

Cover crops do not give rise to positive net ecosystem C balance

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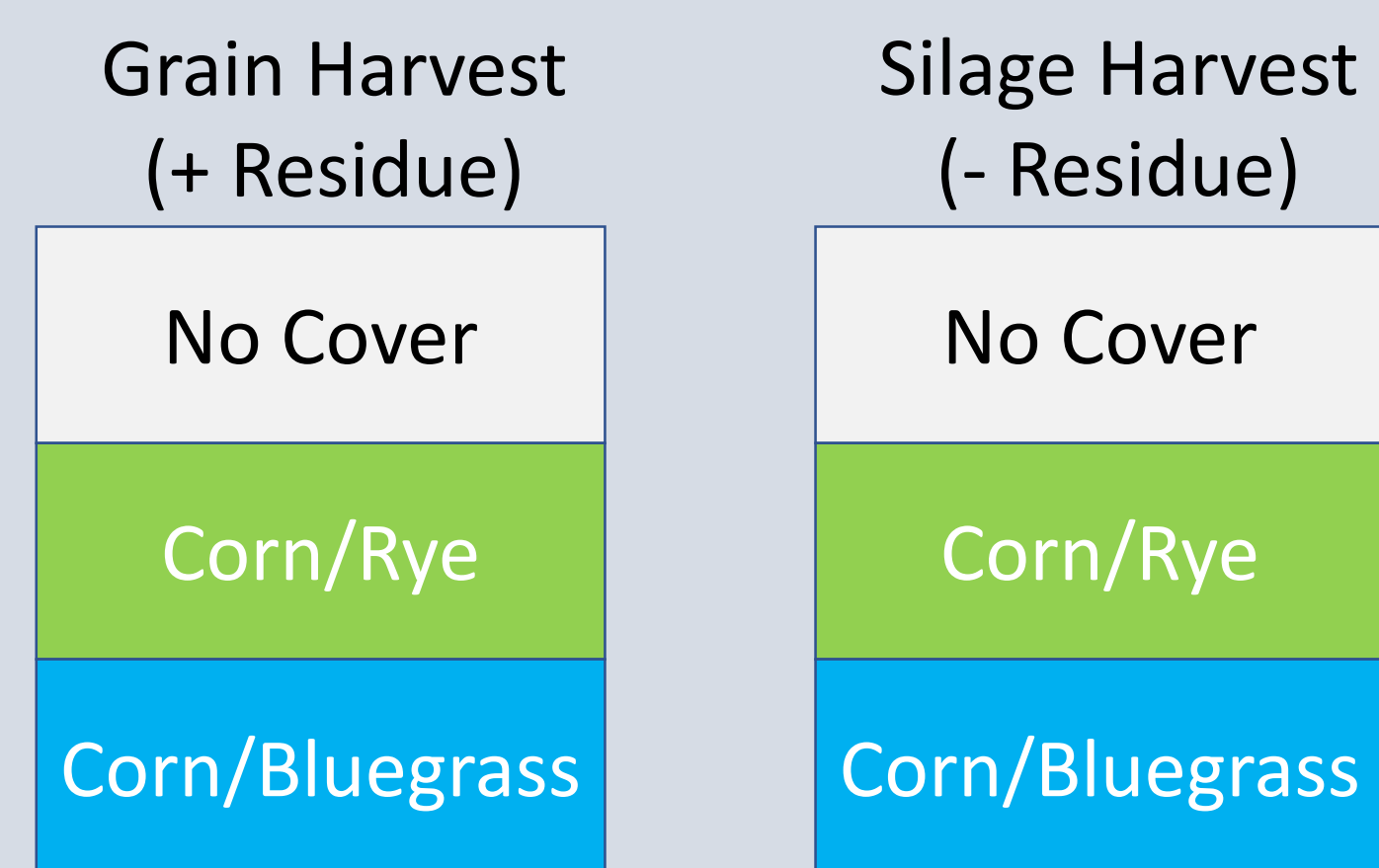
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Introduction

Increasing soil C storage requires increasing biomass C produced relative to C lost via harvest and soil respiration, for a positive net ecosystem C balance (NECB). Cover crops grown during fall and spring should increase biomass compared to annual corn alone. We measured C inputs and losses to evaluate the NECB of strip-till corn harvested for grain or silage with rye or bluegrass cover crop.

Site and Methods

- Site: Arlington ARS, Arlington, WI
- Soil: Plano silt loam, Haplic Argiudoll
- Split plot RCBD, 5 blocks
- Whole plot: grain or silage harvest of strip-till corn.
- Split plot: winter rye (planted after corn harvest, sprayed with glyphosate pre-planting), perennial Kentucky bluegrass (est 2014-2015 between corn rows), or no cover crop



- Measurements (2015 and 2016):
 - Above and below ground primary productivity (ANPP and BNPP), harvest losses
 - Soil Respiration (2x/month in growing season)
- Estimates:
 - Heterotrophic (Rh) portion of respiration, based on literature values (Rochette et al. 1999, Zhang et al. 2013, von Haden et al., personal communication)
 - Root turnover and root exudates based on Bolinder et al. (2007), Austin et al. (2017)
- Statistical Analysis:
 - ANOVA on ANPP, BNPP, annual Rh, total NECB
 - Potential residue removal rate = (NECB - Harvest)/Harvest

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Figure 1: Silage harvest lowered NECB

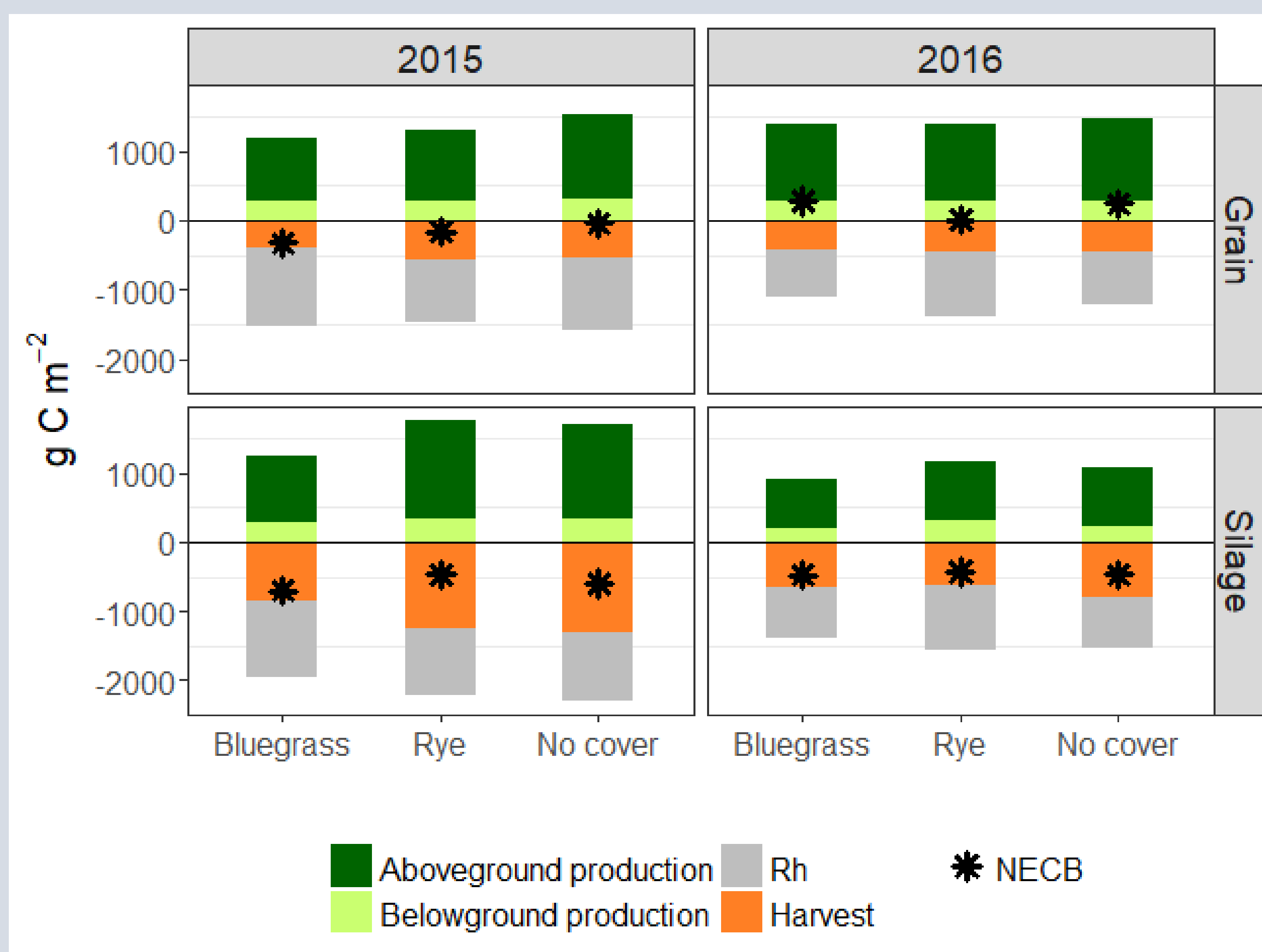
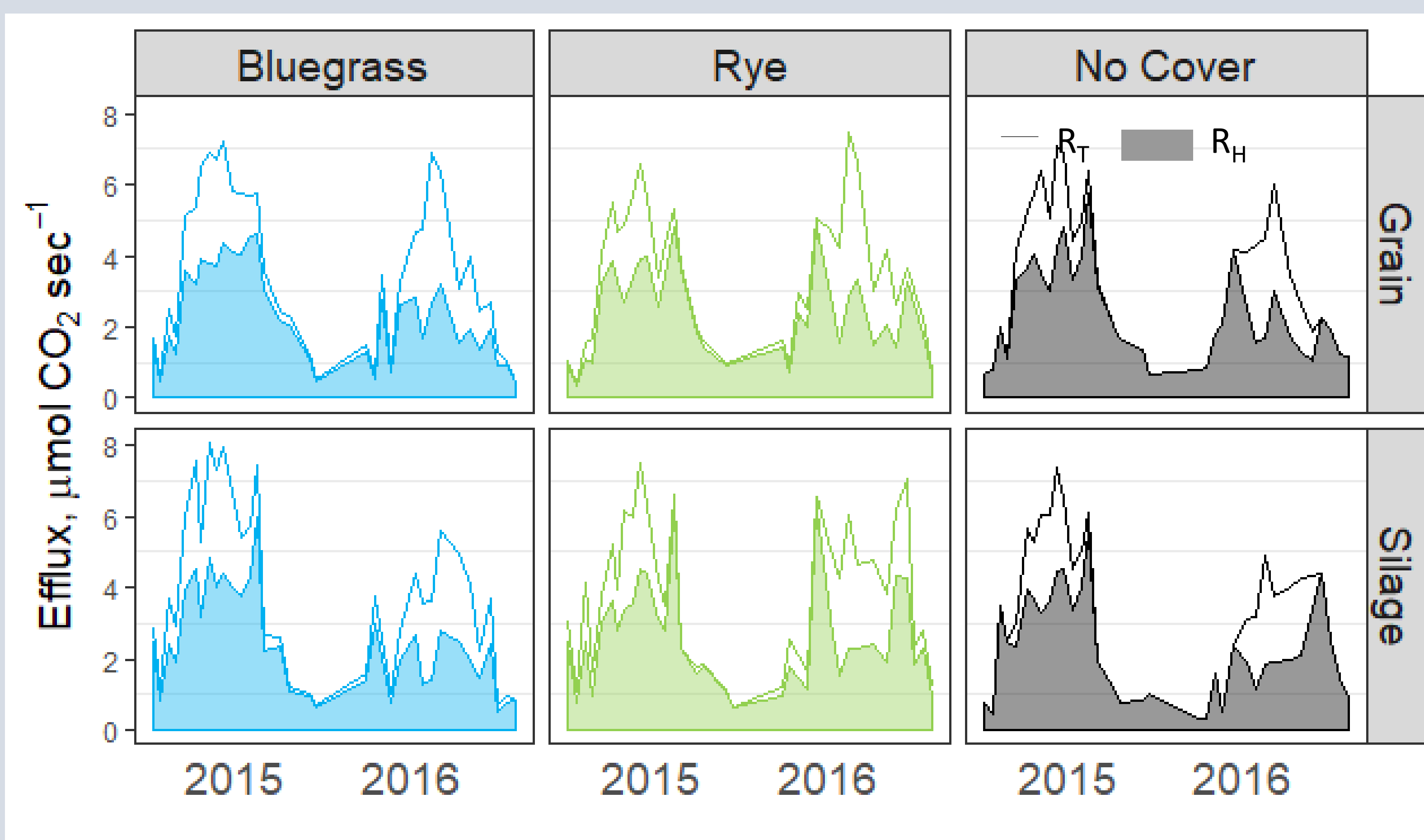
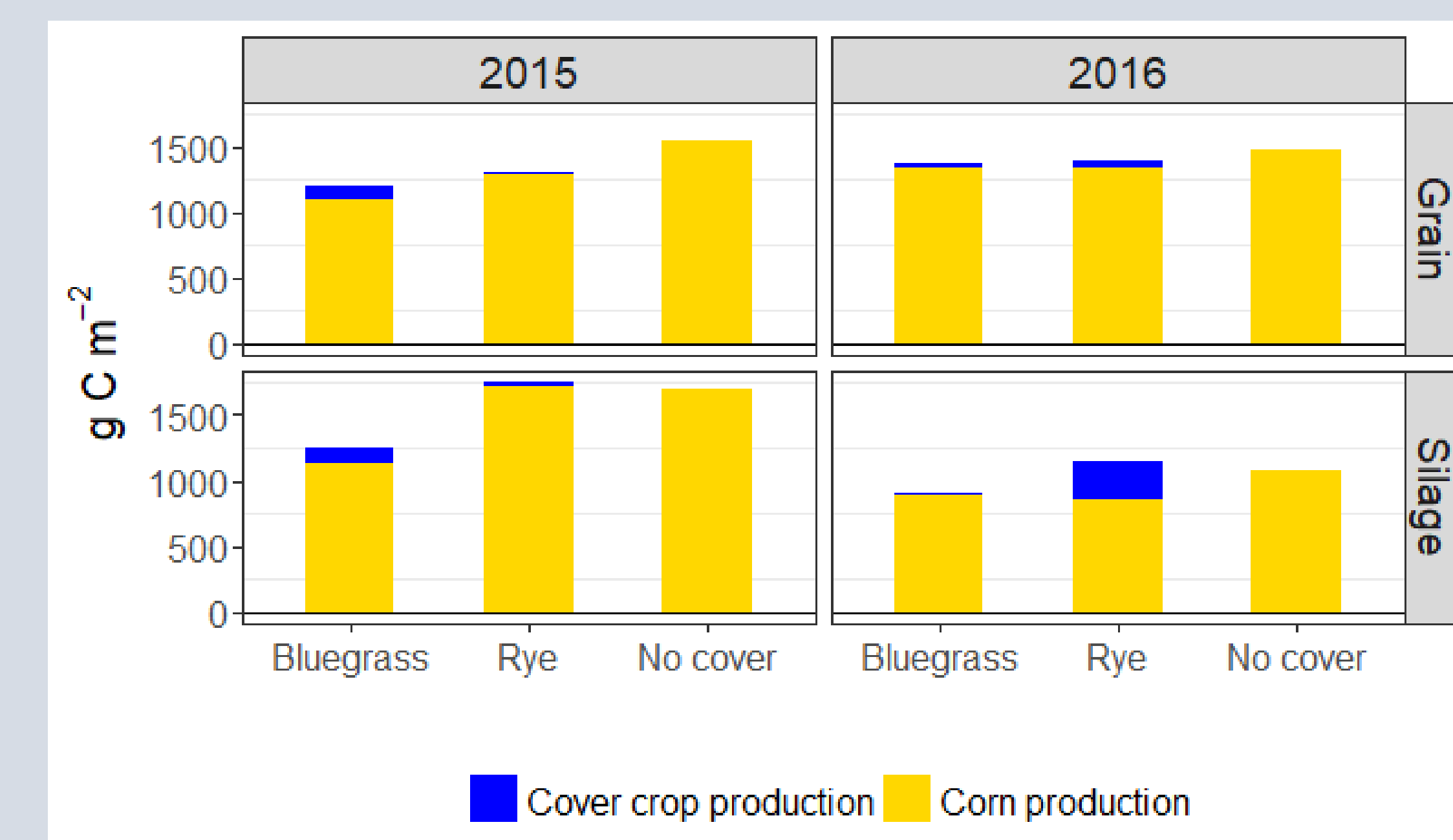


Figure 3: Cover crops stimulated CO2 efflux, but bluegrass lowered Rh in 2016



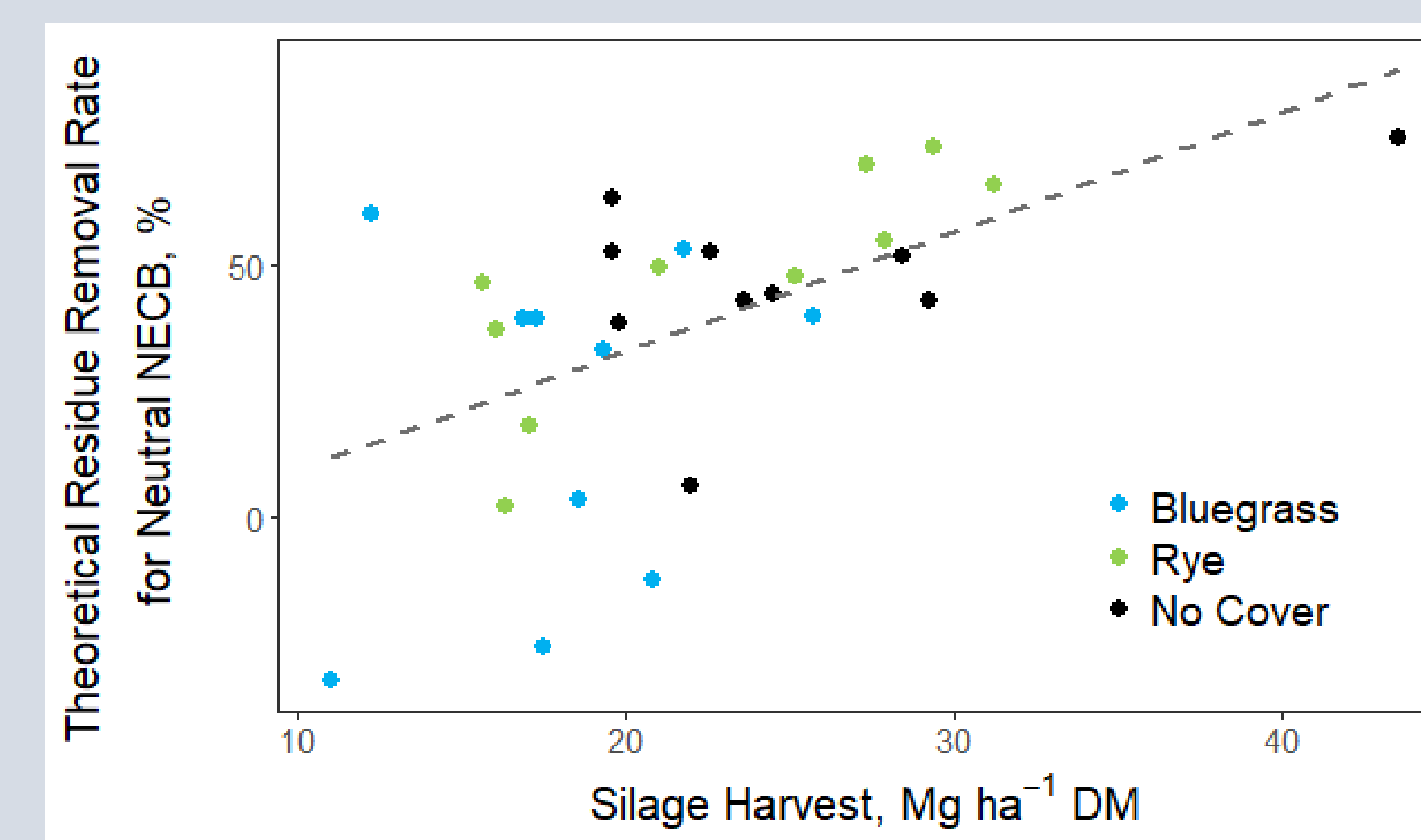
- Increased seasonal variation in Rh may indicate more variable microbial activity with cover crops
- No detectable differences in soil moisture or temperature

Figure 2: Cover crop biomass too little to replace corn harvest loss



- Cover crops may increase risk for growers by decreasing harvest (Figure 1, 2015).
- Cover crops contributions to NPP ranged from 1-25% (Figure 2)
- Cover crops do not increase theoretical residue removal rates (Figure 4)

Figure 4: Potential for residue removal increased with silage yield



Conclusions

While cover crops provide physical protection to the soil, impacts on soil C in corn systems were minimal because their inputs to the C cycle are nominal compared to corn biomass. Large losses to Rh and harvest mean corn systems have limited ability to increase soil C.