

Reducing tillage on organic dryland farms in the Northern Great Plains with grazers



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INTRODUCTION

- Reliance on tillage is one of the biggest sustainability challenges facing organic farmers.
- Integrating grazers may be an alternative to tillage for weed management and cover crop termination.
- Cover crop termination methods act as ecological filters on the weed community
- We compared three management systems:
 - Grazed with sheep in transition to organic
 - Tillage in transition to organic
 - Conventional no-till
- Agronomic traits and weed communities were analyzed for a 2013 winter pea cover crop (*Pisum sativum* L.) and subsequent 2014 winter wheat crop (*Triticum aestivum* L.).



Figure 1: (Left) Sheep grazing to terminate pea cover crop. (Right) Tillage to terminate pea cover crop.

METHODS

- 2012 summer was the first transitional year to organic tillage and graze-based systems.
2015 will be first year certified organic.
- Research site was a lattice design with 3 reps per system.
- Fall of 2012, we planted Austrian winter pea and terminated it at flowering in June 2013 with the use of sheep grazing, tillage, or herbicide.
- Plots were planted to HR winter wheat, variety "Yellowstone" in Fall of 2013.

METHODS CONTINUED

- Eight 0.5 m² frames were collected in 2013 and 2014 crops. Weed and crop aboveground shoot biomass were measured at termination or harvest, respectively.
- Shoot biomass was analyzed for C:N content. Grain yield and quality parameters were assessed.
- Data were analyzed using a linear model ANOVA and Tukey HSD.
- Multivariate analysis (NMDS) was fit on a Bray/Curtis dissimilarity matrix.



Figure 2: (Left) Sampling for shoot biomass. (Right) Sheep-grazed cover crop.

RESULTS

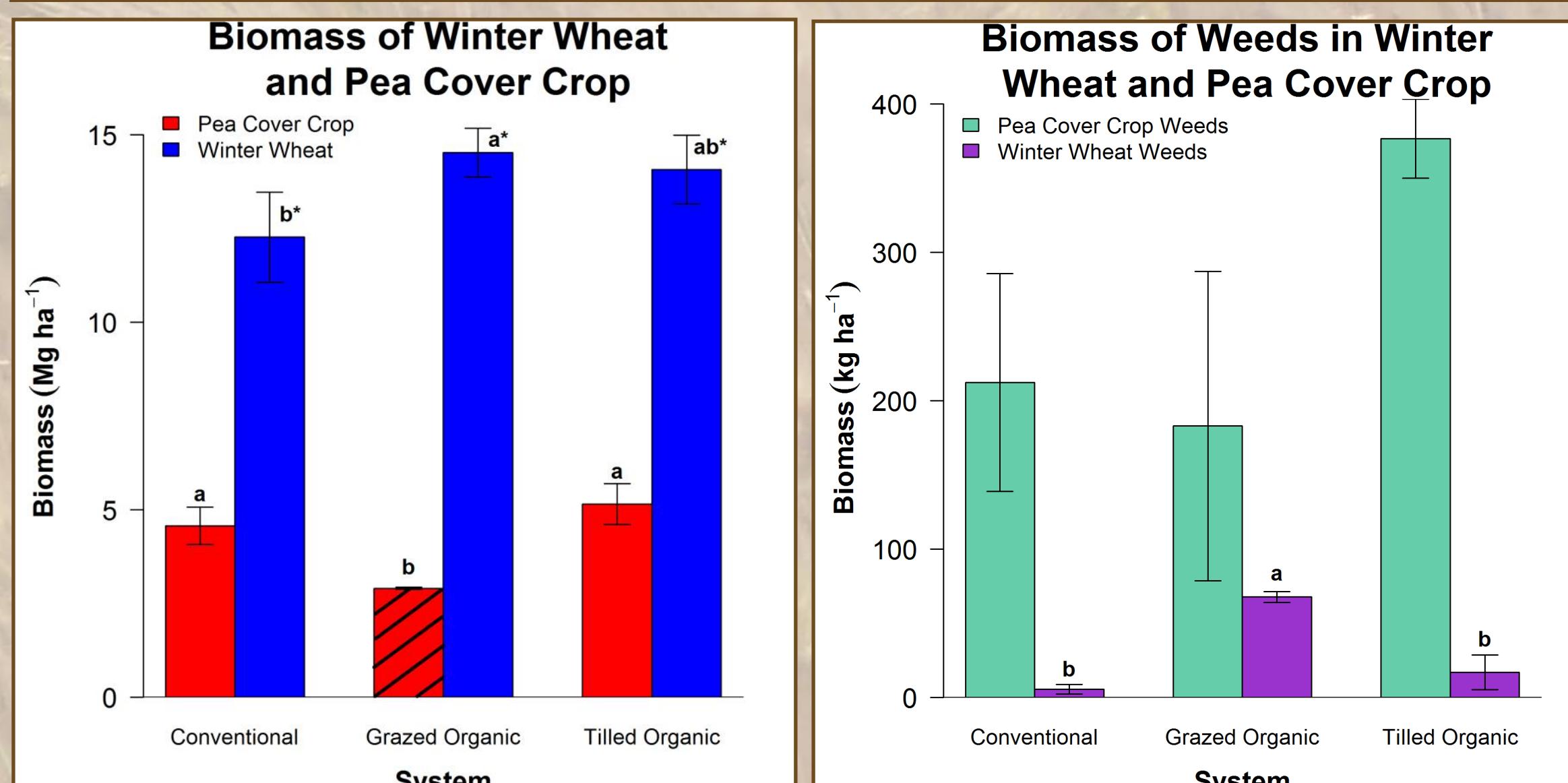


Figure 3: (Left) Comparison of crop biomass by system. Winter wheat biomass was 15% lower in the conventional system due to a lower seeding rate. Pea cover crop biomass averaged 40% lower in the grazed system due to an earlier termination date. (Right) Comparison of weed biomass in the above crops by system. Grazed organic winter wheat plots had more weed biomass, however this encompassed less than 1% of the total crop and weed biomass at this transition stage.

* denotes significance at the p=0.10 level.

Table 1: Grain, productivity, and nutrient parameters in winter wheat and winter pea cover crop. Tukey HSD, p<0.1.

System	Protein g kg ⁻¹	Test Weight kg hL ⁻¹	Harvest Index	Pea kg N ha ⁻¹	WW Chaff kgN ha ⁻¹	WW Grain kgN ha ⁻¹
Grazed Organic	152	74 a	0.37	124 b	60	142
Tilled Organic	159	71 b	0.40	188 a	65	154
Conventional No-till	143	74 a	0.45	173 ab	39	138

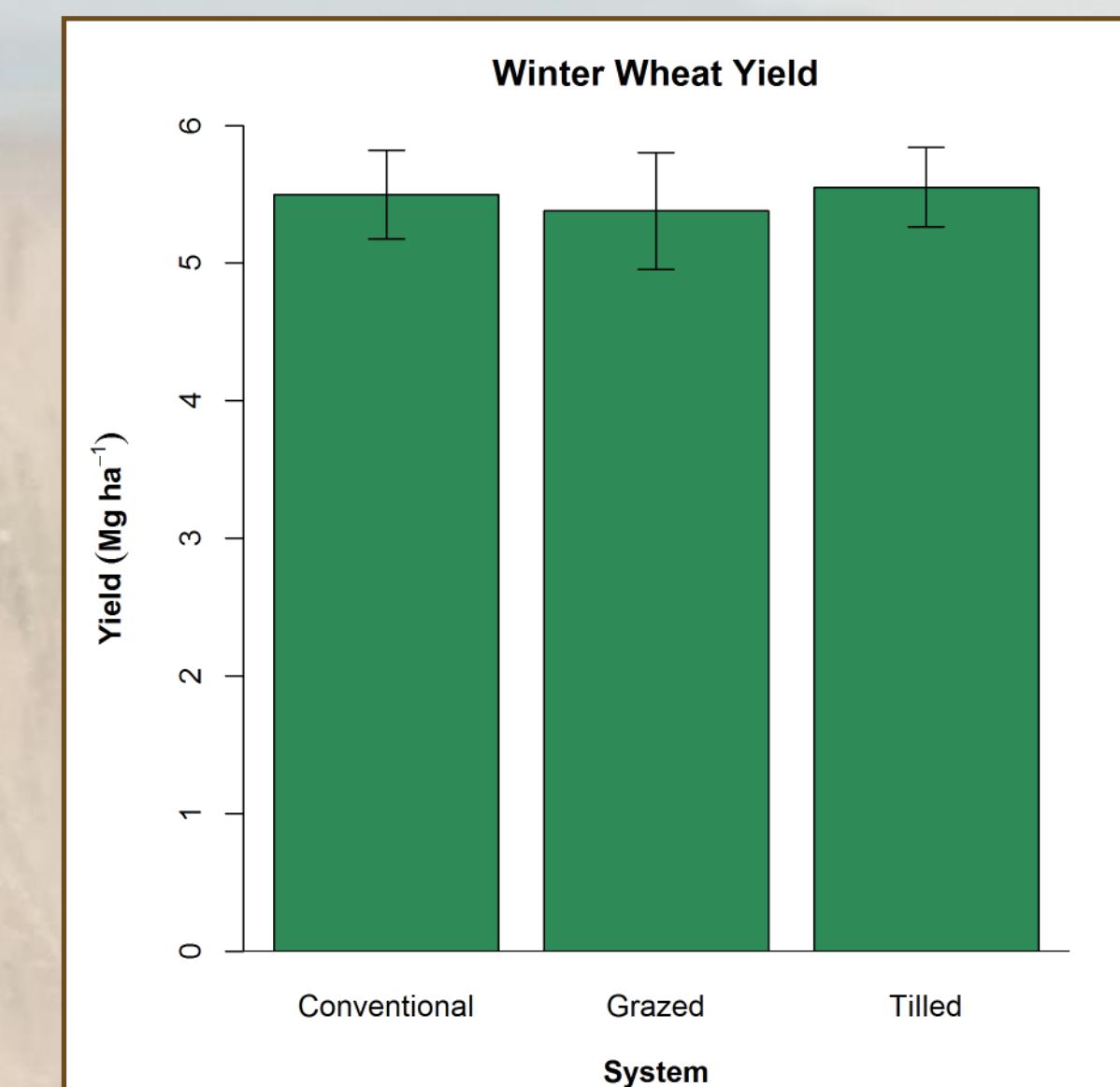


Figure 4: (Left) There were no yield differences in winter wheat among systems. (Right) Non-metric multi-dimensional scaling (NMDS) of weed community from 2013 winter pea cover crop and 2014 winter wheat. ▲ = grazed organic, ● = tilled organic, ■ = conventional no-till. Open shapes = 2013 pea, solid shapes = 2014 winter wheat. Shapes closer together have similar weed communities. 2013 pea crop had similar communities among systems. In 2014 winter wheat, the two organic systems had similar communities.

CONCLUSIONS

- There was little evidence of agronomic differences among the three systems compared during early transition
- Farmers transitioning from conventional to organic should not expect yield or grain quality losses in this period when following a legume cover crop. Note that these fields were old pasture ground and 2014 had low weed pressure.
- Grazed and tilled organic systems selected for weed communities different from conventional no-till. However, 2015 winter wheat following a grazed legume cover crop appears weedier than the tilled organic (Figure 5)



Figure 5. 2015 winter wheat crop following 2014 sweet clover (*Melilotus alba* L.) cover crop. (Left) Conventional no-till. (Middle) Grazed Organic. (Right) Tilled Organic.

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