Results

0.1 Soil strength

Depth to hardpan was affected significantly overall by tillage treatments (H = 38.2, df = 2, n = 72, p = <0.0001) by ~52.4% across cover crop treatments (Fig 1a). Tractor-till had the largest significant effect on depth to hardpan compared to no-till (p_{adj} = <0.0001), deepening the depth to hardpan by ~9.4 cm (~83.3%) compared to no-till, down to ~20.6 ± 4.6 cm across all cover crop mixes. Roto-till also had a marginally significant effect on depth to hardpan compared to no-till (p_{adj} = 0.1), deepening the depth to hardpan by ~9.4 cm (~83.3%) compared to no-till, down to ~13.8 ± 1.9 cm The overall effect from tillage stemmed from significant effects among the perennial (p_{adj} = *<0.01*) and weed suppression (p_{adj} = *<0.01*) mixes (Fig 1a). The effect of roto-till was more pronounced in the perennial mix (p_{adj} = *<0.01*), where depth to hardpan was about twice as deep as in no-till plots (Fig 1a). There was also a significant difference of ~6.9 cm (~50%) between tractor- and roto-till among all cover crop mixes (Fig 1a).

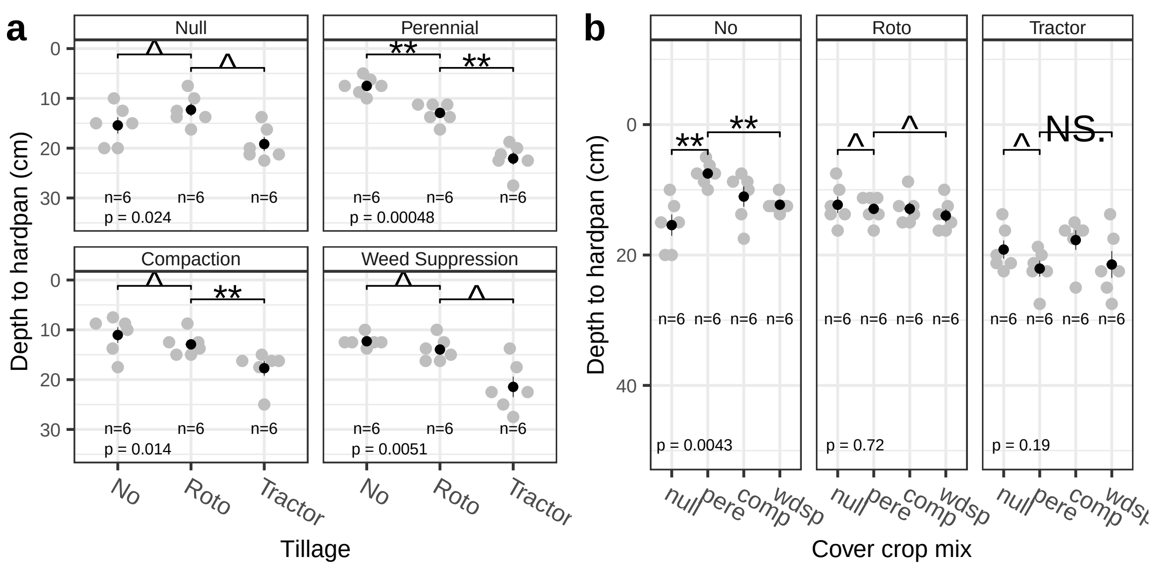

Figure 1: Compaction data (a) by tillage, and (b) cover crop mix. Gray dots show plot medians and black point ranges show group mean ± 1 std error and may be small. Significant pairwise post-hoc Wilcoxon test outcomes shown (**** p < 0.0001, *** p < 0.001, ** p < 0.01, * p < 0.05, *^ p < 0.1, ^ p > 0.1 or ns)

Depth to hardpan was not affected by cover crops among tillage groups overall (H = 2, df = 3, n = 72, p = 0.57), but was significantly affected by cover crops specifically under no-till conditions (p_{adj} = *<0.01*) (Fig 1b). Under no-till, the perennial mix had significantly shallower depth to hardpan compared to both null (p_{adj} = *<0.01*) and weed suppression mixes (p_{adj} = *<0.01*). Specifically, the perennial mix raised the depth to hardpan by ~2.5 cm (~16.7%) compared to other mixes, up to ~12.5 ± 7.4 cm below the soil surface (Fig 1b).

0.2 Infiltration

Soil infiltration was significantly affected by tillage (H = 8.5, df = 2, n = 48, p = 0.01) and marginally significantly by cover crop mix (H = 5.9, df = 3, n = 48, p = 0.1) (Fig 2). Roto-till had significantly faster infiltration compared to no-till (p_{adj} = 0.027) and marginally significantly compared to tractor-till (p_{adj} = 0.1), speeding up infiltration by ~14.5% compared to each tillage groups, up to ~ 13.4 ± 10.7 mL per sec (Fig 2a).

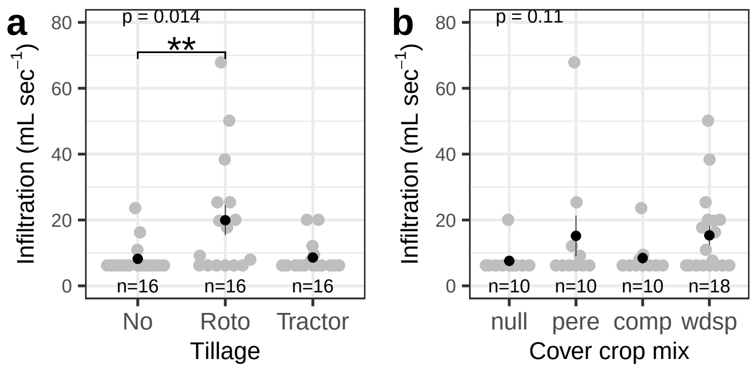

Figure 2: Infiltration data (a) by tillage, and (b) cover crop mix. Gray dots show plot medians and black point ranges show group mean ± 1 std error and may be small. Significant pairwise post-hoc Wilcoxon test outcomes shown (**** p < 0.0001, *** p < 0.001, ** p < 0.01, * p < 0.05, *^ p < 0.1, ^ p > 0.1)

0.3 Weed pressure

Weed density was overall significantly affected by tillage (H = 6.5, df = 2, n = 72, p = 0.039) by ~25.1%, although weed cover (H = 1.6, df = 2, n = 72, p = 0.44) and richness (H = 0.2, df = 2, n = 36, p = 0.92) were not (Fig 3a). Weeds under tractor-till were significantly denser compared to no-till (p_{adj} = 0.06) and marginally significantly compared to roto-till (p_{adj} = 0.1), denser by ~6.5% compared to each tillage group, up to ~ 8 ± 2 *stems per m*$^{-2}$.

All measured weed variables were affected significantly by cover crop mix, including weed density (H = 20.1, df = 3, n = 72, p = 0.00016) changing overall by ~6.5%, weed cover (H = 31, df = 3, n = 72, p = <0.0001) lowering overall by ~0.5% , and weed richness (H = 10, df = 3, n = 36, p = 0.019) also lowering overall by ~5.5% (Fig 3b). The weed suppression mix had the most detectable effects on both weed density and cover. The weed suppression mix significantly lowered weed density compared to all other cover crop mix treatments, namely the null (p_{adj} = <0.001), perennial (p_{adj} = 0.017), and compaction (p_{adj} = 0.025) mixes, by ~4 *stems m*$^{-2}$ (~50%), down to ~ 4 *stems per m*$^{-2}$. The weed suppression mix also significantly lowered weed cover compared to all other cover crop mix treatments, namely the null (p_{adj} = <0.0001), perennial (p_{adj} = <0.0001), and compaction (p_{adj} = 0.00093) mixes, by ~20 *stems m*$^{-2}$ (~33.3%), down to ~ 40 ± 15% . Finally, the null mix showed significantly higher richness compared to the weed suppression mix (p_{adj} = 0.03) and marginally significantly compared to perennial (p_{adj} = 0.1) and compaction (p_{adj} = 0.2) mixes, up to ~ 4 taxa.

0.4 Yield

Radish yield was not significantly affected by tillage (H = 1.4, df = 2, n = 8, p = 0.5), and centered at ~ 67.8 *g m*$^{-2}$ –> and ~ 13.2 cm –> –> long (Fig 4). Notably, radish yield under roto-till tended to be lower compared to other treatments, and also appeared more variable in mass.

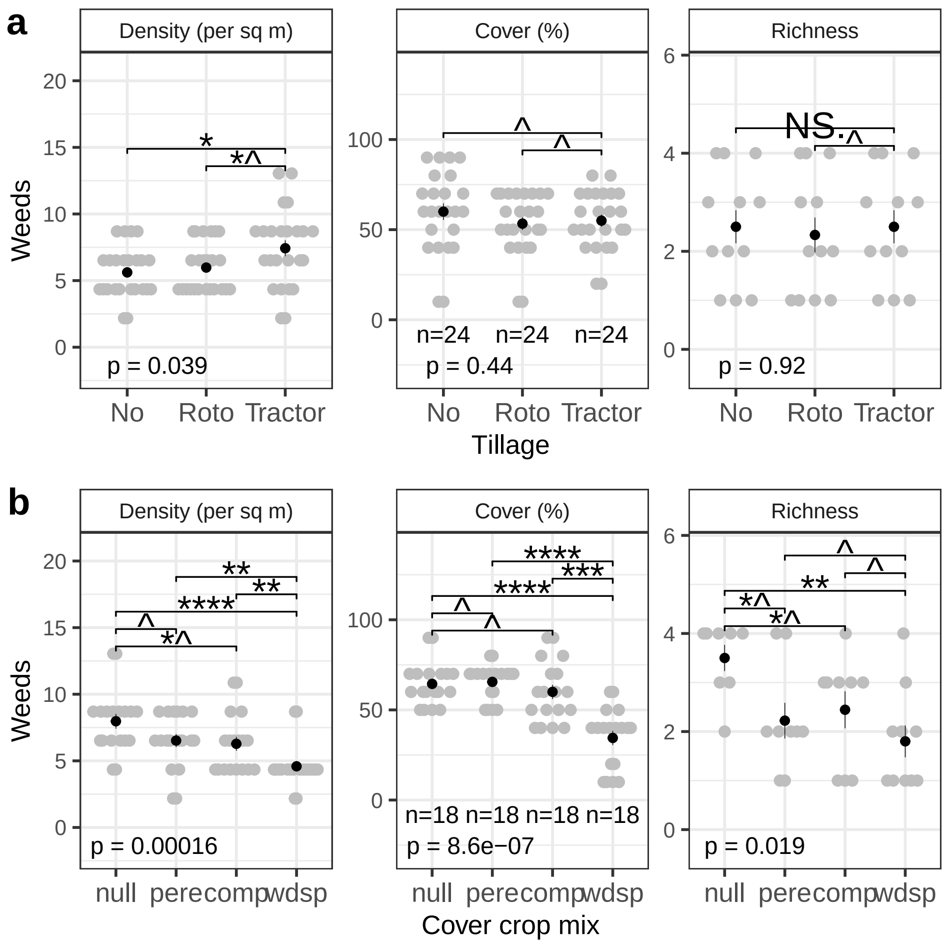

Figure 3: Weeds data (a) by tillage, and (b) cover crop mix. Gray dots show plot medians and black point ranges show group mean ± 1 std error and may be small. Significant pairwise post-hoc Wilcoxon test outcomes shown (**** $p < 0.0001$, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, *ˆ $p < 0.1$, ˆ $p > 0.1$ or ns)

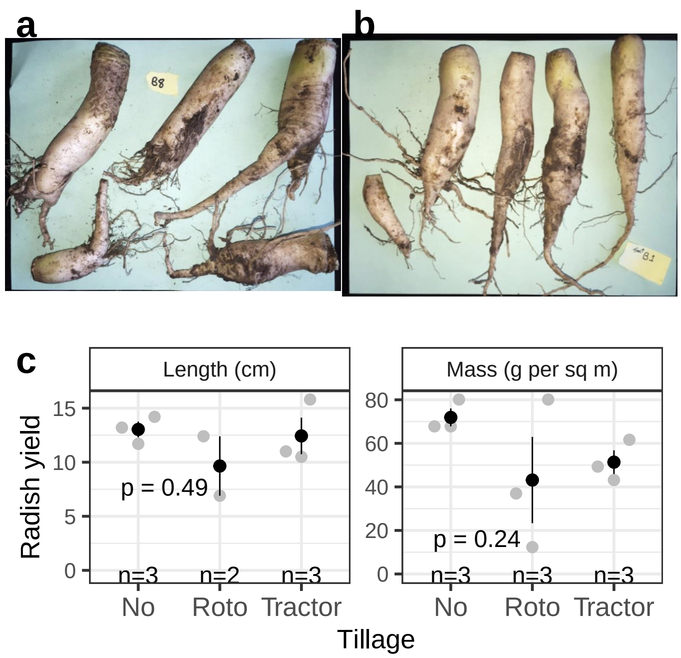

Figure 4: Yield data (a) from no-till, (b) tractor-till, and (c) all tillage groups. Gray dots show plot medians and black point ranges show group mean ± 1 std error and may be small. Photo credits: Naim Edwards.