

Design Of Intelligent Balcony Agricultural Cultivation Equipment

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Abstract. The original design of a new type of intelligent balcony agricultural cultivation equipment, the equipment mainly includes two parts: cultivation room and cultivation trough. The cultivation bottom trough is filled with soilless cultivation nutrient solution to provide nutrition for the growth of crop seedlings. The cultivation chamber can control the growth environment of seedlings. The equipment is also designed with an automatic control system to monitor the environmental factors of the air in the cultivation room and the nutrient components in the nutrient solution. The equipment adopts an integral closed structure, which can prevent mosquito breeding and bird invasion, and is suitable for agricultural planting and leisure use of family balcony.

1 Introduction

At Balcony agriculture is also called space agriculture. It is an agricultural production activity carried out on the balcony or roof of a certain height. Most of it is composed of various new cultivation methods separated from the soil, which is related to the important living environment of balcony and roof. It is also related to the scarcity of urban soil resources and heavy carrying of buildings. In addition, balcony agriculture pays more attention to the multiple effects of ornamental and beautifying harvest. It is an important artificial space environment returning to natural experience plants in home environment decoration. It is the unique environment of balcony agriculture that determines the special technology it needs to adopt. Balcony agricultural cultivation has become a new way of planting, which combines fashion and leisure, and is entering thousands of families.

Zhang Chaoyue and others analyzed and studied the current situation of balcony agriculture in China: in some developed countries abroad, vegetable food produced by balcony agriculture of residents accounts for 20% - 30% of residents' supply. Compared with developed countries, balcony agriculture in China started late and developed slowly, and its facilities, technology and popularization are far behind those of western countries. The planting mode of balcony agriculture adopted by most residents in small cities in China is still the traditional soil planting mode, which is limited by conditions and technology. Although the residents have high enthusiasm for planting, it is often difficult to carry out in practice. There are still many gaps in balcony agriculture in China, such as seed research and development, facilities supporting, technical guidance and a series of supporting professional company teams. In reality, many departments often only involve a small part of the whole industrial chain, and there is no perfect supporting

system. Although there are many problems at present, more and more people join in the development of balcony agriculture. At present, some new balcony agricultural facilities and technologies have been successfully developed and promoted. For example, Beijing Agricultural Technology Extension Station has successfully launched family ladder type, wall hanging type, pumpkin type and other balcony garden devices to save family balcony space. More and more people from various institutes of agriculture have jointly organized "Sunshine Garden" and "balcony planting" activities, which have made more and more people understand the situation of "high-speed Agricultural Research Institute" and "balcony planting".

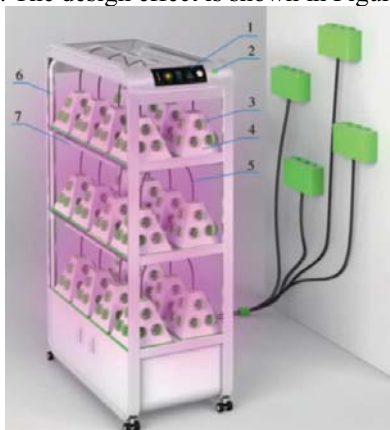
Zheng Shiyong and others analyzed the characteristics of urban balcony agriculture: balcony agriculture has multiple functions. It is a new breakthrough to traditional agriculture both in concept and in practice. Traditional agricultural production is to obtain people's living materials or transformed products for the purpose of processing, and balcony agriculture has more additional functions. For example, it plays a green role on the roof of the balcony; it is an important food basket for families; it is the best material for children's science education; it is a beautiful space for the elderly and a natural oxygen bar with fresh environment. Balcony agriculture has high yield and high quality. The microclimate environment on the balcony or roof, as well as the particularity of the cultivation mode, make the growth speed of the balcony plants greatly accelerate, the flowering and fruiting performance is greatly improved, especially the application of the aerosol mode, can make the growth rate of most plants increase exponentially, and the yield several times or even dozens of times. The high-yield and high-quality characteristics of the balcony cultivation plants, except for the particularity of the mode, everything In addition to the nutrient solution

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cultivation, it is also related to the larger marginal effect of balcony or roof space and the best ventilation conditions, which makes the sugar content and color index of fruits and vegetables higher. Balcony agriculture has a wide range of adaptability. Balcony agriculture is a complete artificial agriculture. It can use various integrated environmental control technologies, such as balcony greenhouse to create the best plant living space, and scientific cultivation methods can also be used to break the various restrictions of traditional soil cultivation. For example, in the northern region, pineapple, banana, papaya and other tropical fruits can be cultivated in the Mini Greenhouse on the small balcony. Balcony agriculture is also clean and pollution-free, easy to operate and sustainable development[2].

Chen Sixuan et al. proposed a three-dimensional green vegetable planting method for balcony agriculture in southern China: intelligent soilless three-dimensional planting mode of balcony. This system can realize soilless cultivation of vegetables and automatic replenishment of water and light to adapt to the environment of plant growth according to the different lighting environment of each balcony and the work and rest changes of each householder[3].

Gao Ruitao and others optimized the design of balcony agricultural vegetable planting equipment from three aspects of informatization, serialization and ecology [4]. The design effect is shown in Figure 1.



- 1- display panel
- 2- power switch
- 3- cultivation cup
- 4- culture tower
- 5- liquid supply pipeline
- 6- reflux pipeline
- 7- plant light supply lamp

Figure 1. Design effect picture

The balcony agricultural vegetable planting equipment developed by Gao Ruitao has the following characteristics: green environmental protection, reasonable spatial layout, friendly operation mode, etc. combined with computer control technology, the precise control of cultivation environment is realized, and the product has certain promotion value.

Wu guojuan and others discussed the adaptability of balcony agriculture, and designed the maintenance equipment suitable for balcony agriculture [5].

At present, there are many mosquito and bird pests in the open balcony agricultural cultivation mode, and the degree of intelligence is low. In view of the above problems, an intelligent balcony agricultural cultivation equipment is proposed, which can effectively prevent mosquito breeding and bird invasion, and has the characteristics of intelligence.

2 Composition & Characteristics

2.1 Composition

The intelligent balcony agricultural cultivation equipment is mainly composed of four parts: lamp cover, cultivation room, cultivation bottom trough and cultivation board, and automatic control system. A lamp cover is arranged on the top of the cultivation chamber to provide light for the crop seedlings. The bottom of the cultivation chamber is arranged on the cultivation bottom groove. One side of the outer wall of the cultivation room is designed with a vent hole, and a baffle plate is slidably connected on the outer wall of the cultivation room to realize the sealing and opening of the vent hole. The top of the cultivation bottom groove is open, and the bottom is filled with soilless cultivation nutrient solution; the middle of the cultivation bottom groove is installed with cultivation plate; the cultivation plate is designed with cultivation holes, and the seedlings are inserted, and the roots of the seedlings are placed in the cultivation solution. The equipment also has an automatic control system, including temperature and humidity sensor, carbon dioxide sensor, light sensor, element content online real-time monitoring device, controller and display screen, which can automatically display and control the growth environment of agricultural crops on the balcony.

2.2 Characteristics

Affiliations of authors should be typed in italic 8-point Arial. They should be preceded by a numerical superscript corresponding to the same superscript after the name of the author concerned. Please ensure that affiliations are as full and complete as possible and include the country. Intelligent balcony agricultural cultivation equipment has the following advantages:

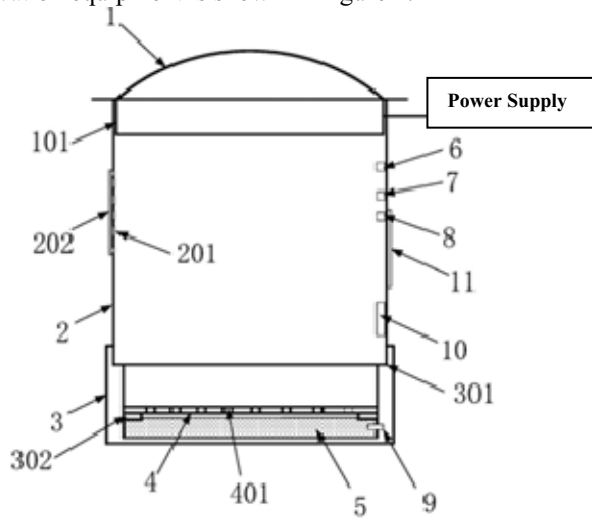
The new intelligent balcony agricultural cultivation equipment adopts the overall closed structure, which can prevent mosquito breeding and bird invasion.

The equipment has the characteristics of intelligence, the light intensity can be adjusted automatically according to the external environment, the environmental parameters of the cultivation room and the nutrient solution parameters of the cultivation bottom can be displayed quantitatively, which is convenient for understanding and regulating the plant production.

The equipment is easy to assemble and disassemble.

3 Structure & Installation

The structure of intelligent balcony agricultural cultivation equipment is shown in Figure 2.



- 1- lamp cover
- 101- ring joint
- 2- cultivation room
- 201- connecting section
- 202- arc baffle
- 3 - cultivation bottom trough
- 301 - support shoulder A
- 302 - support shoulder B
- 4 - cultivation plate
- 401 - cultivation hole
- 5- culture solution
- 6- temperature and humidity sensor
- 7- carbon dioxide sensor
- 8- light sensor
- 9- online real-time monitoring device for nutrient element content
- 10- controller
- 11 display screen

Figure 2. Structure diagram of intelligent balcony agricultural cultivation equipment

The top of the lamp cover is a circular arc, and the top of the inner wall is equipped with white LED energy-saving lamps, which are arranged horizontally and vertically. The side wall of the top cover has a power interface, which is connected with a 220 V power supply through the power line to supply power for the LED energy-saving lamp. The bottom of the top cover is

designed with a ring joint, and the outer wall of the ring joint has a male thread structure, which is used for connecting with the cultivation chamber. The bottom two sides of the lamp cover are also provided with the edge of the outer protrusion, which can be used for the user to hold and lift the cultivation chamber.

The cultivation chamber is a transparent rigid plastic cylinder structure, with a connection section at the top. The inner wall of the connection section has an internal thread structure, which is connected with the external thread of the ring joint at the bottom of the top cover to make the lamp cover and the cultivation chamber relatively fixed. A ventilation area is designed on one side of the outer wall of the cultivation room. There are m rows and N rows of air holes on the outer wall of the ventilation area. M and N are positive integers, all of which are greater than 1. Through the baffle plate, each air hole in the ventilation area can be sealed and opened. The baffle is arc-shaped plate, with the same radian as the outside wall of the cultivation room. Slide blocks are installed at the upper and lower edges of the baffle, which are respectively installed on the slideway designed along the peripheral of the outer wall of the cultivation room at the upper and lower edge of the ventilation area; thus, the baffle can be slid along the slideway by pushing and pulling the baffle, and the baffle can be opened or closed according to the needs of plants for gas, temperature and humidity.

The cultivation bottom trough is a cylindrical structure, with an opening at the top and a nutrient solution for soilless cultivation at the bottom. The top outer wall of the cultivation bottom trough is designed with a supporting shoulder a to support the positioning cultivation chamber. Thus, the cultivation chamber can be placed on the cultivation bottom groove, and the bottom end is placed on the support shoulder a, supported by the support shoulder a, and the radial movement of the cultivation chamber can be limited by the side wall of the cultivation bottom groove. The middle part of the inner wall of the cultivation bottom groove is designed with a support shoulder B to support the cultivation plate. Thus, the cultivation plate can be embedded in the interior of the cultivation bottom groove, and the bottom surface is placed on the support shoulder B, supported by the support shoulder B, and the radial movement of the cultivation plate can be limited by the side wall of the cultivation bottom groove. The cultivation plate is used to place the crop seedlings, on which there are x rows and Y rows of cultivation holes. The crop seedlings can be inserted into the cultivation holes to locate, and the roots are placed in the cultivation solution.

The automatic control system of the equipment includes temperature and humidity sensor, carbon dioxide sensor, light sensor, online and real-time monitoring device for nutrient element content, controller and display screen. Among them, the temperature and humidity sensor, carbon dioxide sensor, light sensor and controller are installed in the interlayer designed on the inner wall of the cultivation room to obtain the temperature and humidity data, carbon dioxide content and light intensity data in the cultivation room.

The on-line real-time monitoring device of nutrient element content is installed on the inner wall of the cultivation bottom trough to obtain the data of nitrogen, phosphorus and potassium content in the nutrient solution. The display is embedded in the outer wall of the cultivation room. The temperature and humidity sensor, carbon dioxide sensor and light sensor are all connected with the display to display the acquired data in the display. Therefore, the environmental factors in the air and the nutrients in the nutrient solution of the cultivation room can be monitored by the automatic control system. The above environment factor controller is connected with the light sensor. After receiving the light intensity data sent by the light sensor, the controller compares it according to the light intensity threshold stored in the interior. If it is higher than the light intensity threshold, the controller will control to weaken the brightness of the LED energy-saving lamp; if it is lower than the light intensity threshold, the controller will control to turn on the enhanced LED energy-saving lamp, and realize the automatic adjustment of the light and shade of the energy-saving lamp in the top cover, so as to realize the cultivation Automatic control of indoor light intensity.

Acknowledgments

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