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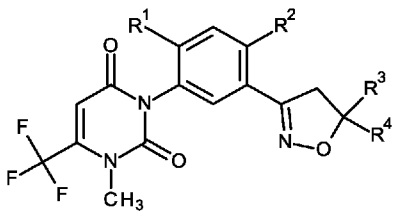
(54) Title: HERBICIDAL COMPOSITIONS



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(57) Abstract: The present invention relates to a herbicidal composition comprising a mixture of components (A) and (B) as active ingredients, wherein component (A) is a compound of formula (I) and component (B) is mesotrione or agrochemically acceptable ester or salt thereof.

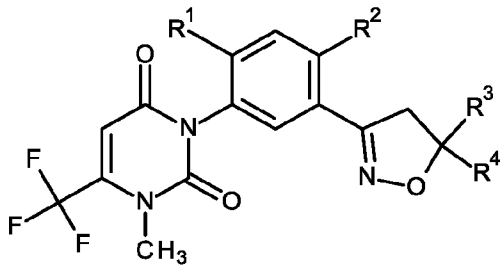
HERBICIDAL COMPOSITIONS

The present invention relates to novel herbicidal compositions comprising a combination of herbicidal active ingredients which provides control of weeds in crops of useful plants. The invention further provides methods of controlling weeds in crops of useful plants, and to the use of the herbicidal composition to control weeds.

In particular, there is provided a fungicidal composition comprising a mixture of components (A) and (B) as active ingredients, wherein component (A) is a compound of Formula (I), and component (B) is mesotrione, or agrochemically acceptable salts, N-oxides, diastereoisomers, enantiomers or tautomers thereof.

WO 2016/095768 and WO 2020/063613 disclose herbicide compounds of Formula (I) and processes for making them. EP186118B1 describes mesotrione and processes for making it. WO 2020/234422 and WO 2022/095908 disclose herbicidal mixtures of compounds of Formula (I) and mesotrione.

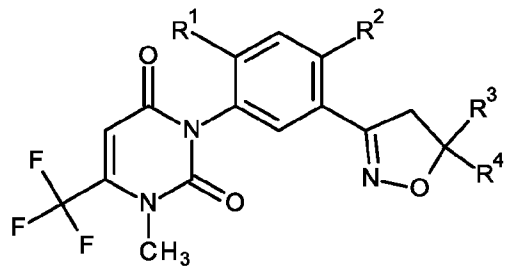
Compounds of Formula (I)



(I)

are known from WO2016/095768 and WO2020/063613 and provide effective control of problematic weeds in crops. Combinations of herbicidal active ingredients are often used in agriculture to increase and/or broaden the control of problematic plants (weeds) in crops of useful plants. In some instances, the combination can give rise to a valuable greater-than-additive (synergistic) effect which can, for example, enable efficient weed control through lower application rates. The present invention is based upon novel compositions comprising compounds of Formula (I).

Thus, according to the present invention there is provided a herbicidal composition comprising as component (A) a herbicidally effective amount of a compound of Formula (I)



(I)

wherein

R^1 is hydrogen, chloro, or fluoro;

R^2 is chloro or bromo;

R^3 is CO_2R^5 or CH_2OR^6;

R^4 is hydrogen, methyl, or ethyl;

R^5 is hydrogen, C_1-C_4alkyl, C_1-C_4haloalkyl, allyl, propargyl, C_1-C_3alkoxyC_1-C_3alkyl, C_1-C_3alkoxycarbonylC_1-C_3alkyl, or tetrahydrofuranylmethyl;

R^6 is C_1-C_4alkylcarbonyl, cyclopropylcarbonyl, or C_1-C_2alkylsulfonyl;

and component (B) is mesotrione, or agrochemically acceptable salts, N-oxides, diastereoisomers, enantiomers or tautomers thereof.

In another embodiment, there is provided a method of controlling weeds at a locus comprising applying to the locus of a weed controlling amount of a composition of the present invention.

In another embodiment, there is provided a method of selectively controlling weeds at a locus comprising crop plants and weeds, said method comprising applying to the locus a weed controlling amount of a composition according to the invention. In a preferred embodiment the crop plant is oil palm, corn, cereals, or soy. Preferably, the crop plant is corn, cereals, or soy. In this context, weeds could include, for example, volunteer maize (corn), including genetically-modified maize.

As used herein, the term "C_1-C_4alkyl" refers to a straight or branched hydrocarbon chain radical consisting solely of carbon and hydrogen atoms, containing no unsaturation, having from one to four carbon atoms, and which is attached to the rest of the molecule by a single bond. Examples of C_1-C_4alkyl include, but are not limited to, methyl, ethyl, n-propyl, n-butyl, and the isomers thereof, for example, iso-propyl, iso-butyl, sec-butyl, or tert-butyl.

As used herein, the term "C_1-C_4haloalkyl" refers to a C_1-C_4alkyl radical as generally defined above substituted by one or more of the same or different halogen atoms. The terms "C_1-C_3haloalkyl" and "C_1-C_2haloalkyl", are to be construed accordingly. Examples of C_1-C_4haloalkyl include, but are not limited to difluoromethyl, trifluoromethyl, 1,1-difluoroethyl, and 2,2,2-trifluoroethyl.

As used herein, the term "C_1-C_3alkoxy" refers to a radical of the formula $-OR_a$ where R_a is a C_1-C_3alkyl radical as generally defined above. The term "C_1-C_2alkoxy" is to be construed accordingly. Examples of C_1-C_3alkoxy include, but are not limited to, methoxy, ethoxy, 1-methylethoxy (iso-propoxy), and propoxy.

As used herein, the term "C_1-C_3alkoxyC_1-C_3alkyl" refers to a radical of the formula R_bOR_a- wherein R_b is a C_1-C_3alkyl radical as generally defined above, and R_a is a C_1-C_3alkylene radical as generally defined above. The term "C_1-C_2alkoxyC_1-C_2alkyl" is to be construed accordingly. Examples of C_1-C_3alkoxyC_1-C_3alkyl, include, but are not limited to, ethoxymethyl, ethoxyethyl, methoxyethyl, and methoxymethyl.

As used herein, the term "C_1-C_4alkylcarbonyl" refers to a radical of the formula $R_aC(O)$-, wherein R_a is a C_1-C_4alkyl radical as generally defined above. Examples of C_1-C_4alkylcarbonyl include, but are not limited to, acetyl.

As used herein, the term "C_1-C_3alkoxycarbonylC_1-C_3alkyl" refers to a radical of the formula $R_bOC(O)R_a$-, wherein R_b is a C_1-C_3alkyl radical as generally defined above, and R_a is a C_1-C_3alkylene radical as generally defined above. Examples of C_1-C_3alkoxycarbonylC_1-C_3alkyl include, but are not limited to, methoxycarbonylmethyl.

As used herein, the term "C_1-C_2alkylsulfonyl" refers to a radical of the formula $-S(O)_2R_a$ wherein R_a is a C_1-C_2alkyl radical as generally defined above. Examples of C_1-C_2alkylsulfonyl include, but are not limited to methylsulfonyl.

The following list provides definitions, including preferred definitions, for substituents R^1, R^2, R^3, R^4, R^5, and R^6, with reference to compounds of Formula (I). For any one of these substituents, any of the definitions given below may be combined with any definition of any other substituent given below or elsewhere in this document.

R^1 is hydrogen, chloro, or fluoro. Preferably, R^1 is chloro or fluoro. More preferabyl, R^1 is fluoro.

R^2 is chloro or bromo. Preferably, R^2 is chloro.

R^3 is CO_2R^5 or CH_2OR^6. Preferably, R^3 is CO_2R^5.

R^4 is hydrogen, methyl, or ethyl. Preferably, R^4 is methyl or ethyl. More preferably, R^4 is methyl.

R^5 is hydrogen, C_1-C_4alkyl, C_1-C_4haloalkyl, allyl, propargyl, C_1-C_3alkoxyC_1-C_3alkyl, C_1-C_3alkoxycarbonylC_1-C_3alkyl, or tetrahydrofuranylmethyl. Preferably, R^5 is C_1-C_4alkyl. More preferably, R^5 is ethyl.

R^6 is C_1-C_4alkylcarbonyl, cyclopropylcarbonyl, or C_1-C_2alkylsulfonyl.

In a preferred embodiment, component (A) is a compound of formula (I), wherein

R^1 is fluoro;

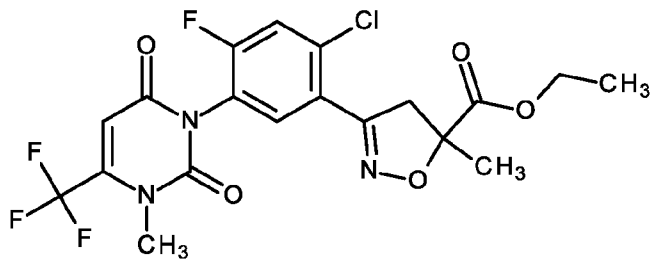
R^2 is chloro;

R^3 is CO_2R^5;

R^4 is C_1-C_4alkyl; and

R^5 is C_1-C_4alkyl.

In a more preferred embodiment of the present invention, component (A) is a compound of formula (Ia)



(Ia);

i.e., a compound of formula (I) wherein

R^1 is fluoro;

R^2 is chloro;

R^3 is CO_2R^5;

R^4 is methyl; and

R^5 is ethyl.

Component (A), a compound of formula (Ia) is referred to as 'Compound 6' in WO 2016/095768, and can be prepared according to Example 1 of WO 2016/095768.

In general, the weight ratio of component (A) to component (B) in the compositions of the invention is from 1000:1 to 1:1000, especially from 100:1 to 1:100, more especially in a ratio from 50:1 to 1:50, even more especially in a ratio of from 40:1 to 1:40, even more especially still from 25:1 to 1:25, very especially from 10:1 to 1:10, very especially still from 5:1 and 1:5, and in particular from 5:2 to 2:5.

The mass ratio of any two ingredients in each combination is selected as to give the desired, for example, synergistic action. In general, the mass ratio would vary depending on the specific ingredient and how many ingredients are present in the combination. Generally, the mass ratio between any two ingredients in any combination of the present invention, independently of one another, is from 100:1 to 1:100, including from 99:1, 98:2, 97:3, 96:4, 95:5, 94:6, 93:7, 92:8, 91:9, 90:10, 89:11, 88:12, 87:13, 86:14, 85:15, 84:16, 83:17, 82:18, 81:19, 80:20, 79:21, 78:22, 77:23, 76:24, 75:25, 74:26, 73:27, 72:28, 71:29, 70:30, 69:31, 68:32, 67:33, 66:34, 65:45, 64:46, 63:47, 62:48, 61:49, 60:40, 59:41, 58:42, 57:43, 56:44, 55:45, 54:46, 53:47, 52:48, 51:49, 50:50, 49:51, 48:52, 47:53, 46:54, 45:55, 44:56, 43:57, 42:58, 41:59, 40:60, 39:61, 38:62, 37:63, 36:64, 35:65, 34:66, 33:67, 32:68, 31:69, 30:70, 29:71, 28:72, 27:73, 26:74, 25:75, 24:76, 23:77, 22:78, 21:79, 20:80, 19:81, 18:82, 17:83, 16:84, 15:85, 14:86, 13:87, 12:88, 11:89, 10:90, 9:91, 8:92, 7:93, 6:94, 5:95, 4:96, 3:97, 2:98, to 1:99.

Preferred mass ratios between any two components of present invention are from 75:1 to 1:75, more preferably, 1:1 to 1.50, especially 1:3 to 1:50, advantageously 1:3 to 1:32, such as 1:4 to 1:32, for example 1:4 to 1:24 or 1:8 to 1:16. The mixing ratios are understood to include, on the one hand, ratios by mass and also, on other hand, molar ratios.

Specific individual approximate ratios that are preferred include the ratios of 1:1, 5:1, 5:2, 5:3, 5:4, 4:1, 4:2, 4:3, 3:1, 3:2, 2:1, 1:5, 2:5, 3:5, 4:5, 1:4, 2:4, 3:4, 1:3, 2:3, 1:2, 1:600, 1:300, 1:150, 1:100, 1:50, 1;40, 1:35, 1:20, 2:35, 4:35, 1:10 1:75, 2:75, 4:75, 1:6000, 1:3000, 1:1500, 1:350, 2:350, 4:350, 1:750,

2:750, and 4:750. Out of these, 1:100, 1:50, 1:25, 1:10, 1:8, 1:6, 1:5, 2:5, and 2:1 may be particularly preferred.

In another embodiment, the ratios of 1:8, 1:6, 1:4, 1:1, and 2:1 are preferred.

In one embodiment, the weight ratio of component (A) to component (B) is from 20:1 to 1:20.

In one embodiment, the weight ratio of component (A) to component (B) is from 10:1 to 1:10.

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:8.

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:8, and the weed species controlled is selected from *Echinochloa sp. and Lolium sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:6.

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:6, and the weed species controlled is selected from *Alopecurus sp., Echinochloa sp., Ipomoea sp.*, *Lolium sp.,* and *Setaria sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:8, and the weed species controlled is selected from *Echinochloa crus-galli* and *Lolium perenne*.

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:6, and the weed species controlled is selected from *Alopecurus myosuroides, Echinochloa crus-galli, Ipomoea hederacea, Lolium perenne,* and *Setaria faberi*.

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:4, and the weed species controlled is *Alopecurus sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is 2:1, and the weed species controlled is *Alopecurus sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is 2:1, and the weed species controlled is *Alopecurus myosuroides.*

In one embodiment, the weight ratio of component (A) to component (B) is from 2:1 to 1:4, and the weed species controlled is *Alopecurus myosuroides.*

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is selected from *Alopecurus sp.* and *Echinochloa sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is selected from *Alopecurus myosuroides* and *Echinochloa crus-galli.*

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Alopecurus sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Alopecurus myosuroides.*

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Echinochloa sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Echinochloa crus-galli.*

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Lolium sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Lolium perenne.*

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Ipomoea sp.*.

In one embodiment, the weight ratio of component (A) to component (B) is 1:4, and the weed species controlled is *Ipomoea hederacea.*

In one embodiment, the weight ratio of component (A) to component (B) is 1:6, and the weed species controlled is selected from *Ipomoea sp.*, *Lolium sp.,* and *Setaria sp.*.

In one embodiment the weight ratio of component (A) to component (B) is 1:6, and the weed species controlled is selected from *Ipomoea hederacea, Lolium perenne,* and *Setaria faberi.*

In one embodiment the weight ratio of component (A) to component (B) is 1:8, and the weed species controlled is selected from *Echinochloa crus-galli* and *Lolium perenne*.

In another embodiment of the invention, the herbicidal composition further comprises one or more additional herbicidal component(s) (C), thus providing 3-way, 4-way or even 5-way or more mixes.

Component (C) can, for example, be an auxin herbicide (e.g. 2,4-D or dicamba including acceptable salts thereof), an HPPD-inhibiting herbicide, an ACCase-inhibiting herbicide (e.g. clethodim) or a VLCFA herbicide, especially those selected from the group consisting of acetochlor, metolachlor and S-metolachlor and pyroxasulfone, preferably S-metolachlor.

Preferably, component (C) is a herbicide selected from bicyclopyrone, paraquat dibromide, diquat dibromide, saflufenacil, trifludimoxazin, tiafenacil, pyroxasulfone S-metolachlor, glufosinate, L-glufosinate, glyphosate, metribuzin, and [3-(2-methoxy-4-prop-1-ynyl-phenyl)-4-oxo-2-bicyclo[3.2.1]oct-2-enyl] methyl carbonate.

When applied in a composition of the invention component (A) is typically applied at a rate of 25 to 2000 g ha, more particularly 25, 50, 75, 100, 125, 150, 200, 250, 300, 400, 500, 750, 800, 1000, 1250, 1500, 1800, or 2000 g/ha. Such rates of component (A) are applied typically in association with 5 to 2000g/ha of component (B), and more specifically in association with 5, 10, 15, 20, 25, 50, 75, 100, 120, 125, 140, 150, 200, 240, 250, 300, 400, 480, 500, 750, 1000, 1250, 1500, 1800, or 2000g/ha of component (B). The Examples described herein illustrate but do not limit the range of rates of components (A) and (B) that may be employed in the invention.

The amount of a composition according to the invention to be applied. will depend on various factors, such as the compounds employed; the subject of the treatment, such as, for example plants, soil or seeds, the type of treatment, such as, for example spraying, dusting or seed dressing, or the application time. In agricultural practice the application rates of the composition according to the invention depend on the type of effect desired, and typically range from 30 to 4000 g of total composition per hectare, and more commonly between 30 and 2000g/ha. The application is generally made by spraying the composition, typically by tractor mounted sprayer for large areas, but other methods such as dusting (for powders), drip or drench can also be used.

In another embodiment of the invention, the herbicidal composition further comprises a herbicide safener.

Preferably, the herbicide safener selected from benoxacor, cloquintocet, cyprosulfamide, dichlormid, fenchlorazole, fenclorim, fluxofenim, furilazole, isoxadifen, mefenpyr, metcamifen and oxabetrinil.

In another embodiment of the invention, the weeds comprise species selected from *Abutilon sp., Alopecurus sp., Amaranthus sp., Brachiaria sp., Borreria sp., Chenopodium sp., Commelina sp., Digitaria sp., Echinochloa sp., Eleusine sp., Erigeron sp., Ipomoea sp., Kochia sp., Lolium sp., Portulaca sp., Setaria sp., Sorghum sp.,* and *Stellaria sp.*.

In another embodiment, there is also disclosed the use of a composition according to the invention over crops that are resistant to the compound of formula (I). Crops may have been rendered resistant to the compound of formula (I) by conventional methods of breeding or by genetic engineering.

In another embodiment, there is also disclosed the use of a composition according to the invention to control weeds that are resistant to other PPO herbicides except the compound of formula (I), such as flumioxazin, fomesafen, and/or lactofen. The weeds may have been rendered tolerant to PPO herbicides by evolution, by conventional methods of breeding or by genetic engineering. Examples include *Amaranthus palmeri* and *Amaranthus tuberculatus* that has evolved resistance to PPO herbicides.

In another aspect, there is provided a method for controlling the growth of protoporphyrinogen IX oxidase (PPO) inhibitor herbicide resistant weeds, which comprises applying to the weed, part of the weed, weed propagation material, or the locus of the weed, an effective amount of a composition according to the invention, wherein the PPO-resistant weeds are weeds that are resistant to at least one PPO-inhibiting herbicide, except the compounds of Formula (I).

In another aspect, there is provided a method for controlling the growth of PPO-resistant weeds, which comprises applying to the weed, part of the weed, weed propagation material, or the locus of the weed, an effective amount of a composition according to the invention, wherein the PPO-resistant weeds are weeds that are resistant to at least one PPO-inhibiting herbicide, except the compounds of Formula (I), and have a mutation at amino acid 98, amino acid 210, amino acid 361, and/or amino acid 399 in the gene coding for the protoporphyrinogen oxidase enzyme.

In another aspect, there is provided a method for controlling the growth of PPO-resistant weeds, which comprises applying to the weed, part of the weed, weed propagation material, or the locus of the weed, an effective amount of a composition according to the invention, wherein the PPO-resistant weeds have a mutation at amino acid 98, amino acid 210, and/or amino acid 399 in the gene coding for the protoporphyrinogen oxidase enzyme.

In another aspect, there is provided the use of a composition according to the invention, over the top of crops that are tolerant to PPO inhibitors. As a known PPO-inhibitor, it is obvious that the compound of Formula (Ia) can be used in methods of controlling undesired vegetation in crop plants which are tolerant to protoporphyrinogen oxidase (PPO) inhibitors. Such plants can be obtained, for example, by transforming crop plants with nucleic acids which encode a suitable protoporphyrinogen oxidase, which may contain a mutation in order to make it more resistant to the PPO inhibitor. Examples of such nucleic

acids and crop plants are disclosed in WO95/34659, WO97/32011, WO2007/024739, WO2012/080975, WO2013/189984, WO2015/022636, WO2015/022640, WO2015/092706, WO2016/099153, WO2017/023778, WO2017/039969, WO2017/217793, WO2017/217794, WO2018/114759, WO2019/117578, WO2019/117579 and WO2019/118726. In a preferred embodiment, the crop plants which are tolerant to PPO inhibitors comprise a gene encoding for the HemG enzyme H_N90, as disclosed in WO2017/023778 and WO2024/015950. In another preferred embodiment, the crop plants which are tolerant to PPO inhibitors are cotton, corn, and soy.

When active ingredients are combined, the activity to be expected (E) for any given active ingredient combination obeys the so-called Colby Formula and can be calculated as follows (Colby, S.R., Calculating synergistic and antagonistic responses of herbicide combination, Weeds, Vol. 15, pages 20-22; 1967):

ppm = milligrams of active ingredient (a.i.) per liter

X = % action by first active ingredient using p ppm of the active ingredient

Y = % action by second active ingredient sing q ppm of the active ingredient.

According to Colby, the expected action of active ingredients A + B using p + q ppm of active ingredient is represented by the following formula:

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

If the action actually observed (O) is greater than the expected action E then the action of the combination is *super-additive,* i.e. there is a synergistic effect. In mathematical terms, synergism corresponds to a positive value for the difference of (O-E). In the case of purely complementary addition of activities (expected activity), said difference (O-E) is zero. A negative value of said difference (O-E) signals a loss of activity compared to the expected activity.

Accordingly, the combination of the present invention takes advantage of any additive herbicidal activity, and certain embodiments may even exhibit a synergistic effect. This occurs whenever the action of an active ingredient combination is greater than the sum of the actions of the individual components.

Combinations of the invention may also provide for an extended spectrum of activity in comparison to that obtained by each individual component, and/or permit the use of lower rates of the individual components when used in combination to that when used alone, in order to mediate effective herbicidal activity.

In addition, it is also possible that the composition of the invention may show increased crop tolerance, when compared with the effect of the component (A) alone. This occurs when the action of an active ingredient combination is less damaging to a useful crop than the action of one of the active ingredients alone.

Throughout this document the expression "composition" should be interpreted as meaning the various mixtures or combinations of components (A) and (B), for example in a single "ready-mix" form, in a combined spray mixture composed from separate formulations of the single active ingredient components, such as a "tank-mix", and in a combined use of the single active ingredients when applied

in a sequential manner, i.e., one after the other with a reasonably short penod, such as a few hours or days. The order of applying the components (A) and (B) is not essential for working the present invention.

The term "herbicide" as used herein means a compound that controls or modifies the growth of plants. The term "herbicidally effective amount" means the quantity of such a compound or combination of such compounds that is capable of producing a controlling or modifying effect on the growth of plants. Controlling or modifying effects include all deviation from natural development, for example killing, retardation, leaf burn, albinism, dwarfing and the like.

The term "locus" as used herein means fields in or on which plants are growing, or where seeds of cultivated plants are sown, or where seed will be placed into the soil. It includes soil, seeds, and seedlings, as well as established vegetation.

The term "plants" refers to all physical parts of a plant, including seeds, seedlings, saplings, roots, tubers, stems, stalks, foliage, and fruits The term "plant propagation material" denotes all generative parts of a plant, for example seeds or vegetative parts of plants such as cuttings and tubers. It includes seeds in the strict sense, as well as roots, fruits, tubers, bulbs, rhizomes, and parts of plants.

The term "safener" as used herein means a chemical that when used in combination with a herbicide reduces the undesirable effects of the herbicide on non-target organisms, for example, a safener protects crops from injury by herbicides but does not prevent the herbicide from killing the weeds.

Crops of useful plants in which the composition according to the invention can be used include perennial and annual crops, such as berry plants for example blackberries, blueberries, cranberries, raspberries and strawberries; cereals for example barley, maize (corn), millet, oats, rice, rye, sorghum triticale and wheat; fibre plants for example cotton, flax, hemp, jute and sisal; field crops for example sugar and fodder beet. coffee, hops, mustard, oilseed rape (canola), poppy, sugar cane, sunflower, tea and tobacco; fruit trees for example apple, apricot, avocado, banana, cherry, citrus, nectarine, peach, pear and plum; grasses for example Bermuda grass, bluegrass, bentgrass, centipede grass, fescue, ryegrass, St. Augustine grass and Zoysia grass; herbs such as basil, borage, chives, coriander, lavender, lovage, mint, oregano, parsley, rosemary, sage and thyme; legumes for example beans, lentils, peas and soya beans; nuts for example almond, cashew, ground nut, hazelnut, peanut, pecan, pistachio and walnut; palms for example oil palm; ornamentals for example flowers, shrubs and trees; other trees, for example cacao, coconut, olive and rubber; vegetables for example asparagus, aubergine, broccoli, cabbage, carrot, cucumber, garlic, lettuce, marrow, melon, okra, onion, pepper, potato, pumpkin, rhubarb, spinach and tomato; and vines for example grapes. However, the compositions of the present invention are particularly useful in controlling weeds in oil palm, corn, cereals or soya.

Crops are to be understood as being those which are naturally occurring, obtained by conventional methods of breeding, or obtained by genetic engineering. They include crops which contain so-called output traits (e.g, improved storage stability, higher nutritional value and improved flavour).

Crops are to be understood as also including those crops which have been rendered tolerant to herbicides or classes of herbicides (e.g. ALS-, GS-, EPSPS-, PPO-, ACCase- and HPPD-inhibitors) by conventional methods of breeding or by genetic engineering. An example of a crop that has been rendered tolerant to imidazolinones, e.g. imazamox, by conventional methods of breeding is Clearfield summer rape (canola). Examples of crops that have been rendered tolerant to herbicides by genetic engineering methods include e.g. glyphosate- and glufosinate-resistant vaneties commercially available under the trade names RoundupReady® and LibertyLink®.

Crops are also to be understood as being those which have been rendered resistant to harmful insects by genetic engineering methods, for example Bt maize (resistant to European corn borer), Bt cotton (resistant to cotton boll weevil) and also Bt potatoes (resistant to Colorado beetle). Examples of Bt maize are the Bt 176 maize hybrids of NK® (Syngenta Seeds). The Bt toxin is a protein that is formed naturally by *Bacillus thuringiensis* soil bacteria. Examples of toxins, or transgenic plants able to synthesise such toxins, are described in EP-A-451 878, EP-A-374 753, WO 93/07278, WO 95/34656, WO 03/052073 and EP-A-427 529. Examples of transgenic plants comprising one or more genes that code for an insecticidal resistance and express one or more toxins are KnockOut® (maize), Yield Gard® (maize), NuCOTIN33B® (cotton), Bollgard® (cotton), NewLeaf® (potatoes), NatureGard® and Protexcta®. Plant crops or seed material thereof can be both resistant to herbicides and, at the same time, resistant to insect feeding ("stacked" transgenic events). For example, seed can have the ability to express an insecticidal Cry3 protein while at the same time being tolerant to glyphosate.

Examples of crops that have been rendered tolerant to PPO inhibiting herbicides by genetic engineering are known in the art, for example as described in WO95/34659. Examples of crops that have been rendered tolerant to HPPD inhibiting herbicides by genetic engineering are known in the art, for example as described in WO2011/063411, WO2011/063413, WO2012/082542, WO2012/082548, WO2010/085705 and WO2011/068567.

The compositions of the present invention comprising glufosinate and/or glyphosate have potential utility in glyphosate- and glufosinate-resistant crops respectively, especially engineered soybean crops. The compositions of the present invention comprising a PPO-inhibiting herbicide have potential utility in PPO-resistant crops, especially engineered soybean crops. The compositions of the present invention, especially any comprising 2,4-D (or an agrochemically acceptable ester or salt thereof), have potential utility in crops which are have been engineered to tolerate 2,4-D herbicides, for example Enlist™ crops, especially EnlistE3™ Soybeans. The compositions of the present invention, especially any comprising dicamba (or an agrochemically acceptable ester or salt thereof) have potential utility in crops which are have been engineered to tolerate dicamba herbicides, for example Roundup Ready 2 Xtend™ Soybeans.

The compositions of the invention can typically be used to control a wide variety of monocotyledonous and dicotyledonous weed species in the crop. The compositions of the present invention provide particular good control of *Alopecurus sp.* (e.g. *Alopecurus myosuroides* (ALOMY)), *Avena sp. Digitaria sp.* (e.g *Digitaria sanguinalis* (DIGSA), *Digitaria insularis* (TRCIN)), *Echinochloa sp.* (e.g *Echinochloa crus-galli* (ECHCG)), *Eleusine sp. (*e.g. *Eleusine indica* (ELEIN)), *Lolium sp.*, *Setaria sp.* (e.g. *Setaria*

faberi (SETFA)) and *Sorghum sp.* (e.g *Sorghum halepense* (SORHA). In all aspects of the invention, in any particular embodiment, the weeds, e.g. to be controlled and/or growth-inhibited, may be monocotyledonous or dicotyledonous weeds, which are tolerant or resistant to one or more herbicides for example, HPPD inhibitor herbicides such as mesotrione, PSII inhibitor herbicides such as atrazine or EPSPS inhibitors such as glyphosate. Such weeds include, but are not limited to resistant Amaranthus biotypes.

Similarly compositions of the invention (which includes those comprising one or more additional pesticide(s)) can further include one or more safeners. In particular, the following safeners are especially preferred: benoxacor, cloquintocet (including cloquintocet-mexyl), cyprosulfamide, dichlormid, fenchlorazole (including fenchlorazole-ethyl), fenclorim, fluxofenim, furilazole, isoxadifen (including isoxadifen-ethyl), mefenpyr (including mefenpyr-diethyl), metcamifen and oxabetrinil.

The compositions of the invention can be applied before or after planting of the crops, before weeds emerge (pre-emergence application), or after weeds emerge (post-emergence application). Where a safener is combined with mixtures of the invention, it is preferred that the mixing ratio of compound of Formula (I) to safener is from 100:1 to 1:10, especially from 20:1 to 1:1.

It is possible that the safener and the compositions of the invention are applied simultaneously. For example, the safener and the composition of the invention might be applied to the locus pre-emergence or might be applied to the crop post-emergence. It is also possible that the safener and the composition of the invention are applied sequentially. For example, the safener might be applied before sowing the seeds as a seed treatment and the composition of the invention might be applied to the locus pre-emergence or might be applied to the crop post-emergence.

The compositions of the invention can be applied before or after planting of the crops, before weeds emerge (pre-emergence application), or after weeds emerge (post-emergence application). Where a safener is combined with mixtures of the invention, it is preferred that the mixing ratio of component (A) to safener is from 100:1 to 1:10, preferably from 20:1 to 1:1.

It is possible that the safener and the compositions of the invention are applied simultaneously. For example, the safener and the composition of the invention might be applied to the locus pre-emergence or might be applied to the crop post-emergence. It is also possible that the safener and the composition of the invention are applied sequentially. For example, the safener might be applied before sowing the seeds as a seed treatment and the composition of the invention might be applied to the locus pre-emergence or might be applied to the crop post-emergence.

However, the skilled person will appreciate that compositions of the invention are particularly useful in non-selective burn-down applications, and as such may also be used to control volunteer or escape crop plants. In such situations, it is clearly not necessary to include a safener in a composition of the invention.

The Examples described herein illustrate but do not limit the range of rates of components (A) and (B) that may be employed in the invention.

The compositions of the invention can advantageously be used in the below-mentioned formulations (in which case "active ingredient" relates to the respective mixture of component (A) with component (B) or, when a safener is also used, the respective mixture of the component (A) with component (B) and the safener).

Compositions of this invention can also be mixed with one or more further pesticides including herbicides [typically different to the herbicides (A) and (B)], fungicides, insecticides, nematicides, bactericides, acaricides, growth regulators, chemosterilants, semiochemicals, repellents, attractants, pheromones, feeding stimulants or other biologically active compounds to form a multi-component pesticide giving an even broader spectrum of agricultural protection.

The compositions of present invention can also be used in mixture with one or more additional herbicides and/or plant growth regulators. Examples of such additional herbicides or plant growth regulators include acetochlor, acifluorfen (including acifluorfen-sodium), aclonifen, ametryn, amicarbazone, aminopyralid, aminotriazole, atrazine, beflubutamid-M, benquitrione, bensulfuron (including bensulfuron-methyl), bentazone, bicyclopyrone, bilanafos, bipyrazone, bispyribac-sodium, bixlozone, broclozone, bromacil, bromoxynil, butachlor, butafenacil, carfentrazone (including carfentrazone-ethyl), cloransulam (including cloransulam-methyl), chlorimuron (including chlorimuron-ethyl), chlorotoluron, chlorsulfuron, cinmethylin, clacyfos, clethodim, clodinafop (including clodinafop-propargyl), clomazone, clopyralid, cyclopyranil, cyclopyrimorate, cyclosulfamuron, cyhalofop (including cyhalofop-butyl), 2,4-D (including the choline salt and 2-ethylhexyl ester thereof), 2,4-DB, desmedipham, dicamba (including the aluminium, aminopropyl, bis-aminopropylmethyl, choline, dichloroprop, diglycolamine, dimethylamine, dimethylammonium, potassium and sodium salts thereof) diclosulam, diflufenican, diflufenzopyr, dimethachlor, dimethenamid-P, dioxopyritrione, diquat dibromide, diuron, epyrifenacil, ethalfluralin, ethofumesate, fenoxaprop (including fenoxaprop-P-ethyl), fenoxasulfone, fenpyrazone, fenquinotrione, fentrazamide, flazasulfuron, florasulam, florpyrauxifen (including florpyrauxifen-benzyl), fluazifop (including fluazifop-P-butyl), flucarbazone (including flucarbazone-sodium), fluchloraminopyr (including fluchloraminopyr-tefuryl), flufenacet, flufenoximacil, flumetsulam, flumioxazin, fluometuron, fomesafen flupyrsulfuron (including flupyrsulfuron-methyl-sodium), fluroxypyr (including fluroxypyr-meptyl), flusulfinam, fomesafen, foramsulfuron, glufosinate (including L-glufosinate and the ammonium salts of both), glyphosate (including the diammonium, isopropylammonium and potassium salts thereof), halauxifen (including halauxifen-methyl), haloxyfop (including haloxyfop-methyl), hexazinone, hydantocidin, icafolin (including icafolin-methyl), imazamox (including R-imazamox), imazapic, imazapyr, imazethapyr, indaziflam, indolauxipyr (including indolauxipyr-cyanomethyl), iodosulfuron (including iodosulfuron-methyl-sodium), iofensulfuron (including iofensulfuron-sodium), ioxynil, iptriazopyrid, isoproturon, isoxaflutole, lancotrione, MCPA, MCPB, mecoprop-P, mesosulfuron (including mesosulfuron-methyl), mesotrione, metamitron, metazachlor, methiozolin, metolachlor, metosulam, metribuzin, metsulfuron, napropamide, nicosulfuron, norflurazon, oxadiazon, oxasulfuron, oxyfluorfen, paraquat dichloride, pendimethalin, penoxsulam, phenmedipham, picloram, pinoxaden, pretilachlor, primisulfuron-methyl, prometryne, propanil, propaquizafop, propyrisulfuron, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen (including pyraflufen-ethyl), pyraquinate, pyrasulfotole, pyridate, pyriftalid, pyriflubenzoxim, pyrimisulfan, pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quizalofop (including quizalofop-P-ethyl and

quizalofop-P-tefuryl), rimisoxafen, rimsulfuron, saflufenacil, sethoxydim, simazine, S-metalochlor, sulfentrazone, sulfosulfuron, tebuthiuron, tefuryltrione, tembotrione, terbuthylazine, terbutryn, tetflupyrolimet, thiencarbazone, thifensulfuron, tiafenacil, tolpyralate, topramezone, tralkoxydim, triafamone, triallate, triasulfuron, tribenuron (including tribenuron-methyl), triclopyr, trifloxysulfuron (including trifloxysulfuron-sodium), trifludimoxazin, trifluralin, triflusulfuron, tripyrasulfone, 3-(2-chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-trifluoromethyl-3,6-dihydropyrimidin-1(2H)-yl)phenyl)-5-methyl-4,5-dihydroisoxazole-5-carboxylic acid ethyl ester, 4-hydroxy-1-methoxy-5-methyl-3-[4-(trifluoromethyl)-2-pyridyl]imidazolidin-2-one, 4-hydroxy-1,5-dimethyl-3-[4-(trifluoromethyl)-2-pyridyl]imidazolidin-2-one, 5-ethoxy-4-hydroxy-1-methyl-3-[4-(trifluoromethyl)-2-pyridyl]imidazolidin-2-one, 4-hydroxy-1-methyl-3-[4-(trifluoromethyl)-2-pyridyl]imidazolidin-2-one, 4-hydroxy-1,5-dimethyl-3-[1-methyl-5-(trifluoromethyl)pyrazol-3-yl]imidazolidin-2-one, (4R)1-(5-tert-butylisoxazol-3-yl)-4-ethoxy-5-hydroxy-3-methyl-imidazolidin-2-one, (1RS,5SR)-3-[2-methoxy-4-(prop-1-yn-1-yl)phenyl]-4-oxobicyclo[3.2.1]oct-2-en-2-yl methyl carbonate, ethyl-2-[[3-[[3-chloro-5-fluoro-6-[3-methyl-2,6-dioxo-4-(trifluoromethyl)pyrimidin-1-yl]-2-pyridyl]oxy]acetate, methyl 2-[2-[2-bromo-4-fluoro-5-[3-methyl-2,6-dioxo-4-(trifluoromethyl)pyrimidin-1-yl]phenoxy]phenoxy]-2-methoxy-acetate, 6-chloro-4-(2,7-dimethyl-1-naphthyl)-5-hydroxy-2-methyl-pyridazin-3-one, (2-fluorophenyl)methyl 6-amino-5-chloro-2-(4-chloro-2-fluoro-3-methoxy-phenyl)pyrimidine-4-carboxylate, 6-amino-5-chloro-2-(4-chloro-2-fluoro-3-methoxy-phenyl)pyrimidine-4-carboxylic acid, methyl 3-[2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2H)-pyrimidinyl]-4-fluorophenyl]-3a,4,5,6-tetrahydro-6-methyl-6aH-cyclopent[d]isoxazole-6a-carboxylate, 2-[(2-bromo-6-fluoro-phenyl)methoxy]-4-isopropyl-1-methyl-7-oxabicyclo[2.2.1]heptane and (isopropylideneamino) 6-amino-2-(4-chloro-2-fluoro-3-methoxy-phenyl)-5-methoxy-pyrimidine-4-carboxylate.

The individual components of the composition of the invention may be utilised as the technical active ingredient as produced. More typically however, the compositions according to the invention may be formulated in various ways using formulation adjuvants, such as carriers, solvents and surface-active substances. The formulations can be in various physical forms, e.g. in the form of dusting powders, gels, wettable powders, water-dispersible granules, water-dispersible tablets, effervescent pellets, emulsifiable concentrates, microemulsifiable concentrates, oil-in-water emulsions, oil-flowables, aqueous dispersions, oily dispersions, suspo-emulsions, capsule suspensions, emulsifiable granules, soluble liquids, water-soluble concentrates (with water or a water-miscible organic solvent as carrier), impregnated polymer films or in other forms known e.g. from the Manual on Development and Use of FAO and WHO Specifications for Pesticides, United Nations, First Edition, Second Revision (2010). Such formulations can either be used directly or diluted prior to use. The dilutions can be made, for example, with water, liquid fertilisers, micronutrients, biological organisms, oil or solvents.

The formulations can be prepared e.g. by mixing the active ingredient with the formulation adjuvants in order to obtain compositions in the form of finely divided solids, granules, solutions, dispersions or emulsions. The active ingredients can also be formulated with other adjuvants, such as finely divided solids, mineral oils, oils of vegetable or animal origin, modified oils of vegetable or animal origin, organic solvents, water, surface-active substances or combinations thereof.

The active ingredients can also be contained in very fine microcapsules. Microcapsules contain the active ingredients in a porous carrier. This enables the active ingredients to be released into the environment in controlled amounts (e.g. slow-release). Microcapsules usually have a diameter of from 0.1 to 500 microns. They contain active ingredients in an amount of about from 25 to 95 % by weight of the capsule weight. The active ingredients can be in the form of a monolithic solid, in the form of fine particles in solid or liquid dispersion or in the form of a suitable solution. The encapsulating membranes can comprise, for example, natural or synthetic rubbers, cellulose, styrene/butadiene copolymers, polyacrylonitrile, polyacrylate, polyesters, polyamides, polyureas, polyurethane or chemically modified polymers and starch xanthates or other polymers that are known to the person skilled in the art. Alternatively, very fine microcapsules can be formed in which the active ingredient is contained in the form of finely divided particles in a solid matrix of base substance, but the microcapsules are not themselves encapsulated.

The formulation adjuvants that are suitable for the preparation of the compositions according to the invention are known *per se*. As liquid carriers there may be used: water, toluene, xylene, petroleum ether, vegetable oils, acetone, methyl ethyl ketone, cyclohexanone, acid anhydrides, acetonitrile, acetophenone, amyl acetate, 2-butanone, butylene carbonate, chlorobenzene, cyclohexane, cyclohexanol, alkyl esters of acetic acid, diacetone alcohol, 1,2-dichloropropane, diethanolamine, p-diethylbenzene, diethylene glycol, diethylene glycol abietate, diethylene glycol butyl ether, diethylene glycol ethyl ether, diethylene glycol methyl ether, *N,N*-dimethylformamide, dimethyl sulfoxide, 1,4-dioxane, dipropylene glycol, dipropylene glycol methyl ether, dipropylene glycol dibenzoate, diproxitol, alkylpyrrolidone, ethyl acetate, 2-ethylhexanol, ethylene carbonate, 1,1,1-trichloroethane, 2-heptanone, alpha-pinene, d-limonene, ethyl lactate, ethylene glycol, ethylene glycol butyl ether, ethylene glycol methyl ether, gamma-butyrolactone, glycerol, glycerol acetate, glycerol diacetate, glycerol triacetate, hexadecane, hexylene glycol, isoamyl acetate, isobornyl acetate, isooctane, isophorone, isopropylbenzene, isopropyl myristate, lactic acid, laurylamine, mesityl oxide, methoxypropanol, methyl isoamyl ketone, methyl isobutyl ketone, methyl laurate, methyl octanoate, methyl oleate, methylene chloride, m-xylene, *n*-hexane, *n*-octylamine, octadecanoic acid, octylamine acetate, oleic acid, oleylamine, o-xylene, phenol, polyethylene glycol, propionic acid, propyl lactate, propylene carbonate, propylene glycol, propylene glycol methyl ether, p-xylene, toluene, triethyl phosphate, triethylene glycol, xylenesulfonic acid, paraffin, mineral oil, trichloroethylene, perchloroethylene, ethyl acetate, amyl acetate, butyl acetate, propylene glycol methyl ether, diethylene glycol methyl ether, methanol, ethanol, isopropanol, and alcohols of higher molecular weight, such as amyl alcohol, tetrahydrofurfuryl alcohol, hexanol, octanol, ethylene glycol, propylene glycol, glycerol, *N*-methyl-2-pyrrolidone and the like.

Suitable solid carriers are, for example, talc, titanium dioxide, pyrophyllite clay, silica, attapulgite clay, kieselguhr, limestone, calcium carbonate, bentonite, calcium montmorillonite, cottonseed husks, wheat flour, soybean flour, pumice, wood flour, ground walnut shells, lignin and similar substances.

A large number of surface-active substances can advantageously be used in both solid and liquid formulations, especially in those formulations which can be diluted with a carrier prior to use. Surface-active substances may be anionic, cationic, non-ionic or polymeric and they can be used as emulsifiers, wetting agents or suspending agents or for other purposes. Typical surface-active substances include,

for example, salts of alkyl sulfates, such as diethanolammonium lauryl sulfate; salts of alkylarylsulfonates, such as calcium dodecylbenzenesulfonate; alkylphenol/alkylene oxide addition products, such as nonylphenol ethoxylate; alcohol/alkylene oxide addition products, such as tridecylalcohol ethoxylate; soaps, such as sodium stearate; salts of alkylnaphthalenesulfonates, such as sodium dibutylnaphthalenesulfonate; dialkyl esters of sulfosuccinate salts, such as sodium di(2-ethylhexyl)sulfosuccinate; sorbitol esters, such as sorbitol oleate; quaternary amines, such as lauryltrimethylammonium chloride, polyethylene glycol esters of fatty acids, such as polyethylene glycol stearate; block copolymers of ethylene oxide and propylene oxide; and salts of mono and di-alkylphosphate esters; and also further substances described e.g. in McCutcheon's Detergents and Emulsifiers Annual, MC Publishing Corp., Ridgewood New Jersey (1981).

Further adjuvants that can be used in pesticidal formulations include crystallisation inhibitors, viscosity modifiers, suspending agents, dyes, anti-oxidants, foaming agents, light absorbers, mixing auxiliaries, antifoams, complexing agents, neutralising or pH-modifying substances and buffers, corrosion inhibitors, fragrances, wetting agents, take-up enhancers, micronutrients, plasticisers, glidants, lubricants, dispersants, thickeners, antifreezes, microbicides, and liquid and solid fertilisers.

The formulations according to the invention can include an additive comprising an oil of vegetable or animal origin, a mineral oil, alkyl esters of such oils or mixtures of such oils and oil derivatives. The amount of oil additive in the composition according to the invention is generally from 0.01 to 10 %, based on the mixture to be applied. For example, the oil additive can be added to a spray tank in the desired concentration after a spray mixture has been prepared. Preferred oil additives comprise mineral oils or an oil of vegetable origin, for example rapeseed oil, olive oil or sunflower oil, emulsified vegetable oil, alkyl esters of oils of vegetable origin, for example the methyl derivatives, or an oil of animal origin, such as fish oil or beef tallow. Preferred oil additives comprise alkyl esters of C_8C_{22} fatty acids, especially the methyl derivatives of C_{12}-C_{18} fatty acids, for example the methyl esters of lauric acid, palmitic acid and oleic acid (methyl laurate, methyl palmitate and methyl oleate, respectively). Many oil derivatives are known from the Compendium of Herbicide Adjuvants, 10th Edition, Southern Illinois University, 2010.

The formulations generally comprise from 0.1 to 99 % by weight, especially from 0.1 to 95 % by weight, of compounds (A) and (B) and from 1 to 99.9 % by weight of a formulation adjuvant which preferably includes from 0 to 25 % by weight of a surface-active substance. Whereas commercial products may preferably be formulated as concentrates, the end user will normally employ dilute formulations.

The rates of application vary within wide limits and depend on the nature of the soil, the method of application, the crop plant, the pest to be controlled, the prevailing climatic conditions, and other factors governed by the method of application, the time of application and the target crop. As a general guideline, compositions may be applied at a rate of from 1 to 2000 l/ha, especially from 10 to 1000 l/ha.

Preferred formulations can have the following compositions (weight %), wherein the term “active ingredient” refers to the total weight % of the combination of all active ingredients in the composition:

Emulsifiable concentrates:	
active ingredient:	1 to 95 %, preferably 60 to 90 %
surface-active agent:	1 to 30 %, preferably 5 to 20 %
liquid carrier:	1 to 80 %, preferably 1 to 35 %
Dusts:	
active ingredient:	0.1 to 10 %, preferably 0.1 to 5 %
solid carrier:	99.9 to 90 %, preferably 99.9 to 99 %
Suspension concentrates:	
active ingredient:	5 to 75 %, preferably 10 to 50 %
water:	94 to 24 %, preferably 88 to 30 %
surface-active agent:	1 to 40 %, preferably 2 to 30 %
Wettable powders:	
active ingredient:	0.5 to 90 %, preferably 1 to 80 %
surface-active agent:	0.5 to 20 %, preferably 1 to 15 %
solid carrier:	5 to 95 %, preferably 15 to 90 %
Granules:	
active ingredient:	0.1 to 30 %, preferably 0.1 to 15 %
solid carrier:	99.5 to 70 %, preferably 97 to 85 %

Various aspects and embodiments of the present invention will now be illustrated in more detail by way of example. It will be appreciated that modification of detail may be made without departing from the scope of the invention.

EXAMPLES

FORMULATION EXAMPLES

Wettable powders	a)	b)	c)
active ingredients	25 %	50 %	75 %
sodium lignosulfonate	5 %	5 %	-
sodium lauryl sulphate	3 %	-	5 %
sodium diisobutylnaphthalenesulfonate	-	6 %	10 %
phenol polyethylene glycol ether	-	2 %	-
(7-8 mol of ethylene oxide)	-	-	-
highly dispersed silicic acid	5 %	10 %	10 %
Kaolin	62 %	27 %	-

The combination is thoroughly mixed with the adjuvants and the mixture is thoroughly ground in a suitable mill, affording wettable powders that can be diluted with water to give suspensions of the desired concentration.

Powders for dry seed treatment	a)	b)	c)
active ingredients	25 %	50 %	75 %
light mineral oil	5 %	5 %	5 %
highly dispersed silicic acid	5 %	5 %	-
Kaolin	65 %	40 %	-
Talcum	-		20 %

The combination is thoroughly mixed with the adjuvants and the mixture is thoroughly ground in a suitable mill, affording powders that can be used directly for seed treatment.

Emulsifiable concentrate	
active ingredients	10 %
octylphenol polyethylene glycol ether (4-5 mol of ethylene oxide)	3 %
calcium dodecylbenzenesulfonate	3 %
castor oil polyglycol ether (35 mol of ethylene oxide)	4 %
Cyclohexanone	30 %
xylene mixture	50 %

Emulsions of any required dilution, which can be used in plant protection, can be obtained from this concentrate by dilution with water.

Dusts	a)	b)	c)
Active ingredients	5 %	6 %	4 %
Talcum	95 %	-	-
Kaolin	-	94 %	-
mineral filler	-	-	96 %

Ready-for-use dusts are obtained by mixing the combination with the carrier and grinding the mixture in a suitable mill. Such powders can also be used for dry dressings for seed.

Extruded granules	
Active ingredients	15 %
sodium lignosulfonate	2 %
Carboxymethylcellulose	1 %
Kaolin	82 %

The combination is mixed and ground with the adjuvants, and the mixture is moistened with water. The mixture is extruded and then dried in a stream of air.

Coated granules	
Active ingredients	8 %
polyethylene glycol (mol. wt. 200)	3 %

Kaolin	89 %

The finely ground combination is uniformly applied, in a mixer, to the kaolin moistened with polyethylene glycol. Non-dusty coated granules are obtained in this manner.

Suspension concentrate

active ingredients	40 %
propylene glycol	10 %
nonylphenol polyethylene glycol ether (15 mol of ethylene oxide)	6 %
Sodium lignosulfonate	10 %
Carboxymethylcellulose	1 %
silicone oil (in the form of a 75 % emulsion in water)	1 %
Water	32 %

The finely ground combination is intimately mixed with the adjuvants, giving a suspension concentrate from which suspensions of any desired dilution can be obtained by dilution with water. Using such dilutions, living plants as well as plant propagation material can be treated and protected against infestation by microorganisms, by spraying, pouring or immersion.

Flowable concentrate for seed treatment

active ingredients	40 %
propylene glycol	5 %
copolymer butanol PO/EO	2 %
Tristyrenephenole with 10-20 moles EO	2 %
1,2-benzisothiazolin-3-one (in the form of a 20% solution in water)	0.5 %
monoazo-pigment calcium salt	5 %
Silicone oil (in the form of a 75 % emulsion in water)	0.2 %
Water	45.3 %

The finely ground combination is intimately mixed with the adjuvants, giving a suspension concentrate from which suspensions of any desired dilution can be obtained by dilution with water. Using such dilutions, living plants as well as plant propagation material can be treated and protected against infestation by microorganisms, by spraying, pouring or immersion.

Slow Release Capsule Suspension

28 Parts of the combination are mixed with 2 parts of an aromatic solvent and 7 parts of toluene diisocyanate/polymethylene-polyphenylisocyanate-mixture (8:1). This mixture is emulsified in a mixture of 1.2 parts of polyvinylalcohol, 0.05 parts of a defoamer and 51.6 parts of water until the desired particle size is achieved. To this emulsion a mixture of 2.8 parts 1,6-diaminohexane in 5.3 parts of water is added. The mixture is agitated until the polymerization reaction is completed. The obtained capsule suspension is stabilized by adding 0.25 parts of a thickener and 3 parts of a dispersing agent. The capsule suspension formulation contains 28% of the active ingredients. The medium capsule diameter

is 8-15 microns. The resulting formulation is applied to seeds as an aqueous suspension in an apparatus suitable for that purpose.

BIOLOGICAL EFFICACY TESTS

Seeds of a variety of test species are sown in standard soil in pots (*Alopecurus myosuroides* (ALOMY), *Echinochloa crus-galli* (ECHCG), *Lolium perenne* (LOLPE), *Setaria faberi* (SETFA), and *Ipomoea hederacea* (IPHOE)) and cultivated under controlled conditions in a glasshouse (at 24/16 °C, day/night; 14 hours light; 65% humidity), the plants are sprayed with an aqueous spray solution derived from the dissolution of Component (A) in acetone and IF50 (11.12% Emulsogen EL360 TM + 44.44% N-methylpyrrolidone + 44.44% Dowanol DPM glycol ether) and Component (B) which was then diluted to the required concentration using 0.2% Genapol XO80 (CAS No.9043-30-5) in water as the diluent. Test compounds or compositions are applied at the rates stated. The test plants are then grown in a glasshouse under controlled conditions in a glasshouse (at 24/16 °C, day/night; 14 hours light; 65% humidity) and watered twice daily. After 14 days, the test is evaluated for the percentage damage caused to the plant (100 = total damage to plant; 0 = no damage to plant), and the result are shown below in table B1 to B5.

Table B1: Post-emergence efficacy for a composition of compound of formula (Ia) and mesotrione against *Alopecurus myosuroides* (ALOMY)

Component (A)	Component (B)			
Compound (Ia) (g/Ha)	Mesotrione (g/Ha)	Ratio (A):(B)	Observed Activity (%)	Expected Activity (%)
0.9375		-	1.3	-
30.0	-	-	67.5	-
-	3.75	-	0.0	-
-	15.0	-	17.5	-
0.9375	3.75	1:4	**12.5**	1.3
30.0	15.0	2:1	**82.5**	73.2

Table B2: Post-emergence efficacy for a composition of compound of formula (Ia) and mesotrione against *Lolium perenne* (LOLPE)

Component (A)	Component (B)			
Compound (Ia) (g/Ha)	Mesotrione (g/Ha)	Ratio (A):(B)	Observed Activity (%)	Expected Activity (%)
0.46875				
0.9375	-	-	0.0	-
7.5	-	-	42.5	-
15	-	-	50.0	-
-	5.625	-	0.0	-
-	7.5	-	5.0	-

-	15	-	10.0	-
-	45	-	35.0	-
-	60	-	5.0	-
0.46875	3.75	1:8	2.5	0.0
7.5	60	1:8	**22.5**	17.1
0.9375	5.625	1:6	**5.0**	0.0
7.5	45	1:6	**67.5**	62.6
7.5	30	1:4	**20.0**	17.1
15	15	1:1	**65.0**	55.0
15	7.5	2:1	**65.0**	52.5

Table B3: Post-emergence efficacy for a composition of compound of formula (Ia) and mesotrione against *Setaria faberi* (SETFA)

Component (A)	Component (B)			
Compound (Ia) (g/Ha)	Mesotrione (g/Ha)	Ratio (A):(B)	Observed Activity (%)	Expected Activity (%)
3.75	-	-	67.5	-
-	22.5	-	5.0	-
3.75	22.5	1:6	**85.0**	69.1

Table B4: Post-emergence efficacy for a composition of compound of formula (Ia) and mesotrione against *Ipomoea hederacea* (IPHOE)

Component (A)	Component (B)			
Compound (Ia) (g/Ha)	Mesotrione (g/Ha)	Ratio (A):(B)	Observed Activity (%)	Expected Activity (%)
0.9375	-	-	82.5	-
-	5.625	-	72.5	-
0.9375	5.625	1:6	**100.0**	95.2
7.5	30.0	1:4	**99.0**	95.1

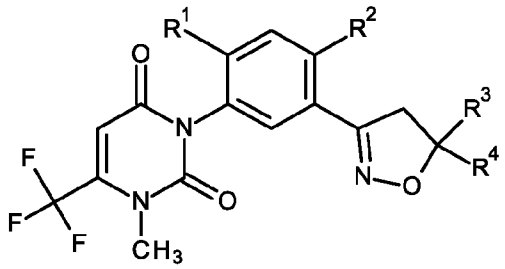
Table B5: Post-emergence efficacy for a composition of compound of formula (Ia) and mesotrione against *Echinochloa crus-galli* (ECHCG)

Component (A)	Component (B)			
Compound (Ia) (g/Ha)	Mesotrione (g/Ha)	Ratio (A):(B)	Observed Activity (%)	Expected Activity (%)
1.75				
3.75	-	-	16.3	-
-	15.0	-	2.5	-

1.75	15.0	1:8	22.5	15.9
3.75	15.0	1:4	**55.0**	18.3

CLAIMS

1. A herbicidal composition comprising a mixture of components (A) and (B) as active ingredients, wherein component (A) is a compound of formula (I):



(I)

R^1 is hydrogen, chloro, or fluoro;
R^2 is chloro or bromo;
R^3 is CO_2R^5 or CH_2OR^6;
R^4 is hydrogen, methyl, or ethyl;
R^5 is hydrogen, C_1-C_4alkyl, C_1-C_4haloalkyl, allyl, propargyl, C_1-C_3alkoxyC_1-C_3alkyl, C_1-C_3alkoxycarbonylC_1-C_3alkyl, or tetrahydrofuranylmethyl;
R^6 is C_1-C_4alkylcarbonyl, cyclopropylcarbonyl, or C_1-C_2alkylsulfonyl;
or agrochemically acceptable ester or salt thereof;

and component (B) is mesotrione or agrochemically acceptable ester or salt thereof.

2. A herbicidal composition according to claim 1, wherein
R^1 is fluoro;
R^2 is chloro;
R^3 is CO_2R^5;
R^4 is methyl; and
R^5 is ethyl.

3. A herbicidal composition according to claim 1 or claim 2, wherein the ratio of components (A) to (B) is from 20:1 to 1:20.

4. A herbicidal composition according to any one of claims 1 to 3, wherein the ratio of components (A) to (B) is from 10:1 to 1:10.

5. A herbicidal composition according to any one of claims 1 to 4, wherein the ratio of components (A) to (B) is from 2:1 to 1:8.

6. A herbicidal composition according to any one of claims 1 to 5, wherein the ratio of components (A) to (B) is from 2:1 to 1:6.

7. A herbicidal composition according to any one of the previous claims, wherein the composition further comprises an additional herbicidal component (C).

8. A herbicidal composition according to claim 7, wherein component (C) is a herbicide selected from bicyclopyrone, paraquat dibromide, diquat dibromide, saflufenacil, trifludimoxazin, tiafenacil, pyroxasulfone S-metolachlor, glufosinate, L-glufosinate, glyphosate, metribuzin, and [3-(2-methoxy-4-prop-1-ynyl-phenyl)-4-oxo-2-bicyclo[3.2.1]oct-2-enyl] methyl carbonate.

9. A herbicidal composition according to any one of claims 1 to 8, further comprising a herbicide safener.

10. A herbicidal composition according to claim 9, wherein the herbicide safener is selected from the group consisting of benoxacor, cloquintocet, cyprosulfamide, dichlormid, fenchlorazole, fenclorim, fluxofenim, furilazole, isoxadifen, mefenpyr, metcamifen and oxabetrinil.

11. A method of controlling weeds at a locus comprising applying to the locus of a weed controlling amount of a herbicidal composition according to any one of claims 1 to 10.

12. A method of selectively controlling weeds at a locus comprising crop plants and weeds, said method comprising applying to the locus a weed controlling amount of a herbicidal composition according to any one of claims 1 to 11.

13. A method according to claim 12, wherein the crop plant is oil palm, corn, cereals, or soy.

14. A method according to claim 13, wherein the crop plant comprises a herbicide tolerance trait.

15. A method according to any one of claims 1 to 14, wherein the weeds comprise species selected from *Abutilon sp., Alopecurus sp., Amaranthus sp., Brachiaria sp., Borreria sp., Chenopodium sp., Commelina sp., Digitaria sp., Echinochloa sp., Eleusine sp., Erigeron sp., Ipomoea sp., Kochia sp., Lolium sp., Portulaca sp., Setaria sp., Sorghum sp.,* and *Stellaria sp.*.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/069739

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01N25/02 A01N25/26 A01N41/10 A01N43/54 A01P13/00
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, WPI Data, 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 2020/234422 A1 (SYNGENTA CROP PROTECTION AG [CH]) 26 November 2020 (2020-11-26) cited in the application page 1, line 1 - line 6 page 1, line 16 - line 36 page 4, line 11 page 4, line 41 - page 5, line 10 page 7, line 1 - line 4 page 8, line 4 - line 5 ----- -/--	1,2, 7-12,14, 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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"P" document published prior to the international filing date but later than the priority date claimed

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"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

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 September 2024	16/09/2024

Name and mailing address of the ISA/	Authorized officer
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2022/267487 A1 (NANTONG JIANGSHAN AGROCHEMICAL & CHEMICALS CO LTD [CN]) 29 December 2022 (2022-12-29) abstract paragraphs [0001] - [0004], [0007] - [0010], [0054] - [0056] paragraphs [0109] - [112,] claim 1	1-15
A	CN 112 690 283 A (SINOCHEM CORP) 23 April 2021 (2021-04-23) paragraphs [0001], [0012] - [0013], [0052] - [0054], [0060] - [0061], [0076], [0092], [0108], [0119] - [0124], [0169], [0204] paragraph [0243] 1-3; table A	1-15
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Information on patent family members

International application No
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