FERTIGATION SCREENING MECHANISM FOR CUCUMIS SATIVUS TREE

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ABSTRACT

Fertigation is an innovative cultivation method by which liquid nutrient fertilisers are applied through an irrigation system using a drip and sensor control technology. Fertigation provides nutrients directly to the root, thus minimising losses of expensive nutrients, which ultimately helps reduce water use, improve the productivity and quality of farm produce, and reduce the risk of environmental pollution. Fertigation involves specific equipment according to the crop type and irrigation system and precise selection of suitable fertiliser and its combination. This study uses a systematically controlled fertigation method to guarantee the continuous supply of balanced and sufficient nutrient fertilisers for the growth of the cucumis sarivus or cucumber tree. The development of the project site, fertigation systems, including pipe design and planting methods, and the Blynk platform for monitoring and database record system are all part of the process. The project's success is based on sensor testing kits used to gather information on the development of cucumber plants, water temperature, pH, and moisture levels. Additionally, this method produced more than 112 kg of quality cucumbers. In conclusion, this study has significantly contributed to improving green technology, enhancing the efficiency of agriculture and fertilisation systems, and boosting crop yields in Malaysia's agro sector.
Keywords: Fertigation System, Blynk, Database, Cucumber Tree, Green Technology

1. Introduction

The fertigation system is a method that has gained tremendous popularity in Malaysian agriculture. Farmers can save time, energy, and effort by using the fertigation approach to accomplish two tasks: fertilisation and irrigation. Modern fertigation systems can be customised with software to monitor the plant growth, water irrigation, soil moisture, and water level in a tank. Drip fertigation is the most efficient way to reduce inputs and deliver nutrients to the plant root. As there are large and small-scale fertigation systems with manual or fully automated control, the technology is ideal for farms of all sizes [1]. The fertigation system proves to be more efficient than the conventional fertilisation method. Fertigation systems stimulate rapid root growth, reduce water pollution by using fewer chemicals, optimise water use, reduce fertiliser expenditure, and limit leakage due to heavy rains or water supply.

Fertiliser plays a critical function in the development of fertigation systems. Ammonium nitrate, urea ammonium nitrate, calcium nitrate, ammonium thiosulfate, potassium chloride, potassium sulphate, potassium nitrate, phosphoric acid, sulfuric acid, and other water-soluble fertilisers are often used for fertigation. Aside from giving nutrients, some fertilisers can act like acidifiers and improve soil quality.

The first criterion to consider when using a fertilisation system is the size and scope of the application. Large businesses typically utilise major-scale fertigation systems, whilst small-scale fertigation systems are appropriate for smaller farms or greenhouses and small to medium-sized businesses. The second criterion is crop management, which can be done manually or automatically as part of the overall system control procedure. The third criterion is an irrigation method, such as flood irrigation, sprinkler, nozzle and splash head irrigation, or drip fertigation [2]. A timer can be integrated into the irrigation method, allowing water flow at predetermined intervals.

Fertigation can ensure that the root receives the maximum amount of nutrients with the least amount of waste. It effectively decreases runoff and waste, particularly during heavy rains or flooding. Fertigation timing is determined by the crop's demands and can be done daily, weekly, or monthly, depending on the nutrient management strategy. Sensors for measuring pH and electric conductivity are included in most fertigation systems. The fertigation and irrigation system injectors can then be tuned accordingly. Farmers will be able to establish the appropriate fertiliser rates in this manner.

This study uses the Blynk platform as an "Internet of Things" (IoT) technology to make it easier for farmers to control and monitor crop growth through sensors. The system also uses the Blynk mobile application system, with the aim of recording data in a database [3].

2. Methodology

The methodology explained in-depth the procedures and steps needed to complete the project. Before starting any crop production, some factors must be considered, such as location, crop selection, tillage method, fertigation system, and product pricing. Crop selection considers the best market price after harvesting, consumer demand, fertiliser quantities, water requirements, plant diseases and insect control strategies. After considering all these factors, the researchers decided on cucumber because of its short harvest period, produce high yield, and strong market demand. It was decided that the crop would use a total yield model.

Fig. 1. Research on Cucumber Crops at Kedah Federal Agricultural Marketing Authority (FAMA)

After selecting the crop, the following step was to locate a suitable fertigation site. After receiving consent from Tuanku Sultanah Bahiyah Polytechnic's management, the authorised site was behind the Department of Mechanical Engineering's project workshop. Soil site preparation is vital for producing good crops. However, for this fertigation system project, researchers used polybags and studied three types of crops: above-ground crops, hanging crops, and covered crops [4].

Fig. 2. Fertigation Site at Tuanku Sultanah Bahiyah Polytechnic

The next step was to prepare the land. The project frame used iron poles, pipes, and wooden poles. The iron and wooden pipes and poles were measured and marked with a measurement of 6 feet high, while the timber was 1.5 feet high. The process of cutting 49 iron poles was done after obintiaining accurate measurements. Forty-nine iron poles were used as fences at the hanging plantation project and land planting for the irrigation and fertigation project. Each iron pole was cut to 8 feet for hanging plants, while the poles were cut to 6 feet for ground crops. In addition, wooden poles were cut to the size of 1.5 feet.

The drilling process was carried out using a 5-inch drill size to drill holes in the wooden pole. A hammering process was carried out to insert iron poles in holes above the ground surface. The process incorporated 2 feet of iron poles from 8 feet in the ground. Before starting the hammering process, the pole was inserted in the centre of the hole. The cucumber nets were raised and tensioned on the poles to make it easier for the cucumber trees to grow [5].

The piping process was carried out for the cucumber irrigation system. Therefore, according to the layout diagram, a prescribed pipe size was installed for the irrigation system. AC pump was used to draw in water from the tank and send it for irrigation.

The planting process was carried out by filling coco peat into a polybag. Inside the polybag, two seeds of cucumber plant were planted. Microtubes for irrigation and PH sensors were inserted to monitor the soil temperature and condition.

Fig. 3. Land Preparation

Next, tanks and piping systems were installed to make drainage. Cables were used to connect the water pump and irrigation controller to the tank. One dripper pipe was connected to the 16 mm pipe for each coco peat. The tank was filled with water until it reached level 1, then mixed with organic fertiliser. The water PH was measured. Once the PH water was at a proper level, the irrigation controller was switched to begin the water flow through to the fertigation field. Water flowed from the main pipe to the tank, then to the fertigation area. The dripper pipe provided water and fertiliser to the coco peat [6]. The irrigation controller operation will repeat itself daily, and it is easier to regulate the process with a timer to control the water flow.

Fig. 4. Tank and Piping System Supply Water to the Farm

Real-time monitoring of these features is possible with suitable sensors [7]. The sensors were connected to the Internet via a Wi-Fi connection. This project used ESP8266 NodeMCU using Arduino programming software to control the fertigation system [8]. Timers and switches were used to manage the 'on' and 'off' functions of any water delivery motor used in an agricultural irrigation system.

The soil moisture sensor is the system's working principle in developing electronic circuits [9]. The sensor measured the soil moisture of the cucumber tree, and the DHT11 sensor measured the temperature and humidity of the air in the cucumber plants. Then the two sensors sent the data to NodeMCU ESP8266.

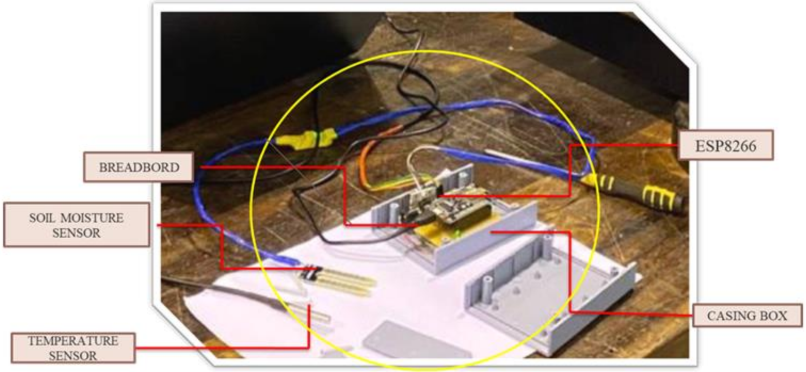

Fig. 5. Electronic Board with ESP8266

Blynk platform manages hardware from a distance, shows sensor data, saves and visualises the data [10]. Three primary components make up this Blynk platform: using the numerous widgets given by the designer, Blynk app can develop outstanding interfaces. When a person touches a button in the Blynk app, the message is delivered to Google Sheets, where the message is made to the hardware efficiently. It also works in reverse, and everything happens in seconds. All communication between the smartphone and the hardware is managed by Blynk Server [11].

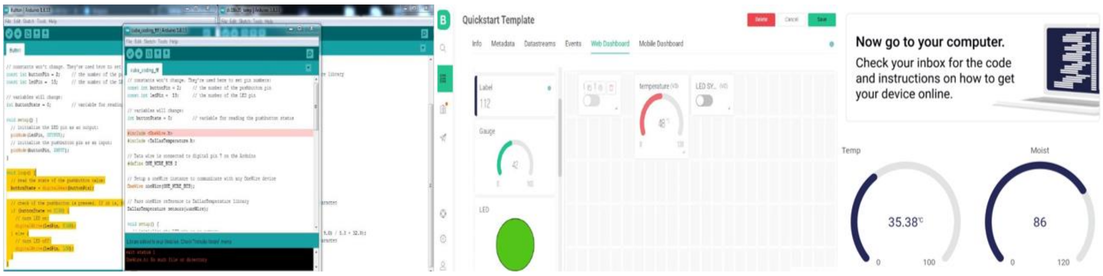

Fig. 6. Blynk Development for Crop Monitoring

3. Result and Discussion

Data related to temperature and relative humidity were measured based on the findings from the ground cropping method, hanging cropping method, and cover cropping method. The monitoring aimed to determine which cropping method was more effective and suitable for improving vegetable quality. All cropping methods were controlled using IoT, which is DEV1 for ground crops, DEV2 for hanging crops, and DEV3 for covered crops. From the result, there were differences between fruit growth, fruit diameter, fruit length, percentage of defoliation and pest attack. All the information was recorded in a database.

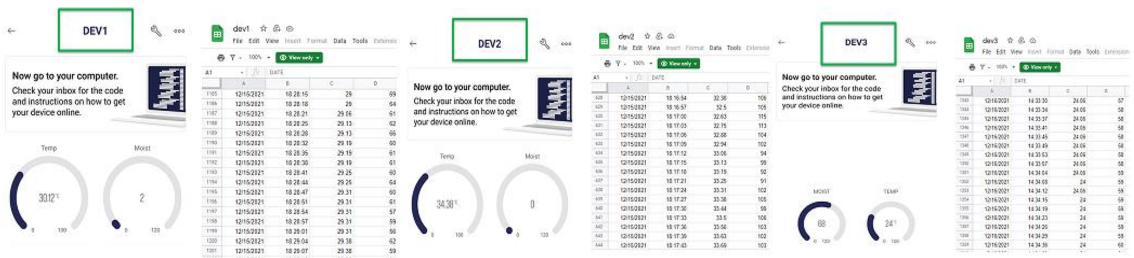

Fig. 7. IoT Monitoring for Three Crop Methods; Ground Crop, Hanging Crop and Cover Crop

An analysis was also conducted on leaf defoliation for ground crops and hanging crops. Defoliation is the loss or peeling of leaves from a plant on a large scale. Many factors can contribute to this, including pest infestations, disease, or chemical runoff from herbicides. The percentage of defoliation was measured using BioLeaf Foliar analysis apps. The data obintiained showed that hanging crops has a low percentage of defoliation.

Fig. 8. Analysis on the Percentage of Defoliation

4. Conclusion

In conclusion, cucumber fertigation was easier than traditional cucumber cultivation. In addition, this project optimised the use of IoT systems to control soil temperature and humidity and the rate of fertiliser in terms of technology [12]. Indirectly, this application has made it easier to get the actual data with a real-time application. Therefore, the new fertigation system is more accessible using the Blynk application because it can remotely control ambient temperature and soil moisture by monitoring through laptops or smartphones. This technology can reduce the labour and costs required by farmers to operate the farm [13].

Fertigation is an essential process in which fertiliser is supplied to plants and crops using irrigation channels. Fertigation has led to the improvement of agriculture as the plants properly get the nutrients to help improve the production of the crops [14]. The fertigation process directs the nutrients directly to the plant root. The observation found no fertiliser waste, as the fertiliser system will directly target the plant roots. This project saved the use of fertiliser by 30%. In conclusion, fertigation helps increase crop yield in the National Agro-Food sector, optimises the application of green technology, and can overcome the problem of increasing vegetable prices in the market.

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