(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
30. März 2023 (30.03.2023)

WIPO | PCT

(10) Internationale Veröffentlichungsnummer
WO 2023/046351 A1

(51) Internationale Patentklassifikation:
A01M 7/00 (2006.01) *G06V 20/10* (2022.01)

(21) Internationales Aktenzeichen: PCT/EP2022/072086

(22) Internationales Anmeldedatum:
05. August 2022 (05.08.2022)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
10 2021 210 510.6
22. September 2021 (22.09.2021) DE

(71) Anmelder: **ROBERT BOSCH GMBH** [DE/DE]; Postfach 30 02 20, 70442 Stuttgart (DE).

(72) Erfinder: **FREUDIGMANN, Hans-Arndt**; Eberhardstr. 37, 72072 Tuebingen (DE). **LINK-DOLEZAL, Johanna**; Lange Aecker 66, 73770 Denkendorf (DE).

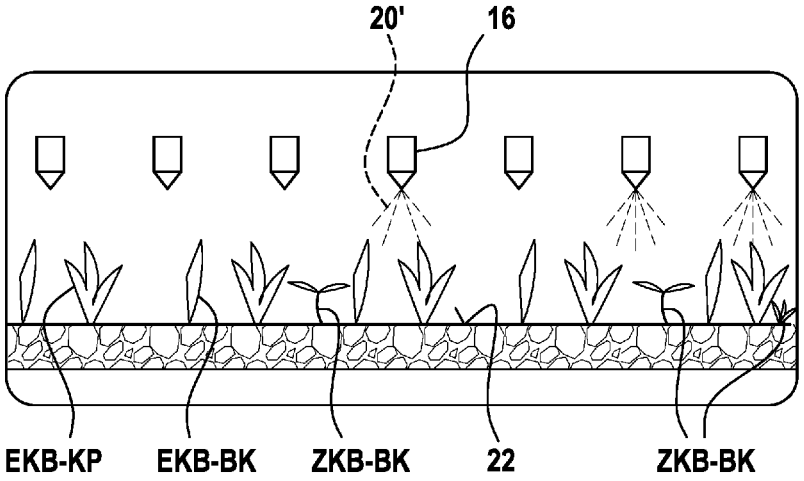
(81) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart)*: ARIPO (BW,

(54) **Title:** METHOD FOR APPLYING AT LEAST ONE SPRAY PRODUCT TO AGRICULTURAL LAND

(54) **Bezeichnung:** VERFAHREN ZUM AUSBRINGEN ZUMINDEST EINES SPRITZMITTELS AUF EINE LANDWIRTSCHAFTLICHE FLÄCHE

Fig. 3



(57) **Abstract:** The invention relates to a method for applying at least one spray product (20, 20') to agricultural land (24) having crops (KP) and weeds (BK), wherein the crops (KP) and weeds (BK) can be assigned to a cotyledon class of monocotyledons (EKB-KP, EKB-BK) or to a cotyledon class of dicotyledons (ZKB-KP, ZKB-BK), wherein the at least one spray product (20, 20') is applied to the detected field section of the agricultural land (22) by means of at least one spray nozzle unit (16) of an agricultural spraying device depending on the cotyledon class (EKB-KP, ZKB-KP) of the crops (KP) and a first determined weed indicator and/or a second determined weed indicator.

(57) **Zusammenfassung:** Es wird ein Verfahren zum Ausbringen zumindest eines Spritzmittels (20, 20') auf eine landwirtschaftliche Fläche (24) mit Kulturpflanzen (KP) und Beikräutern (BK) vorgeschlagen, wobei die Kulturpflanzen (KP) und Beikräuter (BK) einer Keimblattklasse von Einkeimblättrigen (EKB-KP, EKB-BK) oder einer Keimblattklasse von Zweikeimblättrigen (ZKB-KP, ZKB-BK) zuordenbar sind, wobei das zumindest eine Spritzmittel (20, 20') in Abhängigkeit von der Keimblattklasse (EKB-KP, ZKB-KP)

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[Fortsetzung auf der nächsten Seite]

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

Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

der Kulturpflanzen (KP) und einer ersten ermittelten Beikrautkennzahl und/oder einer zweiten ermittelten Beikrautkennzahl auf den erfassten Feldabschnitt der landwirtschaftlichen Fläche (22) mittels zumindest einer Spritzdüseneinheit (16) einer landwirtschaftlichen Spritzvorrichtung ausgebracht wird.

Description

Title

Method for applying at least one spray product to agricultural land

State of the art

The invention relates to a method for applying at least one spray product to agricultural land with crops and weeds, wherein the crops and weeds can be assigned to a cotyledon class of monocots or a cotyledon class of dicots, by means of at least one spray nozzle unit of an agricultural spraying device as well as a control unit and an agricultural spraying device for applying at least one spray product according to the preamble of the independent claims.

In today's agricultural plant protection measures (spraying operation), the spray mixture consisting of plant protection products, growth regulators or liquid fertilizer and carrier liquid is applied to the entire area of a field to be treated. It is not possible to react to the nature of the field and the actual local need for crop protection products and carrier liquid with such an application to the entire area.

Modern plant protection devices have the technical requirements for the specific application of spray mixture to a partial area. These technical requirements comprise, on the one hand, the ability to switch individual nozzles or sections on and off as well as the ability to couple the nozzle or section control with an application map or a suitable sensor system. Such a sensor system can be, for example, a weed sensor.

In a specific application to a partial area, in contrast to an application to the entire area, not all area sections of the field are treated with the target application amount. Due to the nature of the method, this application method poses the challenge that the partial areas to be treated must be identified prior to application. For example, as mentioned above, weed sensors can be used for this purpose. Typically, the weeds are always treated in the same way, regardless of the type, size and further characteristics.

With regard to weed composition, a basic distinction is made between 2 classes of plants: grasses (monocotyledons, monocots) and weeds (dicotyledons, dicots), which differ in terms of morphology and physiology (absorption of the active ingredient, transport to the site of action, metabolism/activation of the active ingredient, site of action of herbicides) differentiate. Depending on the weed class and species, different selective herbicides can be used for effective treatment. Today, whether treatment of the respective weed species is carried out depends primarily on the so-called economic damage threshold.

The cultivated plants can also be assigned to the two classes of plants (e.g., monocotyledonous crop = grain, dicotyledonous crop = sugar beet). This means that a monocotyledonous crop will also be negatively affected by grass herbicides; as will also a dicotyledonous crop by weed herbicides. An attempt is made to avoid this negative effect of herbicides on the crop (phytotoxicity) by timing (before sowing or before emergence of the crop) and location (depth of placement of the herbicide), as well as by adding so-called safeners. However, these measures are limited, so that the treatment of grasses in monocotyledonous crops and weeds in dicotyledonous crops is generally more difficult (the risk of phytotoxicity is greater, or the effectiveness of the measure is reduced). This means that certain weed compositions can be treated better/more effectively in one crop than in another crop.

The object of the invention is to adapt the application strategy of application to a partial area depending on the respective crop. In particular, it is the object of the invention not only to use the economic damage threshold as a basis for the application decision, but rather the prospect of a high effectiveness of the application. This makes it possible to improve the treatment success of a selective application.

DE 10 2017 210 804 A1 discloses a method for applying a spray product to a field, wherein the spray product is applied depending on a degree of coverage of an evaluation area.

Disclosure of the invention

Subject of the present invention is a method for applying at least one spray product to agricultural land with crops and weeds, wherein the crops and weeds can be assigned to a cotyledon class of monocots or a cotyledon class of dicots, by means of at least one spray nozzle unit of an agricultural spraying device, with the steps:
- providing or determining the cotyledon class of the crops;

- detecting a field section of the agricultural land by means of an optical detection unit of the agricultural spraying device in order to obtain image information;
- identifying the weeds in the detected field section by means of the control unit using the image information in order to assign each of these to one of the two cotyledon classes;
- determining a first weed indicator for the weeds assigned to the monocots and a second weed indicator for the weeds assigned to the dicots by means of the control unit;
- applying the at least one spray product depending on
  - the cotyledon class of the crops and
  - the first determined weed indicator and/or the second determined weed indicator

  to the detected field section of the agricultural land by means of the at least one spray nozzle unit of the agricultural spraying device.

Subject of the present invention is further a control unit, arranged to carry out and/or control the following steps:

- receiving or determining a cotyledon class of crops, wherein the crops can be assigned to a cotyledon class of monocots or a cotyledon class of dicots;
- identifying weeds in image information of a field section of an agricultural land, detected by means of an optical detection unit, in order to assign each of these to a cotyledon class of monocots or a cotyledon class of dicots;
- determining a first weed indicator for the weeds assigned to the monocots and a second weed indicator for the weeds assigned to the dicots;
- outputting a control signal depending on
  - the cotyledon class of the crops and
  - the first determined weed indicator and/or the second determined weed indicator,

  in order to apply at least one spray product to the detected field section of the agricultural land by means of at least one spray nozzle unit of an agricultural spraying device.

Subject of the present invention is further an agricultural spraying device for applying at least one spray product to agricultural land with crops and weeds, with at least one spray nozzle unit, at least one optical detection unit and a control unit described above.

Subject of the present invention is finally a computer program, arranged to execute and/or control the steps of a method described above and/or a control unit as described above, when the computer program is executed on a computer, as well as a machine-readable storage medium with the computer program stored thereon.

The method according to the invention provides a strategy for specifically spreading or applying at least one spray product that is optimized in terms of effectiveness and adapted to the combination of crops and weeds present on or to a partial area. Core of the invention is a comparison of the crop class with the occurring weed classes and a derivation of the spreading or application strategy based thereon. Background is that monocot weeds can be treated better or more effectively in dicot crops and, conversely, dicot weeds can be treated better or more effectively in monocot crops.

The method is intended for, but not limited to, agricultural purposes. In the context of the present invention, an agricultural purpose can be understood as a purpose that is aimed at the economic cultivation of crops.

The spreading or application of the at least one spray product takes place on agricultural land or an agriculturally used area. This can be understood to mean a field or a cultivation area for plants or even a plot of such a cultivation area. Agricultural land can therefore be arable land, grassland or pasture.

The plants can comprise, for example, cultivated plants, i.e., crops whose fruit is used agriculturally (for example, as food, animal feed or as an energy crop) as well as weeds, i.e., weeds and grass weeds. Both the crops and the weeds can be assigned to either a cotyledon class of monocots or a cotyledon class of dicots.

All steps of the method are preferably carried out during a movement, in particular, a journey or a flight, of the agricultural spraying device over agricultural land.

Advantageously, the agricultural spraying device is designed to carry out the method automatically and/or autonomously in order to enable rapid, reliable and efficient treatment of the agricultural land.

The agricultural spraying device can in particular be part of an agricultural field sprayer or a crop protection device or can be designed as an agricultural field sprayer or a crop protection device. The agricultural spraying device can comprise a mobile unit or can be disposed on a mobile unit, wherein the mobile unit can in particular be designed as a land vehicle and/or aircraft and/or trailer. The mobile unit can in particular be an agricultural machine, for example, a tractor, a towing vehicle, a self-propelled or autonomous field sprayer or a self-propelled or autonomous robot. The agricultural spraying device can in particular be a towed field sprayer, a self-propelled field sprayer or a mounted field

sprayer. The agricultural spraying device can also be mounted to a hydraulic device of an agricultural machine. It is also conceivable that the agricultural spraying device is mounted on a loading area of an agricultural machine. Alternatively, the spraying device can be hitched to the agricultural machine. The agricultural spraying device or the field sprayer can have at least one spray product tank for holding the spray product. The agricultural spraying device or the field sprayer can also have a mixing unit which mixes a spray concentrate with water directly on the agricultural spraying device to form the spray product to be applied. The agricultural spraying device or the field sprayer can have a respective spray product tank for water and various spray products or spray product concentrates and can mix the spray product to be applied by means of the mixing unit and apply it via the same or different spray product line systems of the agricultural spray device.

The at least one spray product is in particular a spray liquid. The spray product can have or be an agricultural preparation or plant protection product (PSM), in particular, a plant protection product concentrate. The spray product can therefore contain a pesticide, such as an herbicide, fungicide or an insecticide. The spray product can also have a fertilizer, in particular a fertilizer concentrate. Here, the spray product can have a growth regulator. The spray product can have a granular active agent that has been mixed with a carrier liquid. The spray liquid can be designed, for example, as: liquid, suspension, emulsion, solution or a combination thereof. Preferably, the spray liquid is designed in the form of a plant protection product diluted with water or a fertilizer diluted with water. Therefore, the spray liquid can be, for example, a spray mixture.

The spray nozzle unit preferably has at least one spray nozzle for applying the spray product and at least one valve for controlling or regulating the amount of spray product applied. Accordingly, the spray nozzle unit is designed to be controllable or actuatable. The valve can be disposed or integrated in the spray nozzle. However, the valve can also be disposed in front of the spray nozzle, i.e., (in the flow direction of the spray product) upstream of the spray nozzle. However, the spray nozzle unit can also have several spray nozzles, each with an upstream positioned valve. The spray nozzle unit can further have several spray nozzles with only one valve positioned upstream of the spray nozzles, so that, when the valve is actuated, the spray product is applied by means of all spray nozzles of the spray nozzle unit. The valve can be designed as a pulse width modulated valve (PWM valve) or as a proportional valve. The spray nozzle unit can be designed as a section of a nozzle system of the agricultural spraying device. The spray nozzle units can be controllable individually or separately and/or in defined groups or associations and/or

all together. The spray nozzles of each spray nozzle unit can be controllable individually or separately and/or in defined groups or associations and/or all together. The spray nozzle unit can also have different spray nozzles for applying various spray products.

Each field section row (=field sections along the direction of movement or travel) can be assigned one or more spray nozzle units or spray nozzles of a spray nozzle unit. For example, each field section row can be assigned exactly one spray nozzle unit or spray nozzle of a spray nozzle unit or exactly two spray nozzle units or spray nozzles of a spray nozzle unit in order to be treated.

The application of the spray product can be carried out in particular by means of a conveying unit. Here, the conveying unit can be designed to convey or direct, in particular to meter, a liquid and/or granules under pressure. Accordingly, the conveying unit can, for example, comprise one or more pumps, delivery pumps, metering pumps, pressure accumulators, screw conveyors, valves, orifices, etc.

The optical detection unit is preferably disposed on the agricultural spraying device. The optical detection unit can have at least one, preferably several, cameras. The cameras can be selected from the group consisting of: multispectral and/or hyperspectral and/or infrared and/or camera and/or 3D camera. The optical detection unit can be designed to detect or record images in the NIR and/or visual range. The optical detection unit can have a light unit or illumination unit. The optical detection units can be designed to communicate with one another. However, the optical detection units preferably work autonomously, i.e., independently of one another. An optical detection unit can be assigned to each field section row. However, it is also conceivable for an optical detection unit to detect two or more field section rows.

The spray nozzle unit or the spray nozzles and the optical detection unit or the cameras are preferably disposed on a spray boom of the agricultural spraying device.

The image information is preferably an image or copy of the detected field section or a part of the detected field section. Accordingly, several pieces of image information can together represent the entire field section, for example, by stringing them together and/or overlapping them and/or stitching them together.

In the context of the present application, “providing” may comprise processing and/or inputting information and/or transmitting and/or receiving information by wire or

wirelessly. Accordingly, the cotyledon class of the crops can be entered or received manually, for example. Alternatively, the cotyledon class of the crops can also be determined using the image information obtained.

The step of identifying weeds can comprise detecting a colour component, in particular, a green colour component and/or an infrared component in the field section or image section. Here, plants can be detected by means of the optical detection unit, for example, using a predetermined NDVI value (Normalized Differenced Vegetation Index, which is formed from reflection values in the near infrared and visible red wavelength range of the light spectrum), by differentiating biomass or vital plants and parts of plants from the ground. Thus, an identification of plants can therefore be carried out, for example, by recognizing green pixels or connected green pixels in the image information.

Preferably, in the step of identifying, all plants, i.e., also the crops in the entire detected field section or the entire image information, are identified. Using the identified plants, crop rows can then be identified in the field section or the image information. More preferably, according to DE 10 2017 210 804 A1 mentioned in the introduction, crop areas are defined, wherein identified plants in the crop areas are classified as crops by definition, and weed areas further defined, wherein identified plants in the weed areas are classified as weeds by definition.

The assignment involves a classifying or classification of the identified weeds into one of the two cotyledon classes by means of the control unit.

After the assignment, a first weed indicator for the weeds assigned to the monocots and a second weed indicator for the weeds assigned to the dicots are determined by means of the control unit. The weed indicators represent preferably a number of the respective weeds or a degree of coverage of the detected field section of plant material of the respective weeds or an amount of plant material of the respective weeds.

Preferably, a step of providing or determining a first application threshold value for the first weed indicator and a second application threshold value for the second weed indicator depending on the cotyledon class of the crops is provided here, wherein in the application step the at least one spray product is further applied depending on the first application threshold value and/or the second application threshold value.

Preferably, the first application threshold value for the first weed indicator is greater than the second application threshold value for the second weed indicator if the crops are assigned to the monocots. Alternatively or additionally, the second application threshold value for the second weed indicator is preferably greater than the first application threshold value for the first weed indicator if the crops are assigned to the dicots. In other words, e.g., the corresponding application threshold value is greater if the cotyledon class of weeds corresponds to the cotyledon class of crops. So, if monocotyledonous crops grow on agricultural land, the first application threshold value for the weeds of the same cotyledon class, i.e., for the monocotyledonous weeds (=first weed indicator), is greater, and vice versa.

Preferably, the second application threshold value for the second weed indicator is selected such that if the crops are assigned to the monocots and at least one of the identified weeds is assigned to the dicots, the at least one spray product or at least one of the spray products is applied. Alternatively or additionally, the first application threshold value for the first weed indicator is preferably selected such that if the crops are assigned to the dicots and at least one of the identified weeds is assigned to the monocots, the at least one spray product or at least one of the spray products is applied. In other words, e.g., each time a single corresponding weed is identified or assigned, the spray is applied accordingly, so that a zero-tolerance strategy is applied in this regard. For the application threshold value of the other cotyledon class, however, a more moderate strategy is used, e.g., according to the economic damage threshold.

In the application step, the at least one spray product or at least one of the spray products is applied depending on the cotyledon class of the crops and the first determined weed indicator and/or the second determined weed indicator to the detected field section of the agricultural land by means of the at least one spray nozzle unit of the agricultural spraying device. In the context of the present invention, the expression “the at least one spray product” comprises all spray products or at least one of the spray products in the case of several spray products, depending on the case.

Here, in the application step, the first weed indicator is preferably compared with the first application threshold value and/or the second weed indicator is compared with the second application threshold value by means of the control unit, wherein at least one spray product is applied, when reaching, falling below or exceeding the first application threshold value or the second application threshold value. Preferably, it is determined by

means of the control unit whether and/or how much and/or which of the at least one spray product is applied.

For example, the cotyledon class of the crop can first be derived from the crop to be treated. According to this cotyledon class, an application threshold value for the treatment worthiness of the cotyledon classes of the weeds can then be determined. This is different for both classes of cotyledons (monocots, dicots). Taking into account the phytotoxicity and effectiveness of the measure, a common first application threshold value (e.g., economic damage threshold) is then set for treatment, for example, of monocotyledonous weeds in a monocotyledonous crop, while a second "zero tolerance" application threshold value is set for treatment of dicotyledonous weeds in the monocotyledonous crop (and vice versa for dicotyledonous crops). The respective application threshold value is stored in the algorithm for the spreading or application strategy. The information about the actual weed indicator or weed population is integrated into the algorithm for the application strategy via the optical detection unit. If a weed population is above the first or second application threshold value defined for the cotyledon class, the corresponding spray product or spray products are spread or applied.

Furthermore, two spray products are preferably applied, wherein a first spray product is applied depending on the first determined weed indicator and/or a second spray product that is different from the first spray product is applied depending on the second determined weed indicator. Here, the spray products can be provided premixed in separate spray product tanks of the agricultural spraying device of can be mixed as required during the application step by means of a mixing unit of the agricultural spraying device.

Furthermore, the spray product is preferably applied essentially uniformly. In the context of the present invention, uniform application can be understood to mean application with the same or constant predefined application rate per area. A predefined application rate can be understood as meaning an application rate that is determined in advance or at the beginning of the treatment. The defined application rate can be preset or entered in advance.

The method or the method steps are understandably repeated or cyclically carried out. Here, the steps of detecting the field sections are preferably carried out or carried out repeatedly in a defined, in particular, fixed time interval or in a time interval adapted to

the driving speed of the agricultural spraying device. In other words, the field sections are detected with a defined or a speed-dependent repetition rate.

The control unit may comprise a plurality of subordinate control units. The control unit and/or each subordinate control unit can have a computing unit or a plurality of computing units for processing signals or data, at least one storage unit for storing signals or data, at least one communication interface for inputting data, in particular for receiving image information and for outputting data, in particular, control signals to a unit, in particular, an actuator. A control unit or subordinate control unit and/or a computing unit can be assigned to each optical detection unit, or each optical detection unit can have its own control unit or subordinate control unit and/or a computing unit. The optical detection units can each, for example, have their own subordinate control unit and work autonomously, wherein corresponding data are transmitted to the (superordinate) control unit, which makes the second "spraying decision" and accordingly controls the spray nozzle units assigned to the adjacent field evaluation areas.

The computing unit or units are designed or arranged for image processing, so that it can carry out calculation steps or image processing steps for carrying out the method according to the invention. Accordingly, each computing unit has a corresponding image processing software. The computing unit can be, for example, a signal processor, a microcontroller or the like, wherein the storage unit can be a flash memory, an EPROM or a magnetic storage unit. The communication interface can be designed to input or output data wirelessly and/or by wire, wherein a communication interface that can input or output wired data, for example, input this data electrically or optically from a corresponding data transmission line or output it into a corresponding data transmission line.

Accordingly, the method according to the invention can be implemented, for example, in software or hardware or in a mixed form of software and hardware in the control unit or a control device.

The control unit can be disposed completely or partially on the agricultural spraying device or can be integrated into it. However, the control unit can also be completely or partially integrated externally, for example, in a cloud.

Drawings

The invention is explained in more detail below using the accompanying drawings. It is shown in:

Fig. 1 a schematic representation of an agricultural spraying device;

Fig. 2 a schematic representation of monocotyledonous and dicotyledonous weeds in a monocotyledonous crop;

Fig. 3 a corresponding application strategy for a dicotyledonous crop; and

Fig. 4 a flowchart of a method.

In the following description of preferred exemplary embodiments of the present invention, the same or similar reference signs are used for the elements depicted in the various figures and having a similar effect, wherein a repeated description of the elements is omitted.

In Fig. 1, a schematic representation of an agricultural spraying device, which in its entirety is provided with the reference sign 10 is depicted.

The agricultural spraying device 10 is designed as a field sprayer 10. The field sprayer 10 is disposed on a mobile land vehicle 12, which is designed as a towing vehicle 12 or tractor 12.

The agricultural spraying device 10 has a spray boom 14. Spray nozzle units 16 and optical detection units 18 are disposed on the spray boom 14. The spray nozzle units 16 are designed to apply a spray product 20, 20' to crops KP or weeds BK of agricultural land 22. The optical detection units 18 are designed as optical cameras 18. The optical cameras 18 each comprise a filter unit in order to extract a colour component, such as the green colour component, of a received or detected image information or a detected image in order to detect a field section of agricultural land 22 with the crops KP and weeds BK.

Thereby, the crops KP can be assigned to either a cotyledon class of monocots EKB-KP or a cotyledon class of dicots ZKB-KP. Analogously, the weeds BK can also be assigned to either a cotyledon class of monocots EKB-BK or a cotyledon class of dicots ZKB-BK.

The agricultural spraying device 10 further has a conveying unit (not shown), by means of which the application rate or an active agent rate in the spray product 20, 20' to be applied can be adjusted or varied.

The agricultural spraying device 10 also has a control unit 24 that is connected to the optical cameras 18 to receive information therefrom. The control unit 24 has a computing unit 26, which is designed to carry out calculation steps or image processing steps for carrying out the method according to the invention. The control unit 24 is further designed to output a control signal in such a way to apply the spray product 20, 20' to the detected field section of agricultural land 22 depending on the cotyledon class EKB-KP, ZKB-KP of the crops KP and a first weed indicator for the weeds BK assigned to the monocots EKB-BK and a second weed indicator for the weeds BK assigned to the dicots ZKB-BK.

Fig. 2 shows a schematic representation of monocotyledonous and dicotyledonous weeds EKB-BK, ZKB-BK in a monocotyledonous crop EKB-KP.

To illustrate the method or the application strategy, FIG. 3 shows a field section of the agricultural land 22 with monocotyledonous crops EKB-KP as well as monocotyledonous weeds EKB-BK and dicotyledonous weeds ZKB-BK. First, the crop KP to be treated is determined or specified and the cotyledon class of the crop EKB-KP is derived from therefrom. According to this cotyledon class EKB-KP, the first application threshold value for the first weed indicator of the monocotyledonous weeds EKB-BK and a second application threshold value for the second weed indicator of the dicotyledonous weeds ZKB-BK are then provided or specified. This is different for both cotyledon classes (EKB, ZKB). Taking into account the phytotoxicity and effectiveness of the measure, a common first application threshold value (e.g., economic damage threshold) is then set for treatment for the monocotyledonous weeds EKB-BK in the monocotyledonous crop EKB-KP, whereas a second “zero tolerance” application threshold value is set for the dicotyledonous weeds ZKB-BK. Therefore, already if a single dicotyledonous weed ZKB-BK is identified, the spray product 20' is spread on or applied to the partial area.

Fig. 4 shows a flow chart of a method 100 for applying at least one spray product 20, 20' to agricultural land 24 with crops KP and weeds BK, wherein the crops KP and weeds BK can be assigned to a cotyledon class of monocots EKB-KP, EKB-BK or a cotyledon class of dicots ZKB-KP, ZKB-BK by means of at least one spray nozzle unit 16 of an agricultural spraying device 10. The method 100 comprises a step of providing 102 or

determining 102' the cotyledon class EKB-KP, ZKB-KP of the crops KP. The method 100 further comprises a step of detecting 106 a field section of the agricultural land 22 by means of an optical detection unit 18 of the agricultural spraying device 10 in order to obtain image information. The method 100 also comprises a step of identifying 108 the weeds BK in the detected field section by means of the control unit 24 using the image information in order to assign each of these to one of the two cotyledon classes EKB-BK, ZKB-BK. The method 100 also comprises a step of determining 110 a first weed indicator for the weeds BK assigned to the monocots EKB-BK and a second weed indicator for the weeds BK assigned to the dicots ZKB-BK by means of the control unit 24. The method 100 further comprises a step of applying 112 the at least one spray product 20, 20' depending on the cotyledon class EKB-KP, ZKB-KP of the crops KP and the first determined weed indicator and/or the second determined weed indicator to the detected field section of the agricultural land 22 by means of the at least one spray nozzle unit 16 of the agricultural spraying device 10.

Furthermore, the method 100 comprises an optional step of providing 104 or determining 104' a first application threshold value for the first weed indicator and a second application threshold value for the second weed indicator depending on the cotyledon class EKB-KP, ZKB-KP of the crops KP, wherein in the application step 112 the at least one spray product 20, 20' is further applied depending on the first application threshold value and/or the second application threshold value.

If an exemplary embodiment comprises an “and/or” link between a first feature and a second feature, this should be read as meaning that the exemplary embodiment, according to one embodiment, has both the first feature and the second feature and, according to a further embodiment, has either only the first feature or only the second feature.

Claims

1. Method (100) for applying at least one spray product (20, 20') to agricultural land (24) with crops (KP) and weeds (BK), wherein the crops (KP) and weeds (BK) can be assigned to a cotyledon class of monocots (EKB-KP, EKB-BK) or a cotyledon class of dicots (ZKB-KP, ZKB-BK) by means of at least one spray nozzle unit (16) of an agricultural spraying device (10), with the steps:
   - providing (102) or determining (102') the cotyledon class (EKB-KP, ZKB-KP) of the crops (KP);
   - detecting (106) a field section of the agricultural land (22) by means of an optical detection unit (18) of the agricultural spraying device (10) in order to obtain image information;
   - identifying (108) the weeds (BK) in the detected field section by means of the control unit (24) using the image information in order to assign each of these to one of the two cotyledon classes (EKB-BK, ZKB-BK);
   - determining (110) a first weed indicator for the weeds (BK) assigned to the monocots (EKB-BK) and a second weed indicator for the weeds (BK) assigned to the dicots (ZKB-BK) by means of the control unit (24);
   - applying (112) the at least one spray product (20, 20') depending on
     - the cotyledon class (EKB-KP, ZKB-KP) of the crops (KP) and
     - the first determined weed indicator and/or the second determined weed indicator

     to the detected field section of the agricultural land (22) by means of the at least one spray nozzle unit (16) of the agricultural spraying device (10).

2. Method (100) according to claim 1, **characterized by** a step of providing (104) or determining (104') a first application threshold value for the first weed indicator and a second application threshold value for the second weed indicator depending on the cotyledon class (EKB-KP, ZKB-KP) of the crops (KP), wherein in the application step (112) the at least one spray product (20, 20') is further applied depending on the first application threshold value and/or the second application threshold value.

3. Method (100) according to claim 2, **characterized in that,** in the application step (112), the first weed indicator is compared with the first application threshold value

and/or the second weed indicator is compared with the second application threshold value by means of the control unit (24), wherein at least one spray product (20, 20') is applied, when reaching, falling below or exceeding the first application threshold value or the second application threshold value.

4. Method (100) according to claim 2 or 3, **characterized in that**
   - the first application threshold value for the first weed indicator is greater than the second application threshold value for the second weed indicator if the crops (KP) are assigned to the monocots (EKB-KP); and/or
   - the application threshold value for the second weed indicator is greater than the application threshold value for the first weed indicator if the crops (KP) are assigned to the dicots (ZKB-KP).

5. Method (100) according to claim 4, **characterized in that**
   - the second application threshold value for the second weed indicator is selected such that if the crops (KP) are assigned to the monocots (EKB-KP) and at least one of the identified weeds (BK) is assigned to the dicots (ZKB-BK), the at least one spray product (20, 22') or at least one of the spray products (20, 22') is applied; and or
   - the first application threshold value for the first weed indicator is selected such that if the crops (KP) are assigned to the dicots (ZKB-KP) and at least one of the identified weeds (BK) is assigned to the monocots (EKB-BK), the at least one spray product (20, 22') or at least one of the spray products (20, 22') is applied.

6. Method (100) according to any one of the preceding claims, **characterized in that** the weed indicators represent a number of the respective weeds or a degree of coverage of the detected field section of plant material of the respective weeds (BK) or an amount of plant material of the respective weeds (BK).

7. Method (100) according to any one of the preceding claims, **characterized in that,** in the application step (112), it is determined by means of the control unit (24) whether and/or how much and/or which of the at least one spray product (20, 20') is applied.

8. Method (100) according to one of the preceding claims, **characterized in that,** in the application step (112), a first spray product (20) is applied depending on the first determined weed indicator and/or a second spray product (20') that is different from

the first spray product is applied depending on the second determined weed indicator.

9. Method (100) according to claim 8, **characterized in that** the spray products (20, 20')
   - are provided premixed in separate spray product tanks of the agricultural spraying device (10); or
   - are mixed as required during the application step (112) by means of a mixing unit of the agricultural spraying device (10).

10. Control unit (24), arranged to carry out and/or control the following steps:
   - receiving or determining (102') a cotyledon class (EKB-KP, ZKB-KP) of crops (KP), wherein the crops (KP) can be assigned to a cotyledon class of monocots (EKB-KP) or a cotyledon class of dicots (ZKB-KP);
   - identifying (108) weeds (BK) in image information of a field section of an agricultural land (22), detected by means of an optical detection unit (18), in order to assign each of these to a cotyledon class of monocots (EKB-BK) or a cotyledon class of dicots (ZKB- BK);
   - determining (110) a first weed indicator for the weeds (BK) assigned to the monocots (EKB-BK) and a second weed indicator for the weeds (BK) assigned to the dicots (ZKB-BK);
   - outputting a control signal depending on
     - the cotyledon class (EKB-KP, ZKB-KP) of the crops (KP) and
     - the first determined weed indicator and/or the second determined weed indicator,

   in order to apply at least one spray product (20, 20') to the detected field section of the agricultural land (22) by means of at least one spray nozzle unit (16) of an agricultural spraying device (10).

11. Agricultural spraying device (10) for applying at least one spray product (20, 20') to agricultural land (24) with crops (KP) and weeds (BK), with at least one spray nozzle unit (16), at least one optical detection unit (18) and a control unit (24) according to claim 10.

12. Computer program, arranged to execute and/or control the steps of a method according to any one of claims 1 to 9 and/or a control unit (24) according to claim 10, when the computer program is executed on a computer.

13. Machine-readable storage medium with the computer program according to claim 12 stored thereon.

Fig. 1

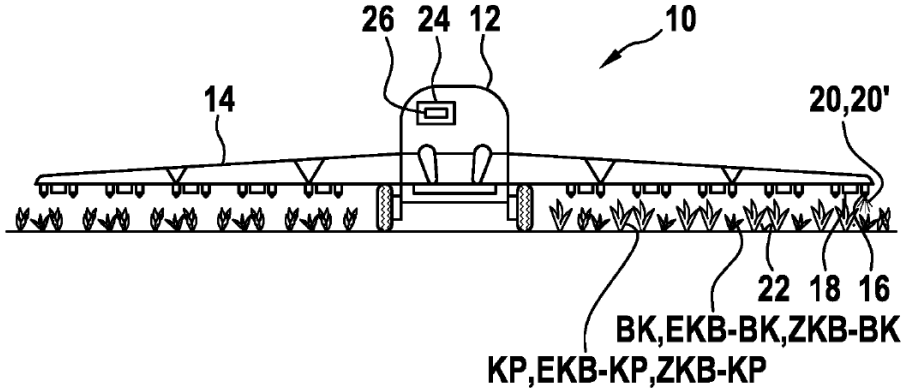

26
24
12
10
14
20,20'
22
18
16
BK,EKB-BK,ZKB-BK
KP,EKB-KP,ZKB-KP

Fig. 2

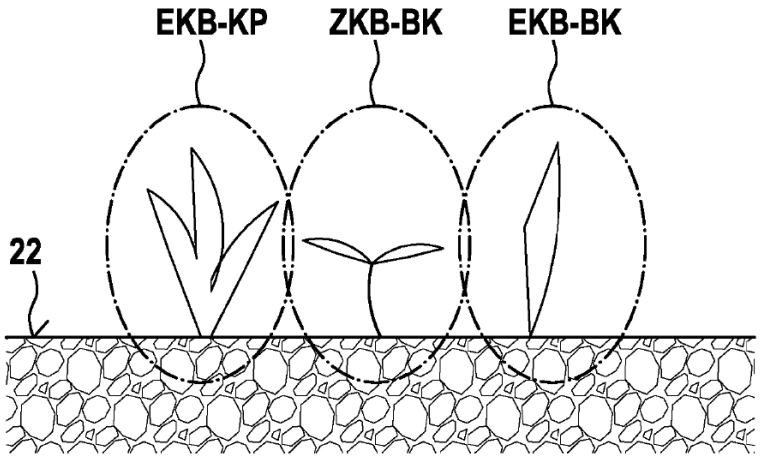

EKB-KP
ZKB-BK
EKB-BK
22

Fig. 3

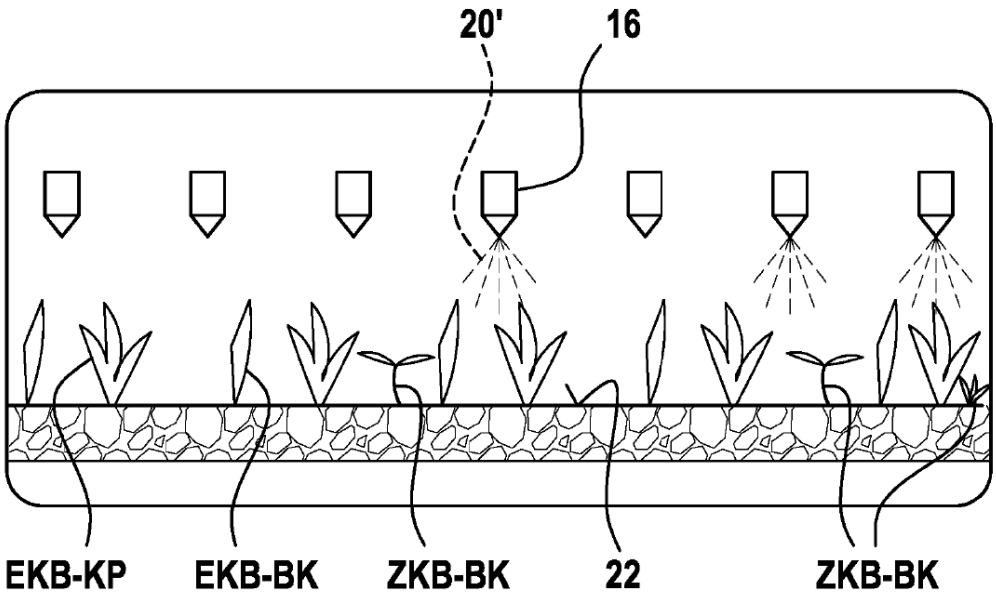
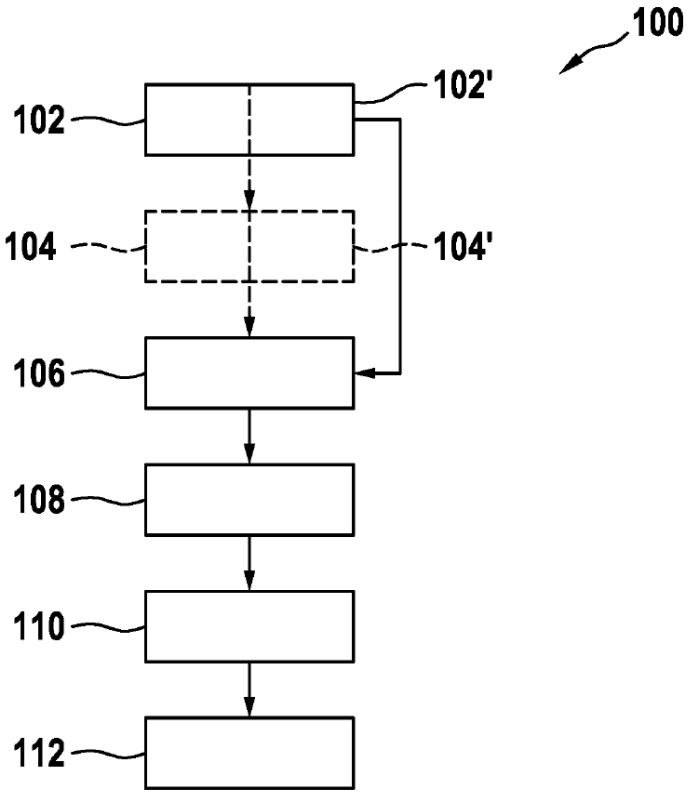

20'
16
EKB-KP
EKB-BK
ZKB-BK
22
ZKB-BK

Fig. 4


100
102
102'
104
104'
106
108
110
112