

Intelligent spray system

The present invention relates to the application of liquid active substances. The subject matter of the present invention is a system and a method for applying an active substance concentrate from a replaceable cartridge in a diluted form to a target object using a portable spraying device, wherein important parameters of the spraying process are exchanged between the cartridge and/or the spraying device and/or an external computer system.

Portable spraying devices for applying active substances such as pesticides, insecticides, herbicides and fungicides are known (DE102013109785A1, US2006/0249223A1, US2006/0102245A1, US2006/0261181A1, US2005/0006400A1).

Spraying devices which are referred to as compression sprayers are widespread in this context. They comprise a tank for holding the liquid to be sprayed. An air pressure pump which is usually manually activated and forms part of the tank contains a customary piston rod structure and activation handle for it. This air pressure pump is used to generate an air pressure by means of the liquid to be sprayed. The tank is pressurized by the operator periodically activating the pump until a desired tank pressure is reached. Owing to the air pressure acting on the spray liquid, the latter exits through a pipe dipping into the liquid in the tank and then flows through a hose, a spray jet valve at the outer end of the hose, an extension pipe and finally through a spraying nozzle to the selected target region.

Pesticides, insecticides, herbicides and fungicides are being increasingly marketed in the form of concentrates nowadays. Concentrates have the advantage of lower transportation costs. The user has to dilute the active substance before use. The dilution instructions are usually provided on the packaging or on an accompanying leaflet.

However, dilution which is performed by the user is disadvantageous for the following reasons:

The user can come into undesired contact with the active substance. It is conceivable that the user will make errors during the calculation of the quantities of concentrate and diluent.

A high viscosity of the concentrate can lead to inaccurate volumetric dimensioning of the necessary quantity.

Inaccurate dosing of active substances can result in a series of undesired consequences.

- 5 The treatment of the sprayed object may be ineffective, or overdosage may occur. It is conceivable that official instructions about dispensed quantities are not complied with. It is conceivable that faults occur in the stock monitoring, since the dispensed quantities have been calculated incorrectly.
- 10 In many cases, the application of active substances is carried out by a service provider by order. An example of one such service provider is a pest controller which is engaged to combat outbreaks of pests. For various purposes, inter alia for the purpose of billing or stock keeping, it is important, even necessary, to record which person has dispensed what quantity of which active substance at which location. Until now, this information has been
- 15 recorded in an unsystematic and inaccurate way.

- In addition, it is conceivable that the entire quantity of active substance is not used up during one application. Accordingly, a residual quantity of active substance concentrate remains in the cartridge. Here, it would be good to know how large this residual quantity is
- 20 in order, for example, to be able to decide whether or not this residual quantity is sufficient for a subsequent spraying order.

- Taking the described prior art as a starting point, the object has consisted in making the application of active substances more efficient and simpler, in supporting the user during
- 25 the application, so that errors can be very largely avoided during the application, and in recording the application process better.

- According to the invention, this object is achieved by means of the subjects of independent Claims 1, 9 and 14. Preferred embodiments can be found in the dependent claims and in
- 30 the present description.

A first subject of the present invention is a method for applying an active substance comprising the following steps:

- making available a replaceable cartridge, wherein the cartridge contains an active substance concentrate and has an electronic memory unit,
- 5 - making available a portable spraying device which comprises the following components: a container, means for connecting the cartridge to the spraying device, a control unit and a spraying nozzle,
- filling the container with a diluent,
- connecting the replaceable cartridge to the spraying device,
- 10 - application of the active substance to one or more target objects by a user, wherein the flows of the active substance concentrate and of the diluent are controlled, by means of a control unit, in a such a way that the active substance concentrate and the diluent exit the spraying device as a mixture with a constant mixing ratio via the spraying nozzle,
- 15 - determining the quantity of applied active substance concentrate by means of the control unit,
- determining the quantity of the active substance concentrate remaining in the cartridge by means of the control unit,
- storing the quantity of the active substance concentrate remaining in the cartridge in
20 the memory unit,
- transferring information about the applied active substance, and the quantity of the applied active substance, to an external computer system.

A further subject of the present invention is a system comprising:

- 25 - a portable spraying device which comprises the following components:
 - a container for holding a diluent,
 - a spraying nozzle,
 - means for feeding the diluent in the direction of the spraying nozzle,
 - means for reversibly connecting a replaceable cartridge containing an active
30 substance concentrate to the spraying device,
 - means for feeding the active substance concentrate in the direction of the spraying nozzle, and

- a control unit,
 - a replaceable cartridge which comprises means for reversibly connecting the cartridge to the spraying device, the active substance concentrate and an electronic memory unit, and
 - 5 - an external computer system,
- wherein the system is configured in such a way that it determines the quantity of active substance concentrate applied during a spraying process, determines the quantity of active substance concentrate remaining in the cartridge after the spraying process and stores it in the electronic memory unit, and transfers information about a spraying process which has
- 10 taken place to the external computer system.

A further subject matter of the present invention is a computer program product comprising a data carrier on which a computer program, which can be loaded into the working memory of a computer system is stored and causes there the computer system to

15 carry out the following steps:

- receiving a mixing ratio,
- actuating feed means to feed a diluent from a container in the direction of a spraying nozzle and to feed the active substance concentrate from the cartridge in the direction
- 20 of the spraying nozzle,
- regulating the flow of the diluent and/or of the active substance concentrate with the result that diluent and active substance concentrate pass as a mixture with the received mixing ratio through the spraying nozzle,
- determining the quantity of active substance concentrate which is fed through the
- 25 spraying nozzle,
- determining the quantity of active substance concentrate which remains in the cartridge,
- storing the quantity of active substance concentrate which remains in the cartridge in the electronic memory unit of the cartridge,
- 30 - transferring the quantity of applied active substance concentrate to an external computer system.

According to the present invention, the active substance concentrate and the diluent are present in separate containers. However, the user does not have to carry out the dilution of the active substance concentrate manually by himself, rather the mixing process takes place automatically during the spraying process. In a preferred embodiment, the user does
5 not even have to be concerned with the ratio in which the active substance concentrate and the diluent have to be mixed; the correct mixing ratio is set by a control unit which is configured in such a way that it can read out information on the mixing ratio to be set from a memory unit of the concentrate cartridge.

10 In addition, the quantity of applied active substance is recorded automatically and transferred to an external computer system. Since the data is recorded automatically, it can be used directly for stock control and/or for billing and/or for further purposes. Errors owing to incorrect manual inputs are avoided.

15 The residual quantity of active substance concentrate remaining in the cartridge after a spraying process is also determined and stored in a memory unit on the cartridge. By reading out the memory unit it is possible to determine the residual quantity of active substance concentrate which is still present in the cartridge; irrespective of whether the cartridge is still located on the spraying device or has been removed from the spraying
20 device after a spraying process and has been placed, for example, in a store.

The individual elements which characterize the system and method according to the invention are explained in more detail below. During this explanation, no differentiation is made between the individual subjects of the invention (system, method, computer program
25 product). Instead, the following descriptions apply analogously to all subjects of the invention, irrespective of their context.

One component of the present invention is a portable spraying device. The term "portable" is intended to mean that the device can be transported by a person from one location to
30 another without machine aids.

The spraying device is preferably embodied in such way that the user can carry and transport part of the spraying device, comprising the container with the diluent, on his back (back pack device). Another part, comprising the spraying nozzle, may be carried with one hand. In order to carry the container on the back, it is preferably equipped with
5 corresponding straps.

The spraying device comprises a container for holding a diluent. The diluent is used for mixing with the concentrate in order thereby to bring about dilution of the concentrate.

10 The diluent, like the concentrate also, is a liquid. The term "liquid" is to be understood here as also including solutions, emulsions and suspensions.

In a preferred embodiment, the diluent is water.

The concentrate is preferably an active substance concentrate. The term "active substance concentrate" is understood to mean a formulation of an active substance which is present in
15 a more concentrated form and must/should be diluted before its use. An active substance is a substance or mixture of substances which has a biological effect. Examples of active substances are pesticides, insecticides, herbicides and fungicides. In a further preferred embodiment, the concentrate is a pesticide concentrate. The pesticide is preferably a means for combatting pests, more preferably an acaricide (for combatting mites/arachnids), an
20 insecticide (for combatting harmful insects) or a rodenticide (for combatting rodents).

The container for holding the diluent can be composed of any desired material which is compatible with the diluent. The term "compatible" means that the material should not be chemically attacked by the diluent and that the material should be impermeable to the
25 diluent.

The container can be embodied as a tank which withstands excess pressure. The excess pressure can be used to feed the diluent from the tank in the direction of the outlet.

In a preferred embodiment, the container is operated in unpressurized fashion. The fact that the container does not have to withstand an excess pressure means that it can be fabricated
30 from relatively thin-walled and more lightweight material.

In one quite particularly preferred embodiment, the container is embodied as a flexible bag. Such a bag preferably has straps so that it can be strapped onto the user's back and carried like a backpack.

5 The spraying device according to the invention also has means for feeding the diluent from the container in the direction of the spraying nozzle. As already described, the diluent can be fed from the container in the direction of the spraying nozzle by means of pressure. This pressure can be generated, for example, with a manually or electrically operated air pump or with a pressure cartridge.

10 The diluent is preferably fed in the direction of the spraying nozzle with an electrically operated pump.

The spraying device according to the invention comprises a spraying nozzle. A desired spatial distribution of the applied mixture can be achieved using the spraying nozzle. The spraying nozzle usually converts the liquid passing through it into droplets with a specific
15 droplet size distribution which depends, inter alia, on the pressure of the liquid, on the flow rate of the liquid and on the geometry of the spraying nozzle.

The spraying nozzle is preferably replaceable, with the result that a user can select a spraying nozzle which is adapted to the application and to the target object and which has a
20 desired droplet size distribution and spatial distribution of the sprayed material.

The spraying nozzle can be, for example, in the form of a lance or pistol or in some other form. The spraying nozzle is preferably embodied in such a way that it is held with one hand by the user and can be directed onto the target object.

The spraying nozzle usually has a handle which is activated by the user in order to start a
25 spraying process. A valve is usually opened by activating the handle, with the result that active substance concentrate and diluent are fed from their respective containers in the direction of the spraying nozzle and through the spraying nozzle onto the target object.

In a preferred embodiment, the replaceable spraying nozzle and the control unit have
30 means which permit the control unit to detect the presence of a spraying nozzle and/or the

type of the present spraying nozzle. It is conceivable, for example, that the control unit initiates the feeding of the liquids from its containers in the direction of the spraying nozzle only when a spraying nozzle is also connected. If no spraying nozzle is connected, no feeding occurs, for example for safety reasons. Furthermore, it is conceivable that the control unit adapts the parameters for feeding the liquids to the type of spraying nozzle which is present, in order to permit an optimum spraying result. It is conceivable that a spraying nozzle requires a minimum pressure of the incoming liquid in order to generate a desired spatial distribution of the spraying liquid. This minimal pressure could be encoded at the spraying nozzle in a way that the control unit can read, with the result that the user does not have to set such parameters manually.

A pressure is usually built up upstream of the spraying nozzle. It is conceivable that this pressure has to be in a defined range in order to achieve an optimum spraying result.

In a preferred embodiment, a pressure sensor which is connected to the control unit is mounted upstream of the spraying nozzle. By means of the pressure sensor, the control unit regulates the flow of diluent and/or concentrate in such a way that the pressure always varies within a defined range.

A valve is preferably mounted upstream of the outlet. This valve can be opened and closed manually or automatically.

This valve can preferably be activated manually, with the result that the user can direct the spraying nozzle mounted on the outlet onto a target object and start the spraying process by manually opening the valve.

It is also conceivable that the valve is opened automatically. It is conceivable, for example, that the spraying device has a sensor which detects the position of the spraying nozzle in space and automatically opens or closes the valve in a specific position. It is conceivable, for example, that the valve is closed if the spraying nozzle is directed toward the floor and is opened when the spraying nozzle is raised into the horizontal position.

It is also conceivable that the valve is opened automatically when the spraying nozzle approaches the target object. This can be done, for example, by means of sensors or GPS assistance.

- 5 The spraying device according to the invention also comprises means for reversibly connecting a replaceable cartridge to the spraying device. The cartridge serves to hold the concentrate. The cartridge and the spraying device have means, compatible with one another, for connecting the cartridge to the spraying device. If the cartridge is connected to the spraying device, the concentrate contained in the cartridge can be fed from the
10 cartridge through parts of the spraying device in the direction of the spraying nozzle of the spraying device.

The connection of the cartridge to the spraying device can be effected, for example, using a screw connection or a bayonet connection.

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The cartridge is replaceable, that is to say it can be connected to the spraying device and removed again.

The cartridge is then preferably removed again, and if appropriate replaced by another (for example new) cartridge, when it has been emptied.

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The cartridge is embodied in such a way that it is impermeable to the concentrate and cannot be chemically attacked by the concentrate.

- In a preferred embodiment, the cartridge is embodied at least partially from plastic. Plastics
25 are known to be chemically inert with respect to many substances. They are also lightweight, can be processed well and can be fashioned to virtually any desired shapes.

- In a preferred embodiment, the cartridge is embodied as a pressurized container. It preferably contains not only the concentrate but also a propellant which is separate from
30 the concentrate and is in under pressure. The cartridge preferably has a valve. The valve is preferably opened automatically when the cartridge is connected to the spraying device. The propellant which is under pressure forces the concentrate out of the cartridge into the

spraying device. A further valve which is located in the spraying device stops the further flow of the concentrate. This further valve preferably opens when a user starts an application process, usually by activating a handle.

- 5 The cartridge which is preferably embodied as a pressurized container can be composed, for example, of aluminum or tin plate – materials which are pressure-resistant and are used, for example, in spray cans (e.g. shaving foam).

10 It is conceivable that the cartridge contains a bag with the concentrate, wherein the bag is connected to the valve (valve bag system). The propellant surrounds the bag which is filled with the concentrate and applies the necessary pressure to force the concentrate out of the cartridge (see e.g. DE69820260T2, US5505039, EP0718213A).

15 It is also conceivable that the propellant and the concentrate are separated from one another by a piston (see e.g. DE3934237A1). The propellant applies a pressure to the piston. If the valve is opened, the concentrate is forced out of the cartridge by the piston. For example, it is conceivable to use a ZIMA piston.

20 The cartridge can be embodied as a disposable cartridge or multiple-use cartridge.

The cartridge has an electronic memory unit.

25 The term electronic storage covers all storage media which store information in or on the basis of electronic (semiconductor) components. Examples are: ROM (read-only memory), PROM (programmable read-only memory), EPROM (erasable programmable read-only memory), EEPROM electrically erasable programmable read-only memory), Flash EEPROM (e.g. USB memory sticks), FRAM (ferroelectric random access memory), MRAM (magneto-resistive random access memory) and phase-change RAM (phase-change random access memory). The electronic memory unit is preferably a memory unit
30 in which information can be reversibly stored and deleted again; e.g. information about the

residual quantity of active substance concentrate which is still located in the cartridge after a spraying process.

A degree of dilution or information on the degree of dilution is stored in the memory unit.

5 A plurality of degrees of dilution or information on a plurality of degrees of dilution can also be stored. Such a degree of dilution specifies the ratio with which the concentrate and a diluent (usually water) are to be mixed with one another in order to achieve a desired effect. In addition to the term "degree of dilution", the term "mixing ratio" it is also used in this description. The terms are to be considered as being synonymous.

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The spraying device has a control unit. The control unit is capable of reading information from the memory unit of the cartridge. The means for reading out the memory unit and the memory unit itself are correspondingly matched to one another. There are a variety of possible ways of implementing this communication between the control unit and memory
15 unit. Some of these possible ways are described below.

One possible way of reading out is, for example, to provide the cartridge with an RFID tag. An RFID tag has a memory unit. The control unit correspondingly has means to read out the memory unit in the RFID tag.

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In this case, the reading out takes place in a contactless fashion. In addition to the specified form of communication, other contactless types of communication between the memory unit and the control unit, such as Bluetooth or close-range communication, are conceivable.

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However, the communication can also take place in a contact-based fashion. It is, for example, conceivable that both the cartridge and the spraying device have electrical or optical contacts which, when the cartridge is connected to the spraying device, bring about electrical or optical contact between the cartridge and the spraying device, via which
30 contact the control unit can access the memory unit.

In addition to a degree of dilution which is to be set, further information can be stored in the memory unit of the cartridge, such as, for example, the type of active substance, batch number, use-by date and the like.

5 The degree of dilution which is to be set can be stored directly in the memory unit of the cartridge. It is also conceivable that an identifier (series of characters, identification number or the like), with which the control unit, the cartridge and/or the concentrate contained in the cartridge can be unambiguously identified, is stored in the memory unit of the cartridge. It is conceivable that the control unit has a register in which information
10 about a series of concentrates is stored, inter alia the degree of dilution to be set for each concentrate. If the control unit reads out the identifier from the memory unit, it can assign the concentrate unambiguously and determine the associated degree of dilution. In this case, the degree of dilution is not stored directly in the memory unit of the cartridge but instead information with which the degree of dilution can be determined is stored. Since it
15 produces the same result (the degree of dilution has been determined by the control unit using information which has been made available by the memory unit of the cartridge), this embodiment in which the degree of dilution is determined by the control unit using information in the memory unit of the cartridge is to be considered as being equivalent to that embodiment in which the degree of dilution is stored directly in the memory unit of
20 the cartridge.

The spraying device according to the invention has means for feeding the concentrate from the cartridge in the direction of the outlet. This means is preferably an electrically operated pump. In one particularly preferred embodiment, a stepping-motor dosing pump is used
25 (see e.g. DE102004047584, WO2012048976, DE102009006203). Small quantities of the concentrate can also be added to the diluent by the stepping-motor drive.

The control unit determines the necessary or desired degree of dilution and regulates the flow of the diluent and/or of the concentrate correspondingly. Different variants are also
30 conceivable here; a number of them are described below.

It is, for example, conceivable that the diluent is fed from the container in the direction of the outlet, and the flow is determined by means of a flowmeter. The flowmeter can be connected to the control unit and can regulate the flow of the concentrate using the flow of the diluent in the direction of the outlet, in such a way that a constant mixing ratio between the concentrate and the diluent is set. Therefore, while the diluent flows, the flow is measured and the precise amount of concentrate which results in a mixture with the desired/necessary mixing ratio (degree of dilution) is fed to the diluent.

The converse variant is, of course, also conceivable: the concentrate is fed in the direction of the outlet, the flow is measured and the precise amount of diluent which causes the desired/necessary degree of dilution to be set is fed to the concentrate.

It is also conceivable that the flows of the diluent and concentrate are matched to one another by regulating means in order to achieve the desired/necessary degree of dilution. In such a case, both flows are registered by means of corresponding sensors.

In a preferred embodiment, the diluent is fed from the container in the direction of the spraying nozzle with a first electric pump. The flow of the diluent is registered with a flowmeter and transferred to the control unit. The control unit is connected to a second electric pump and regulates the flow of the concentrate in the direction of the spraying nozzle in such a way that the concentrate and diluent exit the spraying device via the spraying nozzle as a mixture with the desired/necessary mixing ratio.

The quantity of liquid flowing per unit of time in the direction of the spraying nozzle is registered with a flowmeter. The term "quantity of liquid" is understood to mean, depending on the measurement method used, the volume or the mass.

The flowmeter is preferably one which is usually used in closed pipelines such as, for example, a magneto-inductive flowmeter, a float-type flowmeter, an ultrasonic flowmeter, a Coriolis mass flowmeter, a calorimetric flowmeter or a vortex flowmeter. However, it is also conceivable to use a measuring orifice or a dynamic pressure probe.

In a preferred embodiment, the flow measurement is carried out using a differential pressure sensor.

5 In a further preferred embodiment, an impeller wheel sensor is used to measure the flow rate. The measuring principle is based on the fact that an impeller wheel assumes a rotational speed in proportion to the flow rate of a fluid by which the impeller wheel is driven. In order to measure the rotational speed it is possible to attach a permanent magnet to the impeller wheel, which permanent magnet moves along with the impeller wheel. A Hall sensor, past which the permanent magnet moves, can be used as a pulse counter. The
10 number of pulses measured per unit of time is proportional to the rotational speed of the impeller wheel and therefore to the flow rate of the fluid.

Details on the flow measurement can be found, for example, in the following manual:
K.W. Bonfig: Technische Durchflussmessung [technical flow measurement], Vulkan-
15 Verlag Essen, 3rd edition 2002, ISBN 3-8027-2190-X.

Active substance concentrate and diluent exit the spraying device via the spraying nozzle as a mixture.

20 It is conceivable that diluent and concentrate are combined in a corresponding feed line directly before the spraying nozzle. However, it is also conceivable that upstream of the spraying nozzle there is a mixing chamber into which the diluent and concentrate are fed via two separate feed lines. The diluent and concentrate are then fed in the mixing chamber before the mixture then exits the spraying device via the spraying nozzle.

25 The thorough mixing of the diluent and concentrate can be promoted by means of suitable measures, for example by means of static mixing elements.

According to the invention, the quantity of applied active substance is registered. In a preferred embodiment, the control unit controls the pump to make it feed the concentrate
30 from the cartridge in the direction of the spraying nozzle, in order to set the desired/necessary degree of dilution. Therefore, the control unit also "knows" how much

active substance concentrate has been fed. If residual quantities which remain in the lines of the spraying device are discounted, the required quantity corresponds to the applied quantity.

This quantity is registered and stored in a memory unit of the control unit.

- 5 In a preferred embodiment, the quantity of applied active substance is stored (additionally or exclusively) in the memory unit of the cartridge, or the residual quantity of active substance concentrate derived therefrom is stored in said memory unit. A cartridge usually contains, if it has not yet been used, a precisely defined quantity of concentrate. If the quantity of concentrate fed from the cartridge in the direction of the spraying nozzle is
10 registered, the residual quantity is obtained as a difference between the original quantity and the fed quantity. If this residual quantity or the required quantity is returned to the memory unit of the cartridge, it can very easily be determined how much active substance is still contained in a cartridge which has already been used.

Therefore, the quantity of active substance which is still present can be monitored
15 continuously during the spraying process. The user can detect on the basis of the residual quantity whether the present quantity is sufficient to carry out a spraying task.

Since the cartridge is replaceable, it is conceivable that after a spraying task the user removes from the spraying device a cartridge which has not yet been completely emptied and places it in a store for a subsequent later spraying task. At a later time, the user can
20 then determine, by simply reading out the memory unit, whether the residual quantity is sufficient for the present spraying task.

The system according to the invention also comprises an external computer system. The term "external" is to be understood as meaning that the computer system is not usually
25 carried along with the spraying device but instead is generally located at another location from the location at which the spraying device is used. The external computer system is usually a stationary system: while the spraying device is used at various locations, the external computer system always remains at the same location.

In a preferred embodiment, the system according to the invention also comprises a mobile computer system. In contrast to the external computer system, the mobile computer system is carried along with the spraying device. In a preferred embodiment, the spraying device can be operated using the mobile computer system. It is conceivable that the mobile
5 computer is connected to the spraying device in order to operate the spraying device using a cable (e.g. using a USB port). However, it is also conceivable that the mobile computer system can communicate with the spraying device via a contactless interface (remote control). It is conceivable that the communication takes place using infrared, ultrasound, Bluetooth or the like.

10 By means of the mobile computer system, the user can detect, for example, whether the cartridge has been detected by the spraying device, which (residual) quantity of concentrate is still contained in the cartridge and which pressure is set upstream of the spraying nozzle, and much more.

By means of the mobile computer system, the user can view data of the spraying device
15 and input data and control commands.

The user can, for example, set the pressure upstream of the spraying nozzle in order to vary the spraying profile.

The user can, for example, initiate the transfer of information about a spraying process to
20 the external computer system by means of the mobile computer system.

In a preferred embodiment, the mobile computer system is a mobile phone (smartphone) with a corresponding software program (for example in the form of what is referred to as an "App").

25 After or during a spraying process, information on the spraying process can be transmitted to an external computer system in order to register the spring process for subsequent purposes.

In this context, at least the active substance being used and the applied quantity of active substance are transmitted. Furthermore, information on the user of the spraying device
30 (who has carried out the application), on the application location (which person has

sprayed which object), on the application time (how long the application has lasted, when it was carried out (day, time) and further information can be transmitted to an external computer system.

This transmission can be carried out, for example, using mobile communication means (for example GSM = Global System for Mobile communication). Communication using
5 WLAN is also conceivable.

The transfer of the information to the external computer system can be carried out by various devices. It is, for example, conceivable that the control unit of the spraying device sets up a connection to the external computer system in order to transmit the information.
10 A connection is preferably set up between the mobile computer system and the external computer system in order to transfer the information.

This means that information about a spraying process is firstly transferred from the control unit to the mobile computer system via a communication channel with a short range (for example Bluetooth), and information is then transferred later from the mobile computer
15 system to the external computer system using a communication channel with a long range (for example GSM).

However, it is also conceivable that the control unit of the spraying device and/or the mobile computer system are/is connected to the external computer system using a fixed data connection (for example using USB = Universal Serial Bus), in order to transmit the
20 information.

The invention will be explained in more detail below with reference to exemplary embodiments without, however, wishing to restrict the invention to these examples.

25 Figure 1 shows a schematic view of an embodiment of the system according to the invention. The embodiment comprises a spraying device (A), a replaceable cartridge (B), an external computer system (C) and a mobile computer system (D).

The spraying device (A) comprises a container (10) which is filled with a diluent (11). The container (10) is embodied as a flexible bag and is provided with a reclosable closure (12).
30 The spraying device (A) comprises straps (17) in order to be able to transport the spraying

device on the user's back. The electronic components (such as, for example, the control unit) and the feeding means (such as, for example, pumps) are accommodated in a housing (16) and are therefore not shown in this figure. The replaceable cartridge (B) is connected to the housing. A concentrate is located in the cartridge (B). The combination of the concentrate with the diluent is carried out within the housing (16). The diluted concentrate exits the housing in the direction of a spraying lance (31) via a flexible hose (33). The spraying lance (31) has a manually activatable valve (32) and a spraying nozzle (30). If the valve (32) opens (the handle is activated), the diluted concentrate is distributed using the spraying nozzle.

10 In Figure 1, an antenna (18) is mounted on the spraying device (A). This antenna is intended to symbolize that the spraying device can be connected to the external computer system (C) and/or the mobile computer system (D) in order to transfer data. The data transfer does not, however, necessarily have to be carried out in a cableless fashion. The cloud (60) represents a network which is formed by the external computer system (C), the spraying device (A) and/or the mobile computer system (D).

The mobile computer system (D) is embodied as what is referred to as a smartphone.

Figure 2 is a schematic view of preferred embodiments of the components of the system according to the invention. The system comprises a spraying device according to the invention and a cartridge according to the invention.

The spraying device according to the invention comprises a container (10) with a diluent (11), a spraying nozzle (30), a first pump (15) for feeding the diluent (11) from the container (10) in the direction of the outlet (30), a valve (40), means (22b) for connecting the replaceable cartridge (20), a second pump for feeding a concentrate (21), located in the cartridge (20), from the cartridge (20) in the direction of the spraying nozzle (30), a flowmeter (2) for measuring the flow of the diluent (11) from the container (10) in the direction of the spraying nozzle (30), a pressure gauge (3) and a control unit (1).

The container (10) is embodied as a flexible bag and is provided with a reclosable closure (12).

The means (15) for feeding the diluent (11) from the container (10) in the direction of the spraying nozzle (30) are illustrated schematically in figure 1 as an arrow which merely indicates the direction of flow. The arrow does not mean that the corresponding means have to be located at this point on the feed line.

- 5 The diluent and the concentrate exit the spraying device in the form of a mixture (50) with a constant mixing ratio via the spraying nozzle.

The cartridge (20) according to the invention contains the concentrate (21). The cartridge has means (22a) for reversibly connecting the cartridge (20) to the spraying device. The cartridge (20) according to the invention also has a memory unit (28).

- 10 The control unit (1) has access to the memory unit (28) (the access is illustrated by the dashed line).

- The control unit (1) is also connected to the flowmeter (2), the pressure gauge (3), the pump (15) and the pump (25). If the valve (40) is opened (manually or automatically), the diluent (11) is fed from the container (10) in the direction of the outlet (30) by the pump
15 (15). The flow of the diluent (11) is registered by means of the flowmeter (2). The control unit (1) regulates, on the basis of the flow measured by the flowmeter (2), the quantity of concentrate (21) which is fed to the diluent (11) by means of the pump (25), with the result that the mixing ratio read out from the memory unit is set. In addition, the control unit sets the flows of diluent (11) and concentrate (21) in such a way that the pressure upstream of
20 the spraying nozzle (measured by the pressure gauge (3)) varies within a predefined range in order to generate a desired spraying profile.

A typical sequence for the use of the system shown in Fig. 1 and of the components shown in Fig. 2 is as follows:

- 25 A user opens the container (10) by removing the reclosable closure (12). The user fills a diluent (11), preferably water, into the container (10) and closes the container (10) by means of the closure (12).

The user picks a cartridge (B, 20) with a concentrate (21) contained therein. The cartridge (B, 20) can be new, but it is also conceivable that the cartridge has already been used.

The user joins the cartridge (B, 20) to the spraying device. To do this, he connects the complementary connecting means (22a) and (22b).

The control unit (1) reads out information from the memory unit (28) of the cartridge (B, 20), either automatically or triggered by involvement of the user. This information can be
5 information on the concentrate (21), the (residual) quantity of concentrate (21) contained in the cartridge and/or a mixing ratio to be set.

It is also conceivable that an identification number is stored in the memory unit (28); the control unit (1) reads out this identification number and determines the identity of the cartridge (B, 20) and of the concentrate (21) contained in it on the basis of an internal
10 register.

In all cases, the control unit (1) reads out data from the memory unit (28) of the cartridge (B, 20) and is then able to set a mixing ratio for the diluent (11) and the concentrate (21).

The user directs the spraying nozzle (30) onto a target object and opens the valve (40). A diluted concentrate exits via the spraying nozzle (30). The user can vary the spraying
15 profile. This is done by increasing or decreasing the pressure upstream of the spraying nozzle (30). The variation of the spraying profile can either be carried out directly using a corresponding input device (which can communicate with the control unit) on the spraying device (A) or by means of the mobile computer system (D) which functions as a remote control.

20 The quantity of fed concentrate is determined during the spraying process. If appropriate, the residual quantity of concentrate in the cartridge is displayed to the user – by means of a corresponding display device on the cartridge, on the spraying device and/or on the mobile computer system. It is also conceivable that, instead of or in addition to the residual quantity which is still present, the time period for which the present residual quantity is
25 still sufficient if the spraying conditions are kept constant, is specified.

After the spraying process has ended, information on the residual quantity of the concentrate can be returned to the memory unit of the cartridge.

The user can document the conclusion of the spraying task by means of an input at the input device of the spraying device or at the mobile computer system (D). In this context,
30 information is compiled on the concluded spraying process. Such information can be: the

quantity of applied concentrate, the residual quantity of concentrate in the cartridge, the user, the spraying nozzle used, the spraying pressure used, the duration of the spraying process, the spraying location, the concentrate used, and so on.

5 This compiled information can be stored in a memory unit of the spraying device, in the memory unit of the cartridge, in a memory unit of the mobile computer system and/or in a memory unit of the external computer system (C).

10 In all cases, such information is transmitted to the external computer system (C), either directly after the conclusion of the spraying task or at a later time, either triggered by the user or automatically. The transmission is carried out in a cableless fashion or by connecting the corresponding component on which the information is stored to the external computer system (C).

The information is then present on the external computer system (C) and can be used for various purposes: stock control, billing, logistical planning, documentation for authorities and much more.

Patent Claims

1. Method for applying an active substance comprising the following steps:
 - making available a replaceable cartridge, wherein the cartridge contains an active
5 substance concentrate and has an electronic memory unit,
 - making available a portable spraying device which comprises the following
components: a container, means for connecting the cartridge to the spraying device,
a control unit and a spraying nozzle,
 - filling the container with a diluent,
 - 10 - connecting the replaceable cartridge to the spraying device,
 - application of the active substance to one or more target objects by a user, wherein
the flows of the active substance concentrate and of the diluent are controlled, by
means of a control unit, in such a way that the active substance concentrate and the
diluent exit the spraying device as a mixture with a constant mixing ratio via the
15 spraying nozzle,
 - determining the quantity of applied active substance concentrate by means of the
control unit,
 - determining the quantity of the active substance concentrate remaining in the
cartridge, by means of the control unit,
 - 20 - storing the quantity of the active substance concentrate remaining in the cartridge in
the memory unit,
 - transferring information about the applied active substance, and the quantity of the
applied active substance, to an external computer system.
- 25 2. Method according to Claim 1, characterized in that the memory unit of the cartridge is
part of an RFID tag.
3. Method according to either of Claims 1 and 2, characterized in that the following
information is transferred to the external computer system:
 - 30 - information about the user of the spraying device,

- information on the location of the application and/or
- information on the duration of the application.

4. Method according to any of Claims 1 to 3, also comprising the step of

- 5 – checking, by reading the memory unit, whether sufficient active substance is present for a pending spraying process.

5. Method according to one of Claims 1 to 4, wherein the control unit transmits the information to a mobile computer system, from where the information is transmitted to an
10 external computer system at a later time.

6. Method according to Claim 5, wherein the spraying device is operated using the mobile computer system.

15 7. Method according to Claim 5 or 6, wherein in the mobile computer system is a smartphone with software (an App) for operating the spraying device.

8. Method according to one of Claims 5 to 7, wherein the mobile computer system communicates with the spraying device via Bluetooth.

20

9. System comprising

- a portable spraying device which comprises the following components:
 - a container for holding a diluent,
 - a spraying nozzle,
 - 25 - means for feeding the diluent in the direction of the spraying nozzle,
 - means for reversibly connecting a replaceable cartridge containing an active substance concentrate to the spraying device,
 - means for feeding the active substance concentrate in the direction of the spraying nozzle, and
 - 30 - a control unit,

- a replaceable cartridge which comprises means for reversibly connecting the cartridge to the spraying device, the active substance concentrate and an electronic memory unit, and
 - an external computer system,
- 5 wherein the system is configured in such a way that it determines the quantity of active substance concentrate applied during a spraying process, determines the quantity of active substance concentrate remaining in the cartridge after the spraying process and stores it in the electronic memory unit, and transfers information about a spraying process which has taken place to the external computer system.
- 10 10. System according to Claim 9, characterized in that information about the quantity or residual quantity of concentrate contained in the cartridge is stored in the memory unit of the cartridge.
11. System according to Claim 9 or 10, characterized in that information about a degree of dilution for the concentrate is stored in the memory unit of the cartridge.
- 15 12. System according to one of Claims 9 to 11, characterized in that the memory unit of the cartridge is part of an RFID tag.
13. System according to one of Claims 9 to 12, characterized in that the spraying device can be operated by means of the mobile computer system.
14. Computer program product comprising a data carrier on which a computer program
- 20 which can be loaded into the working memory of a computer system is stored, and causes there the computer system to carry out the following steps:
- receiving a mixing ratio,
 - actuating feed means to feed a diluent from a container in the direction of a spraying nozzle and to feed the active substance concentrate from the cartridge in the
- 25 direction of the spraying nozzle,
- regulating the flow of diluent and/or of the active substance concentrate with the result that diluent and active substance concentrate pass as a mixture with the received mixing ratio through the spraying nozzle,

- determining the quantity of active substance concentrate which is fed through the spraying nozzle,
 - determining the quantity of active substance concentrate which remains in the cartridge,
- 5
- storing the quantity of active substance concentrate which remains in the cartridge in the electronic memory unit of the cartridge,
 - transferring the quantity of applied active substance concentrate to an external computer system.