

# BIOAg Project Progress Report

## **Title:**

Rotating out of weeds and into soil health: Optimizing cover crops in three Columbia Basin organic production systems

## **Principal Investigator(s) and Cooperator(s):**

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## **Abstract:**

Weeds cause extensive loss in agricultural production and are particularly damaging in organic systems. Control generally relies on mechanical cultivation which reduces soil carbon, decimates soil fauna, and increases erosion potential. Cover cropping, a biologically intensive practice, can be an effective tool to reduce weed pressure and improve soil quality, but it also introduces new challenges as failed or marginal cover crop plantings create fertile ground for opportunistic weeds. This project will optimize use of summer cover crops in three different Columbia Basin production systems with three different on-farm experiments: 1) sudangrass incorporated into a grazing and grain system, 2) planting dates and rates for sorghum-sudangrass, mustard, and mixes preceding onions, and 3) companion planted crops for carrot seed production. In addition to cover crop and cash crop performance, soil health and weed pressure will be analyzed in replicated on-farm experiments allowing us to describe soil quality and weed populations in multiple organic agro-ecosystems across the Columbia Basin.

## **Project Description:**

This project aims to explore cover cropping at three Columbia Basin organic farms (Cloudview Farms, Lenwood Farms, and Andersen Organics) via three different strategies – cover crop blends and planting dates, animal-integrated cover cropping, and companion planting. Research questions were driven, in part, by weed management concerns, soil health interests, and, with input from the three participating producers.

Strategy 1: After establishing varying cover crop mixes at Lenwood Farms and Andersen Organics, biomass (weed and cover crop) and soils collected from research plots will be used to evaluate the effects, if any, between treatments. A similar weed analysis will be conducted during the spring onion crop, prior to any soil disturbance by the grower.

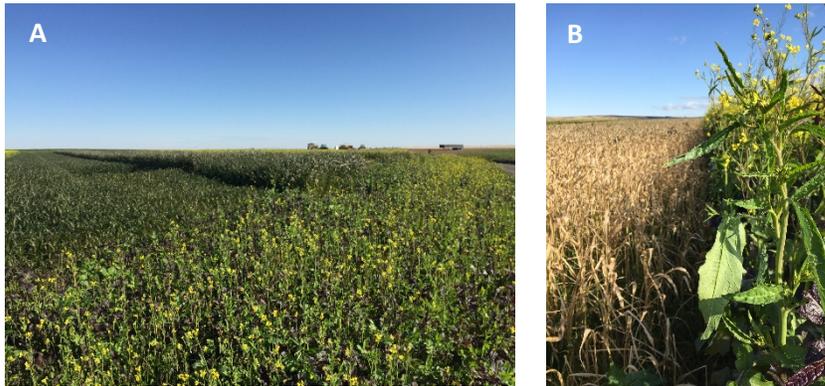
Strategy 2: At Cloudview Farms similar weed and soil assessment will take place following a much different cover cropping approach. Here, one cover crop variety sudangrass is planted, mowed, allowed to re-grow, and then grazed by goats. Biomass and weed samples are collected after the initial establishment and then just before the grazing, while soil samples are collected after the cover crop has been removed by the animals. Research plots are then planted to winter wheat and prior to harvest, weed, cover crop and soil assessments are conducted again.

Strategy 3: In the spring of 2020, at Andersen Organics, three varieties (phacelia (*Phacelia tanacetifolia*), flax (*Linum usitatissimum*) and lentils (*Lens culinaris Medik.*) are established as companion plants in carrot seed production. Biomass samples of each collected prior to harvest and this project also serves as a demonstration area for an outreach event.

## Outputs

### Overview of Work Completed and in Progress:

Strategy 1: Mixes of sorghum-sudangrass (*Sorghum bicolor* (L.) Moench × *S. sudanense* cv Blackhawk) and mustard (*B. juncea* + *S. alba* cv Rojo) were planted at Lenwood Farms and Anderson organics at two different dates, early and late, Aug 1 and 2, and August 13<sup>th</sup> and 14<sup>th</sup>, respectively (Figure 1). Soils, and weed and cover crop biomass, were sampled on Oct. 3 and 4<sup>th</sup> and the cover crop was worked into the soil the following week. Biomass samples were dried, weighed, and ground. Cover crop tissue analysis is pending. Weed analyses were also completed and soil health analyses are still underway.



**Figure 1.** Cover crop treatments before incorporation at (A) Lenwood Farms and (B) Andersen Organics.

Strategy 2: Cover crop (*Sorghum bicolor* (L.)) was planted July 18<sup>th</sup>, and weed and cover crop biomass were collected on Aug. 27<sup>th</sup>, followed by mowing, one day later on Aug. 28<sup>th</sup>. Biomasses were sampled again on Oct. 3<sup>rd</sup>, and the following week control plots were mowed and goats were introduced to the grazing treatment plots. However, due to an unexpected early frost, goats would not graze the cover crop. After discussions with Jim at Cloudview, we decided to try a different route by planting a different winter cover crop and then grazing in the spring. To that end, on October 18<sup>th</sup> a ‘no-till’ seed mix of triticale (X *Triticosecale* Wittmack) and Austrian winter peas (*Pisum sativum arvense*) were re-seeded into the research plots. Biomass samples of weed and cover crop were collected in the spring, and the new experiment followed the original design, except for the soil health assessments that were collected in the spring.

Strategy 3: This component of the project was not possible due to COVID-19. Outreach events were not possible and initiating a new on-farm demonstration project was deemed impossible by the cooperating farmer due to the pandemic.

### **Methods:**

Strategy 1: The study was designed as a two factor (variety mix and timing), full factorial with three replications per site. Cover crop treatments include sorghum-sudangrass and mustard planted at varying proportions (i.e., 100% of each, 66 and 33% mix, and vice versa) including a control, for a total of five treatments. The proportionate planting mixes were calculated from the farmer recommended full rate of 44 and 9 kg ha<sup>-1</sup> for sorghum-sudangrass and mustard, respectively, and, at Lenwood Farms and Andersen Organics, cover crop treatments were planted at two different time periods, Aug. 1<sup>st</sup> and 2<sup>nd</sup> (early) and August 13<sup>th</sup> and 14<sup>th</sup> (late).

From each of 30 plots per site, aboveground biomass was collected from within two randomly placed 0.25 square meter sections, combined in the field, and later separated by cover crop variety and weed. Following separation from the cover crop, specific weed populations were estimated by visual inspection and recorded. All biomass was dried at 80 C for 72 hours, weighed, and then recorded.

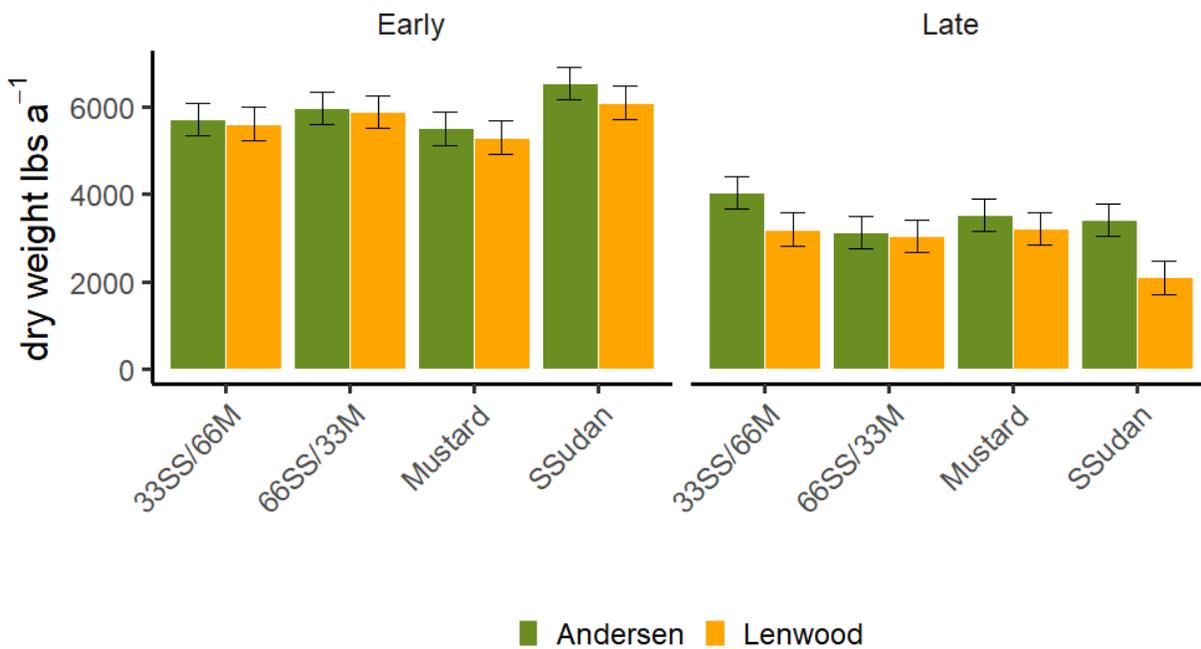
At each site and from the early planting date only, two soil cores (5 x 15 cm) were collected from each of two treatments (100% mustard and control) in three repetitions, homogenized, and sieved to 9 mm before being dried in a forced air oven at 50 C.

Strategy 2: On October 18<sup>th</sup> a 'no-till' seed mix of triticale and Austrian winter peas was re-seeded into the research plots at 123 and 50 kg ha<sup>-1</sup>, respectively. Plots were mowed on 15 May 2020 and grazed on 16 May 2020. Plots were seeded to a 50:50 mix of oats and pea at 150 lbs a<sup>-1</sup> on 21 May 2020.

Strategy 3: Cancelled because of COVID-19.

### **Results:**

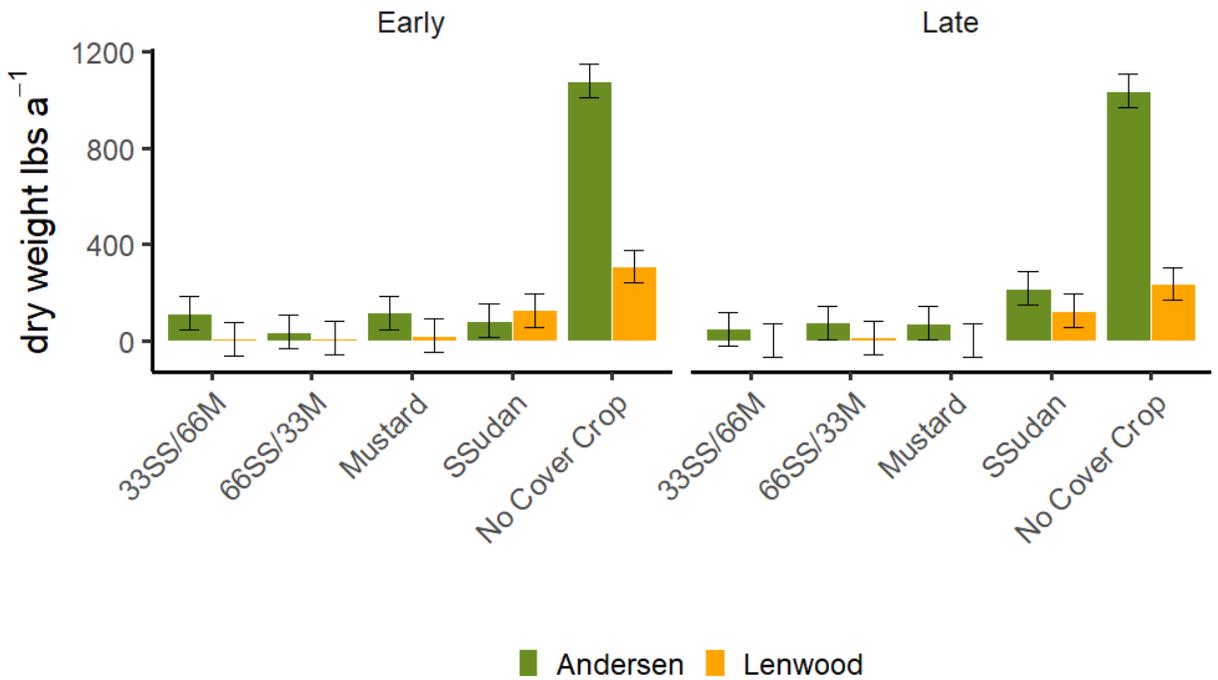
According to preliminary data and including both farm sites, the total aboveground biomass was reduced by half when the cover crop planting date was delayed by two weeks. Cover crops planted on August 1<sup>st</sup> and 2<sup>nd</sup>, and August 13<sup>th</sup> and 14<sup>th</sup>, produced 5824 and 3203 lb a<sup>-1</sup> aboveground biomass, respectively (Figure 2). Statistical analysis indicated little difference in aboveground biomass production between treatments, except for sorghum sudangrass value at Lenwood farms with a late planting (Figure 2).



ANOVA p values  
 Site = 0.02    Time < 0.001    Treatment = 0.79  
 Time x Treatment = 0.008  
 Mean Andersen Early = 5929, Lenwood Early = 5720  
 Andersen Late = 3522; Lenwood Late = 2864

**Figure 2.** Total cover crop biomass from each of four cover crop treatments at two planting dates (Early, August 1<sup>st</sup> and 2<sup>nd</sup>; Late, August 13<sup>th</sup> and 14<sup>th</sup>) and two farm sites.

All cover crop treatments reduced weed biomass relative to the control treatment (Figure 3). Time of planting did not affect weed biomass, but there was a significant site effect with more weed pressure at Andersen Organics than at Lenwood Farms.

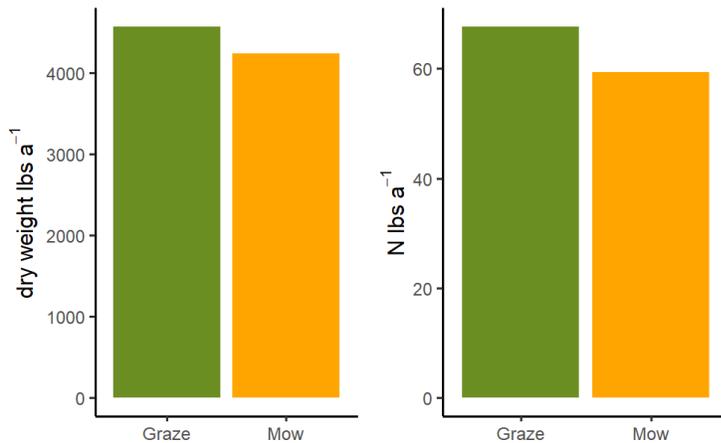


ANOVA p values  
 Site <0.0001 Time < 0.83 Treatment <0.0001  
 TimeXTreatment = 0.72 SiteXTreat<0.001

**Figure 3.** Total weed biomass from each of five cover crop treatments, including a control, at two planting dates (Early, August 1<sup>st</sup> and 2<sup>nd</sup>; Late, August 13<sup>th</sup> and 14<sup>th</sup>) and two farm sites.

Cover crop nutrient content and soil analyses are on-going.

At Cloudview EcoFarm, there were only 2 replications so statistical analysis could not be done. However, the crop planted following grazing (oats and pea mix) was evaluated for aboveground biomass and nitrogen content. Both biomass and N content were slightly larger in the grazed treatment.



**Publications, Handouts, Other Text & Web Products:** None to-date.

**Outreach & Education Activities:**

PI Collins presented at the annual Tilth Alliance conference on 9 November 2020 with farmer cooperators Jim Baird and Brad Bailee. The title of the presentation was “Regenerative Agriculture Practices in Central and Western Washington” and over 50 people participated in the workshop.

**Impacts**

Short-Term:

Though this data is preliminary, planting date has a clear affect on total aboveground biomass production. This provides immediate valuable information for those wishing to adopt cover cropping or for those want to improve their current management strategies.

Evaluations from the Tilth Alliance presentation will be made available from Tilth Alliance to further asses short-term impacts.

Intermediate-Term: N/A – project is on-going.

Long-Term: N/A – project is on-going.

**Additional funding applied for/secured:** None to-date.

**Graduate students funded:** N/A

**Recommendations for future research:**

Recommendations will be made once the project is complete.