HIGH DENSITY SOILLESS PLANT GROWTH SYSTEM AND METHOD

FIELD OF THE INVENTION

The invention relates to low carbon emission, soilless high density plant growth systems and methods.

BACKGROUND TO THE INVENTION

The inventors are aware of traditional farming methods wherein plants are planted in rows in soil and are fertilised and watered and are allowed to grow naturally until they reach a stage of growth in which they are harvested.

These traditional farming methods have a number of limitations and disadvantages, for example, low density of plants per square meter thus requiring large areas of land to be farmed, and relative high carbon emission, resultant from the tractors and or machinery used as well as extensive use of petrochemical based substances such as synthetic fertilizer, herbicides and or pesticides.

Over time these traditional systems have been modified by covering the plants, for example, in tunnels which are made of a material which protects the plants from insects and the elements but to a large extent does very little to increase the plant density, and or to minimise carbon emission, or even to trap carbon for use in the cultivation of plants.

The inventor is aware of high density farming methods in greenhouses, such as hydroponics, which is a method of growing plants using mineral nutrient solutions, in water, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, biochar, mineral wool, expanded clay pebbles or coconut husk.

Although hydroponics increases the yield per square meter which may be obtained and permits the conditions for plant growth to be improved over traditional farming methods, hydroponics only addresses certain aspects of plant growth. The supply of

nutrients to the roots of the plant and exposure to light and the density of plants is still quite limited as the plants are spread out in a single plane and typically have their roots extending into a pool of nutrient solution.

The inventors having considered the above thus propose the invention described below.

SUMMARY OF THE INVENTION

According to a first aspect of the invention, there is provided a soilless system for high density plant growth, said system including

- a greenhouse type structure;
  at least one elongate support member arranged substantially vertically in the greenhouse type structure, the support member having:
  a body having a flow channel defined therein; and
  a plurality of vertically spaced apart receptacles angularly disposed to the vertical axis of the body for receiving a plant therein, the receptacles being in flow communication with the flow channel;
- a fluid supply system in fluid communication with the flow channel for supplying a fluid stream to the said flow channel; and
  a fluid collection system for collecting residual fluid which has flowed through the flow channel.

The greenhouse type structure may comprise so called lumens enhancing means for increasing the amount of visible light in the structure. The lumens enhancing means may be in the form so called light penetrating material for allowing a predetermined amount of sunlight to penetrate the structure. The material may include glass and or clear polycarbonate resistant to ultraviolet radiation. The material may include reflective properties for allowing sunlight to penetrate the structure, but to inhibit sunlight to reflect back to outer the structure. The reflective material may include so called Agri - film™ and or so called Lumenmax™.

A suitable filter may also be included in the material to inhibit wavelengths of so called red and blue light rays to enter the greenhouse structure.

The lumens enhancing means may be in the form of a reflective composition in the flooring of the greenhouse structure for reflecting sunlight away from the floor.

The reflective composition may be in the form of a red and blue colour arrangement on the flooring of the greenhouse.

The lumens enhancing means may include a light source preferably for supplying light having a wavelength of about 800 – 1000 nm.

The greenhouse type structure may further include temperate regulating means for regulating the ambient temperature inside the structure. The regulating means may be in the form of any one or more selected from the group consisting of ventilation shafts and or fans, wetting system for wetting the outer surface of the structure and spraying system for spraying a fine mist inside the structure.

The regulating means may also include a conventional radiator system for regulating the ambient temperature inside the greenhouse.

The greenhouse structure may also include pathogen control means for controlling pathogen levels within predetermined ranges inside the structure. The pathogen control means may include a double air locked access to the structure, a flooring composition for collecting undesirable particles and pathogens.

The elongate support members may be of generally wave shaped form and manufactured from any suitable material, preferably polyvinyl chloride and or polyurethane.

The elongate support members may be of modular design and each support may be assembled from a number of one or more identical parts and which when assembled together form the support member.

Each support element has an opening portion for receiving a plant such as a seedling therein which, when the support elements are assembled, form the vertically spaced apart openings of the support members.

Each support element in turn may comprise two symmetric halves which when assembled, define the support element.

The elongate support members may be of any suitable shape and size, preferably substantially rectangular shape, in cross section. It should be understood that the shape of the supports is not limited to a round cross section and they can be square, rectangular, or any other shape in cross section and need not be of a constant cross section shape or size. The elongate support member may of tubular shape and size.

The vertically spaced apart receptacles may be disposed at an angle of from 3 to 8 degrees to the vertical, typically around 5 degrees to the vertical.

The vertical spaced apart receptacles may be located in a concave region of the support member. A plurality of vertical spaced apart receptacles may be located out of register one another on opposing outer surfaces of the support member.

Spacing formations may extend from inner sidewalls of the receptacle into the opening defined by the receptacle, for spacing a seedling away from the inner wall of the receptacle, substantially centrally therein.

The elongate support members may include channelling means for channelling fluid streaming down the fluid channel towards a root zone of a plant contained in the receptacle.

The channelling means may be in the form of v- shaped ridges extending from an inner surface of the elongate support member.

The elongate support members may include disperser elements for dispersing fluid received from the channelling means.

The elongate support member may include a passage in fluid communication with the opening for introducing temperature and or oxygen regulated air to the root zone of a seedling disposed in the opening.

The fluid stream may have nutrients dissolved therein for promoting plant growth.

The fluid stream may have an organic anionic surfactant dissolved therein.

The identical parts of the elongate support members may be secured together by clips, glue, plastics welding, or any other suitable means.

The carbon dioxide enriching apparatus may be a carbon dioxide scrubber arrangement configured to scrub carbon dioxide from a high carbon dioxide concentration stream, such as a stream from a cylinder of compressed carbon dioxide or an effluent stream from a chemical process which generates carbon dioxide, such as combustion.

The carbon dioxide is scrubbed from the high concentration carbon dioxide stream and the carbon dioxide enriched fluid may be used in the greenhouse for supplying the seedlings with nutrients, for creating the fog, or for other uses.

The carbon dioxide enriched fluid stream may have plant nutrients dissolved therein.

The fluid stream may be trickled over the roots of the seedlings by trickling the fluid stream through the flow channel in the seedling supports.

According to a second aspect of the invention there is provided a soilless system for high density plant growth, said system including:

- a greenhouse type structure;
  at least one elongate support member arranged substantially vertically in the greenhouse, the support member having:
  a body having a flow channel defined therein;

an arm extending at an angle of between 1 and 179 degrees away from the body; and

a receptacle defined on an opposing end region of the arm , the receptacle, arm and body being in fluid communication with one another for allowing fluid received by the receptacle, to flow downstream the arm towards the body;

- a fluid supply system for supplying a fluid stream to the receptacle; and
  a fluid collection system for collecting residual fluid which has flowed through the flow channel.

The support members may be manufactured from any suitable plastics and or synthetic material and may be of any suitable dark colour.

The support members may comprise two symmetric elongate halves to be assembled together to define the said support member.

A sealing formation for complementary receiving a sealing element therein, may be provided to seal off a space defined in-between the two symmetric halves when assembled.

The receptacle may include spacing formations for spacing the plant substantially centrally and away from an inner surface region of the receptacle.

The spacing formations may be in the form of protrusions extending from the inner surface of the receptacle.

The receptacle may be shaped and sized to in turn complementally receive a perforated basket type element therein, which basket type element is configured to receive a seedling plug. The perforated basket type element allow roots of the seedling plug to extend down the arm during the growing process.

The receptacle may include a securing formation arranged at an upper end region thereof for receiving and securing a fluid source in fluid communication therewith for trickling a nutrient enriched fluid to the receptacle.

Engagement formations defined on end regions of the body allow coupling of a plurality of soilless plant cultivating containers together, thereby defining a soilless plant cultivating pipe.

The engagement formations may take the form of male and female engagement formations, shaped and sized to sealably couple with one another so as to inhibit escape of fluid out of the soilless cultivating pipe, when assembled.

The body and the arm may comprise two symmetric halves to be assembled together to define the soilless plant cultivating container.

A sealing formation for complementary receiving a sealing element therein, may be provided to seal off a space defined when the two symmetric halves are assembled to define the soilless plant container.

Securing formations may further be provided for securing the assembled halves together in assembled mode.

The receptacle may include spacing formations for spacing the plant substantially centrally and away from an inner surface region of the receptacle.

The receptacle may be shaped and sized to in turn complementally receive a perforated basket type element therein, which basket type element is shaped and sized to receive a seedling plug. The basket type element is perforated for allowing roots of the seedling plug to extend down the arm during the growing process.

The receptacle may include a securing formation for receiving and securing a fluid source in fluid communication therewith for trickling a nutrient enriched fluid source to the receptacle.

The spacing formations may be in the form of protrusions extending from an inner surface of the receptacle.

Engagement formations defined on end regions of the body allow coupling of a plurality of soilless plant cultivating containers together, thereby defining a soilless plant cultivating pipe.

The engagement formations may take the form of male and female engagement formations, shaped and sized to sealably couple with one another so as to inhibit escape of fluid out of the soilless cultivating pipe, when assembled.

The carbon dioxide enriching apparatus may be a carbon dioxide scrubber arrangement configured to scrub carbon dioxide from a high carbon dioxide concentration stream, such as a stream from a cylinder of compressed carbon dioxide or an effluent stream from a chemical process which generates carbon dioxide, such as combustion.

The carbon dioxide is scrubbed from the high concentration carbon dioxide stream and the carbon dioxide enriched fluid may be used in the greenhouse for supplying the seedlings with nutrients, for creating the fog, or for other uses.

The carbon dioxide enriched fluid stream may have plant nutrients dissolved therein.

The fluid stream may be trickled over the roots of the seedlings by trickling the fluid stream through the flow channel in the seedling supports.

According to a third aspect of the invention, there is provided a soilless method for high density plant growth, said method including at least the steps of:

- enriching a nutrient fluid stream with carbon dioxide; and
- supplying seedlings with the carbon dioxide enriched fluid stream.

The method may include enriching the fluid stream with carbon dioxide until the pH of the fluid stream is adjusted to between 6 and 7, typically 6.2. The fluid stream may have increased carbonic acid levels due to the enrichment of the stream with carbon dioxide.

Prior to enriching, the fluid stream to be enriched has a low to very low dissolved solids, such as distilled water, water recovered from condensers, from air conditioning systems, and RO systems.

According to a fourth aspect of the invention, there is provided a system for long distance farming, said system including a high density soilless system as hereinbefore described, characterised in that the control of the greenhouse environment as well as nutrient levels are controlled and managed via a

computerised system, which system is located in a location different from where the greenhouse is located.

The different location may be a different country.

The computerised system receives data input from the greenhouse environment, such as but not limited to in – house temperature, water nutrient levels, water carbonic levels and pathogenic levels.

The data received may allow the user of the computerised system to communicate corrective measures to be taken so as to optimise growing conditions.

The invention will now be described, by way of a non-limiting example only.

DESCRIPTION OF THE INVENTION

Figure 1 shows one symmetric half of a first embodiment of a support element in accordance with the invention;

Figure 2 shows the support element as shown in Figure 1, when assembled.

Figures 3 to 4 shows a second embodiment of the support member in accordance with the invention;

Figure 5 shows a greenhouse of the invention; and

Figure 6 shows a CO_2 scrubber system for use in the invention for enriching a fluid stream with carbonic acid and/or CO_2.

In figures 5 and 6 are shown a high density soilless system 10 also referred to as innovative controlled environment-accelerated growth enhancement chamber, for growing leafy plants such as lettuce and herbs. The system 10 is not a hydroponic system as that term is understood by the inventors as the roots are not permanently

immersed in a nutrient fluid or in a nutrient fluid soaked medium and accordingly the system is rather closer to an aeroponic system since the roots are exposed to a trickle of nutrient rich fluid, whereas in traditional aeroponic systems the roots are sprayed with a nutrient rich fluid.

The greenhouse type structure comprises so called lumens enhancing means for increasing the amount of visible light in the structure. The lumens enhancing means can be in the form so called light penetrating material covering the structure for allowing a predetermined amount of sunlight to penetrate the structure. The material can include glass and or clear polycarbonate resistant to ultraviolet radiation. The material will typically also include reflective properties for allowing sunlight to penetrate the structure, but to inhibit sunlight to reflect back to outer the structure, ie so called Agri - film™. A suitable filter can also be included in the material to promote wavelengths of so called red and blue light rays to enter the greenhouse structure.

Reflective composition in the flooring of the greenhouse structure for reflecting sunlight away from the floor will typically also be included for increasing the visible sunlight inside the greenhouse. Coating the flooring in a red and blue colour arrangement further promotes the reflection of red and blue wavelength away from the flooring towards the plants.

In order to regulate the ambient temperature inside the greenhouse, ventilation shafts and or fans, wetting system for wetting the outer surface of the structure and a spraying system for spraying a fine mist inside the structure, can be applied. A conventional radiator system can also be incorporated for regulating the ambient temperature inside the structure.

The greenhouse structure also includes pathogen control measures for controlling pathogen levels within predetermined ranges inside the structure. The pathogen control measures include a double air locked access to the structure, and a flooring composition for collecting undesirable particles and pathogens.

In a preferred embodiment in the greenhouse there is provided, in a grid layout, a plurality of wave shaped supports 12 (Figures 1 and 2), rather than simply a straight vertical pipe portion, the supports having an internal flow channel 14 for a

fluid or a vapour stream, such as a nutrient and/or CO_2 enriched water stream, to flow between an upper and a lower portion thereof.

The wave shaped supports 12 have vertically spaced apart openings 16 angularly disposed to the vertical axis thereof, said opening being sized for receiving seedlings therein so that, in use, seedlings are planted in the openings with their roots dangling into the flow channel i.e. the openings are in flow communication with the flow channel so that the roots can come into contact with a fluid trickling down the flow channel or a gas or a mist in the flow channel.

A fluid supply is connected to an upper end of each of the supports so that the fluid trickles down the flow channel and brings the roots of the seedlings into contact therewith.

At the bottom of the supports, and in flow communication with the bottom outlets of the flow channels, there is provided a fluid collection system for collecting residual fluid which has trickled through the supports.

The openings for the seedlings are disposed at an angle of around 5 degrees to the vertical as this is believed to optimise sunlight for the seedlings.

In the example of the invention, the supports are of modular design and each support is assembled from a number of identical parts which when assembled together form the support. This has the advantage that only a single mould need to be made and the vertical tubular supports can be assembled from a number of these identical parts which reduces the costs and complexity thereof. However, it is not inconceivable that there may be two or more part types which are assembled to form a unit from which the tubular supports are assembled.

Any number of identical parts may be secured together to form a vertical support of a desired length. Likewise, the dimensions of the identical parts can be selected to form a vertical tubular support of any desired equivalent diameter, for example 50 mm, and/or to match any standard piping size available.

Thus, the plant and or seedling supports of the system of the invention have the advantage that there is directional flow of the nutrient fluid and this is assisted by

having fins 18 inside the flow channel as well as the shape thereof, which ensures that the nutrient fluid will trickle over the root zone of a seedling planted therein. Dispersing element 20 ensures that fluid are dispersed to increase oxygenation thereof.

Temperature control in the receptacle and or plant root zone, is achieved by the passage and slot formation 22 for allowing oxygenated air to be introduced to the root zone of the plant. The control of temperature in the preferred region of 16 – 25 degrees celcius around the plant root zone is achieved by the introduction of air of the required temperature, down the passage, entering the root zone via the slot formations. The passage and slot formation contributes to the energy efficiency of the system, in that the temperature around the root zone is regulated without the need to control the complete environment inside the greenhouse structure. Air of the required temperature will be introduced intermittently through the passage via the slots to the root zone to facilitate maximum plant growth.

The guiding formations 24 inhibits the escape of fluid out of the receptacle should the receptacle be overgrown by plant roots thereby obstructing the flow of fluid.

The disposition of the openings at 5 degrees to vertical is believed to be optimal for latitude position on globe and angle of sunlight.

Certain plants such as cauliflower become top heavy during growing and to prevent the plant from falling out of the growing container, the support members 26 as depicted in figures 3 and 4 are proposed. This embodiment of the support member also includes a perforated receptacle 28 to secure the seedling. This embodiment further incudes spacer 30 for spacing the plant relatively centrally the receptacle. A securing formation 32 allows a fluid source to be connected to the rim of the receptacle thereby allowing fluid to trickle downward the receptacle.

In the system, as the fluid flow is vertically from top to bottom, the mixing of fertilised hydroponic or aeroponic feed and gasses is enhanced due to the trickle flow.

The system provides for maximum light penetration through the system, thus when the vertical supports are placed in close proximity as in a greenhouse, some of the pipes are at risk of being in the shade of other pipes and thus the shape and form of the vertical supports of the system is such that it minimises the shade risk for neighbouring vertical tubular supports, which are known as vertical growth stacks.

The system thus provides for a density of from 100 to 1000 percent of current growth systems, or more and typically permits for from 200 to 400 plants per square meter although this can be increased by use of artificial lighting.

The system thus allows for directional gas enhancement and growth medium recirculation in same system.

The system also allows for good airflow through the growing environment with the vertical tubular supports form allowing for good air flow through the rows of growing plants.

By harvesting water using adiabatic distillation and condensation methods, conventional atmospheric water generators and treated water and or fluid in circulation by exposure to UV and ozone, a relatively self-sustainable plant growth environment is created, wherein the self-sustainability is aided by the close loop circulation of fluid / water inside the greenhouse.

OPERATION OF AN EXAMPLE OF A SYSTEM OF THE INVENTION

Without limiting the scope of the invention or how it may be used, the system can conveniently be used as follows:

A CO_2 rich stream is scrubbed into a water stream treated with M3T™ surfactant to form carbonic acid and higher concentration CO_2 in the water thus the water exiting the scrubber includes dissolved CO_2 and carbonic acid.

The CO_2 can be from industrial processes or captured from the air e.g. Carbon Capture and Storage.

The scrubber water enriched with carbonic acid and/or CO_2 is used as the water base for the vertical growing stack root side supply. The water with the dissolved carbonic acid is optimally at a pH of 6.2 but can be in the range pH 6 to 7. The water used to form the carbonic acid must have very low dissolved solids e.g. distilled water, water recovered from condensers of air-conditioning system and the water has a maximum temperature of about 25 degrees Celsius.

In the greenhouse the temperature should be between 17 and 20 degrees Celsius with either natural circulation or through mist spray.

Thus, in the normal operation of the system, the following steps are followed:

1. For a period of 3 days seedlings, seeds, cuttings or bulbs are firstly so called “hardened off”” and sterilised in a controlled environment incubator wherein they are exposed to a combination of artificial light, ozone, ultraviolet light (UV) and infra-red light (IR), while constantly sprayed with a water mist containing a combination of organic fungicide, M3T™, citrus oil, green tea extract, organic pesticide and organic fungicide This step is necessary to prepare the plant for second growing phase as described hereunder, and also to reduce the risk of fungus or insect attack. The water can be sterilised with ozone and UV and optionally passed over a magnet to magnetically treat the water. The mist is an ultrafine mist. The water or the mist may be ionised e.g. by polarising the spray nozzle. The droplet size range is from 1 to 100 micron.

2. The seedlings are transferred to the growth environment e.g. a greenhouse, which includes:

a. Removable hail cover to protect against hail damage and also to act as shading if necessary;

b. Water distribution system on the roof of the greenhouse via a system of interconnected pipes and nozzles for spraying water on the roof of the tunnel when needed;

c. Climate control system which includes a conventional water cooler, chiller, infrared red light source as well as a humidifier for controlling the ambient temperature in the range of 15-24, ideally 17°C degrees celcius, as well as the relative humidity inside the tunnel;

d. Heating mechanisms for example boiler and pipe configurations for increasing the in house temperature as well as the water temperature when such temperatures reach 5°C.

e. Reflectors preferably in the form of polycarbonate sheeting including reflector elements, positioned inside the tunnel for reflecting incoming light inside the tunnel so as to increase the light density inside the tunnel by about 5 - 17%, over and above ambient surrounding light.

f. Floor cover consisting of a reflective material and / or coating in silver and / or having anti-microbial properties, to obtain 200 to 1000 watt/m^2, typically around (50 watt/ft^2) 500 watt/ m^2. The ideal light wavelength is 400 – 700 nm. ;

g. The roof of the tunnel being hingedly connected so as to allow the roof to be partially removed in order to ventilate the greenhouse should the temperature and / or humidity reach maximum levels;

h. A double entrance system creating an enclosed cubicle between the two doors. The cubicle having a floor configured to hold disinfectant mixture consisting of an aqueous mixture of green tea extract, citrus oil, M3T, organic fungicide for disinfecting feet of people entering the tunnel;

i. The cubicle is further connected to a source of air supply for maintaining a relative positive pressure inside the cubicle, for preventing the introducing of foreign airborne substance into the cubicle and the tunnel;

j. Temperature and humidity inside the tunnel is controlled via a centralised remote controlled system where the system receives input on parameters such as temperature and humidity and the control is achieved via, but not limited to, the climate control unit, spraying of mist inside the tunnel and partial removal of the roof;

k. Water harvesting system for harvesting water as a by-product of the watercooler system as well as from the atmosphere by means of adiabatic distillation and condensation methods such as Skywater™ .

l. Water treatment system for treating the water which is kept in a reservoir for applying to the roots of the growth stack.

m. Blowers or fans running at typically a rate of 2m/s (range 1-5m/s) for enabling continuous air flow in the greenhouse, so as to prevent the build-up of gasses exchanged during plant propagation, typically CO2 and oxygen.

n. Solar panels for generating electricity for driving the motor driven apparatus such as the water cooler, blowers and fans such as the Smart Power ™ concept.

o. Purpose made "Hortimax™ to monitor real time plant propagation process and early detection of nutrient loss, Ph fluctuation, pathogens outbreak so as to allow for remote management.

p. Hydrathron for electrochemical treatment of pathogens such as Pythium, Phytophthora and Fusarium, by releasing colloidal silver and hydrogen peroxide into the spray mist and / or the trickle water supply.

The water treatment system consists of a UV light source, electro-magnetic cation exchanger, ozone source, organic filters for removing organic matter, biofilters, sand filters, nanotech filters, carbon activated or oilshale filters, ultrasound, aeration via cascade means and / or so called ventury, reverse hydro-chemical activation for enriching water oxygen as well as with trace elements such as copper and iron.

The water reservoir is a sealed unit in fluid communication with the system of interconnected pipes for recollection of water trickled down the pipe modules, the reservoir further including a source of air creating a positive air pressure inside the reservoir, allowing for directional gas enhancement and growth medium recirculation in the same system with a counter flow of gasses flowing up in the flow channel in an opposite direction to nutrient flow.

The positioning of the vertical growth stacks (vertical tubular supports) will be selected to permit the plants to have maximum exposure of their leaves to sunlight. The growth environment is designed to restrict losses of gasses and heat from the greenhouse so that the greenhouse operates under a slight positive pressure. IR and UV lights are used to compensate for lack of sunlight due to weather conditions.

A fogging system is used to spray a fine mist of water, or water with M3T™ and seaweed extract onto the leaves in order to improve cell structure. The mist spra

serves 4 functions i.e. temperature control, leaf feeding, pest control/pathogen control, and to control humidity.

Nutrients i.e. macro elements such as organic NPK are mixed with water which has been treated with M3T™, and this is then supplied to the root side of the vertical growth stack where it trickles through the vertical tubular supports over the roots and keeps them wetted with the nutrient enriched water. Micro-elements could be provided through electrochemical processes, for example, dissolving metal electrodes into water e.g. iron and magnesium via reverse hydro chemical activation.

Prior to harvest, the plants are treated for a period of 48 hours with a mixture of anionic surfactant, organic Ph stabiliser, organic anti bacteria and organic preservative resulting in an increase in hydro carbohydrate levels and so called BRIX content of the plant leaves.

Harvesting is done during night time and plants are cut using pressurised air supply. All cutting and instruments are treated with a mixture of M3T™ and Zoonocide™ or similar. From point of harvest until transport temperature is kept below 10 degrees celcius. All personnel wear protective wear to limit contamination. Packed product is stored between 3 – 7 degrees celcius.

To promote shelf life and freshness, a composition which includes nutrients and moisture, is added in the packaging. During transportation the plant will continue absorbing moisture and nutrients from the composition.

To further enhance growth in the greenhouse, the plants are exposed to a predetermined range of sound waves, known as acoustic grow.

The use of oxidation process, commonly known as AOP, further enhance the quality and purity of the nutrient enriched fluid.

The use of an anionic surfactant such as M3T™ herein described promotes the wetting of roots, thereby increasing osmosis, diffusion, alleviation of the root pressure differential with a resultant increase in the rate of water uptake with a decrease energy expenditure in doing so.

M3T™ is a surfactant product available from Marine 3 Technologies (Pty) Ltd in South Africa and is a patented product.

The Applicant considers the invention advantageous in that a low carbon emission high density plant cultivation systems and method is described wherein the low carbon emission is attributed to factors such as the use of solar panels for generating electricity, reflective material for enhancing visible light inside the tunnel, the incorporation of airflow passages with slot formations in the vertical plant supports for localised regulation of temperature around the plant root zone, no petrochemical based substances such as synthetic fertiliser, pesticides and or herbicides, commonly used in traditional farming practices. The carbon enriching scrubber apparatus further contributes to low carbon footprint of the system by acting as a carbon sink, wherein the scrubbed carbon is converted into edible plant material.

CLAIMS

1. A soilless system for high density plant growth, said system including:

- a greenhouse type structure;

at least one elongate support member arranged substantially vertically in the greenhouse type structure, the support member having:

a body having a flow channel defined therein; and

a plurality of vertically spaced apart receptacles angularly disposed to the vertical axis of the body for receiving a plant therein, the receptacles being in flow communication with the flow channel;

- a fluid supply system in fluid communication with the flow channel for supplying a fluid stream to the said flow channel; and

a fluid collection system for collecting residual fluid which has flowed through the flow channel.

2. A soilless system for high density plant growth as claimed in claim 1 wherein the greenhouse type structure includes lumens enhancing means for increasing the amount of visible light therein.

3. A soilless system for high density plant growth as claimed in claim 2 wherein the lumens enhancing means is in the form of light penetrating material which includes reflective properties for allowing sunlight to penetrate the structure, but to inhibit sunlight to reflect back to outer the structure.

4. A soilless system for high density plant growth as claimed in claim 2 wherein the lumens enhancing means is in the form of a reflective composition in the flooring of the greenhouse structure for reflecting sunlight away from the floor towards the support members.

5. A soilless system for high density plant growth as claimed in claim 4 wherein the reflective composition comprise a wavelength specific coating for reflecting red and blue light spectrums away from said flooring.

6. A soilless system for high density plant growth as claimed in claim 2 wherein the lumens enhancing means is in the form of a light source for supplying light having a wavelength of about 800 – 1000 nm.

7. A soilless system for high density plant growth as claimed in any one of the preceding claims wherein the greenhouse type structure includes temperature regulating means for regulating temperature inside the structure.

8. A soilless system for high density plant growth as claimed in claim 7 wherein the temperature regulating means is in the form of any one or more selected from the group consisting of ventilation shafts and or fans, a wetting system for wetting the outer surface of the greenhouse structure, a spraying system for spraying a fine mist inside the structure and a radiator system.

9. A soilless system for high density plant growth as claimed in any one or more of the preceding claims wherein the elongate support member is of generally wave shaped form.

10. A soilless system for high density plant growth as claimed in any one or more of the preceding claims wherein the elongate support member is of substantially rectangular shape, in cross section.

11. A soilless system for high density plant growth as claimed in any one or more of the preceding claims wherein the receptacles are located in a concave region of the support member.

12. A soilless system for high density plant growth as claimed in claim 11 wherein spacing formations extend from an inner sidewall of the receptacle for positioning a seedling substantially centrally and away from said inner sidewalls of said receptacle.

13. A soilless system for high density plant growth as claimed in any one of the preceding claims wherein the elongate support member includes channelling means for channelling fluid streaming down the fluid channel towards a root zone of a plant contained in the receptacle.

14. A soilless system for high density plant growth as claimed in claim 13 wherein the channelling means is in the form of v- shaped ridges extending from an inner surface of the elongate support member.

15. A soilless system for high density plant growth as claimed in any one of the preceding claims wherein the elongate support member includes disperse elements for dispersing fluid received from the channelling means.

16. A soilless system for high density plant growth as claimed in any one of the preceding claims wherein the support member includes a passage in fluid communication with the receptacle for introducing temperature and or oxygen regulated air to the root zone of a seedling contained therein.

17. A soilless system for high density plant growth as claimed in any one of the preceding claims wherein the fluid supply system includes a carbon dioxide enriching apparatus for enriching the fluid stream with carbon dioxide.

18. A soilless system for high density plant growth as claimed in claim 17 wherein the carbon dioxide enriching apparatus is in the form of a carbon dioxide scrubber arrangement configured to scrub carbon dioxide from a high carbon dioxide concentration stream.

19. A soilless system for high density plant growth as claimed in claim 18 wherein the high carbon dioxide concentration stream is selected from any one or more from the group consisting of a cylinder of compressed carbon dioxide and, an effluent stream from a chemical process which generates carbon dioxide.

20. A soilless system for high density plant growth as claimed in any one of the preceding claims wherein the fluid stream has nutrients dissolved therein for promoting plant growth.

21. A soilless system for high density plant growth as claimed in any one of the preceding claims wherein the fluid stream has an organic anionic surfactant dissolved therein.

22. A soilless system for high density plant growth, said system including:

- a greenhouse type structure;

at least one elongate support member arranged substantially vertically in the greenhouse, the support member having:

a body having a flow channel defined therein;

an arm extending at an angle of between 1 and 179 degrees away from the body; and

a receptacle defined on an opposing end region of the arm , the receptacle, arm and body being in fluid communication with one another for allowing fluid received by the receptacle, to flow downstream the arm towards the body;

- a fluid supply system for supplying a fluid stream to the receptacle; and

a fluid collection system for collecting residual fluid which has flowed through the flow channel.

23. A soilless system for high density plant growth as claimed in claim 22 wherein the receptacle includes a spacing formation for spacing the plant away from an inner surface of the receptacle, substantially centrally therein.

24. A soilless system for high density plant growth as claimed in any one of claims 21 or 22 wherein the receptacle includes a perforated basket type element for receiving a seedling plug therein.

25. A soilless system for high density plant growth as claimed in any of claims 22 to 24 wherein the fluid supply system includes a carbon dioxide enriching apparatus for enriching the fluid stream with carbon dioxide.

26. A soilless system for high density plant growth as claimed in claim 25 wherein the carbon dioxide enriching apparatus is in the form of a carbon dioxide scrubber arrangement configured to scrub carbon dioxide from a high carbon dioxide concentration stream.

27. A soilless system for high density plant growth as claimed in claim 26 wherein the high carbon dioxide concentration stream is selected from any one or more from the group consisting of a cylinder of compressed carbon dioxide and, an effluent stream from a chemical process which generates carbon dioxide.

28. A soilless system for high density plant growth as claimed in any one of claims 22 to 27 wherein the fluid stream has nutrients dissolved therein for promoting plant growth.

29. A soilless system for high density plant growth as claimed in any one of claims 22 to 28 wherein the fluid stream has an organic anionic surfactant dissolved therein.

30. A soilless method for high density plant growth, said method including at least the steps of:

- enriching a nutrient fluid stream with carbon dioxide; and
- supplying seedlings with the carbon dioxide enriched fluid stream.

31. A soilless method for high density plant growth as claimed in claim 30 wherein the fluid stream have increased carbonic acid levels due to the enrichment of the stream with carbon dioxide.

32. A system for long distance farming, said system including a high density soilless system as claimed in any one of the preceding claims, characterised in that the control of the greenhouse environment as well as nutrient levels are controlled and managed via a computerised system, which system is located in a location different from where the greenhouse is located.

33. A soilless system for high density plant growth, according to the invention, substantially as hereinbefore described or exemplified.

34. A soilless system for high density plant growth as specifically described with reference to or as illustrated in any one of the accompanying drawings.

35. A soilless system for high density plant growth, including any new and inventive integer or combination of integers, substantially as herein described.