SUMMARY OF THE DISCLOSURE

[0011] The present disclosure is directed to facility layouts and configurations for an automated crop production system for controlled environment agriculture. In some implementations, the facility layouts establish consolidated utility and plant production zones that achieve a variety of operational and cost efficiencies. In particular implementations, the core of the facility comprises a controlled growth environment and a central processing system. The controlled growth environment includes systems for exposing crops housed in modules, such as grow towers, to controlled environmental conditions. The central processing system may include various stations and functionality both for preparing crop-bearing modules to be inserted in the controlled growth environment, for harvesting crops from the crop-bearing modules after they have been extracted from the controlled growth environment, and for cleaning or washing crop-bearing modules for re-use. The remaining aspects of the crop production facility--such as seeding stations, propagation facilities, packaging stations and storage facilities--are arranged to achieve one or more desired efficiencies relating to capital expenditures or operating costs associated with an automated crop production facility.

[0011a] According to a first aspect of the present invention, there is provided a crop production facility for controlled environment agriculture, comprising: a nutrient and thermal corridor; an array of one or more grow rooms adjacent to the nutrient and thermal corridor, the array having a first end and a second end, the array extending substantially parallel to the nutrient and thermal corridor; a conveyance mechanism that injects and ejects grow structures from a side of the one or more grow rooms opposite the nutrient and thermal corridor; a propagation space adjacent to the first end of the array and interfacing with the nutrient and thermal corridor; and a central processing system comprising one or more grow structure processing systems adjacent to the array of grow rooms and opposite the nutrient and thermal corridor; wherein each of the grow rooms comprises: 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 grow lines comprises a first path section, a second path section, and a

return mechanism operative to transfer grow towers from the first path section to the second path section; wherein the grow conveyance mechanism conveys grow towers along the first path section in a first direction, and along the second path section in a second direction opposite the first direction; wherein one of the one or more grow structure processing systems is a harvester station, and wherein the crop production facility further comprises a post-harvest processing facility located adjacent to the central processing system and proximal to the harvester station; and wherein the harvester station comprises a crop harvesting machine, and a feeder mechanism to receive a grow tower in a horizontal orientation and feed the grow tower through the crop harvesting machine in a horizontal orientation; and wherein the crop production facility further comprises an automated laydown station comprising a first robot including an end effector adapted to releasably grasp a grow tower, and control logic operative to cause the first robot to pick the grow tower from a pick location in a vertical orientation, rotate the grow tower to a horizontal orientation and place the grow tower on a conveyor for loading into the harvester station.

[0012] The present disclosure is also directed to a vertical farming structure having vertical grow towers and associated conveyance mechanisms for moving the vertical grow towers along one or more grow lines through a controlled environment, while being exposed to controlled conditions, such as lighting, airflow, humidity and nutritional support. The present disclosure describes a return transfer mechanism that creates a return or u-shaped path for each grow line. The present disclosure also describes an automated crop production system for controlled environment agriculture that selectively routes grow towers through various processing stages of an automated crop production system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Figure 1A is a functional block diagram illustrating an example controlled environment agriculture system; and Figure 1B is a functional block diagram illustrating a second example controlled environment agriculture system.

CLAIMS

What is claimed is:

1. A crop production facility for controlled environment agriculture, comprising:

a nutrient and thermal corridor;

an array of one or more grow rooms adjacent to the nutrient and thermal corridor, the array having a first end and a second end, the array extending substantially parallel to the nutrient and thermal corridor;

a conveyance mechanism that injects and ejects grow structures from a side of the one or more grow rooms opposite the nutrient and thermal corridor;

a propagation space adjacent to the first end of the array and interfacing with the nutrient and thermal corridor; and

a central processing system comprising one or more grow structure processing systems adjacent to the array of grow rooms and opposite the nutrient and thermal corridor;

wherein each of the grow rooms comprises:

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 grow lines comprises a first path section, a second path section, and a return mechanism operative to transfer grow towers from the first path section to the second path section;

wherein the grow conveyance mechanism conveys grow towers along the first path section in a first direction, and along the second path section in a second direction opposite the first direction;

wherein one of the one or more grow structure processing systems is a harvester station, and wherein the crop production facility further comprises a post-harvest processing facility located adjacent to the central processing system and proximal to the harvester station; and

wherein the harvester station comprises a crop harvesting machine, and a feeder mechanism to receive a grow tower in a horizontal orientation and feed the grow tower through the crop harvesting machine in a horizontal orientation; and

wherein the crop production facility further comprises an automated laydown station comprising a first robot including an end effector adapted to releasably grasp a grow tower, and control logic operative to cause the first robot to pick the grow tower from a pick location in a vertical orientation, rotate the grow tower to a horizontal orientation and place the grow tower on a conveyor for loading into the harvester station.

2. The crop production facility of claim 1 further comprising a seeding area adjacent to the propagation space.

3. The crop production facility of claim 1 wherein one of the one or more grow structure processing systems is a harvester station, and wherein the crop production facility further comprises a post-harvest processing facility located adjacent to the central processing system and proximal to the harvester station.

4. The crop production facility of claim 3 further comprising a cold storage facility adjacent to the post-harvest processing facility.

5. The crop production facility of claim 3 further comprising a conveyor configured to carry bins or harvested product directly on the belt from the harvester station to the post-harvest processing facility.

6. The crop production facility of claim 4 further comprising a loading bay adjacent to the cold storage facility.

7. The crop production facility of claim 1 wherein each of the grow rooms is substantially encapsulated and comprises one or more control systems for controlling one or more environmental variables.

8. A crop production facility for controlled environment agriculture, comprising:

a nutrient and thermal corridor;

an array of one or more grow rooms adjacent to the nutrient and thermal corridor, the array having a first end and a second end, the array extending substantially parallel to the nutrient and thermal corridor; wherein each of the grow rooms comprises a substantially

encapsulated growth environment containing a vertical grow tower conveyance system comprising

one or more grow lines, wherein each of the one or more grow lines comprises a first path section, a second path section, and a return mechanism operative to transfer grow towers from the first path section to the second path section;

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 plurality of grow towers includes a plurality of grow sites extending at least along one face thereof; and

a grow tower conveyance mechanism operative to convey grow towers along the first path section in a first direction, and along the second path section in a second direction opposite the first direction;

a central processing system, arranged adjacent to the array of one or more grow rooms and opposite the nutrient and thermal corridor, comprising

a harvester station comprising a crop harvesting machine, and a feeder mechanism to receive a grow tower in a horizontal orientation and feed the grow tower through the crop harvesting machine in a horizontal orientation;

a washing station comprising a second feeder mechanism to receive a grow tower in a horizontal orientation and feed the grow tower through the washing station in a horizontal orientation;

a transplanter station comprising a third feeder mechanism to receive a grow tower in a horizontal orientation and feed the grow tower through the transplanter station in a horizontal orientation;

a plurality of conveyors arranged to convey grow towers to and from respective ones of the harvester station, the washing station and the transplanter station, wherein the plurality of conveyors include a first conveyor arranged to feed a grow tower to the harvester station, a second conveyor arranged to feed a grow tower to the washing

station, a third conveyor arranged to feed a grow tower to the transplanter station, and a fourth conveyor arranged to feed a grow tower from the transplanter station to a pickup location; and

an automated laydown station comprising a first robot including an end effector adapted to releasably grasp a grow tower, and control logic operative to cause the first robot to pick the grow tower from a pick location in a vertical orientation, rotate the grow tower to a horizontal orientation and place the tower on a conveyor for loading into the harvester station;

an automated pickup station comprising a second robot including an end effector adapted to releasably grasp a grow tower, and control logic operative to cause the second robot to grasp a grow tower from the pickup location in a horizontal orientation, rotate the grow tower to a vertical orientation for transfer to a select grow line of the plurality of grow lines; and

a propagation space adjacent to the first end of the array and interfacing with the nutrient and thermal corridor.