A root-proof water-supply string being a flexible string composed of a capillary material having a capillary function and a root-proof and water-permeable material which has a water-permeability and a root-proof function and covers the entire outer periphery of the capillary material. A method of manufacturing a root-proof water-supply string including the steps of winding a root-proof and water-permeable material around a capillary material, overlapping the end parts one on the other and then fixing the end parts together.
Figure 1
ROOT-PROOF WATER-SUPPLY STRING AND
METHOD FOR MANUFACTURING
ROOT-PROOF WATER-SUPPLY STRING

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

The present invention relates to a gardening material used for allowing vegetables and fruits to grow and more particularly to a root-proof water-supply string which prevents penetration of crop roots while allowing the transmission of water (nutrient solution) therethrough and further to a manufacturing method of the root-proof water-supply string and also to a method for installing the root-proof water-supply string in a culture pot.

[0002] 2. Description of the Related Art

In cultivation of vegetables and fruits (hereafter, "crops"), it is known that by controlling the spreading of roots, excessive growth of roots is suppressed, so that the transfer of nutrients to stems and fruit is promoted, thus making it possible to harvest fruit that has good flavor. Because of this, it has been generally practiced to restrict the size of culture beds by using pots or the like. On the other hand, it is also known that if nutrients or water is supplied in a managed manner, the growth efficiency of crops increases. In light of this, in one method, a capillary sheet exhibiting the capillary phenomenon and connected to a water-supply device is stretched in a culture bed, so that water (meaning nutrient solution, same hereafter) is efficiently supplied from the water-supply device to the capillary sheet. However, in this method, as the crops grow, the roots enter the capillary sheet and causes loss of capillary effect.

[0005] Because of this, in the Patent Reference 1 noted below, a method is proposed in which a capillary sheet is spread on the bottom of a pot, and over this, a root-proof sheet having fine holes through which water can pass but crop roots do not penetrate is spread, and then the pot is filled with culture soil, and crops are grown. In this method, since the roots are blocked by the root-proof sheet and do not penetrate inside the capillary sheet, there is no loss of the capillary effect for the capillary sheet. However, since the root-proof sheet and the capillary sheet are spread over the entire surface inside the pot, a large volume of these sheets is required, which causes waste; and in addition, a great deal of effort is required to do the spreading of the sheets. Furthermore, there is a problem that a large volume of water is supplied by the capillary sheet that is spread over the entire inside the pot, and so-called water stress does not occur with the crops; as a result, the flavor of the fruit is deteriorated.

[0006] In light of this, Patent Reference 2 noted below uses a method in which the crop culture soil is wrapped by a root-proof sheet, and another root-proof sheet is stretched over the outside of this wrapping root-proof sheet, so that the crop root extends between these two sheets. In this method, since the crop root is sandwiched between the two root-proof sheets and extend between these sheets, the root area is restricted. However, the gap between the two root-proof sheets is narrower naturally; and because of this, there occurs too much water stress; and thus the cultivation period becomes shorter, and there is a problem that the harvest is small. When tomatoes are taken as an example, only a few items can be harvested in a short period of time. In addition, the problem that a large volume of the root-proof sheet is required due to the full surface coverage and the problem that the work for spreading is complicated are exacerbated further by the fact that two root-proof sheets are required.

Furthermore, Patent Reference 3 discloses a water-conducting tube device comprised of a water-conducting section, in which both ends of the water-conducting section having a capillary function are exposed and the remaining part is wrapped by a watertight covering section, and a water-supply-covering section, which has a root-proof water-permeable function that wraps the exposed part of the water-conducting section. However, this device includes three components: the water-conducting section, the covering part, and the water-supply-covering section; as a result, the structure is complicated, and the cost is high. Also, since the length of the water-supply-covering section that is inserted in the culture pot is as short as 20 to 100 mm, such a problem is pointed out that the water supply to the crop in the pot is not sufficient. Furthermore, since it is necessary to do the work of fixing the water-conducting section and the covering water-supply-covering section in position, manufacturing is complex. In addition, Patent Reference 4 discloses a device in which the outer periphery of a string-type body having a capillary function placed inside the culture pot is covered by a cotton and resin net or hose having holes; however, for this device, no consideration is given to prevention of the penetration of the crop roots into the cotton and resin net or hose having holes (root-proofing). Accordingly, as the crop grows, the roots pierce and tear these components and penetrate into the string-type body, causing clogging.


BRIEF SUMMARY OF THE INVENTION

[0012] The present invention is to resolve the problems noted above, wherein a capillary material is wrapped by a root-proof water-permeable material so as to form a string-type body, thus making it possible to secure a sufficient occupying area required inside a pot (or culture soil), to provide an appropriate water stress imposed on to the crop, and in addition, to reduce the work of spreading of soil as much as possible.

[0013] In light of the problems noted above, the present invention provides a root-proof water-supply string which is characterized in that a flexible string-shaped body is obtained by a capillary material having a capillary function on which a root-proof water-permeable material having a water permeability and a root-proof function is wrapped on its outer periphery for the entire length; and it further provides, for this root-proof water-supply string, a means in which the capillary material of the end surface of the string-shaped body is covered by the root-proof water-permeable material, a means in which the cross section of the string-shaped body is square, round, oval, or polygonal, and also a means in which the string-shaped body is a flat band shape having a width of 20 to 50 mm and a thickness of 2 to 6 mm.

[0014] Furthermore, the present invention provides, as a manufacturing method of the root-proof water-supply material noted above, a method in which a capillary material is wound by a root-proof water-permeable material, each one of
the end parts is put on the other, and these part are fixed together, and it further provides, as a specific example of manner of this fixing, a method that uses adhesion, welding or attachment by sewing. Also, instead of this, the present invention provides a means in which the root-proof water-permeable material is wound in advance into a cylindrical shape and the capillary material is pulled into this. The present invention further provides a means in which a weaving machine or a knitting machine that can form woven cloth or knitted cloth in a round cylindrical shape around the outer periphery of the capillary material, and while a capillary material is being fed, weaving or knitting of the root-proof water-permeable material is performed around the circumference of the capillary material.

According to the present invention, since the root-proof water-supply string is comprised of a capillary material and a root-proof water-permeable material so as to form an integrated body, it saves work for individually spreading such materials; and since it is a string-shaped body, it is possible to install a sufficient amount thereof inside the pot and to avoid spreading across the entire surface and further to avoid waste. In addition, according to the present invention, roots do not penetrate into the capillary material even when the end surface of the string is inside the pot; and according to the present invention, the string has an excellent handleability, and it can impose appropriate water stress to the crops.

Meanwhile, according to the present invention, it is possible to easily manufacture a string-shaped body using a capillary material and a root-proof water-permeable material each of which is available on the market; and according to the present invention, it is possible to manufacture a product which is of excellent quality and has a length as desired.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is an explanatory diagram of a root-proof water-supply string according to the present invention;

FIG. 2 is an explanatory diagram showing one example of the manufacturing method for the root-proof water-supply string; and

FIG. 3 is an explanatory diagram showing a method for growing crops using the root-proof water-supply string.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present invention will be described below with reference to the accompanying drawings. FIG. 1 is a perspective view of a root-proof water-supply string according to the present invention. This root-proof water-supply string A is obtained by wrapping, for its entirety, the outer periphery of a capillary material 1, which has a capillary function, with a root-proof water-permeable material 2 that has water permeability and has a root-proof function (does not let crop roots penetrate), thus making a string-shaped body 3. The capillary material 1 in this case is an item that is given a capillary function and is formed by synthetic or natural fiber cloth or non-woven cloth; and for example, an item on the market called by a product name “Love Sheet” (made by Nicholas Corp.) can be used.

On the other hand, the root-proof water-permeable material 2 also exists in various items on the market that are made by, for example, Toyobo Co., Ltd., and these products can be used. This root-proof water-permeable material 2 uses as its basic materials synthetic fibers such as polyester, polyethylene, or polypropylene; and minute holes of size 7×10² to 2×10² μm², that allow no crop roots to penetrate but allow water to pass through, are formed therein and such basic materials are woven or knitted so as to have a thickness of approximately 0.2 to 3 mm. It is also possible to use an item made of natural fiber fabric, non-woven fabric, or porous film.

The capillary material 1 described above is wrapped by the root-proof water-permeable material 2, and to do this, the following method can be used. FIG. 2 is an explanatory diagram showing one manufacturing method, and in this method, the root-proof water-permeable material 2 which is adjusted to a predetermined length and width is spread over a platform or the like, and on this root-proof water-permeable material 2, the capillary material 1 adjusted to a specified width and thickness is placed with specified extra portions 2a and 2b left remaining on both ends of the shorter-side direction of the root-proof water-permeable material 2, and one of the extra portions 2a and 2b (2a in the drawing) folded back to wrap the capillary material 1, and the extra portions 2a and 2b are overlapped together and this overlapped part is fixed together. As specific examples of this fixing, adhesion using an adhesive agent or welding by heat is typically employed. In this case, the adhesive agent and welding temperature can be suitably selected according to the material.

In addition, it is also possible to fix the overlapped part by sewing using sewing thread. In the case of fixing by sewing, it is necessary that the gaps between the sewing holes and gaps between the sewing holes and sewing thread are fine enough to have a root-proof function; and thus, it is possible, after sewing, to fill the gaps with resins or the like. Furthermore, if the ends in the lengthwise direction of the root-proof water-permeable material 2 are overlapped and then these parts are fixed, so that the entire surface of the capillary material 1 is covered by the root-proof water-permeable material 2. In this case, it is preferable that the thickness of the root-proof water-permeable material 2 be 1 mm or less so as to have a flexibility.

According to the manufacturing method described above, the overlapped part projects from the edge of the capillary material in the shorter-side direction (or the lengthwise direction); however, this is because such part allows the fixing work of the root-proof water-permeable material to be easy; and even if such an overlapped part exists, there is no problem in terms of performance of root-proof water-supply string. Of course, it is also possible to avoid the overlapped part from projecting from the edge. In another manufacturing method, though not shown in the drawings, it is also possible to wind, in advance, the root-proof water-permeable material 2 into a cylindrical shape that has an overlapped part, and attach a thread or string to the capillary material 1, and then bring this capillary material into the root-proof water-permeable material 2 and pull, so that the capillary material 1 is installed inside the root-proof water-permeable material 2. The advantage of this method is that the overlapped part can be formed relatively easily without projecting.

As to the size of the string-shaped body 3 described above, it is preferable that the width W be 20 to 50 mm, and the thickness t be approximately 2 to 6 mm, since this size provides an appropriate occupied surface area for a culture pot. This width W and thickness t are the dimensions that are decided before manufacturing of the capillary material 1 and root-proof water-permeable material 2. Particularly in regards to the thickness t, if the item available on the market as described above is used, the thickness is relatively small.
(approximately 2.5 mm); as a result, it is possible to use one item or to overlap several items to make a desired thickness t. Of course, it is also possible to order a manufacturer or the like to make, from the beginning, an item that has a desired thickness t.

[0026] Using an example of cultivation of tomatoes, sizes will be described below. From the perspective of root area restriction, it is preferable for a pot to be approximately 15 to 20 cm in diameter and 20 to 30 cm in depth; and with use of the string-shaped body 3 of the size noted above, only one string of this string-shaped body 3 is simply installed inside the pot, and an appropriate water stress is conferred. Therefore, when the size of the string-shaped body 3 is smaller than this, a larger number of string-shaped bodies 3 are needed; and when the size of the string-shaped body 3 is larger, then the water supply becomes excessive, which is undesirable. Also, as for the length, when using the method described above, it is difficult to manufacture a very long string-shaped body 3, and therefore the limitation of the length would be approximately 1 m, and string-shaped bodies 3 of approximately this length is practically sufficient. The cross sectional shape of the string-shaped body 3 is determined by the cross sectional shape of the capillary material 1; accordingly, if the capillary material 1 is square, round, oval, or polygonal, then the string-shaped body 3 will be that shape. Among these shapes, a flat square shape (band shape) string-shaped body 3 described above has a larger outer surface area with respect to the cross section area, making it excellent in terms of water permeability, and giving it good handleability, which is desirable.

[0027] It is also possible to manufacture a continuous string-shaped body 3. One method, for example, is that a capillary material 1 and a root-proof water-permeable material 2 are continuously fed out; and during this time, the root-proof water-permeable material 2 is wound into a round shape by a guide or the like, thus wrapping the capillary material 1; and the end parts thereof are adhered, welded or sewn so as to be attached together. It would not be impossible as well to use a method in which a weaving machine or a knitting machine which can form a woven cloth or knitted cloth in a round cylindrical shape around a capillary material 1 is provided; and while feeding the capillary material 1, a root-proof water-permeable material 2 is woven or knitted by the weaving machine or knitting machine around the circumference of the capillary material 1. With this method, it is possible to make a long string-shaped body 3, and such a long string-shaped body 3 is wound into a suitable roll and put on distributions, and the purchaser can cut this long string-shaped body 3 into a suitable length upon use.

[0028] FIG. 3 is an explanatory diagram showing the manner to grow tomatoes in a pot using the root-proof water-supply string A described above. Culture soil 5 is placed in a pot 4 of the size noted above, and a tomato plant 6 is planted in the soil 5. In the side wall of the pot 4, a hole 7 is opened, through which the string-shaped body 3 can pass, at a height of 2 to 5 cm from the bottom of the pot. A nutrient solution pot 9 in which a nutrient solution 8 is placed is prepared and set underneath the side wall of the pot 4, one end of the string-shaped body 3 is dipped in the nutrient solution 8, and the other end side is pulled upward and extended to the opposite side after having it pass through the hole 7, and then the string-shaped body 3 is raised from here along the side wall and extended to near the surface of the culture soil 5. Meanwhile, at the terminal end, it is preferable that the string-shaped body 3 be wound a few times to form a ball 10.

[0029] With the above-described setting, the tomato plant 6 absorbs the nutrient solution 8 using the string-shaped body 3, and it grows and bears fruit, which can be harvested. Since the pot 4 has the size noted above, the root area is restricted and the nutrients do not go to the roots of the tomato plant unnecessarily, making tomatoes have good flavor. Also, since the string-shaped body 3 is of the size noted above, suitable water stress is conferred with respect to the size of the pot 4, and this aspect also leads to tomatoes of good flavor. Furthermore, if the end of the string-shaped body 3 is made into the ball 10, the nutrient solution 8 can be supplied particularly from this part and is transferred evenly to the culture soil 5. In this case, the root 6a of the tomato plant 6 seeks water and extends to surge to the string-shaped body 3; however, the root 6a of the tomato plant 6 is blocked by the root-proof water-permeable material 2 provided on the surface of the string-shaped body 3 and cannot penetrate into the capillary material 1 inside the root-proof water-permeable material 2, and the capillary function of the string-shaped body 3 is not inhibited. Generally, as tomato plants grow, they require a large amount of nutrient solution 8. Accordingly, it is possible to install a plurality of string-shaped bodies 3 in a pot 4 in advance, and the number of the string-shaped bodies 3 dipped in the nutrient solution 8 is increased under shifted timing so as to meet the growth of the tomato plant; and this provides efficient growth of tomato plant.

[0030] In view of the above, the hole 7 which is opened in the side wall of the pot 4 and through which the string-shaped body 3 is passed has a desirable effect. If the hole was formed in the bottom of the pot, there would be a risk that the root 6a would extend and advance out of the hole 7 since it would be easy for the root 6a to extend due to the gravity effect. If the root 6a advances and extends out of the hole 7, it extends on the string-shaped body 3 and enters the nutrient solution pot 9; and if this happens, water stress is not imposed, and there occurs hydroponics, and the taste of the tomato deteriorates. However, with the hole 7 provided in the side wall of the pot 4, it is difficult for the root 6a to advance. Even in this case, it is necessary to make the gap between the hole 7 and the string-shaped body 4 as small as possible.

[0031] It is also preferable to have the nutrient solution pot 9 and the pot 4 separated to some degree. In addition, inside the pot 4, securing a culture soil space a of 2 to 5 cm at the bottom of the string-shaped body 3 also provides a desirable effect. This is because the root 6a that surges to the string-shaped body 3 can go around this space a; and in this limited (root area restricted) space, the root 6 can grow in as wide range as possible as well as evenly, and this also leads to good flavor. By installing the string-shaped body 3 inside the pot 4 as such a placement manner as described above, the tomato plant 6 continues to bear fruit with good flavor over a long period of time of about ten months. The inventor confirmed that it was possible to cultivate such plants for about one year for up to 25 tires of branches.

[0032] Described above is one example of the present invention, and the present invention is not limited to this. For example, the size of the root-proof water-supply string can be adjusted appropriately for the crop growing process. In more specific terms, in the summer season when a large amount of water is necessary, it is effective to use a string-shaped body that has a large cross section area. Also, the crops are not
limited to tomatoes, and it can be other vegetables and fruits such as melons. Furthermore, the relationship between the nutrient solution pot and the pot does not have to be 1:1, and the nutrient solution pot can be made in a form of a shared tub; and the pot does not have to be an individual item, and it can be in a form of a continuous tub. By doing this, there is such an advantage that the equipment cost can be low. In addition, the root-proof water-supply string is not limited only for culture pots, and it can be applied to outdoor culturing. In other words, by installing the root-proof water-supply string through the inside of ridges, the root-proof water-supply string functions as a water channel and further promotes the growth of the crops.

1. A root-proof water-supply string characterized in that a capillary material having a capillary function is wrapped, on an outer periphery thereof and for an entire length thereof, by a root-proof water-permeable material having water permeability and a root-proof function so as to form a flexible string-shaped body.

2. The root-proof water-supply string according to claim 1, wherein the capillary material at end surfaces of the string-shaped body is covered by the root-proof water-permeable material.

3. The root-proof water-supply string according to claim 1, wherein a cross sectional shape of the string-shaped body is one selected from square, round, oval, or polygonal.

4. The root-proof water-supply string according to claim 1, wherein the string-shaped body is a flat band shape of 20 to 50 mm in width and 2 to 6 mm in thickness.

5. A method for manufacturing the root-proof water-supply string according to claim 1, comprising the steps of: wrapping a capillary material by a root-proof water-permeable material, overlapping end parts of the root-proof water-permeable material together, and fixing the overlapped parts together.

6. The method for manufacturing the root-proof water-supply string according to claim 5, wherein the fixing of the overlapped part is performed by one selected from adhesion, welding and attachment by sewing.

7. A method for manufacturing the root-proof water-supply string according to claim 1, comprising the steps of: winding a root-proof water-permeable material in advance into a cylindrical shape, and pulling a capillary material into an inside of the cylindrical root-proof water-permeable material.

8. A method for manufacturing the root-proof water-supply string according to claim 1, comprising the steps of: providing a weaving machine or a knitting machine that can form woven cloth or knitted cloth in a round cylindrical shape around an outer periphery of a capillary material, feeding the capillary material thereto, and weaving or knitting of the root-proof water-permeable material around a circumference of the capillary material.

9. (canceled)
10. (canceled)
11. (canceled)

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