

TITLE OF THE INVENTION

PLANT CULTIVATION DEVICE AND PLANT CULTIVATION METHOD

TECHNICAL FIELD

[0001]

This invention relates to a plant cultivation device having a cultivation shelf that stores plural steps of plant setting panels, each panel having plural culture mediums for planting and a plant cultivation method.

BACKGROUND ART

[0002]

Various kinds of configurations of plant cultivation devices each having a cultivation shelf that stores plural steps of plant setting panels have been proposed (see Patent related document 1, for instance).

[0003]

Fig.3 is a front view that shows an instance of a conventional configuration of a plant cultivation device. A reference number 102 in the figure denotes a plant setting panel that has two or more culture mediums for planting plants V, a reference number 103 denotes a cultivation shelf that stores plural plant setting panels 102, and a reference number 107 denotes a lighting device for irradiating light on the plants V. A plant cultivation device 101 as shown in the figure has sensor units 106A, 106B for detecting height of the plant V and an elevator 112 that supports the lighting device 107 that can go up and down so as to drive the elevator 112 such that a distance between the plant V and the lighting device 107 is made constant according to detected result by the sensor units 106A, 106B. By such a configuration of the plant cultivation device 101, it is possible to certainly irradiate light on many plants V and to stably cultivate the plants.

PRIOR ART

PATENT RELATED DOCUMENT

[0004]

Patent related document 1: Official gazette of Japanese patent application publication No.2013-153691

SUMMARY OF INVENTION

PROBLEMS TO BE SOLVED BY INVENTION

[0005]

But, the configuration exemplarily shown in Fig.3 has such a problem that the cultivation shelf itself is made complicated since the lighting device 107 itself can go up and down through the elevator 112.

[0006]

In plant factories (plant cultivation devices), some plants grow up only in the height direction (abnormally long growth) due to poor growth, without growing up in the lateral direction. Then, a result detected on such a poor growth plant may lead to an error control of the elevator 112 since the plant cultivation device 101 detects only the height through the sensors 106A, 106B.

[0007]

An object of the invention is to provide a plant cultivation device and a plant cultivation method for solving the above-mentioned problems.

MEANS FOR SOLVING PROBLEMS

[0008]

A first aspect of the invention is a plant cultivation device (1) having a cultivation shelf (3) that stores plural plant setting panels (2), each plant setting panel having plural culture mediums (not shown) for planting plants (V), as exemplarily shown in Figs.1 and 2, comprising:

- a camera unit (4) arranged on an upper hand of the plant setting panel (2) in order to take images of the plant (V) planted on the plant setting panel (2) from its upper side;

- a growth width analysis unit (5) for analyzing growth width of the plant (V) through processing the images of the plant (V)

obtained by the camera unit (4);

a sensor unit (6) for detecting a growth height of the plant (V);

a lighting device (7) for irradiating light on the plant (V) that is set on the plant setting panel (2); and

a lighting control unit (8) that controls the lighting device (7) so as to adjust quantity of the light irradiated on the plant (V);

whereby the lighting control unit (8) is configured to adjust the quantity of the light irradiated on the plant (V) on the basis of an analysis result through the growth width analysis unit (5) and/or a detected result through the sensor unit (6) when the analyzed result through the growth analysis unit (5) shows the growth width of the plant (V) does not exceed a predetermined threshold value and the sensor unit (6) shows the growth height of the plant (V) does not exceed a predetermined threshold value, and to reduce the quantity of the light irradiated on the plant (V) into predetermined quantity regardless of the analyzed result through the growth width analysis unit (5) or the detected result through the sensor unit (6) when the analyzed result through the growth width analysis unit (5) shows the growth width of the plant (V) exceeds a predetermined threshold value and the sensor unit (6) shows the growth height of the plant (V) exceeds a predetermined threshold value.

[0009]

A second aspect of the invention is the plant cultivation device, wherein the camera unit (4) is located on a position so as to take images of two or more plant stocks (V) that are set on the plant setting panel (2) from an upper hand, and the growth width analysis unit (5) analyzes a maximum width dimension of each of plant stocks (V) set on the plant setting panel and/or an area of each of the plant stocks (V) set on the plant setting panel (2) that is projected on a horizontal face, and

if there is the plant stock having poor growth in two or

more plant stocks (V) that are imaged through the camera unit (4), the growth width analysis unit (5) analyzes the maximum width dimensions and/or the areas projected on the horizontal face for the plant stocks that are not poorly grown.

[0010]

The third aspect of the invention is the plant cultivation device, further comprising a timer (9) that measures lapse time, wherein the light control unit (8) reduces the quantity of light irradiated on the plant (V) stepwise according to time measured through the timer (9) when an analysis result by the growth width analysis unit (5) shows that the growth width of the plant (V) exceeds a predetermined threshold value and the sensor unit (6) shows that the growth height of the plant (V) exceeds a predetermined threshold value.

[0011]

The fourth aspect of the invention is the plant cultivation device, further comprising a variety data input unit (10) through which data as to which plant variety the plant (V) on the plant setting panel (2) belongs to is inputted, and

an optimum data holder (11) that stores data regarding optimum quantity of light for plant varieties (V),

whereby the light control unit (8) adjusts the quantity of light irradiated on the plant (V) based on the data that is inputted through the variety data input unit (10) and the data that is stored in the optimum data holder (11).

[0012]

The fifth aspect of the invention is a plant cultivation method of cultivating plants (V), making use of a cultivation shelf (3) that stores plural steps of plant setting panels (2), each plant setting panel having plural culture mediums (not shown) for planting, comprising:

a step of taking images of the plant (V) set on the plant setting panel (2) from an upper side through a camera unit (4) that is located on an upper hand of the plant setting panel (2),

a step of processing the images of the plants (V) of the camera unit (4) through a growth width analysis unit (5) and

analyzing a growth width of the plant (V),

a step of detecting a growth height of the plant (V) through a sensor unit (6),

a step of controlling a lighting device (7) through a light control unit (8) so as to adjust quantity of light irradiated on the plant (V) based on an analyzed result through the growth width analysis unit (5) and/or a detected result through the sensor unit (6) if an analyzed result of the growth width analysis unit (5) shows the growth width of the plant (V) does not exceed a predetermined threshold value and the sensor unit (6) shows the growth height of the plant (V) does not exceed a predetermined threshold value, and

a step of controlling the lighting device (7) through the light control unit (8) so as to reduce the quantity of light irradiated on the plant into predetermined quantity regardless of the analyzed result through the growth width analysis unit (5) or the detected result through the sensor unit (6) if the analyzed result of the growth width analysis unit (5) shows the growth width of the plant (V) exceeds a predetermined threshold value and the sensor unit (6) shows the growth height of the plant (V) exceeds a predetermined threshold value.

[0013]

The sixth aspect of the invention is the plant cultivation method, wherein the camera unit (4) takes the images of plural stocks of the plants (V) that are set on the plant setting panel (2) from the upper hand,

whereby when poor growth stocks are found in such images, the growth width analysis unit (5) analyzes maximum width dimensions and/or areas projected in a horizontal direction for the stocks that are not poorly grown.

[0014]

The seventh aspect of the invention is the plant cultivation method, wherein the light control unit (8) reduces stepwise the quantity of light irradiated on the plants (V) with lapse of time when the analysis result through the growth width analysis unit (5) shows that the growth width of the plant (V) exceeds

a predetermined threshold value and the sensor unit (6) shows that the growth height of the plant (V) exceeds a predetermined threshold value.

[0015]

The eighth aspect of the invention is the plant cultivation method, further comprising a step of inputting data as to which variety of the plant (V) the plant (V) that is set on the plant setting panel (2) belong to, and

a step of obtaining optimum quantity of light to be irradiated on the plant (V) that is set on the plant setting panel (2) from data regarding the optimal quantity of light for various varieties of plants (V) that is stored in the optimal data holder (11) and the data that has been inputted,

whereby the light control unit (8) controls the lighting device (7) such that the quantity of light to be irradiated on the plant (V) is made optimum.

[0016]

The number in parentheses shows the corresponding element in the drawings for the sake of convenience, accordingly, the descriptions are not restricted and bound by the descriptions on the drawings.

EFFECTS OF INVENTION

[0017]

According to the first and fifth aspects of the invention, the configuration of the cultivation shelf can be made simplified since the elevator exemplarily shown in Fig.3 is not provided. The light control unit controls the lighting device to reduce the quantity of the light irradiated on the plant into predetermined quantity if the growth width of the plant analyzed through the growth width analysis unit exceeds a predetermined growth width threshold value and the growth height detected through the sensor unit exceeds a predetermined height threshold value, so that it is possible to weaken the growth of the plant and to avoid such a situation that the plant is broken by hitting against the plant setting panel being on the

upper side. Besides, it is possible to avoid a tipburn phenomenon due to excessive exposure of the light. In plant factories (plant cultivation devices), some plants grow up only in the height direction (abnormally long growth) due to poor growth, without growing up in the lateral direction. But, such a poor growth can be accurately detected since the growth width of the plant can be also detected through the camera unit in addition to the detection of the growth height of the plant through the sensor unit according to the invention.

[0018]

According to the second and sixth aspects of the invention, it is possible to accurately judge a state of growth of the plants without receiving influences of the poor growth stocks.

[0019]

According to the third and the seventh aspects of the invention, it is possible to properly control the quantity of light.

[0020]

Besides, according to the fourth and eighth aspects of the invention, it is possible to cultivate the plants with proper quantity of illumination light that is set for each plant variety, improving energy efficiency.

BRIEF DESCRIPTION OF DRAWINGS

[0021]

Fig.1 is a typical view (block diagram) that shows an instance of a configuration of a plant cultivation device according to the invention.

Fig.2 is a side view of a cultivation shelf that is exemplarily shown in Fig.1.

Fig.3 is a front view that shows an instance of a conventional configuration of the plant cultivation device.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0022]

Embodiments of the invention are mentioned, referring to appended drawings Figs.1 and 2.

[0023]

A plant cultivation device according to the invention is exemplarily shown with a reference number 1 in Figs.1 and 2, and has a cultivation shelf 3 that stores plural steps of plant setting panels 2. Two or more culture mediums (not shown) for planting plants V are placed on each plant setting panel 2.

[0024]

And, the plant cultivation device 1 according to the invention has

- a camera unit 4 arranged on an upper hand of the plant setting panel 2 in order to take images of the plant V set on the plant setting panel 2 from its upper side;
- a growth width analysis unit 5 for analyzing growth width of the plant V (concretely speaking, a maximum width dimension of the plant V and/or an area horizontally projected) by processing the images of the plant V obtained by the camera unit 4 with a well-known method;
- a sensor unit 6 for detecting a growth height of the plant V (the maximum growth height);
- a lighting device 7 for irradiating light on the plant V that is set on the plant setting panel 2; and
- a lighting control unit 8 that controls the lighting device 7 so as to adjust quantity of the light irradiated on the plant V.

The light control unit 8 is configured to adjust the quantity of the light irradiated on the plant V on the basis of an analysis result through the growth width analysis unit 5 and/or a detected result through the sensor unit 6 when the analyzed result through the growth width analysis unit 5 shows the growth width of the plant V does not exceed a predetermined threshold value (growth width threshold value) and the sensor unit 6 shows the growth height of the plant V does not exceed a predetermined threshold value (height threshold value), and to reduce the quantity of the light irradiated on the plant V into predetermined quantity irrespective of the analyzed result through the growth width analysis unit 5 and the detected result

through the sensor unit 6 when the analyzed result through the growth width analysis unit 5 shows the growth width of the plant V exceeds a predetermined growth width threshold value and the sensor unit 6 shows the growth height of the plant V exceeds a predetermined height threshold value. "Irrespective of the analyzed result through the growth width analysis unit 5 and the detected result through the sensor unit 6" in the specification means "the analyzed result through the growth width analysis unit 5" and "the detected result through the sensor unit 6" are not considered when the light control unit 8 controls the lighting device 7, and the light control unit 8 controls the lighting device 7 without adding such an analyzed result and such a detected result. In such a case, the light control unit 8 reduces the quantity of the light irradiated on the plant V into predetermined quantity without considering the analyzed result through the growth width analysis unit 5 and the detected result through the sensor unit 6. When only one of both the growth width of the plant V that is analyzed through the growth width analysis unit 5 and the growth height that is detected through the sensor unit 6 exceeds a predetermined threshold value and the other does not exceed a predetermined threshold value, the light control unit 8 controls the quantity of the light according to the growth width when the growth width of the plant V that was analyzed through the growth width analysis unit 5 does not exceed a predetermined growth threshold value, or according to the growth height when the growth height that was detected through the sensor unit 6 does not exceed a predetermined height threshold value.

[0025]

Preferably, the lighting device 7 is a LED light source, but may be other well-known light source, such as a fluorescent lamp, a high pressure sodium lamp and a metal halide lamp.

[0026]

Furthermore, there are an analog dimming of adjusting lightness by changing current supplied to the lighting device 7 and a PWM dimming of adjusting the lightness by controlling

light-on time and light-off time as the methods of the control of the lighting device 7 through the light control unit 8, and both methods may be appropriately used depending on kinds of the lighting devices 7. When the LED light source is used as the lighting device 7, the quantity of light may be controlled with both the analog dimming and the PWM dimming. In such a case, it has been known that a photosynthesis rate increases if the light is intermittently irradiated on plants rather than successively (the light irradiation which light time width is 200μ sec or so and light-dark cycle is 2.5kHz or so although these are slightly different, depending on varieties of plants). Then, the intermittent light irradiation with the PWM dimming is preferable in an aspect of promoting photosynthesis in comparison with the successive light irradiation with the analogue dimming.

[0027]

Preferably, the camera unit 4 may take still pictures, but the camera unit 4 having moving picture function may not be excluded. Preferably, the imaging timing through the camera unit 4 is synchronized with the timing of the light irradiation through the lighting device 7 in case of the above-mentioned PWM dimming through the lighting device 7.

[0028]

According to the invention, the configuration of the cultivation shelf 3 can be simplified since the elevator 112 exemplarily shown in Fig.3 is not provided. Besides, the light control unit 8 controls the lighting device 7 to reduce the quantity of the light irradiated on the plant V into predetermined quantity when the growth width of the plant V analyzed through the growth width analysis unit 5 exceeds a predetermined growth width threshold value and the growth height detected through the sensor unit 6 exceeds a predetermined height threshold value, so that it is possible to weaken the growth of the plant V and to avoid such a situation that the plant V is broken by hitting against the plant setting panel 2 being on the upper side. Furthermore, it is possible

to avoid a tipburn phenomenon due to the excessive exposure of the light. In plant factories (plant cultivation devices), some plants grow up only in the height direction (abnormally long growth) due to poor growth, without growing up in the lateral direction. But, such a poor growth can be accurately detected since the growth width of the plant V can be also detected through the sensor unit 6 in addition to the detection of the growth height of the plant V through the sensor unit 6 according to the invention.

[0029]

On the other hand, preferably, the camera unit 4 is located on a position so as to image two or more plants V that are set on the plant setting panel 2, and the growth width analysis unit 5 analyzes the maximum width dimension of each of the plants V set on the plant setting panel 2 and/or an area of each of the plants V on the plant setting panel 2 that is projected on a horizontal face. If there is the plant V having poor growth (that is, the spindly growth plant) in two or more plants V that are imaged through the camera unit 4, the growth width analysis unit 5 may extrude the stock having poor growth and may analyze the maximum width dimensions and/or the areas projected on the horizontal face of the stocks that are not poorly grown. In such a case, it is possible to accurately judge the growth condition of the plant with no influence from the stock having poor growth.

[0030]

As mentioned above, the light control unit 8 is configured to reduce the quantity of the light irradiated on the plant V into predetermined quantity regardless of the analysis result by the growth width analysis unit 5 or the detection result by the sensor unit 6 if the analyzed result through the growth width analysis unit 5 shows that the growth width of the plant V exceeds a predetermined growth width threshold value and the sensor unit 6 shows that the growth height of the plant V exceeds a predetermined height threshold value. In such a case, the quantity of light to be irradiated on the plant V may be reduced

stepwise with lapse of time. Concretely, the plant cultivation device 1 may be provided with a timer 9 that measures the lapse time such that the quantity of the light to be irradiated on the plant V is reduced stepwise through the light control unit 8 with lapse of time. For instance, if the irradiation quantity of light in a moment that the growth width of the plant V analyzed through the growth width analysis unit 5 exceeds a predetermined growth width threshold value and the growth height detected through the sensor unit 6 exceeds a predetermined height threshold value is 50%, the irradiation quantity of light may be reduced stepwise in such a way that the irradiation quantity of light in the first day (that is, the first day is a day when the growth width of the plant V analyzed through the growth width analysis unit 5 exceeds a predetermined growth width threshold value and the growth height detected through the sensor unit 6 exceeds a predetermined height threshold value) is 45% and the irradiation quantity of light in the second day is 40%. Some plant varieties, such as lettuces, growth in a height direction stops when having a certain height, but growth in a lateral direction continues. So, it is difficult to continuously detect the degree of the growth only with the sensor unit 6 in such plant varieties. If the plant continues to grow in the lateral direction as mentioned above, it may be difficult for the growth width analysis unit 5 to analyze the width dimension per one stock of the plant and the area projected in the horizontal direction since the plants adjacent to each other exist together and grow. When reducing the irradiation quantity of light stepwise with lapse of time after the growth of the plant V exceeds a predetermined threshold value, it is properly control the quantity of light without depending on the sensor unit 6 and the growth width analysis unit 5.

[0031]

On the other hand, the optimum quantity of light to be irradiated on the plant V in the growing season (that is, the light time width or the light-dark cycle that is closely related

to the photosynthesis rate in the case of PWM dimming, and the quantity of the current to be supplied to the lighting device 7 in the case of the analogue dimming) and the optimum quantity of light to be irradiated on the plant before harvest (that is to say, the quantity of light reduced through the light control unit 8 when the growth width of the plant V exceeds a predetermined growth width threshold value and the growth height exceeds a predetermined height threshold value) vary more or less, depending on the plant varieties. Then, the plant cultivation device 1 according to the invention has a variety data input unit 10 through which data as to which plant variety the plant V on the plant setting panel 2 belongs to is inputted, and an optimum data holder 11 that stores data regarding the optimum quantity of light for plant varieties such that the light control unit 8 adjusts the quantity of light irradiated on the plant based on the data that is inputted through the variety data input unit 10 (that is, data as to which plant variety the plant V on the plant setting panel 2 belongs to) and the data that is stored in the optimum data holder 11 (that is, the data regarding the optimum quantity of light for plant varieties). That is, if the growth width of the plant V that is analyzed through the growth width analysis unit 5 does not exceed a predetermined growth width threshold value and the growth height that is detected through the sensor unit 6 does not exceed a predetermined height threshold value, the light control unit 8 controls the quantity of light based on the analyzed result through the growth width analysis unit 5 or the detected result through the sensor unit 6, and the data that is inputted through the variety data input unit 10 (that is, data as to which plant variety the plant V on the plant setting panel 2 belongs to) and the data that is stored in the optimum data holder 11 (that is, the data regarding the optimum quantity of light for plant varieties in the end of cultivation. Besides, if the growth width of the plant V analyzed through the growth width analysis unit 5 exceeds a predetermined growth width threshold value and the growth height detected through the

sensor unit 6 exceeds a predetermined height threshold value, the light control unit 8 controls the quantity of light based on the data that is inputted through the variety data input unit 10 (that is, data as to which plant variety the plant V on the plant setting panel 2 belongs to) and the data that is stored in the optimum data holder 11 (that is, the data regarding the optimum quantity of light for plant varieties). In such a case, it is possible to cultivate the plants with proper quantity of illumination light that is set for each plant variety, improving energy efficiency. For instance, the variety data input unit 10 is a well-known touch panel or switch, and may be located at a position exemplified in Fig.2. Besides, the optimum data holder 11 is a well-known media, such as a hard disk, a SSD, a USB memory and a SD card, for instance.

[0032]

On the other hand, the sensor unit 6 which is exemplarily shown in Fig.1 is a non-contact type photoelectric sensor that is comprised of emitters 6A and 6B, but is not limited to such a type. The other well-known non-contact type and contact type of sensors may be used. Alternatively, another camera different from the camera unit 4 may be provided as the sensor unit 6. In such a case, a captured image is inputted in an image analyzer in order to detect the height through image processing. Such an image analyzer may be the growth width analysis unit 5.

[0033]

The cultivation shelf 3 has plural steps of plant setting panels 2. Then, preferably, the camera unit 4 is attached to an upper hand of any of the plant setting panels 2 (concretely speaking, a lower face of the plant setting panel 2 located at the upper hand of any of the plant setting panels 2). Generally, the same plants are set on one cultivation shelf 3 in a plant factory, and different varieties of plants are rarely set on one cultivation shelf 3. For these reasons, if the same plants are set on one cultivation shelf 3, it is not necessary to take images of all plants through the camera unit 4, and it is

sufficient to take an image of at least one stock of plant, preferably to take images of plural stocks of plants. A unit which is comprised of the camera unit 4 and the lighting device 7 may be attached to the cultivation shelf 3. In such a case, the attachment work of the camera unit 4 and the lighting device 7 can be made simplified.

[0034]

A plant cultivation method according to the invention is a method of cultivating the plants V, making use of the cultivation shelf 3 that stores plural steps of the plant setting panels 2, each plant setting panel 2 having culture mediums for planting the plants V (not shown). Such a method has

- a step of taking images of the plant V set on the plant setting panel 2 from the upper side through the camera unit 4 that is located on the upper hand of the plant setting panel 2,
- a step of processing the images of the plants V of the camera unit 4 through the growth width analysis unit 5 and analyzing the growth width of the plant V (concretely speaking, the maximum width dimension of the plant V and/or an area horizontally projected),
- a step of detecting the growth height of the plant V through the sensor unit 6,
- a step of controlling the lighting device 7 through the light control unit 8 so as to adjust the quantity of light irradiated on the plant V based on the analyzed result through the growth width analysis unit 5 and/or the detected result through the sensor unit 6 if the analyzed result of the growth width analysis unit 5 shows the growth width of the plant V does not exceed a predetermined growth width threshold value and the sensor unit 6 shows the growth height of the plant V does not exceed a predetermined height threshold value, and
- a step of controlling the lighting device 7 through the light control unit 8 so as to reduce the quantity of light irradiated on the plant V into predetermined quantity regardless of the analyzed result through the growth width analysis unit 5 or the

detected result through the sensor unit 6 if the analyzed result of the growth width analysis unit 5 shows the growth width of the plant V exceeds a predetermined growth width threshold value and the sensor unit 6 shows the growth height of the plant V exceeds a predetermined height threshold value.

To detect the height through the sensor unit 6, to take images of the plants V through the camera unit 4 and to analyze through the growth width analysis unit 5 are not necessary always to be done. For instance, these may be done during 10 days that are end season of the cultivation, such as twice a day.

[0035]

According to the invention, the configuration of the cultivation shelf 3 can be made simplified since the elevator 112 as exemplarily shown in Fig.3 is not provided. The light control unit 8 controls the lighting device 7 so as to reduce the quantity of light irradiated on the plant V into predetermined quantity if the growth width of the plant V analyzed through the growth width analysis unit 5 exceeds a predetermined growth width threshold value and the growth height detected through the sensor unit 6 exceeds a predetermined height threshold value, so that it is possible to weaken the growth of the plant V, and to avoid such a situation that the plant V is broken by hitting against the plant setting panel 2 being on the upper side. Furthermore, it is possible to avoid the tipburn phenomenon due to the excessive exposure of the light. In plant factories (plant cultivation devices), some plants grow up only in the height direction (abnormally long growth) due to poor growth, without growing up in the lateral direction. But, such a poor growth can be accurately detected since the growth width of the plant V can be also detected through the sensor unit 6 in addition to the detection of the growth height of the plant V through the sensor unit 6 according to the invention.

[0036]

When the camera unit 4 takes the images of the plural stocks of plants V that are set on the plant setting panel 2 from the

upper hand and the poor growth stocks are found in such images, the growth width analysis unit 5 analyzes the maximum width dimensions and/or the areas projected in the horizontal direction regarding the stocks that are not poorly grown. By doing so, it is possible to certainly judge the state of growth of the plants without receiving influences of the poor growth stocks.

[0037]

The light control unit 8 may reduce stepwise the quantity of light irradiated on the plants V with lapse of time when the analyzed result through the growth width analysis unit 5 shows that the growth width of the plant V exceeds a predetermined growth width threshold value and the sensor unit 6 shows that the growth height of the plant V exceeds a predetermined height threshold value. By doing so, it is properly control the quantity of light.

[0038]

Preferably, the plant cultivation method according to the invention has

- a step of inputting data as to which variety of the plant V the plant V that is set on the plant setting panel 2 belong to, and
- a step of obtaining optimum quantity of light to be irradiated on the pant V that is set on the plant setting panel 2 from the data regarding the optimal quantity of light for various varieties of plants V that is stored in the optimal data holder 11 and the data that has been inputted so as to control the lighting deice 7 through the light control unit 8 such that the quantity of light to be irradiated on the plant V is made optimum. In such a case, it is possible to cultivate the plants with the proper quantity of light that is set on each variety of plants, improving the energy efficiency.

EXPLANATION OF REFERENCE NUMBERS

[0039]

1 Plant cultivation device

2 Plant setting panel
3 Cultivation shelf
4 Camera unit
5 Growth width analysis unit
6 Sensor unit
7 Lighting device
8 Light control unit
9 Timer
10 Variety data input unit
11 Optimal data holder
V Plant

CLAIMS

1. A plant cultivation device having a cultivation shelf that stores plural steps of plant setting panels, each plant setting panel having plural culture mediums for planting plants, comprising:

- a camera unit arranged on an upper hand of the plant setting panel in order to take images of the plant on the plant setting panel from its upper side;

- a growth width analysis unit for analyzing growth width of the plant through processing the images of the plant obtained by the camera unit;

- a sensor unit for detecting a growth height of the plant;

- a lighting device for irradiating light on the plant that is set on the plant setting panel; and

- a lighting control unit that controls the lighting device so as to adjust quantity of the light irradiated on the plant;

- whereby the lighting control unit is configured to adjust the quantity of the light irradiated on the plant on the basis of an analyzed result through the growth width analysis unit and/or a detected result through the sensor unit when the analyzed result through the growth analysis unit shows the growth width of the plant does not exceed a predetermined threshold value and the sensor unit shows the growth height of the plant does not exceed a predetermined threshold value, and to reduce the quantity of the light irradiated on the plant into predetermined quantity regardless of the analyzed result through the growth width analysis unit or the detected result through the sensor unit when the analyzed result through the growth width analysis unit shows the growth width of the plant exceeds a predetermined threshold value and the sensor unit shows the growth height of the plant exceeds a predetermined threshold value.

2. The plant cultivation device according to claim 1, wherein the camera unit is located on a position so as to take images

of two or more plant stocks that are set on the plant setting panel from an upper hand, and the growth width analysis unit analyzes a maximum width dimension of each of plant stocks set on the plant setting panel and/or an area of each of the plant stocks set on the plant setting panel that is projected on a horizontal face, and

if there is the plant stock having poor growth in two or more plant stocks that are imaged through the camera unit, the growth width analysis unit analyzes the maximum width dimensions and/or the areas projected on the horizontal face for the plant stocks that are not poorly grown.

3. The plant cultivation device according to claim 1 or 2, further comprising a timer that measures lapse time, wherein the light control unit reduces the quantity of light irradiated on the plant stepwise according to time measured through the timer when an analyzed result by the growth width analysis unit shows that the growth width of the plant exceeds a predetermined threshold value and the sensor unit shows that the growth height of the plant exceeds a predetermined threshold value.

4. The plant cultivation device according to any one of claims 1 to 3, further comprising a variety data input unit through which data as to which plant variety the plant on the plant setting panel belongs to is inputted, and

an optimum data holder that stores data regarding optimum quantity of light for plant varieties,

whereby the light control unit adjusts the quantity of light irradiated on the plant so as to be optimum based on the data that is inputted through the variety data input unit and the data that is stored in the optimum data holder.

5. A plant cultivation method of cultivating plants, making use of a cultivation shelf that stores plural steps of plant setting panels, each plant setting panel having plural culture mediums for planting, comprising:

a step of taking images of the plant set on the plant setting panel from an upper side through a camera unit that is located on an upper hand of the plant setting panel,

a step of processing the images of the plants of the camera unit through a growth width analysis unit and analyzing a growth width of the plant,

a step of detecting a growth height of the plant through a sensor unit,

a step of controlling a lighting device through a light control unit so as to adjust quantity of light irradiated on the plant based on an analyzed result through the growth width analysis unit and/or a detected result through the sensor unit when an analyzed result of the growth width analysis unit shows the growth width of the plant does not exceed a predetermined threshold value and the sensor unit shows the growth height of the plant does not exceed a predetermined threshold value, and

a step of controlling the lighting device through the light control unit so as to reduce the quantity of light irradiated on the plant into predetermined quantity regardless of the analyzed result through the growth width analysis unit or the detected result through the sensor unit when the analyzed result of the growth width analysis unit shows the growth width of the plant exceeds a predetermined threshold value and the sensor unit shows the growth height of the plant exceeds a predetermined threshold value.

6. The plant cultivation method according to claim 5, wherein the camera unit takes the images of plural stocks of the plants that are set on the plant setting panel from the upper hand,

whereby when poor growth stocks are found in such images, the growth width analysis unit analyzes maximum width dimensions and/or areas projected in a horizontal direction for the stocks that are not poorly grown.

7. The plant cultivation method according to claim 5 or 6,

wherein the light control unit reduces stepwise the quantity of light irradiated on the plants with lapse of time when the analyzed result through the growth width analysis unit shows that the growth width of the plant exceeds a predetermined threshold value and the sensor unit shows that the growth height of the plant exceeds a predetermined threshold value.

8. The plant cultivation method according to claim 7, further comprising a step of inputting data as to which variety of the plant the plant that is set on the plant setting panel belong to, and

a step of obtaining optimum quantity of light to be irradiated on the plant that is set on the plant setting panel from data regarding the optimal quantity of light for various varieties of plants that is stored in the optimal data holder and the data that has been inputted,

whereby the light control unit controls the lighting device such that the quantity of light to be irradiated on the plant is made optimum.