

AIR MOVEMENT CONTROL AND AIR SOURCE DEVICE FOR CULTIVATION

Cross-reference to related applications

This application is a Singapore National Stage entry of PCT Application No: PCT/TH2017/000082 filed November 17, 2017, which claims priority to Thai Patent Application No. 1601007444, filed December 14, 2016, the contents of which are incorporated herein by reference.

Technical field

The present invention relates to agriculture and engineering, plant growing, devices and method, in particular air movement control and air velocity retention device cultivation.

Background

The air movement is the air moving from one place to another. There are two types of air movement: 1. Wind refers to the movement of air in the horizontal direction. It causes the distribution of air to the locations of the earth. 2. Air current refers to the movement of air in the direction perpendicular formation. For example clouds, rain, drought, etc.

Wind is another important factor for plant growth. In addition to helping to pollinate crops, distribute seeds and also plays an important role in the growth of plants, which helps for caring carbon dioxide for photosynthesis. The movement of water vapor, the other gases and temperature affect the photosynthesis process. The process is faster. By comparison, a plant that grows in areas where the wind blows lightly and plant-growing area of wind blows with speed of 1-5 mph. Found that the plants grow in area with wind speeds 1-5 mph. The rate of growth is better to plant in area with light wind, especially the growth of the stem and roots of plants. At the same time, there are also disadvantages effect, such as when strong wind will cause the crop to blow down, crop losses, destroy soil fertility and obstacle to spray chemical element. Corrosion of nutrients is the indirect effect of cropping.

The patent No. ZA 200803785 **B** announces methods and tools to control the air flow move through the plant at least one tree, which can be applied to crops as a group. And control the airflow through various parts of the plant.

The patent No. CN204513637 announcement of Shanghai Yizhuo Energy Technology Co., Ltd. announced the weather system that includes air purifiers, fan, box and the acreage controlled environment (container type). Its work by fan inflating the airflow pressure into the box through the plant nutrient (culture medium), located at the roots of the plant. To solve the problem of pollution from crop acreage controlled

environment (container type) with an aerator. Low power consumption and use less space as well.

The patent No. JP2011015655 announcement of Dyna Air KK announces the system and methods of air conditioning to controlled temperature of plants growth system and wind. By blowing air from the side of the plant to air through the top. The air flow out perpendicularly direction to the import air. To solve the problem of temperature control of the plant.

From the patent No. JP2012000028 announcement of Shimizu Corp. (Shimizu Corp.) revealed that the carbon dioxide in the air to help plant growing. By installing a two key position fan to assist in controlling the wind, the fan in the ventilation duct adjacent to the root of the plant . And fan in the plant room that help ventilating. To blow up the air back into the incoming tube.

From finding announcement, we only find the winds control for plant growing system. There are no relevant inventions related to the use of air currents in the plant . growing system.

Planting under conditions of a controlled wind is another factor that helps plants grow faster, but often presents problems in controlling the wind to stabilize the entire area. And the temperature distribution is stabilize in the entire plant area. So the quality of plants is not equal. The plants near the wind generator grow better than the plants on the tip. Occasionally, plants in some areas are dwarfed or dead. The planters solve the problem by planting the plant only in the stabilized wind. This results in a limited area of growing is less than it should be and less commercial output. Another problem is plants that grow vertically. Plants on the upper floor of the plant rail grow fewer than the plant on the ground floor. Cause due to carbon dioxide, which is the key gas in photosynthesis, move down densely below. The growth of the top and bottom crops in the same row of crops although they provide the same nutrition and light.

Summary of invention

According to aspect of the present invention there is provided the air movement control and air source device for cultivation comprising:

The air movement control wherein fixed the installation of air velocity retention device (AVRD) or the air source device for cultivation, or both. A process of bringing carbon dioxide and products resulting from the photosynthesis process that can be pick up by the movement of air through an area that cropping at a steady speed, constant
5 temperature and high carbon dioxide concentration throughout the planted area. Solves the problem of vertical cropping, which have a distribution of carbon dioxide dense at the bottom of the crop rail (931). Vertical crop at the top growing area is not as good as the crops below. If the height of the crop rail (931) is used to grow the vertical crop, It will be found that the crops planted above will grow less than the lower area. And sometimes
10 the top cannot grow.

Brief description of the drawings

An embodiment, incorporating all aspect of the invention, will now be described by way of example only with reference to the accompanying drawing in which,

Figure 1 is the block diagram of a plant cultivation in accordance with an
15 embodiment of the system.

Figure 2 is the drawing of the crop rail (931) with plants and air velocity retention device for air movement control.

Figure 3 is the dramatic diagram of Figure 2 in accordance with an embodiment of the direction air movement.

20 Figure 4 is the drawing compare the air movement of the emission point (048) and the air intake (049) of each environment.

Figure 5 is the drawing compare the air movement on the crop rail (931) between vertical and horizontal cultivation wherein the air movement tilt.

25 Figure 6 is the drawing of the crop rail (931) with horizontal direction, compare the air movement between wind and air current.

Figure 7 is the drawing of the crop rail (931) with vertical direction, compare the air movement between wind and air current.

Detailed description

Definition of “air velocity retention device ” or “AVRD” refers to a device that reduces or increases the speed of air movement. It has the ability to control the direction of air movement by install fans with propellers or bladeless fan. For example, the speed at which device passes is equal to, or close to, the speed of movement of the air that the grower sets for each crop.

The definition of “crop rail” refers to the small container used for planting crops. It may be a long one or separate into pieces or separate and put them together.

The definition of “plane” refers to area that has line with at least 2 dots and can be drawn straight. If there is any object or material placed on the pass line, you can drag any point on object or materials in line. And say that the objects or materials that are on the same plane.

The definition of “air movement” refers to the change of air that moves from one place to another place . That has two types: wind and air. It also includes the movement of air in an angle which not horizontal and not perpendicular.

Air current is the movement of air in the dormant. It is caused by the temperature at the bottom hotter than the top area. Then the heat take a leave and the cold air moves to replace. It causes drought, rain, clouds, wind and natural phenomena which causes the distribution and circulation of wind that affect the growth of plants. It explains that plants use carbon dioxide to photosynthesize, so the winds blow in the horizontal direction will help catalyze faster. Carbon dioxide from the plant and the photosynthetic oxygen is removed from the leaf area faster and the wind is maintained and extinguish the plants with cold air.

A natural phenomenon that occurs when the wind is strong, the air current in the area becomes turbulent. From mathematical knowledge can explain that the velocity of motion is a vector, with the speed of motion of the air , the size of the vector and the direction of the air and the direction of the vector. So the importantly direction of air movement is not just only speed. But the direction of air movement is also important although the velocity is the same. But in different directions it becomes a different vector immediately.

In the case of air movement as well, the movement of air in each direction is not just named by the direction of the moving air. But it is also a different vector, so it is concluded that winds and air currents are completely different.

According to aspect of the present invention air movement control and air source
5 device for cultivation is described as process aerial movement of crops , that including of,

The operation of air source devices as shown in Figures 1 and 2 can be described as follows. Bring gas from the gas storage tank (201), which consists of the gas that used for photosynthesis of plants and travel through gas nozzle (311) to inject air into the air inlet (045), which works as an air supply to the air conditioner (100), which regulates the
10 air temperature to the temperature used to grow crops. Then the air is released through the air outlet of the air conditioner (046) through the air inlet accelerator (325). The air enters the air collector tube (328) and distribution air into the discharge pipe (047), which releases the air to the emission point (048), which scatters at various points dependently. When the air is released from the emission point (048), then passed to the AVR (110)
15 through the plant (001) and AVR (111) through the plant (002) respectively and chase all the available stages of the crops. By installing equipment to maintain the speed of the movement air that are spaced at a constant speed movement of air . When air passes through the plant, it is sucked through the air intake (049) and flow into the pipe (050) which is being sucked into the pipe (050) is the air, gases, water, and solution formed by
20 photosynthesis of the plant. Then it is sucked into the pipe (050). It is conveyed to the collecting pipe (329). It then separates the conveyor into a two-state product: gas and liquid. Liquid products and the solution water enters the solution tank (354). The product is in a gas state enters into the air aspirator (326) and then goes to the excess moisture trap (320). The excess moisture trap (320) works as a moisture trap and separates the
25 product into two liquid states. Gas and liquid flow to the storage tank (354) for use in plant nutrient processing. The gas flows to the gas nozzle (311) to combine with the gas being dispensed from the gas storage tank (201) into the aerosol plant for re-vegetation.

The work of the movement air caused by the device that create air movement, as shown in Figure 3. It refers to the movement of air affecting the crop. Can be explained
30 as follows. When the air is released from the discharge point (048). From Figure 2 , AVR (110) was shown the trajectory of the air (507) to a constant speed. The optimum speed is 0.1 to 5 meters per second. The optimum velocity depends on the growth stage

of the plant, which is divided into three phases: the first stage is the seed stage. The seed stage is the embryonic axis and cotyledon, which attached and has a radicle that is ready to grow to the plant root. The second stage is the seedling stage, which is the distance from the seed stage till the plant has 3 – 4 leaves. The roots of the plant are longer than first stge. The third stage is the growth stage, which is the distance from the seedling stage until the plant is ready for harvest. The speed of movement of the air to the cultivation of the plant will affect the plant growth in the seedlings and growing stage. The optimal speed for drought tolerant plants is 0.3 meter per second. The optimal speed for growing plants is 1 meter per second. The air flows through the plant (001) while the airflows through the plant (001) carry carbon dioxide to plant for using in photosynthesis. The optimum carbon dioxide concentrated for equipment is 450 to 1600 parts per million (ppm). The best suitable carbon dioxide is 500 to 1000 parts per million parts. At the same time when the air passes the carbon dioxide through plants, it will blow products from photosynthesis of previous plants, such as oxygen and water. Especially single molecular sugars are used for plant growth (001). When the air blows through the area with a lot of plant photosynthesis, the plants will be able to synthesize photosynthesis faster than the air that passes through less or none.

At the same time, the air movement from the air source device in the process is shown in Figure 3 as air from the air conditioner (100). The air is cool enough for planting crops. It acts to spread the cold and transfer heat to the growing area better. When the air move to the plant (001), the air passes through an unobstructed area and the speed decreased. The air velocity retention device AVR (111) works as to speed up and give direction of the air to the plant (002). The next tree, when the air move into the plant (002) and passes through an unobstructed area, the speed is speeded up to normally by the AVR (112). The air is drawn into the air outlet (049) and flow into the air movement device described earlier.

To measure carbon dioxide and other gases that affected the plant growth. We will measure in the planting room. By installing more measurement devices into the air movement device later. By measuring it can be done in two ways: automatic measurement and measure with the device that uses by data collector. We can do either or both.

Air source device have the following characteristics for planting crops:

1. The AVR D maintains the speed of the movement air has cross-sectional area that can maintain a reasonable speed at 5 to 15,000 square centimeters. Depends on the growing stage of the plant. The optimal cross-section area for the seedlings is 10 - 100 cm. The
5 optimal cross-section area for most growing plants is 10000 to 13000 square centimeters.
2. The distance between the AVR D , which keeping the air velocity on the same plane in line is 15 to 300 centimeters, depends on the selected cross-sectional area that can keep the speed correlated with distance. By using engineering calculations or experimental
10 installation and use of speed measuring velocity, either one or both. We can control the speed of air for the growth stage of the crop. In the planted seedling stage, keep the speed appropriately at range of 0.01 to 1 meter per second. The optimal speed is 0.1 to 0.7 meters per second. In growth stage , we control the optimum range of 0.3 to 6 meters per second. The optimal speed is 0.3 to 5 meters per second.
3. By Installing AVR D, it can be installed between plants. Or to placed the plants between
15 the device to maintain air velocity, either or both. The appropriate approach is to install the air velocity fanless, air handling equipment and place plants in the air velocity retention devices.
4. The gas storage tank (201) is designed to have characteristics suitable for storing carbon dioxide. The main gas is imported into the device that creates the movement of
20 air. Depends on the choice whether to store carbon dioxide gas or liquid, which are packaged in a pressure-resistant container as follows. Carbon dioxide cylinders are contained in high pressure container CO2 cylinders. Liquid carbon dioxide is stored in a pressure-resistant container under temperature control. By controlling the temperature at - 180 degrees Fahrenheit or 0 degrees Celsius (low pressure CO2 tank).
- 25 5. Air conditioning (100) is a device that adjusts the air temperature to desired. The air conditioner used as part of the air movement device, which can adjust the optimum temperature is at 5 to 50 degrees Celsius and can adjust the optimal temperature is at 15 to 45 degrees Celsius.
6. The air blower (325) and the air acceleration device (326) are characterized by causing
30 the movement of air with the desired speed and desired direction. This can be achieved by rotating the propeller centrifugal force causes a liquid or air to flow along the

circumferential direction. Or the air flow along the axial line into the air intake behind the propeller fan and flow through axial flow fan. The device is appropriately operated as the air blower (325) and the air accelerator device (326) is a centrifugal pump and an axial flow fan, either or both. The most suitable equipment used to work as the air blower (325) and an air acceleration device (326) is a centrifugal pump. Also any devices that have a speed boosting behavior, which can cause airflow or exhaust. It can be used as the air blower (325) and as the air acceleration device (326) within the concept and scope of this invention.

7. The air discharge tube (047) and pipe (050) work as the passage of the airflow. And the passage of air used for crops that do not require much pressure. There is no corrosion from what it passes. Therefore, it is possible to select the recyclable material and replace them. The suitable manufactured materials is aluminum, plastic, stainless steel and foil.

8. The air collector tube (328) works to collect air from unequally in feed to a single location before releasing air to the air discharge tube (047), then ventilate to the emission point (048) at all emission points. So that each emission point (048) has the same constant velocity. The most suitable material is aluminum, plastic, stainless steel. The most suitable material is plastic. The surface area of the air collector tube (328) is 19 to 6360 square centimeters. The optimum cross sectional area of the air collector tube (328) is 120 to 1110 square centimeters.

9. The compilation pipe (329) collect air from a pipe (050) that receives air from the air intake (049) at each point of air entering, which has not the same pressure. Then the air move through the pipe (050) and collect it at the compilation pipe (329) for keeping the pressure constant. And release to the compilation pipe (329) that can shape many aspects to suit each application area. The suitable manufactured materials is aluminum, plastic, stainless steel. The most suitable material is plastic. The size of the air compilation pipe (329) is 19 to 6360 square centimeters. The optimum area of the air compilation pipe (329) is 120 to 1110 square centimeters.

10. The air compilation pipe (329) collect air from a pipe (050) that receives air from the air intake (049) at each point of air entering, which has not the same pressure. Then the air move through the pipe (050) and collect it at the air compilation pipe (329) for keeping the pressure constant. And release to the air compilation pipe (329) that can shape many aspects to suit each application area. The suitable manufactured materials is aluminum,

plastic, stainless steel . The most suitable material is plastic. The size of the air compilation pipe (329) is 19 to 6360 square centimeters. The optimum area of the air compilation pipe (329) is 120 to 1110 square centimeters.

11. The solution storage tank (354) store photosynthetic products in form of liquid. There is a closed container which has a two way passage and one outlet, that is a liquid get from the collecting pipes (329). The passage from the excess moisture trap (320) and the solution outlet are removed. It can be injected into the plant nutrient process.

12. The excess moisture trap (320) is a device that works to trap excess moisture from the air, which separate water and air apart. There are many types of mechanical refrigeration, desiccant dehumidifier, air filter, humidity control unit and so on. The excess moisture trap (320) is a desiccant dehumidifier, an air filter and a humidity control unit.

13. The crop rail (931) is used to grow plants. The special characteristics of crop rail (931) are only used with the air source device. However, to describe the process of air movement. The crop rail (931) are both horizontal and vertical. The use of crop rail for the air source device has the most appropriate character: 1. Made of the suitable materials such as Polyvinyl Chloride, Polyethylene, Polypropylene, 316L stainless steel, 304 stainless steel and 308 stainless steel. 2. There is a color on the exterior surface that gives the density of photosynthetic photon flux density (PPFD) in the range of 100 - 1000 microns per square meter per second (micron mol/sqr.m. sec). 3. The surface of the crop rail (931) can be touched roughly by hand or visible by eyes. 4. The shape of the crop rail (931) is tall pot planted with stacked up or pot placed together to a higher floor.

14. We can add any device that work to remove the air from the air intake (049) and flow through the air collector tube (328). This new device will be counted as one of the parts of the air acceleration device (326) by setting any side of the system.

15. In the application of the aerial movement devices by the horizontal crop rails (931) can reduce the installation process of the air velocity retention devices. Or not necessary to install its in system. And count scope in this invention concept.

According to this invention may be the modification of the various inventive steps and sorting of parts of the device. Switching position is also considered within the concept and scope of this invention.

The process of creating the air movement of an invention is explained . Because the air is the vector that give the direction by installing the air emission (048) and the air outlet point (049). So that the two mounting positions are compared the effective of the growth of plants. That can be describe in figure 4.

5 Figure 4 divided into 3 separate room such as left, middle and right room respectively. There are three cases: the left hand shows the air emission point (048), the air intake (049) and the plant (001) in the same plane. Air from the air emission point (048) was released. The aerial movement (507) is directed straight to the plant (001), which is planted on the crop rail (931). That cause the speed decrease and the air move
 10 into the air intake (049), respectively. If we increase the suction pressure to the air intake (049), the air will move faster. The middle room shows the air emission point (048), the air intake (049) and the plant (001) which are in the same plane. When the air is released from the air emission point (048), it represents the air movement path (507) and (508). The air movement path (507) moves through the plants (001) planted on the crop rails
 15 (931) that cause the speed decreases and move to the wall (503). And cause to change the direction of movement that has some flow to the exhaust point and some air flows in opposite directions to the air intake (049) which cause the air distributed and flow back. So that the installation of the air intake (049) in a different direction of the air emission point (048) and the plant (001), some air is suck into the air intake (049) that
 20 make the path of air movement (508). When the path of air movement increases, the force of the movement of air move into the plant (001) is less than in the left room. The right room shows the air emission point (048) placed in different planes with the suction point (504) and the plant (001). When the air is released from the air emission (048), the air is sucked to the air movement path (508) that make the path of air movement (507).
 25 And the air pressure is less at some areas of the plant (001) and some area the air do not move through. The right room shows the image that installed at an improper distance which cause the movement of air to the plant (001) is very low and none air. In addition to it may be the case that the plant (001) fails to grow at full rate because it is not suitable for growth.

30 Show the difference from Figure 4 as comparison table:

Comparison	Left-hand room	Middle room	Right-hand room
Increasing the suction in the air intake.	Can do both ways	Do not increase the suction	Increase the suction
Air movement characteristics	Moves from the point of air emission outlet through the plant in the same plane line	Scattered when move into the wall.	Moves from the air emission to the air outlet point in straight line and some paths do not pass through plants.
Movement through plants	thorough	thorough	Not thorough
Size or pressure of air movement when hit plants .	most	Less than the left room.	Less than the left and middle rooms, respectively. And do not pass the plants sometime.
When the movement of air from the air emission point increases.	The plant is fully replenished and has exhaust air at the suction point rapidly .	The plant has been fully replenished. And the direction of motion diffused scatter when impacting the wall and the suction point that cause it is sucked slower because of the impact directions on the wall.	In the area where the air move through the plants, that can be fully replenish. But the plants has not replenished at the none air movement area .
Operation of carbon	Carbon dioxide	Oxygen and carbon	At no air

dioxide and oxygen in photosynthesis process	flow up to the photosynthetic area of plants and quickly exchange oxygen from that area.	dioxide diffuse on the wall scattered. So that some oxygen move back to area that carbon dioxide in the photosynthesis process which cause the plant to grow not fully.	movement area, plants do not use carbon dioxide from the air emission point, but it uses carbon dioxide in the closed room. That show the same process work as regular cropping without using any equipment.
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From the comparison table, we will see that. The control of air movement affects the plant growth. Optimal control method is to control the direction of all air movement in the same direction. By placing or installing both the air emission point (048) and the
5 air intake (049) which are in the same line or plane as to the plant (001).

Air movement control the direction in the same direction is divided into three types: horizontal, vertical and tilt. The horizontal movement is the wind, and the vertical movement is the air current.

From now on, we will find the same directional air movement for optimal cropping.
10 Considering the crop rail (931) there are two types: horizontal and vertical. To consider the crop rail (931) that can be divide by cases.

Case 1: Considering the plant growing by the moving air in angle plane, as shown in Figure 5. We divide the image to two rooms: the left and right room. As shown in image, show direction of air movement in angle plane which flow from the air emission
15 point (048) to the air intake (049). It can be seen that either the horizontal or vertical crop rail (931) to be used, which cause the problem of moving air through every plant. As the picture on the left hand room, the horizontal crop rail (931) has the plant (001) and the plant (002) that not in line with the movement of the air. Only the plant (003) is in same plane. As the picture on the right hand room, the vertical crop rail (931) has and

the plant (001) and the plants (003) that not in line with the movement of the air. Only the plant (002) is in same plane. By placing or installing the air emission point (048) and the air intake (049) in the same position as in the image that used the space used for planting more than the space from controlling the direction of air movement in Figures 5 6 and 7.

Case 2: Considering the horizontal crop rail (931), as shown in Figure 6. That is divided to two rooms. The left hand room show the control air movement by the wind. The right hand room show the control air movement by the air current. In the left room , the air flow from the air emission point (048) make the airflow (510) that moves to the plant (001), plant (002) and plant (003) respectively. The force of the airflow (510) is less when it pass from the plant (001) through the plant (002). And the velocity of the air flow (510) decreases at the plant (003), because the airflow (510) pass through the plant (001) and plant (002) respectively then the air flow to the air intake (049). In the right hand room, the air flow out of the air emission (048) located above. The movement of air flows show that the airflow (511) move to the area of plant (001), plant (002), and plant (003). Then it is sucked into the air intake (049). By comparing the air movement in the horizontal crop rail (931), the control air current is better than the wind because all plants have constant air speed. While using the wind, the air speed will decrease.

Case 3: Considering the vertical crop rail (931), as shown in figure 7. That is divided to two rooms. The left hand room shows the direction of air movement in the wind. In the right hand room, the control direction of air movement is in form of the air current. The explanation of the left hand room divide into two phases. In the first phase, the non- air movement control AVR D (110) and AVR D (111). In the second phase, the air movement with the air movement control AVR D (110), and AVR D (111). The first phase is described below. The airflow out of the air emission point (048). It moves into the airflow (510) through the plant (001), the plant (002), the plant (003) and move to the obstructed crop rail (931). Then it flow to the air intake (049). The vertical crops planting is often used the in line crop rail (931) at one least. To consider the crop rail (931) installation, which are spaced long apart, the airflow (510) are less and less, respectively. So that the crop rail (931) near the air intake (049) have less the air flow (510). Carbon dioxide from the airflow (510) are less to help in photosynthesis , because of the replacement of carbon dioxide and oxygen. The temperature of the airflow (510) is also unevenly distributed. So that the plant

on the crop rail (931) far away from the air emission point (048) grows worse and not growth or eventually die respectively. In case 3, the vertical crop rail (931) must consider the weight of gas unlike growing crops in horizontal. Carbon dioxide is heavier than oxygen. So making the emitted carbon dioxide flow to the bottom. The velocity of the
5 airflow (510) help the carbon dioxide to flow distributed horizontally. But when speed of the airflow (510) drops, carbon dioxide will gradually fall to the bottom of the crop rail (931). And when the height of the crop rail (931) increase, the planted area above will have less chance to grow. And up to the top of the rails cannot grow. This is another major problem of crop planting.

10 The second phase is described as follows. The airflow out of the air emission point (048) into the airflow (510) and flow through the plant (001), the plant (002), the plant (003), AVR (110) and the crop rail (931) into the air intake (049). AVR (110) and AVR (111) operate to their installation characteristics. This can be installed in two ways: the wind installation and the air current installation. The first installation keep the velocity
15 of the airflow (510) constantly. Or to closely the velocity of the airflow (510) from the air emission point (048), but it is very difficult because of the obstructed part to the wind, such as the crop rail (931). So that the system require more energy and power to keep speed of the air flow constant. To consider the vertical crop rail (931) with at least one rail added, the velocity of the airflow (510) at the crop rail (931) drop down sequentially.
20 The engineering calculations to install AVR (110) and AVR (111) device in each rail are unequally and are difficultly to produce. It also does not solve the problem of carbon dioxide flow down the bottom of the crop rail (931). The plants at the top of the crop rail (931) grow less or not grow. The second installation method, which work to create air current as the vertical air movement. So that the system keep the carbon
25 dioxide flowing down gradually, that causes the carbon dioxide float around the plant in plane. However, because the wind and the air current are perpendicularly vector that create new force in that area which cause diffusion. So that the replacement of carbon dioxide and oxygen does not work functionally. This is a new problem. In addition to the installation does not solve the problem of the vertical crop rail (931). This installation
30 cannot carry the airflow (510) to flow through every crop rail (931) in the plant container.

The right hand room shows the control of the air movement direction inform of air current. In the right hand room, which can be divided the explanation into two phases: the first phase describes the air movement without AVR (110) and AVR (111).

In the second phase, the aerodynamic movements with AVR (110) and AVR (111) are described as follows. The air flows out of the air emission point (048) and form the air flow (511) that flow down through the plant (001), plant (002) and plant (003). Then the air flow into the air intake (049). In addition to the airflow (511), the speed at the air emission point (048) is set, the temperature is readily available for each type of plant. To keep the temperature of the upper is cooler than bottom for creating the air currents naturally. So this makes the air movement stronger than the other plane. If you use the horizontal crop rail (931), you will not notice clearly because it has only one plane crop rail. While the crop rail (931) is vertically, the results are clear because it has the multiple crop rails. So when you planted the crop at very high, It uses less energy to generate air velocity than other cases because it has a natural air current that is another vector. That increases the energy of air movement. In the air release process, the carbon dioxide is mixed for plant photosynthesis. The carbon dioxide is heavier than oxygen, so it flow down to the bottom. That cause the plant on the top crop rail (931) grows less. At the higher crop rail (931), the higher plants has lower photosynthesis, even if the light is uniform. Because the carbon dioxide used in photosynthesis falls down below.

The second phase is described as follows. The air flows through the air emission point (048) inform the airflow (511) through the plant (001), AVR (110), the plant (002), AVR (111), the plant (003), and the air intake (049) finally. To maintain the velocity of airflow (511) and keep the collision of carbon dioxide slowly and flow back to top. To make photosynthesis occur on every floor.

As indicate in Case 1, the appropriate air movement for planting is the wind and air current. From case 2, the optimal air movement for horizontal crop is the air current . Because it does not require any additional equipment to solve the problem. From case 3, the optimal air movement for vertical crop is the air current that in form of the unsolving problem has less problem than the wind. And the form of solved problem by increasing the speed of air treatment equipment can solve the problem of maintaining the speed of air movement, temperature distribution and to keep the carbon dioxide density constant.

The process of creating the air movement has special characteristics for planting.

1: Determine the direction of air movement to cover the growing area. The air is moving around the plant stem to catalyze photosynthesis and converse the carbon dioxide and oxygen by using the wind or the air current. To control the direction of air movement

can be achieved by installing the position of the air velocity retention device. The air flow from the air emission point (048) to the air intake (049), that are in alignment the air velocity retention device which mounted on the crop rail (931). That is located perpendicularly and horizontally to the air emission point (048) and the air intake (049) or angle from the plane of the air emission point (048) and the air outlet point (049) less than or equal to 45 degrees. The most appropriate installation of the crop rail (931) is perpendicular to the plane of the air emission point (048) and the air intake (049). 2: When the air velocity retention device is added in the same manner. By increasing the air velocity retention devices at least one, which depend on the suitable crop and rails. 3: To install equipment that maintain air velocity and cover all installations that cause the direction of air movement in the same direction as the direction of air flow out of the air emission point (048).

The process of creating the air movement control is the most suitable for planting, that including of,

1. Determine the direction of air movement that cover the crop area by using direction of air current. To angle the direction of airflow which can be achieved by installing the position of the air source device. The air flow from the air emission point (048) to the air intake (049) linearly or equivalent. And install the air velocity retention devices on the crop rails perpendicular to the horizontal plane of the air emission (048) and the air intake (049). Or angle the air emission point (048) and the air intake (049) is less than or equal 45 degrees. The appropriate position is perpendicular to the plane line of the air emission point (048) and the air intake (049).

2. When the air velocity retention device is added in the same manner. That increase the air velocity retention devices at least one, which depend on the suitable crop and rails.

3. To install AVR D that maintain air velocity and cover all installations that cause the direction of air movement in the same direction as the direction of air flow out of the air emission point (048) and the air intake (049).

According to this invention, the process of creating the air movement control applied to horizontal and vertical crop rail more than one piece. That is considered in the area of the concept and scope of this invention.

Claims

1. An air mixture and air movement system for plant cultivation, the system comprising:

A crop rail configured for holding plants;

An air conditioning system for the cooling of incoming air and producing cooled outgoing air, the outgoing air routed to an air emission point (048);

A mixing arrangement for introducing stored gases into the incoming air;

An air movement device for creating a flow of air movement of the outgoing air, further configured to direct the air movement from the air emission point (048) to flow over an area of plants and arranged so that the flow of air movement traverses an essentially linear path from the air emission point (048) to an air intake (049);

At least one air velocity retention device (AVRD) attached to the crop rail, the AVRD comprising an air intake for drawing in air and an air output for expelling air at a velocity associated with the operation of the AVRD;

Wherein the path is arranged to traverse surfaces of at least one plant held in the plant rail, and

Wherein the at least one AVRD is oriented and arranged to assist the air flow on the path from the air emission point (048) to the air intake (049).

2. The system of claim 1 wherein a plurality of AVRDs are attached to the crop rail, the plurality of AVRDs configured in a consecutive sequence so that air expelled from one of the AVRDs is directed towards the air intake of the next AVRD in the consecutive sequence.

3. The system of claim 2 wherein the AVRDS are spatially arranged in a consecutive sequence, and wherein the distance between consecutive AVRDS in the sequence is separated by a distance within a range of 15 to 300 centimeters.
4. The system of claim 2 wherein the crop rail is arranged to be able to hold at least one plant between a consecutive pair of AVRDS.
5. Air movement control and air source device for cultivation in accordance with claim 1, the system configured to implement an air movement control process comprising:

Retrieving at least one gas from a gas storage tank (201), the gas capable of affecting the growth of plants;

Transferring the gas through a nozzle (311) to inject the gas into the airflow of an air inlet (045) to an air conditioner (100), the air conditioner for regulating the air temperature to be suitable for growing plants;

Directing the flow from an air outlet of the air conditioner (046) through the air inlet accelerator (325), wherein the air enters the air collector tube (328) for distribution air into the discharge pipe (047), which releases the moving air through at least one emission point (048) into a spatial volume comprising living plants;

Passing the moving air from the at least one emission point (048) to a first AVRDS (110), then through a region configured to comprise at least one plant (001) and into a second AVRDS (111), then through a region configured to comprise at least plant (002), the AVRDS configured to maintain directed air movement;

Drawing the flow through the air intake (049) and into the pipe (050) which is conveyed to the collecting pipe (329);

Separating the flow into gas product and liquid product;

Directing the liquid product into a solution tank (354);

Directing the gas product into an air accelerator device (326) and subsequently to an excess moisture trap (320) for removing moisture from the gas product, and is then directed to the air conditioner,

Wherein the liquid product directed the storage tank (354) is available for use in plant nutrient processing.

6. The system of claim 5 wherein the gas storage tank (201) is arranged to comprise at least carbon dioxide gas.
7. The system of claim 1 wherein the concentration of gases that affected plant growth can be measured.
8. The system of claim 5 wherein the solution storage tank (354) is a closed container comprising at least one passage and an outlet.
9. The system of claim 5 wherein the air inlet accelerator (325) comprises at least one of a centrifugal pump or an axial flow fan.
10. The system of claim 5 wherein at least one of the air discharge tube (047), air collector tube (328), air compilation pipe (329), and pipe (050) comprise at least one of aluminum, plastic, stainless steel, foil, or equivalent.

11. The system of claim 5 wherein the surface area of the air collector tube (328) is within a range of 19 to 6360 square centimeters.
12. The system of claim 5 wherein the air compilation pipe (329) can be shaped to suit a specific application area.
13. The system of claim 1 wherein the crop rail (931) has an exterior surface color comprising a photosynthetic photon flux density (PPFD) within the range of 100 - 1000 microns per square meter per second (micron mol/sqr.m. sec).
14. The system of claim 1 wherein the surface of the crop rail (931) comprises a textured surface.
15. The system of claim 1 wherein the crop rail (931) can be vertically positioned to support a plurality of plants in a vertical stack or horizontally positioned as a shelf to support a plurality of plants in horizontal array.
16. The system of claim 5 wherein the air conditioner (100) is arranged to be able to provide an air temperature within the range 5 to 50 degrees Celsius.
17. The system of claim 5 wherein the excess moisture trap (320) comprises at least one of a desiccant dehumidifier, an air filter, and a humidity control unit.
18. The system of claim 1 wherein add any device that work to remove the air from the air intake (049) and flow through the air collector tube (328), and new device counted as one of the parts of the air acceleration device (326) by setting any side of the system.

19. The system of claim 1 wherein externally-sourced wind can be used to reduce the number of AVRDS.
20. The system of claim 5 wherein the air accelerator device (326) comprises at least one of a centrifugal pump or an axial flow fan.
21. The system of claim 1 wherein the air movement velocity is essentially within a range of 0.1 — 5 meters per second.
22. The system of claim 1 wherein the carbon dioxide concentration in the outgoing air is in a range of 450 to 1600 parts per million (ppm).
23. The system of claim 5 wherein the surface area of the air complication pipe (329) is within a range of 19 to 6360 square centimeters.
24. The system of claim 1 wherein the crop rail (931) comprises at least one of Polyvinyl Chloride, Polyethylene, Polypropylene, 316L stainless steel, 304 stainless steel, 308 stainless steel, or equivalent.