Scott Valley Perennial Grass Deficit Irrigation Trial

The goal of this project is to identify the most productive and persistent perennial grass species and varieties under (mostly) dryland conditions in Scott and Shasta Valleys. We aim to provide valley-specific information to farmers and ranchers who are adapting to limited and uncertain irrigation water availability (i.e., due to drought, curtailment orders, and dam removal). Adaptive management, based on available resources and current conditions, is a key component of this trial. As most recent variety trials in Siskiyou County have been conducted at the Intermountain Research and Extension Center in Tulelake, this project will inform future research in Scott and Shasta Valleys. This trial is a collaboration between UCCE Siskiyou, UC Davis, and local farmers who volunteered their time and resources to support this research.

Data to be collected:

- Establishment: how many plants within each species germinate
- Yield: total biomass at peak production
- Persistence: survival of individual plants over several years (at least 3)

MANAGEMENT:

Overview:

- Site selection:
  - Grenada (Shasta Valley site): dryland, no irrigation infrastructure available
  - Etna (Scott Valley site): partial irrigation available, land owner's Local Cooperative Solution (LCS) = 70% of crop demand
- Planting date: 9/26/22
- Size of plots: 5' x ~21' long (depending on seed quantity)
- Management regime: landowner makes management decisions with UCCE Siskiyou/UC Davis input
- Weed management: Site-specific treatment strategy.
- Harvest: first harvest completed in year 2 of trial (summer 2024) with small-plot harvester.

Grass selection:

We selected several summer perennial grass species in addition to standard, winter varieties of orchard grass and fescue. Siskiyou is too cold to for summer dormant varieties to be productive throughout winter (as they often are in the central valley). Instead, we aim to identify how productive these varieties are before they enter dormancy and how persistent they are under dryland management. Previous work has identified wheatgrass varieties as the most productive and persistent under dryland conditions; however, wheatgrass forage quality is relatively poor compared to other grass species. Therefore, we primarily examined the performance of orchard grass and fescue, both highly desirable for hay and grazing.

Seeding rate:

Species	PLS, lbs/acre
Orchardgrass – summer dormant	3
Tall Fescue – summer dormant	3-5
Orchardgrass	15
Tall Fescue	25
Tall Wheatgrass	20
Meadow Bromegrass	20

ESTABLISHEMENT YEAR, FALL 2022-23:

Irrigation regime:

- Grenada: dryland, no irrigation water applied.
- Etna: Irrigation water was applied during the establishment year, but not enough to meet crop demand as curtailment orders were in effect. The collaborating ranch was managed under a LCS and irrigation was approved through October as a roll-over of water not used in September. In addition, the trial received a research exemption. Germination was observed on Oct. 17 and irrigation ended on Oct. 21. The first rain of the 2023 water year occurred on 10/23/22 and, overall, the 2023 water year was well above average.

Irrigation water applied to Scott Valley trial			
Water Year	Date	Amount (inches)	Notes
2023	10/6/22	0.5	
	10/17-10/21/22	1.0	
	5/15-5/17/23	3.0	
	5/22-5/23/23	3.0	
	6/27-6/28/23	3.0	
	7/12-7/13/23	3.0	
	7/24-7/26/23	3.0	
	8/23-8/24/23	3.0	August rain events: 2 @ 2/10 in and 1 @ 1/10 in.
2024	No irrigation water applied		

Germination:

- Grenada: Very poor, if any, germination. <10 perennial grasses were observed in April 2023 (spring after planting) when weed competition started to overtake trial.
- Etna: Germination was first observed on 10/17/22. Grasses continued establishing well and entered dormancy in early November.

Weeds and spraying:

- Grenada: problematic weed competition beginning spring 2023, mainly mustard species. Herbicides (i.e., 2,4-D and Telar), were applied in the spring of 2023, successfully controlling burr buttercup. However, tansy mustard was only minimally suppressed and became problematic as the season progressed. Competition from foxtail species that germinated later, along with other factors, negatively impacted the grass stand.
- Etna: 2,4-D applied in April 2023 and successfully controlled mustard species.

Mowing: Etna Trial

- Goals: remove taller weeds and encourage root growth, particularly the growth of secondary roots, and remove seed heads to keep grasses in the vegetative growth stage.
- 5/6/23: First mowing (3-3.5 in stubble height)
- 5/27/23: Second and final mow in 2023 (a 3rd was anticipated, but scheduling prohibited). Trial over-wintered without being mowed.

SECOND YEAR, FALL 2023-24:

- Grenada Trial: failed. Minimal germination in 2023 coupled with overwhelming weed pressure that did not respond well to spraying. No additional germination in 2024.
- Etna Trial: Above average precipitation winter 2023-24, trial over-wintered without being mowed. By spring of 2024, trial was well established.
  - Management: Decided to manage the trial as dryland from year 2 (Oct 2023) on to prioritize examination of most persistent varieties.
  - Mowing: Mowed May 1, 2024 to clean up trial and remove tall weeds.
  - Harvest: June 11, 2024 by IREC, using carter harvester. Collected yield data on June 11, 2024. Minimal regrowth post-harvest.

RESULTS

Varieties TFSD-Chisholm, RC-Chiefton, and HG-Holdfast were less competitive against weeds and were therefore excluded from statistical analysis. There was no significant difference in dry matter percentage among the varieties, which ranged from 37% to 44% in the subsamples taken at harvest.

However, there were significant differences in dry matter yield among the varieties. Although most varieties did not differ statistically from each other, Profit, Quickdraw HSG, and Baridana—each an orchardgrass variety—were the lowest yielding, with dry matter yields ranging from 1.40 to 1.31 tons/ac (table X). In contrast, tall fescue varieties dominated the top five yields, with Jose, a wheatgrass, being the highest yielding variety in the first year at 3.09 tons/ac.

Although the top 18 varieties exhibited numerical differences, these differences were not statistically significant, likely due to the yield variability observed within each replication. A notable blocking effect was present, indicating that other factors in the experimental area influenced the overall yield results within each block. Abiotic factors such as soil water availability, irrigation uniformity, and soil fertility may have contributed to this variability.
The first-year yield data highlight that, despite their superior feed quality, orchardgrass species have shallower root systems compared to tall fescue and wheatgrass. This shallower root structure makes orchardgrass more vulnerable to drought stress, as it does not access the soil profile as effectively as the deeper-rooted tall fescue and wheatgrass.

The main objective of this trial is to assess how different perennial grass varieties and species perform during extreme drought stress. Although irrigation was highly restricted—limited to few irrigation events during the first year after planting—the optimal approach would have been to provide full irrigation during crop establishment. This would have allowed the plants to develop deeper root systems, enhancing their drought resistance in subsequent years. Nevertheless, given the uncertainty related to water availability in Siskiyou County, this trial aims to identify which grass varieties could be produced under conditions of severe irrigation water restrictions.

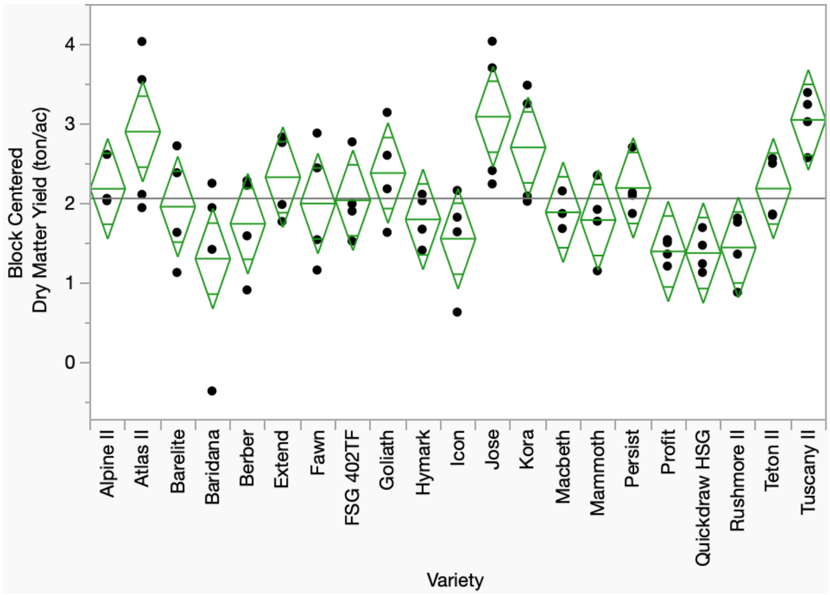

Fig. Y (above): 21 perennial grass varieties' dry matter yield. There were four replications distributed in a Randomized Complete Block Design.

Table X (below): Dry matter yield from one cutting in 2024. Levels not connected by same letter are significantly different.

Level				Mean
Jose	A			3.0950000
Tuscany II	A	B		3.0550000
Atlas II	A	B	C	2.9075000
Kora	A	B	C	2.7100000
Goliath	A	B	C	2.3875000
Extend	A	B	C	2.3350000
Persist	A	B	C	2.2000000
Teton II	A	B	C	2.1925000
Alpine II	A	B	C	2.1900000
FSG 402TF	A	B	C	2.0450000
Fawn	A	B	C	2.0050000
Barelite	A	B	C	1.9650000
Macbeth	A	B	C	1.8950000
Hymark	A	B	C	1.8050000
Mammoth	A	B	C	1.7975000
Berber	A	B	C	1.7500000
Icon	A	B	C	1.5625000
Rushmore II	A	B	C	1.4525000
Profit		B	C	1.4025000
Quickdraw HSG			C	1.3825000
Baridana			C	1.3125000

DISCUSSION

Spring vs fall planting

Spring planting can be successful if adequate irrigation water is available. Warmer temperatures during spring accelerate germination and support crop development, but insufficient water after planting can be particularly detrimental to perennial grasses. Conversely, fall planting often benefits from winter rainfall and lower evapotranspiration rates. It also promotes better root development compared to spring planting, which is crucial for enduring drought conditions later. Therefore, in situations with limited water resources, prioritizing irrigation for the year of crop establishment is essential.

Weed Control

Effective weed control should begin before planting, ideally in the previous fall. As cool-season weeds germinate with the first autumn rains, applying a post-emergent herbicide like glyphosate controls emerged weeds and gives the crop competitive advantage. To achieve optimal weed management, establishing a strong crop stand is essential. Once the crop is well-established, an integrated pest management (IPM) approach should be employed. This includes timely mowing, applying both pre-emergent and post-emergent herbicides, and implementing cultural controls, such as overseeding bare spots. Combining these methods will enhance crop growth and help reduce the weed seed bank in the soil. Effective weed management is particularly crucial in areas with limited irrigation, as weeds often adapt more readily to drought conditions than crops.

Hay production, stand longevity and water use efficiency

This trial showed a significant variation in dry matter yields, ranging from 3.1 tons per acre for Jose wheatgrass to 1.3 tons per acre for Baridana orchardgrass. After planting in October 2022, a total of 1.5 inches of irrigation water was applied, followed by 18 inches of irrigation in 2023, and complemented by 20 inches of precipitation during the same period. Overall, this amount of water was sufficient to establish a good stand of most plant species during the first year. Since this trial will be conducted under dryland conditions, cool-season precipitation will play a crucial role in determining both yields and the longevity of the species over the years. In situations with limited water availability, it's more effective to use it early in the season. Cool season perennial grasses tend to be more productive in the spring, and this approach also takes advantage of the winter moisture already present in the soil.

NEXT STEPS

We will continue to manage the trial under dryland conditions and will report persistence and yield data annually.

ACKNOWLEDGEMENTS

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