

ABSTRACT

The research centered on determining an efficient measurement approach for a curical parameter for plantation, namely the soil water content (SWC). Indirect methods have been proposed as efficient, and cost-effectives. The indirect measurement approach involves utilizing electromagnetic waves during the sensing process, with the primary objective of observing the behavior of the soil sample dielectric permittivity. In this method, the microwave sensor equipped with of a microstrip antenna which direct to the soil sample and obtaine the resonant frequency as result. By analyzing the resonant frequency, the SWC can be estimated using this measurement

This research entails the specification determination, design and simulation of the microstrip antenna. The aim is to obtain its performance and sensitivity, thereby achieving accurate results for SWC. Lastly, the fabrication of the antenna was performed to support the experiment scenario. Furthermore, in order to aid in determining the SWC values, a combination of theoretical analysis and simulations was utilized. This approach involved investigating the relationship between the resonant frequency and the dielectric permittivity, to deriving a mathematical formulation to estimate the SWC values. Both the simulated and fabricated microstrip antennas exhibited good performance, with resonant frequencies of 956.4 MHz and 971.4 MHz respectively. These resonant frequencies met requirements.

The experimental setup consisted of two scenarios. The first scenario involved collecting five samples from two different areas. In this scenario, the microstrip antenna sensing method was compared to the gravimetric method, which served as the calibration method. The SWC values obtained from both methods exhibited a difference of approximately 3-4%. This comparison suggests that the microstrip antenna method yields accurate results, as it aligns closely with the results obtained from the gravimetric method. In the second scenario, the microstrip antenna was used to check homogeneous of the soil sample which divided in two area. As the result, the soil sample show homogeneous result. In conclusion, the proposed method demonstrated a high accuracy to estimate SWC, and its prove as a reliable approach for agricultural applications.

Keywords: soil water content (SWC), microstrip antenna, dielectric permittivity, resonant frequency,