

CLAIMS

What is claimed is:

1. A crop production system for controlled environment agriculture, comprising:
 - one or more grow lines, each of the one or more grow lines comprising a grow conveyance mechanism; and
 - a plurality of grow towers, each of the plurality of grow towers vertically attached to, and moveable along, a respective one of the one or more grow lines;
 - wherein each of the one or more of the conveyance mechanisms comprises:
 - a common beam disposed in a track, the track extending in a direction parallel to the grow line;
 - an actuator attached to the common beam, wherein the actuator is operative to move the common beam along the track in a forward stroke and a back stroke; and
 - a plurality of cams pivotally attached at select positions along the common beam, wherein each cam is mounted to limit rotation of the cam during the forward stroke causing the cam to engage and push a first tower forward in a first direction during the forward stroke and to allow the cam to slide over a second tower during the back stroke;
 - wherein the select positions of the plurality of cams are each configured such that in a forward stroke a respective cam engages a first grow tower during the forward stroke and ratchets over a second grow tower adjacent to the first tower during the back stroke.
2. The crop production system of claim 1 wherein the spacing of the select positions increases in the first direction such that spacing of the grow towers increases as such grow towers are pushed along the one or more grow lines with successive cycles of the actuator.
3. The crop production system of claim 1 wherein the common beam has a u-shaped profile having first and second walls extending from a base, and wherein the plurality of cams are each mounted at the select positions along the first and second walls.

4. The crop production system of claim 1 wherein each of the plurality of grow towers comprises a hook attached to the top of the grow tower, wherein the hook is configured to engage the grow line.
5. The crop production system of claim 4 wherein each of the one or more grow lines includes a groove region to which the hook of a grow tower slidably attaches.
6. The crop production system of claim 1 wherein each of the plurality of grow towers comprises a first plurality of plug containers arranged along a first face of the grow tower.
7. The crop production system of claim 6 wherein each of the plurality of grow towers comprises a second plurality of plug containers arranged along a second face of the grow tower, wherein the second face is opposite to the first face.
8. The crop production system of claim 1 further comprising an onloading mechanism comprising a powered and free conveyer and one or more carriages; wherein the one or more carriages are configured to releasably engage grow towers; and wherein the powered and free conveyer is configured to insert a grow towers on a selected grow line of the one or more grow lines.
9. The crop production system of claim 2 wherein the common beam comprises a first beam section, a second beam section, and an expansion joint attached to opposing ends of the first and second beam sections, wherein the expansion joint is movable from a collapsed position to an open position and configured such that, during the forward stroke, the expansion joint moves from the collapsed position to the open position thereby causing the first beam section to move forward while the second beam section remains stationary until the expansion joint is in the open position and, during the back stroke, the expansion joint moves from the open position to the collapsed position.

10. A crop production system for controlled environment agriculture, comprising:
 - a grow line;
 - a plurality of grow towers, each of the plurality of grow towers vertically attached to, and moveable along, the grow line;
 - a conveyance mechanism operative to move the plurality of towers to select positions along the grow line; and
 - an irrigation system operative to supply a fluid to respective tops ends of the plurality of grow towers at one or more of the select positions along the grow line;wherein each of the plurality of grow towers comprises a tower body and a funnel disposed on the top of the tower body, the funnel configured to direct fluid flowing therethrough over a desired region within the tower body.
11. The crop production system of claim 10 wherein the irrigation system comprises one or more irrigation lines including openings located proximally over the select positions.
12. The crop production system of claim 10 wherein each of the grow towers comprises a plurality of plug containers disposed along the tower body.
13. The crop production system of claim 12 wherein each of the plurality of grow towers comprises a first plurality of plug containers arranged along a first face of the grow tower.
14. The crop production system of claim 13 wherein each of the plurality of grow towers comprises a second plurality of plug containers arranged along a second face of the grow tower, wherein the second face is opposite to the first face, and wherein each of the plurality of grow towers includes a central wall defining a first cavity containing the first plurality of plug containers and a second cavity containing the second plurality of plug containers.

15. The crop production system of claim 14 wherein each funnel comprises
- a collector;
 - first and second passageways in fluid communication with the collector;
 - a first slot disposed in the collector and in the fluid communication path between the collector and the first passageway; and
 - a second slot disposed in the collector trough and in the fluid communication path between the collector trough and the second passageway;
- wherein the first and second slots are arranged to cause fluid to accumulate in the collector trough and distribute the fluid substantially evenly to the first and second passageways, the first passageway in fluid communication with the first cavity, and the second passageway in fluid communication with the second cavity.
16. The crop production system of claim 10 wherein the spacing of the select positions increase in a first direction such that spacing of the grow towers increases as such grow towers are pushed along the grow line.
17. The crop production system of claim 10 wherein the conveyance mechanism comprises a reciprocating cam mechanism.
18. The crop production system of claim 10 wherein each of the plurality of grow towers comprises a hook attached to the top of the grow tower, wherein the hook is configured to engage the grow line.
19. The crop production system of claim 18 wherein each of the grow line includes a groove region to which the hook of a grow tower slidably attaches.
20. A funnel for use in a vertical grow tower, comprising
- a collector;
 - first and second passageways in fluid communication with the collector;
 - a first slot disposed in the collector and in the fluid communication path between the collector and the first passageway; and

a second slot disposed in the collector and in the fluid communication path between the collector trough and the second passageway;

wherein the first and second slots are arranged to cause fluid to accumulate in the collector and distribute the fluid substantially evenly to the first and second passageways.

21. The funnel of claim 20 further comprising a hook integrally attached to at least the collector.

22. The funnel of claim 20 wherein the first and second slots are v-shaped slots extending upwardly from a bottom surface of the collector.

23. The funnel of claim 20 further comprising first and second flange members extending opposite from the collector, wherein outlets of the first and second passageways are arranged adjacent to and on opposing sides of the first and second flange members.