

# BIOAg Project Progress Report

**Report Type:** PROGRESS

**Title:** Improving forage quantity and quality through organic fertilizer and no-till seeding in western WA

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## **Abstract:**

Forage production is the largest agricultural land use in western Washington supporting a diverse livestock industry. Poor grazing management and repeated hay removal, without amendment contribute to reduced productivity, encroachment of weeds, erosion, and inadequate forage quality to support animal health. This integrated research and extension project addresses the WSU Sustaining Resources Grand Challenge. Its goal is to optimize organic fertilizer and no-till practices in order to reduce cost of pasture renovation, increase regional production of quality forage, conserve soil resources and improve organic weed management.

This project leverages existing funding and partnerships between WSU Extension and Conservation Districts implementing no-till seeding programs. Research will: 1) test the impact of fertilizer and no-till seeding on forage quantity, quality and species composition; 2) test fall and spring plantings of five legume species to determine appropriate planting time and species for no-till seeding. Extension components will: 1.) facilitate producer to producer information exchange, 2.) training on the use of no-till seed drill and 3.) new literature on forage management in western Washington giving producers access to the information, training and tools they need to successfully evaluate and implement new practices.

## **Project Description:**

This project is investigating techniques for improving forage quality and quantity of established hay fields through use of no-till seeding and organic fertilizer amendment. This will be achieved through the three primary objectives:

Objective #1: Evaluate impact of organic fertilizer and no-till seeding on forage quantity, quality and species composition.

Objective #2 Identify optimum legume species and planting time for no-till seeding in established sod.

Objective #3: Conduct outreach to support adoption of forage quality improvement through fertilizer and no-till forage seeding.

## **Outputs**

### **Overview of Work Completed and in Progress:**

Objective #1: Evaluate impact of organic fertilizer and no-till seeding on forage quantity, quality and species composition.

- Three on-farm trials were established in San Juan County. First year of data collection was completed. Data analysis is in progress.

Objective #2 Identify optimum legume species and planting time for no-till seeding in established sod.

- Two on-farm trials were established in fall 2020 to evaluate 5 legume species, one in San Juan County and one in Pierce County. Additionally, 7 on-farm demonstrations were planted in San Juan County and one tilled demonstration plot was planted in Pierce County.
- Spring planted no-till legume trials are planned for 2021 in Pierce and San Juan counties. This spring planting was delayed one-year due to COVID-19 suspension of new research activities in spring of 2020.

Objective #3: Conduct outreach to support adoption of forage quality improvement through fertilizer and no-till forage seeding.

- One webinar was conducted in June 2020.
- Planning is underway for grower listening sessions in February and March 2021, as well as no-till drill training in spring of 2021 with SJICD and Pierce CD. Additional on-line, or in-person events are anticipated in summer and fall of 2021.
- In-person outreach was suspended in 2020 due to COVID-19 restrictions.

## Methods

*Objective #1: Evaluate impact of organic fertilizer and no-till seeding on forage quantity, quality and species composition.*

*Field Trials:* Three on-farm trials (Coffelt, Beaverton, Dill) were established in San Juan County. At each site four plots (12 ft x 50 ft) were seeded in fall of 2019 with a mixture of perennial rye grass 'Crusader' and white clover 'Kakariki' using a no-till drill (Land Pride 606NT), adjacent to unplanted control plots. Coffelt and Beaverton locations were mowed prior to seeding, Dill had minimal vegetation so was not mowed. In spring 2020 seeded and control plots were split into five sub plots (12 ft x 10 ft) and amended with a base fertilizer and varying rates of nitrogen using bone meal (4-13-0), K+SOP (0-0-50) and feather meal (11-0-0). Design is split-plot complete block with four replicates of main plot level.

*Treatments:* Main plot treatments are: 1.) Seeded (perennial ryegrass at 30 lbs/acre and white clover at 6 lbs/acre); and 2.) Unseeded Control. Subplot treatments are: i.) Control (no fertilizer); ii. Base (32 lbs N/acre, 104 lbs P2O5/acre, 60 lbs K2O/acre); iii.) Base + 22 lbs N/acre; iv.) Base + 54 lbs N/acre; and v.) Base + 88 lbs N/acre. Base fertilizer rate was determined from soil tests taken fall 2019. Trial areas were cut for hay by farmer cooperators after forage data was collected.



Figure 1. Laying out plots and applying organic fertilizer at Dill Rd location, April 30, 2020 (credit: B. Brouwer).

**Data Collection and Analysis:** Forage quantity and quality was determined by harvesting, drying and weighing plant material in one randomly placed quadrat (0.5 m x 0.5 m) in each sub plot. Forage was cut at a height of 2 inches and wet weight was measured. Samples were sealed, refrigerated and shipped to Puyallup Research Extension Center where it will be oven dried and weighed to determine moisture content. Dry samples were milled and submitted to Soiltest Lab (Moses Lake, WA) to measure forage quality parameters by NIR. Species composition was determined at the time of forage sampling, by placing one quadrat in the center of each plot and estimating percent coverage of species present. In the fall, percentage cover of functional groups (grass, legume, other forbs and bare ground) was estimated in the center of each plot. Data analysis will be conducted using *R version 3.5.1*.



Figure 2. Species composition and percent cover determination at Coffelt trial plots. June 22, 2020 (credit: B. Brouwer).

**Objective #2 Identify optimum legume species and planting time for no-till seeding in established sod.**

**Field Trials:** On-farm trials will be conducted in Pierce and San Juan counties to evaluate spring and fall plantings of five legume species: alfalfa (*Medicago sativa*), hairy vetch (*Vicia villosa*), red clover

(*Trifolium pretense*), white clover (*Trifolium repens*), birds foot trefoil (*Lotus corniculatus*) and a no-seed control. Legume seed was inoculated with species appropriate Rhizobium spp.. The trial design is split-plot complete block with four replicates of main plot level. Main plot is legume species and sub plot is seeding time (spring or fall). Sub plots are 6 ft x 50 ft. Trial sites are established hay fields and will be harvest according to local practice after forage data collection.

*San Juan County:* Trial was located at SJC Land Bank Beaverton Marsh Preserve. The field was mowed to approximately 1" stubble height on 9/22/20. Planting was started on 9/29/20 (vetch, birdsfoot, and white clover) and completed 9/30/20 (alfalfa and red clover). Based on soil test collected 9/3/20 from each block, organic fertilizer was applied to reach target of 100 lbs P2O5/acre and 115 lbs K2O/acre using bone meal (4-13-0) and K+SOP (0-0-50).



Figure 3. Seeding legume trial at Beaverton Marsh Preserve 9/30/20 (credit: B. Brouwer).

*Pierce:* The field experiment was initiated on 9/29/2020 at a cooperating farmer's pasture in Puyallup, WA. The field was mowed with a flail mower as low as possible without disturbing soil (approximately 1 in). Treatments were planted with a no-till drill (Land Pride 606NT).

In addition to the replicated no-till experiment a tilled demonstration plot was installed adjacent to the no-till experiment. The plot was 30 X 20 ft and plants were seeded at the same rate as the no-till trial

Soils were sampled by taking one sample across the no-till field and a separate sample across the full-till plot. Fertilizer application is planned for spring 2021.

*Data Collection and Analysis:* Visual observation in fall of 2020 indicated that determining stand establishment would not be possible, due to limited growth of new seedings. Spring forage quantity, quality and species composition will be determined as described above under Objective #1 methods.

Table 1. No-till pasture legume trial species, variety, germination, target and actual seeding rates for Pierce and San Juan County.

Plant	Species	Variety	Germ	Target Seeding Rate (lbs/acre)	Target (correct for germ) lbs/acre	Actual San Juan (lbs/acre)	Actual Pierce (lbs/acre)
Hairy Vetch	Vicia villosa	Namoi	0.92	30	33	33	47
Alfalfa	Medicago sativa	Magnum 7	0.85	15	18	18	18
Red Clover	Trifolium pratense	Emarwan	0.85	12	14	14	17
White Clover	Trifolium repens	Haifa	0.85	5	6	6	8
Birds Foot Trefoil	Lotus corniculatus	VNS	0.31	8	26	20	32

**Results**

Analysis of forage yield, forage quality and species composition data are under way for Objective #1. Preliminary results based on biomass wet weight indicate a possible response to fertilizer treatment (Figure 4). Data collection for Objective #2 will begin in spring of 2021.

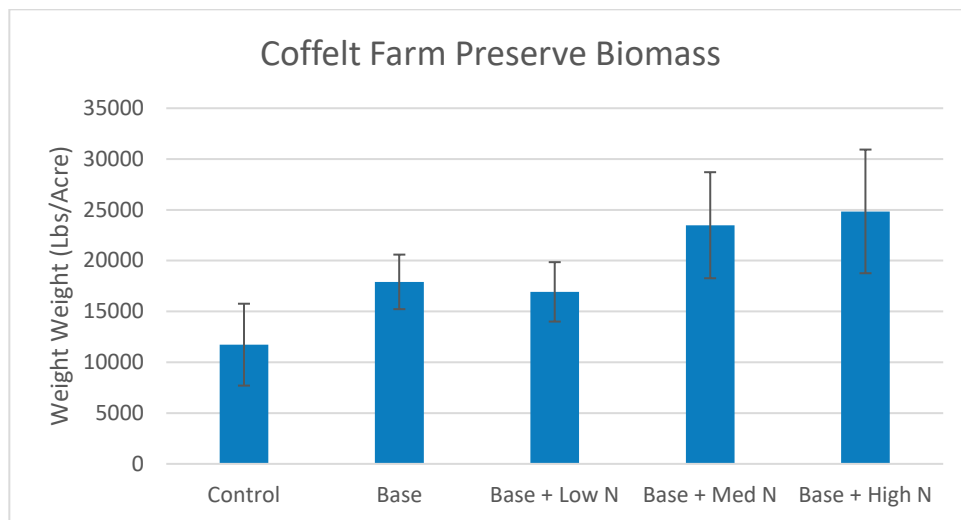


Figure 4. Forage biomass weight wet (lbs/acre) at Coffelt Farm harvested 6/22/20.

**Publications, Handouts, Other Text & Web Products:**

No Publications have been completed at this time.

**Outreach & Education Activities:**

- Brouwer, B., A. Greene, S. Pope, B. Gregory, and A. Borner. June 29 2020. Field Webinar Walk: Improving forage quality and quantity. WSU San Juan County. Online. 25 participants. This presentation included sharing of photos and experiences by farmer cooperators, as well as examples from SJICD and custom no-till drill operator Natural Plant Solutions to encourage grower to grower information exchange in an online setting.
- As an additional outreach activity, 7 farms cooperating with SJICD on an existing no-till program were engaged to host demonstration plantings on their farms. At each site strips of 5 legume species were planted in fall of 2020. This will provide opportunity for additional direct connection with producers, as well as observation of seeding performance with a wide range of fall planting dates, soil types and management, which can help inform future research efforts.

**Impacts****Short-Term:**

In follow up to June 29<sup>th</sup> webinar, evaluation respondents (10/25 participants) all indicated their knowledge had increased in areas of impact of fertilizer on forage quality and quantity, pasture aeration, no-till seeding into established fields, as well as measuring forage and soil quality. Additionally, 100% of participants were extremely or somewhat likely to implement changes in forage and soil testing, 90% would change fertilize and amendment practices, 80% would change no-till drill practices, and 30% would change pasture aeration practices. Evaluation respondents managed over 500 acres and over 675 livestock. Based on WSDA mapping there are approximately 9,000 acres of forage and pasture land in San Juan County so this outreach event reached approximately 5% of managed acres in San Juan County.

**Intermediate-Term:**

TBD

**Long-Term:**

TBD

**Additional funding applied for/secured:**

Project has leveraged Department of Ecology funding provided to SJICD to enable additional planting of demonstration strips on 7 cooperating farms.

**Graduate students funded:**

None.

**Recommendations for future research:**

Recommendations for future research will be considered after completion of data analysis.