

Smart Fertilizer Mixer System for Fertigation

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Abstract— In modern agriculture, the fertigation technique is widely used to grow healthy crops and achieve quality yields. It involves mixing fertilizer into the water supply, typically referred to as the irrigation system, for crop cultivation. In the case of manually mixed fertilizer, the challenge lies in determining the appropriate level of electrical conductivity (EC) of the mixture. High EC value will reduce the chance of survival in young plants, whereas low EC value could reduce the yield of matured plants. This paper intends to address the situation by proposing an automated nutrient solution mixing method that matches the required EC level. As part of the research setup, this study makes use of a systematic fertilizer mixer that carries out the fertilization system and the irrigation system concurrently. The stock solution of this fertigation system is a type of liquid fertilizer that, when dissolved in water, produces the positively charged Mg (+2) ions and the negatively charged SO₄ ions (-2) thus making it possible to get an EC reading. Through this uncomplicated and economical method, farmers can confidently rely on EC sensors to check the concentration level of the mixed nutrition solution on their behalf.

Keywords—Fertigation, Internet-of-Thing, EC sensor, Agriculture, Automatic system

I. INTRODUCTION

To keep up with the global food demand, governments and businesses invest hefty sums to support the development of agricultural technologies. Fertigation methods are gaining popularity in Malaysia, where agricultural entrepreneurs try to boost the productivity of their farm while minimizing operational costs by combining fertilization and irrigation. It is common practice to use nutrient-specific fertilizers on vegetables such as chillies, cucumbers, and tomatoes, as well as high-value fruits such as rock melons and durian. In general, these types of plants are the most valuable on the local markets and abroad. Crops producing up to five times the normal yield size per unit area have been reported, contributing to the growing popularity and public interest in the fertigation technology.

In simple terms, fertigation is the process of providing nourishment to plants by delivering a nutrient mixture with irrigation water through pipelines or sprinklers. It is a modern agricultural technique extensively used in commercial agriculture and horticulture. However, effective fertigation is by default labour-intensive as it requires farmers to hire workers to seed the fertilizer. As a way forward, the project proposes an automatic fertigation water preparation system and has developed the necessary control system that is accessible via smartphone or tablet.

The proposed system is highly recommended for farmers whose plantations consist of more than 3,000 plants. Typically, plantations of such size require up to 8,000 liters of fertigation water per day, with a specific fertilizer composition as defined by the electrical conductivity (EC) parameter. The implementation of this system can make it easier for farmers to manage the required EC value in the fertilizer. Additionally, accurate and timely reading of the EC level is crucial because the value must correspond to the different growth stages of the plant. Fig. 1 below depicts the typical fertigation system used by farmers in Malaysia.

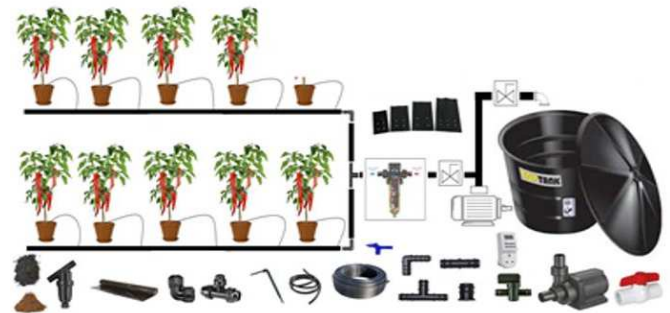


Fig. 1. Typical Fertigation System

The first challenge is in determining the EC value required for specific crops. Each plant requires a different amount of EC value based on its type and age. This is critical for plant growth because if the EC value is lower than recommended, the plants may not receive enough nutrients, whereas if the EC value is too high, the plant may receive too much nutrients. Both conditions will affect the crop growth. Next, we'll go over how to transition a fertigation system's batch process from being manual to automated. The main tank serves as a mixer tank, mixing the fertilizer solution and tap water to produce the desired EC value. The goal of this project is to come out with an efficient fertigation system for small farmers by designing a real-time multitasking control system for the fertilizer mixer system by implementing the necessary hardware and software components to determine the actual EC measurement that is suitable for the crop's needs.

II. LITERATURE REVIEW

This chapter will explore the details of the automated water preparation system concepts, and the types of systems used in fertilizer systems. The installation of a water