

PLANT GROWTH SYSTEM

TECHNICAL FIELD

The present disclosure relates generally to hydroponic plant growth system; and more specifically, to a plant growth system for cultivating plants in a soil-less
5 environment.

BACKGROUND

Plants are an important part of human life and necessary for human survival as the humans primarily consumes plants and plant-based products for fulfilling their nutritional requirements. The humans consume various parts of different plants
10 such as roots, stems, leaves, flowers, fruits etc. to fulfil nutritional requirements. The ever-increasing population is increasing the demand of humans for food which is primarily fulfilled by the plants. Thus, the requirement for cultivable land is increasing. However, the increase in human population is resulting in faster urbanisation and increasing the requirement of land for other uses such as housing,
15 thus, squeezing the availability of cultivable land and creating pressure on existing agricultural techniques to fulfil the increasing demand.

In the recent past, newer and modern agricultural and horticultural techniques are being employed to grow plants. One such modern horticulture technique is hydroponics. Generally, the hydroponic systems are used to grow fruit bearing
20 smaller plants without soil using a nutrient solution in an aqueous solvent. In the hydroponic systems, the roots are exposed to the nutrient solution for the uptake of nutrients by the plant. The roots are generally supported in mediums such as coco-peat, perlite etc. However, there are a lot of drawbacks associated with the conventional hydroponic systems. In the conventional hydroponic systems, it is
25 difficult to maintain the composition of nutrient solution creating imbalance of nutrients in the nutrient solution which may result in poor growth and health of the plant. Moreover, there is a lot less control on the chemical properties of the nutrient solution such as pH, electrical conductivity etc. which may adversely affect the

growth of the plant. Furthermore, the control over the physical properties of the nutrient solution such as temperature, dissolved oxygen etc. requires a lot of energy input. Furthermore, the conventional hydroponic systems require frequent flushing and buffering of cocopeat medium and are difficult to maintain, thereby increasing the overall cost of production. Furthermore, the conventional hydroponic systems require frequent replacement of the growth medium such as cocopeat, which increases the waiting period between two transplantations and overall cost of production.

Moreover, due to the design and maintenance constraints, the chances of bacterial and fungal contamination of the nutrient solution and growth chambers are higher in the conventional hydroponic systems. Furthermore, the conventional hydroponic systems do not provide additional support for healthy root growth which results in poor overall growth of the plants in the system.

Therefore, in light of the foregoing discussion, there exist a need to at least partially solve the above-mentioned problems by providing an improved plant growth system for cultivating plants in a soil-less environment.

SUMMARY

The present disclosure seeks to provide a plant growth system for cultivating plants in a soil-less environment.

The object of the present disclosure is to provide a plant growth system for cultivating plants in a soil-less environment that overcomes at least partially the problems encountered in the prior art.

In one aspect, an embodiment of the present disclosure provides a plant growth system for cultivating plants in a soil-less environment, the system comprising:

- at least one plant growth chamber for accommodating roots of at least one plant;
- a root volume adaptability module for identifying and maintaining water level in the at least one plant growth chamber for the roots of the at least one plant;

- a conditioning module for identifying and maintaining at least one plant growth parameter in adjoining surrounding of the roots inside the at least one plant growth chamber;
- a control module communicably coupled with the root volume adaptability module and the conditioning module for controlling at least one actuators of the plant growth system; and
- at least one image capturing module for capturing visual data of the at least one plant, wherein the least one image capturing module is communicably coupled with the control module for sharing the captured visual data to detect deficiency in the at least one plant.

The present disclosure is advantageous in terms of providing healthy growth to the plants in the system.

Optionally, the at least one plant growth chamber has a trapezoidal structure and contains nutrient media and water mixture.

- Optionally, a composition of the nutrient media varies according to a growth stage of the at least one plant.

Optionally, the at least one plant growth chamber comprises a plurality of openings for mounting the at least one plant in the at least one plant growth chamber.

- Optionally, the at least one plant growth chamber has a length, width and height ratio in a range of 60 – 100 : 6 – 10 : 4 – 6.

Optionally, the root volume adaptability module comprises a water level sensor for identifying water level in the at least one plant growth chamber for the roots of the at least one plant.

- Optionally, the root volume adaptability module comprises at least one of a solenoid valve and a siphon mechanism for maintaining water level in the at least one plant growth chamber for the roots of the at least one plant.

Optionally, the at least one plant growth parameter comprises at least one of temperature, humidity, pH, electrical conductivity, dissolved oxygen, total dissolved solid (TDS) and CO₂ level.

Optionally, the conditioning module maintains the humidity in adjoining
5 surrounding of the roots by increasing an irrigation frequency with lowest water and oxygen level.

Optionally, the irrigation frequency in adjoining surrounding of the roots is modulated using the siphon mechanism.

Optionally, the at least one actuator comprises at least one solenoid valve, at least
10 one pressure gauge, at least one exhaust fan, at least one circulation fan, at least one fogger, sprayer, sprinkler, irrigation motor, cooling pad motor or combination thereof.

Optionally, the control module, when in operation, receives data from the root
15 volume adaptability module, the conditioning module and the at least one image capturing module for real-time operation of the at least one actuator.

Optionally, the at least one image capturing module is placed inside the plant growth chamber to capture visual data of the roots of the at least one plant and the at least one image capturing module is placed outside the plant growth chamber to capture visual data of a shoot part of the at least one plant.

20 Optionally, the system comprises a polyhouse for maintaining the at least one plant growth parameter for a shoot part of the at least one plant.

Optionally, the system comprises a server arrangement communicably coupled with the control module for remote monitoring and management of the system.

Optionally, the system comprises an underground storage unit for the nutrient
25 media and water mixture.

Embodiments of the present disclosure substantially eliminate or at least partially address the aforementioned problems in the prior art, and enables healthy growth of the plant in the system.

Additional aspects, advantages, features and objects of the present disclosure would
5 be made apparent from the drawings and the detailed description of the illustrative embodiments construed in conjunction with the appended claims that follow.

It will be appreciated that features of the present disclosure are susceptible to being combined in various combinations without departing from the scope of the present disclosure as defined by the appended claims.

10 BRIEF DESCRIPTION OF THE DRAWINGS

The summary above, as well as the following detailed description of illustrative embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the present disclosure, exemplary constructions of the disclosure are shown in the drawings. However, the present
15 disclosure is not limited to specific methods and instrumentalities disclosed herein. Moreover, those in the art will understand that the drawings are not to scale. Wherever possible, like elements have been indicated by identical numbers.

Embodiments of the present disclosure will now be described, by way of example only, with reference to the following diagrams wherein:

20 FIG. 1 is a schematic illustration of a plant growth system for cultivating plants in a soil-less environment, in accordance with an embodiment of the present disclosure.

FIG. 2A, 2B, and 2C are schematic illustrations of perspective view, side view, and top view of at least one plant growth chamber respectively, in accordance with an
25 embodiment of the present disclosure.

FIG. 3 is a schematic illustration of a siphon mechanism connected with at least one plant growth chamber, in accordance with an embodiment of the present disclosure.

FIG. 4 is a schematic illustration of a frame for mounting at least one plant growth chamber, in accordance with an embodiment of the present disclosure.

- 5 In the accompanying drawings, an underlined number is employed to represent an item over which the underlined number is positioned or an item to which the underlined number is adjacent. A non-underlined number relates to an item identified by a line linking the non-underlined number to the item. When a number is non-underlined and accompanied by an associated arrow, the non-underlined
10 number is used to identify a general item at which the arrow is pointing.

DETAILED DESCRIPTION OF EMBODIMENTS

- The following detailed description illustrates embodiments of the present disclosure and ways in which they can be implemented. Although some modes of carrying out the present disclosure have been disclosed, those skilled in the art would
15 recognize that other embodiments for carrying out or practicing the present disclosure are also possible.

- The terms “a” and “an” herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items. The terms “having”, “comprising”, “including”, and variations thereof signify the presence of a
20 component.

- Referring to Fig. 1, there is illustrated a block diagram of a plant growth system **100** for cultivating plants in a soil-less environment, in accordance with an embodiment of the present disclosure. The plant growth system **100** comprises at least one plant growth chamber **102**, a root volume adaptability module **104**, a
25 conditioning module **106**, a control module **108**, and at least one image capturing module **110**. The at least one plant growth chamber **102** of the plant growth system **100** accommodates roots of at least one plant. The root volume adaptability module

104 of the plant growth system 100 identifies and maintains water level in the at least one plant growth chamber 102 for roots of the at least one plant. The conditioning module 106 of the plant growth system 100 identifies and maintains at least one plant growth parameter in adjoining surrounding of the roots in the at least one plant growth chamber 102. The control module 108 of the plant growth system 100 is communicably coupled with the root volume adaptability module 104 and the conditioning module 106 for controlling at least one actuators of the plant growth system 100. The at least one image capturing module 110 of the plant growth system 100 captures visual data of the at least one plant. The at least one image capturing module 110 of the plant growth system 100 is communicably coupled with the control module 108 of the plant growth system 100 and shares the captured visual data with the control module 108 of the plant growth system 100 to detect deficiency in the at least one plant.

The plant growth system 100 of the present invention would be advantageous in terms of providing healthy growth to the at least one plant in the plant growth system 100. Advantageously, the plant growth system 100 of the present invention maintains composition of nutrients in the nutrient solution for the proper nutrition of the plant, resulting in healthy plant growth. The plant growth system 100 of the present invention extensively supports healthy root growth by maintaining optimal plant growth parameters around the roots. Advantageously, the plant growth system 100 of the present invention maintains the optimum physical and chemical properties of nutrient media for the healthy growth of the plants in the system. It would be appreciated that the plant growth system 100 of the present invention reduces the chances of bacterial and fungal contamination of the nutrient media and the at least one plant growth chamber 102. Moreover, the plant growth system 100 of the present invention is easy to clean and does not require frequent flushing and buffering. Advantageously, the plant growth system 100 of the present invention can be maintained and controlled remotely. Moreover, it will be appreciated that the plant growth system 100 of the present invention does not require waiting period between two transplantations.

Referring to Fig. 2a, there is illustrated a perspective view of the at least one plant growth chamber **200** (such as **102** of Fig. 1).

Referring to Fig. 2b, there is illustrated a side view of the at least one plant growth chamber **200** (such as **102** of Fig. 1).

- 5 Referring to Fig. 2c, there is illustrated a top view of the at least one plant growth chamber **200** (such as **102** of Fig. 1) with a cover on the top. Optionally, the at least one plant growth chamber **200** may be covered on top surface and comprises a plurality of openings **202** for mounting the at least one plant in the at least one plant growth chamber **200**. More optionally, the at least one plant growth chamber **200**
10 may comprise a cavity in each of the plurality of openings **202** to provide structural support to the roots of the plant growing the plant growth system.

Throughout the present disclosure, the term “plant growth system” refers to an integrated hydroponic system with a plurality of components for growing the at least one plant in the plant growth system **100**.

- 15 Throughout the present disclosure, the term “at least one plant growth chamber” refers to a container-like structure for accommodating roots of the at least one plant growing in the plant growth system **100**.

Optionally, the at least one plant growth chamber **102** may have a trapezoidal structure.

- 20 Optionally, the at least one plant growth chamber **102** may contain a nutrient media, water and/or a mixture thereof. More optionally, a composition of the nutrient media may vary according to a growth stage of the at least one plant.

Optionally, the at least one plant growth chamber **102** may have a length to width to height ratio in a range of 60 - 100:6 - 10:4 - 6.

- 25 Optionally, the at least one plant growth chamber **102** may be made up of a polymer material. More optionally, the at least one plant growth chamber **102** may be made up of a composite material. More optionally, the at least one plant growth chamber **102** may be made up of a combination of the polymer material and the composite

material. Advantageously, the at least one plant growth chamber **102** thermal insulation to the roots of the at least one plant from the outside temperature to keep the roots of the at least one plant at a lower temperature for better yield. Beneficially, the at least one plant growth chamber **102** may be made up of inert
5 polymer or composite or the combination thereof.

In an embodiment, the at least one plant growth chamber **102** is made up of a polymer composite material. A composition of the polymer composite material comprises at least one of: a polymer, an ultra-violet stabilizer and a metallic masterbatch. The composition of the polymer composite material may comprise the
10 polymer in the range of 80% w/w to 99% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise the polymer in the range of 85% w/w to 95% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise the
15 polymer in the range of 90% w/w to 95% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise 80% w/w, 81% w/w, 82% w/w, 83% w/w, 84% w/w, 85% w/w, 86% w/w, 87% w/w, 88% w/w, 89% w/w, 90% w/w, 91% w/w, 92% w/w, 93% w/w, 94% w/w, 95% w/w, 96% w/w, 97% w/w, 98% w/w or 99%
20 w/w polymer of total weight of the composition of the polymer composite material. Optionally, the polymer in the polymer composite material is Linear low-density polyethylene. Alternatively, the composition of the polymer composite material may comprise clay in replacement of Linear low-density polyethylene. Alternatively, the composition of the polymer composite material may comprise a
25 combination of clay and Linear low-density polyethylene. Optionally, the Linear low-density polyethylene is rotomolding grade.

The composition of the polymer composite material may comprise the ultra-violet stabilizer in the range of 1% w/w to 10% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer
30 composite material may comprise the ultra-violet stabilizer in the range of 1% w/w

to 5% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise the ultra-violet stabilizer in the range of 5% w/w to 10% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise 1% w/w, 2% w/w, 3% w/w, 4% w/w, 5% w/w, 6% w/w, 7% w/w, 8% w/w, 9% w/w or 10% w/w ultra-violet stabilizer of total weight of the composition of the polymer composite material.

The composition of the polymer composite material may comprise the metallic masterbatch in the range of 1% w/w to 10% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise the metallic masterbatch in the range of 1% w/w to 5% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise the metallic masterbatch in the range of 5% w/w to 10% w/w of total weight of the composition of the polymer composite material. Optionally, the composition of the polymer composite material may comprise 1% w/w, 2% w/w, 3% w/w, 4% w/w, 5% w/w, 6% w/w, 7% w/w, 8% w/w, 9% w/w or 10% w/w metallic masterbatch of total weight of the composition of the polymer composite material. Optionally, the metallic masterbatch in the polymer composite material comprises at least one metal, at least one metal oxide or a combination thereof. Optionally, the metallic masterbatch in the polymer composite material may comprise aluminium. Optionally, the metallic masterbatch in the polymer composite material may comprise titanium oxide. Optionally, the metallic masterbatch in the polymer composite material comprises 70% w/w to 90% w/w of the at least one metal, at least one metal oxide or a combination thereof. Optionally, the metallic masterbatch in the polymer composite material comprises 80% w/w of the at least one metal, at least one metal oxide or a combination thereof.

In another embodiment, the at least one plant growth chamber **102** is made up of a polymer composite material comprising clay and linear low-density polyethylene.

Beneficially, the clay in the at least one plant growth chamber **102** provides better evaporative cooling.

In yet another embodiment, the at least one plant growth chamber **102** is made up of a polymer composite material comprising clay, linear low-density polyethylene and marble dust. Beneficially, the marble dust in the at least one plant growth chamber **102** provides better evaporative cooling, white colouring and strength.

In yet another embodiment, the at least one plant growth chamber **102** is made up of a polymer composite material comprising clay, linear low-density polyethylene, marble dust and super absorbent polymer. Beneficially, the super absorbent polymer in the at least one plant growth chamber **102** maintains relative humidity, reduce the number of irrigation cycles. Furthermore, the super absorbent polymer in the at least one plant growth chamber **102** provides moisture and nutrients for a long time to the plant roots.

In yet another embodiment, the at least one plant growth chamber **102** is made up of a polymer composite material comprising clay, linear low-density polyethylene, marble dust and cocopeat.

Optionally, the at least one plant growth chamber **102** is moulded at a temperature range of 250° C to 350° C. More optionally, the at least one plant growth chamber **102** is moulded at a temperature range of 250° C to 300° C. More optionally, the at least one plant growth chamber **102** is moulded at a temperature range of 300° C to 350° C. More optionally, the at least one plant growth chamber **102** is moulded at a temperature range of 260° C to 300° C. More optionally, the at least one plant growth chamber **102** is moulded at a temperature range of 270° C to 300° C. More optionally, the at least one plant growth chamber **102** is moulded at a temperature range of 280° C to 300° C. More optionally, the at least one plant growth chamber **102** is moulded at a temperature range of 290° C to 300° C.

Beneficially, the at least one plant growth chamber **102** thermally insulates the roots of the at least one plant from the outside ambient temperature. Beneficially, the at least one plant growth chamber **102** maintains inside temperature in the range of

15° C to 30° C in comparison to outside temperature that varies in the range of 5° C to 50° C. More beneficially, the at least one plant growth chamber **102** maintains inside temperature in the range of 15° C to 25° C in comparison to outside temperature that varies in the range of 5° C to 50° C. More beneficially, the at least one plant growth chamber **102** maintains inside temperature in the range of 15° C to 20° C in comparison to outside temperature that varies in the range of 5° C to 50° C. More beneficially, the at least one plant growth chamber **102** maintains inside temperature in the range of 20° C to 25° C in comparison to outside temperature that varies in the range of 5° C to 50° C. Beneficially, the at least one plant growth chamber **102** is made up of material with high specific heat capacity, thus, requires more heat for an increase in the temperature compared to the material with low specific heat. Beneficially, the at least one plant growth chamber **102** comprises material with high reflective property that reflects most of the incident heat and let the outside temperature to increase the inside temperature. Beneficially, the at least one plant growth chamber **102** comprises a super absorbent polymer. Beneficially, the at least one plant growth chamber **102** shows high evaporative cooling phenomenon due to the composition as described above. Beneficially, the at least one plant growth chamber **102** is lined with polyurethane foam on the outer surface to insulate the at least one plant growth chamber **102** from the outside temperature.

Throughout the present disclosure, the term “root volume adaptability module” refers to a module for identification and maintenance of optimum water level in the at least one plant growth chamber **102**.

Optionally, the root volume adaptability module **104** may comprise a plurality of water level sensors for identifying the water level in the at least one plant growth chamber **102**.

Optionally, the root volume adaptability module **104** comprises at least one solenoid valve and a siphon mechanism **300** for maintaining the water level in the at least one plant growth chamber **102**.

Optionally, the root volume adaptability module **104** may be operable to maintain the water level in the at least one plant growth chamber **102** according to the optimum requirement of the at least one plant growing in the at least one plant growth chamber **102**. It would be appreciated that the roots of the at least one plant
5 growing in the at least one plant growth chamber **102** may require different water level in the plant growth chamber **102** according to its size, volume and stage of growth such as germination, vegetative, budding, flowering, fruiting etc. Advantageously, the root volume adaptability module **104** may alter the water level in the at least one plant growth chamber **102** according to the growth stage and the
10 resulting actual requirements of the at least one plant.

Referring to Fig. 3, there is illustrated a siphon mechanism **300**, in operation with the at least one plant growth chamber **302** (such as **102** of Fig. 1). The siphon mechanism **300** comprises siphon tubes (U-tubes) **322** at one end may be connected with the at least one plant growth chamber **302**. The siphon tubes **322** of the siphon
15 mechanism **300** at another end may be connected with an underground storage unit **324** through a mechanical pump and a solenoid valve.

Optionally, the plant growth system **100** comprises an underground storage unit **324** for storing the nutrient media, water and/or the mixture thereof. Beneficially, the underground storage unit **324** is made up of brick and cement to provide natural
20 thermal insulation to the storage media and prevents frequent change in temperature of the nutrient media.

Throughout the present disclosure, the term “siphon mechanism” refers to a device with U-shaped tubes for the flow of liquids through the tubes. The siphon mechanism **300** may facilitate the maintenance of water level in the plant growth
25 chamber **102**. Beneficially, the siphon mechanism **300** operates to ensure optimum level of dissolved oxygen is maintained and available to the at least one plant. More beneficially, the siphon mechanism **300** operates to maintain the temperature in adjoining surrounding of the roots well below the ambient temperature of the shoot part of the plant. Furthermore beneficially, the siphon mechanism **300** operates to
30 ensure regular mixing of nutrient media. Beneficially, the siphon mechanism **300**

creates high pressure water droplets to increase the dissolved oxygen in the water flowing in the at least one plant growth chamber **102**. The availability of higher dissolved oxygen in the water ensures higher uptake of oxygen and nutrients by the plants, thereby resulting in faster harvesting cycles. It would be appreciated that the increased natural availability of the oxygen increases the uptake by plant without any added cost. More beneficially, the higher uptake of the oxygen and nutrients by the plants results in at least 20% faster growth of the plant. In an embodiment, the at least one plant growth chamber **102** is filled with the nutrient media and water to expose the roots of the at least one plant growing in the at least one plant growth chamber **102** for a defined time. After the defined time, once desired nutrition, humidity and water level is achieved inside the at least one plant growth chamber **102**, the siphon mechanism is activated to drain the nutrient media and water. The nutrient media and water are recycled in the at least one plant growth chamber **102** with a defined irrigation frequency. The irrigation frequency may be maintained based on the at least one of: ambient temperature in the at least one plant growth chamber **102**, ambient humidity in the at least one plant growth chamber **102**, growth stage of the at least one plant, time of the day and variety of the at least one plant.

Optionally, the solenoid valve turns on/off the flow of water through the siphon mechanism **300** for maintaining the water level in the at least on plant growth chamber **302**.

Throughout the present disclosure, the term “conditioning module” refers to module for identification and maintenance of optimum levels of at least one plant growth parameter in the at least one plant growth chamber **102**.

Throughout the present disclosure, the term “at least one plant growth parameter” refers to physical, chemical, physiological factors which are important for the optimum growth of the at least one plant growing in the plant growth system **100**.

Optionally, the at least one plant growth parameter comprises at least one of temperature, humidity, pH, electrical conductivity, dissolved oxygen, total dissolved solid (TDS) and CO₂ level.

Optionally, the conditioning module **106** maintains the humidity in adjoining
5 surrounding of the roots by increasing the irrigation frequency with lowest water and oxygen level. More optionally, the irrigation frequency in adjoining surrounding of the roots is modulated using the siphon mechanism **300**. Beneficially, during the irrigation, complete root volume is not under contact with the cool water.

10 Throughout the present disclosure, the term “control module” refers to module for controlling at least one actuators of the plant growth system. The control module **108** of the plant growth system **100** controls the actuators to regulate and maintain the at least one plant growth parameter in the plant growth system **100**. Beneficially, the control module **108** operates actuators to maintain optimum growing conditions
15 in the plant growth system **100**.

Optionally, the control module **108**, when in operation, receives data from the root volume adaptability module **104** and the conditioning module **106** and the at least one image capturing module **110** for real-time operation of the at least one actuator.

Throughout the present disclosure, the term “actuator” refers to any device which
20 cause a machine or any other device to operate and result in some changes in the plant growth system **100**. Optionally, the at least one actuator may be fitted inside the at least one plant growth chamber **102** to operate inside the at least one plant growth chamber **102** for regulating water level inside the at least one plant growth chamber **102**. More optionally, the at least one actuator fitted inside the at least one
25 plant growth chamber **102** may be operated to regulate the at least one plant growth parameter inside the at least one plant growth chamber **102**.

Optionally, the at least one actuator may comprise at least one high pressure meter, at least one solenoid valve, at least one pressure gauge, at least one exhaust fan, at

least one circulation fan, at least one fogger sprayer, sprinkler, irrigation motor cooling pad motor or combination thereof.

Optionally, the at least one actuator such as solenoid valve may be fitted with the siphon mechanism **300** to regulate flow of water through the siphon mechanism **300**
5 and the at least one plant growth chamber **102**.

Optionally, the at least one image capturing module **110** is placed inside the plant growth chamber to capture visual data of the roots of the at least one plant growing in the plant growth system **100**. More optionally, the at least one image capturing module **110** is placed outside the plant growth chamber to capture visual data of a
10 shoot part of the at least one plant growing in the plant growth system **100**.

Throughout the present disclosure, the term “image capturing module” refers to at least one visual data capturing device for capturing images and/or visual data of the at least one plant growing in the plant growth system **100**. Optionally, the image capturing module **110** may capture the visual data in form of at least one still image.
15 More optionally, the image capturing module **110** may capture the visual data in form of at least one video recording. Optionally, the image capturing module **110** employs hyperspectral imaging for capturing images of the of the at least one plant growing in the plant growth system **100**. Beneficially, the hyperspectral imaging enables detection of deficiencies in the at least one plant growing in the plant growth
20 system **100** by employing different wavelengths of the electromagnetic spectrum to capture the visual data.

Throughout the present disclosure, the term “deficiency” refers to a condition when at least one of the nutrient is not available to at least one of the plant for its optimum growth. The deficiency or nutrient deficiency may occur when an actual amount of
25 the particular nutrient is less than the required amount of that nutrient in the nutrient media for the optimum growth of the at least one plant growing in the plant growth system **100**. Beneficially, the control module **108** detects deficiency of nutrient in the at least one plant by processing the visual data received from the at least one image capturing module **110**. The control module **108** may operate the at least one

actuator based on the detected deficiency to add the required nutrient in the nutrient media flowing in the at least one plant growth chamber **102**. The control module **108** may instruct the root volume adaptability module **104** and/or the conditioning module **106** to change the at least one plant growth parameter in the at least one plant growth chamber **102** for the roots of the at least one plant. The control module **108** may operate actuators installed in the polyhouse to change the at least one plant growth parameter and ambient conditions of the shoot part of the at least one plant. Beneficially, the control module **108** creates a feedback loop between plant growth and nutrient supply for optimum growth and health of the at least one plant in the plant growth system.

Throughout the present disclosure, the term “nutrient media” refers to a mixture of substances used for growing the at least one plant in the plant growth system **100**. The nutrient media comprises all nutrients required for growth of the at least one plant. The nutrients required for growth of the at least one plant may comprise compounds such as carbohydrates, vitamins, minerals, trace elements etc. The nutrient media comprises the nutrients in a specified proportion for optimum growth of the at least one plant. The composition of the nutrient media may be varied by altering the proportions of the nutrients in the nutrient media. Optionally, the nutrient media may comprise water as a solvent for the flow of nutrient media in the at least one plant growth chamber **102**. More optionally, the nutrient media may comprise antibiotics and/or fungicides to prevent the growth of micro-organisms such as bacteria and/or fungi in the nutrient media.

In another embodiment, the plant growth system **100** comprises a polyhouse (not shown in the Figs.) for maintaining the at least one plant growth parameter for a shoot part of the at least one plant.

Throughout the present disclosure, the term “polyhouse” refers to a covering structure enclosing the components of the plant growth system **100** and the at least one plant growing in the plant growth system **100**. The polyhouse may comprise a skeleton of materials, such as wood, galvanized steel, iron, aluminium etc. to provide the mechanical support to the polyhouse structure. The polyhouse may

further comprise a cover of materials such as polymers, plastics glass etc. over the skeleton. Optionally, the polyhouse may allow controlled and selective transmission of sunlight radiation. More optionally, the polyhouse may provide controlled environment for the optimum growth of the shoot part of the at least one
5 plant growing in the at least one plant growth chamber **102**. More optionally, the polyhouse may comprise actuators such as at least one exhaust fan, at least one circulation fan, at least one fogger sprayer, sprinkler, irrigation motor, cooling pad motor etc. to control the environment inside the polyhouse. The environment inside polyhouse may be controlled in terms of temperature, humidity, carbon-dioxide
10 concentration etc.

In yet another embodiment, the plant growth system **100** comprises a server arrangement (not shown in the Figs.) communicably coupled with the control module **108** for remote monitoring and management of the plant growth system **100**.

15 Throughout the present disclosure, the term “server arrangement” refers to an arrangement of one or more servers that includes one or more processors that performs various operations, for example, as mentioned earlier. Optionally, the server arrangement includes any arrangement of physical or virtual computational entities capable of performing the various operations. Moreover, it will be
20 appreciated that the server arrangement can be implemented by way of a single hardware server. The server arrangement can alternatively be implemented by way of a plurality of hardware servers operating in a parallel or distributed architecture. As an example, the server arrangement may include components such as memory, a processor, a network adapter and the like, to store and process information
25 pertaining to the document and to communicate the processed information to other computing components, for example, such as client device monitoring and managing the plant growth system **100**. Beneficially, a user may operate and manage the plant growth system **100** from a remote location using the server arrangement. The server arrangement may receive instructions from the user using
30 the client device and communicates the instruction to the control module **108** for

operating the at least one actuator resulting in the regulation of the at least one plant growth parameter in a remote manner.

Optionally, the server arrangement may employ the at least one image capturing module **110** for remote monitoring of the plant growth system **100**. Beneficially,
5 the server arrangement may receive visual data from the at least one image capturing module **110** and displays the visual data to the user on the client device.

In yet another embodiment, the plant growth system **100** comprises a renewable energy source (not shown in the Figs.) for supplying energy to the various modules and actuators installed in the plant growth system **100**. Optionally, the energy
10 supplied may be in a form of electricity. Beneficially, the renewable energy source supplies electricity to the plant growth system **100** for the uninterrupted and independent operation of the various modules and actuators installed in the plant growth system **100**. The renewable energy source may include but not limited to photovoltaic panels.

15 Referring to Fig. 4, there is illustrated a structure of stand **400** for mounting the at least on plant growth chamber **102**. The stand **400** supports the at least on plant growth chamber **102** at a height from the ground.

Referring to Fig. 5, there is illustrated a temperature vs time graph showing the results obtained during the testing of the plant growth chamber **102** in different
20 setup configurations at specific time of the year. The X- axis of the graph shows the temperature inside the plant growth chamber **102**. The Y-axis of the graph denotes the time. The plant growth chamber **102** may be arranged in the configurations comprising at least one of: polyurethane foam on the plant growth chamber **102**, aluminium foil on the plant growth chamber **102** or thermocol on the plant growth
25 chamber **102**. The above-mentioned configurations of the plant growth chamber **102** have been compared against the control plant growth chamber and commercial polyhouse. As evident from the graph, the plant growth chamber **102** of the present invention, as arranged in the above configurations, is beneficial in terms of keeping the ambient temperature inside the plant growth chamber **102** in the range best

suited for the growth of the roots of the at least one plant growing inside the plant growth chamber **102**. More beneficially, the plant growth chamber **102** of the present invention keeps the ambient temperature around the roots of the at least one plant in the range of 15° C - 25° C.

- 5 Referring to Fig. 6, there is illustrated a temperature vs time graph showing the results obtained during the testing of the plant growth chamber **102** in different setup configurations at yet another specific time of the year. The X- axis of the graph shows the temperature inside the plant growth chamber **102**. The Y-axis of the graph denotes the time. The plant growth chamber **102** may be arranged in the configurations comprising at least one of: polyurethane foam on the plant growth chamber **102**, aluminium foil on the plant growth chamber **102** or thermocol on the plant growth chamber **102**. The above-mentioned configurations of the plant growth chamber **102** have been compared against the control plant growth chamber and commercial polyhouse. As evident from the graph, the plant growth chamber **102** of the present invention, as arranged in the above configurations, is beneficial in terms of keeping the ambient temperature inside the plant growth chamber **102** in the range best suited for the growth of the roots of the at least one plant growing inside the plant growth chamber **102**. More beneficially, the plant growth chamber **102** of the present invention keeps the ambient temperature around the roots of the at least one plant in the range of 15° C - 25° C.

The foregoing descriptions of specific embodiments of the present disclosure have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the present disclosure to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the present disclosure and its practical application, and to thereby enable others skilled in the art to best utilize the present disclosure and various embodiments with various modifications as are suited to the particular use contemplated. It is understood that various omissions and substitutions of equivalents are contemplated as circumstances may suggest or render expedient,

but such omissions and substitutions are intended to cover the application or implementation without departing from the spirit or scope of the present disclosure.

We Claim:

1. A plant growth system for cultivating plants in a soil-less environment, the system comprising:
 - at least one plant growth chamber for accommodating roots of at least one plant;
 - 5 - a root volume adaptability module for identifying and maintaining water level in the at least one plant growth chamber for the roots of the at least one plant;
 - a conditioning module for identifying and maintaining at least one plant growth parameter in adjoining surrounding of the roots in the at least one plant growth chamber;
 - 10 - a control module communicably coupled with the root volume adaptability module and the conditioning module for controlling at least one actuators of the plant growth system; and
 - at least one image capturing module for capturing visual data of the at least one plant, wherein the least one image capturing module is communicably coupled with
 - 15 the control module for sharing the captured visual data to detect deficiency in the at least one plant.
2. The system as claimed in claim 1, wherein the at least one plant growth chamber has a trapezoidal structure and contains nutrient media and water mixture.
3. The system as claimed in claim 2, wherein a composition of the nutrient
20 media varies according to a growth stage of the at least one plant.
4. The system as claimed in claim 1, wherein the at least one plant growth chamber comprises a plurality of openings for mounting the at least one plant in the at least one plant growth chamber.
5. The system as claimed in claim 1, wherein the at least one plant growth
25 chamber has a length, width and height ratio in a range of 60 - 100:6 - 10:4 - 6.
6. The system as claimed in claim 1, wherein the root volume adaptability module comprises a water level sensor for identifying water level in the at least one plant growth chamber for the roots of the at least one plant.

7. The system as claimed in claim 1, wherein the root volume adaptability module comprises at least one of a solenoid valve and a siphon mechanism for maintaining water level in the at least one plant growth chamber for the roots of the at least one plant.
- 5 8. The system as claimed in claim 1, wherein the at least one plant growth parameter comprises at least one of temperature, humidity, pH, electrical conductivity, dissolved oxygen, total dissolved solid (TDS) and CO₂ level.
9. The system as claimed in claim 1, wherein the conditioning module maintains the humidity in adjoining surrounding of the roots by increasing an
10 irrigation frequency with lowest water and oxygen level.
10. The system as claimed in claim 9, wherein the irrigation frequency in adjoining surrounding of the roots is modulated using the siphon mechanism.
11. The system as claimed in claim 1, wherein the at least one actuator comprises at least one solenoid valve, at least one pressure gauge, at least one
15 exhaust fan, at least one circulation fan, at least one fogger, sprayer, sprinkler, irrigation motor, cooling pad motor or combination thereof.
12. The system as claimed in claim 1, wherein the control module, when in operation, receives data from the root volume adaptability module, the conditioning module and the at least one image capturing module for real-time operation of the
20 at least one actuator.
13. The system as claimed in claim 1, wherein the at least one image capturing module is placed inside the plant growth chamber to capture visual data of the roots of the at least one plant and the at least one image capturing module is placed outside the plant growth chamber to capture visual data of a shoot part of the at least
25 one plant.
14. The system as claimed in claim 1, wherein the system comprises a polyhouse for maintaining the at least one plant growth parameter for the shoot part of the at least one plant.

15. The system as claimed in claim 1, wherein the system comprises a server arrangement communicably coupled with the control module for remote monitoring and management of the system.

16. The system as claimed in claim 1, wherein the system comprises an
5 underground storage unit for the nutrient media and water mixture.