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Membrane-Meniscus Method

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Innovation Patent Application

Invention Title: Membrane-Meniscus Method.

Abstract: The Membrane-Meniscus Method is applied to the hydroponic method of plant growth and it is used as a means of supplying nutrient to the root systems of any number of plants.

There are many ways in which nutrient can be supplied to plants, but almost all popular current techniques, either commercial or domestic, allow roots to come into direct contact with the liquid nutrient supply.

This creates many problems because root exudates tend to contaminate the nutrient supply, whilst the electrical conductivity (strength) including the pH, are also significantly affected due to the disparate uptake of the various mineral elements contained in the nutrient.

Commercial growers go to considerable lengths to keep their nutrient supply in the correct "balance" by computer control of additives and other measures. Even with this level of control, the nutrient storage tanks (through which the solution is recirculated) need to be emptied periodically and replaced with fresh nutrient.

The Membrane-Meniscus Method however, employs a membrane which presents itself as an impenetrable barrier to roots, whilst at the same time the membrane allows nutrient to enter the Root Zone by way of capillary action. The absence of roots from the Nutrient supply Zone ensures that the nutrient supply cannot become contaminated in any way and intervention to maintain "balance" is unnecessary.

A further important feature of the Membrane-Meniscus Method is that nutrient is supplied to the roots exclusively by a meniscus "film" rather than a significant depth of "liquid". The meniscus film provides the essential moisture that roots need, and permits rapid diffusion of oxygen from the surrounding air to the roots.

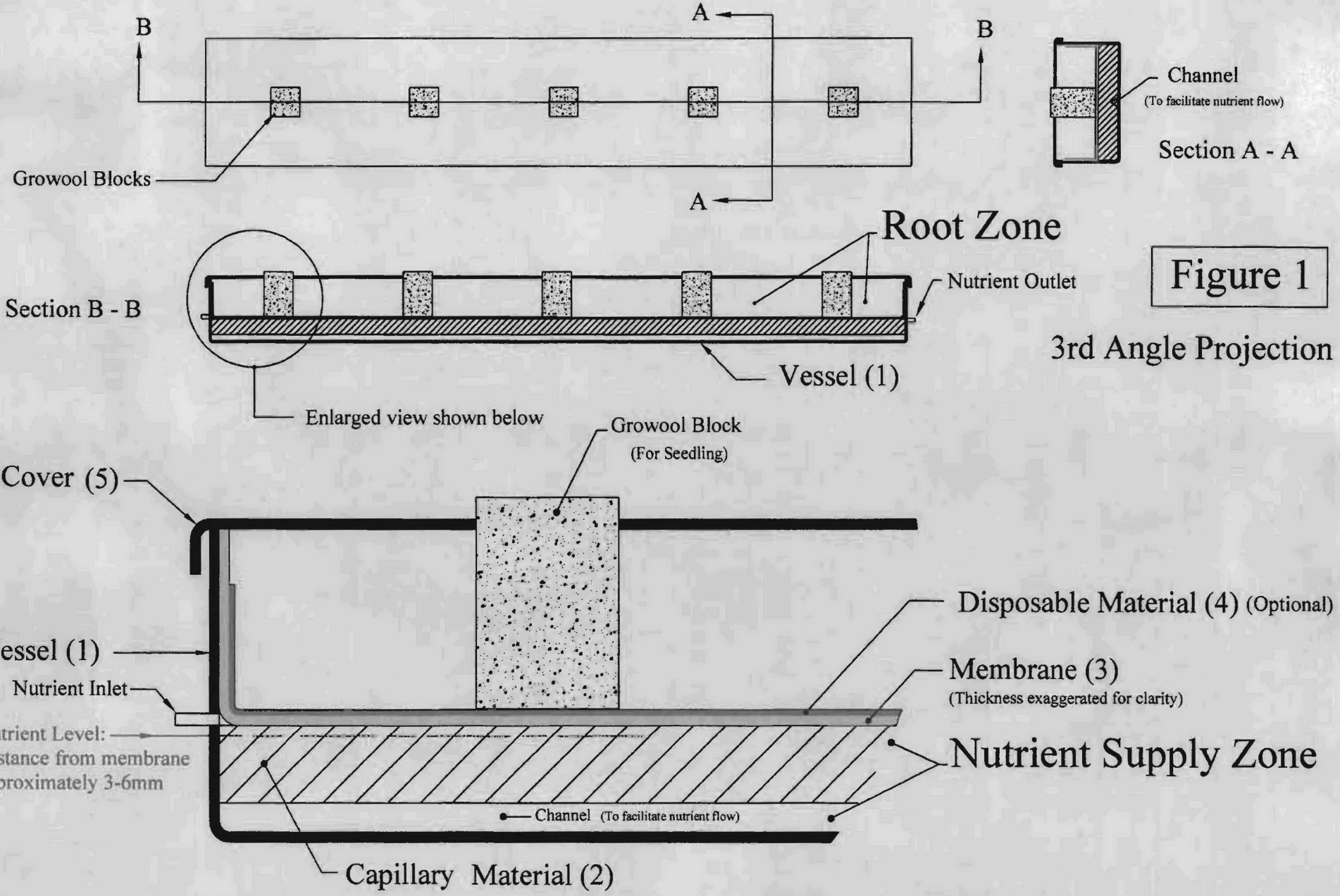


Figure 1

3rd Angle Projection

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There are 4 pages of Description

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The Membrane-Meniscus Method is described in the following statement, and hereinafter also referred to as "Membrane Method":

In the description that follows, the terms "nutrient", and "liquid" are synonymous. Component names commencing with upper case letters are illustrated in assembly drawing, Figure 1.

Description: The full description of the Membrane-Meniscus Method is presented in three parts:
Part (A): Assembly drawing. All illustrations are shown in Figure (1).
Part (B): Component details.
Part (C): Membrane-Meniscus Method: (i) Assembly. (ii) Function.

Part (A): Assembly drawing: - see Figure (1).

Part (B): Component details:

The Membrane-Meniscus Method utilizes the following components:
Vessel (1)
Capillary Material (2)
Membrane (3)
Disposable Material (4) (Optional)
Cover (5)

Vessel (1) is a watertight plastic container and is depicted in figure (1) as rectangular, however it could be made from any suitable material and be of any appropriate length, width or depth.
At the left end (as illustrated) of the said Vessel, is a Nutrient Inlet, whilst at the other end there is a Nutrient Outlet which is located slightly below the level of the inlet tube, as depicted in Figure 1. The height of the Nutrient Outlet above the base of said Vessel will determine the level to which the nutrient will rise.

Capillary Material (2) is a material which covers the base of Vessel (1) and conveys nutrient, by capillary action, to the underside of Membrane (3). The said Capillary Material does not necessarily need to be hydrophilic but it must have properties which would facilitate a strong capillary action. The Capillary Material (2) may be of any suitable thickness as determined by the grower, and materials such as vermiculite, perlite, finely woven plastics or proprietary substances such as "Growool" may be used for this purpose. Provision may also be made on the underside of the Capillary Material for a small Channel which extends along its entire length. The Channel aids in the even distribution of solution throughout Vessel (1), and more than one Channel may be required for wide vessels. The need for "channels" and their configuration will depend upon the particular substance that is chosen for the said Capillary Material (2).

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Membrane (3) is a material which covers the entire upper surface of Capillary Material (2) and all inside walls of Vessel (1) as depicted. The said Membrane may be made from a single layer of finely woven polyester fibre such as "Ceconite", "Dacron", or any other material which satisfies the following essential criteria:

(i) The material must be very finely woven such that roots are unable to penetrate it.

(ii) The material must have a "slippery" texture to prevent minute root hairs from growing into it and "bonding" to the surface.

(iii) The material must demonstrate a strong capillary action.

The said Membrane remains in place at all times. It does not require maintenance and at the end of each cropping period, only the said Disposable Material needs to be replaced.
For some plants with vigorous root systems, the grower may wish to extend the said Membrane fully up the sides of Vessel (1), as depicted in the enlarged view of section B – B, or even extended further, to be held in place between the Cover (5) and Vessel (1).

Disposable Material (4) is made from hydrophilic material which covers the surface of Membrane (3). It is an optional feature of the Membrane Method and is applied at the discretion of the grower. The Disposable Material (4) is depicted schematically by a red line, where the said line represents any suitable hydrophilic material such as perlite, rockwool, or any other material that the grower may deem suitable. The said Disposable Material freely allows roots to penetrate it, thus the majority of roots will lie *between* the Membrane (3) and the Disposable Material (4). It is disposed of together with the root mass of the spent plants.

Cover (5) is a close-fitting closure for Vessel (1), having openings of any suitable size and shape, through which seedlings are passed and their spacing is determined by the grower. The said Cover may be made from any suitable polymeric material. If required, additional holes (not shown) may be made in the said Cover to improve ventilation around the roots. Alternatively, the holes made in said Cover to receive the Growool Blocks may be made larger to provide ventilation.

Part (C): Membrane-Meniscus Method: (i) Assembly. (ii) Function.

(i) **Assembly:** The following description relies upon the terms and component names that are illustrated in Figure (1).

Vessel (1) may be located on any supportive surface which may be either horizontal or slightly sloping, depending upon the grower's requirements.

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Capillary Material (2) is placed on the inside base of said Vessel (1) as depicted, and then thoroughly wetted with nutrient solution.

Membrane (3) is then placed on top of the said Capillary Material, such that it will also rest on all of the internal walls of Vessel (1) as depicted, to form an "enclosure" from which the roots cannot escape. The Membrane makes intimate contact with the upper surface of Capillary Material (2).

Disposable Material (4) (if used) is then placed on top of the Membrane (3) as depicted.

Cover (5) is then fitted onto Vessel (1).

(ii) Function: Following the assembly of the aforesaid components, Membrane (3) and Disposable Material (4) (if used), are then thoroughly wetted whereupon capillary action will commence between the Nutrient Supply Zone and the Root Zone.
It is intended that seedlings placed into the System are already established in Growool Blocks or other suitable media and as roots grow, they will form a "curtain" (not depicted), around and externally to those Blocks . The roots will make their way down, through the surrounding air, whereupon they will be deflected horizontally by the Membrane (3) to grow across the said Membrane in all directions.

As the roots take up nutrient from the said Membrane, it will be quickly replaced by fresh, uncontaminated nutrient, thus all parts of each individual root system will always receive 100% fresh nutrient from a meniscus film, rather than nutrient in "liquid" form. The *direction* of nutrient flow will always be *from* the Nutrient Supply Zone *to* the Root Zone, thus it is impossible for any products of metabolism to contaminate the nutrient supply.

A critical aspect of the Membrane-Meniscus Method, is the level to which nutrient is maintained within the said Vessel (1), relative to the thickness of Capillary Material (2). The higher the level of nutrient, the more saturated the Capillary Material will become.

If the said Capillary Material is not sufficiently saturated with liquid where it makes contact with the membrane, then the meniscus film will not develop fully around the roots as they grow across the membrane and plant growth will be poor.

The presence of the meniscus provides a vehicle for nutrient transport to the roots, and because the meniscus is essentially a *film,* it will rapidly become saturated with diffused oxygen from the surrounding air, - a feature that is essential for healthy growth.

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To provide the required amount of saturation in the said Capillary Material it is necessary to maintain a nutrient level that is close to the underside of the membrane. The precise level required will depend upon the type of material that is used for the said Capillary Material, but the nutrient level will generally be within 3 - 6mm. of the membrane as indicated in Figure 1.

As the plants consume solution from the Nutrient Supply Zone, it must be continually replaced and accurately maintained at the required constant level. This can be achieved by passing nutrient through Vessel (2) at an appropriate rate. At the left end (as illustrated) of the said Vessel, is a Nutrient Inlet, whilst at the other end there is a Nutrient Outlet which is located slightly below the level of the inlet tube, as depicted in Figure 1. The height of the Nutrient Outlet above the base of said Vessel will accurately determine and maintain the level to which the nutrient will rise.

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There is 1 page of Claims

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The Claims defining this patent application are as follows:

Claims

(1) A membrane-meniscus method comprising a vessel, capillary material, membrane, disposable material and cover as described in the aforementioned Parts A, B, & C of this application and assembled as illustrated in the aforementioned Figure (1).

(2) The membrane-meniscus method of Claim (1), in which a membrane is placed entirely within a rigid closed vessel, such that said membrane will create two separate compartments, depicted in the said Figure (1) as Root Zone and Nutrient Supply Zone, and where said membrane presents as an impenetrable barrier to plant roots, such that all roots are always confined to the Root Zone.

(3) The membrane-meniscus method of Claims (1), and (2) in which the nutrient is maintained at a constant level of approximately 3mm from the upper surface of said membrane such that the resultant liquid saturation at its surface is sufficient to cause the formation of a full meniscus film of nutrient solution around and between plant roots as they grow across the membrane.

(4) The membrane-meniscus method of Claims (1), (2), and (3) in which the nutrient supply has no contact with plant roots such that the nutrient supplied to the plants is always uncontaminated and where nutrient leaving the said vessel is also uncontaminated and re-useable.

(5) The membrane-meniscus method of Claims (1), (2), (3) and (4) in which nutrient flows through said vessel by way of a nutrient inlet and nutrient outlet and where the outlet height above the base of said vessel, determines and maintains the nutrient at the required constant level.

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Date... 1/6/2011

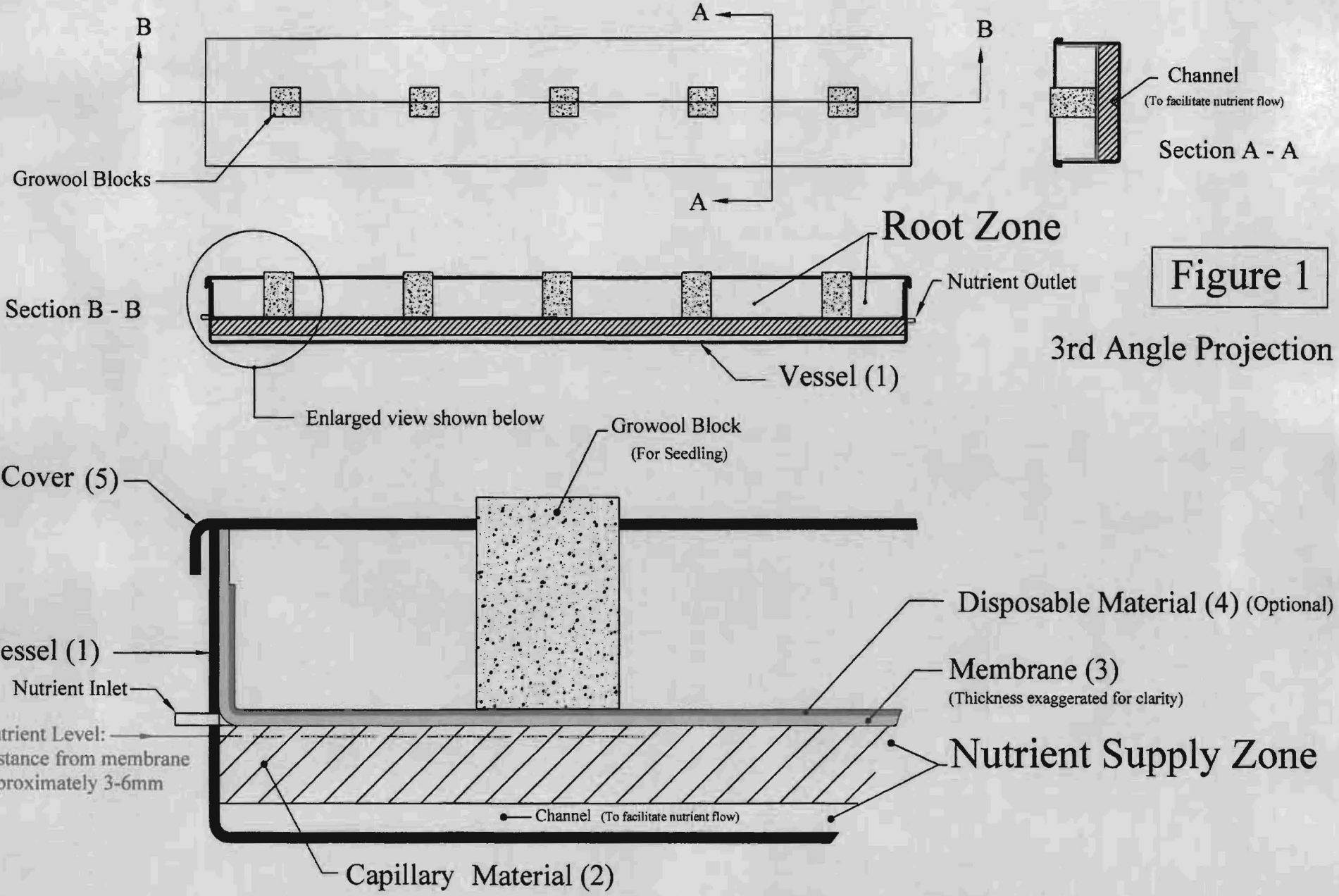


Figure 1

3rd Angle Projection