2024 Spring Research Update

Intermountain

Research and Extension Center

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Table of Contents

Page Number

Director Message......... 2

Drones' Activities Update at IREC......... 3-5

2024 Grass Forage Variety Trial Report......... 6-14

Latest Alfalfa Variety Yield Results......... 15-17

Changing Trends in northeast California Alfalfa Weed Management......... 18-23

2024 Small Grain Variety Trial Report......... 24-31

2024 Potato Variety Development Trial Results......... 32-33

Influence of Fungicides and Soil Moisture on Black Dot (Colletotrichum coccodes) Tuber Blemish 34-37

Season Pictures......... 38

Director Update

The big news in the Klamath Basin is our wild wet winter weather. I feel this winter will likely go down in the history books given the major swings in temperatures, precipitation, and heavy snow. Fortunately, the snowpack for Northern California and Southern Oregon is well above average and weather experts are predicting more precipitation in March! Wet winters like this are a convincing indicator that state and federal water agencies must place high priority on finding innovative ways to store excess water for groundwater recharge and flood control and not just focus on drought mitigation.

This research report contains several short summaries of research conducted at IREC in 2024. If you would like additional information on any project, do not hesitate to call, email, or stop by the office. The IREC staff deserve a big thank you for all their hard work completing this research over the last 12 months. None of the research would be possible without them.

Recent happening at IREC include remodeling our administrative building and getting research projects ready for the upcoming season. The IREC administrative building had a host of electrical, plumbing, and asbestos issues that needed attention, so we made the difficult decision to remodel. As a result, IREC staff offices are scattered around the research center for next few months. The easiest way to find someone is to call, email, or visit the conference building and follow signs for mail delivery.

I encourage anyone interested in staying up to date on IREC events, research, and crop reports to subscribe to the IREC Blog "Intermountain Insights". The web link to subscribe https://ucanr.us21.list-manage.com/subscribe?u=69671e3e426123ee27b6c4d09&id=1f88f0cf67

Sincerely,

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Drones' Activities Update at IREC

By Ahmed, Kayad (Ag. Engineer Advisor at IREC)

Drones have emerged as a powerful and promising tool in agriculture for over a decade. Since then, many drone applications have emerged and proved their reliability, while others are under research and development stages. The first applications of drone imagery in agriculture were to map field variability using vegetation indices like the Normalized Difference Vegetation Index (NDVI) to check crop health, detect disease symptoms, and assist in creating prescription maps to apply variable-rate N fertilizer. Drones can capture high-resolution images from fields, allowing growers to estimate crop health and see field variability. At the Intermountain Research and Extension Center (IREC), I'm testing several drone-based solutions to support growers' decisions as well as research field trials. This article touches on some of the advancements in drone applications in agriculture and IREC activities.

Figure 1: Capturing a drone image from a calibration panel at IREC.

Alfalfa yield mapping techniques:

Mapping alfalfa yield can help growers identify their field variability and improve management decisions. Growers can map alfalfa yield in three main ways: using a hay yield monitoring system located in balers (which costs about $6,000 per system), collecting ground yield samples by hand (which is hard to do and takes a lot of time), or estimating variability through satellite data (which needs a clear sky at a certain crop growth stage). At IREC, a new technique to map alfalfa yield using drone imagery was explored. This technique depends on measuring the distance between bales and forage yield was calculated using the following equation:

$$Yield = \frac{\text{Bale Weight}}{\text{Windrow Width} \times \text{Distance between bales}}$$

Figure 2 shows an example of alfalfa yield measurement using a drone image. This technique can provide an accurate estimation for alfalfa yield in the case of small bales. However, in the case of large bales, this technique loses its accuracy due to the relatively long distance between bales, which doesn't allow for accurate mapping results. Another possible technique for alfalfa yield mapping with drones is measuring the hay windrow volume and subsequently mapping yield variability. This technique was tested in Tulelake, and its accuracy is currently being evaluated for the next two seasons to

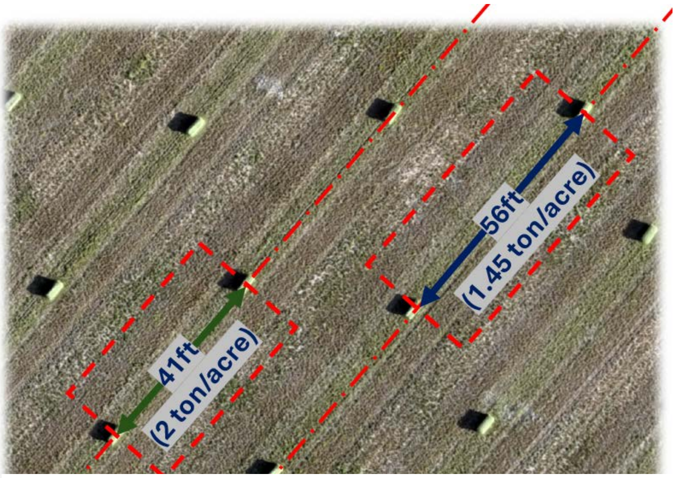

Figure 2: Measuring the distance between bales from a drone image that was acquired after baling.

ensure reliability. This method is better than the first because it doesn't depend on the size of the bale, requires less work from humans to process the data, and gives more yield data points. These factors should lead to more accurate yield maps and definitions for yield zones, but testing is still underway.

Weed density mapping in onions and potatoes:

Another promising drone application is detecting and mapping weed density in potatoes and onions. Last year, we explored the possibility of weed detection using multispectral drone imagery from an onion field. Figure 3 shows an example of weed detection from the onion study field. Also, we explored mapping weed patches in a 20-acre potato field using a new AI tool from the PIX4DFields software. Results matched my field observations but also had significant errors. Mapping weed density has a lot of promise, but I feel this application requires more research and investigation to ensure its reliability, define possible error sources, and maintain a clear workflow for developing weed maps. The most promising solution for mapping weed patches could be early detection of perennial weed patches and difficult to control weeds that growers could spot spray before the weeds become established, spread, and set seed. Early detection of weed patches should also allow more efficient use of the slow and expensive weed robots, and better deployment of hand weeding resources in organic farms.

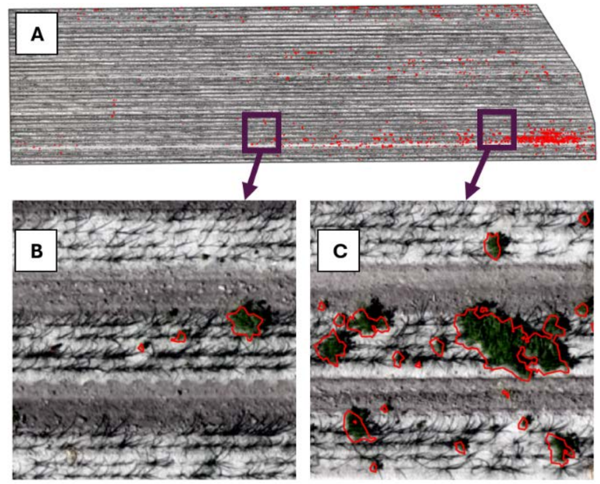

Figure 3: Example of weed detection from an onion field based on multispectral data analysis.

We plan to test two different weed mapping techniques based on the AI tool from Pix4DFields software and a spatiotemporal analysis technique in the coming seasons. Figure 4 shows preliminary results from last season's activities in a tomato field, comparing the two weed mapping techniques, which we plan to repeat in potato fields in Tulelake.

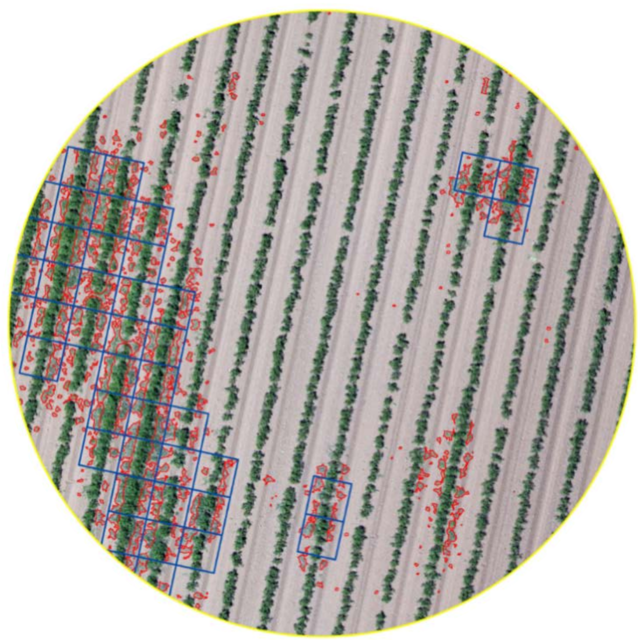

Figure 4: Example of mapping weed patches using the AI-tool from Pix4DFields software (blue grids) and a spatiotemporal analysis technique (red polygons) from a tomato field located in Woodland, CA.

Tracking potato variety trials at IREC

For the last two seasons at IREC, I used multispectral drone imagery to monitor potato variety trials, aiming to have a digital scoring system for potato performance evaluation. For instance, weekly drone images were collected, and vegetation indices were calculated for each variety at different stages of potato growth. This information was used to track each variety's performance throughout the season, which can aid in early disease detection and severity assessments. Additionally, a weekly image of each variety was clipped from drone images, resulting in a digital archive for potato varieties at different growth stages. Breeders scout fields and score each variety for its performance and disease severity, which depends on the breeder's experience. The developed digital archive can be a useful tool for exchanging field observations from field trials between researchers and agronomists, as well as digitally archiving field trials for future comparisons. Moreover, a potato row closure scoring index was developed based on drone imagery. The NDVI was calculated from drone images, a threshold was set to distinguish between soil and vegetation from a 5ft × 15ft sampling frame for each potato variety, the vegetation area in each frame was calculated, and 95% of the vegetation area in each frame was considered as a row closure stage. Figure 5 shows an example for measuring the potato row closure from a variety grown at IREC in the 2024 season. A comprehensive report on tracking potato variety trials is available for the 2023 and 2024 seasons at IREC.

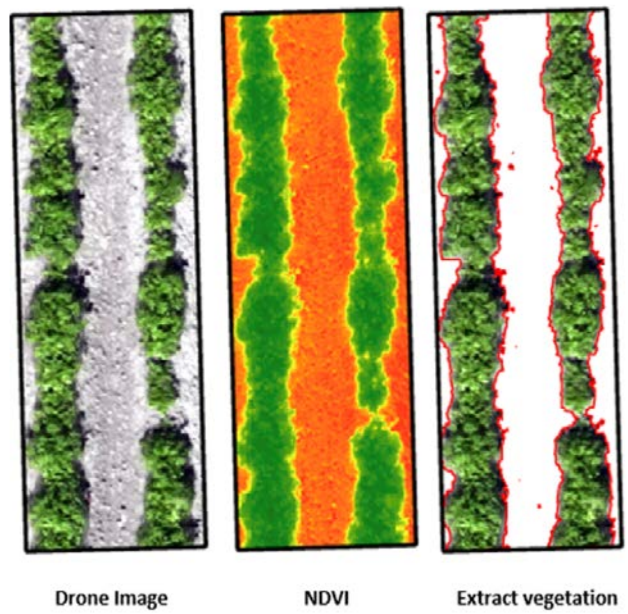

Figure 5: Example of measuring crop coverage area from a drone image acquired on 6/26/2024 for the Russet variety (CO15016-1RUsto).

2024 Grass Forage Variety Trial Report

University of California Agriculture and Natural Resources
Research and Extension Center System

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This report summarizes hay forage yields and agronomic characteristics for public and private grass varieties test at IREC during 2020 to 2024. The variety trial was organized and managed by Dr. Brummer and Grace Woodmansee as a larger effort to evaluate perennial grass performance for hay and grazing throughout Northeast California. All varieties were drill seeded on September 10th, 2020 using the following pure live seeding rates per acre: Orchard Grass -15 lbs; Tall fescue and Meadow fescue - 20lbs; Timothy and Reed Canarygrass - 5 lbs; Tall Wheatgrass - 10 lbs;, and Meadow Bromegrass - 8 lbs.

<u>Site Information and Grass Management</u>: The study was conducted at IREC. Soil type was a Tulebasin mucky silty clay loam with 4.5% organic matter. Grass was grown under solid set sprinkler irrigation. Irrigation was scheduled using crop ET estimates and soil moisture monitoring. Irrigation totals are summarized in Table 1. Grass was fertilized with nitrogen, phosphorus, and potassium with the goal of maximizing yield potential. Fertilizer amounts were determined using soil tests and crop uptake estimates. Fertilizer totals are summarized in Table 2. Nitrogen was low after each grass cutting according to soil tests; thus nitrogen was split applied through the season with a nitrogen application in the form of UAN 32 or urea at 1st irrigation at spring green-up and after each cutting. Phosphorus and potassium fertilizer was applied each fall after last cutting. Weeds were controlled with herbicides and hand-weeding to prevent weed competition. Rodents were controlled with bait or trapping. Insects were not a problem. All orchardgrass and timothy varieties showed mild symptoms of foliar fungal diseases on lower leaves during summer months, but symptoms did not warrant a fungicide application.

Table1: Irrigation Totals

Season Total of Applied Water & Rainfall 4/1 to 9/30		Tall Fescue	Timothy	Orchard Grass
		inches of water		
Fall	2020 [1]	15.06	15.06	15.06
Full Year	2021	37.52	25.89	37.62
	2022	32.54	30.02	32.54
	2023	26.71	26.71	26.71
	2024	34.93	34.93	34.93

[1] Established in 2020; partial year irrigation

Table 2: Fertilizer Totals

Season Total of Applied Nutrients lbs/acre		Total N [1]	P_2O_5	K_2O
Year	2020 [2]	22	100	100
	2021	271	100	150
	2022	321	100	150
	2023	296	100	180
	2024	300	200	200

[1] Nitrogen fertilizer was split applied through the growing season at: spring greenup; after 1st cutting and after 2nd cutting. P and K fertilizer was applied in fall.

[2] 2020 was the establishment year; fertilizer was applied at planting

<u>Comparison of Grass Types</u>: Orchardgrass and timothy are leafy cool-season grasses with high palatability making them popular grasses for horse hay and feed store hay sold off-farm. Tall fescue, meadow fescue, and other cool-season grasses included in the report are primarily grown for grazing or hay fed to livestock on-farm. An important distinction between grass species is their tolerance for cutting and grazing events. Timothy has low tolerance for defoliation, meaning it is slow to regrow after cutting or grazing. As such, most grass growers in Northeast California can only get 2 cuttings of timothy per year. Orchardgrass, tall fescue, and meadow fescue have good tolerance for defoliation. As such, they regrow quickly after cutting and growers often get 3-cuttings per year with these grasses.

Tall fescue has historically produced the highest total yield per year under irrigation compared to other cool season perennial grasses. This trend held true in this study. Tall fescue had the highest 4-year season total yield (averaged across varieties) at 8.8 tons/acre. Season total yields (averaged across varieties) for other grasses included orchardgrass at 7.3 tons/acre, timothy at 6.6 tons/acre, and meadow fescue at 6.4 tons/acre. Reed canarygrass was the highest yielding grass in the "other" category with season total yield over 8 tons/acre. Unfortunately, reed canarygrass is considered an invasive weed by state and federal agencies and it is not recommended for pasture seedings.

Heading date at 1st cutting is an important characteristic for grass hay producers especially those that seed grass with alfalfa and want grass heading to correspond with alfalfa bloom. Tall fescue and meadow fescue were the first types to head out in early June. Orchardgrass tended to head out 5 days later than tall fescue in the second week of June. There was a one week difference in heading time across orchardgrass varieties. Timothy had the latest average heading date in mid-June. Given timothy is sensitive to defoliation, most growers let Timothy fully head out before harvest to maximize yield and head appearance in the hay bale.

Grass stand establishment was above 90% for most tall fescue, orchardgrass, and meadow fescue varieties. These thick stands help prevent weed establishment. Most timothy varieties had thinner stands (60-80%) at establishment compared to tall fescue and orchardgrass. This trend is typical given timothy's spaced bunchgrass growth habit and its' preference for sunlight to reach lower leaves. Grass stand for most grass types and varieties decreased during the 4-year period. The exception was the two reed canarygrass varieties and cache meadow brome. These grasses had poor stands initially, but their stands increased over time. Reed canarygrass has a strong tendency to creep and form dense sod which is the primary reason it's considered invasive when planted in riparian areas.

Table 3: Total 3-Cut Season Yield for Orchardgrass

Variety	2021	2022	2023	2024	2021-24 Average	1st Cut Avg Heading Date (2021-24)
	ton/acre					
Devour	10.5 abc	7.5 a	7.9 a	6.1 ab	8.0 a	10-Jun
Quickdraw HSG	12.0 a	6.8 a	6.6 ab	6.1 ab	7.8 ab	9-Jun
Alpine II	11.1 ab	6.5 a	7.5 ab	6.2 ab	7.8 ab	11-Jun
Tekapo	10.6 abc	6.8 a	7.0 ab	6.3 a	7.7 abc	10-Jun
Barlegrow	11.1 ab	7.2 a	6.8 ab	5.6 abc	7.7 abc	12-Jun
Rushmore II	11.1 ab	7.0 a	6.3 ab	5.8 abc	7.5 abc	9-Jun
Crown Royale	10.9 abc	6.4 a	6.9 ab	5.9 abc	7.5 abc	8-Jun
Persist	10.9 abc	7.1 a	6.1 ab	5.7 abc	7.5 abc	8-Jun
Echelon	10.7 abc	6.8 a	6.5 ab	5.7 abc	7.4 abc	11-Jun
Potomac	11.2 ab	6.8 a	6.2 ab	5.5 abc	7.4 abc	11-Jun
Endurance	11.3 ab	6.9 a	6.0 ab	5.4 abc	7.4 abc	8-Jun
Latar	11.0 abc	6.8 a	6.3 ab	5.5 abc	7.4 abc	9-Jun
Pennlate	10.7 abc	6.8 a	6.3 ab	5.8 abc	7.4 abc	9-Jun
Icon	11.1 ab	6.6 a	6.5 ab	5.1 abc	7.3 abc	7-Jun
Paiute	10.7 abc	6.8 a	6.3 ab	5.4 abc	7.3 abc	7-Jun
Baridana	11.1 ab	6.5 a	6.3 ab	5.2 abc	7.3 abc	8-Jun
HLR Blend	10.4 abc	6.5 a	6.7 ab	5.5 abc	7.3 abc	12-Jun
Bighorn	10.7 abc	6.1 a	7.0 ab	5.5 abc	7.3 abc	10-Jun
Mammoth	11.1 ab	6.4 a	6.5 ab	5.0 abc	7.3 abc	8-Jun
Intensiv	10.5 abc	6.7 a	6.5 ab	5.0 abc	7.2 abc	12-Jun
Profit	11.1 ab	6.2 a	6.4 ab	5.0 abc	7.1 abc	8-Jun
Harvestar	10.5 abc	6.4 a	6.7 ab	4.8 abc	7.1 abc	9-Jun
Niva	10.7 abc	6.3 a	6.3 ab	5.0 abc	7.1 abc	9-Jun
Hallmark	10.9 abc	6.2 a	6.3 ab	4.6 bc	7.0 bc	8-Jun
Extend	11.2 ab	6.1 a	6.1 ab	4.6 bc	7.0 bc	8-Jun
Baraula	10.0 bc	6.0 a	6.3 ab	5.4 abc	6.9 bc	13-Jun
Husar	10.7 abc	6.3 a	5.9 b	4.4 c	6.8 c	12-Jun
Amba	9.4 c	6.4 a	6.7 ab	4.6 bc	6.8 c	7-Jun
Average	**10.8**	**6.6**	**6.5**	**5.4**	**7.3**	**9-Jun**

Table 4: Orchardgrass Plant Stand in Fall of Establishment Year and Spring after 1st Cutting

Variety	2020		2021		2022		2023		2024		2020-2024	
	% stand										% Stand Change	
Barlegrow	96	a	95	a	81	a b	70	a	71	a	-25	a
Paiute	96	a	96	a	84	a b	69	a	71	a	-25	a
Extend	96	a	98	a	86	a b	74	a	70	a	-26	a
Husar	95	a	91	a	84	a b	75	a	68	a	-28	a
Icon	98	a	100	a	84	a b	75	a	70	a	-28	a
Intensiv	98	a	99	a	84	a b	76	a	70	a	-28	a
Profit	94	a	96	a	81	a b	73	a	66	a	-28	a
Quickdraw HSG	98	a	100	a	88	a	75	a	70	a	-28	a
Alpine II	99	a	99	a	84	a b	74	a	70	a	-29	a
Bighorn	99	a	99	a	85	a b	73	a	70	a	-29	a
Crown Royale	99	a	100	a	84	a b	78	a	70	a	-29	a
Harvestar	99	a	100	a	81	a b	70	a	70	a	-29	a
Rushmore II	99	a	100	a	86	a b	78	a	70	a	-29	a
Tekapo	99	a	98	a	83	a b	75	a	70	a	-29	a
Amba	96	a	98	a	81	a b	71	a	66	a	-30	a
Baridana	96	a	98	a	83	a b	70	a	66	a	-30	a
Devour	100	a	94	a	76	a b	70	a	70	a	-30	a
Endurance	98	a	98	a	83	a b	71	a	68	a	-30	a
Mammoth	99	a	99	a	83	a b	74	a	69	a	-30	a
Niva	100	a	96	a	84	a b	73	a	70	a	-30	a
Pennlate	100	a	100	a	86	a b	78	a	70	a	-30	a
Potomac	100	a	99	a	88	a	73	a	70	a	-30	a
HLR Blend	99	a	93	a	75	b	70	a	68	a	-31	a
Latar	100	a	99	a	86	a b	73	a	69	a	-31	a
Persist	99	a	98	a	81	a b	70	a	68	a	-31	a
Baraula	100	a	98	a	80	a b	71	a	68	a	-33	a
Hallmark	100	a	98	a	86	a b	76	a	66	a	-34	a
Echelon	100	a	99	a	81	a b	70	a	63	a	-38	a
Average	**98**		**98**		**83**		**73**		**69**		**-29**	

Table 5: Total 2-Cut Season Yield for Timothy Varieties

Entry Name	2021	2022	2023	2024	2021-24 Average	1st Cut Avg Heading Date (2021-24)
	ton/acre					
Barfleo	9.5 ab	7.0 a	6.2 a	6.6 a	7.3 a	14-Jun
Zenyatta	9.5 ab	7.3 a	6.0 a	5.9 ab	7.2 ab	14-Jun
KY-Early	10.8 a	5.8 ab	6.1 a	5.5 ab	7.1 ab	9-Jun
Conquest	10.0 ab	5.6 ab	6.2 a	6.3 ab	7.0 ab	6-Jun
Aurora	8.7 bc	7.0 a	6.6 a	5.3 ab	6.9 ab	11-Jun
Basho	8.8 bc	6.4 ab	7.1 a	5.2 ab	6.9 ab	13-Jun
Claire	9.6 ab	6.9 a	5.5 a	5.2 ab	6.8 ab	10-Jun
Lischka	9.3 ab	6.7 a	5.2 a	5.6 ab	6.7 abc	15-Jun
Tuuka	6.8 d	6.8 a	6.8 a	5.9 ab	6.6 abc	16-Jun
Barpenta	6.7 d	6.0 ab	7.5 a	5.5 ab	6.4 abc	16-Jun
Presto	7.1 cd	6.1 ab	6.5 a	5.6 ab	6.3 abc	15-Jun
Baronaise	6.2 d	5.3 ab	6.5 a	5.3 ab	5.8 bc	17-Jun
Climax	6.7 d	4.3 b	6.2 a	4.1 b	5.3 c	16-Jun
Average	**8.4**	**6.3**	**6.3**	**5.5**	**6.6**	**13-Jun**

Table 6: Timothy Plant Stand in Fall of Establishment Year and Spring after 1st Cutting

Entry Name	2020	2021	2022	2023	2024	2020-2024 % Stand Change
	% stand					
Claire	54 b	70 ab	75 a	78 a	65 ab	11 a
Conquest	76 a	78 ab	76 a	73 a	73 a	-4 ab
Zenyatta	73 ab	70 ab	75 a	80 a	68 ab	-5 ab
Aurora	75 a	69 ab	75 a	78 a	68 ab	-8 ab
Tuuka	84 a	75 ab	75 a	76 a	70 ab	-14 b
Barfleo	85 a	79 ab	78 a	78 a	70 ab	-15 b
KY-Early	89 a	83 a	80 a	76 a	73 a	-16 b
Lischka	86 a	68 ab	70 a	79 a	69 ab	-18 b
Barpenta	84 a	63 b	70 a	74 a	65 ab	-19 b
Basho	89 a	73 ab	70 a	76 a	70 ab	-19 b
Baronaise	89 a	80 a	76 a	73 a	68 ab	-21 b
Presto	86 a	76 ab	76 a	79 a	64 b	-23 b
Climax	91 a	80 a	76 a	73 a	66 ab	-25 b
Average	**82**	**74**	**75**	**76**	**68**	**-13**

Table 7: Total 3-Cut Season Yield for Tall Fescue Varieties

Entry Name	2021	2022	2023	2024	2021-24 Average	1st Cut Avg Heading Date (2021-24)
	ton/acre					
FSG 402TF	14.0 ab	7.7 a	7.6 a	8.3 a	9.4 a	4-Jun
Goliath	13.8 abc	8.5 a	7.5 a	8.0 ab	9.4 a	4-Jun
Teton II	13.8 abc	8.5 a	7.6 a	7.3 abc	9.3 a	4-Jun
Drover	13.5 abc	8.2 a	7.4 a	7.8 abc	9.2 a	5-Jun
NF1100	13.8 abc	8.1 a	7.7 a	7.2 abc	9.2 a	4-Jun
Kora	14.0 abc	8.2 a	7.5 a	6.8 abc	9.1 a	4-Jun
Texoma MaxQ II	13.8 abc	7.9 a	7.7 a	7.0 abc	9.1 a	5-Jun
Tuscany II	14.1 ab	7.7 a	7.3 a	6.9 abc	9.0 a	5-Jun
Cajun II	13.3 abc	8.1 a	7.4 a	7.1 abc	9.0 a	3-Jun
Tower Protek	13.4 abc	7.9 a	7.1 a	7.5 abc	9.0 a	7-Jun
Hymark	14.1 ab	7.3 a	6.9 a	7.0 abc	8.8 a	6-Jun
Lacefield MaxQ II	13.9 abc	7.3 a	7.2 a	6.9 abc	8.8 a	4-Jun
Atlas II	14.0 abc	7.2 a	7.3 a	6.7 abc	8.8 a	5-Jun
Barolex	12.7 abc	7.8 a	7.9 a	6.6 abc	8.8 a	6-Jun
Baroptima Plus E34	12.9 abc	8.0 a	7.4 a	6.8 abc	8.8 a	6-Jun
Martin II Protek	13.2 abc	7.9 a	7.0 a	7.0 abc	8.8 a	4-Jun
Jesup MaxQ	14.3 a	7.4 a	6.7 a	6.5 abc	8.7 a	4-Jun
Barelite	13.2 abc	8.0 a	7.0 a	6.4 bc	8.7 a	7-Jun
Rustler	13.1 abc	7.6 a	6.7 a	6.8 abc	8.6 a	3-Jun
Fawn	13.1 abc	7.5 a	6.8 a	6.7 abc	8.5 a	3-Jun
Atlas	13.2 abc	7.5 a	6.6 a	6.8 abc	8.5 a	5-Jun
Bronson	13.2 abc	7.7 a	7.0 a	6.2 bc	8.5 a	4-Jun
Jesup MaxQ II	13.4 abc	7.4 a	6.6 a	6.5 abc	8.5 a	4-Jun
Bariane	12.0 c	8.1 a	7.0 a	6.3 bc	8.4 a	8-Jun
Lipalma	13.0 abc	7.5 a	6.5 a	6.0 c	8.2 a	4-Jun
Armory	12.1 bc	7.4 a	6.6 a	6.7 abc	8.2 a	5-Jun
Estancia	12.3 abc	7.2 a	6.7 a	6.4 abc	8.2 a	4-Jun
Average	**13.4**	**7.8**	**7.1**	**6.9**	**8.8**	**4-Jun**

Table 8: Tall Fescue Plant Stand in Fall of Establishment Year and Spring after 1st Cutting

Entry	2020		2021		2022		2023		2024		2020-24 % Stand Change	
	% stand											
Bronson	80	b	98	a	86	a	80	a	74	a	-6	a
FSG 402TF	90	ab	99	a	90	a	80	a	75	a	-15	ab
Lipalma	90	ab	99	a	90	a	80	a	75	a	-15	ab
Barelite	94	a	100	a	86	a	80	a	75	a	-19	b
Armory	95	a	95	a	88	a	80	a	75	a	-20	b
Barolex	95	a	94	a	86	a	80	a	75	a	-20	b
Jesup MaxQ	95	a	98	a	90	a	80	a	75	a	-20	b
Bariane	96	a	98	a	88	a	80	a	75	a	-21	b
Goliath	96	a	98	a	89	a	80	a	75	a	-21	b
Jesup MaxQ II	96	a	98	a	90	a	80	a	75	a	-21	b
Lacefield MaxQ II	96	a	100	a	89	a	80	a	75	a	-21	b
Atlas II	98	a	99	a	90	a	80	a	75	a	-23	b
Cajun II	98	a	96	a	90	a	80	a	75	a	-23	b
Drover	98	a	99	a	89	a	80	a	75	a	-23	b
Kora	98	a	99	a	88	a	80	a	75	a	-23	b
Teton II	98	a	100	a	90	a	80	a	75	a	-23	b
Texoma MaxQ II	98	a	99	a	90	a	80	a	75	a	-23	b
Tuscany II	98	a	100	a	88	a	80	a	75	a	-23	b
Estancia	99	a	99	a	90	a	80	a	75	a	-24	b
Atlas	100	a	99	a	91	a	80	a	75	a	-25	b
Baroptima Plus E34	100	a	100	a	89	a	80	a	75	a	-25	b
Fawn	100	a	99	a	89	a	80	a	75	a	-25	b
Hymark	99	a	100	a	90	a	80	a	74	a	-25	b
Martin II Protek	100	a	98	a	90	a	80	a	75	a	-25	b
NF1100	100	a	100	a	89	a	80	a	75	a	-25	b
Rustler	100	a	99	a	90	a	80	a	75	a	-25	b
Tower Protek	100	a	100	a	89	a	80	a	75	a	-25	b
Average	**96**		**98**		**89**		**80**		**75**		**-22**	

Table 9: Total Season 3-Cut Yield for Meadow Fescue Varieties						
	2021	2022	2023	2024	2021-24 Average	1st Cut Avg Heading Date
Entry Name	ton/acre					(2021-24)
Azov	10.9 ab	6.9 a	4.7 a	4.7 a	6.9 a	6-Jun
Liherald	11.6 a	6.4 a	5.1 a	4.4 a	6.9 a	4-Jun
Preval	11.2 ab	6.1 a	5.3 a	4.3 a	6.7 ab	5-Jun
KF Galaxy	11.0 ab	6.5 a	5.1 a	4.0 a	6.5 ab	6-Jun
Pradel	10.7 ab	6.4 a	5.1 a	4.3 a	6.5 ab	6-Jun
Driftless	10.8 ab	6.2 a	4.7 a	4.3 a	6.5 ab	7-Jun
Hidden Valley	10.2 b	5.7 ab	4.8 a	3.3 a	6.0 bc	8-Jun
Tetrax	8.2 c	4.7 b	4.7 a	4.2 a	5.6 c	11-Jun
Average	**10.6**	**6.1**	**4.9**	**4.2**	**6.4**	**6-Jun**

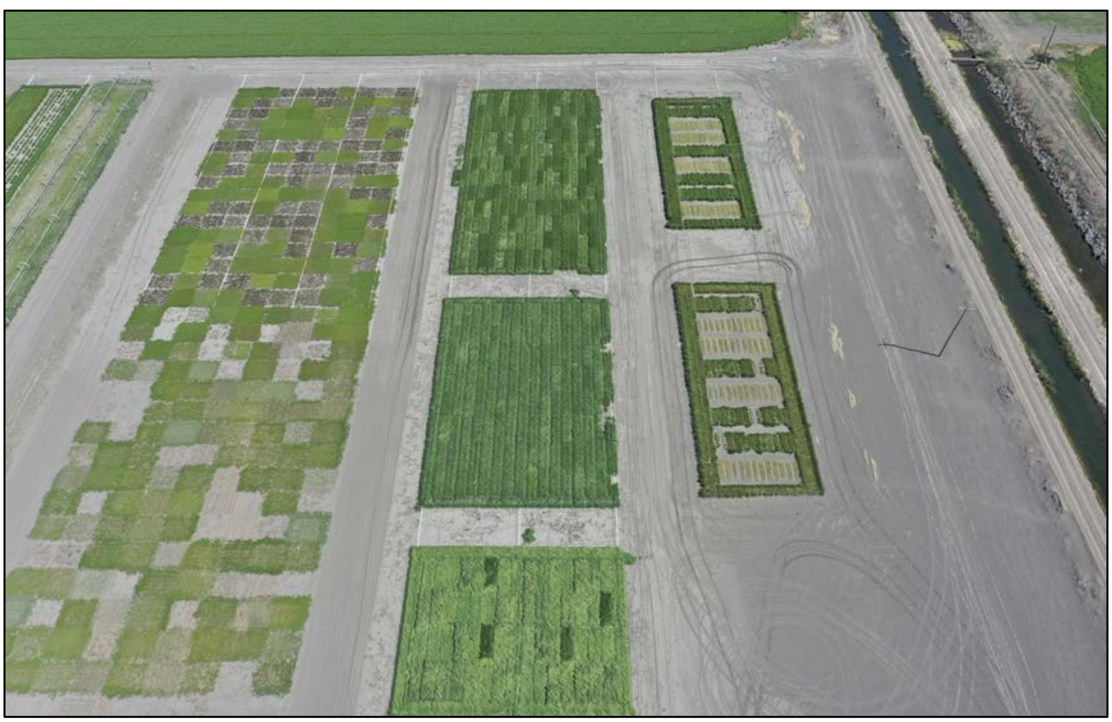
Table 10: Meadow Fescue Plant Stand in Fall of Establishment Year and Spring after 1st Cutting						
	2020	2021	2022	2023	2024	2020-24 % Stand
Entry	% stand					Change
Azov	95 ab	98 a	84 a	79 a	75 a	-20 a
Hidden Valley	91 ab	98 a	81 a	76 a	71 ab	-20 a
Tetrax	86 b	61 b	63 b	74 a	64 b	-23 a
Pradel	93 ab	96 a	83 a	80 a	69 ab	-24 a
Preval	100 a	100 a	86 a	80 a	75 a	-25 a
Liherald	96 ab	96 a	83 a	79 a	70 ab	-26 a
KF Galaxy	95 ab	98 a	86 a	74 a	68 ab	-28 a
Driftless	100 a	100 a	89 a	79 a	71 ab	-29 a
Average	**95**	**93**	**82**	**78**	**70**	**-24**

Table 11: Total Season 3-Cut Yield for Othe Grass Species

Grass Species	Entry	2021	2022	2023	2024	2021-24 Average	1st Cut Avg Heading Date (2021-24)
		ton/acre					
Reed Canarygrass	Chiefton	9.9 ab	8.1 a	7.3 a	7.3 a	8.2 a	16-Jun
Reed Canarygrass	Palaton	10.3 ab	7.5 ab	7.0 a	6.9 a	7.9 a	16-Jun
Tall Wheatgrass	Jose	9.0 bc	6.1 bcd	6.3 ab	3.8 b	6.3 b	15-Jun
Meadow Brome	Macbeth	10.5 a	7.0 abc	3.1 d	4.0 b	6.2 b	28-May
Tall Wheatgrass	NF6020 (Plainsman)	9.8 ab	5.4 cd	4.8 bc	4.2 b	6.0 b	18-Jun
Meadow Brome	Cache	8.2 c	7.9 ab	3.6 cd	4.0 b	5.9 b	28-May
Wheatgrass	NF8000	9.4 abc	4.7 d	4.4 cd	4.4 b	5.7 b	18-Jun
	Average	**9.6**	**6.7**	**5.2**	**4.9**	**6.6**	**11-Jun**

Table 12: Other Grass Species Plant Stand in Fall of Establishment Year and Spring after 1st Cutting

Grass Species	Entry	2020	2021	2022	2023	2024	2020-24 % Stand Change
		% stand					
Reed Canarygrass	Palaton	51 bc	65 bc	75 ab	80 a	75 a	24 a
Meadow Brome	Cache	41 c	54 c	70 ab	76 a	64 ab	23 a
Reed Canarygrass	Chiefton	55 bc	71 abc	79 a	80 a	76 a	21 a
Tall Wheatgrass	Jose	69 ab	90 ab	79 a	78 a	69 ab	0 ab
Wheatgrass	NF8000	74 ab	93 a	81 a	80 a	73 a	-1 ab
Meadow Brome	Macbeth	81 a	89 ab	75 ab	76 a	70 a	-11 b
Tall Wheatgrass	NF6020 (Plainsman)	70 ab	85 ab	59 bc	64 b	55 b	-15 b
	Average	**63**	**78**	**74**	**76**	**69**	**6**



2024 Alfalfa Variety Yield Results

University *of* California
Agriculture and Natural Resources
Research and Extension Center System

By Chris DeBen, E.C Brummer and Daniel H. Putnam

See the University of California Alfalfa and Forages Website for full report and more information. http://alfalfa.ucdavis.edu.

INTRODUCTION

Choosing superior varieties of alfalfa is a significant economic factor for alfalfa growers. Several commercial varieties are currently available, enabling a wide range of options in the different fall dormancy (FD) groups. These UC trials provide unbiased data from a wide range of environments related to variety performance of alfalfa. In California, alfalfa is grown from the Oregon border to the Mexican border, and throughout the Central Valley, which consists of the Sacramento and San Joaquin Valleys. The tables below represent sites using a 3-4 cut system (dormant varieties) in the Intermountain Region.

The data is frequently used by growers to choose varieties, and by breeders to help guide further selection. Both private and public varieties are tested, and experimental lines as space allows. This report provides single year and over-the-year summary from the alfalfa variety trial harvested at Intermountain Research and Extension Center in Tulelake, California in 2024.

VARIETY TESTING METHODS

The California Alfalfa Cultivar Yield, Fall Dormancy, and Forage Quality Trials are open to any certified alfalfa cultivar, which is sold or is likely to be sold in California. Blends or brands (unless they are certified blends) are not included. Seed was planted at approximately 25 lbs./acre live seed in 3' to 4' wide plots x 18 to 20 feet long, depending upon location and specific layout. Four to six replicates of each cultivar were planted at each location, depending upon the expected variation at that site. Experimental design was a randomized complete block design. Harvests for yield estimation were obtained from approximately a 3' x 18' area per plot using a flail-type or cutter-bar type forage harvester, and dry matter yield determined by oven-drying subsamples to a constant weight. A representative group of 5-6 varieties were taken at each harvest, and the average dry matter used for yield determination. Cutting schedules followed the most common practice in that region and are the same for all varieties within a trial.

2024 YIELD RESULTS

2021 UC Tulelake Variety Trial- This 24-entry trial was planted 8/19/21. Four harvests were taken in 2024, the final year of harvest. The average yield for this trial was 8.1 t/A with a spread of 7.0-8.6 t/A among varieties (Table 1). Multi-year yield averaged 7.8 t/A, with all years being very similar in production (Table 2). A replacement yield trial planting is planned for spring 2025 in Tulelake.

2024 YIELDS, TULELAKE ALFALFA CULTIVAR TRIAL. TRIAL PLANTED 8/19/21

Note: Single year data should not be used to evaluate alfalfa varieties or choose alfalfa cultivars

		Cut 1		Cut 2		Cut 3		Cut 4		YEAR		% of
		13-Jun		9-Jul		13-Aug		24-Sep		TOTAL		VERNAL
	FD					Dry t/a						
Released Varieties												
Magna150RR	4	2.92	(2)	1.48	(13)	2.79	(2)	1.40	(12)	8.58	(1)	110.6
54VQ52	4	2.89	(5)	1.51	(12)	2.72	(7)	1.43	(9)	8.55	(3)	110.2
Bison Alfalfa	3.5	2.83	(7)	1.42	(18)	2.80	(1)	1.50	(2)	8.54	(4)	110.2
Nexgrow 6516R	4.5	2.77	(9)	1.63	(2)	2.65	(9)	1.49	(3)	8.54	(5)	110.1
AWS 418RL	4	2.91	(4)	1.62	(3)	2.47	(19)	1.48	(4)	8.48	(6)	109.4
AWS 390	3.9	2.68	(13)	1.42	(17)	2.73	(5)	1.58	(1)	8.40	(7)	108.4
AFX 439	4	2.69	(12)	1.62	(4)	2.62	(10)	1.37	(15)	8.31	(8)	107.2
Ameristand 518NT	5	2.69	(11)	1.59	(6)	2.56	(14)	1.44	(7)	8.29	(9)	106.9
HybriForce-4420/Wet	4	2.86	(6)	1.45	(14)	2.54	(15)	1.37	(16)	8.21	(10)	105.9
6453Q	4	2.78	(8)	1.33	(23)	2.67	(8)	1.42	(11)	8.19	(11)	105.6
LG5R300	5	2.52	(19)	1.60	(5)	2.59	(13)	1.45	(6)	8.15	(12)	105.1
WL341 HVXRR	4	2.91	(3)	1.55	(9)	2.32	(23)	1.36	(18)	8.14	(13)	104.9
6585Q	5	2.52	(18)	1.38	(21)	2.76	(3)	1.46	(5)	8.13	(14)	104.8
54Q29	4	2.74	(10)	1.41	(19)	2.60	(12)	1.38	(14)	8.12	(15)	104.7
WL377 HQ	5	2.57	(16)	1.44	(16)	2.74	(4)	1.34	(20)	8.10	(16)	104.4
Ameristand 428TQ	4	2.67	(14)	1.57	(8)	2.49	(17)	1.35	(19)	8.07	(17)	104.0
Vernal	2	2.60	(15)	1.37	(22)	2.62	(11)	1.16	(23)	7.76	(18)	100.0
LG4R300	4	2.31	(23)	1.57	(7)	2.48	(18)	1.39	(13)	7.74	(19)	99.8
Ameristand 446NT	4	2.52	(17)	1.45	(15)	2.31	(24)	1.43	(8)	7.72	(20)	99.5
WL3441 RR	4	2.33	(22)	1.54	(10)	2.41	(21)	1.42	(10)	7.71	(21)	99.4
Ameristand 416NT RR	4	2.35	(21)	1.39	(20)	2.47	(20)	1.36	(17)	7.56	(22)	97.5
WL375 HVXRR	4.6	2.03	(24)	1.66	(1)	2.54	(16)	1.32	(22)	7.55	(23)	97.3
AWS 455 salt	4	2.48	(20)	1.17	(24)	2.33	(22)	1.03	(24)	7.02	(24)	90.5
Experimental Varieties												
SW4615	5	2.99	(1)	1.54	(11)	2.73	(6)	1.33	(21)	8.58	(2)	110.6
MEAN		2.65		1.49		2.58		1.39		8.10		
CV		15.65		11.85		11.59		12.91		9.38		
LSD (0.1)		NS		0.21		NS		NS		NS		

Trial seeded at 25 lb/acre viable seed at Intermountain Research and Extension Center, Tulelake, CA.

Entries followed by the same letter are not significantly different at the 10% probability level according to Fisher's (protected) LSD.

FD = Fall Dormancy reported by seed companies.

2022-2024 YIELDS, TULELAKE ALFALFA CULTIVAR TRIAL. TRIAL PLANTED 8/19/21

	FD	2022 Yield		2023 Yield		2024 Yield		Average			% of Vernal
		Dry t/a									
Released Varieties											
AWS 418RL	4	7.87	(7)	8.37	(1)	8.48	(6)	8.24	(1)	A	110.1
54VQ52	4	7.90	(4)	8.05	(2)	8.55	(3)	8.16	(2)	A B	109.1
HybriForce-4420/Wet	4	8.11	(3)	7.88	(9)	8.21	(10)	8.07	(4)	A B C	107.8
Magna150RR	4	8.33	(1)	7.12	(24)	8.58	(1)	8.01	(5)	A B C	107.0
54Q29	4	8.26	(2)	7.53	(20)	8.12	(15)	7.97	(6)	A B C D	106.5
AFX 439	4	7.56	(12)	8.04	(3)	8.31	(8)	7.97	(7)	A B C D	106.5
6453Q	4	7.70	(9)	7.98	(6)	8.19	(11)	7.95	(8)	A B C D E	106.3
Nexgrow 6516R	4.5	7.46	(15)	7.84	(10)	8.54	(5)	7.95	(9)	A B C D E	106.2
Ameristand 428TQ	4	7.66	(10)	7.98	(5)	8.07	(17)	7.90	(10)	A B C D E F	105.6
Bison Alfalfa	3.5	7.64	(11)	7.49	(21)	8.54	(4)	7.89	(11)	A B C D E F G	105.4
WL377 HQ	5	7.71	(8)	7.77	(12)	8.10	(16)	7.86	(12)	A B C D E F G	105.0
6585Q	5	7.48	(14)	7.94	(8)	8.13	(14)	7.85	(13)	A B C D E F G	104.9
Ameristand 518NT	5	7.16	(23)	7.94	(7)	8.29	(9)	7.80	(14)	B C D E F G	104.2
WL341 HVXRR	4	7.42	(16)	7.75	(14)	8.14	(13)	7.77	(15)	B C D E F G	103.8
LG5R300	5	7.41	(17)	7.71	(16)	8.15	(12)	7.76	(16)	B C D E F G	103.7
AWS 390	3.9	7.35	(19)	7.45	(22)	8.40	(7)	7.74	(17)	C D E F G	103.4
Ameristand 446NT	4	7.25	(22)	8.02	(4)	7.72	(20)	7.66	(18)	C D E F G	102.4
LG4R300	4	7.25	(21)	7.64	(17)	7.74	(19)	7.55	(19)	D E F G	100.8
Ameristand 416NT RR	4	7.32	(20)	7.75	(13)	7.56	(22)	7.54	(20)	E F G	100.8
AWS 455 salt	4	7.87	(6)	7.74	(15)	7.02	(24)	7.54	(21)	E F G	100.8
WL375 HVXRR	4.6	7.37	(18)	7.63	(18)	7.55	(23)	7.52	(22)	F G	100.4
Vernal	2	7.55	(13)	7.14	(23)	7.76	(18)	7.48	(23)	F G	100.0
WL3441 RR	4	7.08	(24)	7.62	(19)	7.71	(21)	7.47	(24)	G	99.8
Experimental Varieties											
SW4615	5	7.87	(5)	7.77	(11)	8.58	(2)	8.07	(3)	A B C	107.9
MEAN		7.61		7.76		8.10		7.82			
CV		5.11		4.21		9.38		4.49			
LSD (0.1)		0.47		0.40		NS		0.43			

Trial seeded at 25 lb/acre viable seed at Intermountain Research and Extension Center, Tulelake, CA.

Entries followed by the same letter are not significantly different at the 10% probability level according to Fisher's (protected) LSD.

FD = Fall Dormancy reported by seed companies.

CHANGING TRENDS IN NORTHEAST CALIFORNIA ALFALFA WEED MANAGEMENT

University of California Agriculture and Natural Resources
Research and Extension Center System

By Robert Wilson[1] and Tom Getts[2]

***Original article published in the 2024 53rd California Alfalfa Symposium Proceeding. Proceedings can be viewed at:* https://alfalfasymposium.ucdavis.edu/+symposium/proceedings/index.aspx?yr=2024**

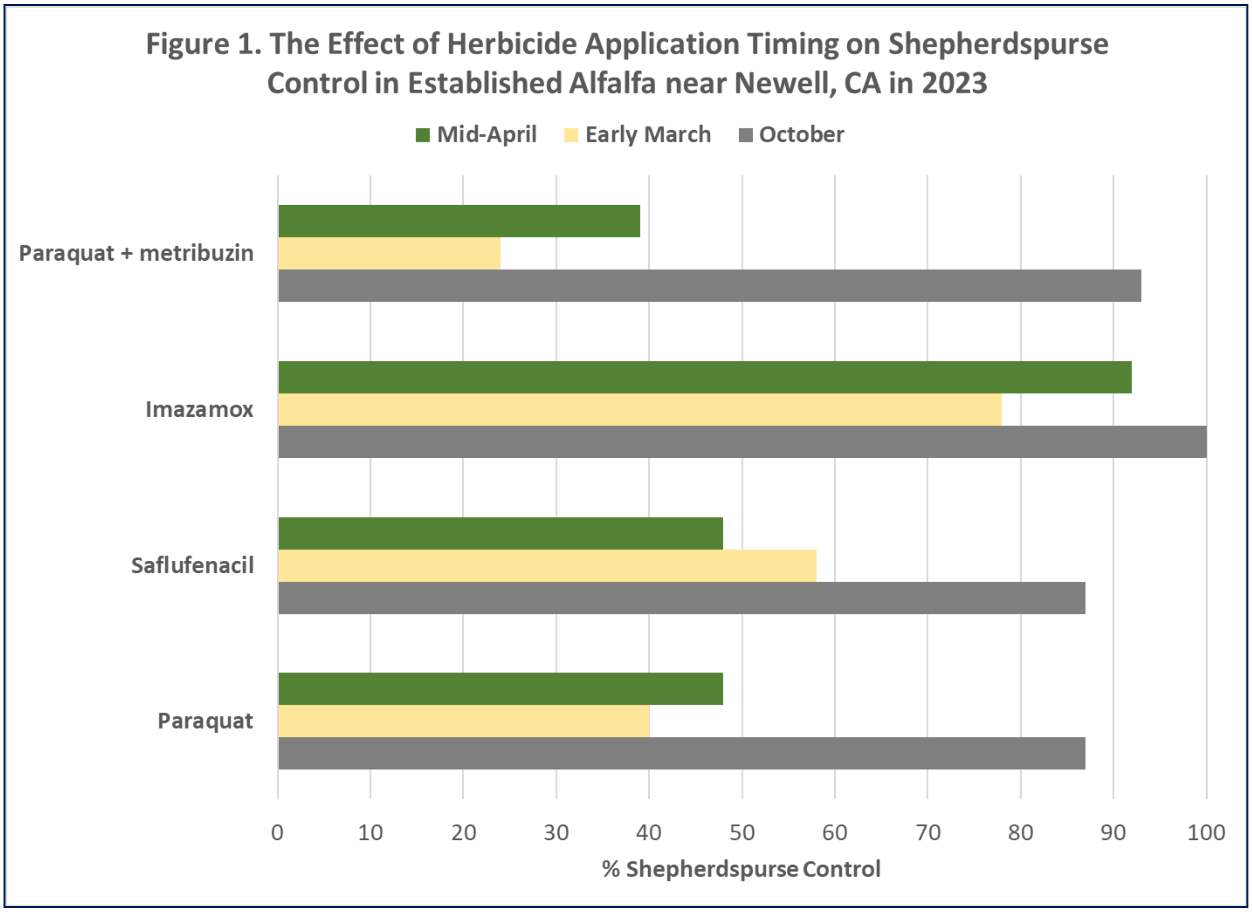
ABSTRACT
Northeast California alfalfa producers have experienced reduced winter annual weed control in recent years with paraquat + metribuzin especially with shepherdspurse. Several factors seem to explain the poor weed control including changes in weed growth, weather, and crop management. Weed control trials conducted near Tulelake, CA from 2021 to 2024 evaluated herbicide performance in established alfalfa. Fall applied paraquat or saflufenacil with or without a preemergent herbicide, late winter applied flumioxazin + paraquat or saflufenacil, and fall and spring applied imazamox gave significantly better control of shepherdspurse compared to late winter applied paraquat + metribuzin. Flumioxazin + paraquat or saflufenacil gave over 90% control of flixweed and prickly lettuce. Spring applied imazamox provided less than 50% control of both weeds. A major downside to using flumioxazin and saflufenacil in established alfalfa is they do not control emerged grass weeds. Paraquat is the only labeled herbicide for controlling small, emerged broadleaf and grass weeds in established conventional alfalfa.

Introduction
Northeast California alfalfa growers have relied on a combination of paraquat and metribuzin or hexazinone applied in late February or early March to control winter annual weeds in established alfalfa for the last twenty years. Unfortunately, winter annual weed control in conventional alfalfa has become increasingly difficult in recent years. Five circumstances explain the reduced weed control from late winter dormant herbicide treatment. First, some weeds especially shepherdspurse are emerging earlier in the fall (September) and growing more during warm winter weather patterns making them too big to control with conventional dormant season herbicides. Second, alfalfa stand density in several fields has decreased due to summer drought, irrigation curtailments, and delayed stand removal. Third, windy weather can delay applications of winter dormant herbicides into late March or early April, again allowing weeds to grow too large. Fourth, lack of measurable precipitation after application prevents herbicide incorporation in the soil. Fifth, some weed populations developed tolerance and resistance to common dormant herbicides such as metribuzin. Finally, some growers have started irrigating after last cutting to bank soil moisture due to unpredictable irrigation water deliveries from year to year. While irrigating int the fall has water storage benefits, it also provides moisture for early germination of winter annual weeds.

From 2021 to 2024, IREC staff conducted winter dormant herbicide trials in grower fields around Tulelake, CA with the hope of finding herbicide options that offer effective weed control. Small plot trials (10ft by 30ft) were laid out in a randomized complete block design with four replications. Herbicides were applied with a CO_2 powered backpack sprayer at 20 GPA. All treatments included a nonionic surfactant (NIS) at 0.25% v/v or methylated seed oil (MSO) at 0.5% v/v in the case of treatments with saflufenacil and carfentrazone. Herbicides were applied at various timings ranging from fall after the first hard frost until April when alfalfa had 3 inches of regrowth. After herbicide application, visual estimate of weed burndown, weed density, weed control, and crop injury (chlorosis and stunting) were evaluated 7 to 30+ days after treatment in each plot.

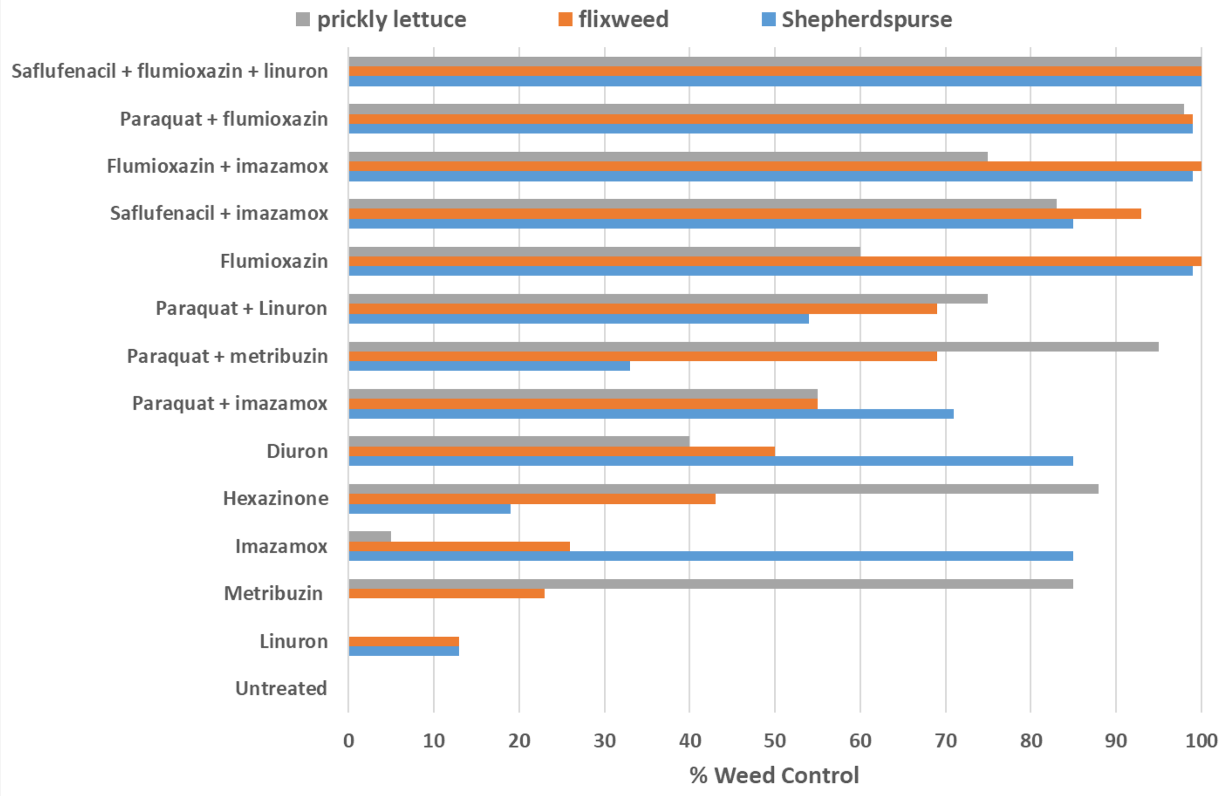
Herbicide Application Timing
Late winter is normally the preferred application window for applying herbicide for winter weed control in alfalfa. Historically weeds are yet to emerge or small at the time of application. Late winter normally allows for adequate precipitation to incorporate preemergent herbicides within a month of application. Late winter also prevents the chance of leaching herbicides below the weed germination zone which can happen with water soluble preemergent herbicides applied in the fall especially during wet winters.

An exception to applying herbicides in late winter is if weeds emerge in early fall. Recent research showed fall application of burn-down herbicides alone or in combination with preemergent herbicides provide the best control of early emerging weeds such as shepherdspurse (Figure 1). A downside to this strategy is more weeds can emerge over the winter requiring a second herbicide application in late winter. Spring herbicide application after alfalfa breaks dormancy is rarely recommended as most weeds have grown too large to kill with labeled herbicides and the risk of crop injury is high. The major exceptions to this rule are application of glyphosate for weed control in Roundup Ready alfalfa and use of imazamox or imazethyapyr for winter weed control.



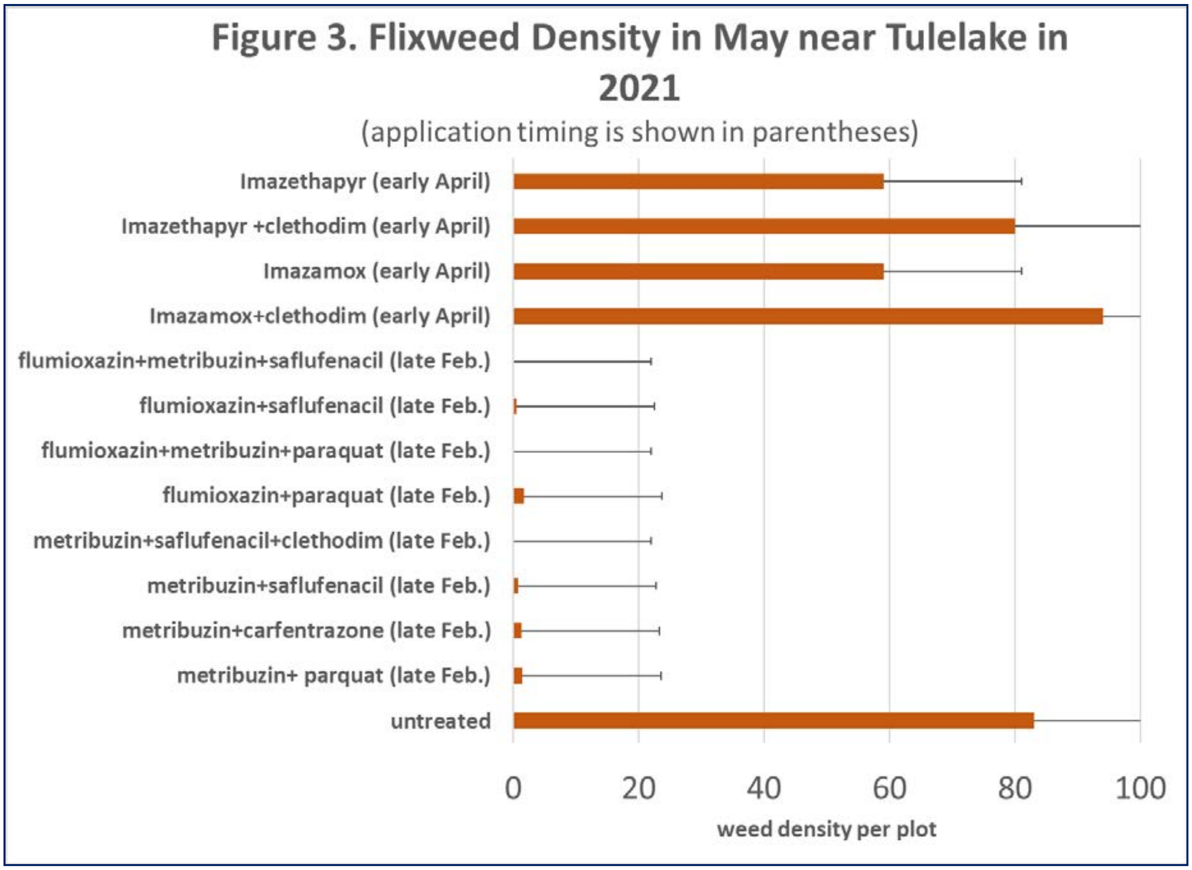
Choice of herbicide active ingredient
Paraquat in combination with hexazinone or metribuzin has been the most popular herbicide treatment for winter weed control for 20+ years. Historically, this combination controlled shepherdspurse, flixweed, prickly lettuce, and downy brome as evidenced by Western US weed management guidelines including UC IPM (Long et al, 2024 & Prather, 2022). As recently as 2020 late winter applications of metribuzin + paraquat in Honey Lake Valley trials provided 90% control of shepherdspurse, and 95% control of tumble mustard. However, in recent trials conducted in the Klamath Basin, late winter application of metribuzin or hexazinone alone or metribuzin + paraquat provided less than 70% control of shepherdspurse and flixweed (Figure 2). Both herbicides still gave over 80% control of prickly lettuce, but poor control of mustard weeds is unacceptable for dairy quality alfalfa. There has been an observation of more fields contaminated with mustard weeds throughout the region.

Figure 2. Weed Control from Late February Applied Herbicides 60 Days after Treatment near Tulelake in 2024

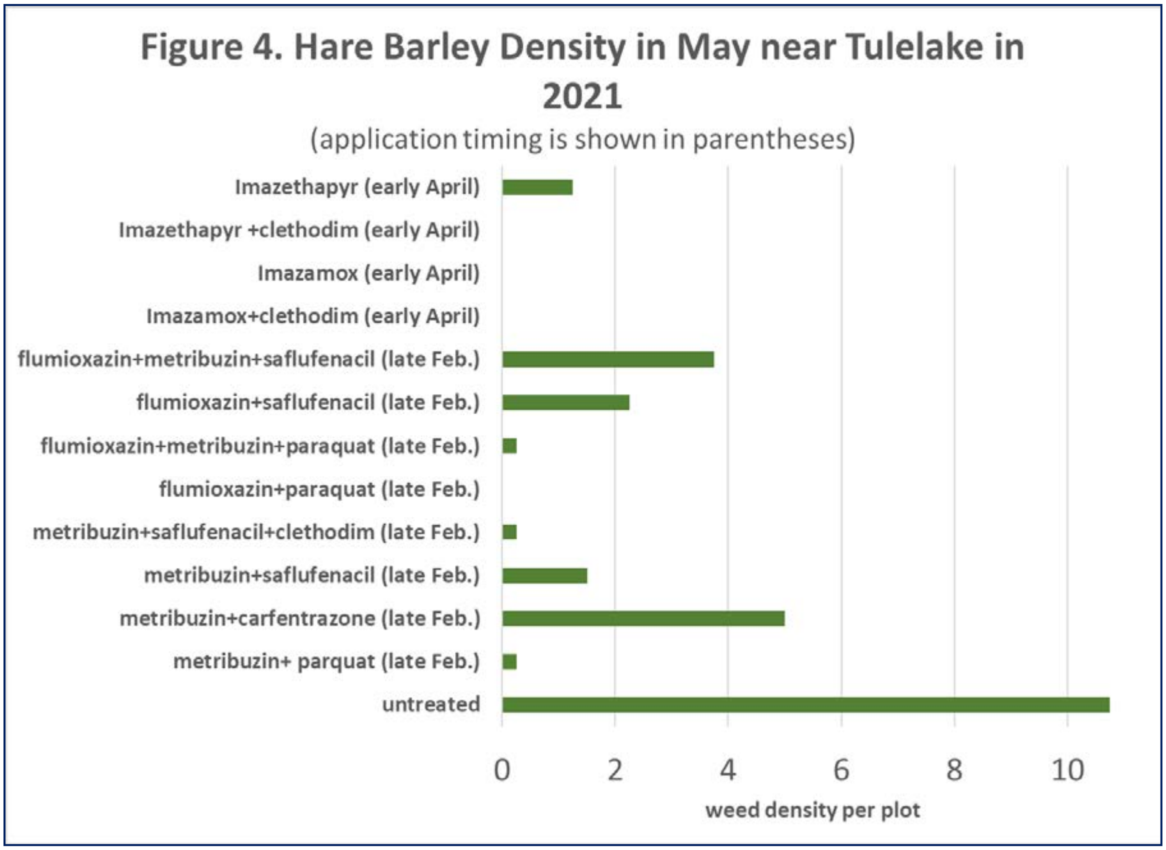


Flumioxazin is an alternative to hexazinone and metribuzin for winter weed control in alfalfa. It offers preemergent and early postemergent control of several broadleaf weeds. It is not as popular as metribuzin since it does not control most grass weeds. Flumioxazin applied in late winter provided over 90% control of shepherdspurse and flixweed (Figure 2). It only gave 60% control of prickly lettuce and failed to control hare barley when used alone. When tank-mixed with paraquat it gave over 90% control of all weeds (Figures 2 and 4). Flumioxazin, a PPO inhibitor, has a different mode action compared to metribuzin and hexazinone, photosynthesis inhibitors making it a good rotation choice for resistance management.

Imazamox and imazethapyr use in established alfalfa has increased in recent years. These herbicides are frequently used in seedling alfalfa, but they can also be used in established alfalfa. Tulelake trials showed imazamox provided over 80% control of shepherdspurse and less than 50% control of emerged flixweed (Figures 2 & 3). Imazamox is usually preferred over imazethapyr since it controls some grass weeds like foxtail and cheatgrass. Both herbicides do not control prickly lettuce and have long plant-back restrictions for rotational crops limiting their wide scale use in established alfalfa, especially in older stands.



Ongoing concerns with paraquat toxicity, worker safety, and corresponding regulations threaten its future in alfalfa. Two alternative contact, burndown herbicides that are used alone or tank-mixed with preemergence herbicides are saflufenacil and carfentrazone. Both control several small broadleaf weeds, but they do not control grasses (Figures 2, 3, & 4). Saflufenacil causes more injury compared to paraquat limiting use to 90+ days before the 1st cutting date. Saflufenacil sometimes gave erratic weed control when temperatures are very cold (personal observation). Adding a grass specific herbicide like clethodim to saflufenacil or carfentrazone can provide grass control, but this mix significantly increases the cost of the application and works best in warm weather.



Summary

Conventional alfalfa growers in Northeast California should consider alternatives to late winter applications of paraquat and metribuzin especially if they experience weed escapes. In fields with shepherdspurse, fall applied paraquat or saflufenacil with or without a preemergent herbicide or late winter applied flumioxazin + paraquat or saflufenacil gave the best control. Fall, winter, and spring applications of imazamox were effective at controlling shepherdspurse. Winter and spring applications of imazamox gave poor control of flixweed and prickly lettuce. Saflufenacil and carfentrazone are effective alternatives to paraquat for controlling broadleaf weeds. Paraquat is the only labeled contract burndown that controls broadleaf and grass weeds. Planting Roundup Ready alfalfa in problem fields is another effective control option for winter weed control in alfalfa.

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2024 Small Grain Variety Trial Report

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Introduction

This report summarizes grain yield and agronomic characteristics for public and private entries evaluated at IREC in 2024. Winter grain variety trials were a cooperative effort between IREC and Oregon State University's Cereal Variety Testing organized by Dr. Ryan Graebner. Spring wheat and triticale variety trials were part of the UC Davis Smalls Grains Breeding program organized by Dr. Xiaofei Zhang and Dr. Josh Hegarty. IREC staff also performed some informal spring strip trials using Westbred wheat varieties of local interest.

Late freeze at the boot stage in 2024 causes blank seed kernels on several grain heads.

Grain yield and agronomic data was collected by IREC staff. Grain protein and test weights were generated in collaboration with Ryan Graebner, Oregon State University and Joshua Hegarty of University of California, Davis. OSU grain tables can be viewed online at: https://cropandsoil.oregonstate.edu/wheat/osu-wheat-variety-trials/2024-oregon-wheat-and-barley-yield-trial-data

UC small grain variety trial summaries for multi-year and multi-trial data can be found at http://smallgrainselection.plantsciences.ucdavis.edu/

2024 General Trial Information for all trials

Location:	Intermountain Research and Extension Center, Tulelake, CA
Soil Type:	Tulebasin mucky silty clay loam
Weed Control:	Rhomene MCPA @ 1 pt./Acre; Detonate @ 2 fl oz./Acre; Express 0.5 oz./Acre
Replicated Plot size:	Winter Trials 100 ft^2; Spring Trials 75 ft^2
Seeding Rate:	100 lbs./Acre
Row Spacing:	6 Inches
Number of Reps:	4

2024 Hard Winter Wheat Trial

Planting Date: 10/17/2023
Previous Crop: Sudan Grass
Spring 2022 Soil Test N: 5.9 ppm (21 lbs. N/Acre)
Nitrogen Fertilizer: Season total applied Nitrogen was 201 lbs. N/Acre applied through the season. 21 lbs. N/A at planting (10/17/2023), 50 lbs. N/A early through late tillering (4/1/2024), 100 lbs. N/A through stem elongation (5/9/2024), 30 lbs. N/A at flowering (6/12/2024) to raise protein in the seed.
Irrigation Quantity: Solid-set sprinklers 13.23 Acre inches (final irrigation 6/12/2024)
Harvest Date: 8/12/2024

Variety Highlights: Winter hard red (HRW) varieties were fertilized with an additional 30 lbs. of nitrogen applied at flowering to increase grain protein. Unfortunately, this late season N application did not increase grain protein over 12% for any variety. IREC staff have struggled to get winter hard red wheat proteins over 12% for several years. This outcome is likely due to several factors including the high yield potential of winter varieties and our unique soil and growing conditions. The HRW variety OR323001OH had the highest grain yield for the 2024 trial at 175 bu/acre. The three varieties with the highest 4-Year average yield were WB4394, Millie, and LCS Jet. WB4394 has acceptable baking quality and an average 4-year yield of 171 bu/A.

2024 OREGON HARD WINTER WHEAT YIELD RESULTS

Tulelake (Irrigated)

Oregon State University

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

Site Description: Trial was relatively uniform.

This trial was a collaboration between OSU and the UC-Davis Intermountain Research and Extension Center.

Variety	Herbicide Traits	Quality*	Class	Yield (bu/acre) 2024 Yield	2024 Rank	2-Year Average	3-Year Average	4-Year Average	5-Year Average	Best Estimate**
OR3230010H (OR3001)	AX		HRW	175	1					**187 ± 22**
WB4394		A	HRW	154	5	163	169	171		**171 ± 11**
LCS Blackbird		LD	HRW	141	13	158	161			**167 ± 12**
Millie		MD	HWW	149	9	163	165	166		**166 ± 11**
LCS Jet		A	HRW	161	2	162	156	164		**164 ± 11**
WB4303		A	HRW	144	12					**164 ± 15**
LCS Eclipse AX	AX		HRW	152	6					**164 ± 22**
WB4510 CLP	CL+		HRW	151	8					**163 ± 22**
OR2190064R			HRW	151	7	158				**163 ± 15**
LWH21-5281			HRW	149	10					**161 ± 22**
Keldin		D	HRW	140	14	155				**161 ± 12**
LCS Missile		MD	HRW	159	3	153	152			**158 ± 12**
OR3230015H (OR3002)	AX		HRW	146	11					**158 ± 22**
Scorpio		MD	HRW	158	4	157	149	157		**157 ± 11**
WA8399			HRW	139	15					**151 ± 22**
OR2190160R			HRW	138	16					**150 ± 22**
WA8401			HRW	130	17					**142 ± 22**
OR2190165R			HRW	124	18					**136 ± 22**
		Average		148		159	159	165		**160**
		LSD (0.05)		15						
		CV (%)		7.4						

*Quality ratings assigned by the USDA Western Wheat Quality Laboratory.
Quality Ratings: MD = Most Desirable; D = Desirable; A = Acceptable; LD = Least Desirable; UCS = Unacceptable Except Customer-Specific Uses
**Best linear unbiased estimators (BLUEs) are best estimators of variety performance relative to other varieties, based on up to five years of data.

2024 OREGON HARD WINTER WHEAT PLANT CHARACTERISTICS

Tulelake (Irrigated)

Site Description: Trial was relatively uniform.

Variety	Class	Height (in)	Test Weight (lb/bu)	Protein (%)	Heading Date
OR3230010H (OR3001)	HRW	40.7	59.1	9.3	6/5
WB4394	HRW	40.0	62.3	9.6	6/7
LCS Blackbird	HRW	34.1	56.9	10.8	6/6
Millie	HWW	37.1	61.4	10.1	6/6
LCS Jet	HRW	36.1	60.0	9.8	6/5
WB4303	HRW	33.5	58.1	9.7	6/5
LCS Eclipse AX	HRW	39.4	58.7	8.9	6/7
WB4510 CLP	HRW	38.1	61.6	9.3	6/5
OR2190064R	HRW	36.4	60.3	9.9	6/7
LWH21-5281	HRW	39.7	60.8	10.5	6/9
Keldin	HRW	37.1	55.2	9.4	6/6
LCS Missile	HRW	38.7	60.6	9.7	6/7
OR3230015H (OR3002)	HRW	39.7	58.5	9.7	6/7
Scorpio	HRW	35.4	59.6	10.0	6/6
WA8399	HRW	34.8	58.7	9.2	6/9
OR2190160R	HRW	34.4	59.5	10.7	6/7
WA8401	HRW	35.8	58.9	9.2	6/8
OR2190165R	HRW	36.1	58.1	10.6	6/7
	Average	37.1	59.3	9.8	6/7
	LSD (0.05)	4.1	3.8	0.4	1.1
	CV (%)	8.0	4.6	2.7	0.0

2024 Soft White Winter Wheat Trial

Planting Date: 10/17/2023
Previous Crop: Sudan Grass
2024 Soil Test N: 5.9 ppm (21 lbs. N/Acre)
Nitrogen Fertilizer: Season total applied Nitrogen was 171 lbs per acre applied through the season. 21 lbs. N/A at planting (10/17/2023), 50 lbs. N/A early through late tillering (4/1/2024), 100 lbs. N/A through stem elongation (5/9/2024).
Irrigation Quantity: Solid-set sprinklers 13.23 Acre inches (final irrigation 6/11/2024)
Harvest Date: 8/13/2024
Variety Highlights: Winter wheat continues to be the highest yielding wheat raised at IREC under full irrigation. Wheat is a cool season grass and winter varieties mature earlier than spring planted types. This usually means winter wheat can more effectively utilize winter/spring soil moisture and avoid maturing during the hottest part of the growing season. LWW20-2867 was the highest yielding variety in 2024. LCS Blackjack and AP Exceed were the highest yielding varieties for the 3-year trial average with yields over 171 bushels/acre. LCS Blackjack has the advantage of being awnless, making it a dual-purpose type.

2024 OREGON SOFT WINTER WHEAT YIELD RESULTS

Tulelake (Irrigated)

Site Description: Trial was relatively uniform.

This trial was a collaboration between OSU and the UC-Davis Intermountain Research and Extension Center.

Variety	Herbicide Traits	Quality	Class	2024 Yield	2024 Rank	2-Year Average	3-Year Average	4-Year Average	5-Year Average	Best Estimate**
VI Gem (UIL 13-046145A)			SWW	159	4					**182 ± 16**
AP Exceed		MD	SWW	162	2	171	177	177		**181 ± 12**
LWW20-2867			SWW	163	1					**178 ± 23**
LCS Blackjack		D	SWW	162	3	174	172	171	177	**177 ± 10**
WB1545			SWW	158	5					**174 ± 23**
LWWC21-0331	CL+		SWW	157	8					**172 ± 23**
OR2180350			SWW	155	10					**171 ± 23**
OR5180072			Club	157	7	162				**169 ± 16**
WA8397			SWW	153	14					**168 ± 23**
LWWC21-0317	CL+		SWW	152	16					**167 ± 23**
WA8398			SWW	152	17					**167 ± 23**
LCS Scorpion AX	AX		SWW	147	20	159				**166 ± 16**
OR2180149			SWW	154	12					**165 ± 16**
Sockeye CL+	CL+	MD	SWW	157	6	157				**165 ± 16**
LCS Hydra AX	AX		SWW	131	40	156				**163 ± 16**
AP Olympia			SWW	148	18					**163 ± 23**
WB1922		D	SWW	143	25	162	159			**163 ± 13**
WB1621		MD	SWW	152	15	159	157			**161 ± 13**
LCS Jefe		D	SWW	157	9	154	162	156		**160 ± 12**
Nova AX (WA8346 AX)	AX	MD	SWW	137	32	152				**160 ± 16**
LCS Shine		MD	SWW	121	47	145	156	156	159	**159 ± 10**
WA8404			SWW	141	28					**156 ± 23**
Rosalyn		A	SWW	125	44	144	149	148	155	**155 ± 10**
Stephens		D	SWW	144	22	148				**155 ± 13**
OR2200083 CL+	CL+		SWW	147	19	147				**155 ± 16**
LWW20-2383			SWW	139	29					**155 ± 23**
TMC M-Pire		D	SWW	144	23	147				**155 ± 16**
LCS Kamiak		A	SWW	142	27	140	148	150		**154 ± 12**
Piranha CL+	CL+	D	SWW	132	39	146				**153 ± 16**
Gale (OR2180377)			SWW	147	21	152	150			**153 ± 13**
OR3230026 AX	AX		SWW	137	31					**153 ± 23**
OR5180071			Club	139	30	156	154	147		**151 ± 12**
Mallory CL+ (ORI2190025	CL+		SWW	153	13	149	147			**151 ± 13**
Calypso (ARS09500-17CBW)			Club	155	11	151	147			**151 ± 13**
ORI2190027 CL+	CL+		SWW	142	26	145	147			**150 ± 13**
WA8405			SWW	135	34					**150 ± 23**
LWW21-1834			SWW	134	36					**150 ± 23**
VI Voodoo CL+	CL+	D	SWW	127	42	141				**148 ± 16**
Nimbus		MD	SWW	134	35	143	142	144		**148 ± 12**
LWWC21-0119	CL+		SWW	133	38					**148 ± 23**
AP Iliad		A	SWW	126	43	135	144			**148 ± 13**
TMC M-Press		D	SWW	119	48	140				**147 ± 12**
OR2170559			SWW	135	33	140	144	140		**144 ± 12**
Cameo		MD	Club	113	49	130	138	139		**143 ± 12**
LCS Drive		D	SWW	133	37	134	138	138		**142 ± 12**
VI Encore CL+ (UIL 17-7706	CL+	D	SWW	127	41	134				**142 ± 16**
Appleby CL+	CL+	D	SWW	143	24	132				**140 ± 16**
ARS Crescent		MD	Club	123	45					**139 ± 23**
OR5190014			Club	123	46					**138 ± 23**
SY Assure		D	SWW	108	52	105	120	127		**131 ± 12**
Norwest Tandem		A	SWW	110	51	118	125	126		**130 ± 12**
LWWA22-D33	AX		SWW	113	50					**128 ± 23**
LCS Reaper II AX	AX		SWW	105	53					**120 ± 23**
ARS Castella		MD	Club	80	54					**112 ± 16**
		Average		139		146	149	148	164	**154**
		LSD		23						
		CV (%)		12.0						

*Quality ratings assigned by the USDA Western Wheat Quality Laboratory.
Quality Ratings: MD = Most Desirable; D = Desirable; A = Acceptable; LD = Least Desirable; UCS = Unacceptable Except Customer-Specific Uses

**Best linear unbiased estimators (BLUEs) are best estimators of variety performance relative to other varieties, based on up to five years of data.

2024 OREGON SOFT WINTER WHEAT PLANT CHARACTERISTICS

Oregon State University

Tulelake (Irrigated)

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

Site Description: Trial was relatively uniform.

Variety	Class	Height (in)	Test Weight (lb/bu)	Protein (%)	Heading Date
VI Gem (UIL 13-046145A)	SWW	41.0	60.7	10.2	6/7
AP Exceed	SWW	39.7	60.1	10.3	6/7
LWW20-2867	SWW	40.0	58.9	9.5	6/9
LCS Blackjack	SWW	36.5	54.2	10.6	6/8
WB1545	SWW	38.3	61.3	11.1	6/5
LWWC21-0331	SWW	40.0	60.6	11.4	6/10
OR2180350	SWW	36.1	58.4	9.7	6/7
OR5180072	Club	36.4	59.7	10.9	6/7
WA8397	SWW	38.0	59.5	10.2	6/10
LWWC21-0317	SWW	41.4	60.6	10.9	6/8
WA8398	SWW	37.7	59.4	10.5	6/10
LCS Scorpion AX	SWW	38.1	60.4	9.7	6/7
OR2180149	SWW	42.3	59.3	10.5	6/8
Sockeye CL+	SWW	43.6	58.1	9.5	6/10
LCS Hydra AX	SWW	39.0	60.6	10.0	6/10
AP Olympia	SWW	39.0	60.0	10.1	6/9
WB1922	SWW	43.4	61.3	10.6	6/11
WB1621	SWW	42.3	60.3	10.4	6/9
LCS Jefe	SWW	39.0	60.1	9.6	6/9
Nova AX (WA8346 AX)	SWW	45.0	59.9	9.4	6/9
LCS Shine	SWW	34.1	59.4	10.9	6/8
WA8404	SWW	39.1	59.6	10.7	6/10
Rosalyn	SWW	39.0	59.0	10.2	6/10
Stephens	SWW	41.1	58.1	10.3	6/7
OR2200083 CL+	SWW	38.1	56.9	11.3	6/8
LWW20-2383	SWW	39.0	60.7	10.4	6/7
TMC M-Pire	SWW	35.4	60.9	11.0	6/8
LCS Kamiak	SWW	38.7	61.0	10.6	6/7
Piranha CL+	SWW	41.1	56.8	10.1	6/9
Gale (OR2180377)	SWW	37.5	56.0	10.8	6/10
OR3230026 AX	SWW	38.1	58.9	10.5	6/7
OR5180071	Club	39.7	57.6	10.7	6/11
Mallory CL+ (ORI2190025 CL+)	SWW	38.5	57.9	10.4	6/7
Calypso (ARS09500-17CBW)	Club	41.7	60.9	10.8	6/10
ORI2190027 CL+	SWW	37.5	59.0	10.6	6/7
WA8405	SWW	39.4	58.7	11.2	6/11
LWW21-1834	SWW	40.3	58.8	10.0	6/7
VI Voodoo CL+	SWW	34.4	60.2	10.7	6/9
Nimbus	SWW	46.2	60.5	10.7	6/9
LWWC21-0119	SWW	39.1	59.8	11.0	6/9
AP Iliad	SWW	34.8	57.8	11.2	6/8
TMC M-Press	SWW	39.0	59.5	10.7	6/10
OR2170559	SWW	39.0	58.9	11.2	6/9
Cameo	Club	39.0	58.7	11.5	6/9
LCS Drive	SWW	32.1	56.4	10.8	6/8
VI Encore CL+ (UIL 17-7706 CL+)	SWW	38.8	60.3	11.8	6/9
Appleby CL+	SWW	41.4	60.3	10.6	6/9
ARS Crescent	Club	43.2	60.3	10.2	6/11
OR5190014	Club	38.0	58.7	10.3	6/10
SY Assure	SWW	33.5	58.9	12.3	6/5
Norwest Tandem	SWW	39.0	58.2	10.5	6/7
LWWA22-D33	SWW	34.4	57.6	10.8	6/9
LCS Reaper II AX	SWW	36.1	60.4	11.6	6/7
ARS Castella	Club	40.4	57.5	11.5	6/9
	Average	39.0	59.2	10.6	6/9
	LSD (0.05)	2.5	1.9	0.8	1.5
	CV (%)	4.7	2.2	5.6	0.0

2024 UC Davis Spring Elite Grain Trial

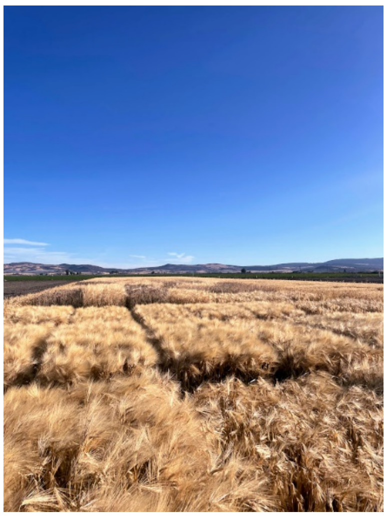
Planting Date: 4/26/2024
Previous Crop: Sudan Grass
2024 Soil Test N: 11.4 ppm (41 lbs. N/Acre)
Nitrogen Fertilizer: Season total applied Nitrogen was 180 lbs per acre applied through the season. 50 lbs. N/A at planting (4/23/2024) urea, 100 lbs. N/A early tillering through late tillering (6/13/2024), 30 lbs. N/A at flowering to increase protein (7/5/2024).
Irrigation Quantity: Solid-set sprinklers 14.49 Acre inches (final irrigation 7/5/2024)
Harvest Date: 8/29/2024

Trial information and Variety Highlights: This trial was organized by the University of California, Davis Small Grains Breeding Program. It included released named varieties of both hard spring wheats and triticale grain classes. UC1991 was the highest yielding entry among the spring wheats yielding around 4 tons/A. Over the past couple of years, UC Central Red, WB9668 and WB9727 produced higher grain yields and similar protein (>14%) compared to Yecora Rojo. WB9990 and WB Patron are awnless hard red spring types that can be harvested for forage; neither had grain protein over 14%. As for triticale types, UC Atrea and UC Bopak are University of California releases with high feed grain and silage yields. More information on both these releases can be found at: https://dubcovskylab.ucdavis.edu/sites/default/files/upload_files/UCAtrea_Summary_CJ_5_19_2021.pdf

UC Small Grains Spring Elite Trial Tulelake, CA (Irrigated)			
Variety	Avg Height (CM)	% Lodging (8-26-24)	Tons/A
Wheat Types			
UC CENTRAL WHITE	79.4	0	3.86
UC CENTRAL RED	77.5	0	3.75
YECORA ROJO 515	66.9	0	2.77
YECORA ROJO	68.8	0	3.44
WB PATRON	78.1	0	3.88
WB 9990	75.0	0	3.80
WB 9727	76.9	0	3.84
WB9749	84.4	0	3.57
WB9668	76.3	0	3.67
UC 1975	80.0	0	3.77
UC 1988	79.4	0	4.01
UC 1989	80.0	0	3.97
UC 1990	86.3	0	3.60
UC 1991	76.3	0	4.10
UC 1992	86.9	0	3.21
UC 1993	63.1	0	3.61
Triticale Types			
UC ATREA	96.3	0	4.45
UC BOPAK	99.4	0	4.24
Merlin Max	123.1	0	3.66
Gunner	141.3	8.25	3.41
Legend	79.4	0	4.32
UC 3198	106.3	0	3.62
UC 3199	90.6	0	3.63
UC 3200	120.6	0	4.00
UC 3201	111.9	0	3.89
UC 3202	106.9	0	4.23
Average			**3.78**

2023 and 2024 Spring West Bred Wheat Strip Trials

Planting Date: 4/24/2024
Previous Crop: Sudan Grass
2024 Soil Test N 11.4 ppm (41 lbs. N/Acre)
Nitrogen Fertilizer: Season total applied Nitrogen was 180 lbs per acre applied through the season on hard red types and 150 lbs. per acre for soft white types. 50 lbs. N/A at planting (4/23/2024) urea, 100 lbs. N/A early tillering through late tillering (6/13/2024), 30 lbs. N/A at flowering to increase protein (7/5/2024) in hard red types.
Irrigation Quantity: Solid-set sprinklers 14.49 Acre inches (final irrigation 7/5/2024)
Harvest Date: 8/29/2024

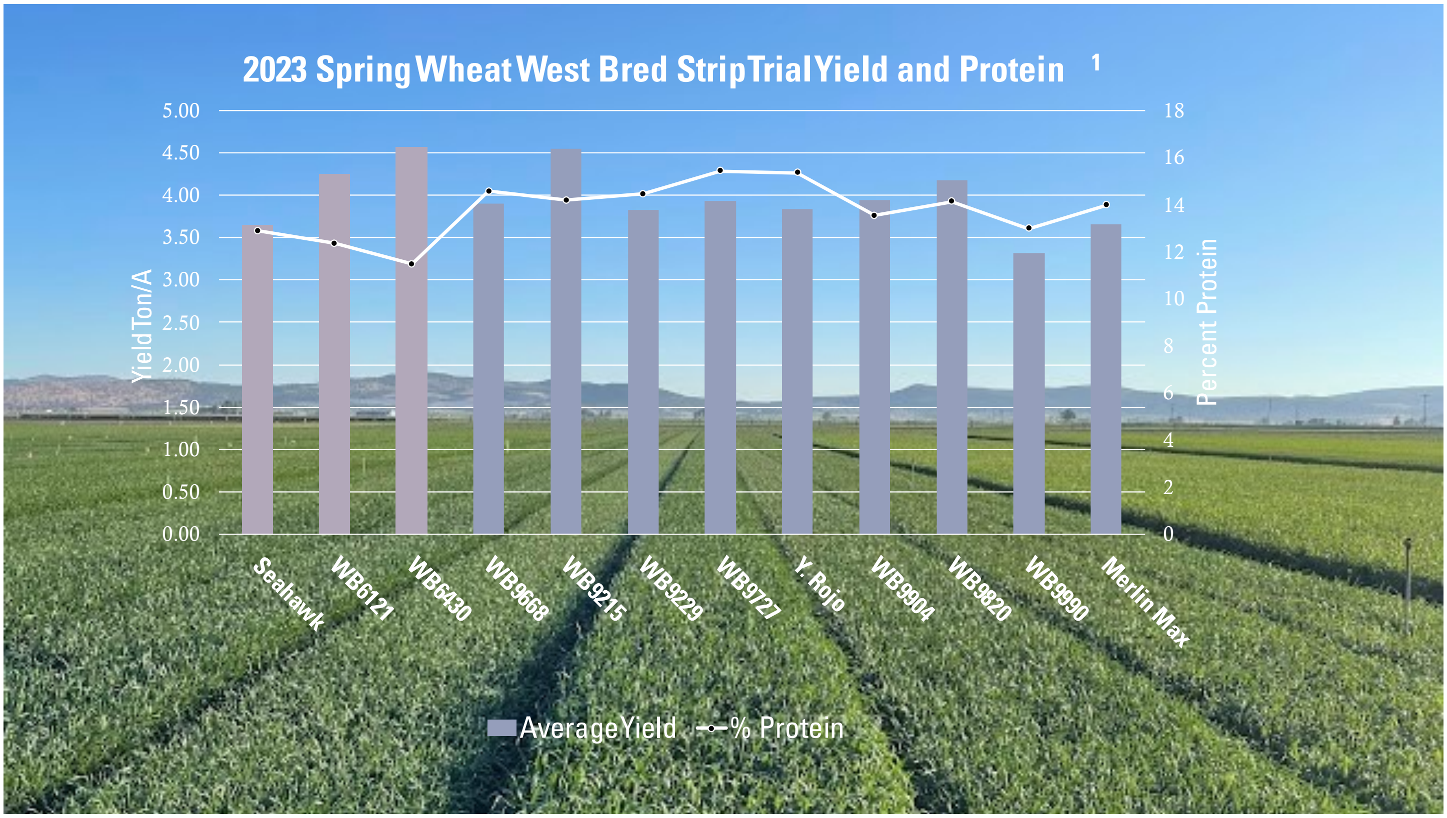


Trial Information: The Intermountain Research and Extension Center has lacked funding to conduct regional, replicated spring grain trials the last two years. WestBred spring wheat lines have historically produced high yields in Tulelake. To maintain some local yield information with minimal cost to the Center, we planted several WestBred lines in unreplicated strips in 2023 and 2024. These strips were maintained using our typical grain rotation and irrigated using solid set sprinklers. In 2023, the trial included three soft white wheat, eight hard red wheat, and one triticale grain type. The UC Davis Small Grains Program provided protein levels for the 2023 trial.

Variety Highlights: In 2023, WB6121 and WB6430 were the best performing spring soft white wheat varieties producing over 4.25 tons/acre. Protein levels for both were above 11%, meaning we likely applied to much nitrogen trying to maximize yield. In 2023 and 2024, West Bred hard red varieties WB9668, WB9215 and WB9727 had protein over 14% and higher grain yield compared toYecora Rojo. See graphs below for a snapshot of results for each year.

Grain Protein Management:
Recently there have been a lot of questions regarding management of protein in different types of grain. The grain protein content in wheat is directly related to the amount of nitrogen plants obtain from the soil and grain yield. To avoid dockage in payment, grain markets have protein standards for spring hard red wheats set at 14% or above, while spring soft wheat need to be below 11%. Growers wanting red wheat protein above 14% will need roughly 20-30 percent more nitrogen available to the plant during the flowering growth stage compared to soft white wheat.

A general rule of thumb is wheat requires about 50 lbs. of available nitrogen in the soil for every ton of grain yield. For example, if you have a grain yield goal of 3 tons, the crop will need roughly 150 lbs. of nitrogen. Fortunately, most soils have residual nitrogen from the previous season and naturally mineralize nitrogen from organic matter. Thus, it's rare a grower needs to apply all 150 lbs of nitrogen as nitrogen fertilizer. If you consider soil residual nitrogen along with organic matter, nitrogen fertilizer amounts can be reduced by more than 50% especially in Tulelake soils with high organic matter. Organic matter is rich in nutrients. Many Tulelake soils have an organic matter content of 4-8%, and these soils can release 50-100 lbs. of nitrogen per acre to spring grain crops. ***Daniel Geissler, a University of California Cooperative Extension Specialist in nutrient management, has conducted multiple years of soil nitrogen mineralization research at IREC. His lab produced an online nitrogen calculator for spring wheat grown for grain.*** The calculator, http://geisseler.ucdavis.edu/Crop_N_Calculator_2025_01_06.html accounts for most factors related to wheat nitrogen needs such as planting date, residual soil nitrate from the previous crop, expected yield, soil organic matter %, irrigation, and soil type. This calculator is a great way to closely estimate spring wheat nitrogen fertilizer amounts. Lastly, hard red wheat growers that want protein over 14% should apply additional nitrogen fertilizer at heading to bump grain protein. For IREC trials, we applied an additional 30 lbs. of nitrogen in the last irrigation.



[1]Trial conducted on both spring soft white wheat and hard red wheat. Soft white types in lighter color (Seahawk, WB6121, and WB6430).

2024 Potato Variety Development

University of California Agriculture and Natural Resources

Research and Extension Center System

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Three potato variety trials were conducted at the Intermountain Research and Extension Center in Tulelake, CA. Trials were categorized by market type and included a Russet trial with 21 entries, a Specialty trial with 14 entries, and a Chipping trial with 9 entries. Entries included selections from the Western Regional (WR) variety development program, Southwest Regional (SWR) variety development program, and varieties of local interest. The tables below highlight some of the results from these trials.

Table 1: 2024 Intermountain Research & Extension Center Russet Variety Trial

	Total CWT/Acre	Culls + 2's CWT/Acre	%1's	U.S. 1's CWT/Acre	Merit Score (1-5, 5=best)	Tubers per Plant	Average Tuber Size (oz)
Clearwater Russet	308.3	8.5	81	248.0	4.0	5.4	5.7
Ranger Russet	422.5	7.1	84	355.7	3.0	6.1	6.2
Russet Burbank	376.9	9.1	77	290.1	3.0	6.9	5.1
A09086-1LB	470.4	2.8	82	383.6	2.5	8.2	5.3
A12304-1sto	481.4	5.1	79	376.6	3.0	8.5	5.5
A12305-2adg	517.9	8.9	92	477.9	4.0	7.1	7.0
A13072-7	429.8	32.6	86	374.4	3.0	4.2	9.6
A13091-5	223.8	4.7	76	174.4	3.0	4.0	5.2
AFA5661-8	466.1	8.6	91	424.4	3.5	6.7	6.8
AOR11217-3	390.9	8.5	88	346.2	3.0	5.8	6.4
AOR13064-2	330.3	9.6	86	285.1	2.5	4.5	6.8
AOR15166-2	298.5	3.5	87	259.0	3.0	4.7	5.8
NWN 278	503.3	9.9	91	459.3	3.5	6.2	7.6
CO13003-1RU	329.5	5.9	78	258.0	3.5	6.1	5.0
CO15016-1RUsto	340.8	3.4	75	257.2	3.5	6.4	5.0
COTX08063-2Ru	397.7	7.5	81	322.3	2.5	7.0	5.4
COTX10080-2Ru	372.7	5.3	83	308.9	3.5	6.1	5.8
CO15070-4RU	413.4	4.8	81	334.2	3.5	7.2	5.6
CO16238-4RU	240.3	0.6	53	126.6	3.0	5.9	3.8
PSS11/357/21Ru	364.4	10.8	90	329.1	3.0	4.6	7.4
PSS11/339/3Ru	384.4	4.0	87	335.1	3.5	5.4	6.6
Mean	**384.0**	**7.7**	**82**	**320.3**	**3.2**	**6.1**	**6.1**

Table 2: 2024 Intermountain Research & Extension Center Specialty Variety Trial							
Clone / Variety	Skin Color	Flesh Color	Total Yield CWT/Acre	Culls CWT/Acre	Merit Score (1-5, 5=best)	Tubers/ Plant	Average Size (oz)
Chieftain	Red	White	590.2	12.9	3.0	9.5	5.7
Modoc	Red	White	433.8	20.6	3.5	11.0	3.7
A11582-1R	Red	White	483	7.0	4.0	16.0	2.8
COOR15108-1	Red	White	362.2	3.9	4.0	14.2	2.4
A11573-5RYsto	Red	Yellow	412.1	6.7	3.5	16.2	2.4
Yukon Gold	Yellow	Yellow	405.2	14.6	3.0	6.0	6.5
A11576-1Ysto	Yellow	Yellow	466.6	7.5	3.5	19.0	2.3
AORTX09037-5W/Ychc	Yellow	Yellow	421.8	5.5	2.0	12.1	3.3
Purple Majesty	Purple	Purple	500.9	8.7	2.5	13.1	3.6
POR16PG25-2	Purple	Purple	465.6	4.3	3.0	12.8	3.5
TC17742-1PW/PW	Purple/White	Purple/White	241.8	0.4	1.0	6.3	3.6
ATX13134-3W/Y	White	Yellow	278.1	2.0	2.0	8.3	3.1
CO16154-2Y	White	Yellow	488.6	12.6	1.5	12.3	3.8
CO16279-5Y	White	Yellow	570.4	11.4	2.5	13.8	4.2
Mean			**425.4**	**8.1**	**2.8**	**12.4**	**3.5**

Table 3: 2024 Intermountain Research & Extension Center Chip Variety Trial						
Clone / Variety	Total Yield CWT/Acre	Culls CWT/Acre	Merit Score (1-5, 5=best)	Tubers/ Plant	Average Tuber Size (oz)	Specific Gravity
Atlantic	456.1	9.9	3.5	7.2	6.3	1.100
Lamoka	445.0	15.7	3.5	7.4	6.0	1.101
Snowden	364.0	11.4	3.0	5.8	5.9	1.099
A13125-3C	508.6	9.4	4.0	9.3	5.2	1.101
A16150-1C	433.1	8.7	3.5	10.0	4.4	1.104
A16153-2C	447.2	11.2	3.0	11.7	3.5	1.097
A16154-2C	401.1	28.4	3.0	6.1	6.3	1.079
AC13125-5W	368.1	9.0	4.0	8.3	4.5	1.079
AC13126-1Wadg	435.8	13.7	3.0	7.9	6.0	1.093
Mean	**428.8**	**13.0**	**3.4**	**8.2**	**5.3**	**1.095**

University of California
Agriculture and Natural Resources
Intermountain Research & Extension Center
RESEARCH REPORT
Number 208, 2024

Influence of Fungicides and Soil Moisture on Black Dot (*Colletotrichum coccodes*) Tuber Blemish

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Introduction

Black dot fungal structures (sclerotia) on harvested tubers are a consistent problem for fresh market potato producers throughout California. Tubers infected with black dot tuber blemish have a rash like appearance that is especially evident on washed red and yellow skin potatoes making them unmarketable. Black dot infection on below ground stems and stolons occurs within weeks of sprouting. Fungicides are effective at suppressing black dot during the growing season, but fungicides have not been shown to reduce tuber blemish.

Cultural management and harvest timing impact black dot on daughter tubers. IREC research in 2021 and 2022 showed harvesting potatoes earlier in the season when vines were >50% green greatly reduced tuber blemish. The studies also showed reducing the amount of time tubers remain in the soil after vine-kill can reduce tuber blemish. Unfortunately, early vine-kill and harvest has negative outcomes such as reduced tuber size and poor skin-set. In 2024, a fungicide trial and irrigation trial were established at IREC to evaluate the effect of fungicides and soil moisture on black dot tuber blemish.

Site Information

- **Soil type-** mucky silty clay loam-6% OM
- **Irrigation –** solid-set sprinklers
- **Potato Spacing-** 36 inch rows with 10 inch seed spacing
- **Design-** Randomized complete block with 4 blocks (reps)
- **Planting and Harvest Dates:** May 20, 2024 and September 13, 2024

Study Methods

Studies were conducted in a field at the IREC with a history of natural black dot infection. Soil samples collected in March 2024 confirmed the presence of black dot in the field using real time q-PCR tests. A yellow skinned potato variety, Constance, was used in both studies. Irrigation plots were 36ft by 42ft arranged in a randomized complete block design with 3 replications. Fungicides plots were 12ft by 20 ft arranged in a randomized complete block design with 4 replications. Potatoes were grown using normal conventional management practices. Vines were killed at 50% green on August 16th 88 days after planting. Vines were killed using Reglone and rolling. Potatoes were harvested 28 days after vine kill. Tubers were harvested from the center row in each plot.

Irrometer watermark sensors were buried at 6-inch and 10-inch depths to record soil moisture in both studies. Irrigation was scheduled using soil moisture and evapotranspiration. Irrigation scheduling for the fungicide trial focused on keeping soil moisture readings between 10 and 30 centibars from early bulking to harvest.

Irrigation scheduling for the irrigation trial keep soil moisture between 0 and 20 centibars from early tuber bulking until potato harvest in the wet treatment. Soil moisture was kept between 20 and 40 centibars in the dry treatment.

Fungicides were not applied in the irrigation trial except for treating the seed with fludioxonil (Maxim) to prevent early season stand loss. Seed used in the fungicide trial was treated with fludioxonil (Maxim) and azoxystroblin (Dynasty). The fungicide trial evaluated eight fungicide treatments with an untreated control (Table 1). All treatments included a fungicide applied in-furrow and foliar applied fungicides at 20 gallons per acre. Foliar fungicides were applied every 14 days starting at the 6-inch rosette stage and ending at vine-kill. Foliar fungicides were broadcast applied with a CO2 backpack sprayer with a nonionic surfactant at 0.25% v/v. **Several fungicide treatments exceeded the maximum labelled rate. The research team decided on this approach to keep mode of action separate between treatments and assure fungicides were applied throughout the growing season**.

Trt #	Fungicide Treatment
1	**Untreated**
2	**Quadris** (azoxystroblin- group 11) trt- **Quadris**- 0.8 fl oz/1000ft of row in-furrow & **Quadris** at 12 fl oz/A foliar
3	**Evito** (fluoxastrobin group 11) trt- **Evito**- 0.24 fl oz/1000 ft of row in-furrow & **Evito** 3.8 fl oz/A foliar
4	**Headline SC** (pyraclostrobin group 11) trt- **Headline** 0.8 fl oz/1000 row ft in-furrow & **Headline** 9 fl oz/A foliar
5	**Fontelis** (penthiopyrad group 7) trt- **Fontellis** - 1.6 fl. oz/1000 row-ft in-furrow & **Fontelis** at 14 fl oz/A foliar
6	**Velum/Luna Tranquality** (fluopyram group 7) trt- **Velum Rise**-13 fl oz/A in-furrow & **Luna Tranquility** 11.2 fl oz/A foliar
7	**Velum/Revus Top** (mandipropamid + difenoconazole group 3 and 40)trt- **Velum Rise**- 13 fl oz/A in-furrow & **Revus top** 7 fl oz/A foliar
8	**Velum/Provysol** (mefentrifluconazole group 3) trt- **Velum Rise** 13 fl oz/A in-furrow & **Provysol** 5 fl oz/A foliar
9	**Velum/Miravis Prime** (pydiflumetofen + fludioxonil group 7 & 12) trt- **Velum Rise** 13 fl oz/A in-furrow & **Miravis Prime** 11.4 fl oz/A foliar

Data included tuber yield, tuber size, and the incidence and severity of black dot on daughter tubers. Tuber yield and size was determined by running all potatoes from each plot across an automated grade-line. Twenty-five tubers were randomly pulled from the gradeline from each plot and then stored for 60 days after harvest. The 25 tubers were washed and polished to remove all soil for the tuber surface. Black dot incidence and severity was determined by visually evaluating percent coverage of black dot tuber blemish on all tubers.

Irrigation Trial Results

Black dot tuber blemish (Figure 1) and tuber defects were similar between irrigation treatments (Table 2). Tubers per plant, tuber size, and tuber yield were also similar between irrigation treatments (Table 3). Potatoes left in the field for an additional two weeks in the dry treatment had significantly more black dot blemish (personal observation) supporting the idea that extended time in the soil after vine kill increasing black dot blemish.

Figure 1. Black dot tuber blemish.

Table 2. Black dot Coverage and Potato Quality for vine kill and skin set treatments at IREC in 2024.

Trt #	Treatment	Black dot blemish tuber coverage %	Incidence of black dot blemish %	Knobs	Growth cracks	Green
				Total Tuber percentages %		
1	wet soil moisture at bulking & harvest	3.50 a[1]	45 a	1.5% a	0.0% a	2.0% a
2	dry soil moisture at bulking & harvest	3.00 a	43 a	1.9% a	0.2% a	1.5% a
	p-value	0.56	0.76	0.36	0.08	0.09

[1] Means with the same letter within columns are not statistically different using the Tukey HSD mean comparison test.

Table 3. Potato stand, yield, and size for vine kill and skin set treatments at IREC in 2024.

Trt #	Treatment	Potato Stand %	Tubers/ plant #	Avg tuber size oz	Total yield CWT/A	>14 oz	10-14 oz	6-10 oz	4-6 oz	<4 oz	culls
						Tuber size class percentages					
1	wet soil moisture at bulking & harvest	93% a	9.92 a	3.03 a	310 a	0.0%	0.0% a	5.6% a	23.3% a	71.0% a	4.4% a
2	dry soil moisture at bulking & harvest	93% a	9.79 a	2.96 a	288 a	0.0%	0.1% a	4.8% a	21.2% a	66.9% a	3.8% a
	p-value	1.00	0.82	0.30	0.18	1.00	0.35	0.69	0.41	0.28	0.37

[1] Means with the same letter within columns are not statistically different using the Tukey HSD mean comparison test.

Fungicide Trial Results

The incidence and coverage of black dot tuber blemish was statistically similar across fungicides (Table 4). Quadris, Evito, and Provysol treatments had numerically lower incidence and coverage compared to the untreated control. Potato yield and size was statistically similar across fungicides (Table 5). Total yield was numerically highest in the untreated control (Table 5).

Table 4. Influence of fungicides on black dot tuber blemish on a yellow-skin fresh market potato (2024 Tulelake, CA)

Trt #	Fungicide Treatment	Coverage of tuber skin with blemish %	Incidence of tuber blemish %
1	**Untreated**	3.7	52
2	**Quadris** in-furrow and foliar	2.5	36
3	**Evito** in-furrow and foliar	1.8	27
4	**Headline SC** in-furrow and foliar	3.0	43
5	**Fontelis** in-furrow and foliar	3.1	38
6	**Velum Rise** in-furrow & **Luna Tranquility** foliar	3.9	46
7	**Velum Rise** in-furrow & **Revus top** foliar	3.9	40
8	**Velum Rise** in-furrow & **Provysol** foliar	2.3	32
9	**Velum Rise** in-furrow & **Miravis Prime** foliar	3.5	43
	ANOVA p-value	0.258	0.257

25 washed and polished tubers per plot (4) were visually evaluated 60 days post-harvest

Table 5. Influence of fungicides on potato yield for a yellow-skin fresh market potato (2024 Tulelake, CA)

#	Fungicide Treatment	Tubers per plant	Ave. tuber size	10-14 oz	6-10 oz	4-6 oz	<4 oz	cull	Total
		#	oz	cwt/A					
1	**Untreated**	10.3	3.0	0	12	63	197	13	285
2	**Quadris** in-furrow and foliar	9.7	2.9	0	9	52	168	13	242
3	**Evito** in-furrow and foliar	9.0	2.9	1	9	49	177	10	245
4	**Headline SC** in-furrow and foliar	10.0	3.0	0	10	69	178	8	265
5	**Fontelis** in-furrow and foliar	10.1	2.8	0	4	47	198	11	260
6	**Velum Rise** in-furrow & **Luna Tranquility** foliar	9.4	2.9	0	6	52	189	9	256
7	**Velum Rise** in-furrow & **Revus top** foliar	9.7	3.0	0	10	67	175	6	257
8	**Velum Rise** in-furrow & **Provysol** foliar	9.2	2.9	0	9	49	181	9	248
9	**Velum Rise** in-furrow & **Miravis Prime** foliar	9.3	3.0	0	9	59	186	9	263
	ANOVA p-value	0.62	0.76	0.46	0.88	0.50	0.23	0.60	0.40

Special Thanks: The research team would like to thank the California Potato Research Advisory Board for financial or in-kind support of this research.

Bundle Threshing Spinach Seed Increase

Melted Sprinkler from Lightning Strike

Dry Bean and Garbanzo Bean Variety Trial

Perennial Grass Breeding Block