

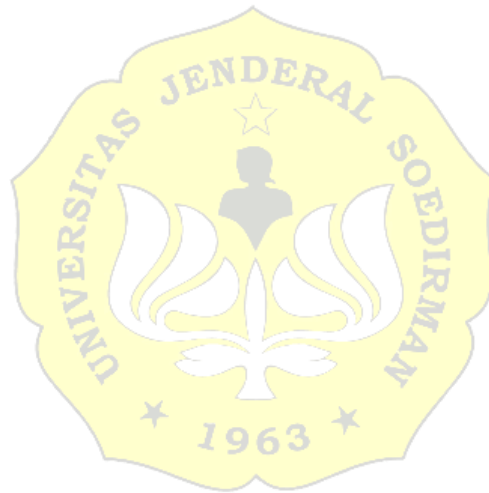
RINGKASAN

Penggunaan traktor roda dua untuk pengolahan tanah mampu meningkatkan produktivitas lahan, namun justru berdampak negatif pada struktur tanah. Kedalaman olah tanah biasanya berkisar 0 – 20 cm namun ada tanaman yang memiliki perakaran lebih dari 20 cm. Pemupukan menjadi salah satu solusi untuk memperbaiki sifat fisik tanah dan meningkatkan pertumbuhan tanaman. Kajian yang ada seringkali berfokus pada kedalaman 0 – 30 cm. Selain itu, proses pengolahan tanah biasanya dilakukan 1 – 2 kali dalam satu tahun, namun kajian mengenai dampak pemadatan tanah biasanya dilakukan sesaat setelah diberi perlintasan. Oleh karena itu, penelitian ini bertujuan untuk 1) Mengetahui perbedaan pengaruh pupuk organik, pupuk kimia, dan pupuk campuran terhadap tingkat pemadatan tanah pada kedalaman 0 – 50 cm saat 6 bulan setelah perlintasan traktor roda dua; 2) Mengetahui hubungan antara beberapa variabel sifat fisik tanah terkait pengaruh pupuk organik, pupuk kimia, dan pupuk campuran terhadap tingkat pemadatan tanah pada kedalaman 0 – 50 cm saat 6 bulan setelah perlintasan traktor roda dua.

Penelitian dilakukan pada bulan September 2024 – Juni 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 4 taraf perlakuan yaitu: tanpa pupuk (P_0), pupuk organik (P_1), pupuk kimia (P_2), dan pupuk campuran (P_3). 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 diambil adalah 100. Alat dan bahan yang digunakan meliputi traktor roda dua 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 1 m × 2 m. Variabel yang diukur adalah *dry bulk density*, *hydraulic conductivity*, porositas, dan kadar air. Analisis data menggunakan analisis korelasi dan *Analysis of variance* (ANOVA) dengan uji lanjut menggunakan uji *Duncan's Multiple Range Test* (DMRT) 5% serta uji T.

Hasil penelitian menunjukkan bahwa pemberian pupuk organik dan pupuk campuran menghasilkan penurunan nilai *dry bulk density*, yang diikuti dengan peningkatan nilai porositas dan konduktivitas hidrolik jenuh, sedangkan pupuk kimia menghasilkan hal yang sebaliknya. Pupuk organik paling efektif dalam mengurangi dampak pemadatan tanah akibat perlintasan traktor roda dua. Peningkatan kedalaman tanah menghasilkan penurunan nilai *dry bulk density* yang diikuti peningkatan nilai porositas dan konduktivitas hidrolik jenuh. Hasil korelasi menunjukkan bahwa *dry bulk density* memiliki hubungan linear negatif dengan konduktivitas hidrolik jenuh ($r = -0,693$), sedangkan porositas dan kadar air keduanya memiliki hubungan linear positif dengan konduktivitas hidrolik jenuh (r masing-masing adalah 0,693 dan 0,627). Hasil pengamatan pada saat 6 bulan setelah perlintasan traktor roda dua

menunjukkan bahwa nilai *dry bulk density* (ρ_d) lebih besar dibandingkan pada saat 0 bulan setelah perlintasan traktor roda dua. Namun, nilai porositas (f), kadar air (w), dan *hydraulic conductivity* (k_s) pada saat 6 bulan setelah perlintasan traktor roda dua memiliki nilai yang lebih rendah dibandingkan pada saat 0 bulan setelah perlintasan traktor roda dua. Hasil uji T menunjukkan bahwa rata-rata nilai *dry bulk density*, porositas, dan kadar air tidak berbeda nyata pada saat 6 bulan dan 0 bulan waktu pengamatan. Sedangkan *hydraulic conductivity* menunjukkan adanya perbedaan nyata antara 6 bulan dan 0 bulan waktu pengamatan.



SUMMARY

The use of two-wheel tractors for soil tillage can improve land productivity; however, it may also have a negative impact on soil structure. Tillage depth generally ranges from 0 to 20 cm, whereas some crops have rooting systems that extend beyond 20 cm. Fertilization is one of the solutions to improve the physical properties of soil and enhance plant growth. Previous studies have mostly focused on the 0 – 30 cm soil depth. Additionally, soil tillage is commonly carried out once or twice a year, while studies on soil compaction are often conducted shortly after machinery passes through the field. Therefore, this study aims to: 1) Analyze the effects of organic fertilizer, chemical fertilizer, and mixed fertilizer on soil compaction levels at depths of 0 – 50 cm, six months after two-wheel tractor traffic; 2) Examine the relationships between various soil physical properties in response to organic, chemical, and mixed fertilizer application and their effects on soil compaction at depths of 0 – 50 cm, six months after tractor traffic.

This research was conducted from September 2024 to June 2025. Soil samples were collected from agricultural land in Karangduren Village, Sokaraja District, and soil physical property measurements were performed at the Integrated Laboratory 1 IAB, Jenderal Soedirman University. The experimental design employed a Completely Randomized Design (CRD) with four treatment levels: no fertilizer (Po), organic fertilizer (P1), chemical fertilizer (P2), and mixed fertilizer (P3). Undisturbed soil samples were taken at depths of 0 – 10, 10 – 20, 20 – 30, 30 – 40, and 40 – 50 cm, with five replications per depth, resulting in a total of 100 samples. The tools and materials used included a two-wheel tractor (Quick/G 3000 ZEVA), 100 cm³ soil ring samplers, head core ring sampler, oven, digital scale, caliper, aluminum cans, falling head meter, measuring tape, stopwatch, organic fertilizer, chemical fertilizer, mixed fertilizer, and four research plots measuring 1 m × 2 m. Measured variables included dry bulk density, saturated hydraulic conductivity, porosity, and water content. Data were analyzed using correlation analysis and Analysis of Variance (ANOVA), followed by Duncan's Multiple Range Test (DMRT) at a 5% significance level and a t-test.

The results showed that the application of organic and mixed fertilizers reduced dry bulk density values, accompanied by increases in porosity and saturated hydraulic conductivity, while chemical fertilizer produced the opposite effect. Organic fertilizer was the most effective in mitigating soil compaction caused by two-wheel tractor traffic. Increasing soil depth was associated with decreased dry bulk density and increased porosity and saturated hydraulic conductivity. Correlation analysis revealed a negative linear relationship between dry bulk density and saturated hydraulic conductivity ($r = -0.693$), whereas both porosity and water content exhibited positive linear relationships with saturated hydraulic conductivity ($r = 0.693$ and 0.627 , respectively). Observations six months after tractor traffic showed higher dry bulk density values compared to those at zero months after traffic. However, porosity, water content, and saturated hydraulic conductivity values were lower at six months than at zero months. The t-test results indicated that the mean values of dry bulk density, porosity, and water content were

not significantly different between the two observation periods, while saturated hydraulic conductivity showed a significant difference.

