

# San Juan County Forage Research

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**Field Webinar Walk**

**June 29, 2020**



**San Juan County**

WASHINGTON STATE UNIVERSITY  
EXTENSION

San Juan County, WA, USA  
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**Legend**

2019WSDACropDistributionMapService

- Berry
- Cereal Grain
- Commercial Tree
- Developed
- Flower Bulb
- Green Manure
- Hay/Silage
- Herb
- Melon
- Nursery
- Oilseed
- Orchard
- Other
- Pasture
- Seed
- Shellfish
- Turfgrass
- Vegetable
- Vineyard

2019WSDAOrganicMapService  
WSDAOrganic\_2019  
+

San Juan County  
 ~15,000 acres farmed  
 ~5,000 acres pasture  
 ~4,000 acres hay







August 20, 2019

# Outline

- Beaverton Preserve Fertilizer Trials
  - Lime + Fertilizer
  - High Fertilizer
- Oak Knoll Aeration and Overseeding
- No-Till + Fertilizer Trial
  - Dill Rd
  - Coffelt Farm
  - Beaverton Preserve
- SJICD No-Till Program
- Natural Plant Solutions No-Till Seeding
  - What is working and what isn't?



# Beaverton Preserve Fertilizer and Lime

- Established Fall 2016
- November 2016 applied Calpril Lime (**500 lbs Lime per acre**)
- May 2017 organic fertilizer (**40 lbs N, 130 lbs P, 165 lbs K per acre**)
- Forage Biomass and Quality Summer 2017, 2018, 2019

# Beaverton Preserve Fertilizer and Lime

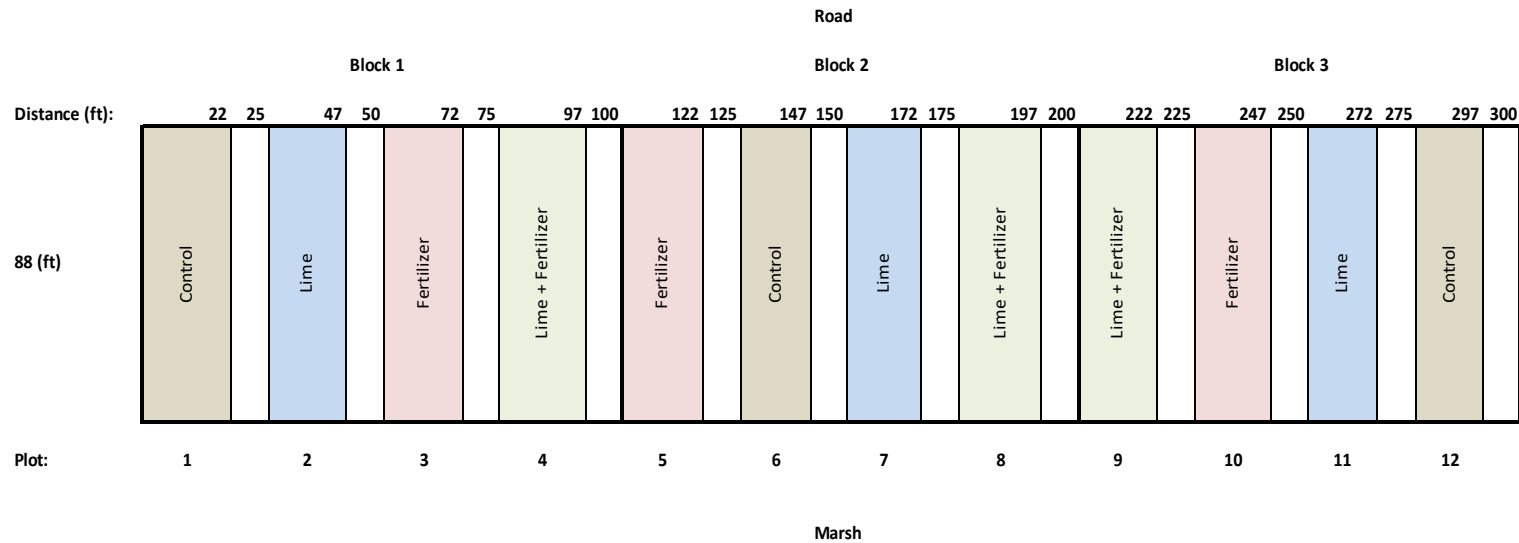


October 10, 2019



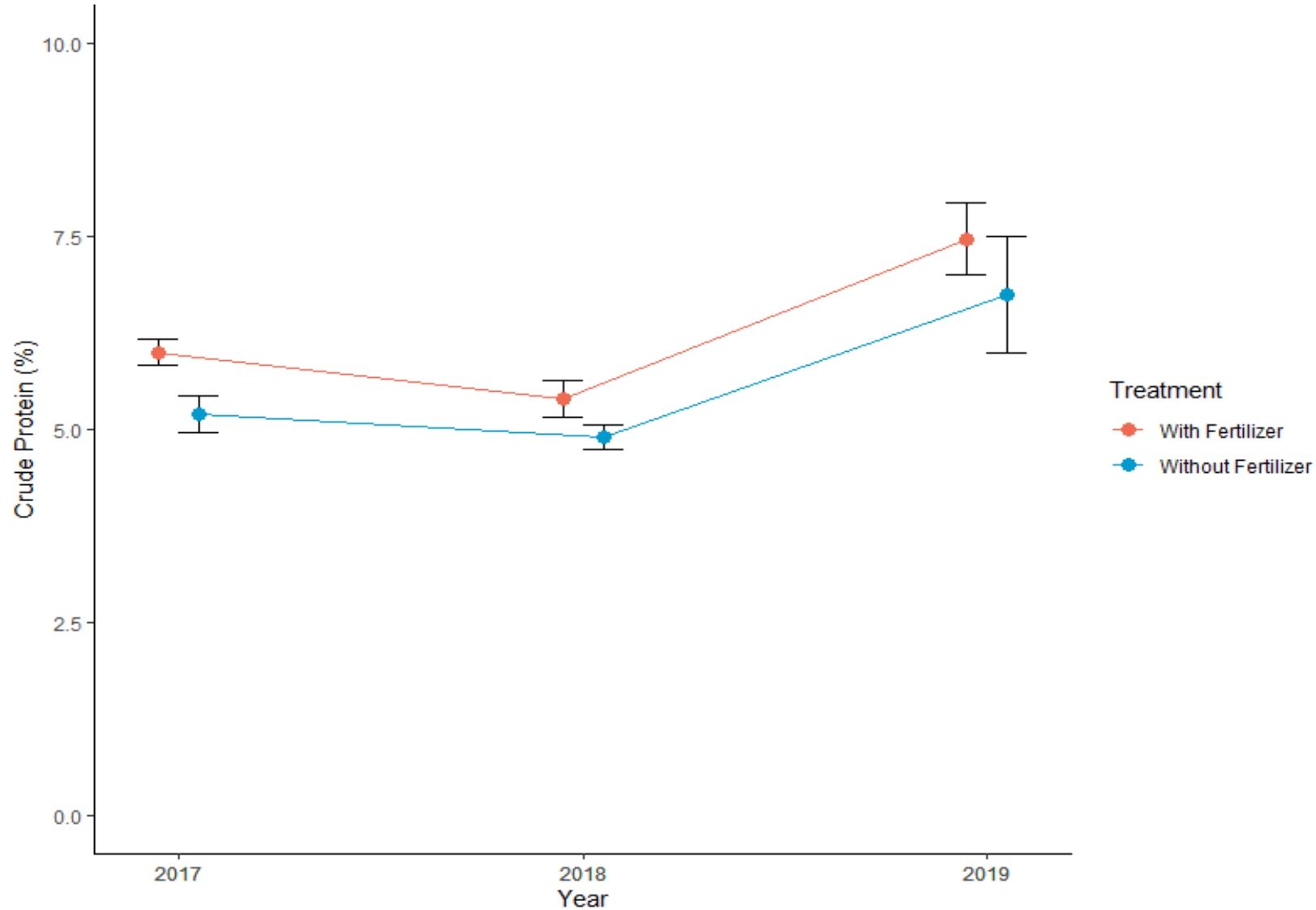
# Beaverton Fertilizer + Lime Plot Map

Beaverton Marsh Preserve



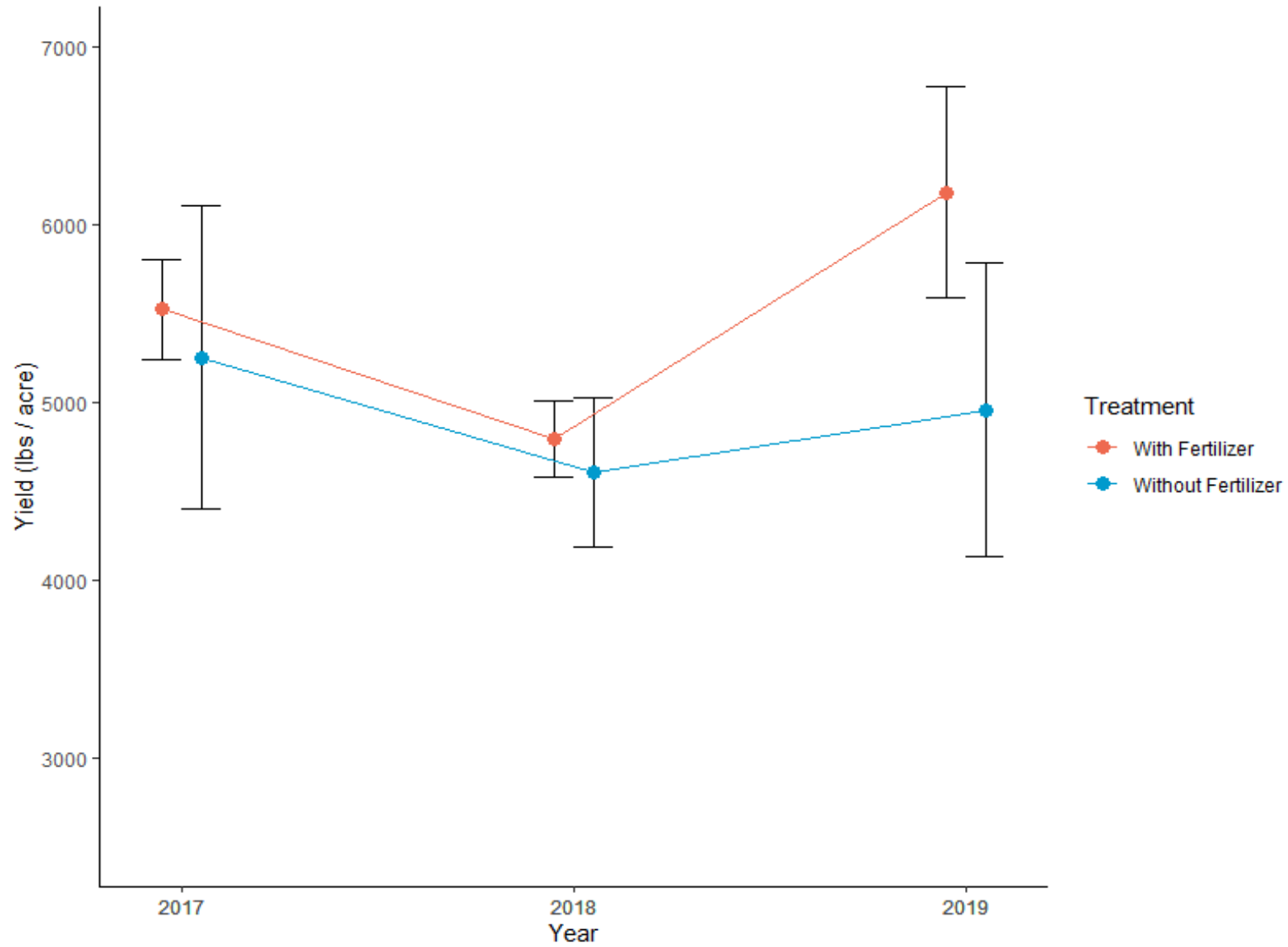
11/11/16 Applied Lime  
 5/10/17 Applied organic fertilizer 40 lbs N,  
 130 lbs P, 165 lbs K per acre  
 7/14/17 Sampled forage yield and quality  
 7/15/17 Hayed  
 9/26/17 Sampled soil  
 7/3/18 Sampled forage yield and quality  
 July 2018 Hayed  
 6/20/19 Sampled forage yield and quality  
 6/21/19 Hayed

Forage Protein Response to a Single Application of Fertilizer Over Three Years



- Significantly higher forage protein in 2017, 2018 not 2019.

Forage Yield Response to a Single Application of Fertilizer Over Three Years

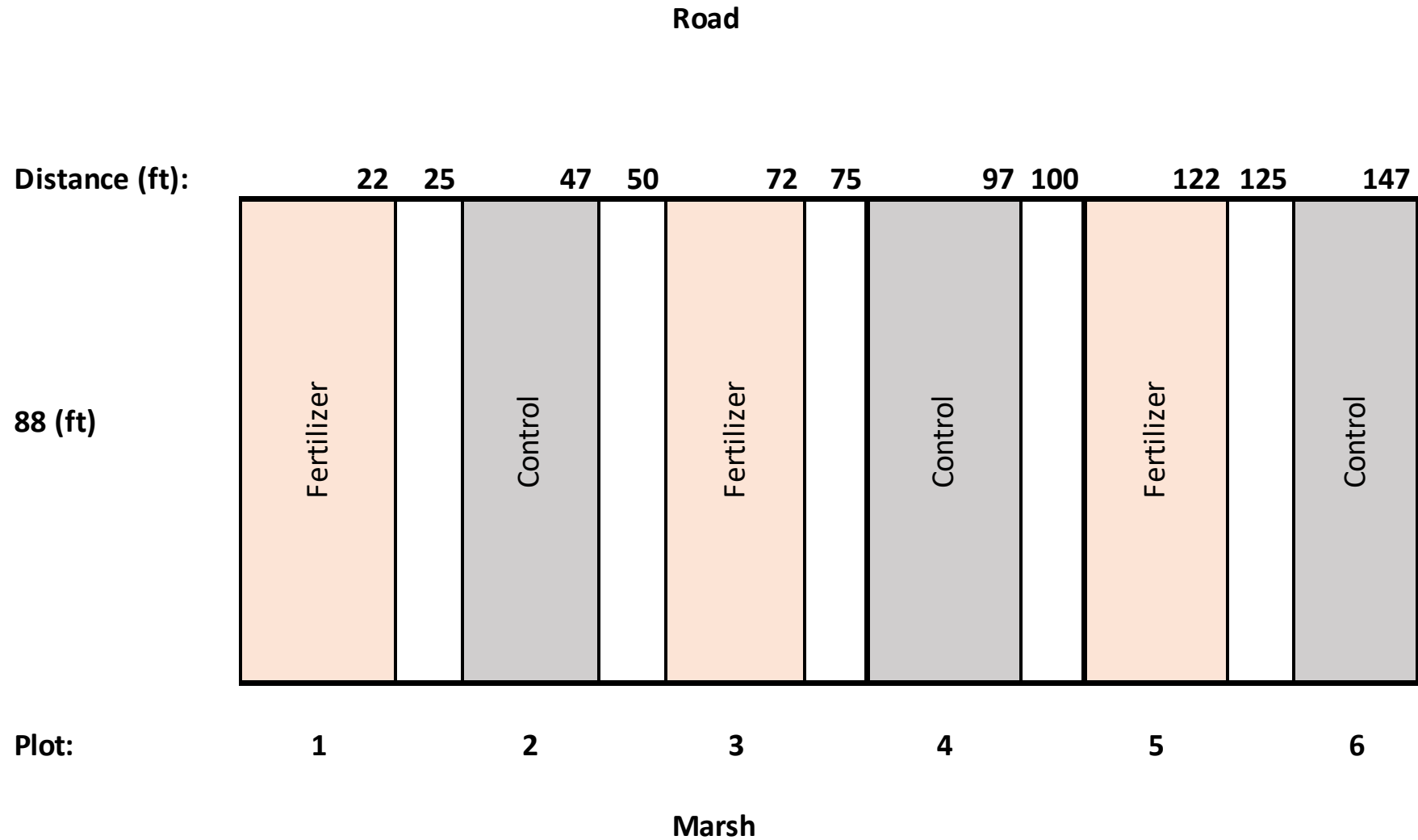


- No significant difference in yield
- Variation in underlying soil conditions

# Beaverton Preserve High Fertilizer Trial

- Established Spring 2018
- May 2018 applied organic fertilizer
  - **117 lbs N, 130 lbs P, 330 lbs K**
- Forage Biomass and Quality Summer 2018, 2019, 2020

# Beaverton High Fertilizer Trial Plot Map



Control

Fertilized

June 20, 2019



Control

Fertilized



June 19 2020

# Control Plot 2020

June 19 2020





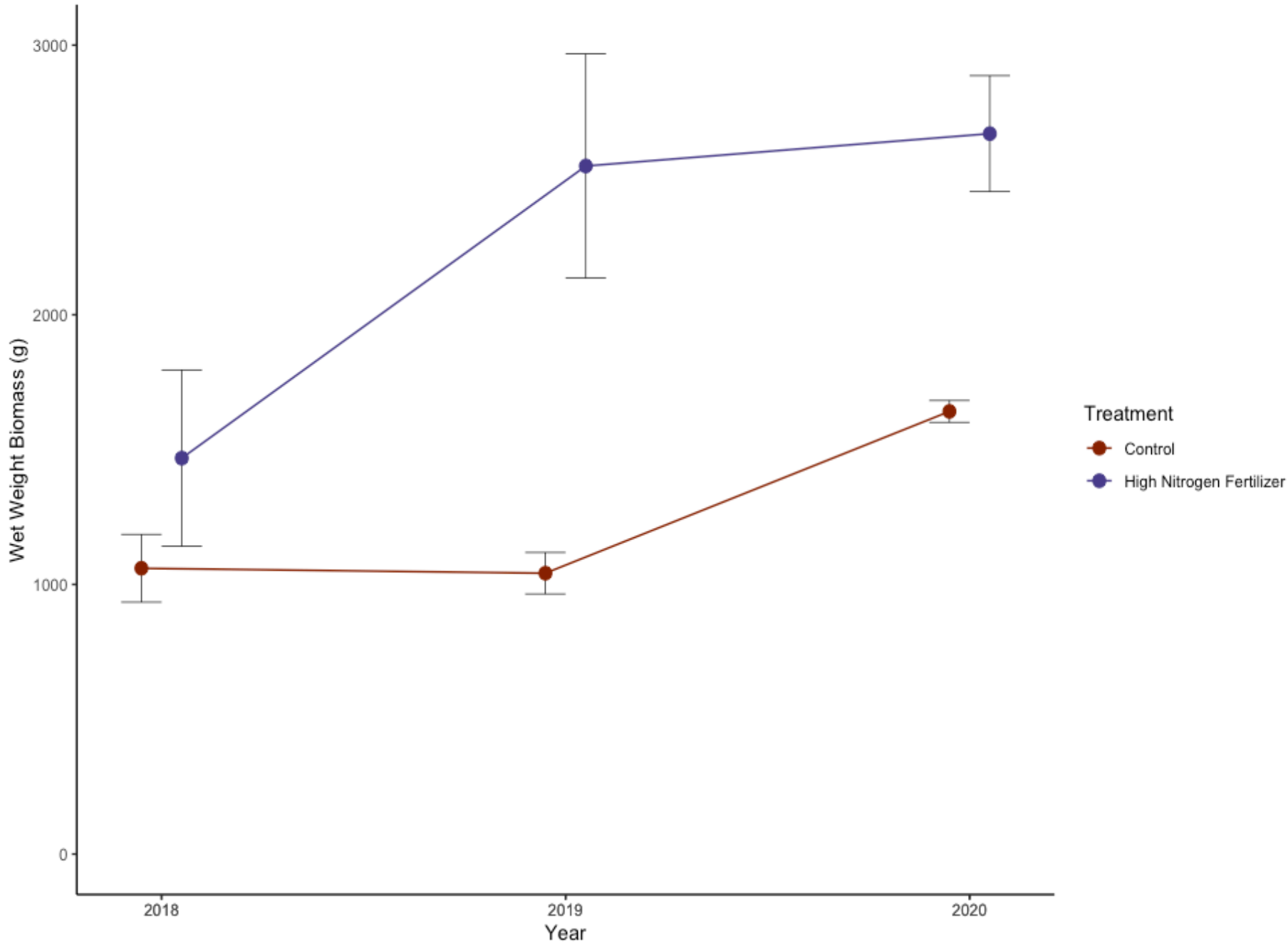
# Fertilized Plot 2020

Fertilizer applied spring 2018  
117 lbs N, 130 lbs P, 330 lbs K

June 19 2020



Beaverton Nitrogen Fertilizer Wet Weight Biomass 2018 - 2020



- 2019 dry weight increased 3,857 lbs/acre to 9,201 lbs/acre
- Significant higher yield in 2019 and 2020
- Significant higher forage protein in 2018 and 2019.
- Sample dates 7/3/18, 6/20/19, 6/19/20

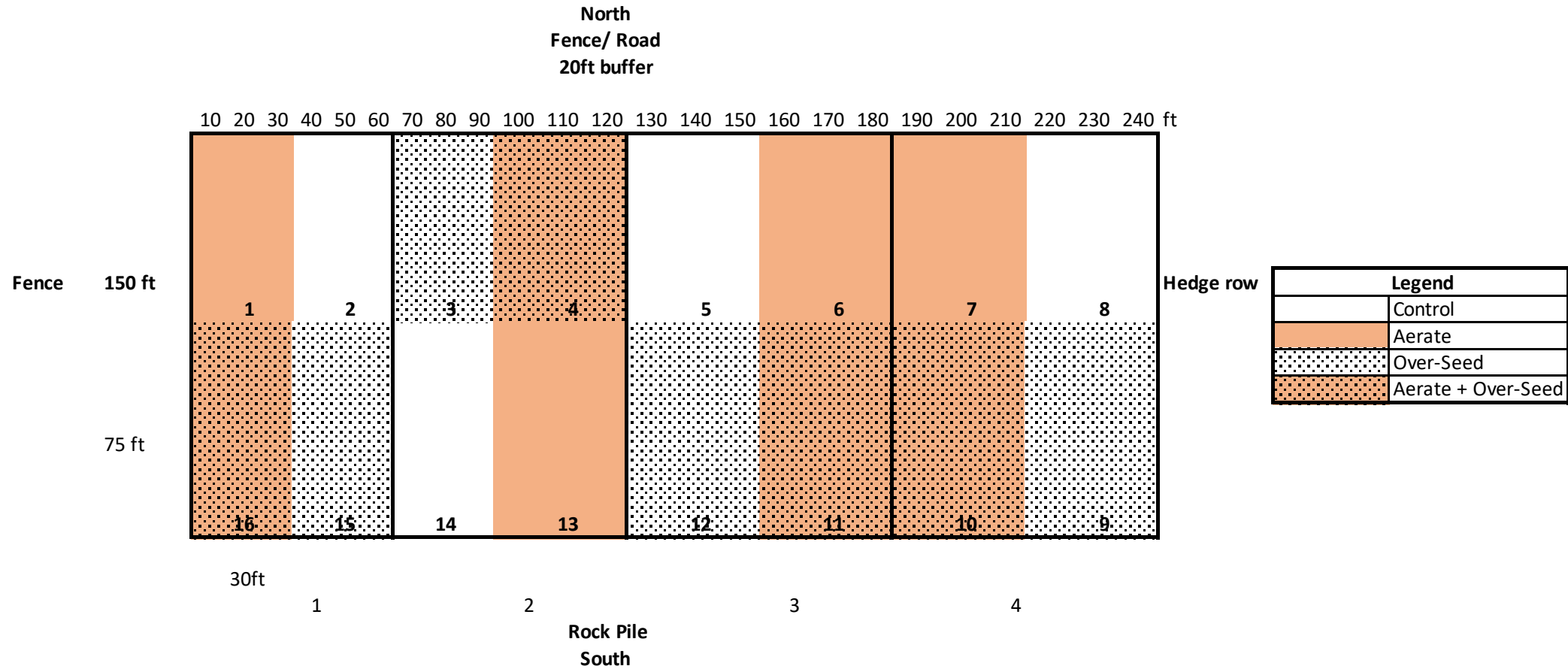


Sustainable Agriculture  
Research & Education

*Evaluating the impact of aeration and over-seeding on soil health, forage quality and forage quantity in perennial hay pastures in western Washington. USDA Western SARE Farmer/Rancher. Sarah Pope and Adam Greene*

# Oak Knoll Plot Map

## Oak Knoll Aeration and Over Seeding Study









July 13, 2018



Sep 11, 2018



Sep 11, 2018

June 16, 2020

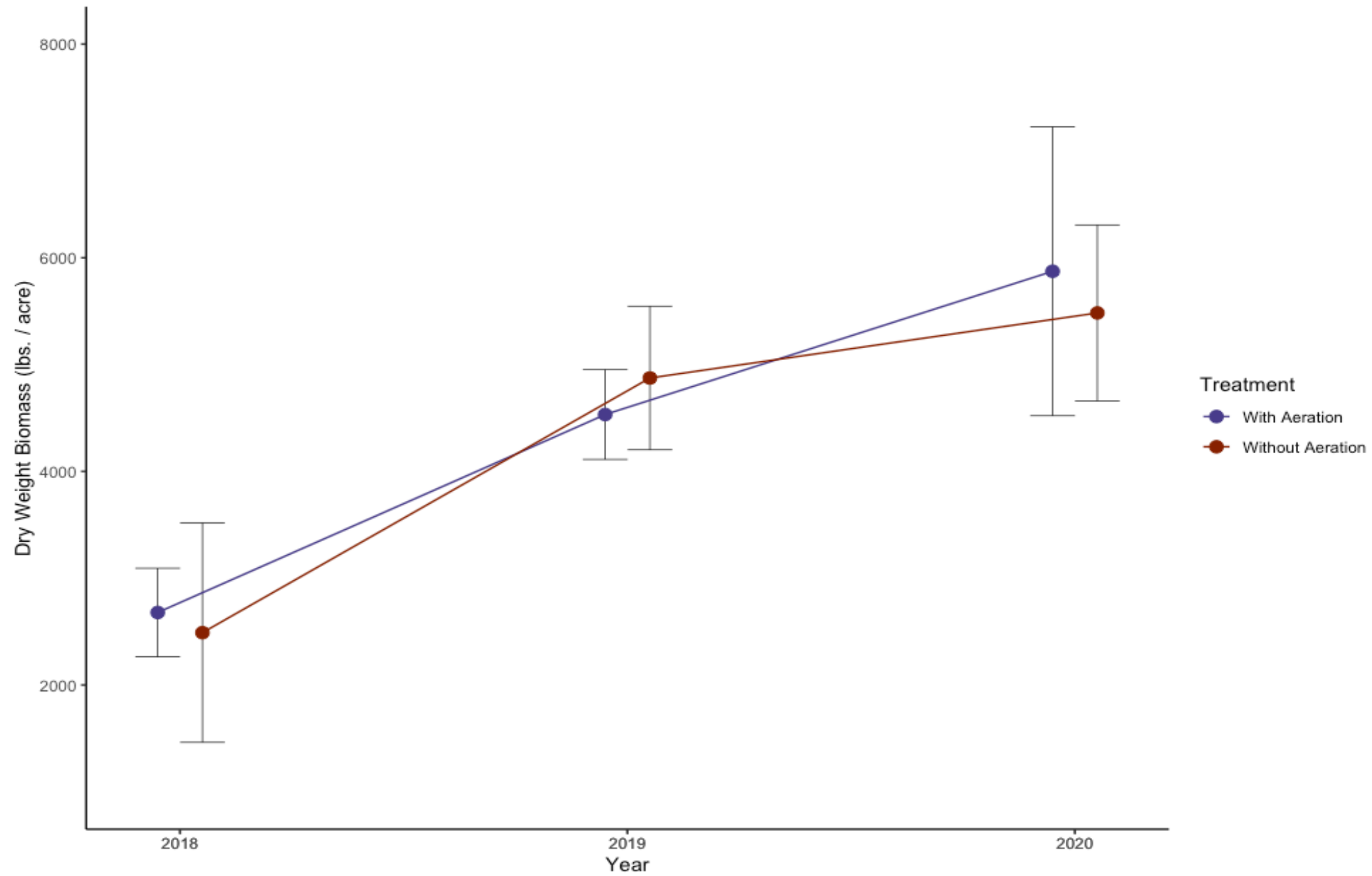




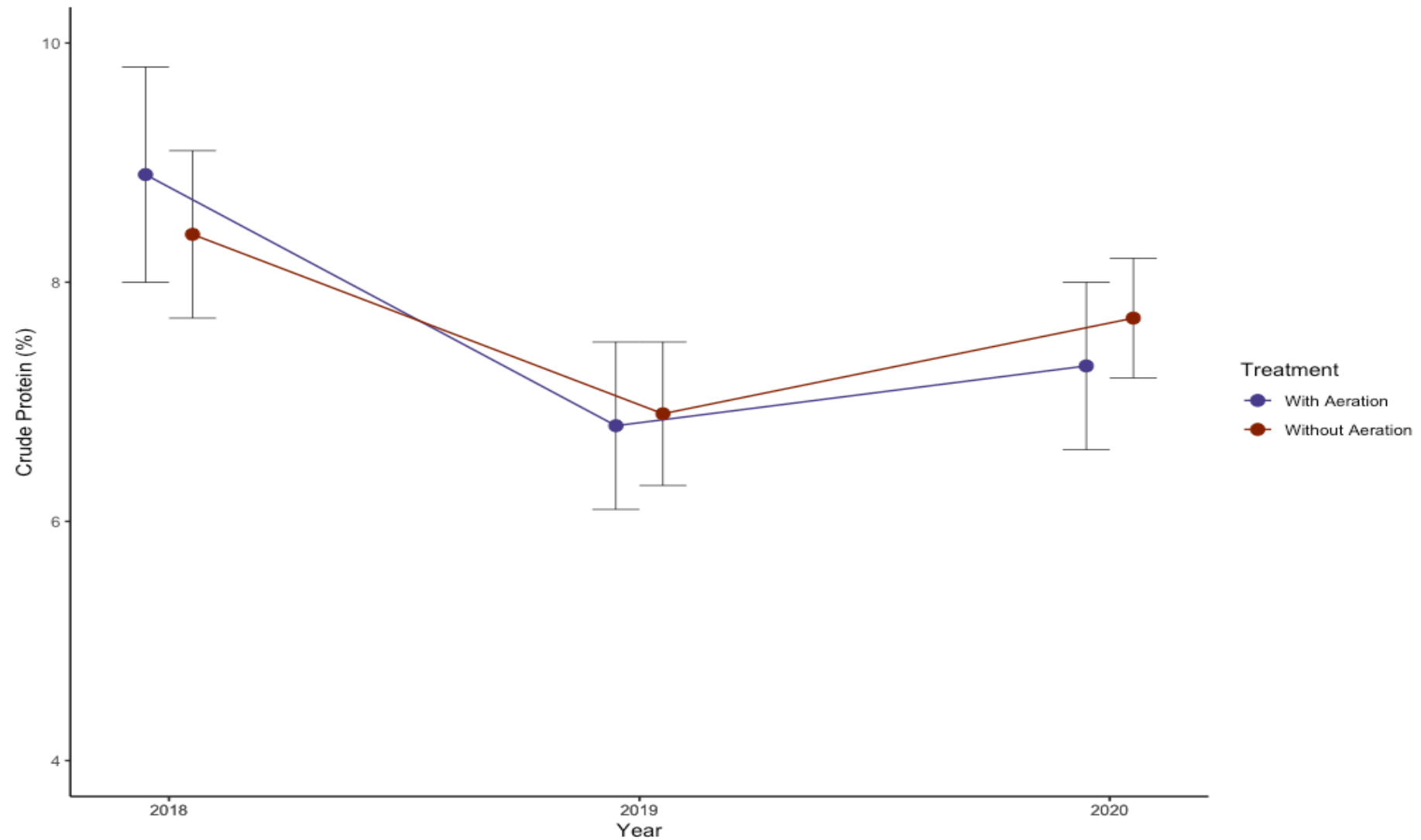
June 16, 2020



Oak Knoll Forage Dry Weight Biomass 2018 - 2020



## Oak Knoll Forage Protein 2018 - 2020



- Fall aeration and broadcast over-seeding with trefoil didn't significantly impact forage quality, quantity or soil quality parameters.
  - Infiltration rate was higher with seeding in 2018, may have been do to underlying soil conditions
- Plan to try summer aeration.

# No-Till Seeding + Fertilizer

- Three Locations
  - Beaverton Preserve
  - Coffelt Farm Preserve
  - Dill Rd.
- No-till Seed (Crusader italian ryegrass + Kakariki NZ white clover) fall 2019
- Organic Fertilizer Spring 2020 (Fish Bone Meal, K-SOP, Feather Meal)

	<b>Applied Nutrient lbs/acre</b>			<b>Organic Fertilizer</b>
<b>Treatment</b>	<b>N</b>	<b>P</b>	<b>K</b>	<b>\$/acre</b>
CONTROL	0	0	0	\$0
BASE	32	104	60	\$710
BASE+LOW N	54	104	60	\$873
BASE+MEDIUM N	76	104	60	\$1037
BASE+HIGH N	120	104	60	\$1365

Dill No-Till Drill Plot Layout

Total Area 50ft x 125ft

Main Plots (12 ft wide x 50ft long)

	Control
	Seed

Sub Plots (12ft x 10ft)

<b>Distance (ft):</b>	3	15	18	30	33	45	48	60	63	75	78	90	93	105	108	120	123
<b>50 ft</b>	1		6		11		16		21		26		31		36		
	2		7		12		17		22		27		32		37		
	3		8		13		18		23		28		33		38		
	4		9		14		19		24		29		34		39		
	5		10		15		20		25		30		35		40		

Block 1

Block 2

Block 3

Block 4

Dill Nov 15, 2019





Feb 12, 2020





April 30, 2020



Dill Rd. April 30, 2020



Dill Rd. May 22, 2020



Dill Rd. May 11, 2002



Dill Rd. June 11, 2020



Dill Rd. June 11, 2020



Dill Rd. June 11, 2020



Coffelt September 26, 2019





Coffelt Oct 17, 2019



Coffelt May 1, 2002



Coffelt June 4, 2020



Coffelt June 22, 2020



Coffelt June 22, 2020



Beaverton October 22 2019



Beaverton April 23, 2020

Clipboard with a white sheet of paper containing a data table and other text.

DATE	TIME	TEMP	WIND	MOIST	RAIN	WIND DIR	WIND SPC	WIND SFC	WIND HGT	WIND DIR	WIND SPC	WIND SFC	WIND HGT
4/23/20	08:00	55	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	09:00	58	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	10:00	60	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	11:00	62	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	12:00	65	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	13:00	68	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	14:00	70	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	15:00	72	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	16:00	75	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	17:00	78	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	18:00	80	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	19:00	82	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	20:00	85	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	21:00	88	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	22:00	90	10	85	0.0	100	10	10	10	100	10	10	10
4/23/20	23:00	92	10	85	0.0	100	10	10	10	100	10	10	10



Beaverton April 28, 2020



Beaverton April 28, 2020





Beaverton June 19, 2020

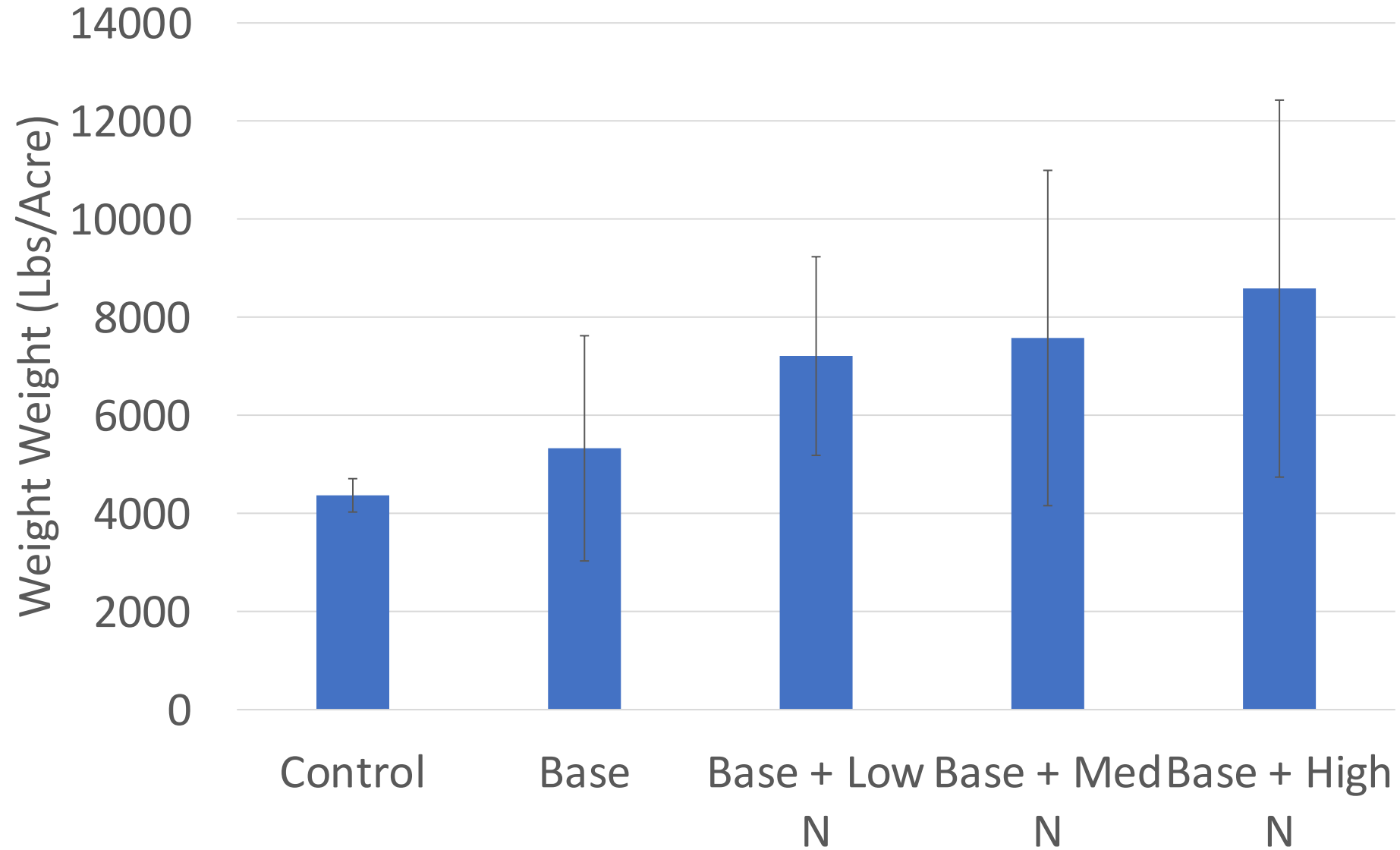


Beaverton June 19, 2020

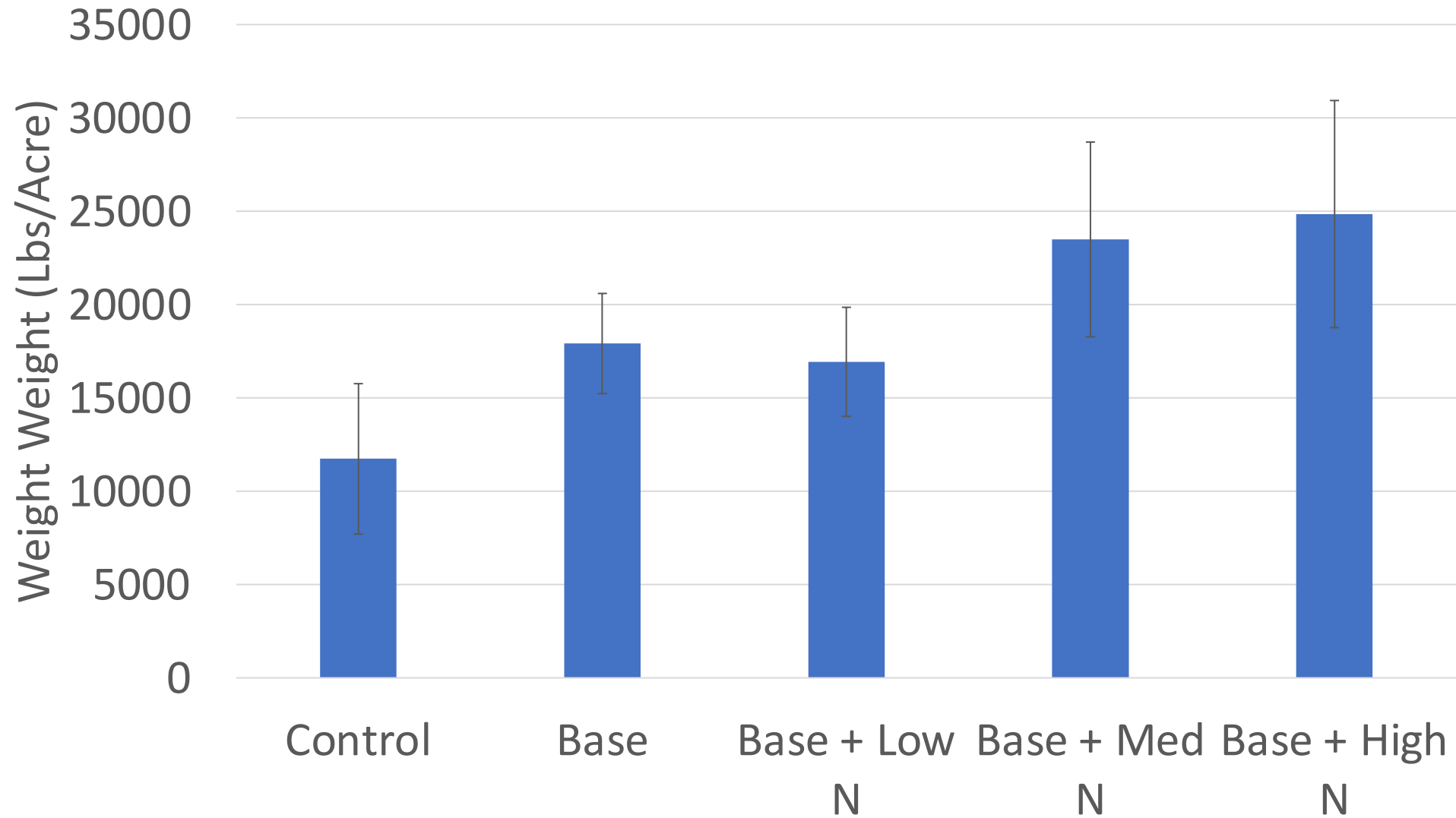
# Beaverton No-till + Fertilizer



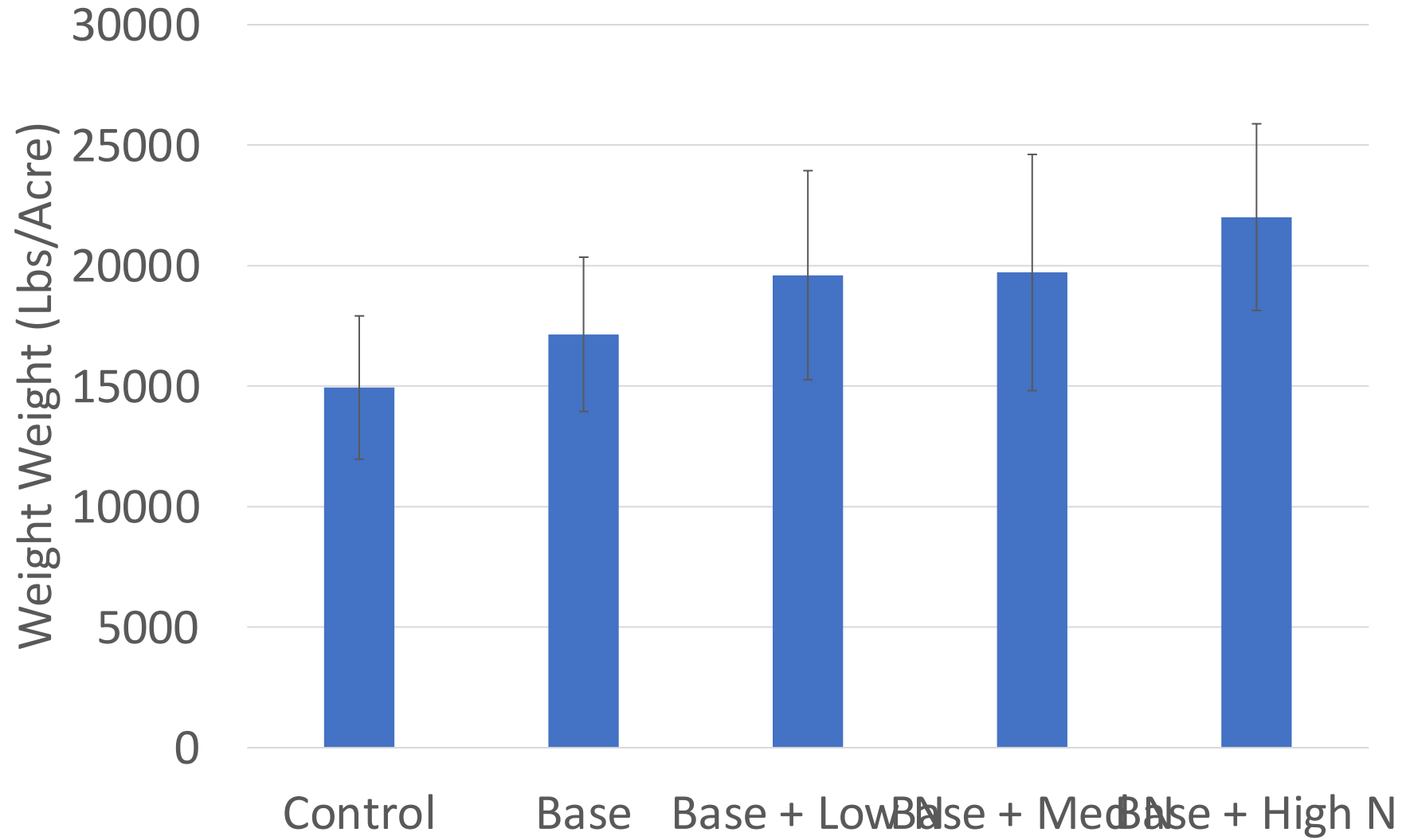
# Dill Rd Biomass Wet Weight



# Coffelt Farm Preserve Biomass



# Beaverton Preserve Biomass



# Resources

- The Western Oregon and Washington Pasture Calendar :  
<https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw699.pdf>
- HAYMAKING ON THE WESTSIDE :  
[https://smallfarms.oregonstate.edu/sites/agscid7/files/haymakingwestside\\_wsueb1897.pdf](https://smallfarms.oregonstate.edu/sites/agscid7/files/haymakingwestside_wsueb1897.pdf)
- Nutrient Management for Pastures: Western Oregon and Western Washington:  
<https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em9224.pdf>
- PASTURE AND HAYLAND RENOVATION FOR WESTERN WASHINGTON AND OREGON:
- <http://pubs.cahnrs.wsu.edu/publications/wp-content/uploads/sites/2/publications/eb1870.pdf>
- WSU SJC Ag Research Reports: <https://extension.wsu.edu/sanjuan/ag-research-reports/>
-



# Acknowledgements

- Funding
  - Western SARE Farmer Rancher
  - WSU CSANR BIOAg
  - San Juan County
- Trial Cooperators and Partners:
  - SJC Land Bank
  - Oak Knoll
  - Mike Sundstrom
  - Lum Farms
  - Travis Arnott
  - SJICD
  - Natural Plant Solutions
- WSU SJC Ag Program past and present
  - Walton Andrews
  - Kate Mikulak
  - Angie Shephard
  - Emma Carter



# Extra Charts

## Summary

### Before planting

Lime	When soil pH is below 5.5, broadcast lime according to Table 2. See page 4.
Nitrogen (N)	Broadcast or band 20 to 25 lb N/acre. See page 5.
Phosphorus (P)	When soil test P is below 30 ppm, broadcast or band P according to Table 4. See page 10.
Potassium (K)	When soil test K is below 200 ppm, broadcast K according to Table 5. Banding K is permitted at less than 60 lb K <sub>2</sub> O/acre. See page 10.
Sulfur (S)	Sulfate-S may be broadcast or band applied to new fields at a rate of 15 to 25 lb S/acre. See page 10.
Magnesium (Mg)	When soil test Mg is below 0.8 meq/100 g or 100 ppm, replace 1 ton lime/acre of the lime requirement with 1 ton dolomite/acre. See page 5.
Calcium (Ca)	When soil test Ca is below 5 meq/100 g or 1,000 ppm, apply 1 ton lime/acre. See page 4.
Boron (B)	For clover pastures, 2 to 3 lb B/acre is recommended when soil test B is below 0.7 ppm. Use a broadcast application; do not band B. See page 11.

### Established stands

Lime	For stand age under 5 years, top-dress lime if pH in the top 6 to 8 inches is below 5.5. For stand age over 5 years, top-dress lime if pH in the top 2 inches is below 5.5. Follow Table 2, page 4.
Nitrogen (N)	Top-dress N when grass is actively growing in early spring and early fall. On irrigated pastures, apply additional N in the summer. See Table 3, Figure 4, and pages 6–9.
Phosphorus (P)	When soil test P is below 30 ppm, top-dress P in either the fall or spring. See Table 4 and page 10.
Potassium (K)	When soil test K is below 200 ppm, top-dress K in either the fall or spring. See Table 5 and page 10.
Sulfur (S)	Top-dress sulfate-S in the spring or fall at a rate of 20 to 30 lb S/acre every year or 40 to 50 lb S/acre every other year. See page 10.
Magnesium (Mg)	When soil test Mg is below 0.8 meq/100 g or 100 ppm, apply either 1 ton dolomite/acre (if pH < 5.5) or 500 lb K-Mag/acre (if pH > 5.5). See page 5.
Calcium (Ca)	When soil test Ca is below 5.0 meq/100 g or 1,000 ppm, apply 1 ton lime/acre. See page 4.
Boron (B)	For clover pastures, broadcast application of 2 to 3 lb B/acre is recommended when soil test B is below 0.7 ppm. See page 11.
Selenium (Se)	Refer to <i>Selenium Supplementation Strategies for Livestock in Oregon</i> (EM 9094) to determine whether you should consider correcting Se deficiencies in grazing animals via fertilizer applications. See page 11.
Molybdenum (Mo)	For clover pastures, Mo deficiencies can be corrected by following lime recommendations in this guide. See page 11.

# Trial 1: 2017 forage yield and quality with and without fertilizer

	No Fertilizer ± SD	With Fertilizer ± SD	P-Value
Total Dry Weight (lbs/acre)	5255 ± 2086	5524 ± 690	0.694
Crude Protein (%)	5.2 ± 0.6	6.0 ± 0.4	0.022*
Acid Detergent Fiber (% ADF)	40 ± 1	38 ± 1	0.013*
Neutral Detergent Fiber (% NDF)	63.3 ± 0.8	61.2 ± 1.9	0.011*
Relative Feed Value (RFV)	85 ± 2	90 ± 4	0.006**

\*p≤0.05, \*\*p ≤ 0.01, \*\*\*p≤0.001, one-way ANOVA

# Trial 1: 2018 forage yield and quality with and without fertilizer

	No Fertilizer ± SD	With Fertilizer ± SD	P-Value
Total Dry Weight (lbs/acre)	4606 ± 1033	4793 ± 523	0.614
Crude Protein (%)	4.9 ± 0.4	5.4 ± 0.6	0.009**
Acid Detergent Fiber (% ADF)	37 ± 2	37 ± 1	0.731
Neutral Detergent Fiber (% NDF)	59.9 ± 2.1	59.5 ± 1.2	0.656
Relative Feed Value (RFV)	93 ± 5	94 ± 2	0.643

Also found better NDF and RFV in lime plots in 2018

\*p≤0.05, \*\*p ≤ 0.01, \*\*\*p≤0.001, one-way ANOVA

# Trial 1: 2019 forage yield and quality with and without fertilizer

	No Fertilizer ± SD	With Fertilizer ± SD	P-Value
Total Dry Weight (lbs/acre)	4958 ± 2030	6182 ± 1453	0.1944
Crude Protein (%)	6.75 ± 1.84	7.47 ± 1.13	0.422
Acid Detergent Fiber (% ADF)	35.48 ± 1.82	35.21 ± 0.64	N/A
Neutral Detergent Fiber (% NDF)	57.02 ± 2.46	56.4 ± 1.21	0.652
Relative Feed Value (RFV)	100.2 ± 6.65	101.33 ± 3.08	0.748

\*p≤0.05, \*\*p ≤ 0.01, \*\*\*p≤0.001, one-way ANOVA

# Trial 2: 2018 forage yield and quality with and without fertilizer

	No Fertilizer ± SD	With Fertilizer ± SD	P-Value
Total Dry Weight (lbs/acre)	3,806 ± 107	4,663 ± 928	0.219
Crude Protein (%)	5 ± 0.36	7.77 ± 0.70	0.013 *
Acid Detergent Fiber (% ADF)	36.73 ± 0.55	34.37 ± 1.29	0.106
Neutral Detergent Fiber (% NDF)	59.47 ± 1.5	57.33 ± 1.32	0.277
Relative Feed Value (RFV)	94.67 ± 3.06	101 ± 3.61	0.193

# Trial 2: 2019 forage yield and quality with and without fertilizer

	No Fertilizer ± SD	With Fertilizer ± SD	P-Value
Total Dry Weight (lbs/acre)	3857 ± 116	9201 ± 1438	0.00935 **
Crude Protein (%)	5.8 ± 0	6.67 ± 0.40	0.0268 *
Acid Detergent Fiber (% ADF)	34.0 ± 0.6	36.0 ± 1.2	0.0955
Neutral Detergent Fiber (% NDF)	55.5 ± 1.0	59.6 ± 1	0.0208 *
Relative Feed Value (RFV)	104.3 ± 2.52	95 ± 1.73	0.0181 *



## 2018 Aeration Trial Results

Observation	No aeration	With aeration	p <sup>1</sup>
Forage quality			
Crude protein, %	8.4 ± 0.7	8.9 ± 0.9	0.240
Relative feed value	109 ± 6	108 ± 8	0.798
Soil characteristics			
Infiltration T2, seconds	118 ± 31	101 ± 39	0.218
Soil organic matter, %	5.8 ± 1.9	6.7 ± 1.4	0.316

<sup>1</sup>The probability value associated with the treatment in the analysis of variance. For observations where a significant treatment effect ( $p \leq 0.05$ ) was indicated, values are highlighted in bold.

# 2019 aeration results

Observation	No aeration	With aeration	p <sup>1</sup>
Yield (lbs/acre)	4874 ± 672	4532 ± 420	0.258
<b>Forage quality</b>			
Crude protein, % Without over-seeding	7.0 ± 0.7	7.6 ± 0.9	0.209
With over-seeding	6.9 ± 0.5	6.3 ± 0.3	0.098
Relative feed value	109 ± 4	111 ± 8	0.472
<b>Soil characteristics</b>			
Infiltration T2, seconds	74 ± 39	64 ± 32	0.622
Penetration, depth (cm)	29 ± 3	27 ± 3	0.216
Soil organic matter, %	5.5 ± 1.2	6.1 ± 1.2	0.338

Forage Yield Response to Single Nitrogen Fertilizer Application For Two Years

