Supplementary Material

# Supplementary Data: Additional Crop-Specific Results and Discussion of Relative Yields

## Maize

Maize yields in the CNV and MNR systems were comparable to county averages (Fig 1; Table S3, P > 0.05) but were significantly lower than county averages in the RT-LEG system (P < 0.05). As discussed in previous work (Pearsons et al. 2022), low nitrogen availability likely limited maize yields in the low-input LEG system while manure inputs and better vetch performance helped MNR maize match conventional yields. In response to tillage, relative maize yields were not significantly different within any of the farming systems (Fig 1A). Although no-till management often increases conventional maize yields (Deines et al. 2019), maize is vulnerable to yield reductions where other practices (e.g., earlier planting dates, good cover crop establishment) have not been co-adopted (Pittelkow et al. 2015). In the RT organic treatments, good cover crop establishment and rotational tillage activities likely helped combat compaction, incorporate fertility inputs, and suppress weeds (Blanco-Canqui and Wortmann 2020).

## Soybeans

Soybean yields in the MNR and CNV systems were higher or comparable to county averages (Fig 1; Table S3; *P* > 0.05) while yields in the LEG system were significantly lower than county averages (*P* < 0.05), likely in response to low nutrient inputs (Pearsons et al. 2022). In response to reducing tillage, soybean yields were not significantly affected in the CNV or MNR systems (Fig 1B), yet yields were significantly reduced by over 23% in the LEG system (*P* = 0.04). For conventional soybeans, these results are consistent with satellite data (Deines et al. 2019) and meta-analysis (Pittelkow et al. 2015) which have shown small positive or negligible effects of reducing tillage on conventional soybean yields. Similar observations have been made for organic soybeans in the Mid-Atlantic region where the FST is located (Wallace et al. 2017), which is consistent with the soybean yields in the MNR system but not the LEG system. Later planting dates and higher weed pressure in the RT-LEG treatment may have exacerbated nutrient limitations (Mirsky et al. 2012; Wallace et al. 2017), which has been hypothesized as a leading cause of low soybean yields in RT organic systems (Delate et. al. 2012).

## Small Grains (wheat, barley, oats)

Nearly all of the wheat planted in the in the FST was less productive than state averages (Table S3; *P* < 0.05) while oat and barley yields were similar or higher than county average. Unlike maize and soybeans, all small grains planted in the RT organic treatments were planted following the same tillage activities as in the FT organic treatments, which likely limited the influence of reducing tillage on wheat and oat yields. Indeed, relative wheat and oat yields in the RT treatments were comparable to the FT treatments (Fig 1C-D). In the MNR system, however, both wheat and oat yields were 13% lower in the RT-MNR treatment compared to the FT-MNR treatment (Fig 1C-D). Although sufficient nutrient availability and improved soil health may have helped no-till maize and soybeans compete with weeds in the MNR system, no-till planting may have increased weed seed abundance or shifted weed seed composition (Ryan et al. 2009; Jernigan et al. 2020) which could have exerted a negative legacy effect on subsequent small grains. The potential for such a phenomenon is worth investigating in the FST and in other long-term cropping system projects, especially since crop rotation length and fertility inputs appear to influence if small grains are affected by prior tillage reductions.

## Forages (maize silage, hay)

In the MNR system, maize silage yields were not significantly lower than county averages (Fig 1; Table S3; *P* < 0.05) while hay yields were over twice that of state averages (*P* < 0.05). These deviations may stem from specific characteristics of the MNR system compared to typical practices in the region. In the mid-Atlantic, most maize silage is grown by dairy farmers who frequently apply manure to crop fields (Roth and Heinrichs 2001). In the MNR system of the FST, the 2-3 year hay phase without manure applications likely limited soil fertility prior to silage production. The use of an alfalfa-grass mixture (Sanderson et al. 2013) as part of a diverse crop rotation (Undersander and Barnett 2008) likely contributed to higher-than-average hay yields in the MNR system. Since reducing tillage did not affect silage nor hay yields (Fig 1F-G), these forage crops appear to be tolerant to the factors that limited small grain yields in the RT-MNR treatment.

**References**

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# Supplementary Tables

**Supplementary Table 1.** Cost estimates for labor, fertilizers, manure, parasitoid wasps (*T. ostriniae*), and purchased seeds used in enterprise budgets. All costs in italics were based on purchase prices of seeds used in the FST or were estimated based on 2021 seed costs.

**Supplementary Table 2.** Crop values used in enterprise budgets. Values in bold are direct values from the USDA NASS, values in italics were estimated or adjusted based on other crop values and trends.

**Supplementary Table 3.** Results of *t*-tests comparing average experimental yields of each tillage × system treatment to county yields. *P*- and *t*-values are bolded where *P* < 0.05.

# Supplementary Figures



**Supplementary Figure 1.** Crop rotations for each entry point in the FST from 2008 – 2013. Orange boxes with asterisks indicate when manure was applied in the MNR system and green boxes with NT = no-till planted crops or cover crops.



**Supplementary Figure 2.** Crop rotations for each entry point in the FST from 2014 – 2020. Asterisks indicate when manure was applied in the MNR system.