

A Modular System for Growing Plants

Field of Invention

- 5 The present invention relates to an apparatus and method for growing plants. In particular, the system relates to low foot print systems for aesthetic and edible plants.

Background

- 10 In a densely populated country, where land is scarce and space has become an issue, traditional farming techniques such as greenhouse and field farming, require farms having a smaller footprint. Vertical farming is one option, whereby crops may be planted in vertical plots, which may be integrated into structures such as buildings, warehouses or shipping containers, and may also be applicable for internal use having large internal atriums or high ceiling
15 greenhouses.

- Many systems and techniques for vertical farming use trays or NFT (Nutrient Film Technique) channels, where multiple trays or channels are arranged in horizontal layers within vertical shelves. However, these systems do not maximise the vertical space efficiently and suffer
20 several drawbacks.

- A significant drawback of these vertical farming systems is the height of each tower unit, which places a height limit of the layers so as to ensure crops are within “easy reach” for harvesting. If the height of a tower unit is out of reach, a ladder or scissor lift is required during harvesting,
25 adding to labour inefficiency and capital costs as well as increasing harvest time.

As the position of the planting layers are fixed, and the height limited, these systems are not scalable, preventing expansion to meet the demand of a growing population.

5 Summary of Invention

In a first aspect, the invention provides a system for growing plants, the system comprising: a plant unit comprising a plurality of plant holders, each plant holder arranged to receive a flora; a guiderail for receiving the plant unit;

10 wherein the plant unit is arranged to be slidingly engaged with said guiderail.

In a second aspect, the invention provides a method of modular planting, the method comprising the steps of: placing flora into a plurality of plant holders coupled to a first plant unit; placing flora into a plurality of plant holders coupled to a second plant unit; inserting the
15 first plant unit into a guiderail and sliding said first plant unit upwards; inserting the second plant unit into the guiderail and sliding said second plant unit upwards, and so; stacking said first plant unit on said second plant unit

Advantageously, by having the plant units stacked so as to be selectively removable, the
20 benefits of a reduced foot print are maintained, whilst maintaining ready access to each plant holder regardless of where it is placed within the system.

Brief Description of Figures

It will be convenient to further describe the present invention with respect to the accompanying drawings that illustrate possible arrangements of the invention. Other arrangements of the invention are possible and consequently, the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

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Fig. 1a is a front elevation view of a modular system according to one embodiment of the present invention;

10 Fig. 1b is a front elevation view of a modular system according to a second embodiment of the present invention;

Fig. 1c is a front elevation view of a modular system according to a third embodiment of the present invention;

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Fig. 2 is a front view of a modular system according to a further embodiment of the present invention;

Fig. 3 is a top view of a modular system according to a further embodiment of the present
20 invention;

Fig. 4 is a front elevation view of the system according to Fig. 1a with the plant units omitted;

Figs. 5a and 5b are a top view of guiderails according to one embodiment of the present
25 invention;

Fig. 6 is a front elevation view of the system with guiderails according to Fig. 2.

Fig. 7 is an isometric view of a plant unit according to one embodiment of the present invention;

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Fig. 8 is a top view of a plant unit according to one embodiment of the present invention;

Figs. 9a and 9b are isometric views of plant units according to a further embodiment of the present invention;

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Fig. 10 is an isometric view of a plant unit according to a further embodiment of the present invention;

Fig. 11 is an end view of a plant unit according to a further embodiment of the present invention;

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Figs. 12a and 12b are various views of a plant holder according to one embodiment of the present invention, and;

Fig. 13 is a side view of a plant holder restraint according to one embodiment of the present invention.

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Detailed Description

Referring to Figs. 1a, 1b, 1c and 2, there is shown four embodiments of the present invention having four alternative arrangements systems 100, 101, 118 and 200, and each having differing support structures 102, 142, 148 and 202.

5 In Figure 1a, the system 100 includes guiderails 106 with each having an upper plant unit 104 and a lower plant unit 112 engaged and stacked with the guiderails. In this embodiment, the guiderails 106 are arranged parallel to a vertical axis of the support structure 102. The guiderails 106 are dimensioned so as to receive a first and second plant unit 104,112, where upper plant unit 104 is stacked on the lower plant unit 112. The guiderails have an opening 114 configured
10 to allow sunlight and water to enter, where the opening 114 is in the middle of guiderails and extends longitudinally from one end of each guiderail to another end.

The guiderails have an entry point 116, which may be fluted to facilitating insertion of the plant units into the guiderails. The plant units may then be slid upwards, either manually or using a
15 lifting mechanism, to be described later.

A rod 110 extends through the guiderails 106 and the plant unit, so as to prevent the upper plant unit 104 from sliding down the guiderails 106 when stacked but not supported by a lower plant unit 112. The rod is arranged to engage both the guiderail and the plant unit, through a
20 connection point (see Figure 7). Other such safety features may be included, including the lifting mechanism to prevent a plant unit accidentally sliding downwards.

The plant units 104, 112 include a linear array of plant holders 108 which are pivotally engaged with the plant unit. Flora is added to the plant holders whilst the plant unit is on the ground (or
25 on a bench etc.) and so are horizontal. As the plant unit is inserted into the guiderails, the plant

units are rotated from a horizontal to a vertical orientation. The plant holders, being pivotally engaged, swivel about the pivotal connection to maintain the plant holder having the opening directed vertically. Thus, the plant holders automatically adjust position during the insertion and removal of the plant unit from the guiderail.

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It will be appreciated that the plant unit may include a rectangular array of plant holders, rather than a vertical array.

The type of plants applicable to this system is extensive and include flowers for aesthetic appeal or edible plants. Leafy plants such as lettuce may be particularly adapted to this arrangement. Vine and ground cover type plants may also be well suited, such as passionfruit and pumpkins. In either case, the foliage may be permitted to hang down from the plant holders. It will be appreciated that for vine and ground cover type plants, support may be required during fruiting. In this case, adjacent plant holders and the plant unit in which the plant is located may assist in such support. The width of the opening is dimensioned to allow the flora within the plant holder to be exposed, and so having a width equal to or greater than the lateral dimension of the plant holder 108.

The system may include a water management mechanism (not shown) comprising a path that extends in the longitudinal direction so as to allow water or fertilizer to be evenly distributed to the flora.

In some embodiments, the support structure 102, 202 may be a frame, wall, supporting structure, tower structure or a gabled roof. With reference to the gabled roof, placing the guiderails on the roof may allow the plant units to be inclined rather vertical. This may allow

the natural pivoting of the plant holders, relative to the plant unit, to have a greater exposure to sunlight. It will therefore be appreciated that in various embodiments, the support structure to which the guiderails are mounted may not be vertical but inclined at an angle to the vertical. Nevertheless, even though the plant units are inclined at an angle to the vertical, because of the inclined gabled roof, there is still a gravity component acting downwards on the plant unit. Thus, on inserting each plant unit, the plant unit must be slid upwards against gravity so as to insert the next plant unit, whether the guiderails are vertical or inclined to the vertical.

Fig 1b shows an alternative arrangement falling within the scope of the present invention. A support structure 142 includes several guiderails 136 arranged to receive plant units 124, 134 into an insertion point 126. However, in this arrangement, the plant units are inserted into the guiderails 136 from above. In this case, the first plant unit 124, stacks on the second plant unit 134, with the second plant unit 134 inserted first. This may be a useful arrangement when the plant units are inserted from a roof of the support structure 142.

Fig 1c shows a still further arrangement 118, whereby the guiderails 168 are mounted to an inclined surface of the support structure. 148. The support structure may be a silo, cooling tower or gabled roof (as described earlier) or even steeply sloping ground. The components for this arrangement 118 remain similar, with guiderails 168 receiving the plant units 138, 158 through an insertion point 128 of the guiderails 168.

It will be further appreciated that, although the variously described embodiments discuss first and second plant units, multiple plant units may be used, with the only limitations being the height of the guiderails, and the capacity of the support structure to support the extra load. As a non-limiting example, a system having 4 metre high guiderail may receive two 2 metre plant units, with each plant unit stacked upon each other to create the vertical garden. Other

orientations are also possible, including four 1 metre plant units, or five 1 metre plant units, such as if the first guide rail is slightly taller than the first unit to allow insertion. The plant units may also be of different sizes, depending upon the application.

- 5 The plant holders 108 may be square shaped or any other geometrical shape, where the width of the plant holders 108 may be equal to or less than the width of the opening 114, so as to allow the flora full exposure to sunlight and not be restricted by the guiderails.

Further, in some embodiments, a lifting mechanism may be present in the system, so as to assist
 10 in lifting the plant unit, such that the plant unit once engaged with the guiderails is lifted and supported by the mechanism. For domestic use, the plant units may be relatively short, for example 1 metre, and so readily manipulated by hand. However, for commercial use, the plant unit may be much longer, and carry several plant holders, adding to the overall weight. The size and weight of the plant unit, when combined with the desired height to which an uppermost
 15 plant unit may be lifted, the lifting mechanism may therefore facilitate lifting and lowering of the plant units for installation and harvesting. The lifting mechanism may be any one of several known systems including a pulley system which may be manually operated or motorized, a chain drive or belt drive, with the cables, chain or belt connected to the plant units through a connection point (as shown in Figure 9).

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In some embodiments, the guiderails may be two parallel rails, where the rails are arranged to slidingly engage the sides of the plant unit. In other embodiments the use of bearings and/or low friction surfaces may facilitate sliding. Tolerance between the plant unit and the guiderails may be relatively loose so as to avoid seizing should a plant unit be misaligned, but not so loose

so as to rattle within the guiderail due to wind. A skilled person will appreciate the level of tolerance required between these extremes in order to ensure safe and efficient operation.

Fig. 3 illustrates the system 300 having a cylindrical tower is used as the support structure 302.

5 Such a purpose-built system allows for optimised number of guiderails about the outer surface of the structure 302, where guiderails 306 arranged circumferentially at an equal distance from each other. In some embodiments, the guiderails may be placed at random where the distance between each adjacent guiderail 306 may not be equal.

10 Fig. 4 shows the system 100 of Fig 1 with the plant units removed, and so only the three guiderails 106 and the rod element 110 extending through the guiderails 106. The guiderails 106 occupy an upper half of the structure 102, the bottom half of the structure 102 is empty to allow for a plant unit to be positioned beneath the guiderail 106 ready for insertion. Accordingly, the bottom half is at least the length of a plant unit for easy removal from the system.

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Figs. 5a and 5b show guiderail 106 on a support structure 202, where the guiderail may be arranged in a single configuration 500 or a multiple configuration 501. In the multiple configuration 501, three structures are aligned in a parallel with a gap 502 between each adjacent guiderail.

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Fig. 6 shows the system 200 of Fig 2 in the form of a frame 202, where the frame 202 has a single guide rail 106 with the plant unit removed and a rod element 110 passing through the guiderails.

Fig. 7 shows a guiderail 706 mounted to a support structure 702. The guiderail may be mounted to the support structure in a range of known ways, including bolting, dowelling welding if the support structure includes a metal surface. The guiderail may be tied to the reinforcement for a purpose-built reinforced concrete structure. The guiderail 706 includes a connection point
 5 which may be used to connect to a plant holder to secure it in place. Said connection point may also facilitate the use of the rod shown in Fig 1. In some embodiments, the holes may be arranged towards the bottom of the guiderails, or towards the centre of the guiderails.

Fig. 8 shows a plant holder 804 having a pair of swivel clips 802 to permit plant holder 808 to
 10 pivot as the plant unit 804 moves from the horizontal to the vertical. The swivel clips for this embodiment are one form of the pivot mentioned previously.

Figs 9a and 9b show two alternative arrangements of the plant unit 904, 914. In the embodiment of Fig 9a, the plant holders 908 are set low into the body 906 of the plant holder 904, with the
 15 pivots 912 arranged in an open face of the body 906. This may suit plant holders being relatively shallow, where there is good access to sunlight when the plant holder is inserted.

The embodiment for Fig 9b, however, may be more suited to arrangements where the plants need to project from the plant holder for better access to sunlight, and so having the extra distance may provide this.

20 The embodiment of Fig 9b may also suit the embodiment of Fig 10, whereby the plant holders 1003 are prevented from fully pivoting to a vertical alignment when the plant unit is vertical. The means by which full pivoting may vary, and include a c-ring on the pivot or a physical block such as a wedge 1006 positioned to prevent full rotation of the plant holder. Such a wedge
 25 1006 is better shown in Fig 13, whereby the wedge has a mounting surface 1026 for mounting

to the plant unit and a blocking surface 1022 for contacting the plant holder and so blocking the rotation relative to the plant unit. Whichever means is used to prevent full rotation, the pre-determined angle for which the plant holders are oriented may depend upon the type of plant, the position of the support structure, the seasons etc. For instance, an angle in the range 20° to 45° maybe useful depending upon the circumstances. The means by which the angle is adjusted may include using differently angled wedges or repositioning the wedges to accommodate for the seasons etc.

Fig 11 shows an end view of one plant unit 1104 having a body 1106. While the cross-section indicates the plant unit is a rectangular prism, other prismatic shapes are possible, including circular prism (cylinder), semi-circular, trapezoidal etc. Similarly, the guiderails, as shown in Figure 7, suggest a rectangular prism, whereas other prismatic shapes are possible so as to correspond with the shape of the plant unit. The body includes ridges 1105 for slidingly engaging a guiderail, and the locking rod 702 (Fig 1) which is arranged to engage the plant unit. It will be further appreciated that the guiderail may be shaped to receive a ridge 1105 only, and so the guiderail shape may be independent of the shape of the plant unit. The rod may engage with a recess 902 such as that shown in Figs 9a and 9b, such that the recess 902 of the plant unit 904, 914 sits on the rod, rather than the rod penetrating the plant unit. The plant unit may then be lifted up before removing the rod, which may be an easier process than pulling out the rod and instantly releasing the plant unit. A Carabiner (not shown) may also be used in conjunction with the connection point to assist in the lifting of the plant units.

Figs 12a and 12b show an embodiment of the plant holder 1201, having a cavity 1208 into which a plant may be placed. In this embodiment, pivoting is achieved by lugs 1204 which fit

into recesses in the plant unit, which the plant holder swivelling about the throat 1206 of the lug 1204.

Claims

1. A system for growing plants, the system comprising:
a plant unit comprising a plurality of plant holders, each plant holder arranged to receive
5 a flora;
a guiderail for receiving the plant unit;
wherein the plant unit is arranged to be slidingly engaged with said guiderail.
2. The system according to claim 1, wherein the plant holders are pivotally connected to
10 the plant unit and arranged to pivot relative to the plant unit
3. The system according to claim 1 or 2, further including a second plant unit arranged to
be inserted into the guiderail such that the first plant unit stacks upon the second plant
unit.
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4. The system according to claim 3, further including a third plant unit arranged to be
inserted into the guiderail such that the first and second plant units stack upon the third
plant unit.
- 20 5. The system according to claim 4, further including additional plant units arranged to be
inserted into the guiderail such that the preceding plant units stack upon the lower plant
units.
- 25 6. The system according to any one of claims 3 to 5, wherein the guiderail is arranged to
be mounted to a support structure in a vertical orientation, such that the first plant unit
is stacked vertically upon the second plant unit.

7. The system according to any one of claims 3 to 6, wherein the guiderail is arranged to be mounted to a support structure at an angle inclined to the vertical, such that the first plant unit and second plant units are stacked at the inclined angle.

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8. The system according to claims 3 to 7, further including a holding mechanism arranged to hold the first plant unit within the guiderail, so as to selectively remove the second plant unit.

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9. The system according to any one of claims 2 to 8, further including:

a block, said block mounted to the plant unit;

wherein the block is arranged to contact the plant holder as it rotates relative to the plant unit, and so prevent the plant holder from rotating beyond a pre-determined angle relative to the plant unit.

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10. The system according to claim 9, wherein the pre-determined angle is in the range 20° to 45° to a vertical axis when the plant unit is vertically arranged in the guiderail.

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11. A method of modular planting, the method comprising the steps of:

placing flora into a plurality of plant holders coupled to a first plant unit;

placing flora into a plurality of plant holders coupled to a second plant unit;

inserting the first plant unit into a guiderail and sliding said first plant unit upwards;

inserting the second plant unit into the guiderail and sliding said second plant unit

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upwards, and so;

stacking said first plant unit on said second plant unit.

12. The method according to claim 11, further including the step of pivoting the first and second plant holders relative to the plant unit during the inserting steps.

5 13. The method according to claim 11 or 12, further including the steps of:

sliding the second plant unit down the guiderail and;

removing the second plant unit from the guiderail.

14. The method according to claim 13, further including the steps, after the removing

10 step, of:

sliding the first plant unit down the guiderail and;

removing the first plant unit from the guiderail.

15. The method according to claim 13, further including the step, before the removing

15 step, of holding the first plant unit in the guiderails using a holding mechanism, and

so;

preventing the first plant unit of accidentally sliding down the guiderail.