

ABSTRAK

DETEKSI KADAR HARA NITROGEN, FOSFOR DAN KALIUM (NPK) PADA TANAH MENGGUNAKAN METODE KONDUKTIVITAS LISTRIK

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Kesuburan tanah yang ditentukan oleh kandungan unsur hara NPK (Nitrogen, Fosfor, Kalium) sangat penting untuk produktivitas tanaman. Metode deteksi NPK konvensional seperti uji laboratorium memiliki keterbatasan dalam hal waktu, biaya, dan aksesibilitas bagi petani sedangkan alat ukur NPK dipasaran tergolong mahal. Penelitian ini bertujuan mengembangkan metode alternatif pengukuran kadar NPK tanah menggunakan konduktivitas listrik yang lebih ekonomis dan praktis. Percobaan ini dilaksanakan di Laboratorium Elektronika Dasar, Jurusan Fisika FMIPA Universitas Lampung pada bulan Desember 2024 - Mei 2025. Sistem pengukuran dirancang menggunakan metode 4-titik dengan sumber arus konstan, sistem pembacaan tegangan, dan penguat *non-inverting* yang terintegrasi dengan mikrokontroler Wemos D1 Mini. Tanaman tomat digunakan sebagai indikator biologis untuk menguji efektivitas pemupukan NPK dengan tiga variasi komposisi pupuk: NPK 15-15-15, NPK 16-16-16, dan NPK 20-10-10. Hasil penelitian menunjukkan bahwa (1) sistem berhasil dikembangkan dengan akurasi sistem pembacaan tegangan 99,2% dan penguat *non-inverting* 97,92% menggunakan sumber arus konstan 1,25mA, (2) pupuk NPK 20-10-10 menghasilkan konduktivitas tertinggi (0,4441 S/m), diikuti pupuk NPK 16-16-16 (0,38 S/m), dan NPK 15-15-15 (0,32891 S/m) yang menunjukkan korelasi positif antara kandungan nitrogen dengan konduktivitas tanah, (3) Pertumbuhan tanaman tomat optimal dicapai pada NPK 20-10-10 dengan penambahan tinggi 1,8 cm dibandingkan NPK lainnya (1,5 cm), mengkonfirmasi bahwa konduktivitas listrik dapat menjadi indikator yang baik untuk memprediksi laju pertumbuhan tanaman.

Kata kunci: NPK, pengukuran 4-titik, konduktivitas listrik, tanah, tomat.

ABSTRACT

DETECTION OF NUTRIENT LEVELS OF NITROGEN, PHOSPHORUS AND POTASSIUM (NPK) IN SOIL USING THE ELECTRICAL CONDUCTIVITY METHOD

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Soil fertility determined by NPK (Nitrogen, Phosphorus, Potassium) nutrient content is crucial for plant productivity. Conventional NPK detection methods such as laboratory testing have limitations in terms of time, cost, and accessibility for farmers, while NPK measuring instruments on the market are relatively expensive. This research aims to develop an alternative method for measuring soil NPK content using electrical conductivity that is more economical and practical. This experiment was conducted at the Basic Electronics Laboratory, Department of Physics, Faculty of Mathematics and Natural Sciences, University of Lampung from December 2024 to May 2025. The measurement system was designed using a 4-point method with a constant current source, voltage reading system, and non-inverting amplifier integrated with a Wemos D1 Mini microcontroller. Tomato plants were used as biological indicators to test the effectiveness of NPK fertilization with three fertilizer composition variations: NPK 15-15-15, NPK 16-16-16, and NPK 20-10-10. The research results show that (1) the system was successfully developed with voltage reading system accuracy of 99.2% and non-inverting amplifier accuracy of 97.92% using a constant current source of 1.25mA, (2) NPK 20-10-10 fertilizer produced the highest conductivity (0.4441 S/m), followed by NPK 16-16-16 fertilizer (0.38 S/m), and NPK 15-15-15 (0.32891 S/m), demonstrating a positive correlation between nitrogen content and soil conductivity, (3) Optimal tomato plant growth was achieved with NPK 20-10-10 with a height increase of 1.8 cm compared to other NPK fertilizers (1.5 cm), confirming that electrical conductivity can serve as a good indicator for predicting plant growth rates.

Keywords: NPK, 4-point probe measurement, electrical conductivity, soil, tomato.