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(54) Title: AGRICULTURAL ACTIVE COMPOSITION COMPRISING A GLYOXAL-MODIFIED POLYSACCHARIDE

(57) Abstract: The present invention relates to an agricultural active composition containing at least one beneficial microorganism agent and at least one glyoxal-modified polysaccharide. The invention also relates to a method for preparing the agricultural active composition according to the invention, to the use of a glyoxal-modified polysaccharide as an adjuvant for improving the homogeneity of dispersion in an agricultural active composition, and to the use of the composition according to the invention for the treatment of soils, plants and/or seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils.

AGRICULTURAL ACTIVE COMPOSITION COMPRISING A GLYOXAL-MODIFIED POLYSACCHARIDE

The present invention relates to an agricultural active composition containing at least one beneficial microorganism agent and at least one glyoxal-modified polysaccharide.

The invention also relates to a method for preparing the agricultural active composition according to the invention, to the use of a glyoxal-modified polysaccharide as an adjuvant for improving the homogeneity of dispersion in an agricultural active composition, and to the use of the composition according to the invention for the treatment of soils, plants and/or seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils.

In recent years, both environmental and human health concerns have fostered interest in promoting alternatives to synthetic pesticides, based on conventional agrochemical molecules. Through the use of living organisms, natural substances or semiochemicals, biological control agents prevent or reduce damage from pests and pathogens, emerging as one of the most promising tools for sustainable agriculture.

However, the global rate of adoption of biological control-based solutions remains relatively low in comparison with conventional pesticides, with often less consistent biological efficacy reported in the field, in adverse conditions. Classical root causes analysis includes lack of stability of the product during storage, issues of application due to a lack of homogeneity of dispersion of the actives, less active material reaching the target and rapid degradation of the biopesticide once applied related to environmental factors.

It is for example a well-known problem that bacterial or fungal microbial pesticides concentrate formulations have a strong tendency to agglomerate as such in the concentrate when they are in liquid form or upon dilution in water. This causes significant application issues for the end user such as the risk of nozzles clogging on delivery devices, and/or the adhesion to the inner surface of a delivery tank (often referred to as “staining”), hence the lack of biological availability of microbial active and its metabolites to the targeted surface, with potential biological efficacy issues.

Agricultural active compositions with conventional agrochemical micronized actives typically include dispersants to improve the quality of dispersion, and in

particular to provide homogeneity and to help reduce and/or prevent flocculation, sedimentation and/or agglomeration.

Dispersion is the process through which agglomerates of solid particles become separated, and a new interface forms between each of the smaller particles and the surrounding media. This process is facilitated by the application of external force (milling) and the use of amphiphilic additives such as dispersants. Traditional dispersants technologies typically used to obtain homogeneous and stable dispersion formulations of micronized conventional actives, such as acrylic copolymers or alkoxylated block copolymers, are generally not satisfactory for biological control compositions, especially for the ones that contain beneficial microorganisms.

Specific rheological agents such as some polysaccharides which have a pseudoplastic behaviour and/or which bring a yield stress can improve the homogeneity of dispersion in water, but they are often not efficient enough and/or impart a too high level of viscosity in the water based medium, which cause application issues.

Thus, there is a continuous need for providing improved compositions for agriculture needs, in particular compositions based on beneficial microorganism agents, with good intrinsic properties, in particular good physicochemical properties such as a good stability on storage and a good viscosity. Such compositions should present good performances at dilution including good suspensibility of the agricultural material (such as a beneficial microorganism agent) and/or good homogeneity of the dispersion of agricultural material, even for high loading formulations.

These objectives are preferably achieved with the present invention, a subject-matter of which is a composition comprising:

(i) at least one beneficial microorganism agent, and

(ii) at least one glyoxal-modified polysaccharide,

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

The compositions according to the invention present good intrinsic physicochemical properties.

In addition, it has been noted that the compositions according to the invention advantageously guarantee good performances at dilution including a good homogeneity of the dispersion of the beneficial microorganism agents, generally even for high loading formulations.

More particularly, the biopesticides have a good viability when they are present in the agricultural active compositions according to the invention. In particular, it has been observed a good biocompatibility between glyoxal-modified polysaccharides and microbial species.

According to an embodiment of the invention, the concentrate compositions according to the invention display a good wettability (that is to say a fast hydration of particles of beneficial microorganism agents upon dilution in water) and/or a good homogeneity of dispersion of the beneficial microorganism agents upon dilution in water and/or a good suspensibility (as defined later on in the text).

According to an embodiment of the invention, the compositions of the invention when fully formulated (i.e., the actives and/or other excipients) will not be retained within the inside of a holding tank, e.g. reduced adherence/sticking of actives and/or other excipients to the inner surfaces of the a tank, or clog the delivery apparatus or parts thereof, e.g. the nozzles or hoses of the delivery device) and cause minimal, if any, phytotoxic injury to the crops treated with the fully formulated beneficial microorganism agent.

As used herein, an agent is "phytotoxic" if it causes harm or damage to a plant or seed with which it comes in contact. Plant and seed damage or harm includes, for example, stunting, chemical burning, yield depression, malformation, discoloration, lack of germination, reduction in germination rate, death, and the like.

It has been also noted that the compositions according to the invention have a good viscosity and a good dispersion of agricultural materials (in particular the beneficial microorganism agents), which allows easier application onto soils, plants and/or seeds.

According to a preferred embodiment of the invention, the composition presents a high concentration of agricultural material(s) (in particular the beneficial microorganism agents). The use of such concentrated compositions is in particular advantageous for economic reasons (indeed such compositions making it possible to reduce the total weight of the compositions, and consequently their transport costs), the concentrated composition then being generally diluted to the desired concentration by the final user.

Another subject-matter of the invention is a method for preparing a composition (M), comprising at least:

- a step of preparing at least one glyoxal-modified polysaccharide resulting from the mixture of glyoxal and of at least one polysaccharide; then

- a step of mixing said glyoxal-modified polysaccharide with at least one beneficial microorganism agent, so that the weight ratio of the total content of beneficial microorganism agent(s) to the total content of glyoxal-modified polysaccharide(s) ranges from 0.01 to 20.

A subject-matter of the invention is also the use in a composition comprising at least one beneficial microorganism agent, of at least one glyoxal-modified polysaccharide so that the weight ratio of the total content of beneficial microorganism agent(s) to the total content of glyoxal-modified polysaccharide(s) ranges from 0.01 to 20, for improving the homogeneity of dispersion of the beneficial microorganism agent(s) present in the composition.

A subject-matter of the invention is also the use of the composition according to the invention, for the treatment of soils, plants and/or seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils.

Advantageously, a subject-matter of the invention is the use of the composition according to the invention, for the treatment of soils, plants and/or seeds to control pests, to regulate the growth of plants, to induce the defense response in plants and to enhance metabolic and physiological processes within plants and soils.

A subject-matter of the invention is also a method for treating soils, plants and/or seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils, by applying the composition according to the invention to at least one plant, area adjacent to a plant, soil adapted to support growth of a plant, root of a plant, foliage of a plant, and/or seed adapted to produce a plant.

Other characteristics, aspects and advantages of the invention will emerge even more clearly on reading the description and the example that follows.

In the present description, and unless otherwise indicated:

- the expression "at least one" is equivalent to the expression "one or more" and can be replaced therewith;

- the expression "between" is equivalent to the expression "ranging from" and can be replaced therewith, and implies that the limits are included;

- for the purposes of the present invention, the expression “greater than” and respectively the expression “less than” are intended to mean an open range which is strictly greater, respectively strictly less, and therefore that the limits are not included.

An "agricultural active" composition is intended to denote compositions which, either use in its concentrated form or in dilution in water to a targeted use rate, causes or provides a beneficial and/or a useful effect in agriculture and/or provides a biological activity in a seed, a plant, soil, for example to seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils.

The suspensibility of the composition is defined as the percentage in weight of one or more agricultural material(s) remaining in suspension relative to the total weight of compounds after a given time, after the dilution of said composition at a certain $\%_{wt}$ in water (CIPAC A or D standard waters), for example at $1\%_{wt}$ in water. The term "good suspensibility" is intended to denote a suspensibility greater than or equal to 70%, in particular greater than or equal to 80%, more particularly greater than or equal to 85%, for example greater than or equal to 90%.

The suspensibility of a composition can for example be determined according to the CIPAC method MT184, with eventually adapted drying conditions depending on the microorganism nature (lower temperature, in presence of a filter to avoid biofilm formation).

The term "good viscosity upon dilution" is intended to denote compositions that upon dilution in water to the targeted use rate for application exhibits good flowability and good sprayability, that is to say compositions of suitable viscosity upon dilution to the targeted use rate of application, for example of viscosity less than 500 cP (i.e. 500 mPa.s), in particular of viscosity less than 300 cP (i.e. 300 mPa.s) and even better of viscosity less than 150 cP (i.e. 150 mPa.s), measured at 20 rpm and at 25°C using a Brookfield RV viscometer.

The term "suitable dispersion" or "good dispersion" is intended to mean a dispersion after dilution in water (such as in CIPAC A or D standard waters) to the targeted use rate for application which is homogeneous (*that is to say which exhibits substantially no phase separation, sedimentation, syneresis, etc.)* over time, in particular which remains substantially homogeneous when stored for 30 minutes in a water bath thermostatically controlled at 20°C, preferably for 2 hours in a water bath thermostatically controlled at 20°C and ideally for 24 hours in a water bath thermostatically controlled at 20°C (adaptation of the ClPAC MT180 test). Such a

dispersion must in particular make it possible to ensure good properties of use of the dispersed compounds.

The beneficial microorganism agents

The composition according to the invention comprises at least one beneficial microorganism agent.

According to the invention, the term " beneficial microorganism agent " means any microorganism, whether in a vegetative state, a dormant state (e.g., spore) or a whole broth culture, any substance produced from a microorganism (including proteins or secondary metabolites), or any fermentation product (e.g., supernatants, filtrates, extracts, etc.) that are beneficial to a plant.

According to the invention, the term “beneficial microorganism agents” is intended to include (i) biopesticides, (ii) microorganisms that improve plant nutrition and (iii) microorganisms that induce the defense response in plants or that are capable of enhancing metabolic & physiological processes within plants and soils.

As used herein, the term "pesticidal" means any agent or combination of agents that is pathogenic to at least one target pest (e.g., a nematode, an insect, an acari, a fungal pest, a bacterial pest, a viral pest, etc.).

As used herein, the term "biopesticide" (which is equivalent to "microbial pesticide"), means any microorganism, whether in a vegetative state, a dormant state (e.g., spore) or a whole broth culture, any substance derived from a microorganism (e.g., metabolites), or any fermentation product (e.g., supernatants, filtrates, extracts, etc.) that are pathogenic to a pest (e.g., capable of attacking, infecting, killing, disabling, causing disease, compete with and/or causing injury to a pest), and is thus able to be used in the control of a pest by adversely affecting the viability or growth of the target pest. Non-limiting examples of "microbial pesticides" include microbial nematocides, microbial insecticides, microbial fungicides, microbial bactericides, and microbial viricides).

As used herein, "derived from" means directly isolated or obtained from a particular source or alternatively having identifying characteristics of a substance or organism isolated or obtained from a particular source. In the event that the "source" is an organism, "derived from" means that it may be isolated or obtained from the organism itself or medium used to culture or grow said organism.

As used herein, "whole broth culture" refers to a liquid culture containing both cells and media. If bacteria are grown on a plate the cells can be harvested in water or other liquid, whole culture.

As used herein, the term "supernatant" refers to the liquid remaining when cells grown in broth or are harvested in another liquid from an agar plate and are removed by centrifugation, filtration, sedimentation, or other means well known in the art.

As defined herein, "filtrate" refers to liquid from a whole broth culture that has passed through a membrane.

As defined herein, "extract" refers to liquid substance removed from cells by a solvent (water, detergent, buffer) and separated from the cells by centrifugation, filtration or other method.

As used herein, "metabolite" refers to a compound, substance or byproduct of a fermentation of a microorganism, or supernatant, filtrate, or extract obtained from a microorganism that has pesticidal and particularly, insecticidal activity.

As used herein, the terms "spore", "microbial spore", etc., has its normal meaning which is well known and understood by those of skill in the art (i.e., a microorganism in its dormant, protected state).

As used herein, the term "herbicide(s)" is intended to refer to any agent or combination of agents capable of killing weeds and/or inhibiting the growth of weeds (the inhibition being reversible under certain conditions).

As used herein, the term "fungicide(s)" is intended to refer to any agent or combination of agents capable of killing fungi and/or inhibiting fungal growth.

As used herein, the term "nematicide" or "nematicidal" is intended to refer to any agent or combination of agents capable of killing one or more nematodes and/or inhibiting the growth of one or more nematodes.

As used herein, the term "insecticide" or "insecticidal" is intended to refer to any agent or combination of agents capable of killing one or more insects and/or inhibiting the growth of one or more insects. As used herein, the term "acaricide" or "acaricidal" is intended to refer to any agent or combination of agents capable of killing one or more acarids and/or inhibiting the growth of one or more acarids.

Preferably, the beneficial microorganism agents are chosen from biopesticides.

More preferentially, the beneficial microorganism agents are chosen from fungal spores, bacterial spores, and mixtures thereof.

Examples of fungal spores or conidia that are insecticidal or nematicidal or fungicidal include but not limited to the following classes: *Basidiomycetes, Chytridiomycetes, Deuteromycetes, Hyphochytridiomycetes, Oomycetes, Plasmodiophoromycetes, Sordahomycetes, Thchomycetes* and *Zygomycetes*, specifically the following fungi; *Arthrobotrys superba, Arthrobotrys irregular, Beauveria bassiana, Erynia neoaphidis, Fusarium spp., Hirsute/ Ia rhossiliensis, Hirsutella thompsonii, Lagenidium giganteum, Metarhiziurn anisopliae, Myrothecium, Neozygietes fresenii* (Nowakowski), *Nomuraea rileyi, Paecilomyces lilacinus, Pseudomonas chloroaphis, Pseudomonas spp., Psedozyma Flocculosa, Trichoderma harzianum*, and *Vericillium lecanii., Verticillium lecanii*, plus those endoparasitic fungi described in the book of "Nematology Advances and Perspectives, Vol. 2 (2004)", which is incorporated herein by reference in its relevant portion. Also included is a fungus genus "Esteya vermicola as described in US Patent No 6,168,947 (incorporated by reference), as well as the "Arkansas Fungus 18' as described in US Patent No 5,019,389 (incorporated herein by reference).

Examples of bacterial spores include but not limited to *Bacillus agri, Bacillus aizawai, Bacillus albolactis, Bacillus amyloliquefaciens, Bacillus cereus, Bacillus circulans, Bacillus coagulans, Bacillus endoparasiticus, Bacillus endorhythmos, Bacillus firmus, Bacillus kurstaki, Bacillus lacticola, Bacillus lactimorbus, Bacillus lactis, Bacillus laterosporus, Bacillus lentimorbus, Bacillus licheniformis, Bacillus macerans, Bacillus megatehum, Bacillus medusa, Bacillus metiens, Bacillus natto, Bacillus nigricans, Bacillus popillae, Bacillus pumiliss, Bacillus pumilus, Bacillus siamensis, Bacillus sphaehcus, Bacillus spp., Bacillus subtilis, Bacillus thuringiensis, Bacillus uniflagellatus, Bacillus velezensis*, plus those listed in the category of Bacillus Genus in the "Todar's Online Textbook of Bacteriology, (2009)" which is incorporated herein by reference in its relevant portion. Also included are *Streptomyces galbus, Streptomyces griseoviridis, Streptomyces candidus, Streptomyces lydicus, Streptomyces saraceticus, Streptomyces venezuelae, Streptomyces acidiscabies, Streptomyces goshikiensis, Streptomyces lavendulae, Streptomyces prasinus, Streptomyces prasinus, Streptomyces rimosus*. Also included are *Photorhabdus luminescens, Xenorhabdus nematophilus, pantoea agglomerans*, and those nematicidal bacterial antagonists listed in "Nematology Advances and Perspectives, Vol. 2 (2004)".

In one embodiment of the present invention, beneficial microorganism agents are selected among root colonizing bacteria and/or inoculants, for example *Rhizobium leguminosarum, Rhizobium tropici, Rhizobium loti, Rhizobium trifolii, Rhizobium*

meliloti, Rhizobium fredii, Azorhizobium caulinodansPseudomonas, Azospirillum, Azotobacter, Burkholdia, AgrobacteriumEndo Mycorhiza, Ecto Mycorhiza, Vesicular Arbuscular Mycorhiza, Bradyrhizobium.

Beneficial microorganism agents such as fungi or bacteria may be obtained by conventional fermentation processes. The fermentation can be carried out using solid, semi-solid or liquid nutrient media. If spores such as conidia are used, preference is given to solid or semi-solid nutrient media. The nutrient media contain the nutrients suitable and known for the cultivation of the respective microorganisms, in particular one or more metabolizable carbon sources or nitrogen sources and mineral salts. The fermentation is generally carried out at temperatures between about 3 degrees and about 40 degrees centigrade, preferably between 20 degrees and 35 degrees centigrade. For example, a representative fermentation is described in US 5,804,208.

A fermentation process comprises in general the steps of a) incubating spores such as conidia of a microorganism in or on a nutrition medium (such as agar with further additives such as oatmeal); b) separating spores such as conidia from the nutrition medium after the incubation time, (e.g., by shake off the conidia from the medium, centrifuging, filtrating); and optionally c) preparing an emulsion of said isolated conidia. The skilled person is well aware how to adapt fermentation to a given microorganism such as fungi or bacteria.

Even more preferentially, the beneficial microorganism agents are chosen from bacterial spores, in particular from *bacillus subtilis, bacillus amyloliquefaciens, bacillus velezensis, bacillus thuringiensis*, and mixtures thereof.

According to a particular embodiment of the invention, the beneficial microorganism agents are chosen from fungal spores, more particularly from *Beauveria Bassiana, Trichoderma, Paecilomyces lilacinus*, and mixtures thereof.

Even better, the beneficial microorganism agents are chosen from *bacillus subtilis, bacillus amyloliquefaciens, bacillus velezensis, bacillus thuringiensis, Beauveria Bassiana, Trichoderma, Paecilomyces lilacinus*, and mixtures thereof.

Preferably, the amount of beneficial microorganism agent(s) in the composition according to the invention ranges from 0.01 to 95 % by weight, more preferentially from 0.05 to 92% by weight, even more preferentially from 0.07 to 90 % by weight; and even better from 0.1 to 90 % by weight, relative to the total weight of the composition.

According to a first embodiment of the invention (concentrated composition), the amount of beneficial microorganism agent(s) in the composition ranges from 1 to 95 % by weight, more preferentially from 3 to 92% by weight, even more preferentially from 5 to 90 % by weight; and even better from 10 to 85 % by weight, relative to the total weight of the composition.

Preferably, according to this embodiment, the amount of beneficial microorganism agent(s) in the composition ranges from $1.5x10^7$ CFU/g to $1x10^{11}$ CFU/g, more preferentially from $1x10^9$ CFU/g to $5x10^{10}$ CFU/g.

According to a second embodiment of the invention (diluted composition), the amount of beneficial microorganism agent(s) in the composition ranges from 0.01 to 3% by weight, more preferentially from 0.05 to 2% by weight, even more preferentially from 0.07 to 1.5% by weight; and even better from 0.1 to 1% by weight, relative to the total weight of the composition.

Preferably, according to this embodiment, the amount of beneficial microorganism agent(s) in the composition ranges from $1x10^5$ CFU/g to $1x10^9$ CFU/g, more preferentially from $1x10^7$ CFU/g to $5x10^8$ CFU/g.

The glyoxal-modified polysaccharides

The composition according to the invention comprises at least one glyoxal-modified polysaccharide.

Advantageously, the polysaccharide of the glyoxal-modified polysaccharides according to the invention are preferably heteropolysaccharides, that is to say that they comprise the repetition of at least two different saccharide monomers.

Preferably, the polysaccharide of the glyoxal-modified polysaccharides according to the invention comprise at least monomers chosen from galactose, glucose, mannose, pyruvic acid, glucuronic acid and rhamnose.

More preferentially, the polysaccharide of the glyoxal-modified polysaccharides according to the invention are microbial polysaccharides, that is to say polysaccharides produced by bacteria or fungi.

Mention may most particularly be made, alone or as a mixture, of:

- carrageenans;
- furcellerans;

- xanthan gum;
- scleroglucan gum;
- succinoglycan gum;
- gellan gum;
- caesalpinia spinosa gum (also called tara gum);
- cassia gum;
- ceratonia siliqua gum (also called locust bean gum);
- tamarindus indica seed polysaccharide.

The polysaccharides, in particular the microbial polysaccharides, then undergo a chemical treatment with glyoxal. More particularly, the hydroxyl groups which are exposed on the polysaccharide backbone react with glyoxal. The preparation of such polymers has been already described in various applications, for example US 2002/0038019 or US 4041234.

Preferably, the glyoxal-modified polysaccharide(s) according to the invention contains from 0.02 to 5% by weight, more preferably from 0.1 to 2% by weight, for instance from 0.1 to 1% by weight, or even from 0.2 to 0.8% by weight, of glyoxal with regard to the weight of polysaccharide alone (non glyoxal-modified polysaccharide).

More preferentially, the glyoxal-modified polysaccharide(s) may be chosen from glyoxal-modified carrageenans, glyoxal-modified furcellerans, glyoxal-modified xanthan gum, glyoxal-modified succinoglycan gum, glyoxal-modified gellan gum, glyoxal-modified scleroglucan gum, glyoxal-modified caesalpinia spinosa gum, glyoxal-modified cassia gum, glyoxal-modified ceratonia siliqua gum, glyoxal-modified tamarindus polysaccharide, and mixtures thereof.

Even more preferentially, the glyoxal-modified polysaccharide(s) may be chosen from glyoxal-modified xanthan gum, glyoxal-modified succinoglycan gum, glyoxal-modified gellan gum, glyoxal-modified scleroglucan gum, and mixtures thereof; even better from glyoxal-modified succinoglycan gum, glyoxal-modified xanthan gum, and mixtures thereof.

According to a particularly preferred embodiment of the invention, the glyoxal-modified polysaccharide is glyoxal-modified xanthan gum. For example, among glyoxal-modified polysaccharides which can be used according to the invention, mention may be made of Rhodopol 50 MD® sold by SOLVAY. Rhodopol

50 MD® sold by SOLVAY contains from 0.02% to 5% by weight of glyoxal with regard to the weight of polysaccharide alone (non glyoxal-modified polysaccharide).

Preferably, the total content of glyoxal-modified polysaccharide(s) in the composition ranges from 0.01 to 40% by weight, more preferentially from 0.02 to 20% by weight, even more preferentially from 0.05 to 10% by weight, and even better from 0.05 to 5% by weight, relative to the total weight of the composition according to the invention.

According to a first embodiment of the invention (concentrated composition), the total content of glyoxal-modified polysaccharide(s) in the composition preferably ranges from 0.5 to 40% by weight, more preferentially from 1 to 20% by weight, even more preferentially from 1.5 to 10% by weight, and even better from 2 to 5% by weight, relative to the total weight of the composition according to the invention.

According to a second embodiment of the invention (diluted composition), the total content of glyoxal-modified polysaccharide(s) in the composition preferably ranges from 0.01 to 0.3% by weight, more preferentially from 0.02 to 0.2% by weight, and even more preferentially from 0.05 to 0.1% by weight, relative to the total weight of the composition according to the invention

According to the invention, the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

Preferably, the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.05 to 20; more preferably from 0.1 to 20; more preferentially from 0.5 to 10; even more preferentially from 1 to 9; and even better from 2 to 8; and better still from 3 to 7.

The guars

Preferably, the composition according to the invention further comprises at least one guar gum.

The guar gums which may be added to the composition according to the invention, are not modified with glyoxal. In other terms, the guar gums that may be used as additional ingredients, are not glyoxal-modified polysaccharides.

According to the invention, guar designates the plant Cyanopsis tetragonoloba. Cyamopsis tetragonoloba (guar) gums as defined below.

As used herein, "guar seeds" designates seeds derived from guar. Guar seeds comprise the hull, which is more or less fibrous, the germ, and two "guar splits" or "endosperm halves", which constitute the endosperm of guar. The splits (or endosperm) is/are rich in galactomannans. The guar seeds generally consist of 35 to 40% by weight of endosperm, 42 to 47% by weight of germ, and 14 to 17% by weight of hull.

As used herein, "guar flour" or "guar powder" designates a powder derived from the guar endosperm.

As used herein, "native guar" designates macromolecular chains of the galactomannan type, derived from guar endosperm, not having been subjected to chemical modification by the grafting of chemical groups. Native guar comprises macromolecules containing a principal chain of D-mannopyranose units linked in the beta (1-4) position substituted by D-galactopyranose units in the beta (1-6) position. Native guar has a mannose/galactose ratio of about 2.

As used herein, "Cyamopsis tetragonoloba (guar) gum" (also referred to as "guar gum") designates a product substantially consisting of native guar, in the form of guar splits, or of guar flour or powder.

As used herein, the "average molecular weight" of the guar gum means the weight average molecular weight of said guar gum.

Preferably, the guar gum of the invention may have an average molecular weight (Mw) of between 2,000 Daltons and 5,000,000 Daltons.

In one embodiment, the guar gum of the invention may have an average molecular weight (Mw) of between 100,000 Daltons and 4,500,000 Daltons, for instance between 500,000 Daltons and 4,000,000 Daltons, in particular between 1,000,000 Daltons and 3,500,000 Daltons, and better between 2,000,000 and 3,500,000 Daltons.

In another embodiment, the guar gum of the invention may have an average molecular weight (Mw) of between 100,000 Daltons and 2,000,000 Daltons, for instance between 300,000 Daltons and 1,800,000 Daltons, in particular between

350,000 Daltons and 1,700,000 Daltons, and better between 400,000 Daltons and 1,500,000 Daltons.

The average molecular weight of the guar gum may be measured by GPC (Gel Permeation Chromatography). Measurements may be carried out for instance using Shodex OH Pak columns and Agilent Refractive Index Detector.

The guar gum of the invention may be crosslinked or not.

Preferably, the guar gum of the invention is not crosslinked.

The guar gums according to the invention may be modified with a hydroxylalkyl group, in particular with a hydroxy(C_1-C_6)alkyl group.

Preferably, the guar gums according to the invention are modified with a hydroxylalkyl group, more preferentially with a hydroxy(C_1-C_6)alkyl group.

Even more preferentially, the guar gums according to the invention are chosen from hydroxypropyl-guar gums, such as those marketed under the references Jaguar HP 8®, Jaguar HP105®, Jaguar HP120® and/or Jaguar DR2000®.

Preferably, when guar gum(s) are present, the total content of guar gum(s) in the composition ranges from 0.01 to 20% by weight, more preferentially from 0.01 to 15% by weight, even more preferentially from 0.02 to 10% by weight, and even better from 0.03 to 5% by weight, relative to the total weight of the composition according to the invention.

According to a first embodiment of the invention (concentrated composition), the total content of guar gum(s) in the composition ranges from 0.2 to 20% by weight, more preferentially from 1 to 10% by weight, and even more preferentially from 2 to 5% by weight, relative to the total weight of the composition according to the invention.

According to a second embodiment of the invention (diluted composition), the total content of guar gum(s) in the composition ranges from 0.01 to 0.2% by weight, more preferentially from 0.02 to 0.1% by weight, and even more preferentially from 0.03 to 0.07% by weight, relative to the total weight of the composition according to the invention.

Preferably, the weight ratio of the total content of glyoxal-modified polysaccharide(s) (ii) to the total content of guar gum(s) ranges from 0.05 to 30; more

preferentially from 0.2 to 10; even more preferentially from 0.2 to 5; and even better from 0.5 to 3; and still better from 0.5 to 2.

In particular, it has been noted that when the composition according to the invention comprises at least one guar gum, the adhesion, stickiness and rainfastness of the concentrated or diluted composition according to the invention sprayed on an agricultural target (for example soils, plants and/or seeds) is significantly improved, compared to a composition that does not include guar gum.

According to the present invention, the term "rainfastness" (or "waterfastness") refers to the ability of a substance to withstand being washed off by precipitation, condensation, guttation or irrigation. Rainfastness may be for example assessed by comparing the biological efficacy of a beneficial microorganism agent after exposure to water (for instance simulated rainfall) vs biological efficacy of said beneficial microorganism agent without exposure to water (for instance simulated rainfall) (control) for a defined treatment with a given beneficial microorganism agent.

According to the invention, the term "precipitation" refers to rainfall, and includes especially moderate rain (20-mm) as well as heavier rain (40-mm). In one embodiment, heavy morning dew may also be considered as falling under the term "precipitation".

The additional agricultural materials

The composition according to the invention may further comprise at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents as described above, nutrients, biostimulants, plant growth regulators, and mixtures thereof.

According to the invention, the additional agricultural material(s) which may be used in the composition, are different from the beneficial microorganism agents.

The composition according to the invention may comprise at least one pesticide different from the beneficial microorganism agents as described above.

For example, these pesticides may be chosen from fungicides, herbicides, insecticides, algicides, moluscicides, miticides, nematicides, and rodenticides.

The skilled worker is familiar with such pesticides, which can be found, for example, in the Pesticide Manual, 16th Ed. (2013), The British Crop Protection Council, London.

If the composition according to the invention comprise one or more additional pesticides different from the beneficial microorganism agents as described above, it is understood that those skilled in the art will choose the pesticide(s) which will not adversely affect the effectiveness of the beneficial microorganism agents.

The composition according to the invention may comprise at least one nutrient.

Nutrients refer to chemical elements and compounds which are desired or necessary to promote or improve plant growth. Nutrients generally are described as macronutrients or micronutrients.

Suitable nutrients for use in the compositions according to the invention may be micronutrient compounds, preferably those which are solid at room temperature (25°C) or are partially soluble.

Micronutrients typically refer to trace metals or trace elements, and are often applied in lower doses. Suitable micronutrients include trace elements selected from zinc, boron, chlorine, copper, iron, molybdenum, and manganese.

The micronutrients may be in a soluble form or included as insoluble solids, and may in the form of salts or chelates. Preferably, the micronutrient is in the form of a carbonate or oxide.

Preferably, the micronutrients may be selected from zinc, calcium, molybdenum or manganese, or magnesium. More preferentially micronutrients for use in the compositions according to the invention may be selected from zinc oxide, manganese carbonate, manganese oxide, or calcium carbonate.

The composition according to the present invention may also comprise at least one macronutrient.

Macronutrients typically refer to those comprising nitrogen, phosphorus, and potassium, and include fertilizers such as ammonium sulphate, and water conditioning agents. Suitable macronutrients include fertilisers and other nitrogen, phosphorus, or sulphur containing compounds, and water conditioning agents.

Suitable fertilisers include inorganic fertilisers that provide nutrients such as nitrogen, phosphorus, potassium or sulphur. Examples of such fertilisers include:

for nitrogen as the nutrient: nitrates and or ammonium salts such as ammonium nitrate, including in combination with urea e.g. as uran type materials, calcium ammonium nitrate, ammonium sulphate nitrate, ammonium phosphates, particularly mono-ammonium phosphate, di-ammonium phosphate and ammonium

polyphosphate, ammonium sulphate, and the less commonly used calcium nitrate, sodium nitrate, potassium nitrate and ammonium chloride;

for phosphorus as the nutrient: acidic forms of phosphorus such as phosphoric, pyrophosphoric or polyphosphoric acids, but more usually salt forms such as ammonium phosphates, particularly mono-ammonium phosphate, di-ammonium phosphate, and ammonium polyphosphate, potassium phosphates, particularly potassium dihydrogen phosphate and potassium polyphosphate;

for sulphur as the nutrient: ammonium sulphate and potassium sulphate, e.g. the mixed sulphate with magnesium.

The composition according to the invention may comprise at least one biostimulant.

The term "biostimulant" is intended to mean a compound which may enhance metabolic or physiological processes such as respiration, photosynthesis, nucleic acid uptake, ion uptake, nutrient delivery, or a combination thereof.

Non-limiting examples of biostimulants include seaweed extracts (e.g., ascophyllum nodosum), humic acids (e.g., potassium humate), fulvic acids, myoinositol, glycine, and combinations thereof.

The composition according to the invention may comprise at least one plant growth regulator.

Plant growth regulators mean active ingredients used to influence the growth characteristics of plants. Examples of plant growth regulators which may be used in the present disclosure include, but are not limited to: 1-naphthaleneacetic acid, 1-naphthaleneacetic acid -salt, 1-napthol, 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4-DB, 2,4-DEP, 2,3,5-triiodobenzoic acid, 2,4,5-trichlorophenoxyacetic acid, 2-naphthoxyacetic acid, 2-naphthoxyacetic acid sodium salt, 3-chloro-4-hydroxyphenylacetic acid, 3-indoleacetic acid, 4-biphenylacetic acid, 4-chlorophenoxyacetic acid (4-CPA), 4-hydroxyphenylacetic acid, 6-benzylaminopurine, auxindole, a-naphthaleneacetic acid K-salt, ß-naphfhoxyacetic acid, p-chlorophenoxyacetic acid, dicamba, dichlorprop, fenoprop, indole-3 -acetic acid (IAA), indole-3 -acetyl-DL-aspartic acid, indole-3 -acetyl-DL-tryptophan, indole-3-acetyl-L-alanine, indole-3 -acetyl-L-valine, indole-3 -butyric acid (IBA), indole-3-butyric acid K-salt, indole-3 -propionic acid; a-naphthaleneacetic acid, methyl indole-3 -acetate, naphthaleneacetamide, naphthaleneacetic acid (NAA), phenylacetic acid, picloram, potassium naphthenate, sodium naphthenate, 4-hydroxyphenethyl alcohol,

4-CPPU, 6-benzylaminopurine (BA), 6-(Y,Y-dimethylallylamino)purine (2iP), 2-iP-2HC1, adenine, adenine hemisulfate, benzyladenine, kinetin, meta-topolin, N6-benzoyladenine, N- benzyl-9-(2-tetrahydropyranyl) adenine (BP A), N-(2-chloro-4-pyridyl)-N-phenylurea, gibberellic acid (GA3), gibberellins, gibberellins A4 + A7 (GA *n),* ethylene and abscisic acid.

Preferably, when the composition according to the invention further comprises at least one additional agricultural material, the amount of additional agricultural material(s) in the composition ranges from 0.01 to 60% by weight, more preferentially from 0.05 to 30% by weight; even more preferentially from 0.1 to 20% by weight; and even better from 1 to 10% by weight, relative to the total weight of the composition.

According to a first embodiment of the invention (concentrated composition), the total content of additional agricultural material(s) in the composition ranges from 1 to 60% by weight, more preferentially from 2 to 30% by weight, and even more preferentially from 5 to 20% by weight, relative to the total weight of the composition according to the invention.

According to a second embodiment of the invention (diluted composition), the total content of additional agricultural material(s) in the composition ranges from 0.01 to 3% by weight, more preferentially from 0.05 to 2% by weight, and even more preferentially from 0.1 to 1% by weight, relative to the total weight of the composition according to the invention.

The composition according to the invention may be in a solid form or in a liquid form.

More particularly, the composition according to the invention may be in the form of a concentrate of beneficial microorganism agent(s) and optionally of additional agricultural material(s), a diluted concentrate, or a sprayable diluted. In particular, the composition according to the invention may be in the form of an oil dispersion (OD), emulsion in water concentrate (EW), suspension concentrate (SC), flowable concentrate for seed treatment (FS), water dispersible granules (WDG), wettable powders (WP) and/or suspoemulsions (SE).

According to a preferred embodiment of the invention, the composition is in a solid form, at 25°C and at atmospheric pressure ($1.013x10^5$ Pa).

According to this embodiment, the composition may be in the form of a powder, a particle, an agglomerate, a flake, a granule, a pellet, a tablet, a brick, a paste, a block such as a molded block, a unit dose, or another solid form known to those of skill in the art. More particularly, the composition may be in the form of a powder or a granule, and more preferentially in the form of water dispersible granules (WDG) or wettable powders (WP).

Advantageously, the granules can include solid support, filler or diluent material(s) which is desirably inert to the agricultural material(s), but which is readily dispersible in water, if necessary, in conjunction with dispersing agents. These materials may also have the benefit of reducing granule dry clumping and the disintegration rate (on addition to water) and can also be used to adjust the agricultural material(s) concentration(s). Examples include clays such as kaolin (china clay) and bentonite clays, which may be natural bentonites or modified e.g. activated bentonites, synthetic and diatomaceous silicas, calcium and magnesium silicates, titanium dioxide, aluminium, calcium or magnesium carbonate, ammonium, sodium, potassium, calcium or barium sulphate, charcoal, starch, including modified starches such as alkyl and carboxyalkyl starches, cellulose, such as microcrystalline cellulose, and cellulose derivatives such as carboxyalkyl cellulose, and mixtures of two or more such solid support, filler, diluent materials.

According to another preferred embodiment of the invention, the composition is in a liquid form, at 25°C and at atmospheric pressure (1.013×10^5 Pa).

According to this embodiment, the composition may be in the form of a suspension, a dispersion, a slurry, a solution in a liquid carrier selected from water, organic solvents, oils or a mixture thereof. More particularly, the composition may be in the form of a suspension concentrate (SC), a flowable concentrate for seed treatment (FS) or an oil dispersion (OD)

According to this embodiment, the composition may further comprise at least one carrier, which is not a solvent of the glyoxal-modified polysaccharide(s).

In particular, the composition according to the invention may be in the form of a dispersion in at least one carrier (which is not a solvent of the glyoxal-modified polysaccharide(s)), and more preferentially in the form of an oil dispersion.

The carrier(s) may be chosen from oils of animal or vegetable origin, esters of fatty acids and/or hydrocarbonated oils. The oils of animal origin that may be mentioned include, amongst others, sperm whale, dolphin, whale, seal, sardine, herring, dogfish, and cod liver oil. As examples of oils of vegetable origin, the

following, amongst others, may be mentioned: rape-seed, sunflower, ground-nut, olive, walnut, maize, soya, linseed, hemp, grapeseed, copra, palm, cotton-seed, babassu, jojoba, sesame, castor and coriander oil. It is also possible to utilize saturated or non-saturated fatty acid esters, comprising, for the acid part, 6 to 40 carbon atoms, optionally carrying one or more hydroxylated groups. Examples of fatty acids that can be mentioned in particular include oleic, myristoleic, palmitoleic, petroselenic, erucic, linoleic, linolenic and ricinoleic acid. The methyl, ethyl and propyl esters of these acids are particularly suitable. More particularly, mention may be made of the products of alcoholysis, or to be more precise, methanolysis of the oils. It is also possible to utilize aliphatic hydrocarbonated paraffin-type or aromatic oils (petroleum fractions etc.).

Mention may also be mase to a fatty acid (C1-C3)alkyl ester component, comprising one or more of methyl, ethyl, or propyl hexanoate, methyl, ethyl, or propyl heptanoate, methyl, ethyl, or propyl octanoate, methyl, ethyl, or propyl nonanoate, methyl, ethyl, or propyl decanoate, methyl, ethyl, or propyl undecanoate, methyl, ethyl, or propyl dodecanoate, methyl, ethyl, or propyl tridecanoate, methyl, ethyl, or propyl tetradecanoate, methyl, ethyl, or propyl pentadecanoate, methyl, ethyl, or propyl hexadecanoate, methyl, ethyl, or propyl heptadecanoate, methyl, ethyl, or propyl octadecanoate, methyl, ethyl, or propyl nonadecanoate, methyl, ethyl, or propyl eicosanoate, methyl, ethyl, or propyl docosanoate, methyl, ethyl, or propyl tricosanoate, methyl, ethyl, or propyl tetracosanoate, methyl, ethyl, or propyl cis- 9-hexadecenoate, methyl, ethyl, or propyl all cis-7,10,13-hexadecatrienoate methyl, ethyl, or propyl cis-6-octadecenoate, methyl, ethyl, or propyl trans-6-octadecenoate, methyl, ethyl, or propyl cis-7-octadecenoate, methyl, ethyl, or propyl cis-9-octadecenoate, methyl, ethyl, or propyl frans-9-octadecenoate, methyl, ethyl, or propyl cis-1 1 -octadecenoate, methyl, ethyl, or propyl trans- - octadecenoate, methyl, ethyl, or propyl cis-12-octadecenoate, methyl, ethyl, or propyl cis, cis-9, 12-octadecedienoate, methyl, ethyl, or propyl frans-9,12- octadecedienoate, methyl, ethyl, or propyl all cis-6,9,12-octadecatrienoate, methyl, ethyl, or propyl ester all cis-9,12,15-octadecatrienoate, methyl, ethyl, or propyl all cis-6,9,12,15,-octadecatetraenoate, methyl, ethyl, or propyl cis-1 1 - eicosenoate, methyl, ethyl, or propyl cis, cis-1 1 ,14-eicosadienoate, methyl, ethyl, or propyl all cis-1 1 ,14,17-eicosatrienoate, methyl, ethyl, or propyl all cis- 5,8,1 1 ,14-eicosatetraenoate, methyl, ethyl, or propyl all cis-8,1 1 ,14,17- eicosatetraenoate, methyl, ethyl, or propyl all cis-5,8,1 1 ,14,17-eicosapentaenoate, methyl, ethyl, or propyl cis-13-docosenoate, methyl, ethyl, or propyl cis, cis-13,16-docosadienoate, methyl, ethyl, or propyl all cis-6,9,12-octadecatrienoate, methyl, ethyl, or propyl all cis-7,10, 13,16-docosatetraenoate,

methyl, ethyl, or propyl all cis-7,10,13,16,19-docosapentaenoate, methyl, ethyl, or propyl all cis-4,7,10,13,16,19-docosahexaenoate, methyl, ethyl, or propyl cis-15-tetracosenoate methyl, ethyl, or propyl all cis-9, 12,15,18,21 - tetracosapentaenoate, methyl, ethyl, or propyl all cis-6,9,12,15,18,21 - tetracosahexaenoate, including mixtures two or more of any of such fatty acid (C1-C3)alkyl esters. More typically, the fatty acid (C1-C3)alkyl ester component of the composition of the present invention comprises a mixture of two or more of such fatty acid (C1-C3)alkyl esters, in the form of one or more (C1-C3)alkyl esters of one or more vegetable oils, more typically, a methylated vegetable oil, even more typically, methylated soybean oil or methylated rapeseed oil.

Preferably, when the composition according to the invention comprises at least one carrier (which is not a solvent of the glyoxal-modified polysaccharide(s)), the carrier(s) are chosen from water, (C_1-C_8) monoalcohols such as ethanol or isopropanol, (C_2-C_8) polyols such as ethylene glycol or propylene glycol, 1,2-propylene glycol monomethyl ether, 2-pyrrolidone, an aliphatic carboxylic acid alkyl ester, cyclohexanone, di- and triglycols, diacetone alcohol, dialkyl ketone, diethylene glycol, DMSO, ethyl acetate, furfuryl alcohol, gamma-butyrolactone, glycofurol, a glycol ether, phosphoric acid esters, polyethylene glycols, polyhydroxylated alkanes, propylene glycol, pyrrolidine, pyrrolidine, sulfolane, thiodiglycol, triethylene glycol, dibasic esters, dioxolanes, ester-amides or diamides, alkyldimethylamides, alkyl lactates, glycerine or glycerine derivatives (for example chosen among glyceric acid, tartronic acid, glycerol tertiary butyl ether, polyglycerol, glycerol ester and glycerol carbonate), alkylene carbonates, alkyoxyalcohols, ether alcohols, dialkyl alcoholamines, amine alcohols, amino alcohols, and mixtures thereof.

More preferentially, the carrier(s) are chosen from water, (C_1-C_8) monoalcohols such as ethanol or isopropanol, (C_2-C_8) polyols such as ethylene glycol, 1,3-butylene glycol or propylene glycol, dibasic esters, dioxolanes, ester-amides or diamides, alkyldimethylamides, alkyl lactates, glycerine or glycerine derivatives, alkylene carbonates, alkyoxyalcohols, ether alcohols, dialkyl alcoholamines, amine alcohols, amino alcohols, and mixtures thereof.

According to one embodiment of the invention, the composition according to the invention is aqueous.

More preferentially, the water content of the composition ranges from 5% to 99% by weight, more preferentially from 20% to 95% by weight, even more

preferentially from 25% to 90% by weight, better from 25 to 85% by weight, better still from 25 to 70% by weight, relative to the total weight of the composition.

According to a preferred embodiment of the invention, the composition is an aqueous suspension having a concentration of greater than 0.01 g/L of beneficial microorganism agent(s).

According to a particular embodiment of the invention, the composition is in a liquid form, at 25°C and at atmospheric pressure ($1.013x10^5$ Pa), and comprise the glyoxal-modified polysaccharide(s) in the form of an incompletely hydrated water soluble polymer suspended in an aqueous liquid medium, with said composition preferably further containing a suspending agent in an amount effective to impart shear thinning properties and yield strength to the composition, and optionally an hydration inhibitor.

According to another particular embodiment of the invention, the composition is in a liquid form, at 25°C and at atmospheric pressure ($1.013x10^5$ Pa), and further comprises at least one chemical salt compound having (1) at least one cation selected from the group consisting of aluminum, calcium, copper, iron, magnesium, potassium, sodium, and zinc, and (2) at least one anion selected from the group consisting of acetates, bromides, carbonates, chlorides, chlorites, chromates, citrates, condensed phosphates, cyanates, dihydrogen phosphates, dihydrogen phosphates, fluorides, formates, hydrogen carbonates, bicarbonates, hydrogen phosphate, hydrogen phosphites, hydrogen sulfites, hydrogen bisulfites, hypochlorites, hypophosphites, nitrates, nitrites, orthophosphates, oxalates, phosphates, phosphides, phosphonates, pyrophosphates, salicylates, silicates, sulfates, sulfides, sulfites, thiocyanates, and thiosulfates, wherein the stabilizer is preferably sodium sulfate, sodium chloride, potassium chloride or zinc sulfate.

According to another particular embodiment of the invention, the composition is in a liquid form, at 25°C and at atmospheric pressure ($1.013x10^5$ Pa), and further comprises at least one rheological agent, bringing suspension properties or anti-settling properties, such as precipitated or fumed silica, clays including bentonite, laponites, kaolinite, dickite, and nacrite, with the general formula of $Al_2Si_2O_5(OH)_4$; pyrophylite, talc, vermiculite, sauconite, saponite, nontronite, and montmorillonite with the general chemical formula (Ca, Na, H)(Al, Mg, Fe, Zn)$_2$(Si, Al)$_4O_{10}(OH)_2.xH_2O$; attapulgite with the general chemical formula $Mg_5Si_8O_{20}(HO)_2(OH_2)_4.4H_2O$; and illite with the

general formula (K, H)Al_2(Si, Al)$_4O_{10}(OH)_2.xH_2O$, and organically modified montmorillonite clays phyllosilicates, such as attapulgite and bentonite, fumed alumina.

Advantageously, when used, the rheological agent may be present in the range from 0.1 to 25% by weight, preferably from 0.5 to 10% by weight and more preferably from 0.5 to 8 % by weight.

According to another particular embodiment of the invention, the composition may further comprise at least one surfactant.

The suitable surfactants that may be used according to the invention are different from the glyoxal-modified polysaccharides as described above.

Suitable surfactants are chosen from emulsifiers, dispersants or wetting agents having ionic or nonionic properties, or mixtures of these surfactants. Examples of these are salts of polyacrylic acid, salts of lignosulphonic acid, salts of phenolsulphonic acid or naphthalenesulphonic acid, polycondensates of ethylene oxide with fatty alcohols or with fatty acids or with fatty amines, substituted phenols (preferably alkylphenols or arylphenols), salts of sulphosuccinic esters, taurine derivatives (preferably alkyl taurates), phosphoric esters of polyethoxylated alcohols or phenols, fatty esters of polyols, and derivatives of the compounds containing sulphates, sulphonates and phosphates. The proportion of surfactants may be between 1 and 40% by weight relative to the total weight of the composition.

According to a particular first embodiment of the invention (concentrated liquid composition), the composition according to the invention is in a liquid form and the viscosity of the composition, measured at 20 rpm using a Brookfield RV viscometer at 25°C and at atmospheric pressure ($1.013x10^5$ Pa), ranges from 500 mPa.s to 5 000 mPa.s; more preferentially from 700 to 3 000 mPa.s; even more preferentially from 700 to 2 000 mPa.s.

According to a second embodiment of the invention (diluted composition), the composition according to the invention is in a liquid form and the viscosity of the composition, measured at 20 rpm using a Brookfield RV viscometer at 25°C and at atmospheric pressure ($1.013x10^5$ Pa), is less than 500 mPa.s; more preferentially less than 300 mPa.s; and even better less than 150 mPa.s.

When the composition according to the invention is aqueous, the pH preferably ranges from 1 to 11, and more preferentially from 2.5 to 9.5.

The pH of the compositions can be adjusted to the desired value by means of basifying agents or acidifying agents. Use may be made, among the basifying agents, of one or more alkaline agents, such as ammonia, sodium hydroxide or ethanolamine. Mention may be made, by way of examples, among the acidifying agents, of inorganic or organic acids, such as hydrochloric acid or orthophosphoric acid.

The composition according to the invention may further contains additives different from the ingredients described previously, such as binders, diluents, absorbents, stabilizers, dispersants different from those described previously, disintegration agents, wetting agents, antifoam agents, antifreeze agents, dyes and pigments, water-repellents, UV-stabilizers, adjuvants, fillers, viscosity modifiers, penetrants, sequestering agents and/or preservatives.

Each additive can be present in the composition according to the invention in an amount ranging from 0% to 20% by weight, preferably from 0% to 10% by weight, more preferably from 0.5% to 9% by weight, for instance from 1% to 7% by weight, relative to the total weight of the composition.

A person skilled in the art will be able to choose these optional additives and their amounts so that they do not harm the properties of the compositions of the present invention.

According to a preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from bacterial spores, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum,

(iii) optionally at least one guar gum, and

(iv) optionally at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a first variant of this preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from bacterial spores, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a second variant of this preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from bacterial spores, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum, and

(iv) at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to another preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from *bacillus subtilis, bacillus amyloliquefaciens, bacillus velezensis, bacillus thuringiensis*, and mixtures thereof, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum,

(iii) optionally at least one guar gum, and

(iv) optionally at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof, and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a first variant of this other preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from *bacillus subtilis, bacillus amyloliquefaciens, bacillus velezensis, bacillus thuringiensis*, and mixtures thereof, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a second variant of this other preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from *bacillus subtilis, bacillus amyloliquefaciens, bacillus velezensis, bacillus thuringiensis*, and mixtures thereof, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum, and

(iv) at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to another preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from fungal spores, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum,

(iii) optionally at least one guar gum, and

(iv) optionally at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a first variant of this other preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from fungal spores, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a second variant of this other preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from fungal spores, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum, and

(iv) at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to another preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from *Beauveria Bassiana, Trichoderma, Paecilomyces lilacinus*, and mixtures thereof, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum,

(iii) optionally at least one guar gum, and

(iv) optionally at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof, and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a first version of this other preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from *Beauveria Bassiana, Trichoderma, Paecilomyces lilacinus*, and mixtures thereof, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

According to a second variant of this preferred embodiment of the invention, the composition comprises:

(i) at least one beneficial microorganism agent chosen from *Beauveria Bassiana, Trichoderma, Paecilomyces lilacinus*, and mixtures thereof, and

(ii) at least one glyoxal-modified polysaccharide, preferably glyoxal-modified xanthan gum, and

(iii) at least one guar gum, and

(iv) at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof; and

wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

The invention also relates to a method for preparing a composition (M), comprising at least:

- a step of preparing at least one glyoxal-modified polysaccharide resulting from the mixture of glyoxal and of at least one polysaccharide; then
- a step of mixing said glyoxal-modified polysaccharide with at least one beneficial microorganism agent as described previously (and optionally at least one guar gum and/or at least one additional agricultural material as described previously), so that the weight ratio of the total content of beneficial microorganism agent(s) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

Preferably, the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.05 to 20; more preferably from 0.1 to 20; more preferably from 0.5 to 10; more preferentially from 1 to 9; even more preferentially from 2 to 8; and even better from 3 to 7.

The step of preparing said glyoxal-modified polysaccharide has been already described in various applications, for example in US 2002/0038019 and US 4041234.

The invention also relates to the use in a composition comprising at least one beneficial microorganism agent, of at least one glyoxal-modified polysaccharide so that the weight ratio of the total content of beneficial microorganism agent(s) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20, for improving the homogeneity of dispersion of the beneficial microorganism agent(s) present in the composition.

The invention also relates to a method for treating soils, plants and/or seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils, by applying the composition according to the invention as described previously to at least one plant, area adjacent to a plant, soil adapted to support growth of a plant, root of a plant, foliage of a plant, and/or seed adapted to produce a plant.

The invention also advantageously relates to a method for treating soils, plants and/or seeds to control pests, to regulate the growth of plants, to induce the defense response in plants and to enhance metabolic and physiological processes within plants and soils, by applying the composition according to the invention as described previously to at least one plant, area adjacent to a plant, soil adapted to support growth of a plant, root of a plant, foliage of a plant, and/or seed adapted to produce a plant.

The application of the composition according to the invention may kill or inhibit pests and/or clean and/or inhibit growth of undesired plants.

The composition according to the invention can be diluted and applied to at least one plant, area adjacent to a plant, soil adapted to support growth of a plant, root of a plant, foliage of a plant, and/or seed adapted to produce a plant, in a customary manner; for example, by watering (drenching), drip irrigation, spraying, and/or atomizing.

The invention is also the use of the composition according to the invention, for the treatment of soils, plants and/or seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils.

The invention is also advantageously the use of the composition according to the invention, for the treatment of soils, plants and/or seeds to control pests, to regulate the growth of plants, to induce the defense response in plants and to enhance metabolic and physiological processes within plants and soils.

In the above description, all the preferred embodiments with regard to the components may be used individually or in combination.

The examples that follow serve to illustrate the invention.

Examples:

Example 1:

Two blends with *Bacillus Thuringiensis*, glyoxal-modified xanthan gum and guar were prepared and characterized to assess the dispersant performances. In Table 1 are detailed the formulations studied. In the table below, the amounts of ingredients are in gram % of raw material.

Table 1:

Ingredient	**Blend 1**	**Blend 2**
Delfin® from Certis (*Product as is containing 32 000 UI/mg of Bacillus thuringiensis sp. kurstaki strain SA-11 (i.e. 85%$_{wt}$ of Bacillus thuringiensis)*)	75	78
Glyoxal-modified xanthan gum (Rhodopol 50 MD® from Solvay)	15	11
Guar gum	10	11

The blends were then diluted with water, so as to obtain a concentration of about 0.5% by weight of *Bacillus Thuringiensis*, 0.07% (for Blend 2) and 0.1% (for Blend 1) by weight of glyoxal-modified xanthan gum and 0.07% by weight of guar gum, relative to the total weight the blend.

The dispersant performances of the 2 blends were then evaluated visually 30 minutes after dilution, 2 hours after and 24 hours after, compared to a control (0.5%wt *Bacillus Thuringiensis* alone).

24 hours after dilution, the blends and the control were redispersed by turning over by hand, the tubes containing the solutions.

Then, the dispersant performances of the 2 blends were also evaluated visually 30 minutes after redispersion, compared to a control (0.5%wt *Bacillus Thuringiensis* alone).

The results are summarized in the Table 2 below.

Table 2:

Evaluation	Control	Blend 1	Blend 2
30 minutes after dilution	Presence of settlings at the bottom of the test tube	Good homogeneous suspension – No settlings	Good homogeneous suspension – No settlings
2 hours after dilution	Most of the *Bacillus Thuringiensis* is at the bottom of the test tube	Good homogeneous suspension – No settlings	Satisfactory suspension – No settlings
24 hours after dilution	All of the *Bacillus Thuringiensis* is at the bottom of the test tube – no suspension at all	Satisfactory suspension – No settlings	Satisfactory suspension – No settlings
24 hours after dilution + 30 minutes after redispersion	Presence of settlings at the bottom of the test tube	Good homogeneous suspension – No settlings	Good homogeneous suspension – No settlings

It is noted that the compositions according to the invention showed a good viscosity. In particular, even if the suspensions (blends 1 and 2) become a little less homogeneous at 2 hours after dilution (for blend 2) and at 24 hours after dilution (for blend 1), the *Bacillus Thuringiensis* remain in suspension and are not found at the bottom of the test tube.

Example 2:

Two aqueous compositions with *Bacillus Subtilis* and glyoxal-modified xanthan gum were prepared and characterized to assess the dispersant performances. In Table 3 are detailed the formulations studied. In the table below, the amounts of ingredients are in gram % of raw material.

Table 3:

Ingredient	**Composition 3 (Invention)**	**Composition 4 (Comparative)**
Rhapsody® from Bayer (*Product as is containing 1x10^9 CFU/g of Bacillus Subtilis QST713 (i.e. 1.34%wt of Bacillus Subtilis)*)	1	1
Glyoxal-modified Xanthan gum (Rhodopol 50 MD® from Solvay)	0.05	
Natural Xanthan gum - *non-modified* (Rhodopol 23® from Solvay)		0.05
Water	Qs 100	Qs 100

The dispersant performances of the composition 3 according to the invention and the comparative composition 4 were then evaluated visually 30 minutes after mixing of the ingredients, 2 hours after and 24 hours after, compared to a control (only 1%$_{wt}$ of Rhapsody® from Bayer in water).

The results are summarized in the Table 4 below.

Table 4:

Evaluation	**Control**	**Comp. 3 (Inv.)**	**Comp. 4 (Comp.)**
30 minutes after	Presence of settlings at the bottom of the test tube	Homogeneous blend – No settlings	Homogeneous blend – No settlings
2 hours after	A large quantity of the *Bacillus Subtilis* is at the bottom of the test tube	Homogeneous blend – No settlings	Presence of settlings at the bottom of the test tube
24 hours after	Almost all of the *Bacillus Subtilis* is at the bottom of the test tube	Homogeneous blend – No settlings	A large quantity of the *Bacillus Subtilis* is at the bottom of the test tube

It is noted that, compared to the control, compositions 3 and 4 have enhanced dispersion stability. However, it is observed that besides a remarkable ease of dispersion, the composition 3 according to the invention, containing glyoxal-modified xanthan gum, also shows a superior suspending power over time compared to the comparative composition 4, containing non-modified xanthan gum.

Example 3:

Two aqueous compositions with *Bacillus Thuringiensis* and glyoxal-modified xanthan gum were prepared and characterized to assess the dispersant performances. In Table 5 are detailed the formulations studied. In the table below, the amounts of ingredients are in gram % of raw material.

Table 5:

Ingredient	**Composition 5 (Invention)**	**Composition 6 (Comparative)**
Delfin® from Certis (*Product as is containing 32 000 UI/mg of Bacillus thuringiensis sp. kurstaki strain SA-11 (i.e. 85%$_{wt}$ of Bacillus thuringiensis)*)	0.5	0.5
Glyoxal-modified Xanthan gum (Rhodopol 50 MD® from Solvay)	0.1	
Natural Xanthan gum - *non-modified* (Rhodopol 23® from Solvay)		0.1
Water	Qs 100	Qs 100

The dispersant performances of the composition 5 according to the invention and the comparative composition 6 were then evaluated visually 30 minutes after mixing of the ingredients, 2 hours after and 24 hours after, compared to a control (only 0.5%$_{wt}$ of Delfin® from Certis in water).

The results are summarized in the Table 6 below.

Table 6:

Evaluation	Control	Comp. 5 (Inv.)	Comp. 6 (Comp.)
30 min. after	A large quantity of the *Bacillus Thuringiensis* is at the bottom of the test tube	Homogeneous blend – No settlings	Homogeneous blend – No settlings
2 hours after	A large quantity of the *Bacillus Thuringiensis* is at the bottom of the test tube	Homogeneous blend – No settlings	Presence of settlings at the bottom of the test tube
24 hours after	Almost all of the *Bacillus Thuringiensis* is at the bottom of the test tube	Homogeneous blend – No settlings	A layer of the *Bacillus Thuringiensis* is at the bottom of the test tube

It is noted that, compared to the control, compositions 5 and 6 have enhanced dispersion stability. However, it is observed that besides a remarkable ease of dispersion, the composition 5 according to the invention, containing glyoxal-modified xanthan gum, also shows a superior suspending power over time compared to the comparative composition 6, containing non-modified xanthan gum.

Example 4:

Studies were carried out to evaluate the biocompatibility of glyoxal-modified polysaccharides and beneficial microorganism agents.

4.1 The growth curves of *Bacillus Thuringiensis* in presence or absence of glyoxal-modified xanthan gum at 0.05% by weight were determined via a classic colony counting method.

The microorganism *Bacillus thuringiensis* CCT 2335 used for biocompatibility test was obtained from Tropical Culture Collection in André Tosello Foundation – Brazil and was stored at -80°C in the nutrient broth (NB) culture media, containing 15% of glycerol.

For colony counting trials, the microorganisms were reactivated by adding 1mL of the frozen stock culture into 100mL of NB media and incubating the culture at 30°C, 150

rpm for 72 hours. Then, 10 mL of the reactivation media were transferred into a 250 mL Erlenmeyer flask containing 100mL of the same media, with the addition of 0.05% of Rhodopol 23® or Rhodopol 50MD® and incubated at 30°C, 150 rpm, for 96 hours. A control experiment without xanthan gum addition was performed. Samples of 1mL of each flask were taken after 0h, 24h, 48h and 72h of incubation for viability measurements. Serial dilutions of these samples were performed and the dilutions plated in solid NB media ($1x10^{-5}$ up to $1x10^{-8}$). The plates were incubated at 30°C until appearance of colonies. After incubation, the number of colonies present in each dilution was counted and used to evaluate bacterial growth.

For bacterial growth rate determination, a graph of the log10(number of colonies) versus time of incubation was constructed. The straight line in this graph represents the exponential phase of bacterial growth and the angular coefficient represents the bacterial growth rate (μ).

It has been noticed that glyoxal-modified xanthan gum showed no inhibition effect on the bacteria growth.

4.2 The growth behaviour of commercial *Bacillus Subtilis* broth (Rhapsody SC®) in presence or absence of glyoxal-modified xanthan gum at 0.05% and 0.1% by weight were determined via absorbance reading at 600nm (OD_{600}).

In such experiment, 200μL of culture broths containing Rhapsody SC® at $1\%_{v/v}$, in presence or absence of 0.05% and 0.1% of glyoxal-modified xanthan gum, were distributed into a 96-well microplate. The obtained micro assay was then incubated at 20°C under 200rpm agitation speed for 24 hours, before a pre-selected Tryptic Soy Broth (TSB) culture medium was introduced into each well at the concentration of 15g/L. The incubation then continues for another 24 hours, reaching a total incubation time of 48 hours. At each time interval, the micro assay was put under the OD_{600} scanner to read the absorbance value of each well sample, which is a commonly used Spectrophotometry for estimating the concentration of bacteria or other cells in a liquid as the 600nm wavelength does little to damage or hinder their growth.

An inhibition value (%) was calculated as the absorbance reduction percentage of a formulation compared to the control (only Rhapsody dilution in nutrition water, without other additive). A threshold of inhibition value = 20% was used as the cut-off in the decision tree.

It has been noticed that glyoxal-modified xanthan gum has an inhibition value close to 0 (and an almost significant negative value of ~ -20% at 0.1% by weight implying an eventual boosting effect), thus showing no inhibition effect on the bacteria growth.

CLAIMS

1. Composition comprising:
(i) at least one beneficial microorganism agent, and
(ii) at least one glyoxal-modified polysaccharide,
wherein the weight ratio of the total content of beneficial microorganism agent(s) (i) to the total content of glyoxal-modified polysaccharide(s) (ii) ranges from 0.01 to 20.

2. Composition according to the preceding claim, wherein the beneficial microorganism agent is chosen from fungal spores, bacterial spores, and mixtures thereof; preferably from bacterial spores.

3. Composition according to any one of the preceding claims, wherein the beneficial microorganism agent is chosen from *bacillus subtilis, bacillus amyloliquefaciens, bacillus velezensis, bacillus thuringiensis, Beauveria Bassiana, Trichoderma, Paecilomyces lilacinus*, and mixtures thereof.

4. Composition according to any one of the preceding claims, wherein the total content of beneficial microorganism agent(s) ranges from 0.01 to 95 % by weight, preferably from 0.05 to 92% by weight, more preferentially from 0.07 to 90 % by weight; and even more preferentially from 0.1 to 90 % by weight, relative to the total weight of the composition.

5. Composition according to any one of the preceding claims, wherein the glyoxal-modified polysaccharide contains from 0.02 to 5% by weight of glyoxal with regard to the weight of polysaccharide alone.

6. Composition according to any one of the preceding claims, wherein the glyoxal-modified polysaccharide is chosen from glyoxal-modified carrageenans, glyoxal-modified furcellerans, glyoxal-modified xanthan gum, glyoxal-modified succinoglycan gum, glyoxal-modified gellan gum, glyoxal-modified scleroglucan gum, glyoxal-modified caesalpinia spinosa gum, glyoxal-modified cassia gum, glyoxal-modified ceratonia siliqua gum, glyoxal-modified tamarindus polysaccharide, and mixtures thereof; preferably from glyoxal-modified xanthan gum, glyoxal-

modified succinoglycan gum, glyoxal-modified gellan gum, glyoxal-modified scleroglucan gum, and mixtures thereof.

7. Composition according to the preceding claim, wherein the glyoxal-modified polysaccharide is glyoxal-modified xanthan gum.

8. Composition according to any one of the preceding claims, wherein the total content of glyoxal-modified polysaccharide(s) ranges from 0.01 to 40% by weight, preferably from 0.02 to 20% by weight, more preferentially from 0.05 to 10% by weight, and even more preferentially from 0.05 to 5% by weight, relative to the total weight of the composition according to the invention.

9. Composition according to any one of the preceding claims, characterized in that the weight ratio of the total content of beneficial microorganism agent(s) to the total content of glyoxal-modified polysaccharide(s) ranges from 0.05 to 20; preferably from 0.1 to 20; more preferentially from 0.5 to 10; even more preferentially from 1 to 9; even better from 2 to 8; and better still from 3 to 7.

10. Composition according to any one of the preceding claims, further comprising at least one guar gum.

11. Composition according to any one of the preceding claims, further comprising at least one additional agricultural material chosen from pesticides different from the beneficial microorganism agents, nutrients, biostimulants, plant growth regulators, and mixtures thereof.

12. Composition according to any one of the preceding claims, characterized in that the composition is in a liquid form and contains at least one carrier.

13. Method for preparing a composition (M), comprising at least:

- a step of preparing at least one glyoxal-modified polysaccharide resulting from the mixture of glyoxal and of at least one polysaccharide; then
- a step of mixing said glyoxal-modified polysaccharide with at least one beneficial microorganism agent, so that the weight ratio of the total content of beneficial microorganism agent(s) to the total content of glyoxal-modified polysaccharide(s) ranges from 0.01 to 20.

14. Use, in a composition comprising at least one beneficial microorganism agent, of at least one glyoxal-modified polysaccharide so that the weight ratio of the total content of beneficial microorganism agent(s) to the total content of glyoxal-modified polysaccharide(s) ranges from 0.01 to 20, for improving the homogeneity of dispersion of the beneficial microorganism agent(s) present in said composition.

15. Use according to the preceding claim, characterized in that the glyoxal-modified polysaccharide is glyoxal-modified xanthan gum.

16. Use of the composition as defined in any one of claims 1 to 12 for the treatment of soils, plants and/or seeds to control pests and/or to regulate the growth of plants and/or to induce the defense response in plants and/or to enhance metabolic and physiological processes within plants and soils.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2022/083136

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01N63/23 A01P15/00 A01N63/22 A01N25/04 A01N25/30
ADD.

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

B. FIELDS SEARCHED

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2021/022128 A1 (BIOWISH TECH INC [US]) 4 February 2021 (2021-02-04)	1-9, 11-16
A	paragraphs [0134] - [0135]; example 6	10
X	US 2017/360047 A1 (GU GEORGE [US] ET AL) 21 December 2017 (2017-12-21) paragraph [0051]; example 1	1-9,12, 16
X	JP H05 51305 A (SUMITOMO CHEMICAL CO) 2 March 1993 (1993-03-02)	1-9, 11-16
A	paragraph [0036]; example 3	10
A	US 4 363 669 A (COTTRELL IAN W ET AL) 14 December 1982 (1982-12-14) columns 5-6; example 3	10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 February 2023	13/02/2023

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1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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