**Weather**

**Cover crops GDDs (base 0 deg Celsius) accumulated at fall sampling**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **2018** | **2018** | **2019** | **2019** |
| **Cover crop treatment** | **From CC planting** | **From cash crop harvest** | **From CC planting** | **From cash crop harvest** |
| Early planted mix | 3079 | 235 | 2859 | 688 |
| Mid-season planted mix | 1758 | 26.2??? | 1311 | 203 |
| Mid-season planted radish | 1758 | 1950 | 1311 | 793 |
| Post-harvest planted radish | 1033 | 443 | 612 | 223 |
| No cover crop | - | - | - | - |

**Grain yields**

Crop yields ranged from 1.7 to 5.6, 2.4 to 5.4, and 1.7 to 5.8 Mg ha-1 in spring barley, oat, and faba bean, respectively. Grain yields varied significantly by crop (p < 0.01), but the crop impact did not interact with any other factors (p-values ranging from 0.10 to 0.95). The impact of tillage depended on the straw management (p < 0.01). When straw was removed, the no-till treatment yielded less (M(SE)=0.47(0.10) Mg ha-1) less than the tilled treatments. When straw was retained, tillage treatments produced the same crop yields. The cover crop treatment significantly impacted crop yields (p<0.01), but this effect was not moderated by other factors (p-values ranging from x to x) but had a significant effect on crop yields (p < 0.01). Crop yields were lowest in the early-planted mix cover crop treatment (M(SE)=3.82(0.16)), and highest in the mid-season planted radish treatment (M(SE)=4.20(0.16) Mg ha-1). The no-cover crop treatment had intermediate crop yields (XX), and while there were statistical differences between the mixtures and the mid-season planted radish treatments, none of the cover crop treatment yields were statistically different from the no-cover treatment.

**Fall biomass**

Unless otherwise stated, significance was assigned at p <0.01. Full statistical reports including means, standard errors, and p-values for all marginal means and comparisons can be found in supplementary material.

Removing straw after harvest significantly decreased fall vegetative biomass by a small amount (298 and 119 kg ha-1 in 2018 and 2019, respectively), regardless of tillage or cover crop treatment. However, year had the largest impact on fall biomass, and the impacts of cover crop treatment and tillage depended on the year. Cash crop harvest occurred on 8 Aug in 2018 (barley) and 26 Aug 2019 (oats). Fall biomass across all treatments was more than two times larger in 2018 compared to 2019 (2270 kg ha-1 and 985 kg ha-1, respectively). This likely reflects the earlier removal of the crop in 2018 compared to 2019, which allowed for the early- and mid-season planted cover crop treatments to grow without crop interference for an additional 18 calendar days and resulted in earlier planting of the post-harvest radish. Due to the complex interactions between tillage, cover crop, and year combined with the large differences in management contexts between the two years, results are presented separately for each year.

Tillage significantly impacted fall aboveground biomass in a consistent pattern between years, with a stronger effect in 2018 compared to 2019 (p<0.001). Fall biomass was highest in no-till, followed by non-inversion tillage, and lowest in inversion tillage. This pattern was consistent across cover crop treatments. Notably, only the Radmid cover crop treatment increased fall biomass compared to the no cover crop treatment, with the strongest increase occurring in the notill system.

There were no cross-over interactions, patterns were consistent between the two years but were amplified in 2018. The impact of tillage was strongest in the Radmid

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **term** | **sumsq** | **meansq** | **NumDF** | **DenDF** | **statistic** | **p.value** |
| till\_id | 149006 | 74503 | 2 | 177 | 52.01 | <.001 |
| cctrt\_id | 117866 | 29467 | 4 | 177 | 20.57 | <.001 |
| straw\_id | 26010 | 26010 | 1 | 177 | 18.16 | <.001 |
| weayear | 995376 | 995376 | 1 | 177 | 694.9 | <.001 |
| till\_id:cctrt\_id | 23582 | 2948 | 8 | 177 | 2.06 | 0.042 |
| till\_id:straw\_id | 845 | 423 | 2 | 177 | 0.3 | 0.745 |
| cctrt\_id:straw\_id | 3527 | 882 | 4 | 177 | 0.62 | 0.652 |
| till\_id:weayear | 78008 | 39004 | 2 | 177 | 27.23 | <.001 |
| cctrt\_id:weayear | 53282 | 13321 | 4 | 177 | 9.3 | <.001 |
| straw\_id:weayear | 4785 | 4785 | 1 | 177 | 3.34 | 0.069 |
| till\_id:cctrt\_id:straw\_id | 10528 | 1316 | 8 | 177 | 0.92 | 0.502 |
| till\_id:cctrt\_id:weayear | 8702 | 1088 | 8 | 177 | 0.76 | 0.639 |
| till\_id:straw\_id:weayear | 1337 | 668 | 2 | 177 | 0.47 | 0.628 |
| cctrt\_id:straw\_id:weayear | 3360 | 840 | 4 | 177 | 0.59 | 0.673 |
| till\_id:cctrt\_id:straw\_id:weayear | 14893 | 1862 | 8 | 177 | 1.3 | 0.246 |

The proportion of biomass coming from the cover crop



**Fall cover**

Tillage significantly impacted fall aboveground biomass in a consistent pattern between years, with a stronger effect in 2018 compared to 2019 (p<0.001). Fall biomass was highest in no-till, followed by non-inversion tillage, and lowest in inversion tillage. This pattern was consistent across cover crop treatments. Notably, only the Radmid cover crop treatment increased fall biomass compared to the no cover crop treatment, with the strongest increase occurring in the notill system.

Cover crop treatment impacted the composition of the fall cover, but not the extent. We found the percent fall vegetative cover did not vary significantly by (XX%) by ,

Radish cover crop treatments showed predictable and good performance in all metrics across cropping systems and years compared to the grass-legume mix, with particularly good performance in the notill system. This suggests it is a more reliable cover crop compared to the grass-legume mix tested in this study. Straw management had a minor impact on fall vegetation in this study, suggesting it is a less important consideration for producers when deciding on a cover crop system. Likewise, reducing tillage intensity either enhanced or had no impact on cover crop performance.