

RINGKASAN

Penggunaan traktor roda 2 dalam pengolahan tanah mampu mempermudah petani dalam proses budidaya tanaman, namun justru berdampak negatif pada struktur tanah serta dapat menghambat perakaran tanaman dalam penyerapan nutrisi dan air. Pemupukan menjadi salah satu solusi untuk memperbaiki sifat fisik tanah dan menambah kesuburan tanah. Analisis sifat fisik tanah kebanyakan hanya berfokus pada kedalaman 0 – 30 cm, sedangkan beberapa tanaman memiliki perakaran lebih dari 30 cm. Selain itu, proses pengolahan tanah biasanya dilakukan 2 – 3 kali dalam satu tahun, namun kajian mengenai dampak pemadatan tanah pada saat 12 bulan setelah perlintasan traktor roda 2 masih jarang dilakukan. Oleh karena itu, penelitian ini bertujuan untuk: 1) mempelajari perbedaan pengaruh pupuk organik, kimia, dan campuran terhadap tingkat pemadatan tanah pada kedalaman 0 – 50 cm pada saat 12 bulan setelah perlintasan traktor roda 2; dan 2) mempelajari hubungan antar variabel sifat fisik tanah terkait pengaruh pupuk organik, pupuk kimia, dan pupuk campuran terhadap tingkat pemadatan tanah pada kedalaman 0 – 50 pada saat 12 bulan setelah perlintasan traktor roda 2.

Penelitian dilakukan pada bulan Februari – Juli 2025 dengan tempat pengambilan sampel tanah di lahan pertanian Desa Karangduren, Sokaraja dan pengukuran sifat fisik tanah di Laboratorium Terpadu 1 IAB, Universitas Jenderal Soedirman. Rancangan percobaan menggunakan Rancangan Acak Lengkap (RAL) dengan satu faktor dan satu kontrol pada 4 taraf perlakuan yaitu: tanpa pupuk, pupuk organik, pupuk kimia, dan pupuk campuran. Alat dan bahan yang digunakan meliputi traktor roda 2 tipe Quick/G 3000 ZEVA, *soil ring sampler* 100 cm³, *head core ring sampler*, oven, timbangan digital, jangka sorong, cawan alumunium, *falling head meter*, meteran, *stopwatch*, pupuk organik, pupuk kimia, pupuk campuran, dan 4 plot penelitian berukuran 2 m × 1 m. Pengambilan sampel tanah tidak terganggu dilakukan pada kedalaman 0 – 10, 10 – 20, 20 – 30, 30 – 40, dan 40 – 50 cm dengan jumlah ulangan sebanyak 5 kali untuk setiap kedalaman, sehingga total sampel yang diperoleh adalah 100. Variabel yang diukur meliputi *dry bulk density*, *hydraulic conductivity*, porositas, dan kadar air tanah. Analisis data menggunakan *Analysis of variance* (ANOVA) dengan uji lanjut menggunakan uji *Duncan's Multiple Range Test* (DMRT) 5% serta analisis regresi.

Hasil penelitian menunjukkan bahwa pemberian pupuk organik, kimia, dan campuran menghasilkan penurunan nilai *dry bulk density*, diikuti dengan peningkatan nilai porositas dan *hydraulic conductivity*. Pupuk organik paling efektif dalam mengurangi dampak pemadatan tanah akibat perlintasan traktor roda 2. Peningkatan kedalaman tanah menghasilkan penurunan nilai *dry bulk density* serta peningkatan nilai porositas dan *hydraulic conductivity*. Hasil regresi menunjukkan bahwa *dry bulk density* memiliki hubungan linier negatif dengan *hydraulic conductivity* ($R^2 = 0,4747$), sedangkan porositas dan kadar air memiliki hubungan linier positif dengan *hydraulic conductivity* (R^2 masing-masing sebesar 0,4747 dan 0,4984). Nilai *dry bulk density* pada saat 12 bulan setelah perlintasan traktor roda 2 lebih besar, sedangkan porositas, kadar air, dan *hydraulic conductivity* lebih kecil dibandingkan data 6 dan 0 bulan pengamatan.

SUMMARY

The use of two-wheeled tractors in soil cultivation can make it easier for farmers to grow crops, but it has a negative impact on soil structure and can hinder plant roots in absorbing nutrients and water. Fertilization is one solution to improve the physical properties of the soil and increase soil fertility. Analysis of soil physical properties typically focuses only on the 0 – 30 cm depth range, while some plants have root systems extending beyond 30 cm. Additionally, soil preparation is usually conducted 2 – 3 times per year, yet studies on the impact of soil compaction 12 months after two-wheeled tractor traffic are still rare. Therefore, this study aims to: 1) investigate the differences in the effects of organic, chemical, and mixed fertilizers on soil compaction levels at a depth of 0 – 50 cm twelve months after two-wheeled tractor passes; and 2) to examine the relationships among soil physical properties related to the effects of organic fertilizer, chemical fertilizer, and mixed fertilizer on soil compaction levels at a depth of 0 – 50 cm at 12 months after two-wheeled tractor traffic.

The research was conducted from February – July 2025, with soil samples collected from agricultural land in Karangduren Village, Sokaraja, and physical properties of the soil measured at the Integrated Laboratory 1 IAB, Jenderal Soedirman University. The experimental design used a Completely Randomized Design (CRD) with one factor and one control at four treatment levels: no fertilizer, organic fertilizer, chemical fertilizer, and mixed fertilizer. The equipment and materials used included a 2-wheel tractor type Quick/G 3000 ZEVA, a 100 cm³ soil ring sampler, a head core ring sampler, an oven, a digital scale, a vernier caliper, aluminum cups, a falling head meter, a measuring tape, a stopwatch, organic fertilizer, chemical fertilizer, mixed fertilizer, and 4 research plots measuring 2 m × 1 m. Undisturbed soil samples were collected at depths of 0 – 10, 10 – 20, 20 – 30, 30 – 40, and 40 – 50 cm, with five replicates for each depth, resulting in a total of 100 samples. The measured variables included dry bulk density, hydraulic conductivity, porosity, and soil moisture content. Data analysis was performed using Analysis of Variance (ANOVA) with post-hoc tests using Duncan's Multiple Range Test (DMRT) at 5% significance level, as well as regression analysis.

The results showed that the application of organic, chemical, and mixed fertilizers resulted in a decrease in dry bulk density, followed by an increase in porosity and hydraulic conductivity. Organic fertilizer was most effective in reducing the impact of soil compaction caused by two-wheeled tractors. Increasing soil depth resulted in a decrease in dry bulk density and an increase in porosity and hydraulic conductivity. Regression results showed that dry bulk density had a negative linear relationship with hydraulic conductivity ($R^2 = 0.4747$), while porosity and moisture content both had a positive linear relationship with hydraulic conductivity (R^2 values of 0.4747 and 0.4984, respectively). The dry bulk density value at 12 months after the passage of two-wheeled tractors was higher, while porosity, moisture content, and hydraulic conductivity were lower compared to the data at 6 and 0 months of observation.