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(54) Title: CULTURE MEDIUM

(57) Abstract: The invention relates to a culture medium that is suitable for growing plants and growing plants and taht comprises a filler and a polymer. The culture medium is characterised in that it is comprided of a polymerised mixture containing a biologically degradable polymer and the filler. To this polymerisable agent and the filler are mixed together and then polymerised. As biologically degradable polymers it is possible to use, for example, polylactic acid, starch and other substances. The culture medium preferably comprises a foamed polymer, which improves the ability to absorb water. The invention also relates to a method for the production of such a culture medium and to a container into which the culture medium can be put for growing plants.

Culture medium

The present invention relates to a culture medium that is suitable for growing plants, and which comprises a filler and a polymer. The invention also relates to a method for the production of such a culture medium. The invention also relates to a container for a culture medium according to the invention.

A culture medium as mentioned in the preamble is known in the art. This culture medium may consist, for example, of a compost or another suitable organic material, in which a seed can germinate or a plant can grow. Often the culture medium is to some extent solid, that is to say that it has a structure so as to allow a plant to grow roots therein. Culture media are currently available on the market in pot form, wherein a covering holds together a quantity of peat. So-called foam plugs are also known, the peat being contained by means of a foam matrix. The disadvantage of these known embodiments is that the auxiliary substances are not completely degradable. In addition, the auxiliary substance produces a mechanical resistance hindering the roots from growing properly.

The object is to alleviate the above mentioned problems. A particular object is to provide a culture medium that is completely biologically degradable and that does not impede the plant's growth.

According to the invention the above mentioned problems are solved by the fact that the culture medium as mentioned in the preamble is comprised of a polymerised mixture of a biologically degradable polymerisable medium and the filler. In this way the filler, which serves as culture bed is contained by the polymer matrix, thereby providing a very coherent composition during the growing period. After use the medium can be re-used as biological material.

According to a preferred embodiment, the biologically degradable polymer is comprised of a foamed polymer.

To this end a foaming agent may be added to the mixture to provide an open structure in the polymer matrix. This may improve the absorption and retention of water in the mixture, which may be improved further by adding a wetting agent.

According to a preferred embodiment, the culture medium comprises 1 - 90 % by vol. of polymer, 2 - 98 % by vol. of filler, 1 - 80 % by vol. of foaming agent and optionally 0.001 - 20 % by vol. of wetting agent. This provides a widely applicable range of suitable culture medium.

According to a further embodiment the culture medium according to the invention may be used in the form of a granulate. In that case the culture medium may be used as soil improvement agent. To this end it may optionally be mixed in with other substrates to obtain desirable characteristics and to be passed on to the soil.

For growing plants, the culture medium may be put into containers. Such containers comprise a plurality of hollows into which a quantity of medium may be put. For example, the medium may have a form and size so as to exactly fill a hollow. Such plugs may, for example, be cylindrical. Common diameters are 13 mm, 20 mm, 28 mm, 40 mm and 50 mm. The length is variable.

It is also possible to embody the culture medium as a mat, allowing several plants to grow in the culture medium.

By mixing the biologically degradable polymers, the fillers and optionally the thickening agents, the foaming agents (e.g. thermic leavening agents) and the surfactant (wetting agents) in a specific mixing ratios in an extruder, the influence of temperature and a limited amount of water, will yield a mixture, which when leaving the extruder will provide a foamed substrate. Depending on the mixing ratios of the components, the foam effect obtained in the substrate will be more or less, and depending on the outflow diameter of the extruder and the pressure in the extruder, either a thick or thin substrate strand will be produced. The amounts required for a par-

ticular final product may be determined by trial.

The biologically degradable polymer may be any known polymer not producing harmful substances during decomposition. A choice may be made from, for example:

1) biologically degradable polyesters such as statistic, aliphatic-aromatic copolyesters that are based on the different monomers of butanediol, adipic acid and terephthalic acid;

2) polylactic acid compounds, among which the A and the D variant;

3) polyhydroxybutyrate (PHB) compounds and polyhydroxyalkanoate (PHA) compounds; and

4) the starch compounds.

For example, and preferably, a biologically degradable polymer of synthetic origin or a biologically degradable polymer of renewable origin (of the group 2, 3 and 4 above, for example biopolymer) may be used. The above mentioned polymers, separately or combined with each other, may give the foam result mentioned. By means of varying the combinations it is possible to regulate for example the degradation time, the ability to absorb water and the hardness of the substrate.

The filler may be chosen from substances known in the art such as for example peat, compost, clay, soil, coconut fibres, coconut granulate, hemp fibres, grass fibres, straw, sawdust, coffee dregs, residue from the cattle feed industry or from the paper industry.

The method for the production of the culture medium comprises mixing together a polymerisable agent and a filler, wherein according to the invention the polymer obtained is a biologically degradable polymer, and the polymerisation takes place after mixing the polymerisable agent and the filler. In this way a culture medium is obtained in which the filler is distributed through the polymer mould. Preferably also a foaming agent is added to endow the culture medium with improved characteristics, as mentioned above.

The foaming process may be enhanced by the addition of a leavening agent, for example, a thermic leaven-

ing agent such as bicarbonate.

The type of polymer and the amount as well as the mixing ratio of the bio polymers and synthetic polymers, as well as the type and the amount of filler, determine together with the type and the amount of foaming agent, not only the degree of foaming but also other specific characteristics, such as the absorption of water and the rate of biological degradation. Thus this rate of degradation can be regulated and can be adapted for each desired culture application.

The rate of the substrate's absorption of water may be influenced by the addition of a surfactant such as a generally known wetting agent. Larger quantities of this agent will increase the rate of the substrate's water absorption.

The container for the culture medium as mentioned above is produced, in accordance with the invention, from a biologically degradable polymer. This may be produced in the same manner as the culture medium. The substrate is directly injected (warm or cold) from the extruder into a mould after which the mould is pressed. It preferably also comprises a foaming agent and an organic filler. According to a particular preferred embodiment, the container is produced by using a preferably biologically degradable, water-repellent agent (hydrophobic agent, such as organo-modified siloxanes) in the mixture. For example, the biologically degradable polymer may be an at least partly water repellent polymer. In this way the container will not absorb water. Ingrowth of roots will to a certain extent be prevented. According to a further preferred embodiment, the container has a closed structure, for example, surface structure, such that it is not possible for the roots to grow into it.

Under the influence of temperature, moisture and organisms in the soil, the polymer is degraded into the end products CO_2 and H_2O, and biomass. The degradation products must not contain any components that are harmful to plants.

The filler may be any substance known in the art

in the form of granules, fibres or powder that is organic and not harmful to the environment. In particular said substance may not contain any components that are harmful to the plants to be grown.

In general, the method for producing the culture medium is carried out in an extruder. The various substances may be mixed in the extruder or may have already been mixed outside the extruder. Friction and the elevated pressure in the extruder create heat. As a result of the elevated temperature of the mixture polymerisation and foaming are started. By keeping the temperature above 100°C during production a sterile product is obtained. By cooling the formed extruded product a product retaining its shape in the form of a strand is obtained that may be shortened at a later stage or immediately after ejection from the extruder.

If a container according to the invention is produced, at least the biologically degradable polymer is mixed with the filler and polymerised. Optionally a foaming agent and a water-resistant agent may be added. The quantities and the ratios of the various starting materials are determined by the characteristics the container is desired to have. In general, the container should have a structure such as to prevent the ingrowth of roots. It is generally also preferred that the container is at least partly water repellent. In this way the container will retain a sufficiently firm consistency during use. If a foaming agent is added, it will generally be in a relatively limited amount in order to restrict the porosity. The container preferably has a closed surface structure.

If a container is to be used once only, the container may be cut up after the plants have been raised, and used as general soil improvement agent. If the container had a closed surface structure, cutting up will expose the open structure so as to allow biological degradation to take place more quickly.

As foaming agent the known biologically acceptable foaming agents may be used, such as water and sodium bicarbonate. Other foaming agents or methods, such as di-

rect gas injection are of course also possible.

The quantities may be varied, depending on the characteristics the culture medium to be produced is desired to have. If little foaming activity is desired, only a small amount of foaming agent is used. If rapid biodegradability is desired, the amount of polymer may be reduced or another type of polymer or another mixture may be used, whilst of course the culture medium must retain an adequate consistency. The amount of filler may also be adjusted as desired.

The culture medium according to the invention is extremely suitable for use as growth medium or as medium for cuttings, suitable for putting in seeds or cuttings.

It is also very suitable as growth medium wherein young plants are transplanted into a large-volume substrate, to be raised to mature plants.

The culture medium is also very suitable for use as production medium, wherein it is present in the form of a substrate mat, the plants being used as production plant for the harvest of fruit or flowers.

It is also suitable as soil improvement agent, wherein the culture medium according to the invention, preferably in the form of granulates or granules optionally is mixed with other substances to afford better growth conditions.

In the solid form, for example cylindrical, cubic, rectangular, oblong, the culture medium may be used in corresponding hollows in suitable containers provided for the purpose.

As already mentioned, the containers according to the invention may be conveniently used for growing plants and germinating seeds. The containers may also be used for inserting and holding flowers or other parts of plants in bouquets, flower arrangements, Christmas bouquets, etc.

CLAIMS

1. A culture medium suitable for growing plants, comprising a filler and a polymer, **characterised** in that it is comprised of a polymerised mixture of a biologically degradable polymer and the filler.

2. A culture medium according to claim 1, **characterised** in that it comprises a foamed polymer.

3. A culture medium according to claim 1 or 2, **characterised** in that it comprises 1 - 90 % by vol. of polymer, 2 - 98 % by vol. of filler, 1 - 80 % by vol. of foaming agent and optionally 0.001 - 20 % by vol. of surfactant; and preferably 2 - 25 % by vol. of polymer, 30 - 75 % by vol. of filler, 15 - 60 % by vol. of foaming agent and optionally 0.001 - 10 % by vol. of surfactant.

4. A culture medium according to one of the preceding claims, **characterised** in that it comprises a plant or seed to be cultured.

5. A culture medium according to one of the preceding claims, **characterised** in that it is a granulate.

6. A culture medium according to one of the preceding claims, **characterised** in that in addition it comprises 50 - 95 % by vol. of water, preferably 55 - 85 % by vol., and more preferably 65 - 80 % by vol.

7. A culture medium according to one of the preceding claims, **characterised** in that the biologically degradable polymer is chosen from at least one of:

1) biologically degradable polyesters such as statistic, aliphatic-aromatic copolyesters that are based on the different monomers of butanediol, adipic acid and terephthalic acid;

2) polylactic acid compounds, among which the A and the D variant;

3) polyhydroxybutyrate (PHB) compounds and polyhydroxyalkanoate (PHA) compounds; and

4) the starch compounds.

8. A culture medium according to one of the preceding claims, **characterised** in that the filler is cho-

sen from organic material, chosen from for example peat, compost, clay, soil, coconut fibres, coconut granulate, hemp fibres, grass fibres, straw, sawdust, coffee dregs, residue from the cattle feed industry or from the paper industry.

9. A method for the production of a culture medium, comprising mixing together a polymerisable agent and a filler, **characterised** in that the polymerisable agent is chosen from substances that after polymerisation produce a biologically degradable polymer and in that after mixing, the polymerisable agent is polymerised.

10. A method according to claim 9, **characterised** in that a foaming agent in an amount of 15 - 60 % by vol. is mixed together with the polymerisable agent in an amount of 2 - 25 % by vol., and the filler in an amount of 30 - 75 % by vol..

11. A container for a culture medium according to one of the preceding claims 1-8, **characterised** in that the same is produced from a biologically degradable polymer.

12. A container according to claim 11, **characterised** in that it comprises a preferably biologically degradable foaming agent and a polymerisable agent in an amount of 1 - 90 % by vol., optionally combined with an organic filler.

13. A container according to claim 11 or 12, **characterised** in that it comprises a biologically degradable water repellent agent.

14. A container according to claim 11, 12 or 13, **characterised** in that it has a structure such as to prevent roots from growing into it.