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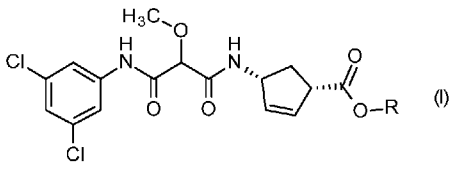
(54) Title: MALONAMIDES FOR SELECTIVE WEED CONTROL IN GRAIN CROPS



(I)

(57) Abstract: A method for selectively controlling weeds in monocotyledonous crops, which comprises applying to the crop cultiva- tion area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I); wherein R is hydrogen, (C_1-C_6)-alkyl or (C_3-C_6)-cycloalkyl.

Malonamides for selective weed control in grain crops

The present invention relates to a method for selectively controlling weeds in monocotyledonous crops, in particular in grain crops, which comprises applying an effective amount of a herbicidal malonamide (herbicide A) to the cultivation area of a monocotyledonous crop, preferably of a grain crop, where weeds grow or may grow, as described herein.

The present invention also relates to the use of said herbicide A for selective weed control in monocotyledonous crops, in particular in grain crops.

BACKGROUND ON THE INVENTION

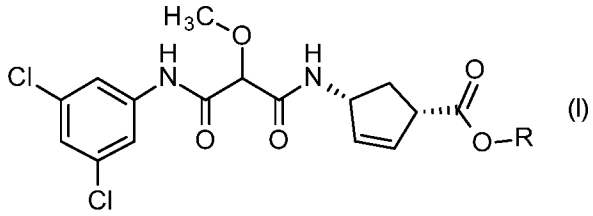
In crop protection products, it is desirable in principle to increase the specificity and the reliability of the action of active compounds. In particular, it is desirable for the crop protection product to control the harmful plants effectively and, at the same time, to be tolerated by the useful plants in question. It is known that in some cases better crop plant compatibility can be achieved by joint application of specifically acting herbicides with organic active compounds, which act as antidotes or antagonists. Owing to the fact that these antidotes or antagonists can reduce or even prevent damage to the crop plants, they are also referred to as safeners.

WO2018/228985 relates to herbicidally active 3-phenylisoxazoline-5-carboxamides of tetrahydro- and dihydrofurancarboxylic acids and esters and their agrochemically acceptable salts and to the use thereof in the field of plant protection. According to WO2021/245003, the compatibility of these compounds with crop plants is not entirely satisfactory under all conditions, and the combination with the safener Isoxadifen-ethyl is therefore proposed to prevent damage to crop plants.

Generally, it is preferred that a herbicidal compound controls undesired vegetation effectively and shows an acceptable phytotoxicity towards the crop plant at the same time.

WO2021/170464 discloses certain malonamide compounds and compositions comprising the same for controlling unwanted vegetation. While these malonamide compounds show excellent herbicidal activity, there remains a need for methods to selectively control weeds specifically in monocotyledonous crops, in particular in grain crops, that provide efficient control of the undesired vegetation and at the same time are well tolerated by monocotyledonous crops such as grain crops.

We have found that this object and further objects are achieved by a method comprising applying to the cultivation area of a monocotyledonous crop, preferably of a grain crop, an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)



(I)

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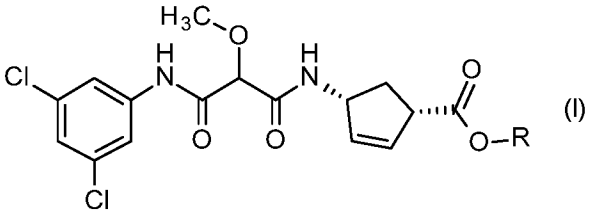
wherein R is hydrogen, (C_1-C_6)-alkyl or (C_3-C_6)-cycloalkyl.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method for selectively controlling weeds in monocotyledonous crops, in particular in grain crops using a herbicidal composition, which allows efficient and reliable control of the weeds which grow or may grow in the cultivation area of a monocotyledonous crop, in particular of a grain crop and which, at the same time, is well tolerated by said crop.
Moreover, the method should allow for efficient weed control in said crops, without requiring the presence of a safener to prevent or reduce damage to the monocotyledonous crops, in particular to the grain crops.

In addition, duration of the herbicidal activity of the composition should be sufficiently long in order to achieve weed control over an adequately long time period, thus allowing a more flexible application.

Surprisingly, it has now been found that weeds that grow or will grow in a cultivation area of monocotyledonous crops, in particular of grain crops are selectively controlled by applying to the crop cultivation area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)



(I)

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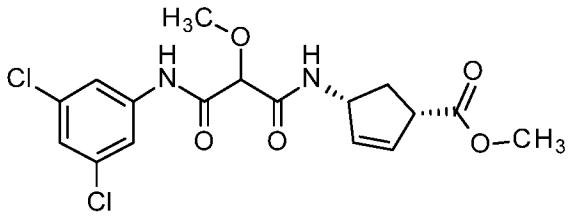
wherein R is hydrogen, (C_1-C_6)-alkyl or (C_3-C_6)-cycloalkyl.

In a preferred embodiment of the method according to present invention, an effective amount of a herbicide A selected from the compound of formula (I) and salts of the compound of formula (I), wherein R is hydrogen, (C_1-C_3)-alkyl or (C_3-C_5)-cycloalkyl, is applied to the crop cultivation area.

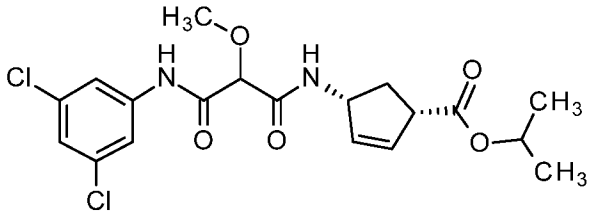
In a more preferred embodiment of the method according to present invention, an effective amount of a herbicide A selected from the compound of formula (I) and salts of the compound of formula (I), wherein R is hydrogen, methyl, ethyl, isopropyl, cyclopropyl, or cyclobutyl, preferably hydrogen, methyl or isopropyl, is applied to the crop cultivation area.

In a particularly preferred embodiment of the method according to present invention, the herbicide A, which is applied to the crop cultivation area, is the compound of formula (I.a) or a salt of the compound of formula (I.a)



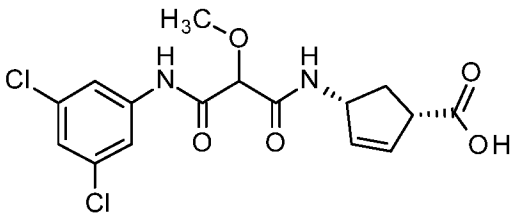
(I.a)

In a further particularly preferred embodiment of the method according to present invention, the herbicide A, which is applied to the crop cultivation area, is the compound of formula (I.b) or salts of the compound of formula (I.b)



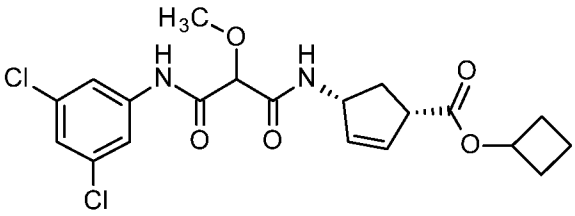
(I.b)

In a further particularly preferred embodiment of the method according to present invention, the herbicide A, which is applied to the crop cultivation area, is the compound of formula (I.c) or salts of the compound of formula (I.c)



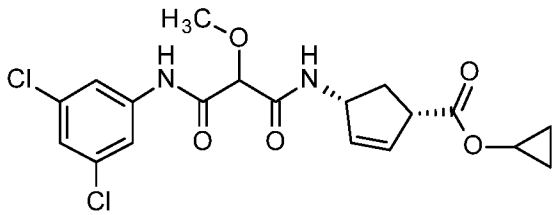
(I.c)

In a further particularly preferred embodiment of the method according to present invention, the herbicide A, which is applied to the crop cultivation area, is the compound of formula (I.d) or salts of the compound of formula (I.d)



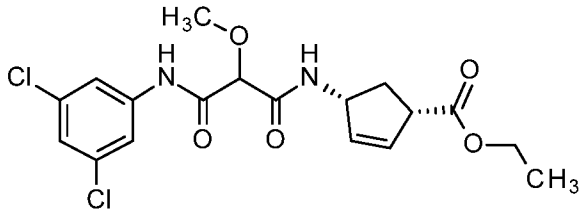
(I.d)

In a further particularly preferred embodiment of the method according to present invention, the herbicide A, which is applied to the crop cultivation area, is the compound of formula (I.e) or salts of the compound of formula (I.e)



(I.e)

In a further particularly preferred embodiment of the method according to present invention, the herbicide A, which is applied to the crop cultivation area, is the compound of formula (I.f) or salts of the compound of formula (I.f)



(I.f)

In the methods according to the present invention, the required application rate of the pure active compounds, i.e. of herbicide A, depends on the density of the undesired vegetation, on the development stage of the plants, on the climatic conditions of the location where the herbicide A or the composition comprising herbicide A is used and on the application method.

In general, the application rate of the herbicide A is from 1 g/ha to 500 g/ha, preferably from 1 g/ha to 250 g/ha, more preferably from 1 g/ha to 100 g/ha of active substance.

The herbicide (A) can generally be applied to weeds at any growth stage with good results. In one embodiment, the herbicide (A) is applied up to BBCH growth stage 37 of the weeds, showing effective weed control.
BBCH growth stages are as defined in "Growth stages of mono- and dicotyledonous plants", BBCH Monograph edited by Uwe Meier Julius Kühn-Institut (JKI), Open Agrar Repositorium, Quedlinburg 2018 DOI: 10.5073/20180906-074619 ISBN: 978-3-95547-071-5.

The present invention relates to a method for selectively controlling weeds in monocotyledonous crops, in particular in grain crops, including cereals, maize, sorghum and rice.

In the method according to the present invention for selectively controlling weeds in monocotyledonous crops, in particular in grain crops, the herbicide (A) can generally be applied pre-emergence of the crop or post-emergence of the crop.

Weeds, which are controlled by the method according to the present invention include monocotyledonous weeds (monocots) and dicotyledonous weeds (dicots), preferably monocots.

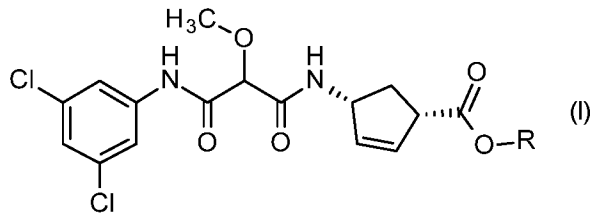
The method of the present invention for selectively controlling weeds in monocotyledonous crops, in particular in grain crops has several advantages over methods applying structurally similar herbicides:

- The method of the present invention shows superior crop compatibility with certain conventional crop plants, in particular with monocotyledonous crops such as grain crops. This is surprising as said crops are monocotyledonous plants as the grass weeds, which are controlled by the method according to the invention.

- Thus, the method of the invention can also be applied after the emergence of the crop plants (post-emergence of the crop plants) without the addition of a safener.
- The method of the invention provides for an adequate duration of herbicidal activity, even under difficult weathering conditions, which allows a more flexible application and minimizes the risk of weeds escaping.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a method for selectively controlling weeds in monocotyledonous crops, in particular in grain crops, which comprises applying to the crop cultivation area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)



(I)

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wherein R is hydrogen, (C_1-C_6)-alkyl or (C_3-C_6)-cycloalkyl.

The present invention is also directed to compounds of formula (I). Furthermore, the present invention is directed to agrochemical compositions for selective weed control in monocotyledonous crops, in particular in grain crops which comprise a compound of formula (I) and one or more auxiliaries, customary for crop protection compositions.

As used herein, the terms "controlling" and "combating" are synonyms, referring to inhibition of growth, control of growth, reduction of growth or complete destruction of weeds.

As used herein, the terms “composition of herbicide A” and “composition comprising herbicide A” refer to any composition of a herbicide A. Different salts of the herbicide A are considered as the same herbicide compound.

As used herein, the term “agrochemical composition” refers to a composition of herbicide A (and to a composition comprising herbicide A) and one or more auxiliaries, customary for crop protection compositions.

As used herein "herbicide" refers to one or more agents, compounds and/or compositions having herbistatic and/or herbicidal activity.

As used herein, the terms "undesirable vegetation", "undesirable species", "undesirable plants", "harmful plants", "undesirable weeds", “volunteer plants”, “weeds” or "harmful weeds" are used synonymously.

As used herein, the term "an effective amount" refers to the quantity or application rate of the herbicide A that is necessary to achieve the desired effect or result. It is the amount of the herbicide A that is sufficient to effectively control

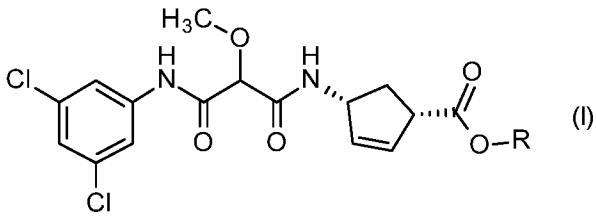
or eliminate the target weeds or plants, while minimizing any adverse effects on non-target organisms or the environment. The specific effective amount may vary depending on factors such as target plant species, application method, environmental conditions, and the desired level of control.

As used herein, "post emergence" refers to an herbicide treatment that is applied to an area after the crop plants have germinated and emerged from the ground or growing medium.

As used herein, "pre emergence" refers to an herbicide treatment that is applied to an area before the crop plants have emerged from the ground or growing medium.

As used herein, "burndown" refers to when an herbicide is used to reduce weed presence at the time of treatment. Burndown is often used in minimum or no-till fields because the weeds cannot be managed by tilling the soil. The burndown application may be used post-harvest and/or prior to crop emergence. Burndown is especially useful against weeds that emerge between growing seasons.

The malonamide compounds of formula (I), wherein R is hydrogen, (C_1-C_6)-alkyl or (C_3-C_6)-cycloalkyl, are known from WO2021/170464. In the methods according to the present invention, malonamide compounds of formula (I), wherein the substituents of the cyclopentene are oriented in the same direction (preferably cis-diastereomers I.a to I.f as shown below), are applied.



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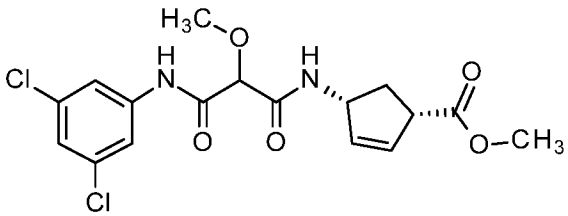
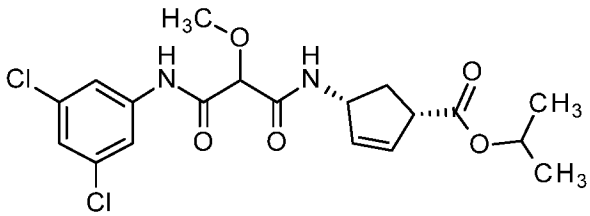
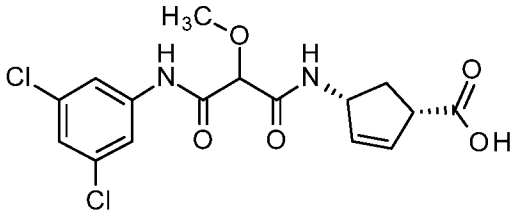


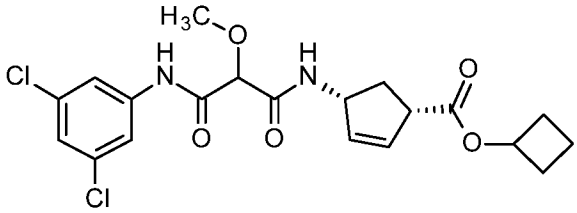
(I.a)



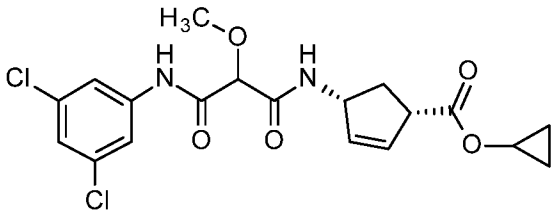
(I.b)



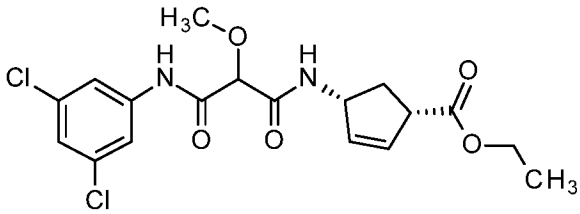
(I.c)



(I.d)



(I.e)



(I.f)

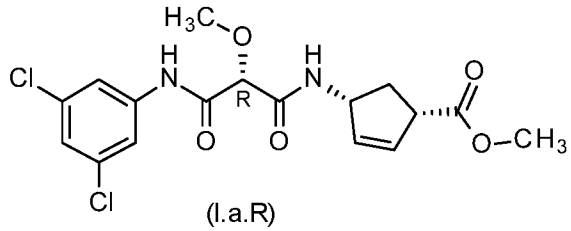
Depending on the stereochemical orientation of the methoxy group (R or S), the cis-diastereomers I.a to I.f are present as epimer/diastereomer mixtures (I.a.R + I.a.S; I.b.R + I.b.S, I.c.R + I.c.S, I.d.R + I.d.S, I.e.R + I.e.S, I.f.R + I.f.S) in varying ratios.

Accordingly, compounds I.a.R, I.a.S, I.b.R, I.b.S, I.c.R, I.c.S, I.d.R, I.d.S, I.e.R, I.e.S, I.f.R, I.f.S and respective epimer/diastereomer mixtures are particularly preferred as herbicide A in the methods of the present invention.

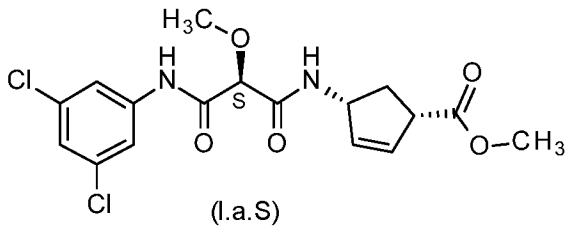
In the context of the present invention, any ratio of the malonamide compound of formula (I) epimers in the respective epimer/diastereomer mixtures is contemplated and useful in the methods for weed control in grain crops. Non-limiting examples for ratios of the epimers in the respective epimer/diastereomer mixtures are 100: 0, 99.9:0.1, 99.5:0.5, 99:1, 98:2, 95:5, 90:10, 80:20, 70:30, 60:40, 55:45, 50:50, 45:55, 40:60, 30:70, 20:80, 10:90, 5:95, 2:98, 1:99, 0.5:99.5, 0.1:99.9, 0:100. In some embodiments, the ratio of the epimers in the respective epimer/diastereomer mixtures is 95:5 or 50:50 +/- 10 % respectively.

In the context of the present invention, epimer/diastereomer mixtures I.a.R + I.a.S, I.b.R + I.b.S, or I.c.R + I.c.S in varying ratios as listed above are particularly preferred components A in the methods according to the present invention; in very particularly preferred epimer/diastereomer mixtures, the percentage the S-epimer in the epimer/diastereomer mixture is equal to or larger than the percentage of the R-epimer. For example, the S-epimer can be in the

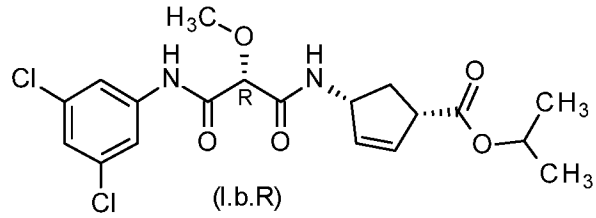
range of, 50-100%, 60 to 100%, 70 to 100%, 80 to 100%, 90 to 100% or 95% +/- 5%, wherein the sum of the S- and the R-epimer is 100%.



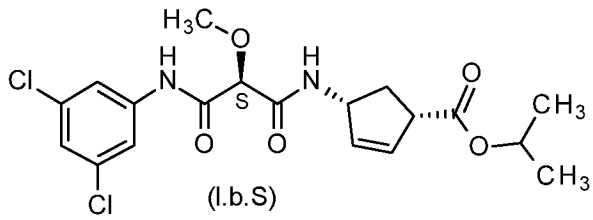
(I.a.R)



(I.a.S)



(I.b.R)



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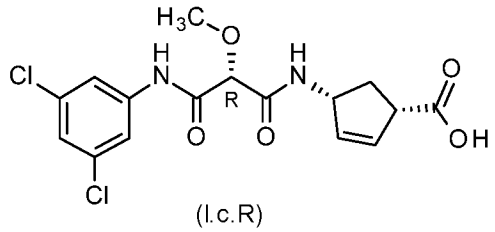
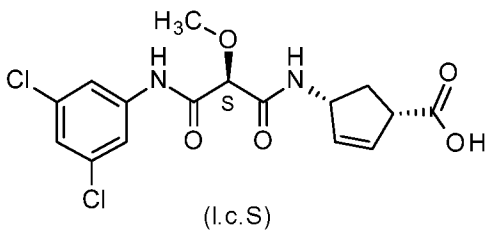


(I.c.R)



(I.c.S)

Here and throughout the specification, the prefixes "C_n-C_m" used in connection with compounds or molecular moieties each indicate a range for the number of possible carbon atoms that a molecular moiety or a compound can have. The term "C_1-C_n-alkyl" denominates a group of linear or branched saturated hydrocarbon radicals having from 1 to n carbon atoms.

For example, the term "C_1-C_4-alkyl" denominates a group of linear or branched saturated hydrocarbon radicals having from 1 to 4 carbon atoms. C_1-C_4-Alkyl is methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl, isobutyl, or tert-butyl.

The term "(C_3-C_6)-cycloalkyl" denominates a monocyclic saturated hydrocarbon group having 3 to 6, in particular 4 to 5, carbon ring members, such as cyclopropyl, cyclobutyl, cyclopentyl, or cyclohexyl.

In the context of the present invention, the malonamide compounds of formula (I), herbicide A, can be employed as such or in the form of their agriculturally acceptable salts. Suitable are, in general, the salts of those cations and the acid addition salts of those acids whose cations and anions, respectively, have no adverse effect on the activity of the active compounds.

Preferred cations are the ions of the alkali metals, preferably of lithium, sodium and potassium, of the alkaline earth metals, preferably of calcium and magnesium, and of the transition metals, preferably of manganese, copper, zinc and iron, further ammonium and substituted ammonium in which one to four hydrogen atoms are replaced by C_1-C_4-alkyl, hydroxy-C_1-C_4-alkyl, C_1-C_4-alkoxy-C_1-C_4-alkyl, hydroxy-C_1-C_4-alkoxy-C_1-C_4-alkyl, phenyl or benzyl, preferably ammonium, methylammonium, isopropylammonium, dimethylammonium, diethylammonium, diisopropylammonium,

trimethylammonium, triethylammonium, tris(isopropyl)ammonium, heptylammonium, dodecylammonium, tetradecylammonium, tetramethylammonium, tetraethylammonium, tetrabutylammonium, 2-hydroxyethylammonium (olamine salt), 2-(2-hydroxyeth-1-oxy)eth-1-ylammonium (diglycolamine salt), di(2-hydroxyeth-1-yl)ammonium (diolamine salt), tris(2-hydroxyethyl)ammonium (trolamine salt), tris(2-hydroxypropyl)ammonium, benzyltrimethylammonium, benzyltriethylammonium, N,N,N-trimethylethanolammonium (choline salt), furthermore phosphonium ions, sulfonium ions, preferably tri(C_1-C_4-alkyl)sulfonium, such as trimethylsulfonium, and sulfoxonium ions, preferably tri(C_1-C_4-alkyl)sulfoxonium, and finally the salts of polybasic amines such as N,N-bis-(3-aminopropyl)methylamine and diethylenetriamine.

Anions of useful acid addition salts are primarily chloride, bromide, fluoride, iodide, hydrogensulfate, methylsulfate, sulfate, dihydrogenphosphate, hydrogenphosphate, nitrate, bicarbonate, carbonate, hexafluorosilicate, hexafluorophosphate, benzoate and also the anions of C_1-C_4-alkanoic acids, preferably formate, acetate, propionate and butyrate.

In the methods according to the present invention, the required application rate of the pure active compounds, i.e. of herbicide A, depends on the density of the undesired vegetation, on the development stage of the plants, on the climatic conditions of the location where the composition is used and on the application method.
In general, the application rate of herbicide A is from 1 g/ha to 500 g/ha, preferably from 1 g/ha to 250 g/ha, more preferably from 1 g/ha to 100 g/ha of active substance.

The recitation of ranges of values is a way of referring to each separate value within the range. This means that each individual value within the range is included in the specification as if it were individually recited. The range includes the endpoints, and any combination of values within the range can be used independently. When referring to numerical values or numerical ranges, integers and fractions within the range are included unless the context clearly indicates otherwise.
Exemplary for application rates, a range of 1 g/ha to 100 g/ha includes all application rates with values between 1 and 100, i.e. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, and 99, as well as values like 30.1, 35.4, 42.5, 48,8 and so on.

The above-mentioned application rates of herbicide indicate the amount of active agent without auxiliaries such as carrier material or surfactants.

In one embodiment of the method according to present invention, the herbicide A is applied pre-emergence of the monocotyledonous crop, in particular of the grain crop with an application rate of 1 g/ha to 250 g/ha, e.g. 2.5 g/ha to 250 g/ha.

In another embodiment of the method according to present invention, the herbicide A is applied post-emergence of the monocotyledonous crop, in particular of the grain crop with an application rate of 1 g/ha to 100 g/ha.

In a particular embodiment of the method according to present invention, the herbicide A is applied post-emergence of the monocotyledonous crop, in particular of the grain crop with an application rate of 1 g/ha to 75 g/ha, preferably with an application rate of 4 to 64 g/ha, more preferably with an application rate of 8 to 48 g/ha.

The method or the use of the present invention is particularly suitable for selectively controlling *weeds*, wherein the herbicide A is applied to the cultivation area of monocotyledonous crops, in particular of grain crops, where weeds grow or may grow.

In a preferred embodiment of the method or the use of the present invention, the herbicide A is applied to an area, where a monocotyledonous crop, in particular a grain crop was planted.

The method or use of the present invention is particularly suitable for controlling weeds in fields of sugar cane and the grain crops, such as

- cereals (small grain crops) such as wheat (*Triticum aestivum*) and wheat-like crops such as durum (T. durum), einkorn (*T. monococcum*), emmer (*T. dicoccon*) and spelt (*T. spelta*), rye (*Secale cereale*), triticale (*Tritiosecale*), barley (*Hordeum vulgare*);
- maize (corn; *Zea mays*);
- sorghum (e.g. *Sorghum bicolour*);
- rice (*Oryza spp.* such as *Oryza sativa* and *Oryza glaberrima*).

If not stated otherwise, the herbicide A is suitable for application in any variety of grain crops as outlined herein.

In a preferred embodiment of the method according to present invention, an effective amount of a herbicide A is applied to the crop cultivation area, where wheat, durum, einkorn, emmer, spelt, rye, triticale, or barley, preferably barley or wheat, was planted.

In a further preferred embodiment of the method according to present invention, an effective amount of a compound (I.a) is applied to the crop cultivation area, where wheat, durum, einkorn, emmer, spelt, rye, triticale, or barley, preferably barley or wheat, was planted.

In a further preferred embodiment of the method according to present invention, an effective amount of a compound (I.b) is applied to the crop cultivation area, where wheat, durum, einkorn, emmer, spelt, rye, triticale, or barley, preferably barley or wheat, was planted.

In a further preferred embodiment of the method according to present invention, an effective amount of a compound (I.c) is applied to the crop cultivation area, where wheat, durum, einkorn, emmer, spelt, rye, triticale, or barley, preferably barley or wheat, was planted.

The method according to the present invention is useful for controlling a large variety of harmful plants (undesired vegetation), including monocotyledonous weeds and dicotyledonous weeds, in particular, for controlling weeds, which are selected from the genera Abutilon, Alisma, Alopecurus, Amaranthus, Ambrosia, Ammania, Ammi, Aneilema, Anthemis, Apera, Atriplex, Avena, Barbarea, Bidens, Brassica, Bromus, Bunias, Butomus, Capsella, Centaurea, Chenopodium, Cirsium, Conium, Convolvolus, Cyperus, Datura, Daucus, Descurainia, Digitaria, Echinochloa, Fumaria, Galinsoga, Galium, Geranium, Helianthus, Heliotropium, Heteranthera, Hibiscus, Hordeum, Lamium, Leptochloa, Leersia, Lolium, Lycopsis, Matricaria, Mercurialis, Orobanche, Oryza, Panicum, Papaver, Poa, Polygonum, Portulaca, Raphanus, Scirpus, Setaria, Sinapis, Solanum, Sonchus, Sorghum, Sisymbrium, Stachys, Stellaria, Thlaspi, Triticum, Veronica, Viola, and Xanthium.

According to one embodiment of the present invention, where the grain crop is maize, weeds including but not limited to the following species are selectively controlled: *Abutilon theophrasti*, *Agropyron repens*, *Alopecurus myosuroides*, *Amaranthus hybridus*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, *Ambrosia trifida*, *Anagallis arvensis*, *Anchusa officinalis*, *Artemisia vulgaris*, *Atriplex patula*, *Bidens pilosa*, *Brachiaria decumbens*¸ *Brachiaria platyphylla*, *Brassica napus*, *Calystegia sepium*, *Capsella bursa-pastoris*, *Cenchrus echinatus*, *Chenopodium album*, *Chenopodium ficifolium*, *Chenopodium hybridum*, *Cirsium arvense*, *Convolvulus arvensis*, *Conyza bonariensis*, *Conyza canadensis*, *Cynodon dactylon*, *Cyperus esculentus*, *Datura stramonium*, *Digitaria sanguinalis*, *Echinochloa colonum*, *Echinochloa crus-galli*, *Equisetum arvensis*, *Euphorbia heterophylla*, *Galinsoga ciliata*, *Galinsoga parviflora*, *Galium aparine*, *Geranium dissectum*, *Helianthus annuus*, *Ipomoea hederacea*, *Ipomoea purpurea*, *Iva xanthiifolia*, *Kochia scoparia*, *Lamium amplexicaule*, *Lamium purpureum*, *Matricaria inodora*, *Panicum dichotomiflorum*, *Pennisetum glaucum*, *Phalaris paradoxa*, *Poa annua*, *Polygonum aviculare*, *Polygonum convolvulus*, *Polygonum lapathifolium*, *Polygonum persicaria*, *Raphanus raphanistrum*, *Setaria faberi*, *Setaria glauca*, *Setaria verticillata*, *Setaria viridis*, *Sinapis arvensis*, *Solanum nigrum*, *Sonchus arvensis*, *Sorghum bicolor*, *Sorghum halepense*, *Stachys annua*, *Stellaria media*, *Symphytum officinale*, *Thlaspi arvense*, *Veronica hederifolia*, *Veronica persica*, *Viola arvensis*, *Xanthium strumarium.*

According to one embodiment of the present invention, where the grain crop is rice, weeds including but not limited to the following species are selectively controlled: *Brachiaria platyphylla, Cenchrus echinatus, Cynodon dactylon, Cyperus esculentus, Echinochloa colonum, Echinochloa crus-galli, Eleusine indica, Euphorbia heterophylla, Pennisetum glaucum, Setaria glauca, Phalaris minor, Setaria faberi, Setaria verticillata, Xanthium strumarium.*

According to one embodiment of the present invention, where the grain crop is a cereal crop, in particular barley or wheat, weeds including but not limited to the following species are selectively controlled: *Aegilops cylindrica, Agropyron repens, Alopecurus myosuroides, Amaranthus retroflexus, Anthemis arvensis, Apera spica-venti, Avena fatua,*

Brassica napus, Bromus secalinus, Bromus sterilis, Bromus tectorum, Capsella bursa-pastoris, Centaurea cyanus, Chenopodium album, Chenopodium ficifolium, Chenopodium hybridum, Cirsium arvense, Convolvulus arvensis, Conyza bonariensis, Conyza canadensis, Cyperus esculentus, Descurainia sophia, Echinochloa crus-galli, Eleusine indica, Equisetum arvensis, Galeopsis tetrahit, Galium aparine, Geranium dissectum, Kochia scoparia, Lamium amplexicaule, Lamium purpureum, Lolium multiflorum, Lolium rigidum, Malva neglecta, Matricaria inodora, Panicum dichotomiflorum, Pennisetum glaucum, Phalaris minor, Phalaris paradoxa, Poa annua, Poa pratensis, Polygonum aviculare, Polygonum convolvulus, Polygonum lapathifolium, Polygonum persicaria, Raphanus raphanistrum, Rumex obtusifolius, Setaria glauca, Setaria viridis, Sinapis arvensis, Sonchus arvensis, Sonchus asper, Sonchus oleraceus, Stellaria media, Thlaspi arvense, Urtica dioica, Veronica hederifolia, Veronica persica, Viola arvensis.

According to a preferred embodiment of the present invention, where the grain crop is maize, weeds including but not limited to the following monocotyledonous species are selectively controlled: *Cenchrus pauciflorus, Chloris virgata, Commelina erecta, Cynodon dactylon, Cyperus spp, Echinocloa colonum, Sorghum halepense, Trichloris crinita, Digitaria insularis, Zea mays (Volunteer), Urochloa or , rachiaria decumbens, Cenchrus echinatus, Commelina benghalensis, Avena strigosa, Pennisetum americanum, Panicum maximum, Echinochloa crus-galli, Urochloa or Brachiaria platyphylla, Digitaria spp, Panicum spp,, Setaria faberi, Eleusine indica, Sorghum halepense, Lolium multiflorum, Lolium spp, Urochloa or Brachiaria spp, Cynodon dactylon, Dactyloctenium aegyptium, Digitaria sanguinalis, Setaria viridis, Commelina communis , Rottboellia cochinchinensis, Setaria spp., Agropyron or Elymus repens, Digitaria horizontalis, Urochloa or Brachiaria plantaginea, Leptochloa filiformis, Leptochloa, Echinochloa spp., Urochloa or Brachiaria spp., Echinochloa colona, Setaria verticillata.*

According to a preferred embodiment of the present invention, where the grain crop is rice, weeds including but not limited to the following monocotyledonous species are selectively controlled: *Commelina communis, Echinochloa oryzicola, Vasing, Echinochloa crus-galli, Paspalum distichum, Leersia japonica, Leptochloa chinensis, Ischaemum rogusum, Eleusine indica, Leptochloa fascicularis, Oryza sativa, Echinochloa colona, Digitaria horizontalis, Urochloa or Brachiaria plantaginea, Leerisa hexandra, Leptochloa spp., Oryza latifolia, Oryza sativa spontaneum, Rottboellia cochinchinensis or exaltata, Digitaria spp, Cenchrus echinatus, Luziola subintegra, Commelina diffusa, Urochloa or Brachiaria platyphylla, Chloris spp., Leptochloa filiformis, Echinochloa crus-pavonis, Digitaria sanguinalis, Cenchrus echinatus, Cynodon dactylon, Setaria verticillate, Digitaria horizontalis, Leptochloa panicoides, Panicum dichotomiflorum, Paspalum spp., Oryza rufipogon.*

According to a preferred embodiment of the present invention, where the grain crop is cereal crop, in particular barley or wheat, weeds including but not limited to the following monocotyledonous species are selectively controlled: *Alopecurus japonicus Steud, Alopecurus aequalis Sobol, Alopecurus myosuroides, Apera spica-venti, Avena spp, Avena fatua L,. Avena sterillis, Bromus japonicus Thunb, Aegilops tauschii Coss, Aegilops cylindrica, Sclerochloa kengiana (Ohwi) Tzvel., Beckmannia syzigachne (Steud.) Fernald, Lolium spp, Lolium multiflorum Lam, Poa trivialis L., Ploypogon fugax. N., Phleum paniculatum, Puccinellia distans, Lolium rigidum, Echinochloa crus-galli, Urochloa panicoides, Chloris virgata, Bromus spp, Bromus sterilis, Hordeum leporinum, Phalaris spp, Phalaris minor, Poa annua, Agrostis*

alba, Agropyron repens, Digitaria horizontalis, Commelina benghalensis, Lolium perenne, Phragmites australia, Imperata cylindrica, Cynodon dactylon, Bromus tectorum, Poa spp, Phalaris brachystachys, Setaria glauca or pumila, Setaria viridis, Phalaris persicaria, Lolium persicum, Agropyron or Elymus repens, Hordeum jubatum, Secale cereale.

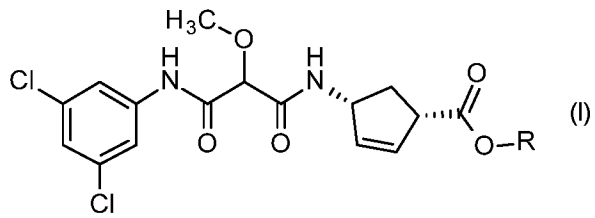
According to a very preferred embodiment of the present invention, where the grain crop is cereal crop, in particular barley or wheat, the following Genera of monocotyledonous weeds are selectively controlled: *Alopecurus, Apera, Avena, Brachiaria, Bromus, Commelina, Digitaria, Echinochloa, Lolium, Poa,* and *Setaria*.

The compositions comprising herbicide (A) can generally be applied to weeds at any growth stage with good results. In one embodiment, the compositions comprising herbicide (A) are applied up to BBCH growth stage 37 of the weeds, showing effective weed control. In a preferred embodiment, the compositions comprising herbicide (A) are applied up to BBCH growth stage 32 of the weeds, showing effective weed control.

In the method according to the present invention for selectively controlling weeds in grain crops, the compositions comprising herbicide (A) can generally be applied post-emergence of the crop.
In one embodiment, the composition comprising herbicide (A) is applied post-emergence of the crop, up to BBCH growth stage 37.
In one embodiment, the composition comprising herbicide (A) is applied post-emergence of the crop at BBCH growth stage 12 to 32.
In another embodiment, the composition comprising herbicide (A) is applied post-emergence of the crop at BBCH growth stage 13 to 29, e.g. BBCH growth stage 14 to 21.
In a very preferred embodiment, the composition comprising herbicide (A) is applied, when both the monocotyledonous crop plants and the weeds have emerged from the soil, e.g. post-emergence at BBCH growth stage 12 to 32 of the crop.

Exemplary methods according to the present invention are described by the following embodiments:

M.1: A method for selectively controlling weeds in grain crops, which comprises applying to the crop cultivation area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)

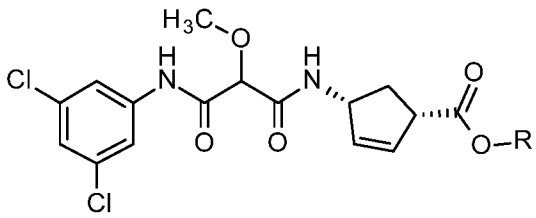


(I)

;

wherein R is hydrogen, (C_1-C_3)-alkyl or (C_3-C_5)-cycloalkyl; and wherein the herbicide A is applied post-emergence of the grain crop with an application rate of 1 g/ha to 100 g/ha, preferably with an application rate of 8 g/ha to 64 g/ha; and wherein no safener is applied.

M.2: A method for selectively controlling weeds in grain crops, which comprises applying to the crop cultivation area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)

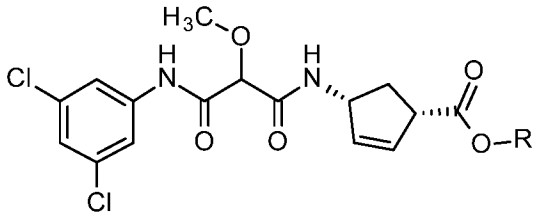


(I)

;

wherein R is hydrogen, (C_1-C_3)-alkyl or (C_3-C_5)-cycloalkyl; and wherein the herbicide A is applied post-emergence of the grain crop and the weeds with an application rate of 1 g/ha to 100 g/ha, preferably with an application rate of 8 g/ha to 64 g/ha; and wherein no safener is applied.

M.3: A method for selectively controlling monocotyledonous weeds in grain crops, which comprises applying to the crop cultivation area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)

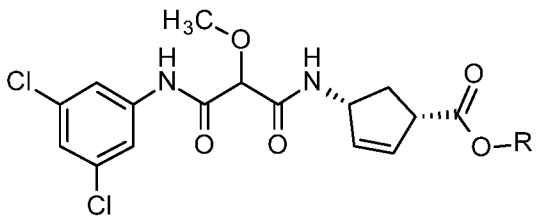


(I)

;

wherein R is hydrogen, (C_1-C_3)-alkyl or (C_3-C_5)-cycloalkyl; and wherein the herbicide A is applied post-emergence of the grain crop with an application rate of 1 g/ha to 100 g/ha, preferably with an application rate of 8 g/ha to 64 g/ha; and wherein no safener is applied.

M.4: A method for selectively controlling monocotyledonous weeds in grain crops, which comprises applying to the crop cultivation area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)



(I)

;

wherein R is R is hydrogen, (C_1-C_3)-alkyl or (C_3-C_5)-cycloalkyl; and wherein the herbicide A is applied post-emergence of the grain crop and the monocotyledonous weeds with an application rate of 1 g/ha to 100 g/ha, preferably with an application rate of 8 g/ha to 64 g/ha; and wherein no safener is applied.

Compositions of the herbicide A can be applied in conventional manner by using techniques a skilled person is familiar with. Suitable techniques include spraying, atomizing, dusting, spreading or watering. The type of application depends on the intended purpose in a well-known manner; in any case, it should ensure the finest possible distribution of the active ingredients.

Compositions of the herbicide A are applied to an area mainly by spraying, in particular foliar spraying of an aqueous dilution of the active ingredient of the composition. Application can be carried out by customary spraying techniques using, for example, water as carrier and spray liquor rates of from about 10 to 2000 l/ha or 50 to 1000 l/ha, for example from 100 to 500 l/ha. Application of the compositions of the herbicide A by the low-volume and the ultra-low-volume method is possible, as is their application in the form of microgranules.

If the active ingredient is less well tolerated by certain crop plants, application techniques may be used in which the compositions of the herbicide A is sprayed, with the aid of the spray apparatus, in such a way that they come into as little contact, if any, as possible with the leaves of the sensitive crop plants while reaching the leaves of undesirable plants which grow underneath, or the bare soil (post-directed, lay-by).

When the compositions of the herbicide A is used in burndown programs, it can be applied prior to seeding (or planting) or after seeding of the crop plants but before the emergence of the crop plants.

The agrochemical compositions of herbicide A, formulations of herbicide A, contain, besides the active ingredient or the composition, at least one organic or inorganic carrier material. The formulations may also contain, if desired, one or more surfactants and, if desired, one or more further auxiliaries customary for crop protection compositions.

In the formulations, the active ingredients and optional further actives are present in suspended, emulsified or dissolved form. The formulation can be in the form of aqueous solutions, powders, suspensions, also highly-concentrated aqueous, oily or other suspensions or dispersions, aqueous emulsions, aqueous microemulsions, aqueous suspo-emulsions, oil dispersions, pastes, dusts, materials for spreading or granules.

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

Suitable carriers include liquid and solid carriers. Liquid carriers include e.g. non-aqueous solvents such as cyclic and aromatic hydrocarbons, e.g. paraffins, tetrahydronaphthalene, alkylated naphthalenes and their derivatives, alkylated benzenes and their derivatives, alcohols such as methanol, ethanol, propanol, butanol and cyclohexanol, ketones such as cyclohexanone, strongly polar solvents, e.g. amines such as N-methylpyrrolidone, and water as well

as mixtures thereof. Solid carriers include e.g. mineral earths such as silicas, silica gels, silicates, talc, kaolin, limestone, lime, chalk, bole, loess, clay, dolomite, diatomaceous earth, calcium sulfate, magnesium sulfate, magnesium oxide, ground synthetic materials, fertilizers such as ammonium sulfate, ammonium phosphate, ammonium nitrate, ureas, and products of vegetable origin such as cereal meal, tree bark meal, wood meal and nutshell meal, cellulose powders, or other solid carriers.

Suitable surfactants (adjuvants, wetting agents, tackifiers, dispersants and also emulsifiers) are the alkali metal salts, alkaline earth metal salts and ammonium salts of aromatic sulfonic acids, for example lignosulfonic acids (e.g. Borrespers-types, Borregaard), phenolsulfonic acids, naphthalenesulfonic acids (Morwet types, Akzo Nobel) and dibutylnaphthalenesulfonic acid (Nekal types, BASF AG), and of fatty acids, alkyl- and alkylarylsulfonates, alkyl sulfates, lauryl ether sulfates and fatty alcohol sulfates, and salts of sulfated hexa-, hepta- and octadecanols, and also of fatty alcohol glycol ethers, condensates of sulfonated naphthalene and its derivatives with formaldehyde, condensates of naphthalene or of the naphthalenesulfonic acids with phenol and formaldehyde, polyoxyethylene octylphenol ether, ethoxylated isooctyl-, octyl- or nonylphenol, alkylphenyl or tributylphenyl polyglycol ether, alkylaryl polyether alcohols, isotridecyl alcohol, fatty alcohol/ethylene oxide condensates, ethoxylated castor oil, polyoxyethylene alkyl ethers or polyoxypropylene alkyl ethers, lauryl alcohol polyglycol ether acetate, sorbitol esters, lignosulfite waste liquors and proteins, denaturated proteins, polysaccharides (e.g. methylcellulose), hydrophobically modified starches, polyvinyl alcohol (Mowiol types Clariant), polycarboxylates (BASF AG, Sokalan types), polyalkoxylates, polyvinylamine (BASF AG, Lupamine types), polyethyleneimine (BASF AG, Lupasol types), polyvinylpyrrolidone and copolymers thereof.

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

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

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

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

Examples of colorants are both sparingly water-soluble pigments and water-soluble dyes. Examples which may be mentioned are the dyes known under the names Rhodamin B, C.I. Pigment Red 112 and C.I. Solvent Red 1, and

also pigment blue 15:4, pigment blue 15:3, pigment blue 15:2, pigment blue 15:1, pigment blue 80, pigment yellow 1, pigment yellow 13, pigment red 112, pigment red 48:2, pigment red 48:1, pigment red 57:1, pigment red 53:1, pigment orange 43, pigment orange 34, pigment orange 5, pigment green 36, pigment green 7, pigment white 6, pigment brown 25, basic violet 10, basic violet 49, acid red 51, acid red 52, acid red 14, acid blue 9, acid yellow 23, basic red 10, basic red 108.

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

To prepare emulsions, pastes or oil dispersions, the active components, as such or dissolved in an oil or solvent, can be homogenized in water by means of wetting agent, tackifier, dispersant or emulsifier. Alternatively, it is possible to prepare concentrates consisting of active substance, wetting agent, tackifier, dispersant or emulsifier and, if desired, solvent or oil, and these concentrates are suitable for dilution with water.

Powders, materials for spreading and dusts can be prepared by mixing or concomitant grinding of the active the herbicides A and B with a solid carrier.

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

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

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

The herbicide A, i.e. active compound or composition, can, for example, be formulated as follows:

Products for dilution with water

A Water-soluble concentrates

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

B Dispersible concentrates

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

C Emulsifiable concentrates

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

D Emulsions

25 parts by weight of active compound (or composition) are dissolved in 35 parts by weight of an organic solvent (e.g. alkylaromatics) with addition of calcium dodecylbenzenesulfonate and castor oil ethoxylate (in each case 5 parts by weight). This mixture is introduced into 30 parts by weight of water by means of an emulsifier (Ultraturrax) and made into a homogeneous emulsion. Dilution with water gives an emulsion. The formulation has an active compound content of 25% by weight.

E Suspensions

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

F Water-dispersible granules and water-soluble granules

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

G Water-dispersible powders and water-soluble powders

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

H Gel formulations

In a ball mill, 20 parts by weight of active compound (or composition), 10 parts by weight of dispersant, 1 part by

weight of gelling agent and 70 parts by weight of water or of an organic solvent are mixed to give a fine suspension. Dilution with water gives a stable suspension with active compound content of 20% by weight.

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

Use Examples

Biological examples

The herbicidal activity of the compounds of formula (I) was demonstrated by the following greenhouse experiments:

The culture containers used were plastic flowerpots containing loamy sand with approximately 3.0% of organic matter as the substrate. The seeds of the test plants were sown separately for each species.
For the pre-emergence treatment, the active ingredients, which had been suspended or emulsified in water, were applied directly after sowing by means of finely distributing nozzles. The containers were irrigated gently to promote germination and growth and subsequently covered with transparent plastic hoods until the test plants had rooted. This cover caused uniform germination of the test plants, unless this had been impaired by the active ingredients.
For the post-emergence treatment, the test plants were first grown to a height of 3 to 20 cm, depending on the plant habit, and only then treated with the active ingredients which had been suspended or emulsified in water. For this purpose, the test plants were either sown directly and grown in the same containers, or they were first grown separately as seedlings and transplanted into the test containers a few days prior to treatment.
Depending on the species, the test plants were kept at 10 -25°C or 20 - 35°C, respectively.
The test period extended over 2 to 4 weeks. During this time, the test plants were tended, and their response to the individual treatments was evaluated.

Evaluation was carried out using a scale from 0 to 100. 100 means no emergence of the test plants, or complete destruction of at least the aerial moieties, and 0 means no damage, or normal course of growth. A good herbicidal activity is given at values of 70 to < 90 and a very good herbicidal activity is given at values of 90 to 100.

The test plants used in the greenhouse experiments were of the following species:

EPPO code	Scientific name
ABUTH	*Abutilon theophrasti*
ALOMY	*Alopercurus myosuroides*
AMARE	*Amaranthus retroflexus*
APESV	*Apera spica-venti*
AVEFA	*Avena fatua*

BRADC	*Brachiaria decumbens*
BROSE	*Bromus secalinus*
BRSNS	rape (spring)
COMBE	*Commelina benghalensis*
DIGSA	*Digitaria sanguinalis*
ECHCG	*Echinochloa crus-galli*
GALAP	*Galium aparine*
GERPU	*Geranium pusillum*
GLXMA	*Glycine max*
HORVS	*Hordeum vulgare* (spring barley)
HORVW	*Hordeum vulgare* (winter barley)
LOLMU	*Lolium multiflorum*
MATIN	*Matricaria inodora*
ORYSA	*Oryza sativa*
PAPRH	*Papaver rhoeas*
POAAN	*Poa annua*
POLAV	*Polygonum aviculare*
POLCO	*Polygonum convolvulus*
RAPRA	*Raphanus raphanistrum*
SEBEX	*Sesbania exaltata*
SETFA	*Setaria faberi*
SETVI	*Setaria viridis*
SINAR	*Sinapis arvensis*
STEME	*Stellaria media*
THLAR	*Thlaspi arvense*
TRZAS	*Triticum aestivum* (spring wheat)
TRZAW	*Triticum aestivum* (winter wheat)
VERPE	*Veronica persica*
ZEAMX	*Zea mays*

The invention is elucidated in more detail by the examples hereinafter.

Legend:

- application rate [g/ha]
- DAT: days after treatment
- GS: BBCH growth stage
- Compound I.b*; I.b.R + I.b.S (ca. 50:50), 5 % [w/v]
- Compound I.b**; I.b.R + I.b.S (ca. 5:95), 5 % [w/v]
- Compound I.a; I.a.R + I.a.S (ca. 50:50), 5 % [w/v]

- Compound I.c; I.c.R + I.c.S (ca. 50:50), 5 % [w/v]
- Compound I.d; I.d.R + I.d.S (ca. 50:50), 5 % [w/v]
- Compound I.e; I.e.R + I.e.S (ca. 50:50), 5 % [w/v]
- Compound I.f; I.f.R + I.f.S (ca. 50:50), 5 % [w/v]
- Compound II.1, 5 % [w/v]
- Compound II.2, 5 % [w/v]
- Compound II.3, 5 % [w/v]
- Compound III.1, 5 % [w/v]
- Compound III.2, 5 % [w/v]
- Compound V.1, 5 % [w/v]
- Compound VI.1, 5 % [w/v]
- Compound VI.2, 5 % [w/v]
- Compound VII.1, 5 % [w/v]

Examples 1 to 6: post-emergence application

Ex. 1 20 DAT	g/ha	ORYSA Koshihikari	ECHCG	SETVI	DIGSA	BRADC	COMBE	ABUTH	AMARE	SEBEX
GS	-	12	12	13	12	12	13	13	14	12
I.b*:	16	10	98	95	90	90	95	98	90	95
	8	0	95	95	65	85	95	95	85	70

*I.b (I.b.R : I.b.S is ca. 50:50

Ex. 2 21 DAT	g/ha	TRZAW cubus	HORVW Kosmos	TRZAS Kadrilj	BRSNS Performer	ALOMY	APESV	AVEFA	LOLMU	POAAN	SETFA	GALAP	VERPE	PAPRH
GS	-	21	21	12	12	12	21	11	12	21	12	22	12	16
I.b*	32	30	0	0	95	80	95	95	95	95	90	98	98	100
	16	0	0	0	98	30	85	95	80	80	75	98	100	98

*I.b (I.b.R : I.b.S is ca. 50:50)

Ex. 3 20 DAT	g/ha	TRZAW Cubus	HORVW Kosmos	ALOMY	APESV	AVEFA	LOLMU	POAAN	SETFA	GALAP	GERPU	VERPE	THLAR	PAPRH	SINAR	RAPRA	AMARE
GS	-	12	12	12	12	11	12	12	12	22	14	22	14	14	12	12	13
I.a	16	30	0	95	95	90	95	85	90	95	98	95	95	98	98	95	95
	8	10	0	80	85	90	90	65	55	85	95	98	98	90	98	75	85

Ex. 4 21 DAT	g/ha	HORVW Kosmos	TRZAS Abound	BRSNS Landmark	HORVS Conlon	ALOMY	APESV	AVEFA	LOLMU	POAAN	SETFA	GALAP	GERPU	MATIN	VERPE	THLAR	POLAV	PAPRH	SINAR	RAPRA	AMARE
GS	-	11	12	12	12	12	12	11	11	12	12	22	14	14	22	14	12	14	12	12	14
I.d	16	10	5	95	10	80	90	85	80	80	85	95	90	75	95	98	95	95	98	75	75
	8	0	5	90	0	80	75	80	75	65	70	85	80	0	90	95	80	85	98	85	60

Ex. 5 21 DAT	g/ha	TRZAW Cubus	BRSNW Avatar	ALOMY	ECHCG	LOLMU	SETVI	AVEFA	AMARE	POLCO
GS	-	11	12	11	12	11	13	11	14	12
I.e	16	15	80	75	85	85	85	90	85	85
	8	15	80	70	85	85	85	80	85	85

Ex. 6 20 DAT	g/ha	TRZAW Cubus	TRZAS Kadrijl	BRSNW Avatar	AVEFA	GALAP	GERPU	MATIN	VERPE	THLAR	PAPRH	SINAR	RAPRA
GS	-	12	12	13	12	21	13	15	14	14	14	13	11
I.f	8	10	5	85	85	90	95	85	90	95	85	90	100

Example 7: pre-emergence application

Ex. 7 20 DAT	g/ha	TRZAW Cubus	TRZAS Kadrijl	ZEAMX Benedicto	GLXMA Sphinxa	ALOMY	AVEFA	LOLMU	PAPRH	SINAR	STEME	AMARE
I.f	250	0	0	0	0	80	98	75	98	70	85	90

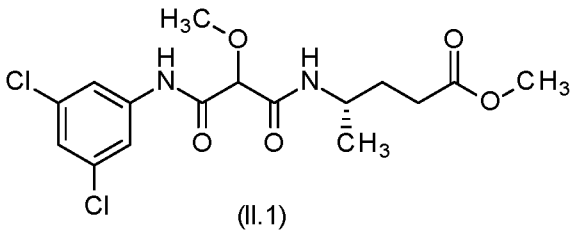
Examples 8 to 9: post-emergence application

Ex. 8 18 DAT	g/ha		TRZAW Cubus	HORVW Kosmos	TRZAS Taifun	BRSNS Performer	ALOMY	AVEFA	LOLMU	POAAN	BROSE	SETFA	GALAP	VERPE	PAPRH
GS	-		12	12	12	12	12	11	11	13	12	13	22	14	16
I.c	32		20	0	0	80	80	90	85	90	75	90	90	95	98

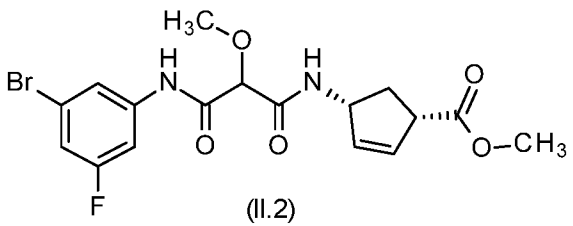
Ex. 9 20 DAT	g/ha	TRZAW Cubus	HORVW Kosmos	TRZAS Brandon	TRZAS Wheatland	HORVS Barke	BRSNS Per-former	ALOMY	APESV	AVEFA	LOLMU
GS	-	12	12	11	12	12	12	12	21	11	11
I.b**	32	0	0	0	0	0	95	70	85	98	80

**I.b (I.b.S : I.b.R : is ca. 95:5)

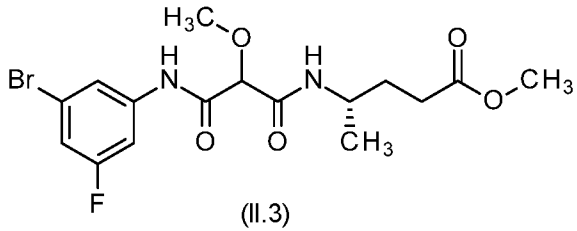
Example 10: Comparative examples: post-emergence application



(II.1)



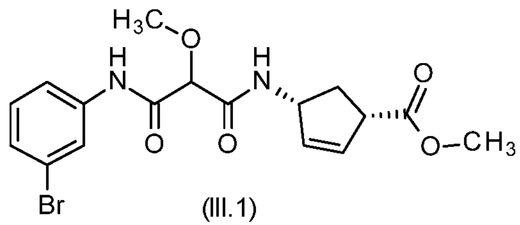
(II.2)



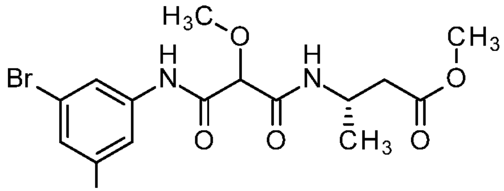
(II.3)

Ex. 10 20 DAT	g/ha	TRZAW Cubus	HORVW Kosmos	TRZAS Carburry	TRZAS Tai-fun	BRSNS Performer	ALOMY	APESV	AVEFA	LOLMU	POAAN	SETFA	GALAP	VERPE	PAPRH
GS	-	11	11	12	12	12	12	12	11	11	13	12	11	12	14
I.a	32	0	0	0	10	95	80	90	95	80	85	90	100	98	90
II.1	32	90	75	95	90	95	80	98	98	98	95	90	98	90	98
II.2	32	50	0	60	60	90	80	95	90	95	90	70	90	100	85
II.3	32	95	80	98	98	95	75	95	95	95	95	90	95	80	100

Example 11: Comparative examples: post-emergence application



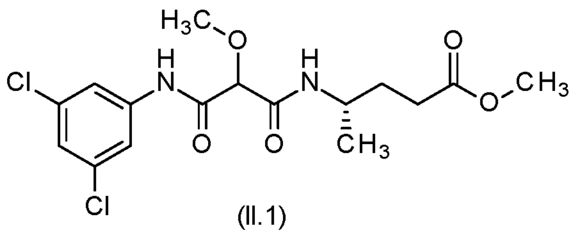
(III.1)



(III.2)

Ex. 11 20 DAT	g/ha	TRZAW Cubus	TRZAS Carburry	TRZAS Tai-fun	BRSNS Performer	APESV	AVEFA	LOLMU	POAAN	SETFA	GALAP	GERPU	VERPE	THLAR	POLAV	PAPRH	SINAR	RAPRA	AMARE
GS	-	31	33	33	62	24	31	31	31	33	37	65	14	65	65	38	24	64	65
I.a	32	15	0	0	95	98	98	98	95	98	98	98	98	98	98	90	98	98	98
III.1	32	90	90	85	95	98	98	98	95	98	98	98	98	98	98	98	98	98	95
III.2	32	95	98	98	95	95	98	98	95	98	98	50	60	98	98	80	98	98	85

Example 12: Comparative example: post-emergence application



(II.1)

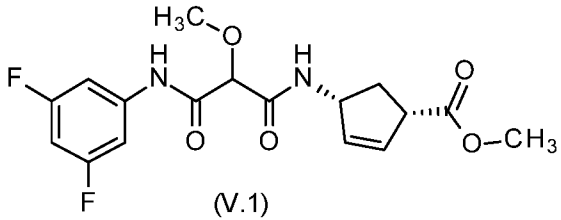
Ex. 12 20 DAT	g/ha	Ø ZEAMX Amadeo*	HELAN NK Neostar	Ø GLXMA Sultana*	ECHCG	SETVI	DIGSA	ELEIN	COMBE	AMARE	IPOHE
GS	-	12	12	13	12	13	13	13	11	14	12
I.a	16	35	85	90	90	95	90	85	95	85	95
I.a	8	25	85	65	90	90	80	80	95	85	95
II.1	16	85	50	60	90	85	60	60	95	90	95
II.1	8	58	35	53	60	60	45	25	95	80	90

*phytotoxicity as average across two sets of crops

Example 13: Selectivity in Rice, post -emergence application

Ex. 13 20 DAT	g/ha	ORYSA Koshihikari	HELAN ES Poetic	GLXMA Shouna	ECHCG	SETVI	ABUTH
GS	-	12	31	32	12	13	15
I.a	16	5	90	80	95	90	95
I.b	16	0	98	65	90	85	95

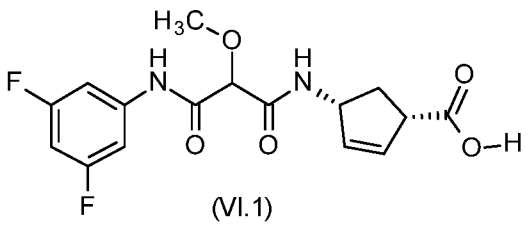
Example 14: Comparative example, post -emergence application



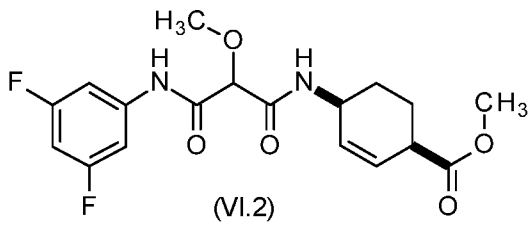
(V.1)

Ex. 14 20 DAT	g/ha	ORYSA Koshihikari	GLXMA Shouna	ECHCG	SETVI	DIGSA	BRADC	COMBE	ABUTH	AMARE	SEBEX
GS	-	12	14	12	13	12	12	13	13	14	12
I.a	64	30	90	98	95	95	95	95	98	95	98
I.a	32	10	98	98	95	90	95	95	98	90	95
I.b	64	25	85	98	95	90	98	95	98	95	98
I.b	32	10	85	98	95	85	95	95	98	85	95
V.1	64	70	90	98	95	98	95	95	98	95	98
V.1	32	40	90	98	95	75	95	95	98	95	90

Example 15: Comparative example, post -emergence application



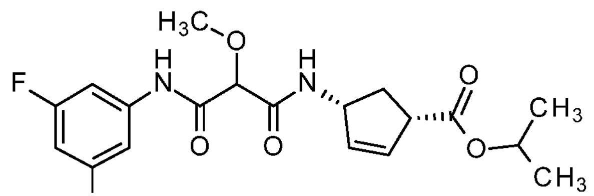
(VI.1)



(VI.2)

Ex. 15 19 DAT	g/ha	TRZAW Cubus	TRZAS Carburry	BRSNS Performer	HORVS Con-lon	APESV	AVEFA	AVEFA	GALAP	GERPU	THLAR	POLAV	SINAR	RAPRA	AMARE
GS	-	12	12	13	11	11	11	11	22	15	16	12	12	13	14
I.a	32	0	0	90	25	85	90	90	98	98	95	95	95	80	98
I.c	32	0	0	90	0	85	90	90	85	80	98	95	98	85	80
VI.1	32	75	80	85	15	85	95	90	95	90	95	98	98	95	75
VI.2	32	80	95	85	75	90	95	95	90	75	95	95	95	80	50

Example 16: Selectivity in Rice and Corn in Comparison, post -emergence application

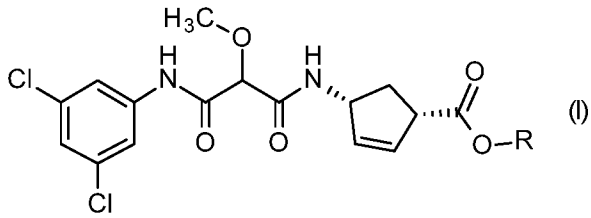


(VII.1)

Ex. 16 20 DAT	g/ha	ORYSA Koshihikari	ZEAMX Benedicto	GLXMA Shouna	HELAN ES Poetic	SETVI	COMBE	ABUTH
GS	-	12	12	13	14	13	12	12
I.b	32	0	45	85	85	98	98	90
I.b	16	0	0	65	70	98	98	85
VII.1	32	20	98	95	98	98	0	100
VII.1	16	0	90	95	75	95	0	100

Claims

1. A method for selectively controlling weeds in monocotyledonous crops, which comprises applying to the crop cultivation area an effective amount of a herbicide A selected from a compound of formula (I) and salts of the compound of formula (I)



(I)

;

wherein R is hydrogen, (C_1-C_6)-alkyl or (C_3-C_6)-cycloalkyl.

2. The method as claimed in claim 1, wherein no safener is applied.

3. The method as claimed in claim 1 or 2, wherein the monocotyledonous crop is a grain crop is selected from cereals, maize, sorghum and rice.

4. The method as claimed in claim 3, wherein the monocotyledonous crop is a cereal crop selected from wheat, durum, einkorn, emmer, spelt, rye, triticale, and barley, preferably barley or wheat.

5. The method as claimed in any one of claims 1 to 4, wherein the weeds are monocotyledonous weeds.

6. The method as claimed in claim 5, wherein the weeds are monocotyledonous weeds selected from the Genera *Alopecurus, Apera, Avena, Brachiaria, Bromus, Commelina, Digitaria, Echinochloa, Lolium, Poa,* and *Setaria*.

7. The method as claimed in any one of claims 1 to 6, wherein the herbicide A is applied pre-emergence of the crop.

8. The method as claimed in any one of claims 1 to 6, wherein the herbicide A is applied post-emergence of the crop.

9. The method as claimed in any one of claims 1 to 6, wherein the herbicide A is applied post-emergence of the crop and the weeds.

10. The method as claimed in anyone of claims 1 to 9, wherein the herbicide A is applied one, two or three times until harvest of the crop, preferably once until harvest of the crop.

11. The method as claimed in anyone of claims 1 to 10, wherein the herbicide A is selected from a compound of formula (I) according to claim 1, and R is hydrogen, (C_1-C_3)-alkyl or (C_3-C_5)-cycloalkyl.

12. The method as claimed in anyone of claims 1 to 10, wherein the herbicide A is selected from a compound of formula (I) according to claim 1, and R is hydrogen, methyl, ethyl, isopropyl, cyclopropyl, or cyclobutyl, preferably hydrogen, methyl or isopropyl.

13. A composition comprising the herbicide A according to claims 1, 11 or 12 and at least one auxiliary, which is customary for formulating crop protection compounds.

14. The composition as claimed in claim 13, comprising a further herbicide.

15. The use of the herbicide A according to claims 1, 11 or 12 or the composition according to claims 13 or 14 for selectively controlling weeds in monocotyledonous crops, selected from cereals, maize, sorghum and rice.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/068528

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01N37/22 A01P13/02
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01N A01P

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2021/170464 A1 (BASF SE [DE]) 2 September 2021 (2021-09-02) claims 1, 12-15 page 1, line 7 - line 29 page 65, line 32 - page 70, line 36 page 71, line 31 - line 32 page 77, line 9 - line 11 page 78, line 11 - line 14 page 78, line 20 - line 21 page 79, line 9 - line 39 page 89, line 123 - line 126 compounds I.29-I.35,I.113,I.123,I.136,I.159,I.184,I.185 page 70, line 38 - line 44 page 77, line 3 - line 5 ----- -/--	1-15

[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 October 2024	10/10/2024

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

2

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/068528

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2023/025854 A1 (BASF SE [DE]) 2 March 2023 (2023-03-02) page 167; compound I.90	1-15
A	AU 613 309 B2 (RHONE POULENC BV [NL]) 1 August 1991 (1991-08-01) background; page 1 disclosure; page 2 structures; page 19	1-15

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2024/068528

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2021170464 A1	02-09-2021	AR 121464 A1	08-06-2022
		AU 2021227378 A1	22-09-2022
		BR 112022017121 A2	16-11-2022
		CA 3169141 A1	02-09-2021
		CL 2022002310 A1	03-02-2023
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