Planting Cover Crops After Compost Application in Winter Wheat Fallow in Eastern Wyoming: Soil Moisture, Weed Competition, and Crop Yield Responses

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Introduction
Cover crops planted in the fallow phase of the winter wheat–fallow rotation have shown to provide multiple benefits including improved soil health and increased soil organic matter (SOM) in many wheat producing regions. But in areas of very low precipitation, such as eastern Wyoming and western Nebraska, cover crop adoption is low due to the negative effect on soil water remaining in the profile for the succeeding winter wheat (Triticum aestivum L.). Planting cover crops in conjunction with composted feedlot manure (compost) can be a viable alternative to improve on soil properties, which, in turn, can increase water storage and other nutrient and non-nutrient benefits.

Objectives
Our objectives were to assess the effects of cover crops planted after compost on weed growth, soil moisture, and subsequent wheat yield.

Materials and Methods
Treatments
A field experiment was conducted at the James C. Hageman Sustainable Agriculture Research and Extension Center (SAREC). In September 2015, compost at 0, 6, 12, and 18 ton/acre—an equivalent of 0, 13, 26, and 39 lb/ac nitrogen (N)—was applied in the fallow phase and in strips from where winter wheat was harvested in July 2015. In May 2016, a mixture of 29 lb/ac of Austrian winter pea and 50 lb/ac of oats was planted to one-half of the fallow plots and tilled in mid-June 2016. In October 2016, inorganic fertilizer at a rate of 79 lb/ac mono-ammonium phosphate and 107 lb/ac ammonium sulfate (a total of 39 lb N/ac) were applied to non-compost amended plots in the fallow. Winter wheat was planted after cover crop termination.

Data Collection
Measurements included (1) weekly monitoring of soil moisture (between May and August of 2016 and May and August of 2017); (2) one time weed density estimates in the fallow phase (July 2016) and succeeding wheat phase (July 2017); and (3) a determination of winter wheat yield (July 2017). Data were subjected to a two-factor (compost and cover crops) factorial analysis of variance, and means were separated by Fischer’s least significant difference at $p<0.05$ (soil water content and weed density) and at $p<0.1$ (winter wheat yield).

Results and Discussion
Weed Density
In 2016, no statistical differences between treatments were observed (Fig. 1). In 2017, weed density was reduced in the wheat phase by ~27–81% in plots planted to cover crops in the preceding year. The biggest differences were observed at 6 and 18 tons/ac (Fig. 2).

Soil Moisture and Wheat Yield
In 2016, cover crops reduced soil moisture by ~3% during cover crop growth; however, the differences between cover crop and no cover crop fallow treatments were no longer present on the day winter wheat was planted. Winter wheat yield increased by ~13% and 28% in the cover crop treatments (Fig. 3). The largest yield increases were observed at 12 and 18 ton/ac compost with cover crops (yields increased from 60 bushels to 90 bushels/ac).

Conclusions
Planting cover crops after a one-time application of compost show successful weed control and improved winter wheat yield, with no reduction in soil moisture within the first two years of the adoption of this practice. This may be a viable practice by winter wheat organic farmers having a readily available, relatively inexpensive supply of weed-free compost.

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Figure 1. Weed density in the cover crop and no cover crop plots in the fallow phase (2016).

Error bars represent standard errors of a mean (n=8).

Figure 2. Weed density in the winter wheat phase preceded by the cover crop and no cover crop planted fallow.

Error bars represent standard errors of a mean (n=8). Means attached by different letters are statistically different at p≤0.05.

Figure 3. Wheat yield after cover crop or no cover crop fallow (2017).

Error bars represent standard errors of a mean (n=8). Means attached by different letters are statistically different at p≤0.05.