

RINGKASAN

Penggunaan traktor roda 4 dapat mempermudah dan mempercepat proses pengolahan tanah. Namun, penggunaan traktor roda 4 pada lahan juga dapat menimbulkan pemadatan tanah yang berdampak negatif terhadap sifat fisik tanah maupun pertumbuhan tanaman. Pemupukan merupakan salah satu upaya untuk memperbaiki sifat fisik tanah guna mendukung pertumbuhan dan hasil budidaya tanaman. Namun demikian, kajian tentang pengaruh penggunaan pupuk terhadap sifat fisik tanah dalam kaitannya dengan dampak pemadatan tanah akibat perlintasan traktor roda 4 khususnya pada saat 12 bulan setelah perlintasan traktor masih belum banyak dilakukan. Lebih dari itu, penelitian sebelumnya lebih banyak mengkaji pada kedalaman 0 – 30 cm saja. Maka dari itu penelitian ini dilakukan dengan tujuan (1) mempelajari perbedaan pengaruh pupuk organik, kimia, dan campuran terhadap tingkat pemadatan tanah pada kedalaman 0 – 50 cm saat 12 bulan setelah perlintasan traktor roda 4, dan (2) mempelajari hubungan antar variabel sifat fisik tanah terkait tingkat pemadatan tanah pada kedalaman 0 – 50 cm saat 12 bulan setelah perlintasan traktor roda 4.

Penelitian dilakukan di lahan pertanian Desa Karangduren, Sokaraja dan pengukuran sifat fisik tanah di laboratorium Terpadu 1 IAB, Universitas Jenderal Soedirman. Penelitian menggunakan Rancangan Acak Lengkap (RAL) dengan satu faktor yang terdiri dari 4 taraf perlakuan yaitu: tanpa pupuk (P_0), pupuk organik (P_1), pupuk kimia (P_2), dan pupuk campuran (P_3). Alat dan bahan yang digunakan meliputi: traktor roda 4, *head core ring sampler*, *soil ring sampler* ukuran 100 cm³ (diameter 5 cm dan tinggi 5 cm), oven, jangka sorong, timbangan digital, *falling head meter*, *stopwatch*, pupuk kandang kambing, pupuk kimia, dan 4 petakan lahan berukuran 2 m x 2 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 diambil adalah 100. Variabel yang diukur adalah *dry bulk density*, konduktivitas hidrolik jenuh, porositas, dan kadar air. 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 pupuk organik, pupuk campuran, dan pupuk kimia memberikan pengaruh terhadap penurunan nilai *dry bulk density*, yang diikuti dengan kenaikan nilai porositas, kadar air, dan konduktivitas hidrolik jenuh. Jenis pupuk paling efektif dalam mengurangi dampak pemadatan tanah akibat perlintasan traktor roda 4 adalah pupuk organik. Peningkatan tingkat kedalaman tanah menurunkan nilai *dry bulk density*, serta meningkatkan nilai konduktivitas hidrolik jenuh, porositas, dan kadar air tanah. Hasil analisis regresi menunjukkan bahwa *dry bulk density* berhubungan linear negatif dengan konduktivitas hidrolik jenuh ($R^2 = 0,6339$) sedangkan porositas dan kadar air tanah berhubungan linear positif dengan konduktivitas hidrolik jenuh ($R^2 = 0,6339$ dan $0,4132$). Data 12 bulan pengamatan menunjukkan adanya kenaikan *dry bulk density* dan penurunan konduktivitas hidrolik jenuh, porositas, serta kadar air dibandingkan data 6 dan 0 bulan pengamatan setelah perlintasan traktor roda 4.

SUMMARY

The use of a four-wheel tractor can simplify and accelerate the soil cultivation process. However, the use of a four-wheel tractor on land can also cause soil compaction, which negatively impacts the physical properties of the soil and plant growth. Fertilization is one way to improve the physical properties of the soil to support plant growth and yield. However, studies on the effect of fertilizer use on soil physical properties, in relation to the impact of soil compaction due to four-wheel tractor passage, especially within 12 months after the tractor passage, are still limited. Furthermore, previous studies have focused on depths of 0 – 30 cm only. Therefore, this study was conducted with the objectives of (1) studying the differences in the effects of organic, chemical, and mixed fertilizers on soil compaction levels at a depth of 0 – 50 cm 12 months after a four-wheeled tractor crossing, and (2) studying the relationship between soil physical property variables and soil compaction levels at a depth of 0 – 50 cm 12 months after a four-wheeled tractor crossing.

The study was conducted in agricultural land in Karangduren Village, Sokaraja, and soil physical properties were measured at the Integrated Laboratory 1 of the Indonesian Agricultural Agricultural Institute (IAB), Jenderal Soedirman University. The study used a Completely Randomized Design (CRD) with one factor consisting of four treatment levels: no fertilizer (P_0), organic fertilizer (P_1), chemical fertilizer (P_2), and mixed fertilizer (P_3). The tools and materials used included: 4-wheel tractor, head core ring sampler, 100 cm³ soil ring sampler (5 cm in diameter and 5 cm in height), oven, calipers, digital scale, falling head meter, stopwatch, goat manure, chemical fertilizers, and four plots measuring 2 m x 2 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 variables measured were dry bulk density, saturated hydraulic conductivity, porosity, and water content. Data were analyzed using Analysis of Variance (ANOVA) with further testing using Duncan's Multiple Range Test (DMRT) at 5% and regression analysis.

The results showed that organic fertilizers, mixed fertilizers, and chemical fertilizers decreased dry bulk density, followed by increases in porosity, water content, and saturated hydraulic conductivity. The most effective type of fertilizer in reducing the impact of soil compaction due to 4-wheel tractor crossing is organic fertilizer. Increasing soil depth decreases the dry bulk density value, and increases the saturated hydraulic conductivity, porosity, and soil water content. The results of the regression analysis show that dry bulk density has a negative linear relationship with saturated hydraulic conductivity ($R^2 = 0.6339$) while porosity and soil water content have a positive linear relationship with saturated hydraulic conductivity ($R^2 = 0.6339$ and 0.4132). Data from 12 months of observation show an increase in dry bulk density and a decrease in saturated hydraulic conductivity, porosity, and water content compared to data from 6 and 0 months of observation after 4-wheel tractor crossing.