

DESCRIPTION

NUTRICULTURE MEMBER AND NUTRICULTURE METHOD

TECHNICAL FIELD

[0001] The present invention relates to a nutriceulture member and a nutriceulture method.

BACKGROUND ART

[0002] Nutrient film technique involves dropping a seedling root ball from a planting hole, locating the seedling root ball on the bottom surface of a cultivation bed, and causing a nutrient solution to flow into the bottom of the cultivation bed as a thin film to cause the seedling root ball to grow.

[0003] Patent Reference 1 (JP-A 8-205700) discloses, as a nutriceulture method using nutrient film technique, a nutriceulture apparatus configured using a cultivation bed placed above a planting panel in which numerous planting holes are drilled. Convex parts arranged in continuous fashion in the longitudinal direction are formed in the nutriceulture apparatus along the bottom surface of the cultivation bed. The nutriceulture apparatus has channels through which a nutrient solution flows between the convex parts.

[0004] According to the nutriceulture apparatuses of the conventional art, convex part configurations are formed along the bottom surface of the cultivation bed, the convex parts being rectangular in cross-section. The nutrient solution bypasses the convex part configurations (of rectangular cross-section) to flow between the convex parts.

However, since a hydrophilic sheet (the hydrophilic material of the conventional art) laid on the bottom surface of the cultivation bed is not appreciably affected by the weight of the nutrient solution flowing between the convex parts, the hydrophilic sheet tends to form an upwardly protruding profile that smoothly covers the convexities of the cultivation bed without conforming thereto, and air bubbles may form between the cultivation bed and the hydrophilic sheet (refer to FIG. 1).

Although nutrient film technique involves dropping a seedling root ball from a planting hole, locating the seedling root ball on the bottom surface of a cultivation bed, and causing a nutrient solution to flow into the bottom of the cultivation bed as a thin film to cause the seedling root ball to grow, a concern is presented that capillary water will be disconnected from the hydrophilic sheet when air bubbles such as the one as aforementioned and the like are formed between the hydrophilic sheet and the convex parts on the bottom surface of the cultivation bed, hindering the supply of nutrient solution to the culture medium part of the seedlings planted on the upper surface of the convex parts of the cultivation bed. In the conventional art, gaps are formed by the edges of the convex parts, as shown in FIG. 1.

Additional concerns are presented in that using a brush to eliminate air bubbles formed between the cultivation bed and the hydrophilic sheet so that the hydrophilic sheet will

adhere to the cultivation bed is labor-intensive, and that the hydrophilic sheet may be damaged when attempts are made to brush the air bubbles out.

PRIOR ART REFERENCES

PATENT REFERENCES

[0005] Patent Reference 1: Japanese Laid-open Patent

Application No. 8-205700

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] An objective of the present invention is to provide a nutriculture member for suppressing the formation of air bubbles between a hydrophilic sheet and convex parts on the bottom surface of a cultivation bed, and reducing the likelihood that capillary water will be disconnected from hydrophilic sheet.

MEANS FOR SOLVING THE PROBLEMS

[0007] As a result of in-depth studies, the inventors discovered that imparting a slant to the side surfaces of the convex parts of the cultivation bed makes it possible to cause the hydrophilic sheet to pass along the slant on the convex parts of the cultivation bed and suppress the formation of air bubbles between the hydrophilic sheet and the cultivation bed.

[0008] Specifically, the present invention aims to provide:

[1] a nutriculture member, characterized in having a planting panel having a plurality of planting holes for locating a seedling root ball;

a cultivation bed having a plurality of convex parts; and
a hydrophilic sheet laid on a bottom surface of the
cultivation bed,

side surfaces of the convex parts being slanted such that
upper surfaces of the convex parts are smaller than lower
surfaces of the convex parts;

[2] the nutriculture member according to [1],
characterized in that the total area of the upper surfaces of
the plurality of convex parts is less than the area of the
bottom surface excluding the convex parts of the cultivation
bed;

[3] the nutriculture member according to [1] or [2],
characterized in that the side surfaces of the convex parts
are slanted 20° to 80° with respect to the lower surfaces of
the convex parts;

[4] the nutriculture member according to any one of [1]
to [3], characterized in that the side surfaces of the convex
parts are slanted 100° to 160° with respect to the upper
surfaces of the convex parts; and

[5] a nutriculture method characterized in that the
nutriculture member according to any one of [1] to [4] is used
to grow a seedling root ball by causing a nutrient solution to
flow on the bottom surface of the cultivation bed.

ADVANTAGES OF THE INVENTION

[0009] In the nutriculture member of the present invention,
the formation of air bubbles between the hydrophilic sheet and

the convex parts of the cultivation bed is suppressed, and the likelihood of capillary water being disconnected from the hydrophilic sheet is reduced.

Furthermore, it is possible to improve the harvest efficiency of the nutriculture method by using the nutriculture member of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a cross-sectional view of the nutriculture member of the prior art;

FIG. 2 is a schematic diagram of the cultivation bed in the present invention; and

FIG. 3 represents an example of the nutriculture member of the present invention.

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0011] A first aspect of the present invention is a nutriculture member, characterized in having a planting panel having a plurality of planting holes for locating a seedling root ball; a cultivation bed having a plurality of convex parts; and a hydrophilic sheet laid on a bottom surface of the cultivation bed, the convex parts are formed at places corresponding to positions below the planting holes when said planting panel is placed above said cultivation bed, side surfaces of the convex parts being slanted such that upper surfaces of the convex parts are smaller than lower surfaces of the convex parts.

[0012] A planting panel cast from, e.g., light-weight

styrofoam is used as the planting panel constituting the nutriculture member of the present invention. Numerous planting holes are drilled into the planting panel. The planting panel may be of any desired size.

The planting holes may be of inverse conical shape, but are preferably cylindrical (having the same diameter at the top and bottom), their size exceeding the diameter of the seedling root balls to be used. A suitable size for the spacing between the planting holes may be determined in accordance with the crop being cultivated.

[0013] The cultivation bed constituting the nutriculture member of the present invention is of such construction that the open upper part is covered by the planting panel. The cultivation bed is cast from, e.g., light-weight styrofoam, similarly with respect to the planting panel. The cultivation bed may of any desired size.

[0014] In the present invention, the cultivation bed has a plurality of convex parts. FIG. 2 represents a schematic diagram of the convex parts of the cultivation bed. In the present invention, "the bottom surface of the cultivation bed" denotes the surface on the bottom of the cultivation bed, and includes the upper and side surfaces of the convex parts as well as the portion comprising the channels between the convex parts.

In the nutriculture member of the present invention, the side surfaces of the convex parts are slanted such that the

upper surfaces of the convex parts are smaller than the lower surfaces of the convex parts. Slanting the side surfaces of the convex parts of the cultivation bed such that the upper surfaces of the convex parts are smaller than the lower surfaces of the convex parts makes it possible to increase the adhesion between the side surfaces of the convex parts and the hydrophilic sheet, and suppress the formation of air bubbles between the convex parts and the hydrophilic sheet.

The inclined side surfaces of the convex parts may be flat, concave, or convex.

[0015] In the present invention, the degree to which the side surfaces of the convex parts are slanted with respect to the lower surfaces of the convex parts is preferably 20° to 80° , more preferably 25° to 70° , and furthermore preferably 30° to 60° . At a slant of less than 20° , the amount of nutrient medium flowing in the cultivation bed may decrease, or the installation space will increase due to the need to enlarge the cultivation bed. At a slant of greater than 80° , air bubbles may infiltrate between the side surfaces of the convex parts and the hydrophilic sheet more readily, and the nutrient solution cannot be supplied to the seedlings as smoothly.

The degree to which the side surfaces of the convex parts are slanted with respect to the upper surfaces of the convex parts is preferably 100° to 160° , more preferably 110° to 155° , and furthermore preferably 120° to 150° . At a slant of less than 100° , air bubbles may infiltrate between the side

surfaces of the convex parts and the hydrophilic sheet more readily, and the nutrient solution cannot be supplied to the seedlings as smoothly. At a slant of greater than 160° , the installation space may increase due to the need to enlarge the cultivation bed.

The angles of slant on the left and right side surfaces of the convex parts may be equal or different.

[0016] The convex parts are preferably 3 to 10 mm in height (as measured from the lowest surface (the channel part) of the cultivation bed). When the convex parts are 3 mm or less in height, the seedling root balls may be washed by the flow of nutrient solution, the medium may be washed away, leaving the seedling root balls to collapse, and gradually sag, or the seedlings may lean. When the convex parts are 10 mm or greater in height, the amount of nutrient solution being pumped per unit time must be increased in order to increase and maintain the amount of nutrient solution being used, and there may be an increase in the cost for the requisite members and electricity associated with the emergent necessity to increase the pump capacity or the diameter of the pipes for supplying the nutrient solution.

[0017] The width of the convex parts is determined according to the diameter of the seedling root balls being used. When the width of the convex parts is smaller than the diameter of the seedling root balls, the seedling root balls may lean and fall from the ridge-like convex parts. The width of the

convex parts is desirably approximately 4 mm wider than the diameter of the seedling root balls being used.

[0018] The convex parts are ordinarily formed in positions directly underneath the planting holes in which the seedling root balls are located when the planting panel is placed on top of the cultivation bed. The convex parts may be arranged mutually independently underneath the plurality of planting holes for locating up the seedling root balls or arranged linearly in a continuous manner underneath the plurality of planting holes.

In order to make the flow of nutrient solution smoother, the convex parts are preferably arranged linearly so as to lie parallel to the flow of nutrient solution.

[0019] In the present invention, the total area of the upper surfaces of the plurality of convex parts is preferably less than the area of the bottom surface excluding the convex parts from the cultivation bed. It is thereby possible to ensure there is adequate growing space without stunting the development of aquatic roots of seedlings grown underwater. When the area of the bottom surface excluding the convex parts from the cultivation bed is less than the total area of the upper surfaces of the plurality of convex parts in the cultivation bed, the space for growing aquatic roots may be reduced, and the growth of the above-ground part of the plants may be inhibited due to root restriction arising from the limited underwater-root-growing region.

The area of the upper surface of each convex part may be equal or different.

[0020] Channels through which the nutrient solution flows are formed between the convex parts, but the width of the channels may be determined as appropriate in accordance with the width of the cultivation bed and the width and number of the convex parts. The width of the channels may be equal or different.

[0021] In the nutriculture member of the present invention, a hydrophilic sheet is laid on the bottom surface of the cultivation bed. Although the hydrophilic sheet extends along the bottom surface of the cultivation bed, greater adhesion between the convex parts of the cultivation bed and the hydrophilic sheet corresponds to a greater possibility of nutrient medium being supplied to the culture medium portion of the seedlings with less interruption of the nutrient solution supply. In the method of the conventional art in which the side surfaces of the convex parts are vertical, the hydrophilic sheet does not readily pass along the side surfaces of the convex parts, and air bubbles form between the side surfaces of the convex parts and the hydrophilic sheet. Although the hydrophilic sheet can be extended so as to adhere to the side surfaces of the convex parts even when the side surfaces of the convex parts are vertical, the effort required to do so for the entire plurality of convex parts would be difficult in practice, would place considerable stress on the hydrophilic sheet, and would make the hydrophilic sheet more

susceptible to damage by tearing or the like.

In the nutriculture member of the present invention, the side surfaces of the convex parts are slanted so that the upper surfaces of the convex parts are smaller than the lower surfaces of the convex parts, improving adhesion between the side surfaces of the convex parts and the hydrophilic sheet. Furthermore, in the present invention, it is possible to suppress damage to the hydrophilic sheet while enabling nutrient solution to be supplied smoothly to the culture medium portion of the seedlings without spending time and care on extending the hydrophilic sheet.

[0022] There is no particular limitation on the type of hydrophilic sheet used, provided that the sheet is capable of drawing liquid by capillary action. The hydrophilic sheet is preferably a material that does not allow the seedling roots to pass therethrough. Examples of such a material include paper and textiles.

[0023] A waterproof sheet is preferably laid between the cultivation bed and the hydrophilic sheet to prevent leakage of nutrient solution from the cultivation bed. Using a waterproof sheet makes it possible to suppress leakage of nutrient solution even when a plurality of cultivation beds are connected for cultivation.

[0024] The present invention according to a second aspect is a nutriculture method characterized in that seedling root balls are cultivated using the nutriculture member of the invention

as described above by causing the nutrient solution to flow on the bottom of the cultivation bed.

[0025] The nutriculture method of the present invention makes it possible to produce roots having two different forms and functions, including aquatic roots grown underwater and roots in the humid atmosphere having numerous root hairs sustained in moisture. The aquatic roots actively absorb fertilizer and water from the nutrient solution, whereas the roots in the humid atmosphere absorb oxygen directly from that atmosphere.

This cultivation method makes it possible to cultivate without solely relying on dissolved oxygen, and plant roots will not be adversely affected by oxygen deficiency even when the plants are cultivated at high-temperature periods in which dissolved oxygen is readily depleted.

A wide cultivation bed is used when employing a plurality of planting rows as a basis when cultivating leafy vegetables such as spinach; however, water can be guided through all of the channels formed between the convex parts even in such a wide cultivation bed.

[0026] The nutriculture method of the present invention can be suitably used for cultivating leafy vegetables; in particular, spinach and Tsukena group (e.g., Japanese mustard spinach).

EXAMPLES

[0027] (Example 1)

A 4-meter-long cultivation bed was fabricated. The convex parts were 5 mm high, the upper surfaces of the convex parts

were 24.5 mm wide, the lower surfaces of the convex parts were 34.5 mm wide, and the side surfaces of the convex parts were slanted 45° with respect to the lower surface of the convex parts and 135° with respect to the upper surface of the convex parts.

FIG. 3 represents a schematic diagram of the cultivation bed. The lower image is an enlarged view of the convex part circled in the upper image.

[0028] (Comparative example 1)

A 4-meter-long cultivation bed in which the convex parts had vertical sides was fabricated. The convex parts were 5 mm high and the convex parts were 24.5 mm in cross-sectional width.

[0029] (Evaluation)

Using the cultivation beds fabricated as described above, waterproof sheets and hydrophilic sheets were laid, and the rate of air bubble formation on the top surface of the convex parts or in the vicinity of the convex parts was investigated.

Air bubbles were confirmed to have formed in approximately 80 places in the cultivation bed of Comparative Example 1, whereas there were fewer than 10 places in which air bubbles formed in the cultivation bed of Example 1.

Spinach was planted in the planting panels in the state described above and cultivated for approximately seven days, whereupon withering due to disconnection of the nutrient solution supply occurred in five plants with Comparative

Example 1 in places where there was high air bubble formation, but no withering occurred in the plants in Example 1.

[0030] Installing the nutriculture member shown in FIG. 3 involved connecting a plurality of cultivation beds in series in the longitudinal direction and positioning the beds at a slope of about 1/80. All internal surfaces were clad with waterproof sheet to prevent water leakage from the connection sites, and a textile, paper, or other hydrophilic sheet was laid on top of the waterproof sheet.

[0031] The cultivation bed was then overlaid with the planting panel, and seedling root balls were dropped from planting holes, whereby the seedling root balls were capable of being readily located on the convex parts of the cultivation bed, the convex parts disposed directly under the planting holes. When the nutrient solution was then caused to flow in portions of channels on both sides of the convex parts from the upstream side of the cultivation bed to the downstream side of the cultivation bed, the surface of the liquid in the channels reached a height of substantially 2-3 mm when the nutrient solution was flowing at a rate of 10L per minute per bed. This height represents approximately half the height of the convex parts. A moist airspace was formed between the lower surface of the planting panel and the liquid surface of the nutrient solution in the channels.

CLAIMS

[Claim 1]

A member for nutrient film technique, characterized in having a planting panel that has a plurality of planting holes for locating a seedling root ball;

a cultivation bed having a plurality of convex parts for locating a seedling root ball; and

a hydrophilic sheet laid on a bottom surface of the cultivation bed,

side surfaces of the convex parts being slanted such that upper surfaces of the convex parts are smaller than lower surfaces of the convex parts, and the total area of the upper surfaces of the plurality of convex parts is less than the area of the bottom surface excluding the convex parts of the cultivation bed, wherein channels through which the nutrient solution flows from an upstream side to downstream side of the cultivation bed are formed between the convex parts.

[Claim 2]

The member for nutrient film technique according to claim 1, characterized in that the side surfaces of the convex parts are slanted 20° to 80° with respect to the lower surfaces of the convex parts.

[Claim 3]

The member for nutrient film technique according to claim

1 or 2, characterized in that the side surfaces of the convex parts are slanted 100° to 160° with respect to the upper surfaces of the convex parts.

[Claim 4]

A nutriculture method characterized in that the member for nutrient film technique according to any one of claims 1 to 3 is used to grow a seedling root ball by causing a nutrient solution to flow on the bottom surface of the cultivation bed.