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CROPWATCH

Cover Crop Mixture Diversity and Function

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This is one of several briefs on NU cover crop research (http://cropwatch.unl.edu/2016/unl-cropwatch-december-9-2016) featured in this week's CropWatch.

Background

Cover crops have long been used for a wide variety of functions including adding organic matter to the soil, suppressing weeds, decreasing nutrient leaching, and stimulating soil biota. Recently, however, there has been increased interest in the use of highly diverse mixtures of cover crops. While it's been asserted that mixing cover crops does everything from increasing biomass productivity to increasing weed suppression, enhancing nutrient retention, and fostering soil health through stimulating increased soil biota, there is actually little empirical evidence to support these claims.

It has been proposed that the many functions of cover crops are only improved with the use of more cover crop species, but these claims have been based less on empirical evidence and more on an intuition about diversity that prevails in both the fields of agriculture and ecology. The overarching objective of this project was to determine the effects of increasing cover crop mixture diversity on cover crop function. Specifically, this study evaluated the effect of increasing cover crop species and functional richness on aboveground biomass productivity, weed suppression, soil nutrient retention, and soil microbial biomass.

Study Description

Twenty to forty cover crop treatments were replicated three to four times at eleven locations across southeastern Nebraska. Treatments were designed using a pool of 18 cover crop species representing three cover crop species each from six pre-defined functional groups:

- cool-season grasses (barley, oats, wheat),
- cool-season legumes (Austrian winter peas, red clover, yellow sweetclover),
- cool-season brassicas (radish, rapeseed, turnip),
- warm-season grasses (proso millet, sorghum sudangrass, teff),
- warm-season legumes (chickpea, cowpea, sunn hemp), and
- warm-season broadleaves (buckwheat, safflower, sunflower).

Each species was planted in monoculture. The most diverse treatment contained all 18 species. Remaining treatments included treatments representing intermediate levels of cover crop species and functional richness and a no-cover-crop control treatment.

Cover crop planting dates ranged from July 19 to September 20. Cover crop and weed aboveground biomass was sampled prior to winterkill. At one of the locations, soil samples were taken the following spring on April 9 and analyzed for soil extractable nitrate, phosphorus, potassium, sulfate, and chloride as well as extracted for fatty acid methyl esters to quantify soil microbial biomass. Extractable soil nutrient analyses were conducted on soil samples taken from the 0-10, 10-20, 20-30, and 30-60 cm depth. Soil microbial biomass assessments were made on soil samples from the 0-10 cm depth.

Applied Questions

How does increasing cover crop mixture diversity affect biomass productivity? More diverse cover crop mixtures were more productive on average than less diverse cover crop mixtures and cover crop monocultures. However, this was mostly due to low yielding cover crop species pulling down the average productivity of the cover crop monocultures and the less diverse cover crop mixtures.

In highly diverse cover crop mixtures, high yielding species compensated for the poor performance of low yielding species. That said, at every site, the highest yielding cover crop monoculture performed just as well if not better than the highest yielding cover crop mixture in terms of biomass productivity. Increasing cover crop diversity did not appear to increase potential biomass productivity but rather simply increased the likelihood of selecting a productive cover crop.

Does increasing cover crop mixture diversity increase weed suppression, soil nutrient retention, or soil microbial biomass? Compared to no-cover controls, cover-cropped plots had fewer weeds, increased soil nutrient retention (with regard to soil extractable nitrate, potassium, sulfate, and chloride), and increased soil microbial biomass. Furthermore, comparing across cover crop treatments, increased cover crop biomass was associated with increased weed suppression, soil nutrient retention, and soil microbial biomass. Because more diverse cover crop treatments were on average more productive than less diverse cover crop treatments, increasing cover crop mixture diversity was often correlated with increases in weed suppression, soil nutrient retention, and soil microbial biomass. However, controlling for variations in cover crop biomass, there was little evidence that increasing cover crop mixture diversity itself increased weed suppression, soil nutrient retention, or soil microbial biomass. Productive cover crop monocultures were just as effective as productive cover crop mixtures at suppressing weeds, retaining soil nutrients, and increasing soil microbial biomass.

Additional Resources

Florence, A. 2016. Cover crop mixture diversity and function. Ph.D. dissertation. University of Nebraska, Lincoln.

Tags: Cover Crops (http://cropwatch.unl.edu/tags/cover-crops)