conditions: seeds of various broad-leaved weed and weed grass biotypes (origins) were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at various BBCH stages 00-25 of the seeds/plants on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned to the greenhouses and fertilized and watered as required. The pots were cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C). The individual comparative groups were subjected to different irrigation techniques. Irrigation was either from below or gradually from above (simulated rain).

7. Pre-emergence and post-emergence action against weeds under various soil conditions: seeds of various broad-leaved weed and weed grass biotypes (origins) were sown in an 8-13 cm diameter pot filled with natural soil and covered with a covering soil layer of about 1 cm. To compare the herbicidal action, the plants were cultivated in various cultivation soils from sandy soil to heavy clay soil and various contents of organic substance. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at various BBCH stages 00-25 of the seeds/plants on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After
the treatment, the plants were returned to the greenhouses and fertilized and watered as required. The pots were cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C).

8. Pre-emergence and post-emergence action against weeds for the control of resistant weed grass/broad-leaved weed species: seeds of various broad-leaved weed and weed grass biotypes (origins) having various resistance mechanisms against different modes of action were sown in an 8-13 cm diameter pot filled with natural soil of a standard field soil (loamy silt; non-sterile) and covered with a covering soil layer of about 1 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at various BBCH stages 00-25 of the seeds/plants on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned to the greenhouses and fertilized and watered as required. The pots were cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C).

9. Pre-emergence and post-emergence action against weeds and crop selectivity under various sowing conditions: seeds of various broad-leaved weed and weed grass biotypes (origins) and crop species (origins) were sown in an 8-13 cm diameter pot filled with natural soil and covered with a covering soil layer of about 0-5 cm. The pots were then cultivated in a greenhouse (12-16 h light, temperature day 20-22°C, night 15-18°C) until the time of application. The pots were treated at various BBCH stages 00-25 of the seeds/plants on a laboratory track sprayer with spray liquors comprising the compositions according to the invention, mixtures or the components applied individually as WG, WP, EC or other formulations. The amount of water used for spray application was 100-600 l/ha. After the treatment, the plants were returned...
HRAC = Herbicide Resistance Action Committee which classifies the approved active compounds according to their mode of action (MoA).

5 HRAC group A = acetyl coenzyme A carboxylase inhibitors (MoA: ACCase).
HRAC group B = acetolactate synthase inhibitors (MoA: ALS).

AS = active substance (based on 100% of active ingredient; syn. a.i.).

10 Dosage g of AS/ha = application rate in grams of active substance per hectare.

LOLSS = Lolium species.

The activities of the herbicidal compositions according to the invention meet the stated requirements and therefore solve the object of improving the application profile of the herbicidally active compound flufenacet (inter alia provision of more flexible solutions with regard to the application rates required for unchanged to enhanced activity).

Insofar as herbicidal effects of the compositions according to the invention compared to mixtures of the prior art or compared to components applied individually against economically important mono- and dicotyledonous harmful plants were the center of attention, the synergistic herbicidal activities were calculated using Colby's formula (cf. S. R. Colby; Weeds 15 (1967), 20-22):

\[ E^C = (A + B + C) - (AxB + AxC + BxC)/100 + (AxBxC)/10000 \]

where:
A, B, C = the activity of components A, B and C, respectively, in percent at a rate of a, b and c grams of AS/ha, respectively;

30 \[ E^C = \text{expected value according to Colby in } \% \text{ at a rate of } a + b + c \text{ grams of AS/ha.} \]
Δ = difference (%) of the measured value (%) to the expected value (%)
(measured value minus expected value)

5 Evaluation: 
- measured values: in each case for (A), (B) and (C) and 
(A)+(B)+(C) in %

Assessment: 
- measured value (%) greater > than \( E^C \): ± synergism (+Δ)
- measured value (%) equal to = \( E^C \): ± additive effect (±0Δ)
- measured value (%) smaller < than \( E^C \): ± antagonism (-Δ).
Table 1: Comparison of the effect of the mixture on resistant biotypes of Lolium spp. following post-emergence treatment (PO, BBCH 11).

<table>
<thead>
<tr>
<th></th>
<th>LOLSS</th>
<th>LOLSS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dose g of AS/ha</td>
<td>resistant to HRAC group A</td>
</tr>
<tr>
<td>flufenacet (A)</td>
<td>60</td>
<td>18</td>
</tr>
<tr>
<td>aclohalifen (B)</td>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>diflufenican(C)</td>
<td>37.5</td>
<td>23</td>
</tr>
<tr>
<td>(A) + (B)+(C)</td>
<td>60+150+37.5</td>
<td>98</td>
</tr>
<tr>
<td>calculation according to Colby&lt;sup&gt;a&lt;/sup&gt;</td>
<td>$E^c = 40; \Delta +58$</td>
<td>$E^c = 84; \Delta +15$</td>
</tr>
<tr>
<td>pinoxaden + cloquintocet-mexyl&lt;sup&gt;1&lt;/sup&gt;; HRAC group A</td>
<td>60+15</td>
<td>0</td>
</tr>
<tr>
<td>mesosulfuron + iodosulfuron + mefenpyr&lt;sup&gt;1&lt;/sup&gt;; HRAC group B</td>
<td>15+3+45</td>
<td>84</td>
</tr>
</tbody>
</table>

<sup>1</sup> Comparative product for demonstrating the resistance present in the various biotypes.

For the plant species investigated, a clear synergistic effect against resistant biotypes of HRAC groups A and B could be demonstrated for the mixture ($\Delta +58 - +15$).
Claims

1. A herbicidal composition comprising, as sole herbicidally active constituents,
   A) flufenacet (component A),
   B) aclonifen (component B) and
   C) diflufenican (component C).

2. The herbicidal composition as claimed in claim 1, wherein the herbicide
   components, with respect to one another, are present in the weight ratio stated below:
   (range component A) : (range component B) : (range component C)
   generally (1 - 2000) : (1 - 100) : (1 - 500),
   preferably (1 - 40) : (1 - 25) : (1 - 30),
   particularly preferably (1 - 10) : (1 - 10) : (1 - 8).

3. The herbicidal composition as claimed in claim 1 or 2, comprising the respective
   herbicide components in the application rates stated below:
   component A: generally 10 - 2000 g of AS/ha, preferably 30 - 400 g of AS/ha,
   particularly preferably 50 – 300 g of AS/ha of flufenacet;
   component B: generally 10 - 5000 g of AS/ha, preferably 80 - 3000 g of AS/ha,
   particularly preferably 80 – 1000 g of AS/ha of aclonifen;
   component C: generally 1 - 500 g of AS/ha, preferably 10 - 300 g of AS/ha,
   particularly preferably 30 – 200 g of AS/ha of diflufenican.

4. The herbicidal composition as claimed in any of claims 1 to 3, additionally
   comprising formulation auxiliaries and/or additives customary in crop protection.

5. The herbicidal composition as claimed in any of claims 1 to 4, additionally
   comprising one or more further components from the group of agrochemical active
   compounds comprising insecticides, fungicides and safeners.
6. The use of the herbicidal compositions defined in any of claims 1 to 5 for controlling harmful plants.

7. The use of the herbicidal compositions defined in any of claims 1 to 5 for controlling herbicide-resistant harmful plants.

8. A method for controlling unwanted vegetation which comprises applying the components A, B and C of the herbicidal compositions, defined according to any of claims 1 to 5, jointly or separately to the plants, plant parts, plant seeds or the area on which the plants grow.

9. The method as claimed in claim 8 for the selective control of harmful plants in plant crops.

10. The method as claimed in claim 9 in which the plant crops are genetically modified or have been obtained by mutation selection.