ABSTRACT

The reduction of agricultural land due to urbanization highlights the need for innovation in efficient and sustainable modern farming systems. One promising solution is indoor farming, which enables plant cultivation without relying on direct sunlight. Red spinach microgreens (Amaranthus tricolor) are ideal for this system due to their short harvest cycle and high nutritional content. However, their growth is highly influenced by the quality and intensity of artificial lighting. This study designed and implemented a prototype of an artificial lighting system based on the ESP32 microcontroller with adjustable light intensity settings. The system utilizes WS2812B LEDs with a 1:1 combination of red and blue light, automatically controlled via the Internet of Things (IoT) and synchronized using the Network Time Protocol (NTP), providing 16 hours of lighting per day. The experiment was conducted over 12 days with three variations of light intensity: 2068 lux, 2336 lux, and 2730 lux. The results showed that a light intensity of 2336 lux produced the highest growth of red spinach microgreens, with an average plant height of 3.34 cm. This indicates that lux, as a unit of light intensity, plays a significant role in supporting the photosynthesis process, where both insufficient and excessive light levels can inhibit plant growth. The value of 2336 lux was proven to be the most appropriate intensity for achieving optimal growth. The developed system successfully regulates lighting automatically and efficiently based on plant needs and has the potential to serve as a practical solution for supporting small to medium-scale farming in urban environments sustainably..

Keywords: Microgreen, Red Spinach, Artificial lighting,, IoT, Light Intensity.