Decomposition Rates of Wheat, Fava Bean, and Pea in Northern California

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Introduction

Cover crops (CC) can improve soil quality and increase environmental sustainability and baseline profits. Common winter CC mixes include plant species from Poaceae, *i.e.*, oat, wheat, and barley; Fabaceae, *i.e.*, pea, vetch, and bell bean; and Brassicaceae, *i.e.*, radish and mustard. In northern California, seeds of these species are mixed in specific ratios and planted with the beginning of rain in fall. The CC is terminated and incorporated back into the soil or crimped and left on the soil surface. In this study, the decomposition rates of three winter CC species (fava, pea, and wheat) were quantified to help growers make informed decisions about CC species choice, timing of CC termination, and planting date of subsequent crops.

Figure 1: Different CC species provide unique benefits to a cropping system. Grasses, such as winter wheat (left) can prevent nutrient loss by scavenging for excess nutrients, while legumes such as field peas (center) and fava beans (right) can convert atmospheric nitrogen into plant-available ammonium and nitrate through a symbiotic relationship with soil bacteria

Objective: to quantify the decomposition rates of three winter CC species (fava, pea, and wheat).

Hypothesis: The rate of decomposition will be different between the three winter cover species.

Materials and Methods

Roots and aboveground biomass (AGB) of winter-grown wheat, fava bean, and pea were harvested in the spring at the legumes' full-pod stage. The root biomass was washed, and both root and AGB were cut into ~1 cm long pieces. For each sample type 40g fresh biomass for fava and wheat and 20-40g for pea was weighed into semipermeable bags and secured with zip ties. Depending on available material, 21-28 samples of each species were prepared. One bag of each set was dried to obtain the initial moisture content. The remaining bags were buried ~1ft deep between rows of established calendula flowers. Over the course of 11 weeks, the bags were removed from the field at 14-day intervals, and their contents were dried and weighed. Decomposition was measured in weekly % loss of biomass.

Figure 2: From left to right: whole root of a fava plant after being harvested and rinsed of soil; wheat above-ground biomass samples being cut into 1cm pieces; bags containing biomass samples placed into holes; sample that has just been dug up for data collection

Results

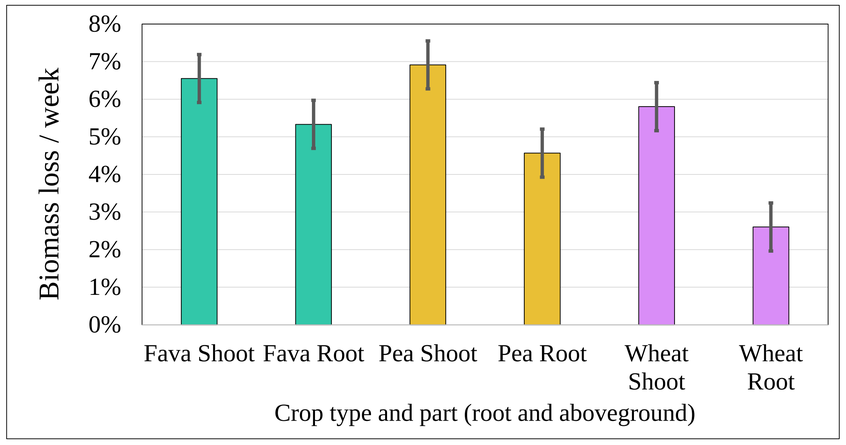

Figure 3: Percent weekly biomass loss of different crops parts during the course of experiment (2 years data)

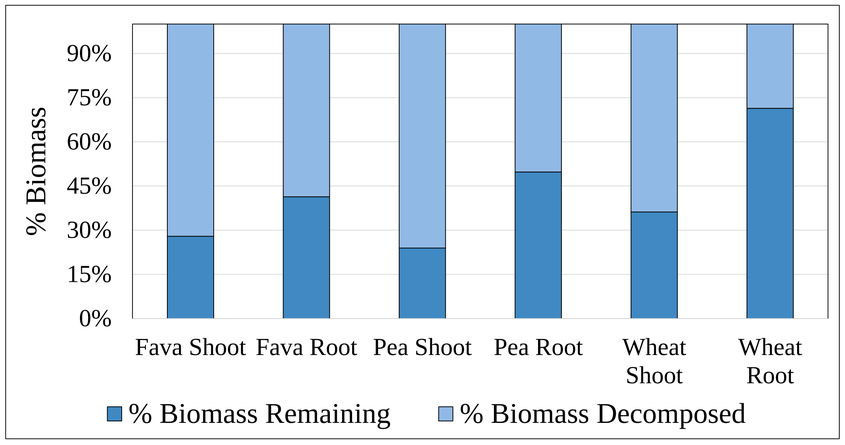

Figure 4: Percent biomass loss compared to the remained biomass at the end of the experiment (2 years data)

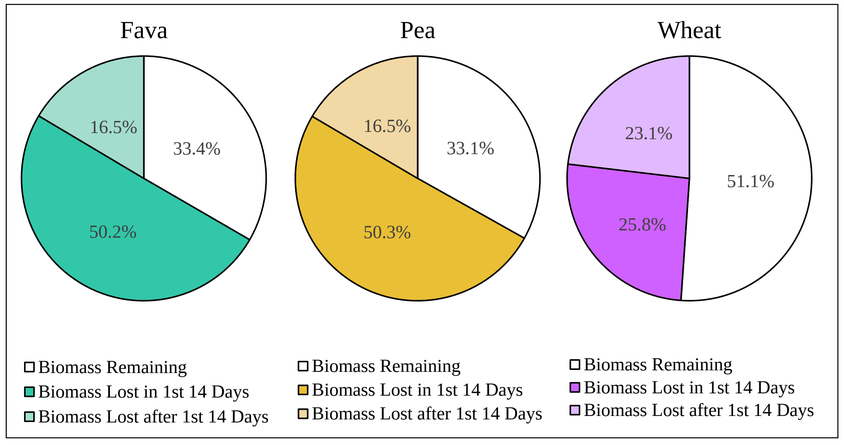

Figure 5: Percentage breakdown of biomass lost during first 14 days compared to biomass lost after first 14 days (2021)

Discussion

- Out of the total biomass lost (decomposed), the percentage lost during the 1st two weeks of experiment was substantial.
  - Biomass loss during this time was higher in fava (75%) and pea (79%) than in wheat (51%). This variation is likely associated with higher cellulose, lignin , and silica content of wheat compared to the legumes (pea and fava).
- In all three species, above-ground biomass decomposed faster than root biomass.
- **Future direction:** future research would benefit from the inclusion of additional cover crop species, such as daikon radish and winter oats, as well as a shorter sampling interval in order to further break down the rate of biomass loss.

References and Acknowledgements

- DeVincentis, et. al. (2020). *Jou Environmental Management*, *261*, 1–2.
- Bodelier et. al. (2020). *Geoderma*, *361*, 1-5.
- Toom et. al. (2019). *Agronomy Research*, *17(4)*:1-2

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