**An attempt to holistically evaluate services and dis-services of fall vegetation in 30 cropping systems varying in tillage, straw management, and cover crop system**

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With increasing pressures from population growth and climate change, there is growing interest in assessing both the potential benefits and drawbacks of in-field, non-crop vegetation (i.e., weeds). This study evaluated fall non-crop communities in 30 replicated cropping systems over two consecutive years in Zealand, Denmark. Treatments included every combination of three tillage methods (minimum, surface, inversion), two residue management strategies (retained, removed), and five cover crop systems (Lolium perenne and Trifolium repens mixture sown early- and mid-season, Raphanus sativus (radish) sown mid-season and post-harvest, and a no cover crop control). Four metrics were used to capture vegetation potential services and harms: (1) percent soil cover (soil protection), (2) total aboveground biomass (potential soil carbon input and nitrate leaching mitigation), percent-cover-weighted species (3) potential ecological benefits and (4) potential agronomic harm. The study coincided with the site’s driest (2018) and wettest (2019) growing seasons in 30 years. Results showed that soil cover remained stable (~75%) across treatments and years. Cropping system had some influence on total aboveground biomass (increasing biomass with decreasing tillage intensity), but more strongly affected the proportion of biomass attributed to cover crops. Radish cover crops consistently contributed over 50% of total biomass, while the mixes’ contributions varied (0–80%) within both planting timings. Radish treatments produced neutral vegetation communities, with neither high potential benefits nor harms. In contrast, the mixes and no cover crop treatments displayed both high potential harm and high potential benefit. These results underscore the complexity of defining ‘beneficial’ vegetation in agricultural systems, highlighting the interplay between multiple ecological and agronomic indices.

**Introduction**

Non-crop vegetation can provide value. Especially fall vegetation, as it will be controlled in the spring before planting with tillage or herbicides

* Cover crops
* Volunteers
* Weeds can provide services
  + Especially fall vegetation, as it will be controlled in the spring before planting with Tillage or herbicides
  + Protect soil from erosion
  + Reduce nitrate leaching
  + Plant diversity
    - Paper I reviewed showed weedy control had more diversity

Ways of quantifying value

* Often location specific
* Nothing that is particularly easy
* Used Yvoz, they provided field-based values to drive their estimates
  + Need to understand more here

Values needed from fall coverage

* Soil cover to protect from erosion
  + Root structure may also contribute (cover crop and erosion paper (De Baets et al., 2011) but difficult to predict roots in mixed stand
* Contributions to soil carbon
  + Soil organic carbon increases positively associated with biomass (Jian et al., 2020)
* Contributions to reduced nitrate leaching
  + Shoot biomass (Thapa et al., 2018)

Results

Weather

Crop yields

Results showed that soil cover remained stable (~75%) across treatments and years.

Figure?

Cropping system had some influence on total aboveground biomass (increasing biomass with decreasing tillage intensity), but more strongly affected the proportion of biomass attributed to cover crops.

Figure

Radish cover crops consistently contributed over 50% of total biomass, while the mixes’ contributions varied (0–80%) within both planting timings. Radish treatments produced neutral vegetation communities, with neither high potential benefits nor harms. In contrast, the mixes and no cover crop treatments displayed both high potential harm and high potential benefit.