

METHOD AND A SUPPLY DEVICE FOR PROVIDING AN AGRICULTURAL
COMPOSITION

5 The present invention relates to the provision of an agricultural composition to an application, and its application to fields, plants, or plant propagation material which allows for individually and precisely dosing one or more bulk agricultural compositions alone or as a mixture, in terms of volume and/or mixing ratio.

10 Background of the invention

Agricultural compositions are available for a fair number of purposes. An agricultural composition includes at least one active ingredient or agent, provided in a solvent or diluent. In general, agricultural compositions may be assumed to be fluid but may also contain particles or viscous compounds in a gel-like constitution,
15 like in a suspension. For the purposes of the present specification, any agricultural composition is flowable through a pipe by applying a pressure difference to respective ends of the pipe.

For treating plants or plant propagation material, it is often needed that
20 commercially available agricultural compositions are diluted, selected, or mixed before applied, to meet actual needs. Not every mixture is commercially available because agricultural compositions underly regulations and e.g. need to be certified to be allowed to be brought into the market, which would apply to every mixture of already certified compositions. Furthermore, some mixtures have short shelf
25 lives and should be prepared as shortly as possible before use.

One use of an agricultural composition is its application as a seed dressing in precision seed treatment during sowing by a sowing machine moving on a field. Seed from a seed container is separated by some separating means, into individual
30 seeds to fall down to the soil, where each individual seed is sensed by one or more sensor arrays, and treated by a seed dressing composition shot in droplet form by an application nozzle during its fall. The application nozzle receives the seed dressing composition by a dressing tank via an application valve which is controlled in response to sensing results of the sensor array(s).

35 WO2021032631A1 discloses an application device for selectively applying a dressing composition comprising an agricultural product and component and at least one adjuvant/carrier component to a plant propagation material externally from the device during sowing and/or planting, and for discharging the dressed

plant propagation material onto an underlying surface, further comprising a mixing control unit configured and operable to adapt the dressing composition by controlling the flow of the dressing composition and/or diluent to obtain a dressing composition to an application state, and/or to a state and composition suitable for the one or more environmental condition, and/or the specific plant propagation material. The diluent is supplied from a diluent reservoir, and the dressing composition is supplied from a dressing reservoir container.

In WO2021032631A1, it is also described that two or more canisters may be operatively coupled in fluid communication to a single nozzle, such that the single nozzle may be controlled to selectively spray a seed coating from any one of the canisters coupled to the nozzle, or that two or more cartridges may each be operatively coupled in fluid communication to their own respective nozzles such that each canister only sprays its respective composition only via its own respective nozzle.

Sometimes it is necessary to mix different commercially available compositions to obtain a new agricultural composition which is not commercially available. Such mixing of compositions is usually done manually on site, before application or during breaks, pouring the different compositions into a mixing basin, tank, or the like. The volumes handled are large, and the mixing basins are large as well, and often open. The mixture, i.e., the new composition, is then filled in bulk containers which are loaded on a moving application device, or filled in a dressing tank carried by the application device. For changing a mixture or the composition used, application usually has to be interrupted, and a new mixture prepared and loaded to an application device.

Summary of the invention

An object of the invention is to provide methods and devices for accurate, secure, user-friendly, sustainable and versatile dosing and/or mixing of agricultural compositions for application on a field, while saving time needed for changing a mixture, reducing waste of chemical products, reducing number of nozzles, reducing hazards to personnel, having simpler application gear, reducing idle times, expanding application periods, overcoming limited shelf time or tank time, enhancing clean-out, enhancing safety of application and reducing environmental impact. It is also an object of the invention to provide a device for easily blending fluids of small volume or contained in small containers.

The object is solved at least in partial terms by a method for providing an agricultural composition, an agricultural composition supply device, an electromagnetic stirring device, an application device, and a plant treatment system, according to the present invention. Advantageous embodiments and
5 further developments are set forth in the subclaims.

The invention is generally based on the idea of dosing small volumes or mixtures of agricultural compositions from reservoir containers on the run, i.e. during application, and feeding the small volumes or mixtures as a new, applicable
10 agricultural composition to an application device for being, e.g., directly applied on seed or seedling during sowing or planting, or injected into a carrier stream during plant spraying. The dosing container is of smaller volume than the bulk containers serving as reservoir containers, or can at least receive small volumes of fluid from those bulk containers. Thereby, the composition actually applied can be adjusted
15 to needs on the run, by selecting from a plurality of available compositions, in volumes actually needed, or tailor-made mixtures. In precision seed treatment, e.g., only one spray nozzle is needed to apply different dressing compositions which allows for simpler gear, adjustment, and control.

20 Here, an agricultural composition in the sense of the invention is a preferably fluid product having at least one active compound or ingredient for treatment of plants, fields, or plant propagation material.

An aspect of the invention is method for providing an agricultural composition.

25 Here, the method includes:

- dosing a predetermined amount of a bulk agricultural composition from a reservoir container into a dosing container, the dosing preferably including applying a predetermined vacuum pressure to the dosing container, and;
and
- 30 – feeding a content from the dosing container, as the agricultural composition, to an agricultural application device, the feeding preferably including applying a predetermined overpressure to the dosing container.

The term “composition” as referred to herein may include a single active
35 compound or more than one active compound in the form of a premix, usually solved in a diluent, in particular a commercially available composition. The term “agricultural” as referred to herein may include any composition used in treatment of agricultural products such as plant propagation material like seed, seedlings, grown plants, or areas as whole, e.g. for growth enhancement, pest control,

disease prevention and handling, etc., as will be further specified below. The “application” as referred to herein may include any treatment of a plant, plant propagation material or any other agricultural product with the composition. A dosing container may be any kind of enclosed volume being able to be filled and emptied in a controlled way. A dosing container may for example include a cylinder with a movable piston connected to a piston drive, and the applying a predetermined vacuum pressure includes controlling the piston drive to move the piston to increase a working volume of the cylinder, and the applying a predetermined overpressure includes controlling the piston drive to move the piston to decrease the working volume of the cylinder. However, other sorts of dosing containers may be used.

With the method of this aspect, accurate, secure, user-friendly, sustainable and versatile dosing of agricultural compositions for application on a field can be realized. In particular, precise volumes of the composition may be provided and fed to the application device as needed. Using a piston-operated cylinder as a dosing container further enhances precision of dosing. The piston may be operated in both directions to both dosing into the dosing container, and feeding to the application device. Operation of such piston is easy to accomplish and to control.

In some embodiments, the dosing may include controlling a valve arrangement in a piping which connects the reservoir container with the dosing container, to selectively communicate and shut off the reservoir container with or from the dosing container to allow a predetermined passing volume to flow from the reservoir container into the dosing container. This allows precise adjustment of volumes. Where more than one agricultural composition is involved stored in different reservoir container, the valve arrangement can be used to shut off any such reservoir container, which avoids cross-contamination.

In some embodiments, the method may further include:

- dosing a predetermined amount of a further agricultural composition from a further reservoir container into the dosing container;
- forming a mixture of the agricultural compositions in the dosing container; and
- feeding the mixture to the agricultural application device.

In other words, at least two agricultural compositions are mixed in the dosing container. The term “mixture” as referred to herein may include any mixture, solution, dispersion or suspension which is fluid enough to flow through a pipe by

applying a pressure difference to respective ends of such pipe. The forming a mixture may be accomplished by any applicable way of blending, stirring, shaking, swirling, letting flow along a baffle configuration to create turbulence in the flow, or the like, or just waiting a predetermined time until the compositions have mingled. By mixing the compositions by the method of the invention, accurate, secure, user-friendly, sustainable and versatile mixing of agricultural compositions for application on a field can be accomplished. In particular a mixing ratio can be precisely realized since small and well-defined volumes may be dosed. Since the mixing ratio can be realized precisely, waste of chemical products can also be avoided or minimized. Furthermore, the mixing is done in a closed environment and can be automated, without any personal having to handle the compositions manually during mixing, which greatly reduces hazards to personnel, hence enhances safety of application. Any splashing which may be associated with manual handling of compositions during mixing can be avoided which also reduces environmental impact.

In some embodiments, the forming a mixture includes stirring a content in the dosing container during and/or after the dosing, the stirring preferably including controlling current through coils of a stator winding placed outside the dosing container, to move a rotor having an armature winding or a plurality of permanent magnets, the rotor being placed within the dosing container. By such method, mixing and stirring may be executed automatically within one same container, in an agricultural appliance.

In some embodiments, the dosing includes controlling a valve arrangement in a piping which connects reservoir containers with the dosing container to selectively communicate and shut off the reservoir containers with or from the dosing container with a predetermined ratio of passing volumes, preferably in a time-interlaced or time-pulsed fashion according to the predetermined ratio of passing volumes. By such control, predetermined mixing ratios may be realized with small amounts of individual doses which will enhance mixing results. It will be noted that selectively communicating and shutting off the reservoir containers may involve two or more containers, or only one container to be communicated and shut off, which in the latter case would correspond to a mixing ratio of 1:0. For two containers communicated alternately, and in a typical agricultural application, mixing ratios of 1:1 down to 1:100 would typically be aimed. However, even lower mixing ratios might be achievable by the method of the present invention. A time interval or pulse time may be chosen according to needs. For example, a small pulse time may allow for a fine mix, and precise dosing of individual volumes. For

a mixing ratio of 1:10, e.g., a minimal pulse time of 0.1 s or 0.3 s or 0.5 s or 0.7s or 0.9 s or 1.5 s, and/or a maximum of 3s or 5 s or 7s or 10 s or 15 s may be advantageous. For other mixing ratios, higher or lower minimal and/or maximum pulse time may be appropriate. The pulse time may also be chosen based on
5 physical properties of the fluids. Pulse times may be different for each of a plurality of fluids being mixed.

In some embodiments, precise metering of the volume can be achieved by measuring the position of the piston. Good results may e.g. be achieved by the
10 following procedure:

- opening a reservoir container shutoff valve;
- changing a volume of the dosing container, e.g. by move a piston of a cylinder by a defined volume which is determined by measuring travel of the piston, and stopping the piston when a predetermined volume change is attained;
- 15 - making sure that a pressure within the system or the dosing container has dropped to environmental pressure (dynamic pressure is zero), in order to make sure that the entire volume defined by the movement of the piston has flown to the dosing cylinder
- close the reservoir container shutoff valve; and
- 20 - if more than one reservoir containers are involved, repeating the above for a next reservoir container shutoff valve.

By such procedure, it is possible to make dosing independent of viscosity (high viscous fluid has less volume flow in the same time).
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In some embodiments, the valve arrangement comprises respective reservoir container shutoff valves for the reservoir containers, and the communicating and shutting off the reservoir containers with or from the dosing container includes opening and closing the respective reservoir container shutoff valves, respectively,
30 wherein the valve arrangement is preferably solenoid-operated with the controlling of the valve arrangement including exciting a solenoid or solenoids of the valve arrangement. Individual shutoff valves are wide-spread, easy to install and of low cost. Alternatively, way valves and/or proportional valves might be applicable.

35 In some embodiments, the feeding includes controlling a/the valve arrangement in a/the piping which connects the reservoir container(s) with the dosing container to shut off the reservoir container(s) from the dosing container and communicating the dosing container with an application interface unit connected to the application

device to allow flow from the dosing container to the application interface unit. In other words, the same container may be used for automatically mixing and supplying an individually prepared agricultural composition to be applied. An application interface unit as referred to herein may include a tank, reservoir, 5 pressurized expansion volume, or a piping directly connected with an application unit. The dosing or mixing can be executed on the run, i.e., right on the same device used on a field for applying, and during applying, the agricultural composition. Optionally, while the dosing container is communicated with the application interface unit, since the dosing container is shut off from the reservoir containers, 10 a reservoir container may easily be exchanging or even re-filled without causing any breaks or idle times in application.

In some embodiments, the method further including a step of:

- 15 – after feeding the product to the application device, removing leftover materials from the piping and/or the/an application interface unit, in particular by transferring the leftover materials into a cleaning container which preferably is an additional dosing container, preferably including leftover materials from the application device or from the dosing container, and/or
- 20 – disposing leftover materials from the cleaning container or the dosing container into a waste container, the waste container preferably being an additional reservoir container.

It will be noted that the cleaning container may also be a the dosing container itself or an additional dosing container of same or similar build.

25 Another aspect of the invention is a method for applying an agricultural composition, the method including the step:

- 30 – receiving the agricultural composition from a dosing container connected to one or more reservoir containers each containing a particular agricultural composition via a piping including a valve arrangement for selectively communicating or shutting off the reservoir container(s), the agricultural composition in the dosing container being a predetermined, preferably small, volume of one or more of the individual agricultural compositions from the reservoir container(s), the one or more of the individual 35 agricultural compositions preferably being in the form of a mixture, and
- delivering the agricultural composition to an application unit, the agricultural composition preferably being provided by the method according to the present invention.

Optionally, the receiving preferably includes letting flow the agricultural composition to an expansion container preloaded with a predetermined, preferably controlled, pressure, and
the delivering includes letting flow the agricultural composition from the expansion
5 container to the application unit.

Further optionally, the pressure of the expansion container may be set or controlled to be higher than a pressure resistance received from the application unit and lower than a dosing pressure received from the dosing container, in
10 particular based on monitoring the pressure of the expansion container and/or a pipe which the expansion container is communicated with.

Further optionally, the method may further include at least one of:

- treating individual plant propagation materials held within a separator
15 means of a precision sowing or planting device with droplets or jets of the agricultural composition,
- treating individual plant propagation materials in free fall or within a guide means of a precision sowing or planting device with droplets or jets of the agricultural composition,
- 20 – injecting a stream (continuously or pulsed) of the agricultural composition into a stream of carrier fluid in a predetermined, preferably controlled, volume ratio, and spraying the carrier fluid with injected agricultural composition onto a field or an individual plant or group of plants.

25 Another aspect of the invention is a supply device for providing an agricultural composition, the supply device including:

- at least one bulk composition intake unit each of which is formed to communicate with a respective reservoir container;
- a dosing container;
- 30 – an application interface unit connectable to an application device for applying an agricultural composition to plants or plant propagation material;
- a piping connecting the dosing container with each composition intake unit and the application interface unit;
- 35 – a valve arrangement formed for selectively communicating or shutting off each composition intake unit and the application interface unit with or from the dosing container through the piping,
- a pressurizing means for providing overpressure or vacuum pressure to the dosing container, for dosing a predetermined amount of the agricultural

composition from any reservoir container or feeding content of the dosing container to the application interface unit when respectively communicated; and

- a control unit formed and connected for controlling the valve arrangement and the pressurizing means, wherein the control unit is preferably formed to control the supply device, by controlling states of the valve arrangement and the pressurizing means, to execute the method as described above.

A “composition intake unit” may be simple pipe ends, or may include some fitting to fit to respective reservoir container and/or or dip tube to reach into the respective reservoir container. This supply device includes respective means to execute the method of the afore-described aspect of the invention, and may achieve the same advantageous effects.

Where the dosing container includes a cylinder and the pressurizing means includes a movable piston connected to a piston drive inside the cylinder, and the control unit is formed to control the piston drive to move the piston to control a working volume of the cylinder, the dosing and feeding may be easily accomplished and automatically controlled.

In some embodiments, the valve arrangement is arranged, formed and connected such that states thereof are controllable to selectively communicate and shut off each bulk composition intake unit or the application interface unit with or from the dosing container to allow a predetermined passing volume to flow from the reservoir container to the dosing container or from the dosing container to the application interface unit, wherein the control unit is preferably adapted to control states of the valve arrangement to allow a flow from one or more reservoir container(s) to the dosing container in a time-interlaced or time-pulsed fashion. Herein, it is preferable that the valve arrangement, in particular individual valves therein, is/are solenoid-operated, and the control unit is formed to control an exciting current of solenoid or solenoids of the valve arrangement. It should be mentioned that not only flow from the dosing container but also flow from the application interface unit to the dosing container or a cleaning container provided separately, which allows for cleaning and/or emptying the system.

In some embodiments, the valve arrangement comprises a shutoff valve per each bulk composition intake unit and the application interface unit, and an optional waste fluid disposal unit, and a first end of each shutoff valve is connected to one bulk composition intake unit or the application interface unit or the optional waste

liquid disposal unit, and a second end of each shutoff valve is connected to a fluid channel which is connected to the dosing container. Optionally the shutoff valves of the valve arrangement may be arranged to form a valve block. There, the fluid channel may be formed by through-holes formed in housings or housing
5 attachments of each shutoff valve with the through-holes being connected with each other. It may be advantageous for cleaning and avoiding larger residues of the agricultural composition that a length of a piping section from the dosing container to the valve arrangement may be short as compared with a length of piping sections from each reservoir container to the valve arrangement, in
10 particular a shutoff valve of the valve arrangement associated with the reservoir container.

In some embodiments, the application interface unit comprises an expansion container connected to a piping section between the valve arrangement and an
15 application connection fitting, the expansion container being formed to provide an changeable expansion volume. Advantageously, the expansion container may include a cylinder with a movable piston connected to a piston drive, the piston drive preferably including an elastic return member acting to reduce a working volume of the expansion container, wherein the control unit is preferably formed
20 to control an action of the elastic return member of the expansion container. Optionally, more than one expansion container may be provided to be filled alternately to provide continuous supply, or to be filled with different agricultural compositions. Each application unit of an application device may have one or more dedicated expansion container(s).

25 In some embodiments, the supply device further comprises a cleaning container different from the dosing container, the cleaning container being connected to the piping through the valve arrangement, in particular a dedicated shutoff valve of the valve arrangement, and having pressurizing means for providing pressure or
30 vacuum pressure to the cleaning container, and the control unit being formed and connected for controlling the valve arrangement and the pressurizing means. Advantageously, the cleaning container may be a cylinder with a movable piston connected to a piston drive while the control unit is formed to control the piston drive to move the piston of the cleaning container. As mentioned before, the
35 cleaning container of same or similar build as the dosing container, and in alternative embodiments, the dosing container itself may serve as a cleaning container.

In further embodiments, the supply device further comprises a waste fluid disposal unit connected to the piping through the valve arrangement, in particular a dedicated shutoff valve of the valve arrangement, and formed to communicate with a waste container to dispose of a content of the cleaning container, the waste container preferably being formed being of identical or similar build as the reservoir containers and the waste fluid disposal unit being of identical or similar build as the bulk composition intake units. Herein, it may be advantageous that an empty reservoir container or a container having similar build may be used as a waste container. A similarity on the container side may be given by a waste container having at least identical connectors for connecting a fitting of a bulk composition intake unit while having larger or smaller volume than a reservoir container. A similarity on the unit side may be given by a waste fluid disposal unit having identical fittings or connectors while having a dip tube of larger or smaller length than the bulk composition intake unit, or having a check valve at its end or other kind of reflow suppressing means. Similarity may be established by a slidable seat of a dip tube to adjust its length, or an adapter to adapt a connector of a container to a fitting of a bulk composition intake unit.

In some embodiments, the supply device may further comprise a stirring device for stirring the content in the dosing container, comprising a stator having a stator winding with coils arranged outside the dosing container and a rotor having a magnetic element, the rotor being placed within the dosing container, the control unit being formed to control a current of the stator winding.

Optionally, the supply device may further comprise a reservoir storage area having reservoir container receptacles for receiving respective reservoir containers to be connected with the piping via respective composition intake units. Such reservoir storage are makes it easy to carry several bulk agricultural compositions and/or exchange bulk containers to be connected to the system on the run.

Another aspect of the invention is an electromagnetic stirring device, in particular for or in the supply device described above. The electromagnetic stirring device comprises a stator having a stator winding with solenoids arranged circumferentially around a rotor axis and a rotor having at least one magnetic element arranged inside the arrangement of the solenoids of the stator, to rotate around the rotor axis upon excitation of the solenoids, and a stirring element, in particular stirring blade, fixed to the magnetic element, the stator being formed to be placeable outside a dosing container, in particular cylinder, and the rotor being formed to be placeable inside the dosing container, to stir a content thereof. It will

be noted that a stator winding may include at least one, preferably two or more, triplets of stator phase windings or coils of three phases, the stator phase windings of each triplet being arranged with a spacing of 120° in circumferential direction, more than one triplets being arranged to interleave with a regular circumferential spacing of coils. Further preferably, the magnetic element of the rotor includes an armature winding or a plurality of permanent magnets placed around the axis with a regular circumferential spacing.

In some embodiments, the stator has a stator frame carrying the stator coils and being formed to support against an outer wall of a container of preferably circular cross-section.

In some embodiments, the stirring device further comprises a rotor support structure formed to support against an inner wall of a container of preferably circular cross-section and including two axial bearing halves of respective axial bearings disposed in line on the axis with a distance, wherein the rotor has a rotor body carrying the magnetic element and forming two axial bearing halves matching the axial bearing halves of the rotor support structure, respectively, the axial bearings preferably formed as pin-and-well pairings.

A further aspect of the invention is an application device for applying an agricultural composition, the application device having a receiving unit for receiving the composition from a dosing container connected to one or more bulk reservoir containers each containing an agricultural composition, and delivering the received composition to an application unit, the receiving unit being connected or having fitting for connecting with an application interface unit of the supply device as described above. The application unit may for example include at least one of:

- a seed treatment unit formed for treating individual seeds or seedlings held within a separator means of a sowing device or planting device with droplets or jets of the composition or mixture,
- a precision seed treatment unit formed for treating individual seeds or seedlings in free fall or within a guide means of a precision sowing or planting device with droplets or jets of the composition or mixture,
- a spraying unit formed for receiving the composition or mixture by injection into a stream of carrier fluid in a predetermined, preferably controlled, volume ratio, and for spraying the carrier fluid with injected composition or mixture onto a field or an individual plant or group of plants,

In some embodiments, the application device further includes the sowing device, in particular precision sowing device, or a spraying unit having one or more of the spraying unit.

- 5 A further aspect of the invention is a plant treatment system including the application device as described before and the supply device as described before, being connected to each other. In some embodiments, the application device and the supply device may be arranged together on one same carrier unit which preferably is mobile by an autodrives or by being carried on or drawn by a tractor
10 unit, and preferably having a running gear for running on a ground. In other appliances, the plant treatment system may be embodied as a fixed installation, possibly coupled with an irrigation installation.

Brief description of drawings

- 15 The invention will now be described in further detail referring to specific exemplary embodiments which are shown in the appended drawings. In the drawings,

Fig. 1A is a schematical block diagram of a supply device according to an embodiment of the invention;

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Fig. 1B is a schematical block diagram of a supply device according to another embodiment of the invention;

- 25 Fig. 2 is a schematical block diagram of an application means useable with the supply device of Fig. 1A or 1B;

Fig. 3 is a logical diagram for illustrating control of a supply device according to an embodiment of the invention;

- 30 Fig. 4A is a time diagram illustrating a method of providing an agricultural composition according to an embodiment of the invention;

Fig. 4B is a continuation of the time diagram of Fig. 4A;

- 35 Fig. 5 is a schematical diagram of an application system according to an embodiment of the invention.

Fig. 6 is a side elevational view of a stirring device according to an embodiment of the invention, mounted on a dosing container in the supply device of Fig. 1;

5 It will be noted that any drawings are of schematical nature. This means that, unless indicated or obviously otherwise, geometric dimensions and relations may be exaggerated for the purpose of illustrating an underlying principle, rather than specific constructive details.

10 Detailed description of exemplary embodiments

Figure 1A shows a supply device 100 according to an embodiment of the invention, together with an application unit 200 to which the supply device 100 is connected to provide an agricultural composition.

15 As used herein, the term “agricultural composition” herein relates to liquid compositions useful for being applied to a seed or plant material or a field at least in part. Such compositions comprise at least one agricultural compound or active compound, and a diluent, solvent or otherwise carrier permitting an application. This “agricultural composition”, also referred to herein as “composition” or
20 “mixture” or “applicable agricultural composition”, relates to a substance formulation which is a liquid or a gel, which contains active agricultural compounds, and additionally may also contain other components, such as fillers, diluents, solvents, adhesive agents, dispersants, stabilizers, emulsifiers, rheology modifiers (thickeners or viscosity modifiers), preservatives, antifreezing agents, antifoaming
25 agents, and colouring agents. In some embodiments, the composition or compound may be an adhesive powder.

A gel-formulation can also be used as diluent (i.e. a gel-diluent formulation) with the active ingredient(s) or with the formulation containing the active ingredient(s). This gel-diluent formulation can comprise more than 50% by weight of water, preferably at least 80% by weight of water, preferably at least 90% by weight of water, preferably at least 95% by weight of water, preferably at least 98% by weight of water, and more preferably at least 99% by weight of water, over the total weight of the gel-diluent formulation. This gel-diluent formulation can further
30 comprise from 0.01 to 10% by weight of thickener(s), and preferably from 0.05 to 1% by weight of thickener(s), over the total weight of the gel-diluent formulation; and from 0.01 to 5% by weight of preservative(s), and preferably from 0.05 to 0.5% by weight of preservative(s), over the total weight of the gel-diluent formulation. Suitable rheology modifiers can be for example selected from silicates or silica based rheology modifiers (such as for example fumed silica, colloidal silica,

precipitated silica), phyllosilicates (such as for example montmorillonite-type clay), polysaccharides (such as for example xanthan gum, diutan gum, carrageenan, guar, alginates), cellulose or cellulose derivatives (such as for example cellulose fibrils, methyl-cellulose, carboxymethylcellulose and its salts, hydroxypropyl methylcellulose), di-ole or tri-ole (such as for example polyethylene glycol, propylene glycol, glycerin), polymeric compounds (such as for example acrylic acid and its polymeric derivatives), and any mixture thereof.

Suitable preservatives can be for example selected from 1,2-benzisothiazol-3-one, 5-chloro-2-methyl-4-isothiazolin-3-one, 2-methyl-4-isothiazolin-3-one, 2-bromo-2-nitropropan-1,3-diol, and any mixture thereof.

A suitable gel-diluent formulation can be as follows: 99.6% by weight of water, 0.3% by weight of xanthan gum (rheology modifier), and 0.1% by weight of 1,2-benzisothiazol-3-one (preservative).

In the following description, all positional information and directional information, such as e.g. top, bottom, above, below, upwards, downwards, vertical, horizontal, etc. relate to an upright position of the supply device according to the invention as illustrated in the figures and corresponding to their practical use.

As used herein, the term “agricultural compound” or “active compound” or “active ingredient” herein relates to compounds such as those biocidal, growth-promoting or growth-regulating, or other biological effects, i.e. compounds and substances known to assist the growth of crops, comprising chemical or biological substances including but not limited to micronutrients, insecticides, for protecting against sucking and eating insects; fungicides for protecting against fungal pathogens; inoculants, antibacterials, herbicides, acaricides, nematocides; virostatics for inactivating viruses; safeners; immune-response-triggering compounds; biologicals, biosimilars, gene modulating seed dressings; growth regulators; and crop enhancers that offer specific, chemically induced, physiological responses of plants that increase and/or improve yields, in particular under abiotic stress; as well as diluents, solvents, carriers, emulsifiers, viscosity modifiers, stabilizers, encapsulants and/or any colorants, and any combinations thereof. Preferred micronutrients include Zinc, Molybdenum, Manganese, Magnesium, Boron, Copper, Iron, Nickel, and Chlorine.

A “bulk agricultural composition” as used herein refers to an agricultural composition provided in bulk containers, as commercially available or re-filled for use, and to be loaded to a movable carrier unit used on the field or stationary

installation. A bulk container may be for example a cartridge or cannister to be carried on an application device or supply device.

5 The supply device 100 according to this exemplary embodiment includes a plurality of reservoir containers RC1, RC2, and a waste container WC1 which may be of identical or different build, respectively. In this embodiment, the reservoir containers RC1, RC2 and the waste container WC1 are bulk containers 110 of a build known in the art for carrying agricultural compositions in bulk volume to be applied on the field or to be mixed with other components for use on the field. Typical bulk
10 containers 110 to be used in the context of this embodiment may have a volume of e.g. 0.1 liter to 200 liter (l). A preferred size of bulk container 110 may have a volume of about 1 l to 100 l, more preferably of about 1 l to 50 l, and even more preferably of 5 l to 25 l.

15 In the present embodiment, the reservoir containers RC1, RC2 carry different bulk agricultural components 102a, 102b each including at least one active compound or ingredient, and waste container WC1 already carries some waste fluid 104 and is prepared to receive further waste fluid. It is to be understood that any number of reservoir containers and waste containers can be provided, without limiting the invention. It is however advantageous that at least one reservoir container RC1 is provided, containing a bulk agricultural composition 102a including at least one active compound to be applied to plants or plant propagation material, for any purpose. It is further advantageous that at least last waste container WC1 is provided, for receiving surplus fluid and draining the system.
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25 The bulk containers 110 in this embodiment are formed identically which however is not limiting the invention but will assumed in the following for ease of description. Each bulk container 110 in this embodiment comprise a body 112 which is limited to the upper side by a top wall 114. A bulk composition intake unit 116 is provided to take content from the bulk container 110. In this embodiment,
30 the bulk composition intake unit 116 includes a dip tube 118 which extends from the top wall 114 into an inside of the body 112. The dip tube 118 may extend to the bottom of the body 112 or shortly before, and have an opening formed to reliably take in any fluid contained in the bulk container 110. Optionally, filter means may be provided to prevent unwanted particles to enter the dip tube 118.
35 Further optionally, a check valve or other reflow preventing means may be provided to prevent reflow of fluid from the system into the bulk container 110. Build and function of dip tubes 118 are well-known in the art so that explicit description can be dispensed of her. In the upper part, i.e., on the side of the top

wall 114, the dip tube 118 ends in a fitting 120 which enables for a connection line 152 to be connected. In variations, the dip tube 118 may be an extended end of the connection line 152 extending through the fitting 120. The fitting 120 may have a connection element (not explicitly shown) to fit with a mating connection element at the top wall 114 of the bulk container 110. The fitting 120 may be formed to replace a lid (not shown) which is used to seal the bulk container 110 until use, or may even be formed by such lid, having a sealed opening to be removed for connecting the connection line 152. The fitting 120, lid, or other part of the bulk container 110 or the bulk composition intake unit 116 may be provided with a vent valve to make sure that an inside of the bulk container 110 is under atmospheric pressure. The vent valve may be sealed or sealable when the bulk container 110 is not in use, to prevent leakage during transport or storage.

For the waste container WC1, a waste fluid disposal unit 117 may be provided instead of a bulk composition intake unit 116. The waste fluid disposal unit 117 may be of exactly the same build as a bulk composition intake unit 116 having a dip tube 188 and a fitting for connecting a connection line 152. However, the waste fluid disposal unit 117 may include adaptations in comparison with a bulk composition intake unit 116. For example, the waste fluid disposal unit 117 may not include a filter unit. Additionally, the waste fluid disposal unit 117 may include a check valve or other reflow preventing means with reversed flow direction as compared with a bulk composition intake unit 116. Namely, a check valve or other reflow preventing means may be provided to prevent reflow of fluid from the bulk container 110 into the system, in the case of the waste container WC1.

The bulk containers 110 used herein may be formed to build a closed transfer system where connecting and disconnecting can be accomplished without getting in contact with the liquid contained therein, which further contributes to handling safety and environmental safety.

The supply device 100 further includes a dosing container DC1. The dosing container DC1 is in the form of a cylinder 130. The cylinder 130 has a cylinder body 132 with a outlet 134 at one end and a through-hole 136 at the other end. The cylinder 130 has a working volume V_d which formed between the outlet 134 and a piston 138. The piston 138 is connected to a piston rod 140 which extends to a piston drive 142. The piston drive 142 includes a motor M1 to drive the piston rod 140 for the piston 138 to move a piston travel x_d . The piston travel x_d is normalized to be 1 when the piston 138 is fully retracted and the working volume V_d of the dosing container DC1 is at maximum, and to be 0 when the piston 138 is fully

extended and the working volume V_d of the dosing container DC1 is at minimum. The piston 138 with piston rod 140 and piston drive 142 form a pressurizing means 144 of the dosing container DC1, to generate a positive or negative pressure (relative to atmospheric pressure) on the working volume V_d of the dosing container DC1. The cylinder 130 is oriented such that its outlet 134 is on top, which is advantageous for de-airing. The cylinder may be designed for handling relatively small volumes, having an active volume or maximum working volume V_d in the range of e.g. 10 to 100 ml. A cartridge volume may be in the range of e.g. 15 to 150 ml. For such volumes a cylinder diameter may be in the range of e.g. 10 to 40 mm, a stroke, i.e., a maximum piston travel x_d , may be in the range of e.g. 10 to 200 mm. It will be noted that these dimensions are for the sake of example, and smaller or larger dimensions or some in between might be applicable or preferable as well. The cylinder 130 and its piston drive 142 may be designed, or can be limited by control for security reasons, to exert a maximum pressing or sucking force on the working volume V_d in the range of e.g. 100 to 1000 N, for generating a maximum overpressure in the range of 3 to 6 bar. In a particular appliance tested by the inventors, the cylinder 130 had a cartridge volume of 55 ml, a maximum working volume of 30 ml, an inner diameter of 22 mm, an outer diameter of 25.5 mm, a stroke of 100 mm, and was built to exert a maximum force of 300 N to generate an overpressure of maximum 6 bar.

The supply device 100 also includes a stirrer S1 (600) which is formed to stir a content inside the dosing container DC1. The stirrer S1 is controllable by applying electrical current. The stirrer S1 in this embodiment has a movable structure inside the dosing container DC1, being movable by electromagnetic force applied from outside to stir the content inside the dosing container DC1, which will be described in more detail later as a further embodiment of the invention. It will be noted however that the stirrer S1 may be formed in any other useful way. It will further be noted that the stirrer S1 may reduce the stroke of the piston 138, also reduce the working volume V_d , and at the same time increase a dead volume of the cylinder 130 (or a dead volume of the dosing/supplying system).

The supply device 100 also includes a piping 150 and a valve arrangement 170 to connect the reservoir containers RC1, RC2, waste container WC1, dosing container DC1, application unit 200 and other elements with each other as will be described in detail below. The valve arrangement 170 includes numerous shutoff-valves 172 which may be of identical or similar or different build but preferably are identical or similar to each other. The shutoff valves 172 include a first reservoir container shutoff valve RV1, a second reservoir container shutoff valve RV2, a waste

container shutoff valve WV1 and an application feed shutoff valve FV1. The piping 150 includes the connection lines 152 each ending, at an end opposite to the fitting 120 associated to the reservoir containers RC1, RC2 and waste container WC1, to first ends of the first reservoir container shutoff valve RV1, second reservoir container shutoff valve RV2, and waste container shutoff valve WV1. Second ends of the first reservoir container shutoff valve RV1, second reservoir container shutoff valve RV2, and waste container shutoff valve WV1 are connected to interconnection lines 154 which run together to a node structure 156 having several nodes 157 which may be embodied, for example by respective fittings such as T-pieces, X-pieces, manifolds or other pipe connectors, and which communicate with each other. From node structure 156, a dosing line 158 extends to the outlet 134 of cylinder 130 (dosing container DC1). A dosing pressure p_d may be monitored by a pressure sensor 190 (PS1) provided at the dosing line 158. A further interconnection line 154 leads to a second end of application feed shutoff valve FV1 which is connected to an application interface unit 180 via feed line 160.

The application interface unit 180 includes an expansion container EC1 which is formed and connected to receive a content of the dosing container DC1, and store it as applicable agricultural composition 108 to eventually be applied, through an application line 164, to the application device 200.

The expansion container EC1 in this embodiment includes a cylinder 182 having a cylinder body 184. The cylinder body 184 has an outlet 185 which is connected to a buffer line 162 branching off from feed line 160. A piston 186 is movably received within the cylinder body 184 to define an expansion volume V_e of the expansion container EC1. The piston 186 is pre-loaded by a spring 188 in the direction of the outlet 185. A piston travel x_e of the piston 186 is normalized to be 1 when the piston 186 is fully retracted and an expansion volume V_e of the expansion container EC1 is at maximum, and to be 0 when the piston 186 is fully extended, and an expansion volume V_e of the expansion container EC1 is at minimum. An application pressure p_a may be monitored by a pressure sensor 192 (PS2) provided at the application line 164. For typical applications, the cylinder 182 of the expansion container EC1 may have a maximum working volume of e.g. 10 to 30 ml. The cylinder 182 and spring 188 or other pressurizing means may be designed to generate a maximum working pressure of e.g. 5 to 20 bar. Meanwhile, in operation, a pressure within the expansion container EC1 should not be higher than a pressure that can be built up by the dosing container DC1 as otherwise the dosing container DC1 could not feed the expansion container EC1.

The supply device 100 also includes a control unit 199 (CTU) for controlling controllable parts of the supply device 100 by receiving and processing sensor signals and sending control signals. In particular, the control unit 199 is formed to receive pressure signals from pressure sensors PS1, PS2 representing dosing pressure p_d and application pressure p_a , a step signal from motor M1 or signal from a way sensor representing piston travel x_d , a signal from a way sensor representing piston travel x_d' , and others according to needs. For example, level sensors may be equipped at the bulk containers 110 providing signals representing a liquid level within each container 110, to indicate when a bulk container 110 is beginning to run or has run empty. Moreover, control unit 199 is formed to control reservoir container shutoff valves RV1, RV2, waste container shutoff valve WV1, and application feed shutoff valve FV1 to selectively communicate or shut off each of the said from the dosing container DC1, and to control piston drive motor M1 to move the piston 138 in the positive or negative direction of piston travel x_d so as to dose pre-compositions 102a, 102b to the dosing container DC1 or feeding its content to the application interface unit 180 or the waste container WC1 according to valve settings. Furthermore, the control unit 199 may be formed to receive sensor signals from the application device 200 and control its elements (an application valve AV1 is shown by way of example in Figure 1). Alternatively, the application device 200 may have its separate control means but it is preferred that both the supply device 100 and the application device 200 are controlled by one same control unit 199, or by distributed control means collaborating with each other. As such, control unit 199 may be included in a control means of the application device 200. The control unit 199 may be a computer being part of the supply device 100 and/or the application device 200 having a software running on it/them to execute the control, or may be a remote computer such as a farm control system or a mobile device such as a laptop or tablet or smartphone or a vehicle control system of a vehicle carrying or dragging the supply device 100 and/or the application device 200, respectively linked with the supply device 100 and/or the application device 200.

It will be noted that the expansion container EC1 is an optional part of the supply device 100. Depending on a type of the application device 200, the application interface unit 180 may include any other type of buffering device, or no buffering at all. Instead of a spring 188, any other pressurizing element may be provided, such as a compressible gas, or a hydraulic or pneumatic or electric motor.

With the supply device 100 of the present invention it is possible to dose an agricultural pre-composition 102a, 102b including at least one active component

- with a precise volume V_d , in particular small volume, to the dosing container DC1 which then can be provided as an agricultural composition to an application unit 200. Different agricultural pre-compositions 102a, 102b can be subsequently dosed to the dosing container DC1 and provided to the application unit 200 according to needs, e.g. for different plants or seedlings or seeds, different purposes, and different external circumstances such as soil, temperature, humidity, pest load, or others. Plural agricultural pre-compositions 102a, 102b can be dosed to the dosing container DC1 at a predetermined precise mixing ratio which enables on-the-run dosing and optionally mixing of pre-compositions according to needs and providing them as an agricultural composition to an application device, optionally via an application interface unit, while at the same time or with only short interruption applying the agricultural composition to where it is needed.
- Figure 1B shows a supply device 100 according to an embodiment of the invention which is a variation of the embodiment of 1A. Except for what is described in the following, this embodiment includes all elements and properties of the embodiment of Figure 1A.
- In the embodiment of Figure 1B, an additional, second dosing container DC2 is provided. The second dosing container DC2 is also in the form of a cylinder 130 working volume V_d' of which is adjustable by a piston 138 driven by a piston drive 142 including a second motor M2 to move a piston travel x_d' . The piston travel x_d' is normalized to be 1 when the piston is fully retracted, and a volume V_d' of the second dosing container DC2 is at maximum, and to be 0 when the piston is fully extended and a volume V_d' of the second dosing container DC2 is at minimum. The second dosing container DC2 is connected via a branch line 166 with a first end of a branch valve BV1 which is added to the control section 180. The second dosing container DC2 can be and preferably is cylinder of same build and dimension as the first dosing container DC1. In this particular embodiment, the second dosing container DC2 is spared of a stirrer, but may optionally receive one. In other regards, the second dosing container DC2 is of same build as the first dosing container DC1.
- The second dosing container DC2 can serve as
- an aid for sucking air out of the system;
 - a safety means for avoiding back-leakage of a mixture into any of the reservoir containers RC1, RC2;

- an additional dosing opportunity for compositions which need not or should not be stirred, or where the mere existence of a stirrer could be unwanted, for example because of its forming an obstacle for flow of a particular composition;
- 5 • a backup for the first dosing container DC1 in case of failure thereof (in which case a stirrer would be advantageous to be equipped with the second dosing container DC2);
- 10 • an system expansion for providing a composition different from that in the first dosing container DC1 (in which case again a stirrer would be advantageous to be equipped with the second dosing container DC2).

Figure 2 shows an exemplary application device 200 according to an embodiment in a schematic illustration. In this example, the application device 200 is for treatment of plant propagation material K with a seed dressing composition. Any seed dressing composition may be an example of an agricultural composition in the sense of the present invention.

The application unit 210 is a precision seed treatment unit which is supplied with an agricultural composition from the supply device 100 as described above via supply line 220. Here, by way of example, the application device 200 has one application unit 210 but more than one application unit 210 may be provided. The supply line 220 may coincide with application line 164 (see Fig. 1A or 1B) or may be an extension line or branch line thereof. As such, the supply line 220 may be considered part of the application device 200, the application unit 210, or the supply device 100.

The application device 200 may be incorporated with or carried by a sowing device which comprises a seed tank for plant propagation material, assumed herein as granular seed K, a separating device which is designed to separate plant propagation materials K fed from the seed tank and to output them individually, and a moving device such as a tractor or the like for moving all over an underlying surface such as a field. The application device 200 is for applying seed dressing to the plant propagation materials K which are output individually by the separating device. The application device 200 is designed and arranged in such a way that it can apply seed dressing to the separated plant propagation materials K after they leave the separating device during their falling movement onto the underlying surface for seed.

The application unit 210 comprises a seed tube 230, a sensor array 240, and an application nozzle 250 for seed dressing, which nozzle is fed from the supply device 100 via supply line 220. An electronic controller may be provided separately in the application unit 210, the application device 200, or as part of control unit 199 of the supply device 100.

The seed tube 230 includes a tube wall 232 having an upper end (not shown) and a lower end 234. The seed tube 230 serves to guide separated seeds K falling from the separator along a fall line f, and also serves as a sensor shaft having a sensor bay 236 to hold the sensor array 240. The seed tube 230 is depicted as being oriented obliquely but may also be oriented vertically during practical use and is open at a top end and bottom end 234. Otherwise, the tube wall 232 is generally closed and defines an interior.

The sensor array 240 in this example includes four individual sensors 242, and a sensor line 244 for transferring sensor signals and control signals. The sensor array 240 may be addressed as a whole as SA1, or each individual sensor 242 may be addressed as SA1a-SA1d, by the electronic controller. Outputs of the individual sensors 242 may be processed internally by some sensor logic built in with the sensor array 240, or be output via sensor line 244 and processed by the electronic controller.

The application device 200 and/or the seed tube 230 thereof, are/is arranged underneath the separating device in such a way that the individual plant propagation materials K which are output by the latter fall through the seed tube 230. After they emerge from a lower end of the seed tube 230, seed dressing is applied to the plant propagation materials K by means of the application nozzle 250, and the plant propagation materials K then fall onto the underlying surface for seed.

The sensors 242 of the sensor array 240 may by way of example be formed as laser optical sensors each including a laser emitter and a laser detector, but may also be formed in any other applicable type. Suitable sensors are known in the art and therefore do not require any more detailed explanation. Any of the sensors 242 of the sensor array 240 may detect the passage of the plant propagation materials K through the seed tube 230, and generate a pulse-shaped sensor signal if a seed K falls through its respective detection range. From the known position of the sensor array 240 and an assumed fall speed, an impact time where seed K falling along the fall line f passes a spraying trajectory j of the spray nozzle 250 can be predicted,

and application valve AV1 of the spray nozzle 250 may be triggered to hit the seed K at an impact location I. Judging from which one of the sensors 242 notices passage of the seed K, the actual fall line f can be estimated, and the impact location I be predicted with more precision.

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For more precise prediction of the impact location I and arrival time of the seed K, a further sensor array may be provided which is arranged spaced apart from the sensor array 240 along the seed tube 230. In accordance with a predefined and known distance between the two sensor arrays and the rate of fall of the plant propagation materials K in the seed tube 230, the sensor signals occur at a time interval which is a measure of the rate of fall of the plant propagation materials K in the seed tube 230. The sensor signals are fed to the controller and processed there to estimate the impact point I and impact time, for the actuation of the application nozzle 250.

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The application nozzle 250 is designed to eject, each time it is actuated or triggered, a predefined quantity of seed dressing of typically of from 0.1 to 30 μl , preferably of from 0.3 to 15 μl along an essentially linear spraying trajectory j, therefore as it were to output a "shot of seed dressing". Suitable application nozzles include corundum, ceramic or hard alloy nozzles. The application nozzle 250 can be embodied in such a way that it permits essentially droplet-shaped application of the seed dressing to a respective seed in each application process. Essentially droplet-shaped application is to be understood as meaning here an application of seed dressing which does not necessarily completely surround the seed but may cover only a relatively small ("punctiform") or relatively large part of the surface of the seed. The same apparatus also allows to change nozzles and/or other parts for the application of other volumes and/or dressing viscosities, for instance. The seed dressing may typically be expediently configured in such a way that it adheres as droplets to the seed without a loss of spray, and dries, without in the process losing its adhesion. The application nozzle 250 can be used, for example, with a pneumatically driven application valve AV1. It is therefore possible for valves for contactless micro-dosing to be used which are closed in the position of rest and can be switched by electro-pneumatic drive with opening times of less than 1 ms. Such valves generally have high dosing frequencies and very high dosing accuracies, as a result of which an extremely precise and reproducible dosing process is ensured. Other possible valves include solenoid valves, piezo valves and the like.

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Fig. 2 illustrates an impact location I which is defined by the intersection point of the fall line f of the plant propagation materials K and the spraying trajectory j of

the application nozzle 250. The application nozzle 250 is oriented in such a way that its spraying trajectory j intersects with the fall line f of the plant propagation materials K at an acute angle α of approximately 30° - 60° . The impact location I is outside or underneath the seed tube 230 here. A "shot of seed dressing" is output
5 when a seed K reaches the impact location I . This is the case, according to a spatial distance between the sensor array 240 and the impact location I and the rate of fall of the plant propagation materials K , after a certain time delay after the sensing the seed K . The controller calculates (or estimates) the time delay and then outputs a trigger pulse which triggers the application nozzle 250, i.e., opens application
10 valve AV1, and brings about the outputting of a "shot of seed dressing", which then applies seed dressing to the seed which is located at the impact location I . The time delay also takes into account the system-inherent response time of the application nozzle 250 and the virtually negligible flight time of the seed dressing from the application nozzle 250 to the impact location I .

15 The seed tube 230 of the application device may be embodied in a relatively narrow fashion and has a funnel-shaped attachment 230a. This has the effect that all the plant propagation materials K within the seed tube 230 move on the same fall lines f or on fall lines f which are located very close to one another, with the result that
20 the impact location I is virtually the same for all the plant propagation materials.

However, the plant propagation materials can also be positioned in some other way on almost the same fall line or at least on fall lines which are located close to one another. For example, by means of air pressure or electrostatic forces or by
25 means of a seed tube which is shaped otherwise, e.g. in the manner of a funnel. When electrostatic forces are used, the electrostatic charge of the plant propagation materials which arises in this context may have a positive effect on the adhesion of the seed dressing, similar to powder coating technology.

30 Figure 3 is a logical diagram for illustrating control of a supply device according to an embodiment of the invention. Here, for different modes of operation, states of controllable elements of the supply device 100 and the application device 200 are illustrated. In particular, a state of dosing container DC1 is given by a moving direction of motor M1 which causes change of piston drive x_d of the piston 138
35 which is assumed to roughly correspond to the working volume V_d of the dosing container DC1, a state of expansion container EC1 is given by a change of piston drive x_e of the piston 186 which is assumed to roughly correspond to the working volume V_e of the expansion container EC1, a state of the stirring device S1 is given by "0" for OFF or "1" for ON which corresponds to an activation state of stator

windings of the stirring device S1, and states of the reservoir container shutoff valves RV1, RV2, waste container shutoff valve WV1, application feed shutoff valve FV1 and application valve AV1 are respectively given by "C" for closed, "O" for open and "T" for sensor-triggered while "+/-" as well as "C/O" or "O/C" stand for an alternating operations. A blank stands for no particular operation. Note that in the case of the dosing container DC1, change of piston travel x_d is actively initiated by way of motor C1 while in the case of expansion container EC1, change of piston travel x_e is reactive, initiated by a tendency to effect balance between pressure and spring force. Optionally, however, an active element may be provided in expansion container EC1 acting on piston 186 or spring 188 to control pressure of the working volume V_e of the expansion container EC1.

In a single dose mode 310, a single bulk agricultural component is dosed into the dosing container DC1. By way of example, the first bulk agricultural component 102a from first reservoir container RC1 is dosed into the dosing container DC1 but this is not limiting, and the description will apply for any bulk agricultural component from any reservoir container. In single dose mode 310, motor M1 is activated to retract the piston 138 to increase the working volume V_d of dosing container DC1 which applies a vacuum pressure to the dosing container DC1. At the same time, the reservoir container shutoff valve RV1 is opened to let pass bulk agricultural component 102a from first reservoir container RC1 under the effect of a pressure difference between the dosing container DC1 and the reservoir container RC1 which is under atmospheric pressure in this exemplary configuration. The flow of bulk agricultural component 102a from first reservoir container RC1 continues until the Motor M1 is stopped, and the pressure difference is balanced. Closing the reservoir container shutoff valve RV1 ends single dose mode 310. During single dose mode 310, in this example, the stirrer S1 is off, and any other shutoff valves RV2, WV1, FV1 of the supply device 100 are closed. In other examples, the stirrer S1 may be on during single dose mode 310.

Likewise, single dose mode 310 may be applied to the second bulk agricultural component 102b to be dosed from second reservoir container RC2 into the dosing container DC1 only that second reservoir container shutoff valve RV2 is open while first reservoir container shutoff valve RV1 is closed. Single dose mode 310 may also be used for priming the system by, e.g. dosing a certain amount of a diluent into the dosing container DC1 which may be provided in any of the reservoir containers RC1, RC2. During dosing, the application of applicable agricultural component 108 from the expansion container EC1 may be executed by triggering application valve

AV1 based on sensing falling seeds K, which with time may decrease working volume V_e of the expansion container EC1.

In a mixed dose mode 320, plural bulk agricultural components are dosed into the dosing container DC1 with a predetermined mixing ratio. In this example, two bulk agricultural components 102a, 102b from first and second reservoir containers RC1, RC2 are mixed but this is not limiting, and the description will apply for any number of bulk agricultural components from even more reservoir containers. In mixed dose mode 320, motor M1 is activated to retract the piston 138 to increase the working volume V_d of dosing container DC1 which applies a vacuum pressure to the dosing container DC1. At the same time, the reservoir container shutoff valves RV1, RV2 are opened alternately to let pass bulk agricultural component 102a from first reservoir container RC1 or bulk agricultural component 102 from second reservoir container RC2 under the effect of a pressure difference between the dosing container DC1 and the respective reservoir container RC1, RC2. Opening times of first reservoir container shutoff valve RV1 and second reservoir container shutoff valve RV2, respectively, are controlled such that volumes dosed into the dosing container correspond to the predetermined mixing ratio. The flow of the last share of bulk agricultural component 102a or 102b continues until the motor M1 is stopped, and the pressure difference is balanced. Closing any reservoir container shutoff valves RV1, RV2 ends mixed dose mode 320. During mixed dose mode 320, the stirrer S1 is off, and any other shutoff valves WV1, FV1 of the supply device 100 are closed. In other examples, the stirrer S1 may be on during mixed dose mode 320.

Mixed dose mode 320 may also be used for diluting a bulk agricultural component in one of the reservoir containers RC1, RC2 by a diluent provided in the other of the reservoir containers RC1, RC2. During mixed dosing, the application of applicable agricultural component 108 from the expansion container EC1 may be executed as before.

In blend mode 330, the stirrer S1 is activated to stir a mixture contained in the dosing container DC1 so that components blend with each other.

In feed mode 340, any reservoir container shutoff valves RV1, RV2 and waste container shutoff valve WV1 are closed while application feed shutoff valve FV1 is opened. At the same time, motor M1 is activated to extend the piston 138 to decrease the working volume V_d of dosing container DC1 which applies an overpressure to the dosing container DC1. Thereby, the working volume V_e of the

expansion container EC1 increases correspondingly, and the content within the dosing container DC1 is emptied into the expansion container EC1 to be provided as an applicable agricultural composition 108.

- 5 In feed mode 340, the application valve AV1 is usually closed which means that the application process (and accordingly a sowing process) is paused during filling the expansion container EC1. By suitable pressure control however, application may be enabled to be continued during feed mode 340.
- 10 A dump mode 350 is provided for dumping any contents of the dosing container DC1 to the waste container WC1. Here, any valves are closed save for the waste container shutoff valve WV1 which is open while motor M1 is activated to extend the piston 138 to decrease the working volume Vd of dosing container DC1 which thereby is emptied into the waste container WC1.
- 15 A flush mode 360 is provided for cleaning the system of active substances. Here, a complex control is applied to exchange a diluent taken from any reservoir container (here, the first reservoir container RV1) between dosing container DC1 and expansion container EC1 and eventually dumping the same into the waste container WC1.
- 20

Variations or combinations of the afore-described modes may be established. For example, in mixed dose mode 320, the stirrer may be activated as soon as any bulk agricultural component, or as soon as a second bulk agricultural component is dosed into the dosing container DC1, which may provide for good blending.

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Figure 4A shows a schematical control timing diagram. In particular, ten control timing part diagrams are shown along a common time axis, which represent from bottom to top:

- 30
- a waste fluid control scheme 405 illustrating an open/close state of waste container shutoff valve WV1,
 - a stirrer control scheme 410 illustrating an on/off state of stirrer S1,
 - an application feed control scheme 415 illustrating an open/closed state of application feed shutoff valve WV1,
- 35
- a first reservoir control scheme 420a illustrating an open/closed state of first reservoir container shutoff valve RV1,
 - a second reservoir control scheme 420b illustrating an open/closed state of second reservoir container shutoff valve RV2,

- a dosing volume control scheme 430 illustrating a target value of the piston drive x_d of motor M1 as a continuous line and a course of an associated working volume V_d of dosing container DC1 as a dashed line,
- a first pressure control scheme 440 illustrating a course of the first pressure sensed by the first pressure sensor PS1,
- a second pressure control scheme 450 illustrating a course of the first pressure sensed by the first pressure sensor PS1,
- an expansion volume control scheme 460 illustrating a course of the working volume V_d' of the expansion container EC1,
- an application valve control scheme 470 illustrating an open/close state of application feed shutoff valve FV1.

The timing control diagram of Figure 4A begins with an idle state 480. In idle state 480, all valves are closed (C) except application feed shutoff valve FV1 which is open (O) for the sake of pressure balance within the system. The piston 138 of dosing container DC1 is fully expanded ($x_1 = 0\%$) which means that the dosing container DC1 is emptied save for some minimum residual volume ($V_d > 0\%$). It will be noted that some residual volume may always be present, and may even be considerable owing to the presence of the stirrer S1. The pressures within the system are balanced at atmosphere ($p_d = p_a = 1\text{bar}$) in which state the expansion container EC1 has some residual filling ($V_e = V_0$). The residual filling of the expansion container EC1 may for example be 20% or 15% 10% or 5% or 3% or 1% of a maximum capacity of expansion container EC1. It is advantageous to have the residual filling of the expansion container EC1 as little as possible, to avoid mangling with applicable agricultural composition 108 to be fed and applied later. Said this, the residual filling of the expansion container EC1 may also be zero or neglectable. When a composition to be applied is to be changed, such change can be planned beforehand according to a map of the field, and may take into account the residual filling of the expansion container EC1.

Before starting applying any composition, the expansion container EC1 has to be filled the first time, which phase will be referred to as a prime filling phase 482. The prime filling phase 482 starts at a control time t_1 with closing the application feed valve FV1, and setting the system to the mixed dose mode 320. As described above, the mixed dose mode 320 involves controlling the motor M1 of the dosing container DC1 to increase piston travel x_d so as to increase working volume V_d of the dosing container DC1 in response while at the same time controlling the first and second reservoir container shutoff valves RV1, RV2 alternately for the

respective bulk agricultural compositions 102a, 102b to be dosed into the dosing container DC1.

In this example, in mixed dose mode 320, any of the reservoir container shutoff valves RV1, RV2 is controlled to be closed while the respective other one of the reservoir container shutoff valves RV1, RV2 is controlled to be open. More generally, where more than two reservoir containers are involved, in mixed dose mode 320, only one of the reservoir container shutoff valves is controlled to be open at the same time. However, the invention is not limited to this, and overlap of opening time intervals Δt_1 , Δt_2 may be allowed according to needs. Moreover, in this example, any of the reservoir container shutoff valves RV1, RV2 is controlled to open at the very time or switch point 422 when the respective other one of the reservoir container shutoff valves RV1, RV2 is controlled to be closed, and vice versa, but the invention is not limited to this, and some idle time between closing one of the reservoir container shutoff valves RV1, RV2 and opening the other may be allowed according to needs. It will be noted that opening time intervals Δt_1 , Δt_2 are constant over time, respectively, in this example but may alternatively vary over time according to mixing behaviour of the bulk agricultural compositions 102a, 102b. Said this, in the present example, a relation of an opening time interval Δt_1 of the first reservoir container shutoff valves RV1 and an opening time interval Δt_2 of the second reservoir container shutoff valves RV2 corresponds to a predetermined mixing ratio of the first bulk agricultural composition 102a and the second bulk agricultural composition 102b, but where opening time intervals Δt_1 , Δt_2 vary over time it is sufficient that a relation of total opening times $\Sigma \Delta t_1$, $\Sigma \Delta t_2$ of the reservoir container shutoff valves RV1, RV2 corresponds to the predetermined mixing ratio.

It will be noted that in an ideal incompressible system, columns of liquids will follow movement of the piston 138 with no delay. However, owing to length of pipes and inertia of the system, little imperfections (micro-compressibility of liquids) will be noticeable. Therefore, when a change in geometrical volume has been completed, flow of liquid will still continue until pressure is balanced. In other words, even if a geometrical volume of a cavity is constant, content of liquid may vary depending on pressure. Precise control may be difficult where these effects are not taken into account. For the sake of control and illustration, thus, the working volume V_d of the dosing container DC1 is considered to be an effective volume normalized to atmospheric pressure which may be different from the geometric volume encompassed by the walls piston 138 of dosing container DC1 depending on pressure (in particular, first pressure p_d).

In this example, at the control time t_1 , the first reservoir container shutoff valve RV1 is controlled to open, and the motor M1 is controlled to travel the piston 138 of dosing container DC1 by a first piston travel Δx_1 . At the same time, the dosing pressure p_d which is measured by first pressure sensor PS1 falls below atmospheric pressure (build-up of vacuum pressure), and the effective working volume V_d of the dosing container DC1 rises. The build-up of vacuum pressure is caught up by the increase of effective working volume V_d at a control time t_2 when the dosing pressure p_d has fallen to a first pressure p_1 . From t_2 on, even though piston travel x_d is further increased, the dosing pressure p_d remains constant at p_1 while the increase of effective working volume V_d further increases. In the control scheme of this embodiment, the first pressure p_1 may e.g. be about 0.8 bar which is a vacuum pressure of about 0.2 bar against atmosphere. However, this is only by way of example, and the first pressure p_1 may be any vacuum pressure suitable for dosing the first bulk agricultural composition into the dosing container DC1.

When the piston 138 has travelled the first piston travel Δx_1 , the motor M1 is controlled to halt which defines a third control time t_3 . From that control time t_3 on, since the first reservoir container shutoff valve RV1 is still open, bulk agricultural composition 102a from the first reservoir container RC1 is continued to be sucked into the dosing container DC1, thereby further increasing its effective working volume V_d while dosing pressure p_d is balanced until it reaches atmospheric pressure again at a fourth control time t_4 .

This control time t_4 is a trigger time for controlling

- the first reservoir container shutoff valve RV1 to close,
- the second reservoir container shutoff valve RV2 to open, and
- the motor M1 to further travel the piston 138 by a second piston travel Δx_2 , to further increase the effective working volume V_d of the dosing container DC1.

It will be noted that, assuming identical flow characteristics (e.g. viscosity, compressibility, surface flow resistance) of both bulk agricultural compositions 102a, 102b and identical line characteristics (e.g. length, cross-section, curvature) of piping from both reservoir containers RC1, RC2 to dosing container DC1, a relation of piston travels Δx_1 , Δx_2 corresponds to the relation of open time intervals Δt_1 , Δt_2 . For different flow characteristics and/or line characteristics, corrections may have to be applied.

After starting piston travel x_d at t_4 again, a generally similar scheme of events as described before will follow. In particular, the dosing pressure p_d falls below atmospheric pressure (build-up of vacuum pressure), and the effective working volume V_d of the dosing container DC1 rises. The build-up of vacuum pressure is caught up by the increase of effective working volume V_d at a control time t_5 when the dosing pressure p_d has fallen to a second pressure p_2 . From t_5 on, even though piston travel x_d is further increased, the dosing pressure p_d remains constant at p_2 while the increase of effective working volume V_d further increases. In the control scheme of this embodiment, the second pressure p_2 may e.g. be about 0.9 bar which is a vacuum pressure of about 0.1 bar against atmosphere. However, this is only by way of example, and the second pressure p_2 may be any vacuum pressure suitable for dosing the first bulk agricultural composition into the dosing container DC1. Even if in this example $p_2 > p_1$, this is only by example, and the relation of p_2 and p_1 will depend, inter alia, on a relation of flowing properties, e.g., viscosities, of the bulk agricultural compositions involved.

When the piston 138 has travelled the second piston travel Δx_2 , the motor M1 is controlled to halt which defines a sixth control time t_6 . From that control time t_6 on, since the second reservoir container shutoff valve RV2 is still open, bulk agricultural composition 102b is continued to be sucked from the second reservoir container RC2 into the dosing container DC1, thereby further increasing its effective working volume V_d while dosing pressure p_d is balanced until it reaches atmospheric pressure again at a control time t_7 .

This control time t_7 is a trigger time for controlling the second reservoir container shutoff valve RV2 to close. Thereby, one dosing cycle 484 is completed, reaching from t_1 to t_7 .

Unless the dosing container DC1 is filled to the desired volume, the dosing cycle 484 is repeated with t_7 becoming a new first control time t_1' triggering

- the first reservoir container shutoff valve RV1 to open, and
- the motor M1 to further travel the piston 138 by a first piston travel Δx_1 , to further increase the effective working volume V_d of the dosing container DC1.

The dosing cycle 484 described above is continued until the dosing container DC1 is filled to the desired volume. In the present example, three dosing cycles 484 are completed, ending with a seventh control time t_7'' of the third dosing cycle 484 which marks the end of the mixed dose mode 320.

In the present example, the stirrer S1 is started when the dosing pressure p_d has reached the first pressure p_1 for the first time, and continues to be on all time further. However, this is not limiting the subject matter. The stirrer S1 may
5 alternatively only be started e.g. at an eighth control time t_8 which coincides with the end of the mixed dose mode 320 at t_7'' , or follows shortly after, and may be stopped at a ninth control time t_9 prior to feeding the stirred content of the dosing container DC1 to the application interface unit 180. Anyway, it is advantageous to have the stirrer running to blend the mixture in dosing container DC1 for some time
10 after mixed-dosing the bulk agricultural compositions, and before feeding the mixture to the application interface unit 180. In these terms, the mixed dose mode 320 is followed by a blend mode 330 until a ninth control time t_9 . The stirrer S1 may be stopped at t_9 or continue to run, as in the depicted example. Continued running of the stirrer S1 may be useful for avoiding sedimentation at a piston wall
15 or deposition at side walls or, as mentioned above, may support blending in general. On the other hand, where excessive stirring is expected to have detrimental effects such as frothing up, unwanted change of viscosity, etc., operation of the stirrer S1 may be limited or interrupted.

20 Blend mode 330 is followed by feed mode 340 to feed dosed agricultural composition in dosing container DC1 to the application interface unit 180.

Feed mode 340 starts at a tenth control time t_{10} which coincides with the end of the blend mode 330 at t_9 , or follows shortly after, by controlling the application
25 feed shutoff valve FV1 to open. At the same time, the motor M1 is controlled to travel the piston 138 to empty the dosing container DC1. Thereby, the expansion container EC1 is filled by a load ΔV_e , to rise the expansion volume V_e to a pre-filling volume V_1 . It will be noted that the load ΔV_e fed to the expansion container EC1 equals a volume emptied from dosing container DC1. By filling expansion
30 container EC1, the dosing pressure p_d measured by first pressure sensor PS1 located in the dosing line 158 connecting the dosing container DC1 rises from atmospheric pressure to a third pressure p_3 . Likewise, an application pressure p_a which is measured by second pressure sensor PS2 located in the application line 164 downstream the buffer line 162 branching off to connect the expansion
35 container EC1, rises from atmospheric pressure to a fourth pressure p_4 . Since the dosing line 158 and the application line 164 communicate when the application feed shutoff valve FV1 is open, the fourth pressure p_4 generally equals the third pressure p_3 ($p_4 = p_3$), safe for line losses and inevitable but small time lags. In the control scheme of this embodiment, the third pressure p_3 may e.g. be about 3 bar

which is an overpressure of about 2 bar against atmosphere. However, this is only by way of example, and the third pressure p_3 may be any overpressure suitable for feeding the content of the dosing container DC1 as a first bulk agricultural composition into the expansion container EC1. Moreover, the pre-filling volume V1 may e.g. be about 80% of the maximum working volume V_e of the expansion container EC1. However, this is only by way of example, and the pre-filling volume V1 may be any suitable filling level.

When the dosing container DC1 is emptied, the piston travel x_d is minimum which marks an eleventh control time t_{11} . At that time, application feed shutoff valve FV1 is controlled to close. Optionally, closing of application feed shutoff valve FV1 may be delayed for some idle time allowing for pressure balance between the dosing side, i.e., p_d , and the application side, i.e., p_a , until a twelfth control time t_{12} .

After closing the application feed shutoff valve FV1, the dosing side is allowed to depressurize e.g. by controlling the piston drive to increase the piston travel x_d a little, at a thirteenth control time t_{13} , until the dosing pressure p_d has fallen to atmospheric pressure which would mark a fourteenth control time t_{14} .

Here, the feed mode 340 ends, and the prime fill phase 482 ends with it. Now, the system is ready for applying applicable agricultural composition by the application device 200.

It will be noted that the control of dosing and feeding described herein may rely on controlling the piston travel rather than the actual opening time of the shutoff valves. This means that the shutoff valves may be left open until a pressure has equalized. Thereby, all the influence factors described (compressibility, etc) may be equalized, which leads to great robustness against many unknown influences. In other words, it is not necessary to adapt control times, opening time intervals etc. to any specific physical influences. Instead, waiting for pressure balance may equal any influences. Here, control times and opening time intervals may be prescribed beforehand but may also be treated as "elastic" which means that they may be overridden in case that pressure balance is not yet reached, where appropriate.

An application campaign 486 may start at a fifteenth control time t_{15} which may coincide with the end of the prime fill phase 482 at t_{14} , or at any control time thereafter. In the present example, as mentioned before in the context of Figure 2, the application includes repeatedly controlling application valve AV1 to open for

a predetermined application time Δt_a to eject an aliquot D of the applicable agricultural composition from expansion container EC1, as triggered by a plant propagation material K passing a sensor array SA1, through an application nozzle 250.

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After beginning of application campaign 486, the application pressure p_a will fall to a fifth pressure p_5 due to balancing effects until a sixteenth control time t_{16} , and remains constant after that or falls by a minimum rate due to spring relaxation. It will be noted that application pressure p_a may be kept constant by active control, e.g. by readjusting spring action in the expansion container EC1. The working volume V_e of the of expansion container EC1 continuously decreases by application of the agricultural composition contained therein, until it has dropped to a refill trigger volume V_2 which marks a seventeenth control time t_{17} . The refill trigger volume V_2 may be higher or lower than or equal to the residual volume V_0 . In particular, the refill trigger volume V_2 may e.g. be about 20% of the maximum working volume V_e of the expansion container EC1. However, this is only by way of example, and the refill trigger volume V_2 may be any suitable level.

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In the meantime, from end of the prime fill phase 482 at t_{14} , a new load may be dosed into dosing container DC1. Since the application feed shutoff valve FV1 is closed to isolate the dosing side from the application side, the dosing into dosing container DC1 may be executed independently from and concurrently with applying the agricultural composition from the expansion container EC1 by the application device 200. To this effect, a re-fill phase 488 may start at or shortly after t_{14} . The re-fill phase 488, like the prime fill phase 482, includes another mixed fill phase 320, another blend phase 330, and another feed phase 340. The re-fill phase 488 is identical with the prime fill phase 482 except for the application campaign 486 running simultaneously, and for other specific details as described below.

Apparently, the feed mode 340 is initiated only after the refill trigger volume V_2 has been reached. Other criteria, however, are possible. For example another preparation of agricultural composition may be needed before the expansion volume V_e has dropped to a refill trigger volume V_2 . However, in general it may be assumed that a load ΔV_e is calculated such that it is exhausted just in time when another preparation is needed, and the seventeenth control time t_{17} marks a further tenth control time $t_{10'}$ for opening the application feed shutoff valve FV1 to start the feed mode 340.

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- Furthermore, at an eighteenth control time t_{18} before the application feed shutoff valve FV1 is opened at t_{10}' , the motor M1 of the dosing container DC1 is controlled to work in the expansion direction of the piston 138, to provide a bias pressure p_6 so as to rise the dosing pressure p_d up to a pressure p_6 which corresponds to the application pressure $p_a = p_{5'}$ prevailing at that time on the application side. For proper timing, the expansion volume V_e is monitored such that the control time t_{18} necessary for initiating the pressure rise can be calculated and applied before the refill trigger volume V_2 has been reached in t_{17} .
- 10 It is assumed that in continuous operation the load ΔV_e fed into the expansion container EC1 is always the same. That means that when starting out from the refill trigger volume V_2 in t_{17} , the working volume V_e in the expansion container EC1 will have reached a full filling volume V_3 which may be different from V_1 which was reached after the prime fill phase 482. Of course, the load ΔV_e fed into the
- 15 expansion container EC1 may be changed during the application campaign 486 at any time so that the working volume V_e in the expansion container EC1 reached after re-filling may also vary. However, it is advantageous that the working volume V_3 is always large enough that the refill trigger volume V_2 is reached only after a new charge of agricultural composition is prepared and ready to be fed in the
- 20 dosing container DC1. Here, the full filling volume V_3 may e.g. be about 90% of the maximum working volume V_e of the expansion container EC1. However, this is only by way of example, and the full filling volume V_3 may be any suitable filling level.
- 25 It will be noted that application campaign 486 may be continued unaffected during feeding the load into the expansion container EC1. This is because the application pressure is maintained, and the dosing pressure is raised to p_6 to balance equal the application pressure $p_{5'}$ before opening the application feed shutoff valve FV1, so that no pressure drop arises in the application pressure p_a .
- 30 Further re-fill phases 490 follow during the application campaign 486, which start out from an expansion volume V_3 , as compared with the first re-fill phase 490 which starts out from an expansion volume V_1 .
- 35 The application campaign 486 includes a number of application cycles 487, each of which may coincide with a re-fill phase 488, 490. Any application cycle 487 may require same or different load volumes ΔV_e and/or same or different preparations of agricultural compositions which may be prepared and provided in a preceding application cycle 487.

Figure 4B shows a continuation of the diagram of Figure 4A, after ending of the application campaign 486. In Figure 4B, the stirrer control scheme 410 is omitted, and waste fluid control scheme 405 and application feed control scheme 415 are reversed, as compared with Figure 4A. Figure 4B is for illustration of a cleaning campaign after an end of application campaign 486, including several executions of mixed dose mode 320, feed mode 340, dump mode 350, and flush mode 360 in the control of the supply device 100, and a particular application cycle which is referred to as a nozzle blowout cycle 487' in the control of the application device 200.

After completing the application campaign 486, the whole system will be held in a transient state 480' where any valves are closed. It is assumed that the expansion container EC1 and the dosing container DC1 are emptied to their respective residual volumes or dead volumes. It is similar to the idle state 480 described before, only that the system is filled with residues of agricultural compositions, according to the last dosing/feeding. In this state, the system is transferred to some place to clean the system.

Here, beginning with a twentieth control time t_{20} , a pre-cleaning fill phase 482' is executed which resembles the prime fill phase 480 described before. In the pre-cleaning fill phase 482', however, a cleaning composition and a diluent are dosed into the dosing container DC1, rather than bulk agricultural compositions, in a time-interlaced or pulsed fashion similar to the above. To this end, the reservoir container shutoff valves RV1, RV2 may be switched to other bulk containers including the cleaning composition and the diluent, respectively. Alternatively, the diagram may be interpreted such that reservoir container shutoff valves RV1, RV2 in a control according to Figure 4B at least partly refer to other reservoir container shutoff valves RV1, RV2 than in a control according to Figure 4A. Here, it is assumed that reservoir container shutoff valves RV1 is connected to a reservoir container which contains the diluent, and reservoir container shutoff valves RV2 is connected to a reservoir container which contains the cleaning composition. As described for the pre-fill phase 480, the pre-cleaning fill phase 482' involves a mixed-dose mode 320 for dosing the cleaning composition and the diluent according to a predetermined mixing ratio into the dosing container DC1, a blend mode 330 for letting blend the cleaning composition and the diluent, and a feed mode 340 for feeding the blended mix of cleaning composition and diluent into the expansion container EC1. This is completed at a twenty-first control time t_{21} .

At a twenty-second control time t_{22} , a first cleaning phase 492 starts with nozzle blowout cycle 487' which is a particular application cycle with the mix of cleaning composition and diluent being blown through the application nozzle 250 (see Figure 2) instead of an applicable agricultural composition from expansion container EC1. The nozzle blowout cycle 487' involves a predetermined number of opening the application shutoff valve AV1, and ends at a twenty-fourth control time t_{24} .

At that time, the working volume V_e of the expansion container EC1 has dropped to a fourth volume V_4 . A mixed dose mode 320' which has started before at a twenty-third control time t_{23} may be continued a while until the control has recognized or determined that nozzle blowout has ended.

At a twenty-fifth control time t_{25} , mixed dose mode 320 is ended, and a modified dump mode 350' is started. That means that any of the reservoir container shutoff valves RV1, RV2 which is possibly open is controlled to close, and the motor M1 of dosing container DC1 is controlled to halt. At the same time, or shortly thereafter, application feed shutoff valve FV1 and waste container shutoff valve WV1 are controlled to open. Thereby, the content of expansion container EC1 is dumped into waste container WC1 until the expansion volume V_e has reduced to the residual volume V_0 while the application pressure p_a has dropped to atmospheric pressure which marks a twenty-sixth control time t_{26} . Meanwhile, the motor M1 of dosing container DC1 is controlled to extend the piston 138 so that the dosing volume V_d is reduced, and the content of dosing container DC1 is dumped into waste container WC1. This phase which ends at a twenty-seventh control time t_{27} can be described as a modified dump mode 350', as compared with the dump mode 350 where the application feed shutoff valve FV1 would be closed as shown in Figure 3. Alternatively, emptying the dosing container could be delayed until t_{26} , and the application feed shutoff valve FV1 could be controlled to close at that time, so that we would have an expansion container dump mode from t_{25} to t_{26} , followed by (dosing container) dump mode 350 as defined in Figure 3 from t_{26} to t_{27} . Here, the first cleaning phase 492 ends.

After the first cleaning phase 492, a second cleaning phase 494 is initiated which involves two rinsing cycles 496. Each rinsing cycle 496 includes controlling the supply device 100 in the flush mode 360, followed by a control in the dump mode 350.

In detail, at the twenty-seventh control time t_{27} , the waste container shutoff valve WV1 is controlled to close, and the reservoir container shutoff valve RV1 is controlled to open. Here, it is assumed that the first reservoir container RC1 contains a diluent. At the same time or shortly thereafter, the motor M1 of dosing container DC1 is controlled to retract the piston 138 so that the dosing volume V_d is increased, and a predetermined amount of diluent is dosed into dosing container DC1 from reservoir container RC1. The dosing involves a build-up of negative pressure in the dosing pressure p_d down to p_7 which in this example equals p_1 . The piston 138 is fully retracted ($x_1 = 100\%$) until which last until a twenty-eighth control time t_{28} , such that the dosing container DC1 is completely filled with diluent ($V_d = 100\%$) which is completed at a twenty-ninth control time t_{29} which is marked by the dosing pressure p_d having relaxed to atmospheric pressure.

At that control time t_{29} or shortly thereafter, the reservoir container shutoff valve RV1 is controlled to close, and the motor M1 of dosing container DC1 is controlled to extend the piston 138 so that the dosing volume V_d is reduced, and the content of dosing container DC1 is emptied. Since the application feed shutoff valve FV1 is still open and any other valves are closed, the diluent from dosing container DC1 is fed into the expansion container EC1 while each of the dosing pressure p_d and the application pressure p_a rise simultaneously. When the dosing container DC1 is empty which marks a thirtieth control time t_{30} , the motor M1 of dosing container DC1 is controlled to reverse piston drive x_d until it is at minimum, which marks a thirty-first control time t_{31} , so that the dosing volume V_d is increased, and the diluent from expansion container EC1 returns into dosing container DC1 while each of the dosing pressure p_d and the application pressure p_a drop simultaneously. When the dosing container DC1 is completely filled again ($V_d = 100\%$), the dosing pressure p_d has returned again to atmospheric pressure which marks a thirty-second control time t_{32} .

At that control time t_{32} or shortly thereafter, control is changed from flush mode 360 to dump mode 350. Here, application feed shutoff valve FV1 is controlled to close, waste container shutoff valve WV1 is controlled to open, and the motor M1 of dosing container DC1 is controlled to extend the piston 138 so that the dosing volume V_d is reduced, and the content of dosing container DC1 is dumped into the waste container WC1, which is completed at a thirty-third control time t_{33} . Then, dump mode 350 is ended which also completes the rinsing cycle 496. It will be noted that the pressure p_d while dumping is depicted as atmospheric in the drawing. Strictly speaking, assuming that the waste container WC1 is under atmospheric pressure, the pressure needed on the side of the dosing container DC1

for dumping will be dependent on the orifice size, speed of moving the piston 138 (dx/dt) and the level of the orifice compared to the dosing container DC1 (potential hydrostatic pressure). This pressure may be certain overpressure with respect to the pressure in the waste container WC1 which overpressure however
5 may be very close to zero.

The rinsing cycle 496 is repeated which however is optional, as well as multiple repetitions are possible as an option. Finally, any valves are closed, and the system is set to idle state 480 again.

10 In the afore description and throughout the application, unless stated otherwise, the expression that an event is controlled to occur “shortly after a time” or “shortly after an event” or “shortly thereafter” indicates a minimum time needed for the control to avoid that the event happens before the time or event or whatsoever
15 referred to.

Figure 5 is a schematical drawing of a plant treatment system 500 as a further embodiment of the invention, including an application device 200 and a supply device 100, and a carrier unit 510 to which the application device 200 and a supply
20 device 100 are mounted or arranged.

The plant treatment system 500 includes a carrier unit 510 which is mobile by having a main frame 512 including a wheel suspension 514 to which wheels 516 are mounted for running on a ground B which for example may be a field or other
25 agricultural area. The carrier unit 510 may be driven on its own by an autodriven, or may be carried on or drawn by a tractor unit (not shown). The main frame 512 bears a chassis 518. The supply device 100 and the application device 200 are mounted wholly or in parts (distributedly) at the main frame 512 and/or the chassis 518.

30 The supply device 100 is formed similar to the supply device depicted in Figure 1B save for some specifics described below, and is a further embodiment of the invention.

35 In the supply device 100 of this embodiment, reservoir containers RC1, RC2, RC4 and waste container WC1 are provided. Here, the reservoir containers RC1, RC2, RC4 and waste container WC1 are received in respective container bays 522 of a reservoir container carrier 520. Likewise, two dosing containers DC1, DC2 are mounted to a dosing container carrier 530. The expansion container EC1 may be

mounted directly to the main frame 512. A valve block 540 and control unit 199 may be mounted directly to the chassis 518. Of course, this is by way of example, and can be changed according to needs or convenience.

5 In the present example, one container bay 522 in the reservoir container carrier 520 is left empty, and one of bulk composition intake units 116 respectively associated to each container bay 522 is left unused while any other bulk composition intake units 116 are mounted with a respective reservoir container RC1, RC2, RC4, and waste fluid disposal unit 117 is mounted with waste container
10 WC1. The unused bulk composition intake unit 116 may be secured at the respective container bay 522 by some securing means such as a clamp or the like (not shown).

The valve block 540 includes seven shutoff valves 172 which include four reservoir
15 container shutoff valves RV1, RV2, RV3, RV4, waste container shutoff valve WV1, application feed shutoff valve FV1, and branch valve BV1. The allocation of valves in valve block 540 corresponds to that in Figures 1A, 1B while two further reservoir container shutoff valves RV3, RV4 are added. The shutoff valves 172 are mounted together to build the valve block, e.g. by bolts or connecting rods reaching through
20 their respective casings (not shown) such that first ends 542 of each shutoff valve 172 are accessible at one side and second ends 544 of each shutoff valve 172 are accessible on another side. In this example, the respective second ends 546 are connected to branch parts 546a of respective interconnection pieces 546 passage parts 546b of which are connected to each other to form interconnection line 154
25 (see Figure 1A) connecting all second ends 546 of the shutoff valves 172 forming the valve block 540 in the form of a manifold or fluid channel 548. The interconnection pieces 546 may be mounted by screws or clamps or other connectors (not shown) to the casings of the respective shutoff valves 172. One end of the fluid channel 548 is closed by an end piece 550, and the other end is
30 connected to dosing line 158 with first pressure sensor PS1. The first pressure sensor PS1 may be integrated in a connector piece 552. Thereby, valve arrangement 170 may be formed effectively, and in a compact form. The interconnection pieces 546 are in the form of T-pieces in this example. Any interconnection pieces 546 may be pre-mounted to form the interconnection line
35 154, and then be mounted to the valve block 540.

At the first ends 542 of the respective shutoff valves 172, the connection lines 152, feed line 160 and branch line 166 are connected, which in turn are connected to the bulk composition intake units 116, waste fluid disposal unit 117, application

interface unit 180, and second dosing container EC2. The bulk composition intake units 116 and waste fluid disposal unit 117 including fittings 120 may be left connected with each connection lines 152 even when an individual bulk containers 110 is replaced which makes such replacement easy.

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Advantageously, reservoir container RC1 which is closest to the downstream piping contains a diluent which makes it easy to flush the system including the channels of the valve block at the end of a cleaning cycle.

- 10 The application device 200 in this example has four application units 210 each having an application nozzle 250 (Fig. 2) supplied via a respective application valve AV1, AV2, AV3, AV4. However, the invention is not limited to a specific number of application valves, like it is not limited to the specific kind of application device 200. Each application unit 210 may be formed like in Figure 2 having a seed tube 230 for
- 15 guiding falling separated plant propagation materials K to the ground B, and an application nozzle 250 being arranged to spray individual aliquots to the individual plant propagation materials K as sensed by the sensor array 240, by triggering the respective application valve AV1, AV2, AV3, AV4 associated to the particular application nozzle 250. The individual supply lines 240 of each application unit 210
- 20 may branch off downstream of the second pressure sensor PS2.

As used herein, the term "ground", or also referred to as "underlying surface", is understood to be an agricultural soil or other solid medium onto which plant propagation material, such as seeds and seedlings, are applied.

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- The term "plant propagation material" herein may refer to any seed, seedling, tuber, stem cutting or otherwise useful material for growing and propagating plants or crops. Many plant species, such as several fruits and ornamental plant species, are commonly reproduced by vegetative propagation (or "clonal propagation" or "vegetative reproduction"). Preferably it may refer to seeds, which
- 30 are usually composed of individual plant propagation materials. The term "plant propagation material" is understood to denote all the generative parts of the plant, including but not limited to seeds, which can be used for the multiplication of the latter and vegetative plant material such as cuttings and tubers, for example,
- 35 potatoes. There may be mentioned, e.g., the seeds (in the strict sense), roots, fruits, tubers, bulbs, rhizomes, parts of plants. Germinated plants and young plants, which are to be transplanted after germination or after emergence from the soil, may also be mentioned. A preferred plant propagation material is the seed. In an aspect of the present invention, these young plants and generative parts may

- be protected before transplantation by a partial treatment, for example, by application of a dressing composition, according to the present invention. The term "seed" to be treated with the compositions of the present invention means a plant body of the initial stage of cultivation used for reproduction of plants, and involves
- 5 not only the so-called seeds but also plant bodies for nutrient reproduction such as bulb, tuber, seed tuber, aerial tuber, scaly bulb, stalks for cuttage, and the like. The term "seeds" herein may be granular seeds, pelleted granular seeds, dummy seeds or combinations thereof.
- 10 Advantageously, "dummy seeds", i.e. particles that are not plant propagation materials may be sown and treated alongside the actual seeds. Such "dummy seeds" may be useful in e.g. spacing apart smaller seeds or may be specifically sowed to carry phytotoxic dressing in e.g. rows parallel and spaced apart from rows of seeds, or fertilizers and growth enhancers to improve the soil quality.
- 15 Yet further, where plant propagation materials are employed that are very small, or irregular in shape and weight, these may be difficult to sow in regular distribution with a single seedling per cell, and with a straight row. Accordingly, there may be a number of erroneously planted seeds, and hence some cells will
- 20 have more than one seed, while others, none. With high seed costs and largely for automated harvesting, it is not desirable simply place multiple seeds per cell, and then remove them to allow only a single plant in due time. It has been found that beneficially, seeds or propagation materials in general may then be put through a process called "pelleting", wherein preferably an inert material is coated onto the
- 25 seeds, thereby forming a more regular and uniform shape and size, e.g. wherein smaller seeds are pelleted to a specific size and shape suited for the planting and/or sowing process, e.g. to a standardized size and shape, e.g. adapting for instance tiny Petunia seeds to be useable in the same apparatus as lettuce seeds. The thus pelleted seeds have several benefits, including easier use of standardized
- 30 equipment, a more regular spread of the seeds, and a higher rate of selective coating with the dressing composition. This in turn may reduce the need for thinning of fields, and easier automation in greenhouse applications seed starting. Preferably, the pelleting material used on the seeds is selected to absorb water quickly, ensuring the uniform moisture around the seeds, and thereby increasing
- 35 germination rates.

Figure 6 shows an exemplary stirring device 600 which is used as stirrer S1 in the supply device 100 shown in Figures 1A, 1B, 5 described above.

The stirring device 600 includes a stator 610, a rotor 630, and a rotor support structure 650. The stator 610 includes a number of solenoids 612 each having a stator phase winding 614 wound around a core 616. According to three-phase circuitries known per se in the art for windings of electric motors, the number of solenoids 612, i.e. windings 614, may be an integer multiple of three, preferably six. A stator frame may be provided to support against the outer wall of the cylinder 130.

The rotor 620 includes a rotor body 632 connected to or formed with a rotor axle 634 which is supported by the rotor support structure 650 such that the rotor body 632 may rotate around a rotor axis 636. The rotor body 632 may include one or more stirring elements 638, e.g. stirrer blades. Each stirring element 638 may have a number of through-holes 640 for allowing fluid to flow through. The rotor body 632 defines an outer periphery 642 which may be formed by outer edges of each stirring element 638 or an annular structure formed around and/or connecting outer edges of the stirring element 638 in a circumferential direction. A number of magnetic elements 644 is received at the outer periphery 642 of rotor 630. The magnetic elements 644 are preferably permanent magnets having one pole (e.g. N) oriented radially outwardly, and another pole (e.g. S) oriented radially inwardly, with respect to rotor axis 636.

The rotor support structure 650 includes a first shell 652 and a second shell 654 which are formed to support against an inner wall of cylinder body 132 of cylinder 130, preferably being held in place by friction. Each first and second shell 652, 654 are disc-shaped, and have a recess 656 formed in a centre of a front face thereof, to receive one of opposite axial ends of rotor axle 634, respectively. Said that, each recess 656 is a first axial bearing half, and each axial end of rotor axle 634 is a second axial bearing half, together forming an axial bearing. The bearing halves be formed differently, in variations, e.g. by having magnetic bearing elements, or any other appropriate bearing means. Each first and second shell 652, 654 may have perforations 640 to allow fluid to flow through. The first and second shells 652, 654 may be connected with each other or supported against each other by a distance-holding structure (not shown) which however is optional.

In use, first and second shells 652, 654 of rotor support structure 650 are arranged to sandwich the rotor 630 therebetween with each recess 656 receiving a respective end of rotor axle 634. Thus arranged, the rotor support structure 650 and rotor 630 are placed near the outlet 134 of cylinder body 132 of cylinder 130. Then, the solenoids 612 of stator 610 are arranged around the cylinder body 132

of cylinder 130 within a cross-sectional plane which the permanent magnets 644 of rotor 630 are located in. Even though not shown in the drawing, stator 610 may include a stator frame accommodating the solenoids 612 in a predetermined, e.g. star-shaped, and fixed arrangement, which stator frame being formed to fit an
5 outer circumferential surface of the cylinder body 132 of cylinder 130, and preferably held in place by friction.

A stirrer control circuit may also be accommodated in such stator frame, and be connected to control unit 199 of the supply device 100 so that an on/off state of
10 the stirring device may be controlled by the control unit 199 while control of individual currents to the solenoids 612 may be controlled by the stirrer control circuit. Alternatively, a stirrer control circuit may be integrated in the control unit 199. By exciting the solenoids 612 of stator 610, the permanent magnets 644 may be moved by a magnetic field generated thereby, and the rotor may be put to
15 rotation.

It will be noted that the form of the rotor body 632 is purely by example. Any shape of the rotor body 632 is possible which allows effective stirring of the content of the cylinder 130. For example the rotor body 632 may be in the form of at least
20 one airscrew or airfoil or blade or any shape having a leading edge to cut through the fluid. The shape of the rotor body 632 may be chosen or designed depending on of the composition or compositions being stirred, in particular fluidic characteristics, physical properties like viscosity or the like, thereof. The axle 634 may be reduced to protrusions, e.g. cones or bumps, protruding from end faces of
25 the rotor body 632. The recesses 656 may be formed curved or funnel-shaped to provide a centering axial bearing for the axle 634.

An arrangement of solenoids 612 and permanent magnets 644 may be found such that the rotor body 630 is held in place by magnetic forces alone, which would
30 make rotor support structure 650 dispensable.

It will be noted that the stirrer S1 in the supply device 100 of the present invention may be formed in any way other than the stirring device 600 described above. For example, a rotor spindle may be arranged through a hollow piston rod 140, bearing
35 some stirring blade at its end.

It will further be noted that the stirring device 600 described and shown herein may be used not only in the supply device 100 of the present invention but is a new development of a stirring device for use in containers. The stirring device can be

used in any type of cylinder or tube, for stirring liquids, and is particularly useful for stirring small volumes in the range of e.g. 1 to 100 ml, or in containers of small diameter in the range e.g. of 5 to 50 mm.

- 5 Further objects and advantages of the present invention will now become apparent from the following description of preferred embodiments of apparatus for carrying out the method, as particularly illustrated in the accompanying drawings which form a part of this application. It is obvious that the invention is not limited to the embodiments described above and shown in the accompanying drawings.
- 10 Modifications remain possible, in particular as regards the constitution or the number of the various elements or by substitution of technical equivalents, without departing from the scope of protection as defined by the following claims.

List of reference signs and symbols

	100	agricultural composition supply device
	102a, 102b	bulk agricultural composition
	104	waste fluid
5	108	applicable agricultural composition
	110	bulk container
	112	body
	114	top wall
	116	bulk composition intake unit
10	117	waste fluid disposal unit
	118	dip tube
	120	fitting
	130	cylinder
	132	cylinder body
15	134	outlet
	136	through-hole
	138	piston
	140	piston rod
	142	piston drive
20	144	pressurizing means
	150	pipng
	152	connection line
	154	interconnection line
	156	node structure
25	157	node
	158	dosing line
	160	feed line
	162	buffer line
	164	application line
30	166	branch line
	170	valve arrangement
	172	shut-off valve
	180	application interface unit
	182	cylinder
35	184	cylinder body
	185	outlet
	186	piston
	188	spring
	190, 192	pressure sensor

	199	control unit
	200	application device
	210	application unit
	220	supply line
5	230	seed tube
	232	tube wall
	234	lower end
	236	sensor bay
	240	sensor array
10	242	sensor
	244	sensor line
	250	application nozzle
	252	trigger line
	310	single dose mode
15	320, 320'	mixed dose mode
	330	blend mode
	340	feed mode
	350, 350'	dump mode
	360	flush mode
20	405	waste fluid control scheme
	410	stirrer control scheme
	415	application feed control scheme
	420a, 420b	first/second reservoir control scheme
	430	dosing volume control scheme
25	440, 450	first / second pressure control scheme
	460	expansion volume control scheme
	470	application valve control scheme
	480	idle state
	480'	transient state
30	482	prime fill phase
	482'	pre-cleaning fill phase
	484	dosing cycle
	486	application campaign
	487	application cycle
35	487'	nozzle blowout cycle
	488, 490	re-fill phase
	492	first cleaning phase
	494	second cleaning phase
	496	rinsing cycle

	500	plant treatment system
	510	carrier unit
	512	main frame
	514	wheel suspension
5	516	wheel
	518	chassis
	520	reservoir container carrier
	522	container bay
	530	dosing container carrier
10	540	valve block
	542	first end (shutoff valve 172)
	544	second end (shutoff valve 172)
	546	interconnection piece
	546a	branch part
15	546b	passage part
	548	fluid channel
	550	end piece
	552	connector piece
	600	stirring device
20	610	stator
	612	solenoid
	614	stator phase winding
	616	core
	630	rotor
25	632	rotor body
	634	rotor axle
	636	rotor axis
	638	stirring element (stirrer blade)
	640	perforation
30	642	periphery
	644	magnetic element
	650	rotor frame
	652, 654	first, second shell
	656	recess
35	AV1, AV2, ...	application valve
	B	ground
	BV1	branch valve
	D	droplet

	DC1, DC2	dosing container (cylinder)
	CTU	control unit
	EC1	expansion container
	FV1	application feed shutoff valve
5	I	impact location
	K	seed
	M1, M2	motor (piston drive)
	PS1, PS2	pressure sensor
	RC1, RC2, ...	reservoir container
10	RV1, RV2, ...	reservoir container shutoff valve
	S1	stirrer
	SA1	sensor array
	Vd, Vd'	dosing volume
	Ve	expansion volume
15	V0, V1, V2, ...	volume values (filling degrees)
	WC1	waste container
	WV1	waste container shutoff valve
	f	fall line
20	j	spraying trajectory
	pd	dosing pressure
	pa	application pressure
	pd1, pd2, ...	pressure values
	t1, t2, ...	control times
25	xd, xd'	piston travel (dosing container)
	xe	piston travel (expansion container)
	α	acute angle
30	$\Delta t1, \Delta t2, \Delta ta$	opening time intervals
	ΔVe	load

The afore list of reference signs is integral part of the description.

Patent Claims

1. A method for providing an agricultural composition, the method including:
 - 5 – dosing predetermined amounts of two or more bulk agricultural compositions from two or more respective reservoir containers (RC1, RC2, RC4) into a dosing container (DC1);
 - forming a mixture of the two or more agricultural compositions in the dosing container (DC1), including stirring a content in the dosing
10 container (DC1) during and/or after the dosing, the stirring including controlling current through coils (614) of a stator winding placed outside the dosing container (DC1), to move a rotor (630) having a magnetic element (644), the rotor(630) being placed within the dosing container (DC1); and
 - 15 – feeding the mixture, as the agricultural composition, to an agricultural application device (200).
2. The method of claim 1, wherein the magnetic element (644) comprises an armature winding or a plurality of permanent magnets.
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3. The method of claim 1 or 2, wherein the dosing includes applying a predetermined vacuum pressure to the dosing container (DC1).
4. The method of any preceding claim, wherein the feeding includes applying a
25 predetermined overpressure to the dosing container (DC1).
5. The method of claim 3 or 4, wherein the dosing container (DC1) includes a cylinder (130) with a movable piston (138) connected to a piston drive, and the applying a predetermined vacuum pressure includes controlling the
30 piston drive (142) to move the piston (138) to increase a working volume of the cylinder (130), and the applying a predetermined overpressure includes controlling the piston drive (142) to move the piston (138) to decrease the working volume (Vd) of the cylinder (130).
- 35 6. The method of any preceding claim, wherein the dosing includes controlling a valve arrangement (170) in a piping (150) which connects the reservoir containers (RC1, RC2, RC4) with the dosing container (DC1), to selectively communicate and shut off the reservoir containers (RC1, RC2, RC4) with or from the dosing container (DC1) to allow predetermined passing volumes to

flow from the reservoir containers (RC1, RC2, RC4) into the dosing container (DC1).

- 5 7. The method of claim 6, wherein the dosing includes controlling the valve arrangement (170) to selectively communicate and shut off the reservoir containers (RC1, RC2, RC4) with or from the dosing container (DC1) with a predetermined ratio of passing volumes, preferably the communicating and shutting off of the reservoir containers being performed in a time-interlaced or time-pulsed fashion according to the predetermined ratio of passing
10 volumes.
8. The method of claim 6 or 7, wherein the valve arrangement (170) comprises two or more reservoir container shutoff valves for the two or more reservoir containers (RC1, RC2, RC4), respectively, and the communicating and
15 shutting off the reservoir containers (RC1, RC2, RC4) with or from the dosing container (DC1) includes opening and closing the respective reservoir container shutoff valves (RV1, RV2, RV3, RV4), respectively, wherein the valve arrangement (170) is preferably solenoid-operated with the controlling of the valve arrangement (170) including exciting a solenoid (612) or solenoids (612)
20 of the valve arrangement (170).
9. The method of any of claims 6 to 8, wherein the feeding includes controlling the valve arrangement (170) to shut off the reservoir containers (RC1, RC2, RC4) from the dosing container (DC1) and communicate the dosing container
25 (DC1) with an application interface unit (180) connected to the application device (200) to allow flow from the dosing container (DC1) to the application interface unit (180).
10. The method of any of the preceding claims, the method further including a
30 step of:
 - after feeding the product to the application device (200), removing leftover materials from the piping (150) and/or the/an application interface unit (180), in particular by transferring the leftover materials into a cleaning container, and/or
35 – disposing leftover materials from the cleaning container or the dosing container (DC1) into a waste container (WC1).
11. The method of claim 10, wherein the cleaning container is an additional dosing container (DC2), including leftover materials from the application

device (200) or from the dosing container (DC1), and/or wherein the waste container (WC1) is an additional reservoir container (RC1, RC2, RC4).

12. A supply device (100) for providing an agricultural composition, the supply device (100) including:
- at least two bulk composition intake units (116) each of which is formed to communicate with a respective reservoir container (RC1, RC2, RC4);
 - a dosing container (DC1);
 - an application interface unit (180) connectable to an application device (200) for applying an agricultural composition to plants or plant propagation material (K);
 - a piping (150) connecting the dosing container (DC1) with each bulk composition intake unit (116) and the application interface unit (180);
 - a valve arrangement (170) formed for selectively communicating or shutting off each bulk composition intake unit (116) and the application interface unit (180) with or from the dosing container (DC1) through the piping (150);
 - a pressurizing means (144) for providing overpressure or vacuum pressure to the dosing container (DC1), for dosing a predetermined amount of the agricultural composition from any reservoir container (RC1, RC2, RC4) or feeding content of the dosing container (DC1) to the application interface unit (180) when respectively communicated;
 - a control unit (199, CTU) formed and connected for controlling the valve arrangement (170) and the pressurizing means (144); and
 - a stirring device for stirring the content in the dosing container (DC1), comprising a stator having a stator winding with coils (644) arranged outside the dosing container (DC1) and a rotor (630) having a magnetic element (644), the rotor (630) being placed within the dosing container (DC1), the control unit (199, CTU) being formed to control a current of the stator winding.
13. The supply device (100) of claim 12, wherein the control unit (199, CTU) is formed to control the supply device (100), by controlling states of the valve arrangement (170) and the pressurizing means (144).
14. The supply device (100) of claim 12 or 13, wherein the dosing container (DC1) includes a cylinder (130) and the pressurizing means (144) includes a movable piston (138) connected to a piston drive (142) inside the cylinder (130), and

the control unit (199, CTU) is formed to control the piston drive (142) to move the piston (138) to control a working volume (V_d) of the cylinder (130).

15. The supply device (100) of claim 12, 13 or 14, wherein the valve arrangement (170) is arranged, formed and connected such that states thereof are controllable to selectively communicate and shut off each bulk composition intake unit (116) or the application interface unit (180) with or from the dosing container (DC1) to allow a predetermined passing volume to flow from the reservoir container (RC1, RC2, RC4) to the dosing container (DC1) or from the dosing container (DC1) to the application interface unit (180), wherein the control unit (199, CTU) is preferably adapted to control states of the valve arrangement (170) to allow a flow from one or more reservoir container(s) (RC1, RC2, RC4) to the dosing container (DC1) in a time-interlaced or time-pulsed fashion.
16. The supply device (100) of any one of claims 12 to 15, wherein the valve arrangement (170) comprises a shutoff valve (172) per each bulk composition intake unit (116) and the application interface unit (180), and an optional waste fluid disposal unit (117), wherein the shutoff valves (172) of the valve arrangement (170) are preferably arranged to form a valve block (540), and a first end (542) of each shutoff valve (172) is connected to one bulk composition intake unit (116) or the application interface unit (180) or the optional waste liquid disposal unit (117), and a second end (544) of each shutoff valve (172) is connected to a fluid channel (548) which is connected to the dosing container (DC1), wherein the fluid channel (548) is preferably formed by through-holes formed in housings or housing attachments of each shutoff valve (172) with the through-holes being connected with each other.
17. The supply device (100) of any of claims 12 to 16, wherein the application interface unit (180) comprises an expansion container (EC1) connected to a piping (150) section between the valve arrangement (170) and an application connection fitting, the expansion container (EC1) being formed to provide an changeable expansion volume (V_e), the expansion container (EC1) preferably including a cylinder (182) with a movable piston (186) connected to a piston drive, the piston drive preferably including an elastic return member (188) acting to reduce a working volume (V_e) of the expansion container (EC1), wherein the control unit (199, CTU) is preferably formed to control an action of the elastic return member of the expansion container (EC1).

18. The supply device (100) of any of claims 12 to 17, wherein
the supply device (100) further comprises a cleaning container different
from the dosing container (DC1), the cleaning container being connected to
the piping (150) through the valve arrangement (170), in particular a
5 dedicated shutoff valve (172) of the valve arrangement (170), and having
pressurizing means (144) for providing pressure or vacuum pressure to the
cleaning container, and the control unit (199, CTU) being formed and
connected for controlling the valve arrangement (170) and the pressurizing
means (144), wherein the cleaning container is preferably a cylinder (130)
10 with a movable piston (138) connected to a piston drive (142) and the control
unit (199, CTU) is formed to control the piston drive (142) to move the piston
(138) of the cleaning container, and/or
a waste fluid disposal unit connected to the piping (150) through the valve
arrangement (170), in particular a dedicated shutoff valve (172) of the valve
15 arrangement (170), and formed to communicate with a waste container
(WC1) to dispose of a content of the cleaning container, the waste container
(WC1) preferably being formed being of identical or similar build as the
reservoir containers (RC1, RC2, RC4) and the waste fluid disposal unit being
of identical or similar build as the bulk composition intake units (116).

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