

RINGKASAN

Pemadatan tanah akibat perlintasan traktor roda 4 menjadi masalah utama dalam pengelolaan lahan pertanian intensif saat ini, yang berdampak negatif pada perubahan sifat fisik tanah mengganggu pergerakan air dan udara di dalam tanah sehingga menghambat pertumbuhan akar. Salah satu cara untuk mengurangi dampak negatif pemadatan tanah adalah dengan penambahan bahan organik seperti pupuk kandang sapi. Namun, penelitian mengenai efek pupuk kandang sapi terhadap pemadatan tanah akibat perlintasan traktor roda 4 saat 12 bulan setelah perlintasan traktor masih terbatas. Selain itu, sebagian besar studi sebelumnya hanya menganalisis sifat fisik tanah hingga kedalaman 30 cm, padahal beberapa tanaman memiliki sistem perakaran yang menembus lebih dalam dari 30 cm. Berdasarkan hal tersebut, penelitian ini ditujukan untuk (1) mengetahui pengaruh dosis pupuk kandang sapi terhadap pemadatan tanah akibat perlintasan traktor roda 4 pada kedalaman 0 – 50 cm saat 12 bulan setelah perlintasan traktor roda 4, serta (2) mempelajari hubungan antar variabel sifat fisik tanah terkait dengan pengaruh pemberian pupuk kandang sapi terhadap pemadatan tanah akibat perlintasan traktor roda 4 pada kedalaman 0 – 50 cm saat 12 bulan setelah perlintasan traktor roda 4.

Penelitian dilaksanakan pada bulan Februari – Juli 2025 di lahan pertanian Desa Karangduren, Kecamatan Sokaraja, Kabupaten Banyumas serta lab Terpadu 1 IAB, Universitas Jenderal Soedirman. Dalam penelitian ini digunakan Rancangan Acak Lengkap (RAL) dengan 4 taraf perlakuan dosis pupuk kandang sapi, yaitu tanpa pupuk kandang sapi (P_0), 15 ton/ha (P_{15}), 20 ton/ha (P_{20}), dan 25 ton/ha (P_{25}). Alat yang akan digunakan dalam penelitian ini meliputi: traktor roda 4, *head core ring sampler*, *soil ring sampler* 100 cm³, oven, jangka sorong (*vernier calliper*), timbangan digital, *falling head meter*, dan *stopwatch*. Sedangkan bahan yang akan digunakan dalam penelitian ini meliputi: pupuk kandang sapi dan 4 buah plot penelitian berukuran 2 m x 2 m. Sampel tanah tidak terganggu diambil pada kedalaman 0 – 10, 10 – 20, 20 – 30, 30 – 40, dan 40 – 50 cm, dengan jumlah ulangan yang diambil sebanyak 5 kali untuk setiap kedalaman, sehingga total sampel tanah yang diambil sebanyak 100 sampel. Variabel yang diukur adalah konduktivitas hidrolik jenuh, kadar air, *dry bulk density*, dan porositas. Data dianalisis menggunakan *Analysis of Variance* (ANOVA) pada taraf signifikansi 5%, dilanjutkan dengan uji pembandingan *Duncan's Multiple Range Test* (DMRT). Analisis regresi digunakan untuk mengetahui hubungan antar beberapa variabel sifat fisik tanah. Selain itu, dilakukan uji *Analysis of Variance* (ANOVA) untuk membandingkan data antara 12, 6 dan 0 bulan pengamatan.

Hasil penelitian menunjukkan bahwa pemberian pupuk kandang sapi menurunkan *dry bulk density* serta meningkatkan nilai porositas, konduktivitas hidrolik jenuh, dan kadar air tanah saat 12 bulan setelah perlintasan traktor. Penambahan tingkat kedalaman tanah menghasilkan penurunan nilai *dry bulk density*, serta menghasilkan peningkatan nilai porositas, konduktivitas hidrolik jenuh, dan kadar air tanah. Dosis pupuk kandang sapi 25 ton/ha paling efektif dalam mengurangi pemadatan tanah. Analisis regresi menunjukkan bahwa *dry bulk density* memiliki hubungan linier negatif terhadap konduktivitas hidrolik jenuh ($R^2 = 0,4118$), sementara porositas dan kadar air memiliki hubungan linier positif terhadap konduktivitas hidrolik jenuh ($R^2 = 0,4118$ dan $R^2 = 0,3693$). Data 12 bulan pengamatan menunjukkan adanya kenaikan *dry bulk density* dan penurunan konduktivitas hidrolik jenuh, porositas serta kadar air dibandingkan 6 dan 0 bulan pengamatan setelah perlintasan traktor roda 4.

SUMMARY

Soil compaction caused by four-wheel tractor passes has become a major issue in intensive agricultural land management, as it negatively affects soil physical properties by disrupting water and air movement within the soil, thereby inhibiting root growth. One approach to reduce the negative impact of soil compaction is the addition of organic matter such as cattle manure. However, studies on the effect of cattle manure on soil compaction caused by four-wheel tractor passes 12 months after traffic remain limited. Moreover, most previous research only analyzed soil physical properties up to a depth of 30 cm, even though some plants have root systems that penetrate deeper than 30 cm. Based on this, the objectives of this study are: (1) To determine the effect of cow manure dosage on soil compaction caused by 4-wheel tractor passes at a depth of 0 – 50 cm, 12 months after tractor traffic, and (2) To study the relationship among soil physical properties in relation to the effect of cow manure application on soil compaction due to 4-wheel tractor passes at a depth of 0 – 50 cm, 12 months after tractor traffic.

The research was conducted from February to July 2025 on agricultural land in Karangduren Village, Sokaraja District, Banyumas Regency, and at the Integrated Laboratory 1 IAB, Jenderal Soedirman University. A Completely Randomized Design (CRD) was used with 4 levels of cow manure application: no manure (P0), 15 tons/ha (P15), 20 tons/ha (P20), and 25 tons/ha (P25). The tools used in this study included: a 4-wheel tractor, head core ring sampler, 100 cm³ soil ring sampler, oven, vernier caliper, digital scale, falling head meter, and stopwatch. Materials used included cow manure and four experimental plots each measuring 2 m × 2 m. Undisturbed soil samples were taken at depths of 0 – 10, 10 – 20, 20 – 30, 30 – 40, and 40 – 50 cm, with 5 replications at each depth, resulting in a total of 100 soil samples. The variables measured were saturated hydraulic conductivity, soil moisture content, dry bulk density, and porosity. Data were analyzed using Analysis of Variance (ANOVA) at a 5% significance level, followed by Duncan's Multiple Range Test (DMRT) for comparison. Regression analysis was used to determine the relationships among soil physical variables. Additionally, ANOVA was conducted to compare data across 12, 6, and 0 months after tractor passes.

The results showed that the application of cow manure reduced dry bulk density and increased porosity, saturated hydraulic conductivity, and soil moisture content 12 months after tractor passes. Increasing soil depth resulted in decreased dry bulk density and increased porosity, saturated hydraulic conductivity, and soil moisture content. The 25 tons/ha cow manure dosage was the most effective in reducing soil compaction. Regression analysis indicated that dry bulk density had a negative linear relationship with saturated hydraulic conductivity ($R^2 = 0.4118$), while porosity and moisture content had a positive linear relationship with saturated hydraulic conductivity ($R^2 = 0.4118$ and $R^2 = 0.3693$, respectively). Data from the 12-month observation showed an increase in dry bulk density and a decrease in saturated hydraulic conductivity, porosity, and moisture content compared to the 6- and 0-month observations after 4-wheel tractor passes.