# RINGKASAN

Penggunaan traktor roda 4 dapat meningkatkan efisiensi dalam proses pengolahan tanah. Meski demikian, alat pertanian ini berpotensi menyebabkan pemadatan tanah yang berdampak negatif bagi tanaman seperti menghambat sirkulasi air dan udara di dalam tanah, menghambat kemampuan akar dalam menembus tanah, serta mengganggu pertumbuhan tanaman. Kajian mengenai pengaruh tekanan angin pada traktor roda 4 terhadap pemadatan tanah masih terbatas. Penelitian sebelumnya hanya berfokus pada dampak langsung setelah perlintasan traktor dan pada kedalaman 0 – 40 cm. Maka dari itu, penelitian ini dilakukan dengan tujuan: (1) mengkaji pengaruh perbedaan tekanan angin roda traktor roda 4 terhadap tingkat pemadatan tanah pada kedalaman tanah 0 – 50 cm pada saat 12 bulan setelah perlintasan traktor, dan (2) mengkaji hubungan antara variabel sifat fisik tanah terkait pengaruh perbedaan tekanan angin roda traktor roda 4 terhadap tingkat pemadatan tanah pada kedalaman 0 – 50 cm pada saat 12 bulan setelah perlintasan traktor.

Penelitian dilaksanakan pada bulan Februari 2025 – Juli 2025 di lahan pertanian Unit Penyewaan Jasa Alsintan (UPJA) Kecamatan Sokaraja dan Laboratorium Terpadu 1 IAB, Univesitas Jenderal Soedirman. Bahan yang digunakan adalah 4 plot penelitian ukuran 2 m x 2 m, sedangkan alat yang digunakan meliputi: traktor roda 4, *pressure gauge, head core ring sampler, soil ring sampler* 100 $cm^3$, *oven*, jangka sorong, timbangan digital, cawan alumunium, *falling head* meter, dan *stopwatch*. Penelitian dilakukan menggunakan Rancangan Acak Lengkap (RAL) dengan satu faktor/perlakuan dan satu kontrol sebagai pembanding. Perlakuan yang diberikan yaitu 4 tingkat tekanan angin roda traktor roda 4 yang terdiri dari: tanpa perlintasan traktor ($T_0$), 7 psi ($T_7$), 15 psi ($T_{15}$), dan 20 psi ($T_{20}$). Sampel tanah tidak terganggu diambil pada kedalaman 0 – 10, 10 – 20, 20 – 30, 30 – 40, dan 40 – 50 cm. Pada masing-masing kedalaman tanah dilakukan 5 kali ulangan sehingga jumlah total sampel tanah yang diambil adalah 100. Variabel sifat fisik tanah yang diukur yaitu konduktivitas hidrolik jenuh, *dry bulk density*, porositas tanah dan kadar air tanah. Analisis data dilakukan menggunakan *Analysis of Variance* (ANOVA) dengan taraf signifikansi 5%, diikuti dengan uji *Duncan's Multiple Range Test* (DMRT), serta analisis regresi.

Hasil penelitian menunjukkan bahwa peningkatan tekanan angin roda traktor roda 4 saat 12 bulan setelah perlintasan traktor meningkatkan nilai *dry bulk density*, yang disertai dengan penurunan konduktivitas hidrolik jenuh, porositas, dan kadar air tanah. Sementara itu, semakin bertambah kedalaman tanah, nilai *dry bulk density* semakin menurun, diikuti dengan kenaikan nilai konduktivitas hidrolik jenuh, porositas, dan kadar air tanah. Hasil analisis regresi menunjukkan bahwa *dry bulk density* memiliki hubungan linier negatif terhadap konduktivitas hidrolik jenuh ($R^2$ = 0,5933), sedangkan porositas dan kadar air menunjukkan hubungan linier positif terhadap konduktivitas hidrolik jenuh ($R^2$ = 0,5933 dan $R^2$ = 0,6209). Dibandingkan saat 0 dan 6 bulan pengamatan, pada saat 12 bulan pengamatan setelah perlintasan traktor terjadi peningkatan nilai *dry bulk density* dan penurunan nilai porositas tanah, kadar air tanah, serta konduktivitas hidrolik jenuh.

# *SUMMARY*

*The use of four-wheeled tractors can improve efficiency in soil cultivation processes. However, this agricultural machinery has the potential to cause soil compaction, which negatively affects plants by impeding water and air circulation within the soil, limiting root penetration, and disrupting plant growth. Studies on the impact of tire pressure on four-wheeled tractors in relation to soil compaction remain limited. Previous research has mainly focused on the immediate effects after tractor passes and at soil depths of 0 – 40 cm. Therefore, this study was conducted with the objectives of: (1) examining the effect of different tire pressures on four-wheeled tractors on soil compaction levels at depths of 0 – 50 cm, 12 months after the tractor passes, and (2) analyzing the relationship between soil physical properties and the effect of varying tire pressures on four-wheeled tractors on soil compaction levels at depths of 0 – 50 cm, 12 months after the tractor passes.*

*The study was carried out from February 2025 to July 2025 on agricultural land managed by the Agricultural Machinery Service Provider Unit (UPJA) in Sokaraja Subdistrict and at the Integrated Laboratory 1 IAB, Jenderal Soedirman University. The materials used included four 2 m × 2 m research plots, while the equipment consisted of a four-wheeled tractor, pressure gauge, head core ring sampler, 100 cm³ soil ring sampler, oven, caliper, digital scale, aluminum cup, falling head meter, and stopwatch. The experiment was designed using a Completely Randomized Design (CRD) with one factor/treatment and one control as a comparison. The treatments consisted of four tire pressure levels on the four-wheeled tractor: no tractor pass ($T_0$), 7 psi ($T_7$), 15 psi ($T_{15}$), and 20 psi ($T_{20}$). Undisturbed soil samples were taken at depths of 0 – 10, 10 – 20, 20 – 30, 30 – 40, and 40 – 50 cm. At each soil depth, five replications were conducted, resulting in a total of 100 soil samples. The measured soil physical properties included saturated hydraulic conductivity, dry bulk density, soil porosity, and soil moisture content. Data were analyzed using Analysis of Variance (ANOVA) at a 5% significance level, followed by Duncan's Multiple Range Test (DMRT), and regression analysis.*

*The results showed that increased tire pressure on the four-wheeled tractor 12 months after the tractor passes led to higher dry bulk density values, accompanied by decreases in saturated hydraulic conductivity, porosity, and soil moisture content. Additionally, as soil depth increased, dry bulk density decreased, while saturated hydraulic conductivity, porosity, and moisture content increased. Regression analysis indicated that dry bulk density had a negative linear relationship with saturated hydraulic conductivity ($R^2 = 0.5933$), while porosity and soil moisture showed positive linear relationships with saturated hydraulic conductivity ($R^2 = 0.5933$ and $R^2 = 0.6209$, respectively). Compared to the observations at 0 and 6 months, the 12-month observations showed an increase in dry bulk density and a decrease in soil porosity, moisture content, and saturated hydraulic conductivity.*