2020 Spring Research Update

Intermountain Research and Extension Center

RECS | University of California Agriculture and Natural Resources

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It's been a roller-coaster first few months for Klamath Basin farmers with the anticipated water shortage, declared drought, COVID-19 disruptions, and uncertain markets. If you are like me, the uncertainty of these events has increased anxiety levels. I don't have a good solution to ending the now almost yearly water crisis, but I do know Klamath Basin farmers are innovative and one of the best farming communities at working together to find solutions. I encourage everyone to band together in these tough times to work toward a more sustainable future for Klamath Basin agriculture.

At IREC, we've been busy summarizing 2019 research results, writing reports, and preparing for 2020. Many of you commented last year you like receiving an annual update on IREC research. So here it is! This report contains several short summaries of research conducted at IREC in 2019 that will hopefully help in your decision making. If you would like additional information on a project, don't hesitate to give me a call or stop by the office.

I've included a short voluntary questionnaire for you to complete along with the report. The last twelve months have brought several changes to Klamath Basin Agriculture with the most prominent being limited water and hemp production. I'd like everyone's feedback and opinions on research needs and priorities for the near future. Please take the time to fill it out and return via mail to assure our research priorities align with local needs.

On another note I hope everyone is aware of our new conference and meeting rooms. The local 4-H clubs along with several local entities held events over the last year. The rooms are available for public use and I encourage everyone to take advantage of this modern facility for meetings and gathering. With that being said, the COVID-19 outbreak is forcing all organizations to limit group meetings and alter operations to try to fight the spread of this disease. For the latest information on use of the conference rooms, stop by the office or call Myra or Laurie at the front desk.

Sincerely,

Rob Wilson
IREC Director/Farm Advisor
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Latest Alfalfa Variety Yield Results

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

By Dan Putnam, Chris DeBen, Brenda Perez, Charlie Brummer, UCCE and UC Davis

Choosing superior varieties of alfalfa is a significant economic factor for alfalfa growers. A large number of commercial varieties are currently available, enabling wide range of options. 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 Great 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. See the University of California Alfalfa and Forages Website for full report and more information. http://alfalfa.ucdavis.edu

Yield Studies: 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 in these trials. Experimental cultivars with a high likelihood of release within the next few years are tested as space permits. Two new trials were established in 2017: a variety trial was planted in Tulelake, and a subsurface drip-irrigated salinity trial at Westside Field Station in Five Points.

The plantings were at approximately 25 lbs/acre live seed. Plots were 3' to 4' wide and 13 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 were determined by the most common practice in that region and are the same for all varieties within a trial. The data is obtained from each of the locations and analyzed and summarized at the UC Davis campus.

2017 Planted Tulelake Yield Trial: This trial was planted with 44 entries on May 22, 2017. Four cuttings were taken during the 2018 and 2019 seasons. The first cuttings took place on June 6th in 2018 and June 12th for the 2019 season. **Tulelake results from 2019 and combined results of 2017-2019 are listed.**

2019 YIELDS, TULELAKE ALFALFA CULTIVAR TRIAL. TRIAL PLANTED 5/22/17

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

	FD	Cut 1 12-Jun		Cut 2 12-Jul		Cut 3 9-Aug		Cut 4 26-Sep		YEAR TOTAL			% of VERNAL
						Dry t/a							
Released Varieties													
SW4107	4	3.54	(1)	2.55	(2)	1.89	(8)	1.52	(4)	9.50	(1)	A	117.3
WL365HQ	5	3.34	(10)	2.52	(4)	2.06	(1)	1.50	(6)	9.42	(2)	A	116.3
Nexgrow 6422Q	4	3.37	(7)	2.54	(3)	1.99	(2)	1.37	(26)	9.27	(3)	A B	114.4
SW5210	6	3.48	(4)	2.40	(14)	1.75	(25)	1.42	(11)	9.05	(4)	B C	111.8
Integra 8450	4	3.27	(15)	2.56	(1)	1.81	(17)	1.38	(21)	9.03	(5)	B C D	111.4
WL377HQ	5	3.10	(29)	2.43	(9)	1.94	(4)	1.51	(5)	8.98	(6)	B C D E	110.8
FG R513W227S	5	3.17	(22)	2.46	(6)	1.88	(10)	1.45	(8)	8.96	(8)	B C D E F	110.6
54Q29	4	3.49	(3)	2.39	(15)	1.66	(37)	1.41	(15)	8.95	(9)	B C D E F	110.5
Hybriforce-4400	4	3.47	(5)	2.37	(19)	1.74	(26)	1.37	(27)	8.95	(10)	B C D E F	110.5
WL363HQ	5	3.15	(23)	2.43	(8)	1.83	(16)	1.52	(3)	8.94	(11)	B C D E F	110.3
FG R513W224S	5	3.13	(26)	2.49	(5)	1.88	(11)	1.43	(10)	8.92	(12)	B C D E F G	110.1
Xtra-3	4	3.04	(34)	2.37	(17)	1.93	(6)	1.55	(2)	8.89	(13)	C D E F G H	109.8
AmeriStand 545NT RR	5	3.09	(30)	2.41	(13)	1.93	(5)	1.40	(17)	8.83	(14)	C D E F G H I	109.0
Nexgrow 6585Q	5	3.15	(24)	2.42	(11)	1.84	(14)	1.43	(9)	8.83	(15)	C D E F G H I	109.0
SW5213	5	3.25	(19)	2.44	(7)	1.74	(28)	1.39	(19)	8.82	(16)	C D E F G H I	108.9
Genuity-RR	4	3.27	(17)	2.36	(20)	1.81	(18)	1.37	(24)	8.81	(17)	C D E F G H I	108.8
Dekalb 43-13	4	3.27	(16)	2.30	(27)	1.78	(23)	1.36	(28)	8.71	(19)	C D E F G H I J	107.6
FG R513M225S	5	2.98	(36)	2.41	(12)	1.90	(7)	1.41	(16)	8.69	(20)	D E F G H I J	107.3
FG R410W253	4	3.00	(35)	2.37	(18)	1.96	(3)	1.34	(31)	8.67	(21)	E F G H I J K	107.0
Hybriforce-3430	3	3.44	(6)	2.21	(37)	1.63	(41)	1.38	(20)	8.66	(22)	E F G H I J K	106.9
PGI459	4	3.34	(9)	2.22	(35)	1.68	(36)	1.40	(18)	8.64	(23)	E F G H I J K	106.7
Hi-Gest 360	3	3.35	(8)	2.32	(24)	1.62	(42)	1.33	(32)	8.63	(26)	E F G H I J K L	106.5
Archer III	5	3.27	(18)	2.30	(28)	1.64	(39)	1.41	(13)	8.62	(27)	F G H I J K L	106.4
WL 372HQ-RR	5	3.09	(31)	2.39	(16)	1.73	(30)	1.35	(30)	8.56	(29)	G H I J K L M	105.7
Hybriforce-3420/Wet	4	3.28	(14)	2.22	(36)	1.68	(35)	1.37	(25)	8.55	(30)	H I J K L M	105.6
Integra 8420	4	3.04	(33)	2.32	(25)	1.72	(31)	1.37	(23)	8.44	(33)	J K L M N	104.2
Integra 8444R	4	2.87	(39)	2.34	(22)	1.84	(13)	1.38	(22)	8.42	(34)	J K L M N	104.0
Hybriforce-3600	6	2.84	(41)	2.17	(39)	1.73	(29)	1.58	(1)	8.32	(36)	K L M N O	102.7
4R200	4	2.94	(38)	2.20	(38)	1.78	(24)	1.36	(29)	8.29	(37)	L M N O	102.3
Ameristand 427TQ	4	3.33	(11)	2.08	(43)	1.63	(40)	1.20	(44)	8.24	(38)	M N O	101.7
Ameristand 445-NT	4	3.21	(20)	2.12	(42)	1.54	(44)	1.25	(40)	8.12	(40)	N O	100.2
Vernal	2	3.29	(12)	2.03	(44)	1.54	(43)	1.25	(42)	8.10	(41)	N O	100.0
Experimental Varieties													
SW4466	4	3.53	(2)	2.35	(21)	1.69	(34)	1.41	(14)	8.98	(7)	B C D E F	110.8
msSunstra-143146	3	3.28	(13)	2.32	(26)	1.65	(38)	1.47	(7)	8.73	(18)	C D E F G H I J	107.7
RRL414M104	4	3.18	(21)	2.42	(10)	1.79	(21)	1.24	(43)	8.63	(24)	E F G H I J K L	106.6
H0415ST202	4	3.13	(25)	2.29	(31)	1.89	(9)	1.32	(33)	8.63	(25)	E F G H I J K L	106.5
RRL514W209	5	3.11	(28)	2.29	(30)	1.87	(12)	1.31	(34)	8.57	(28)	G H I J K L M	105.8
RRL414M377	4	3.12	(27)	2.33	(23)	1.79	(22)	1.28	(36)	8.52	(31)	I J K L M	105.1
H0415A3144	4	3.07	(32)	2.29	(29)	1.81	(20)	1.27	(37)	8.45	(32)	J K L M N	104.3
H0515QT102	5	2.95	(37)	2.28	(32)	1.81	(19)	1.29	(35)	8.33	(35)	K L M N O	102.8
RRL414W208	4	2.78	(44)	2.28	(33)	1.83	(15)	1.26	(39)	8.15	(39)	N O	100.6
msSunstra-155202	6	2.79	(43)	2.14	(41)	1.70	(32)	1.42	(12)	8.04	(42)	O	99.3
RRL514W201	5	2.84	(40)	2.15	(40)	1.74	(27)	1.27	(38)	8.01	(43)	O	98.9
H0415QT111	4	2.82	(42)	2.23	(34)	1.70	(33)	1.25	(41)	8.00	(44)	O	98.7
MEAN		3.17		2.33		1.78		1.38		8.66			
CV		5.44		4.78		5.52		5.84		3.47			
LSD (0.1)		0.20		0.13		0.12		0.10		0.36			

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.

2017-2019 YIELDS, TULELAKE ALFALFA CULTIVAR TRIAL. TRIAL PLANTED 5/22/17

	FD	2017 Yield	2018 Yield	2019 Yield	Average		% of Vernal
			Dry t/a				
Released Varieties							
WL365HQ	5	3.80 (9)	9.64 (9)	9.42 (2)	7.62 (2)	A	115.3
HybriForce-4400	4	4.14 (4)	9.74 (6)	8.95 (10)	7.61 (3)	A	115.2
Integra 8450	4	3.76 (11)	9.72 (7)	9.03 (5)	7.50 (4)	A B	113.6
HybriForce-3430	3	3.98 (6)	9.79 (4)	8.66 (22)	7.48 (5)	A B C	113.2
SW4107	4	3.04 (29)	9.84 (2)	9.50 (1)	7.46 (6)	A B C D	113.0
SW5210	6	3.74 (12)	9.51 (12)	9.05 (4)	7.44 (7)	A B C D E	112.6
HybriForce-3420/Wet	4	4.09 (5)	9.57 (10)	8.55 (30)	7.40 (8)	A B C D E F	112.1
Nexgrow 6422Q	4	3.03 (35)	9.89 (1)	9.27 (3)	7.40 (9)	A B C D E F	112.0
FG R513W224S	5	3.64 (18)	9.50 (13)	8.92 (12)	7.35 (10)	B C D E F G	111.4
WL363HQ	5	3.78 (10)	9.26 (21)	8.94 (11)	7.32 (11)	B C D E F G	110.9
Xtra-3	4	3.54 (21)	9.41 (15)	8.89 (13)	7.28 (12)	B C D E F G	110.3
SW5213	5	3.51 (22)	9.51 (11)	8.82 (16)	7.28 (13)	B C D E F G	110.2
HybriForce-3600	6	4.28 (2)	9.25 (23)	8.32 (36)	7.28 (14)	B C D E F G	110.2
Nexgrow 6585Q	5	3.74 (13)	9.25 (22)	8.83 (15)	7.28 (15)	B C D E F G	110.2
PGI459	4	4.16 (3)	9.01 (31)	8.64 (23)	7.27 (16)	B C D E F G	110.1
Dekalb 43-13	4	3.81 (8)	9.27 (19)	8.71 (19)	7.27 (17)	B C D E F G H	110.0
54Q29	4	3.04 (30)	9.76 (5)	8.95 (9)	7.25 (18)	C D E F G H	109.8
Genuity-RR	4	3.74 (14)	9.20 (25)	8.81 (17)	7.25 (19)	C D E F G H	109.8
WL377HQ	5	3.04 (27)	9.66 (8)	8.98 (6)	7.23 (21)	D E F G H I	109.4
FG R513M225S	5	3.71 (16)	9.19 (27)	8.69 (20)	7.20 (22)	E F G H I J	109.0
AmeriStand 545NT RR	5	3.41 (23)	9.35 (17)	8.83 (14)	7.20 (23)	E F G H I J	109.0
FG R410W253	4	3.61 (20)	9.20 (24)	8.67 (21)	7.16 (24)	F G H I J K	108.4
FG R513W227S	5	3.27 (24)	9.20 (26)	8.96 (8)	7.14 (25)	G H I J K	108.1
Integra 8444R	4	3.72 (15)	9.27 (20)	8.42 (34)	7.14 (26)	G H I J K L	108.1
Archer III	5	3.03 (38)	9.41 (16)	8.62 (27)	7.02 (27)	H I J K L M	106.3
Hi-Gest 360	3	3.03 (39)	9.30 (18)	8.63 (26)	6.99 (28)	I J K L M N	105.8
Integra 8420	4	3.03 (34)	9.42 (14)	8.44 (33)	6.97 (30)	J K L M N O	105.5
WL 372HQ-RR	5	3.02 (42)	9.19 (28)	8.56 (29)	6.92 (31)	K L M N O	104.8
4R200	4	3.67 (17)	8.72 (37)	8.29 (37)	6.89 (32)	L M N O P	104.3
Ameristand 427TQ	4	3.04 (25)	8.95 (32)	8.24 (38)	6.74 (37)	N O P Q R	102.1
Ameristand 445-NT	4	3.04 (26)	8.86 (35)	8.12 (40)	6.67 (39)	P Q R S	101.0
Vernal	2	3.03 (32)	8.68 (39)	8.10 (41)	6.60 (40)	Q R S T	100.0
Experimental Varieties							
msSunstra-143146	3	4.30 (1)	9.83 (3)	8.73 (18)	7.62 (1)	A	115.4
SW4466	4	3.62 (19)	9.13 (29)	8.98 (7)	7.24 (20)	C D E F G H	109.7
msSunstra-155202	6	3.86 (7)	9.03 (30)	8.04 (42)	6.98 (29)	I J K L M N O	105.7
H0415ST202	4	3.03 (37)	8.87 (33)	8.63 (25)	6.84 (33)	M N O P Q	103.6
RRL414M377	4	3.04 (28)	8.86 (34)	8.52 (31)	6.81 (34)	M N O P Q	103.1
RRL414M104	4	3.03 (40)	8.69 (38)	8.63 (24)	6.79 (35)	M N O P Q	102.7
RRL514W209	5	3.03 (31)	8.63 (40)	8.57 (28)	6.75 (36)	N O P Q R	102.1
H0415A3144	4	3.03 (36)	8.73 (36)	8.45 (32)	6.74 (38)	O P Q R S	102.0
H0515QT102	5	3.02 (41)	8.43 (42)	8.33 (35)	6.59 (41)	Q R S T	99.8
RRL414W208	4	3.02 (43)	8.42 (43)	8.15 (39)	6.53 (42)	R S T	98.9
H0415QT111	4	3.02 (44)	8.46 (41)	8.00 (44)	6.49 (43)	S T	98.3
RRL514W201	5	3.03 (33)	8.20 (44)	8.01 (43)	6.41 (44)	T	97.1
MEAN		3.44	9.20	8.66	7.10		
CV		8.16	3.66	3.47	2.96		
LSD (0.1)		0.33	0.40	0.36	0.25		

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.

Roundup Ready Alfalfa Injury

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

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ABSTRACT

Since the second release in 2011, the Roundup Ready (RR) alfalfa technology has given growers an excellent tool, allowing control of difficult weeds while increasing the flexibility of herbicide application timing. Initial screening of the technology provided excellent crop safety at all application timings. In 2014, there was an initial observation of injury to Roundup Ready alfalfa after glyphosate application was followed by frost. Symptomology observed included necrosis of individual stems, as well as stunting of the crop. Replicated field trials in 2015, 2016 and 2017 confirmed these same symptoms regularly occur when glyphosate is applied to RR alfalfa followed by frost in Northern California. The field trials also documented first cutting yield was reduced up to 0.8 ton/acre compared to the untreated control at multiple sites. Yield reduction was greatest when glyphosate was applied to alfalfa between 8 and 10 inches tall, while yield reduction was minimized when the crop was treated before it grew four inches tall after dormancy. Lower rates of glyphosate (0.77 lb a.e./acre) generally caused less injury and yield loss compared to higher rates tested (1.54 lb a.e./acre). In 2019, a multi-state researcher team evaluated this phenomenon at multiple locations in California and Utah to better determine which management practices minimize crop injury from glyphosate. Another objective was to investigate a hypothesis that the crop injury is caused by *Pseudomonas syringae* (bacterial stem blight).

** This research is a continuation of work initially conducted by Steve Orloff, who has since passed on. Steve's terrific scientific insight and constant wise cracks are surely missed.

BACKGROUND/INTRODUCTION

Roundup Ready alfalfa has been a tremendous weed control tool since it's second release in 2011. It has provided a useful strategy for controlling difficult weeds in alfalfa, particularly perennial species. Initial screening of the technology throughout the 2000's found excellent crop safety at a variety of growth stages. In 2014, Steve Orloff and growers in Scott Valley observed injury to Roundup Ready alfalfa after applications of glyphosate (Roundup) were followed by frost. At the time, it was unclear what conditions, or agronomic practices, resulted in the injury occurring, and it was not known what role the glyphosate application played.

During the field season of 2015, initial field trials were conducted, which replicated crop injury observed in 2014. The trials found significant yield differences between alfalfa treated with glyphosate followed by a frost, compared to an untreated control. During the 2016 and 2017 growing seasons, numerous replicated field trials were conducted throughout the Intermountain Region of California evaluating a low rate and high rate of glyphosate applied at various heights after the alfalfa broke dormancy. While some trial locations had minimal crop injury, crop injury at many locations resulted in a significant alfalfa yield reduction after a single application of glyphosate followed by frost. No visible injury or yield reductions occurred when applications were made to alfalfa shorter than 2 inches in height. However, applications to alfalfa 4 inches and taller resulted in noticeable injury weeks after application. Overall, the most severe injury occurred when the high rate of glyphosate (1.54 lb a.e./acre (Roundup Powermax 44oz/acre)) was applied to alfalfa plants between 6 and 8 inches. Multiple frost events occurred following glyphosate applications making it difficult to correlate injury severity with the timing of frost after glyphosate application.

A puzzling aspect in all studies was the crop injury observed is not the typical symptomology associated with a glyphosate treatment. Following frost after application, individual alfalfa stems would curl over and die, forming a shepherd's crook (Photo One and Two). Stems and plants would continue to develop and show this symptomology for weeks after treatment. Additionally, some of the alfalfa plants developed chlorosis and stunting following the application, resulting in yield loss. Injury was not always readily apparent at first glance, as stems in the understory often showed the worst symptoms.

The shepherd's crook symptomology on the affected alfalfa stems looked eerily similar to symptoms caused by bacterial stem blight. *Pseudomonas syringae* is a common bacterium found many places. It has a protein that mimics the crystalline structure of ice and helps start the formation of ice. When water freezes, it needs a starting point for ice crystals to form, which the bacteria provide. After ice formation occurs, damage to the plant tissue allows a pathway for the bacteria to enter the tissue of the plant, causing infection. *Pseudomonas syringae* and frost damage have been studied extensively in a variety of annual crops. However, it has not been the focus of much research, until recently, within alfalfa. Initial trials in 2017 began to investigate the possibility of *Pseudomonas syringae* playing an increased role in crop injury after applications of glyphosate, but trial results were inconclusive. Interestingly, a second bacterial species, *Pseudomonas viridiflava* was identified from these trials that also causes symptoms of bacterial stem blight.

While the 2015-2017 field trials found treating alfalfa early caused the least amount of crop injury, it was still unknown exactly what management practices minimized injury as treatments were not standardized across studies. In 2019, a standardized study was conducted at several locations in California and Utah to replicate previous trials, to test new agronomic practices, and to continue to investigate the role of *Pseudomonas syringae* in injury observed.

Three trial locations were selected in the Intermountain Region of California: Tulelake, Scott Valley and the Honey Lake Valley, with one location in Utah. Two experiments were implemented at each location. The first experiment evaluated glyphosate applied at a low or high rate to alfalfa at six growth stages. This experiment included additional treatments at a taller crop growth stage compared to earlier studies to determine if a late application could avoid crop interaction with frost. The second experiment focused on weekly applications of a bactericide to try to suppress and possibly eliminate *Pseudomonas syringae* populations on the leaf surface of the crop with and without glyphosate application.

METHODS

Treatments were standardized across locations. Each experiment used a randomized complete block design with four replications. Individual plot size was 10 x 20 ft. Herbicide applications were made with a CO_2 pressured backpack sprayer delivering a carrier volume of 20 gal/acre. Roundup Powermax was the glyphosate product used at all locations. Temperature loggers were placed in the trial area at all locations to capture hourly temperatures in the leaf canopy and corresponding frost events. Visual crop injury, number of injured stems, crop height, and yield were measured at timing of the first cutting. Only crop height and yield were measured at the Utah location.

RESULTS

Observed results for the crop height application trial can be observed in Tables 1-4. Table 1 depicts the visual injury assessment data before the first cutting. Variable results were observed across the three sites in California. The Tulelake site and Honey Lake Valley site showed statically significant visual injury compared to the untreated check when applications of the high rate of glyphosate (Roundup Powermax 44 oz/ac) were made to alfalfa at the 6”, 8”, and 12” growth stages. Average crop height in inches at the time of first cutting can be observed for all four sites in Table 2. No statistical differences in crop height were observed at the Utah or Scott Valley locations. The Tulelake site had four glyphosate treatments between the 6” and 16” application height that showed a two-inch reduction in crop height compared to the untreated check. The Honey Lake Valley site had a four-inch reduction in crop height where the high rate of glyphosate (Roundup Powermax 44 oz/ac) was applied at 6”, 8” and 12”. The number of injured alfalfa stems were counted at all three California sites (Table 3). Very little injury occurred at the Scott Valley site, with no statistical differences between treatments. Conversely, at the Tulelake site many stems were injured with no differences between treatments. The Honey Lake Valley site had a moderate number of stems that showed injury, with increased numbers compared to the untreated check when the high rate of glyphosate (Roundup Powermax 44 oz/ac) was applied at the 8” and 12” crop height. While there were numerical difference in crop yield at all sites (Table 4) only the Honey Lake Valley site showed statistical differences. There was a 0.4-0.45 dry tons/acre yield reduction at the Honey Lake Valley site when the high rate of glyphosate (Roundup Powermax 44 oz/ac) was applied to the crop at 6” and 8”.

Results from the bactericide trial can be found in Tables 5-8. Results for the Scott Valley site were not reported because of complications at that location. At both the Tulelake and Honey Lake Valley sites, statistically significant visual injury occurred in both treatments containing glyphosate, regardless of bactericide treatment (Table 5). Crop height at time of harvest was statistically insignificant between treatments at the Utah site (Table 6). The Tulelake site showed a statistical reduction in crop height where glyphosate was applied alone compared to the untreated check. Bactericide treatments with and without glyphosate had similar heights to the untreated check in Tulelake. Crop height was statistically lower in the glyphosate treatments, with and without bactericide at the Honey Lake Valley site. Crop yield showed a similar trend as crop height for each of the three sites. No yield differences between treatments were observed at the Utah site (Table 8). The Honey Lake Valley site had a 0.59-0.62 tons/acre yield reduction for both glyphosate treatments compared to the untreated check. The Tulelake site had a significant yield reduction of 0.42 tons/acre when glyphosate was applied alone, with no statistical difference in yield occurring between the bactericide, bactericide + glyphosate, and untreated check.

Temperatures below 32 °F registered on the data loggers can be found in Graph 1. The Scott Valley site had 25 total days where frost occurred, with a temperature dropping down to 21.8 °F on May first, with five frost events occurring after that date. The Utah site had 25 total days where frost occurred, with a low of 25.5 °F occurring on May second, with eight frost events occurring after that date. The Honey Lake Valley site experienced 24 total days of frost, with a low temperature of 20.7 °F on May first, with eight frost events occurring after that date. Tulelake was the coldest site, with 36 total frost events, a low of 10.5 °F on May first, and 14 frost events occurring after that date.

DISCUSSION

The 2019 experiments confirmed results found in previous trials, namely crop injury following glyphosate and frost was variable across sites and in some instances first cutting yield was reduced by more than 0.5 ton/acre. The 2019 studies also confirmed the recommendation to make Roundup applications to alfalfa at growth stages under 4 inches to minimize the risk of injury. If there is concern of weeds emerging after the glyphosate application, a product with preemergent activity should be tank-mixed with glyphosate to control weeds that have not germinated. Further, when applications are made to alfalfa greater than 4 inches tall, if targeted species will be controlled with the 22 oz. rate, there is evidence to suggest there is less risk of crop injury than with the 44 oz. rate. Trials in 2019 also included applications at larger crop growth stages than previous research to avoid interaction with frost. In these later treatments it was noted that unacceptable weed control occurred, as significant weed growth occurred before herbicide application was made.

Results from the bactericide trial were promising at the Tulelake location, but inconclusive at the Honey Lake and Utah locations. Continued work will need to take place next growing season to confirm what role *Pseudomonas syringae* plays in the crop injury observed. Based on the visual symptoms observed in the plots, our working hypothesis still involves an interaction with *Pseudomonas syringae*, glyphosate, and frost.

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**Visual injury assessment and number of injured stems was not recorded at the Utah trial location.

Height Trial: Visual Injury Assessment - First Cutting						
	Scott Valley		Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report
Control	13	AB	3	E	10	D
Tricor 75% DF + Gramoxone SL 2.0	15	AB	3	D E	13	C D
Roundup Powermax 22 oz/ac-2"	10	B	8	B C D E	20	B C D
Roundup Powermax 44 oz/ac-2"	11	AB	13	A B C D E	20	B C D
Roundup Powermax 22 oz/ac-4"	13	AB	6	C D E	21	B C D
Roundup Powermax 44 oz/ac-4"	13	AB	13	A B C D E	25	A B C
Roundup Powermax 22 oz/ac-6"	14	AB	9	B C D E	24	A B C
Roundup Powermax 44 oz/ac-6"	15	AB	24	A B C	35	A
Roundup Powermax 22 oz/ac-8"	16	AB	24	A B C	31	A B
Roundup Powermax 44 oz/ac-8"	15	AB	31	A	35	A
Roundup Powermax 22 oz/ac-12"	18	A	28	A B	30	A B
Roundup Powermax 44 oz/ac-12"	16	AB	31	A	30	A B
Roundup Powermax 22 oz/ac-16"	18	AB	21	A B C D	19	B C D
Roundup Powermax 44 oz/ac-16"	16	A	30	A	21	B C D

Table 1: Visual injury assessment of crop damage in the first cutting (*color coded by site for visualization) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Sites were analyzed separately. The conventional treatment was applied during dormancy (Tricor 75% DF 2/3 lb/acre + Gamoxone SL 2.0 1qt/acre), where all other applications were made at the corresponding crop height listed in the table.

Height Trial: Average Crop Height in Inches - First Cutting								
	Scott Valley		Utah		Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report
Control	27	A	32	A	25	A	19	A
Tricor 75% DF +Gramoxone SL 2.0	26	A	31	A	24	A B	17	B C
Roundup Powermax 22 oz/ac-2"	28	A	32	A	24	A B C	19	A B
Roundup Powermax 44 oz/ac-2"	27	A	33	A	23	A B C	18	A B C
Roundup Powermax 22 oz/ac-4"	27	A	32	A	23	A B C	17	B C
Roundup Powermax 44 oz/ac-4"	27	A	32	A	22	B C	18	A B C
Roundup Powermax 22 oz/ac-6"	26	A	31	A	23	A B C	17	C
Roundup Powermax 44 oz/ac-6"	25	A	31	A	21	B C	18	A B C
Roundup Powermax 22 oz/ac-8"	24	A	31	A	21	C	17	B C
Roundup Powermax 44 oz/ac-8"	26	A	31	A	21	C	17	C
Roundup Powermax 22 oz/ac-12"	25	A	31	A	23	A B C	18	A B C
Roundup Powermax 44 oz/ac-12"	26	A	30	A	21	C	18	A B C
Roundup Powermax 22 oz/ac-16"	25	A	31	A	23	A B C	17	B C
Roundup Powermax 44 oz/ac-16"	25	A	31	A	22	B C	18	A B C

Table 2: Average crop height before first cutting (*color coded by site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Sites were analyzed separately. The conventional treatment was applied during dormancy (Tricor 75% DF 2/3 lb/acre + Gamoxone SL 2.0 1qt/acre), where all other applications were made at the corresponding crop height listed in the table.

Height Trial: Number of Injured Stems/Plot - First Cutting						
	Scott Valley		Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report
Control	1	A	0	D	19	A
Tricor 75% DF +Gramoxone SL 2.0	2	A	0	D	18	A
Roundup Powermax 22 oz/ac-2"	1	A	1	D	18	A
Roundup Powermax 44 oz/ac-2"	3	A	1	C D	20	A
Roundup Powermax 22 oz/ac-4"	1	A	1	D	18	A
Roundup Powermax 44 oz/ac-4"	2	A	2	C D	22	A
Roundup Powermax 22 oz/ac-6"	2	A	2	C D	22	A
Roundup Powermax 44 oz/ac-6"	3	A	6	B C D	18	A
Roundup Powermax 22 oz/ac-8"	2	A	4	C D	22	A
Roundup Powermax 44 oz/ac-8"	2	A	11	A B	23	A
Roundup Powermax 22 oz/ac-12"	2	A	5	B C D	19	A
Roundup Powermax 44 oz/ac-12"	5	A	17	A	19	A
Roundup Powermax 22 oz/ac-16"	2	A	5	B C D	20	A
Roundup Powermax 44 oz/ac-16"	4	A	8	B C	16	A

Table 3: Average number of injured stems per 0.5m^2 (*color coded across site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Sites were analyzed separately. The conventional treatment was applied during dormancy (Tricor 75% DF 2/3 lb/acre + Gamoxone SL 2.0 1qt/acre), where all other applications were made at the corresponding crop height listed in the table.

Height Trial: Yield in Tons/Acre - First Cutting								
	Scott Valley		Utah		Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report
Control	2.37	A	2.88	A	2.51	A B	1.95	A
Tricor 75% DF +Gramoxone SL 2.0	2.31	A	2.73	A	2.58	A	2.02	A
Roundup Powermax 22 oz/ac-2"	2.60	A	2.91	A	2.38	A B C	2.02	A
Roundup Powermax 44 oz/ac-2"	2.41	A	2.98	A	2.42	A B C	1.88	A
Roundup Powermax 22 oz/ac-4"	2.63	A	2.88	A	2.31	A B C	1.88	A
Roundup Powermax 44 oz/ac-4"	2.24	A	2.87	A	2.16	A B C	1.90	A
Roundup Powermax 22 oz/ac-6"	2.29	A	2.67	A	2.33	A B C	1.76	A
Roundup Powermax 44 oz/ac-6"	2.19	A	2.61	A	2.09	C	1.72	A
Roundup Powermax 22 oz/ac-8"	2.19	A	2.72	A	2.10	C	1.73	A
Roundup Powermax 44 oz/ac-8"	2.28	A	2.71	A	2.05	C	1.67	A
Roundup Powermax 22 oz/ac-12"	1.99	A	2.73	A	2.34	A B C	1.91	A
Roundup Powermax 44 oz/ac-12"	1.99	A	2.66	A	2.13	B C	1.87	A
Roundup Powermax 22 oz/ac-16"	2.28	A	2.72	A	2.29	A B C	1.96	A
Roundup Powermax 44 oz/ac-16"	2.39	A	2.63	A	2.32	A B C	1.82	A

Table 4: Average first cutting yield (*color coded by site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Sites were analyzed separately. The conventional treatment was applied during dormancy (Tricor 75% DF 2/3 lb/acre + Gamoxone SL 2.0 1qt/acre), where all other applications were made at the corresponding crop height listed in the table.

Because of complications at the Scott Valley location, data for that location is not shown.

Bactericide Trial: Visual Assessment of Injury - First Cutting				
	Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report
Control	0	B	15	B
Kocide DF+Manzate Max	3	B	14	B
Kocide DF+Manzate Max+Powermax 44oz/ac	29	A	31	A
Roundup Powermax 44oz/ac	33	A	39	A

Table 5: Visual injury assessment of crop damage in the first cutting (*color coded by site for visualization) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Sites were analyzed separately. Bactericide treatments were applied weekly at the flowing rates, Kocide DF 2lb/ac +Manzate Max 1.6 lb/ac. Roundup Powermax was only applied once at the 8" growth stage.

Bactericide Trial: Average Alfalfa Height Inches - First Cutting						
	Honey Lake Valley		Tulelake		Utah	
Treatment	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report
Control	24	A	19	AB	32	A
Kocide DF+Manzate Max	24	A	20	A	32	A
Kocide DF+Manzate Max+Powermax 44oz/ac	20	B	18	B	32	A
Roundup Powermax 44oz/ac	20	B	17	C	32	A

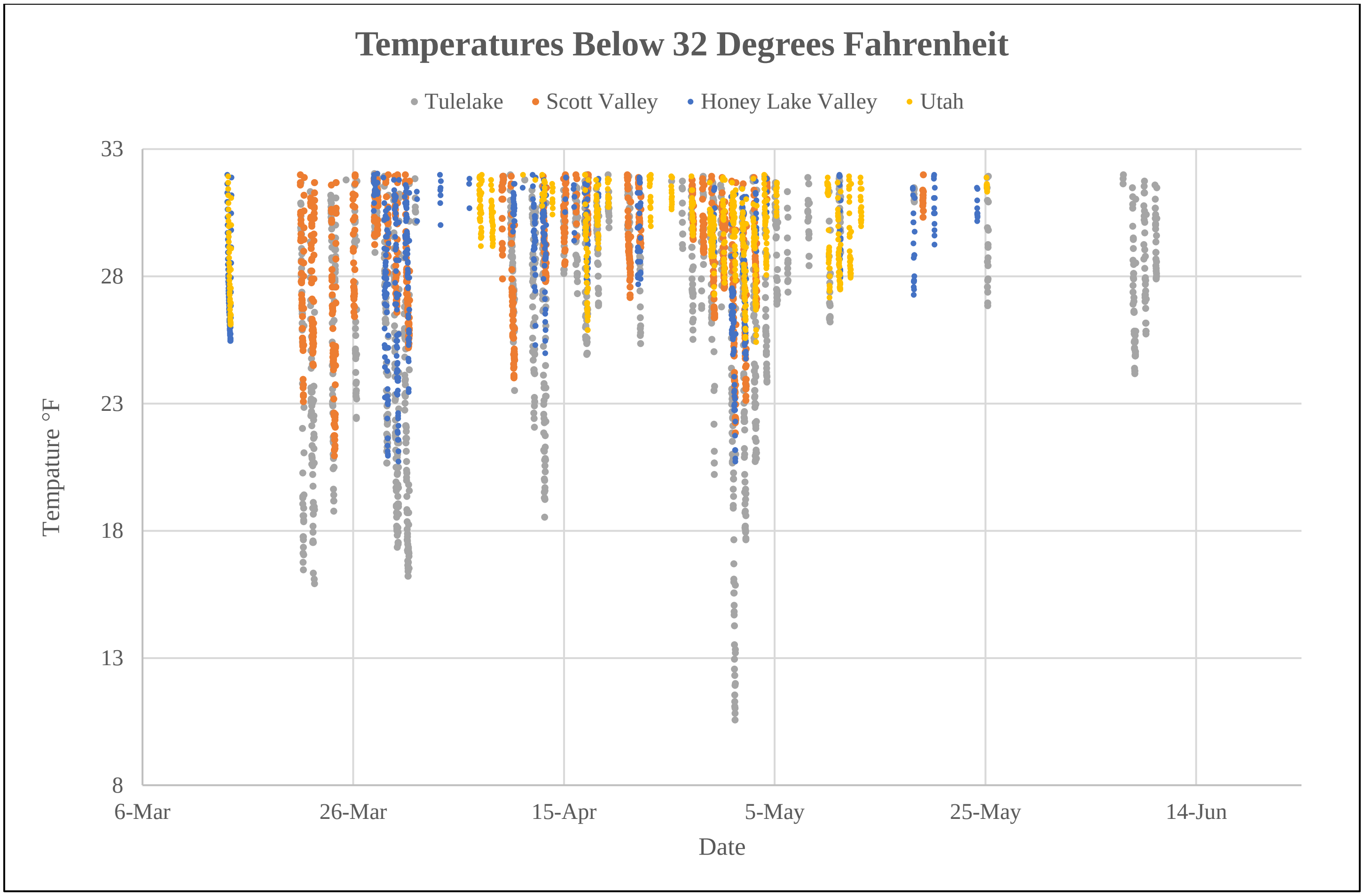
Table 6: Average number of injured stems (*color coded by site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Sites were analyzed separately. Bactericide treatments were applied weekly at the flowing rates, Kocide DF 2lb/ac +Manzate Max 1.6 lb/ac. Roundup Powermax was only applied once at the 8" growth stage.

Bactericide Trial: Number of Injured Stems - First Cutting				
	Honey Lake Valley		Tulelake	
Treatment	Mean	Letter Report	Mean	Letter Report
Control	0	B	13	AB
Kocide DF+Manzate Max	1	B	13	AB
Kocide DF+Manzate Max+Powermax 44oz/ac	12	A	12	B
Roundup Powermax 44oz/ac	16	A	21	A

Table 7: Average number of injured stems (*color coded across site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Sites were analyzed separately. Bactericide treatments were applied weekly at the flowing rates, Kocide DF 2lb/ac +Manzate Max 1.6 lb/ac. Roundup Powermax was only applied once at the 8” growth stage.

Bactericide Trial: Yield in Tons/Acre - First Cutting						
	Honey Lake Valley		Tulelake		Utah	
Treatment	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report
Control	2.59	A	2.13	A	2.59	A
Kocide DF+Manzate Max	2.53	A	2.39	A	2.65	A
Kocide DF+Manzate Max+Powermax 44oz/ac	2.00	B	2.11	A	2.61	A
Roundup Powermax 44oz/ac	1.97	B	1.71	B	2.48	A

Table 8: Yield in tons/acre (*color coded by site for visualization of data) Letter reports indicate means with the same letter were not statically different using the Tukey HSD test. Bactericide treatments were applied weekly at the flowing rates, Kocide DF 2lb/ac +Manzate Max 1.6 lb/ac. Roundup Powermax was only applied once at the 8” growth stage.



Graph 1: Hobo temperature datalogger information collected for all four sites. Only values registered below 32 °F are depicted on the graph.

***** Color was added to the charts in order to better visualize trends in the numerical data and are a non-exact measure of those numerical differences. Color does not indicate statistical differences, which are indicated by the letter reports for each site.

Green colors generally represent a positive value for the associated variable, where red colors indicate a "negative" value for the associated variable. Yellows and oranges fall somewhere in the middle. The table below is an example of values for each variable visualized. High numerical values for yield and alfalfa stem height were considered positive/good, and are highlighted in green. Conversely, large numbers of injured stems and high values of visual ratings were considered negative/bad and are colored in red.

Example of Generalized Color Code: **(Green="good" value Red="bad" value)**			
Yield tons/acre	Height inches	# Injured Stems	% Visual Injury
1.7	14	0	0
1.8	15	2	2
1.9	17	4	4
2	19	6	5
2.1	21	8	8
2.2	22	10	12
2.3	23	12	15
2.4	24	14	20
2.5	25	16	22
2.6	26	18	27
2.7	28	20	32

Photo One: Shepherd's Crook symptomology as the stems die in a glyphosate treated plot

Photo Two: General chlorosis and injured stems in a glyphosate treated plot

Photo Three: Untreated plot with no apparent symptoms

Alfalfa Tolerance of Experimental Herbicide Between Cutting Application

University of California Agriculture and Natural Resources

Research and Extension Center System

RECS

By Thomas Getts, UCCE Lassen County Weed Ecology and Cropping System Advisor

INTRODUCTION

There are limited options for weed control in alfalfa during the field season, and often herbicide applications are not made between cuttings. This trial tested various labeled, and unlabeled combinations of currently registered herbicides, compared to an experimental compound not yet labeled in California alfalfa. Crop safety was the primary aspect investigated.

METHODS

Plots were laid out in a randomized complete block design, with four replications of 10 x 20 ft. plots. Twelve grams (25,000 seeds/gram) of pigweed seed was spread on each plot after first cutting hay harvest to establish a weed population within the plots.

On June 21st, 2019 herbicides were applied with a CO_2 pressurized backpack sprayer at 20 gal/acre with TJETT 11002 flat fan nozzles. No adjuvants were used with the experimental compound. Gramoxone treatments included 0.25%v/v NIS, and other treatments included MSO 1%v/v. Environmental conditions at the time of application were 50 deg F, 49% Rh, with a 5-7 mph wind from the North

Figure 1. Potential crop injury following herbicide application between cutting.

Applications occurred to the crop between the first and second cuttings. The alfalfa ranged from 2-6 inches of regrowth at time of applications. Before applications, hay bales had been removed from the field two days prior, and no irrigation had been applied.

Crop Injury was assessed at intervals of one, two, three, and seven weeks after application. Crop height and yields were taken prior to the second and third cuttings (the second and third cutting following the in-season herbicide applications).

RESULTS

One week after application, many of the treatments showed phytotoxicity and stunting from the herbicide applications (Table 1). By 3 weeks after application, the highest rate of the experimental herbicide showed minimal crop injury, comparable to the untreated check. The two treatments where Shark (carfentrazone) was applied showed significant stunting prior to second cutting, reflected in the injury ratings, height and yield results (Table 1 and 2). This injury observed with Shark resulted in a significant yield reduction of 0.3 ton/acre in the second cutting. All other treatments, including the experimental herbicide, did not show a significant yield reduction in the second cutting. In the third cutting, no yield reductions were found in any of the treatments. However, the treatments with Shark, had a ten cm reduction in height, and significant visual injury prior to the third cutting.

DISCUSSION

Many herbicides labeled for treatment between cuttings have the potential to stunt the crop (Pursuit, Raptor, Shark etc.). In this trial, only Shark caused significant yield reductions in the cutting following application. Acceptable crop injury vs. weed control should be weighted when making the decision to use Shark (or any herbicide) to alfalfa between cuttings.

These preliminary results indicated good crop safety for the experimental compound as an in-season application between cuttings. Further research will follow in 2020, assessing dormant season applications, in between cutting applications and weed control at these timings. Additionally, the research will expand off station to assess other soil types and climatic conditions.

Table 1. Amount of Phytotoxicity Observed on Herbicide Treatments used for Between Cutting Weed Control (0-100% Dead) in Alfalfa.

	Week One		Week Two		Week Three	
Treatment	Mean	Letter Report	Mean	Letter Report	Mean	Letter Report
Untreated check	0	E	1.25	C	0	C
CNV2243 16 oz *(Test Compound)*	15	C D	11.25	B C	1.25	B C
Metribuzin 2/3 lb	20	C D	11.25	B C	2.5	B C
Gramoxone 1 pt.	40	B	12.5	B C	5	B C
Shark 2 oz	87.5	A	61.25	A	27.5	A
Raptor 6 oz	18.75	C D	6.25	B C	1.25	B C
Pursuit 6 oz	12.5	D	10	B C	0	C
Gramoxone + Prowl + Select 1 pt. + 2 qt. + 22oz	37.5	B	16.25	B	3.75	B C
Shark + Prowl + Select 2 oz + 2 qt. + 22oz	92.5	A	65	A	32.5	A
Raptor + Prowl + Select 6 oz + 2 qt. + 22oz	17.5	C D	16.25	B	2.5	B C

Table 2. Second Cutting Yield (tons/Acre)		
Treatment	Average Tons/Acre	Letter Report
Untreated check	1.73	A
CNV2243 16 oz *(Test Compound)*	1.61	A B C
Metribuzin 2/3 lb	1.6	A B C
Gramoxone 1 pt.	1.61	A B
Shark 2 oz	1.34	B C
Raptor 6 oz	1.69	A
Pursuit 6 oz	1.81	A
Gramoxone + Prowl + Select 1 pt. + 2 qt. + 22oz	1.68	A
Shark + Prowl + Select 2 oz + 2 qt. + 22oz	1.29	C
Raptor + Prowl + Select 6 oz + 2 qt. + 22oz	1.59	A B C

2019 Small Grain Variety Testing Research at IREC

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

Mark Lundy, Assistant Cooperative Extension Specialist, University of California
Small Grain Variety Testing

Each year the UC Small Grain Variety Testing Program tests commercial and advanced small grain varieties across a wide range of growing conditions in the state of California in order to determine the relative commercial potential of genotypes. Because of the climatic differences in the Intermountain Region, the varieties grown in this part of the state largely differ from those grown in other parts of California. As a result, the trials carried out in this region are a blend of entries from university and USDA trials targeting production regions in the Pacific Northwest, with the addition of some varieties of regional interest to seed dealers. Fall-planted, winter wheat trials were conducted at two Siskiyou County locations during the 2018-19 growing season (Tulelake and Montague). In addition, spring-planted hard wheat, spring-planted soft wheat, and spring-planted barley trials were grown at the IREC in Tulelake during 2019. Grain yield and quality was measured from these trials.

Multi-year, multi-trial data tends to produce more reliable estimates of crop productivity potential. For this reason, where multiple years of data are available the tables in this report include multi-year estimates of yield and protein in addition to the 2019 trial results. In addition to the information included in this report, results for all UC Statewide Small Grain Variety Trials are available in an interactive online environment. Summaries of small grain varieties by crop type across multiple locations and seasons can be found at http://smallgrainselection.plantsciences.ucdavis.edu/. Summaries of data organized by individual site year can be found at: http://smallgrainselection.plantsciences.ucdavis.edu/explore/. All results can also be viewed and downloaded as static tables and figures, with additional information about site characteristics and crop management here at: http://smallgrains.ucanr.edu/Variety_Results/2019/.

Table 1: 2019 Intermountain (Tulelake) Winter Hard Wheat Variety Trial Results

Variety	Height (cm)	% Lodge	Tons/A (Single-year)	Bushel Wt (lb)	% Protein
WB 4303	93 cdefgh	0 a	5.72 a	61.53 fghi	10.73 de
LCS JET	97 bcde	0 a	5.71 ab	61.43 ghi	10.40 de
UI BRONZE JADE	102 abc	0 a	5.56 abc	60.40 jk	9.80 e
KELDIN	102 abc	0 a	5.47 abc	62.40 bcdefg	10.10 de
AP REDEYE	91 defgh	0 a	5.47 abc	62.33 bcdefg	10.70 de
SCORPIO	85 fgh	0 a	5.41 abc	61.17 hij	10.20 de
WB 4394	107 ab	0 a	5.39 abc	63.67 a	10.47 de
OR2160008R	89 defgh	0 a	5.32 abc	60.10 k	10.53 de
OR2160089R	91 defgh	0 a	5.28 abc	62.23 cdefg	10.80 de
OR2160011R	96 cde	0 a	5.26 abc	61.63 fghi	9.77 e
LCS AYMERIC	84 gh	0 a	5.25 abc	60.00 k	10.23 de
OR2150169R	97 bcde	0 a	5.23 abc	62.03 cdefgh	10.30 de
WA 8289	85 fgh	0 a	5.20 abc	60.80 ijk	10.33 de
OR2150168H	91 defgh	0 a	5.18 abcd	60.07 k	10.87 cde
LCS ROCKET	83 h	0 a	5.17 abcd	58.67 l	10.57 de
IRV	95 cdef	0 a	5.14 abcd	62.43 bcdefg	10.47 de
LCS EVINA	110 a	0 a	5.12 bcd	61.93 defgh	11.27 bcd
LCS ZOOM	97 bcde	0 a	5.08 cd	60.27 jk	10.30 de
MANDALA	106 ab	0 a	5.07 cd	63.03 abc	10.60 de
MILLIE	91 defgh	0 a	5.05 cd	62.80 abcd	10.57 de
SY CLEARSTONE CL2	112 a	13 a	5.03 cd	62.67 abcde	10.67 de
SY TOUCHSTONE	85 fgh	0 a	4.97 cde	62.47 bcdef	10.63 de
OR2160065H	94 cdefg	0 a	4.60 def	61.70 efghi	11.33 bcd
WB 4311	87 efgh	0 a	4.39 ef	62.77 abcd	12.20 ab
WB 4623 CLP	102 abc	0 a	4.11 f	63.27 ab	12.07 abc
BRAWL CL+	98 bcd	0 a	3.28 g	62.07 cdefgh	13.23 a
Mean	**95**	**1**	**5.09**	**61.69**	**10.74**

Table 2: 2019 Intermountain (Tulelake) Winter Soft Wheat Variety Trial Results

Variety	Height (cm)	Tons/A (Single-year)	Tons/A (Multi-year)	Bushel Wt (lb)	% Protein (Single-year)	% Protein (Multi-year)
LCS BLACKJACK	92 bcdefgh	6.18 ab	6.21 a	58.33 opqr	9.13 defghi	10.31 cdefg
LWW16 71088	93 abcdefgh	6.24 a	6.05 ab	60.37 defghi	8.00 hi	9.14 fg
MARY	93 abcdefgh	5.79 abcde	5.73 abc	59.39 ijklmno	8.10 hi	9.58 efg
LCS HULK	95 abcdefgh	5.55 abcdefg	5.73 abc	61.32 cde	8.63 fghi	9.98 cdefg
ROSALYN	97 abcdefg	5.81 abcd	5.72 abc	58.30 opqr	8.57 fghi	9.67 defg
LWW15 71898	90 bcdefgh	5.87 abcd	5.68 abcdef	59.29 ijklmno	9.00 defghi	10.14 cdefg
BOBTAIL	91 bcdefgh	5.65 abcdefg	5.67 abcd	58.50 nopqr	8.93 efghi	10.07 cdefg
WB 1783	101 abc	5.67 abcdefg	5.65 abcd	61.00 cdefg	8.77 efghi	10.14 cdefg
WB 1532	101 abc	5.60 abcdefg	5.64 abcd	61.27 cdef	8.77 efghi	10.42 cdef
SY CANDOR	95 abcdefgh	5.54 abcdefg	5.61 abcde	60.13 efghijk	9.90 cdef	10.30 cdefg
STINGRAY CL+	90 bcdefgh	5.73 abcdef	5.54 abcdefgh	59.77 hijklm	8.60 fghi	9.74 cdefg
NIXON	98 abcde	5.48 bcdefghi	5.53 abcde	59.36 ijklmno	8.47 fghi	9.71 defg
LCS GHOST	94 abcdefgh	5.90 abc	5.48 bcdefg	56.63 s	8.33 ghi	9.29 fg
SY OVATION	92 bcdefgh	5.60 abcdefg	5.48 bcdefg	59.97 ghijklm	9.20 defgh	10.37 cdefg
STEPHENS	101 abc	5.66 abcdefg	5.43 bcdefg	58.38 opqr	8.57 fghi	9.81 defg
NORTHWEST DUET	108 a	5.46 bcdefghi	5.43 bcdefg	60.11 fghijkl	8.37 ghi	9.85 defg
SY DAYTON	93 abcdefgh	5.34 cdefghi	5.39 bcdefg	59.16 jklmnop	8.60 fghi	9.84 defg
06PN212 25	98 abcdef	5.57 abcdefg	5.38 abcdefghijk	60.73 defgh	9.20 defgh	10.34 cdefg
DYNA GRO IMPACT	94 abcdefgh	5.57 abcdefg	5.37 abcdefghijkl	60.30 efghij	9.33 defgh	10.48 bcdefg
IV BULLDOG	92 bcdefgh	5.38 cdefghi	5.34 bcdefgh	58.87 mnopq	9.03 defghi	9.97 defg
KASEBERG	91 bcdefgh	5.20 cdefghijk	5.30 bcdefghi	58.50 nopqr	8.17 hi	9.48 fg
M PRESS	95 abcdefgh	5.52 abcdefg	5.24 bcdefghij	59.83 ghijklm	9.03 defghi	9.82 defg
OR2140401	92 abcdefgh	5.36 cdefghi	5.17 bcdefghijkl	57.71 qrs	7.70 i	8.84 g
11 163 1C	100 abcd	5.34 cdefghij	5.15 bcdefghijkl	60.04 ghijklm	8.70 efghi	9.84 cdefg
LCS BIANCOR	83 efgh	5.21 cdefghijk	5.02 bcdefghijklm	58.00 pqr	8.73 efghi	9.88 cdefg
LCS ARTDECO	87 cdefgh	5.37 cdefghi	5.01 defghijkl	57.57 rs	9.10 defghi	10.47 cdef
SY RAPTOR	84 defgh	5.00 ghijk	4.92 efghijkl	58.54 nopqr	9.30 defgh	10.49 cdef
LCS SHINE	82 fgh	5.44 cdefghi	4.89 efghijklm	59.30 ijklmno	8.83 efghi	9.94 defg
OR2140233	99 abcde	5.07 efghijk	4.88 cdefghijklmn	58.92 lmnop	8.83 efghi	9.98 cdefg
OR2130755	96 abcdefgh	5.04 fghijk	4.84 cdefghijklmn	59.83 ghijklm	9.40 defgh	10.54 bcdefg
LCS SHARK	93 abcdefgh	5.31 cdefghij	4.83 fghijklm	57.34 rs	9.33 defgh	10.19 cdefg
SY COMMAND	93 abcdefgh	4.77 ijkl	4.67 hijklmn	58.27 opqr	9.13 defghi	10.07 cdefg
OR 2x2 CL+	103 ab	4.81 hijk	4.62 ghijklmno	59.67 hijklmn	9.40 defgh	10.54 bcdefg
LCS DRIVE	81 gh	5.15 defghijk	4.57 jklmno	57.45 rs	8.90 efghi	9.94 defg
NORTHWEST TANDEM	80 h	4.81 hijk	4.50 klmno	58.33 opqr	9.03 defghi	10.49 cdef
WB 1604	93 abcdefgh	5.31 cdefghij	4.48 lmno	59.40 ijklmno	9.73 cdefg	10.74 bcde
ORI2161244 CL+	92 abcdefgh	4.61 jkl	4.42 ijklmno	59.06 klmnop	9.03 defghi	10.18 cdefg
APPLEBY CL+	98 abcde	4.58 kl	4.39 jklmno	59.25 ijklmno	9.03 defghi	10.18 cdefg
WB 1529	92 bcdefgh	4.57 kl	4.22 mno	61.56 bcd	10.13 cde	10.82 bcd
SY ASSURE	88 bcdefgh	4.79 ijk	3.97 o	59.32 ijklmno	9.17 defgh	10.19 cdefg
WB 4623 CLP	95 abcdefgh	4.06 l	3.87 nop	62.66 ab	10.40 bcd	11.54 abc
Mean	93	5.34	5.15	59.31	8.94	10.08

Table 3: 2019 Intermountain (Tulelake) Hard Spring Wheat Variety Trial Results

Variety	Plant Height	% Lodging	Tons/A (Single-year)	Tons/A (Multi-year)	Bushel Wt (Lb)	Protein % (Single-year)	Protein % (Multi-year)
SAS-W4	93 a	0 b	5.11 a	4.85 a	57.83 g	11.47 f	12.48 g
AP RENEGADE	87 abc	0 b	4.91 ab	4.61 ab	61.73 ef	12.17 def	12.97 fg
WB 9904	80 bcde	20 b	4.78 abc	4.52 abcd	61.90 def	11.63 f	12.65 fg
IDO1203S A	77 cde	0 b	4.70 abcd	4.49 abc	63.77 ab	12.10 def	13.16 efg
WB 9717	81 bcde	5 b	4.72 abcd	4.37 abcd	64.33 a	11.87 ef	12.90 fg
WB PATRON	75 def	3 b	4.69 abcd	4.34 abcd	61.90 def	12.70 bcdef	13.61 cdef
SY SELWAY	88 ab	13 b	4.58 abcde	4.27 bcde	62.10 cdef	12.30 cdef	13.48 def
SY COHO	80 bcde	0 b	4.67 abcd	4.23 cde	61.27 fg	12.20 def	13.50 def
SOFT SVEVO	79 bcde	55 a	4.43 bcdef	4.17 bcdefg	62.73 bcde	13.03 abcde	14.05 bcde
WB 9668	70 ef	0 b	4.17 cdef	4.13 def	63.47 ab	14.00 ab	14.67 ab
WB 9518	79 bcde	0 b	4.46 bcdef	4.12 def	62.77 bcde	13.20 abcde	14.41 b
WA 8282 HRS	82 abcd	87 a	4.11 def	3.92 efg	63.57 ab	12.30 cdef	13.47 defg
LCS BUCK PRONTO	84 abcd	10 b	4.13 def	3.84 fg	63.03 bc	13.43 abcd	14.64 ab
MSU LANNING	81 bcde	67 a	3.90 fg	3.81 fg	61.83 def	14.30 a	15.26 a
YECORA ROJO	58 g	0 b	3.97 ef	3.77 g	62.33 cdef	13.60 abc	14.30 bc
AP KIMBER CL2	82 abcd	0 b	3.97 ef	3.71 fg	62.93 bcd	13.23 abcde	14.25 bcd
Mean	80	16	4.46	4.20	62.34	12.72	13.74

Table 4: 2019 Intermountain (Tulelake) Spring Soft White Wheat Variety Trial Results

Variety	Plant Height (cm)	% Lodging	Ton/A (Single-year)	Ton/A (Multi-year)	Bushel Wt (lb)	Protein % Single-year)	Protein % (Multi-year)
IDO01405S	86 abcdef	18 a	5.47 ab	5.05 a	60.50 fg	9.50 cde	10.90 de
WB 6341	80 cdef	42 a	5.31 abc	4.96 ab	62.27 abcd	9.17 de	10.39 e
WB 6430	79 def	57 a	5.49 a	4.88 abc	60.40 fg	9.40 de	10.81 de
UI STONE	89 ab	35 a	5.03 abcde	4.80 abc	61.43 def	9.53 cde	10.70 de
WA TEKOA	92 a	48 a	5.28 abcd	4.75 abcd	63.10 a	9.37 de	10.93 de
ALTURAS	88 abc	60 a	4.96 bcde	4.56 abcde	61.63 bcde	9.50 cde	10.71 de
ALPOWA	87 abcd	47 a	4.80 def	4.56 bcde	62.83 a	9.13 e	11.03 cde
WA MELBA	81 bcdef	60 a	5.27 abcd	4.53 cde	60.57 efg	9.40 de	10.41 e
YS 603	86 abcde	12 a	4.87 cdef	4.40 de	62.60 abc	10.87 bc	11.78 bc
WB 6121	79 ef	10 a	4.39 fg	4.35 e	62.70 ab	11.13 b	11.96 b
IDO01702S	78 f	0 a	4.74 ef	4.35 de	62.37 abcd	10.53 bcd	11.27 bcd
AP COACHMAN	91 a	90 a	4.09 gh	3.69 f	59.50 g	9.60 cde	10.81 cde
UC DESERT KING HP (DURUM)	70 g	53 a	3.71 h	3.31 f	60.40 fg	12.83 a	14.05 a
PLATINUM (DURUM)	66 g	17 a	4.19 gh		61.50 cdef	11.67 ab	
Mean	82	39	4.83	4.48	61.56	10.12	11.21

Table 5: 2019 Intermountain (Tulelake) Spring Barley Trial Results

Variety	Plant Height (cm)	Ton/A (Single-year)	Ton/A (Multi-year)	Bushel Wt (lb)	% Protein (Single-year)	% Protein (Multi-year)
LCS VESPA	70 cde	4.58 a	4.64 a	51.43 bcd	10.27 ab	11.87 abc
CLAYMORE	85 ab	4.48 a	4.55 ab	51.47 bcd	9.70 ab	11.30 bc
LCS OPERA	70 cde	4.25 ab	4.32 abcd	50.70 de	8.97 b	10.57 c
LYON	74 bcd	4.15 ab	4.21 abcdef	51.53 bcd	9.53 ab	11.13 bc
AD120341	60 de	3.80 abc	3.87 abcdefg	52.53 b	9.80 ab	11.40 abc
CDC COPELAND	97 a	3.79 abc	3.52 d fg	50.83 cde	9.63 ab	11.74 abc
OSU FULL PINT	63 cde	3.77 abc	3.91 abcdefg	52.60 b	11.13 ab	12.72 ab
LCS GENIE	76 bc	3.76 abc	3.74 bcdefg	51.73 bcd	10.20 ab	11.62 bc
FRANCIN	68 cde	3.61 abc	4.04 abc e	52.03 bc	10.20 ab	11.60 bc
LCS ODYSSEY	66 cde	3.31 bcd	3.38 cdefgh	50.00 e	10.47 ab	12.07 abc
MEG'S SONG	91 a	3.26 bcd	3.32 efgh	61.90 a	11.77 a	13.37 ab
DH120285	62 cde	3.01 cd	3.08 gh	51.00 cde	10.87 ab	12.47 abc
DH120058	59 e	2.42 d	2.49 h	51.17 cde	12.03 a	13.63 a
Mean	**72**	**3.71**	**3.77**	**52.23**	**10.35**	**11.96**

2019 Potato Variety Development

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

By Rob Wilson, Center Director/Farm Advisor,
Darrin Culp, Principal Superintendent of Agriculture, Kevin Nicholson, Staff Research Associate, IREC

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 15 entries, and a Chipping trial with ten 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. To see the complete report including all results and pictures of the entries, go to the link shown below.

http://irec.ucanr.edu/Research/Past_Research/Potato_Projects_313/

Table 1: 2019 Intermountain Research & Extension Center Chip Variety Trial

Clone / Variety	Total CWT/Acre	Culls CWT/Acre	Merit (1-5, 5=Best)	Tubers per Plant	Average Tuber Size (oz)
Atlantic	521.8	10.6	3.4	7.8	6.4
Snowden	483.5	6.7	3.6	10.1	4.7
CO10073-7W	430.6	24.7	3.1	10.1	4.1
CO10076-4W	468.4	13.7	3.0	10.3	4.4
CO11023-2W	401.3	14.2	3.1	8.6	4.7
CO11023-9W	425.0	12.1	3.5	8.3	5.1
CO11037-5W	440.9	20.4	3.5	9.1	4.7
TX09403-15W	447.2	18.6	3.5	8.9	5.0
TX09403-21W	457.0	17.3	3.4	9.1	5.0
ATTX07042-3W	483.7	62.9	3.1	11.5	4.1
Mean	**455.9**	**20.1**	**3.3**	**9.4**	**4.8**

Table 2: 2019 Intermountain Research & Extension Center Russet Variety Trial

Clone/Variety	Total CWT/Acre	Culls + 2's CWT/Acre	%1's	U.S. 1's	Merit Score (1-5, 5=best)	Tubers per Plant	Average Tuber Size (oz)
Ranger Russet	409.8	25.0	74.0	304.6	3.5	6.6	6.2
Russet Burbank	378.3	44.3	65.0	248.0	3.4	7.4	5.2
Russet Norkotah	332.0	21.5	72.0	240.1	3.9	5.8	5.9
A07061-6	478.8	14.7	75.0	358.0	2.3	9.9	4.9
A071012-4BF	452.8	19.1	77.0	349.9	3.4	7.7	5.9
A07769-4	419.5	17.9	78.0	328.7	3.4	6.3	6.8
A08422-4VRsto	405.1	3.9	85.0	345.9	2.9	7.2	5.7
A08433-4VR	393.9	13.2	79.0	311.1	3.4	7.9	5.1
A10021-5TE	385.5	7.5	65.0	251.1	3.4	9.0	4.4
AO02183-2	438.5	17.9	76.0	333.7	3.4	6.8	6.4
AOR07781-5	338.5	52.5	66.0	220.9	3.1	5.4	6.4
CO09076-3RU	341.1	53.4	55.0	186.3	3.1	6.6	5.4
CO09205-2RU	355.4	18.2	76.0	269.9	3.5	6.8	5.3
CO10087-4RU	246.9	9.5	70.0	174.1	3.8	6.1	4.6
CO10091-1RU	269.9	2.7	59.0	160.3	3.1	7.1	4.0
COTX05095-2Ru/Y	424.6	40.9	62.0	264.9	3.4	9.3	4.7
OR12133-10	510.3	8.6	80.0	406.3	3.1	9.4	5.5
POR12NCK50-1	405.5	14.7	76.0	308.7	3.8	7.2	5.9
COTX08322-10RU	348.6	20.3	72.0	252.4	3.0	7.0	5.1
CO10085-1RU	285.5	12.8	71.0	202.2	3.1	5.9	5.0
CO11009-3RU	331.1	17.6	75.0	247.5	3.8	6.9	5.4
Mean	**378.6**	**20.8**	**72.0**	**274.5**	**3.3**	**7.3**	**5.4**

Table 3: 2019 Intermountain Research & Extension Center Specialty Potato Trial

Clone / Variety	Skin Color	Flesh color	Total Yield CWT/Acre	Culls CWT/Acre	Merit (1-5, 5=Best)	Tubers/ Plant	Average Size (oz)
Chieftain	Red	White	617.8	12.9	3.5	11.3	5.6
Red LaSoda	Red	White	626.5	106.7	2.6	7.6	7.9
A08112-7R	Red	White	437.7	15.3	3.6	13.7	3.1
ATTX05175S-1R/Y	Red	Yellow	488.8	18.9	3.6	17.0	2.7
ATX06264s-4R/Y	Red	Yellow	506.9	16.4	3.1	13.4	3.6
COTX04193S-2R/Y	Red	Yellow	434.5	7.5	3.6	13.8	3.2
Yukon Gold	Yellow	Yellow	441.3	23.0	3.4	7.0	6.4
CO09128-5W/Y	Yellow	Yellow	383.8	3.0	3.6	16.4	2.2
CO09218-4W/Y	Yellow	Yellow	288.8	17.3	3.1	11.4	4.0
CO10064-1W/Y	Yellow	Yellow	431.0	26.1	3.4	11.0	4.1
CO10097-2W/Y	Yellow	Yellow	431.0	6.1	2.9	10.1	4.2
CO10098-5W/Y	Yellow	Yellow	314.5	21.0	2.4	11.5	3.4
POR14PG22-3	Yellow	Yellow	559.8	5.6	2.5	21.7	2.4
CO11250-1W/Y	Yellow	Yellow	505.9	14.7	2.3	12.2	3.9
CO11266-1W/Y	Yellow	Yellow	464.4	15.4	2.0	12.3	3.8
Mean			**462.2**	**20.7**	**3.0**	**12.7**	**4.0**

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The California trial was in an established peppermint (Black Mitcham) field. The field was irrigated with solid-set sprinklers and managed for one cutting per season. The soil type is silty clay loam with 5% organic matter.

Plots were 9 by 25 feet. Herbicide treatments were replicated four times in a randomized complete block design. Herbicides were applied with a small plot CO_2 sprayer at 20 gpa. Crop injury, weed burn-down, and weed density were measured multiple times during the growing season. Mint hay yield was determined by harvesting a 5 X 10 ft quadrat in each plot. Hay was weighed, dried and steam distilled to determine oil yield. Data was subjected to ANOVA and treatment means were separated by using Tukey's HSD test.

Table 1. Grass and broadleaf weed treatments for 2019 mint trial in Tulelake.

	Treatment	Rate product	Timing
1	Nontreated - Weedy		
2	Gramoxone 2L + Zeus + NIS	32 fl oz + 6 fl oz	Dormant
3	Zidua + NIS	1.69 oz	Dormant
4	Zidua + NIS	3.38 oz	Dormant
5	Sharpen + MSO+AMS	2 fl oz	Dormant
6	Sharpen + Chateau +MSO+AMS	2 fl oz + 4oz	Dormant
7	Sharpen + Zeus + MSO+AMS	2 fl oz + 6fl oz	Dormant
8	Zeus + NIS	6 fl oz	Dormant
9	Chateau + NIS	4 oz	Dormant
10	Sharpen + Zidua +MSO+AMS	2 fl oz + 1.69 oz	Dormant
11	Shark + Zidua + MSO	1.92 fl oz + 1.69 oz	Dormant
12	Sharpen + Zidua + Zeus+MSO+AMS	2 fl oz + 1.69 fl oz + 6 fl oz	Dormant
13	Sharpen + Zeus+ MSO+AMS & Zidua + NIS in early May	2 fl oz + 6 fl oz 1.69 oz	Dormant Mid-May
14	Chateau + Zidua + NIS	4 oz + 1.69 oz	Dormant

California Results

Sharpen (saflufenacil) and Zidua (pyroxasulfone) alone and in tank-mixes were safe when applied to dormant mint except for a couple combinations (Table 2). The three-way mix of Sharpen + Zidua + Zeus applied to dormant mint and two-way mix of Chateau + Zidua applied to dormant mint caused significant crop injury that lingered into late June. Zidua applied in May after mint broke dormancy also caused significant injury at the June evaluation. Surprisingly, mint bloom, mint biomass, and mint oil yield did not differ between treatments (Table 4). The average oil yield across treatments was 75 lbs per acre.

Weed density and herbicide weed burn-down ratings are shown in Table 3. Prickly lettuce was the dominant weed in the plot area. Sharpen by itself or tank-mixed with preemergent herbicide(s) provided excellent prickly lettuce control. Gramoxone + Zidua also suppressed prickly lettuce. Chateau was the only dormant preemergent treatment that controlled prickly lettuce without tank-mixing a burndown herbicide. Sharpen suppressed groundsel and dandelion (visual observation), but there were no statistical differences in weed density between treatments for these weeds due to high plot to plot variability.

Table 2. Crop Injury in Tulelake, CA 2019		**4/22/2019**	**5/3/2019**	**5/10/2019**	**6/26/2019**
		peppermint injury			
Trt #	**Herbicide Treatment**	**0-10 scale 10=mint dead**			
1	Untreated Control	0c	0.25b	0.375b	0b
2	Gramoxone + Zeus 6 fl oz- dormant mint	0.25bc	0.5ab	0.375b	0b
3	Zidua 1.7 oz- dormant mint	0c	0.75ab	0.625b	0b
4	Zidua 3.4 oz- dormant mint	0.125bc	1ab	0.75b	0b
5	Sharpen 2 fl oz- dormant mint	0.75abc	1ab	0.5b	0b
6	Sharpen 2 fl oz + Chateau 4 oz- dormant mint	1ab	0.75ab	0.5b	0b
7	Sharpen 2 fl oz + Zeus 6 fl oz- dormant mint	0c	0.75ab	0.625b	0b
8	Zeus 6 fl oz- dormant mint	0c	0.25b	0.5b	0b
9	Chateau 4 oz- dormant mint	0.75abc	1ab	0.5b	0b
10	Sharpen 2 fl oz + Zidua 1.7 oz- dormant mint	0.25bc	0.75ab	0.625b	0b
11	Shark 1.9 fl oz + Zidua 1.7 oz-dormant mint	0c	0.75ab	0.625b	0b
12	Sharpen + Zidua + Zeus- dormant mint	1ab	1.75a	0.75b	0.75b
13	Sharpen + Zeus-dormant mint & Zidua in May	0.5bc	1.25ab	0.875b	1.75a
14	Chateau 4 oz + Zidua- dormant mint	1.5a	1.75a	1.5a	0.5b

Table 3. Weed Control in Tulelake, CA 2019		4/4/2019	4/11/2019			6/4/2019
		Weed burn-down rating	prickly lettuce	common groundsel	dandelion	prickly lettuce
Trt #	Herbicide Treatment	%	# of weeds per plot			
1	Untreated Control	0	14ab	2	5	28a
2	Gramoxone + Zeus 6 fl oz- dormant mint	68	4bc	6	2	8bc
3	Zidua 1.7 oz- dormant mint	13	20a	4	7	21ab
4	Zidua 3.4 oz- dormant mint	33	10abc	1	6	13abc
5	Sharpen 2 fl oz- dormant mint	91	0c	3	1	2c
6	Sharpen 2 fl oz + Chateau 4 oz- dormant mint	99	0c	2	0	2c
7	Sharpen 2 fl oz + Zeus 6 fl oz- dormant mint	98	0c	4	1	2c
8	Zeus 6 fl oz- dormant mint	60	9abc	17	5	16abc
9	Chateau 4 oz- dormant mint	60	1c	7	3	5bc
10	Sharpen 2 fl oz + Zidua 1.7 oz- dormant mint	88	0c	10	1	1c
11	Shark 1.9 fl oz + Zidua 1.7 oz-dormant mint	43	7bc	4	4	14abc
12	Sharpen + Zidua + Zeus- dormant mint	100	1c	2	0	1c
13	Sharpen + Zeus-dormant mint & Zidua in May	94	0c	2	0	1c
14	Chateau 4 oz + Zidua- dormant mint	65	1c	6	5	2bc

Table 4. Peppermint Yield in Tulelake, CA 2019				
		mint bloom	mint biomass yield	mint oil yield
Trt #	Herbicide Treatment	%	tons/acre (green)	lbs/acre
1	Untreated Control	13 a	48.0 a	76.1 a
2	Gramoxone + Zeus 6 fl oz- dormant mint	11 a	44.5 a	73.7 a
3	Zidua 1.7 oz- dormant mint	11 a	47.5 a	69.6 a
4	Zidua 3.4 oz- dormant mint	13 a	44.2 a	72.1 a
5	Sharpen 2 fl oz- dormant mint	11 a	47.3 a	70.9 a
6	Sharpen 2 fl oz + Chateau 4 oz- dormant mint	10 a	45.2 a	74.6 a
7	Sharpen 2 fl oz + Zeus 6 fl oz- dormant mint	13 a	46.0 a	76.0 a
8	Zeus 6 fl oz- dormant mint	14 a	45.6 a	74.1 a
9	Chateau 4 oz- dormant mint	13 a	49.0 a	75.8 a
10	Sharpen 2 fl oz + Zidua 1.7 oz- dormant mint	11 a	50.1 a	80.2 a
11	Shark 1.9 fl oz + Zidua 1.7 oz-dormant mint	13 a	42.9 a	75.6 a
12	Sharpen + Zidua + Zeus- dormant mint	13 a	45.2 a	75.8 a
13	Sharpen + Zeus-dormant mint & Zidua in May	10 a	45.4 a	75.0 a
14	Chateau 4 oz + Zidua- dormant mint	10 a	45.7 a	74.9 a

2019 Onion Seed Treatment Testing to Protect Spring-Seeded Onions from Maggots

University of California Agriculture and Natural Resources

Research and Extension Center System

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Introduction

Three trials were conducted in 2019 evaluating seed treatments for management of maggots. All trials were part of a regional study evaluating seed treatments for suppressing maggots and smut. Onion maggot, *Delia antiqua*, and seed corn maggot, *Delia platura*, were captured on yellow sticky traps placed along field edges. Larvae of both species feed on young onion plants, often resulting in seedling mortality. ***Some pesticides listed in this report may not be labeled for use in onions. Please consult pesticide labels for use instructions.***

2019 Site Information

- **Soil type-** mucky silty clay loam-6.8% OM
- **Growing season-** May 8th, 2019 to October 3rd, 2019
- **Irrigation –** solid-set sprinklers
- **Onions-** 36 inch beds with 4 seed-lines spaced 6 inches apart; 4-inch seed spacing; fresh market yellow variety
- **Design-** RCB with 5 blocks (reps)

2019 Study Methods

Studies were conducted at the UC Intermountain Research and Extension Center. Plot size was 2 beds (6 ft) by 24 ft. Seed treatments were commercially applied by Incotec and Alan Taylor's lab. The Agri-Mek in-furrow treatment was applied using 8001 EVS nozzles @ 30 psi. Nozzles were mounted on the onion planter to apply a 3-inch band directly over the seed-line after seed placement but before furrow closure. Treatment efficacy was determined by measuring onion plant density and vigor multiple times during onion establishment. Onion plant density and bulb yield were measured at harvest. Onion stand (plant density) was determined by counting the number of green onions in the entire plot area (6 ft by 24 ft). Onion yield was measured by harvesting all onions in each plot. Onions were run across a grade-line to remove loose soil and green tops. A total weight was recorded for all bulbs in each plot.

Results

Regard, Regard + Cruiser, and Sepresto were the top-performing insecticides for maximizing onion stand and bulb yield (treatments 1-6 in Table). Onion stand and yield associated with these treatments was higher than the no insecticide control, Trigard, and Agri-Mek in furrow. Seed coating method (pellet vs. film-coat) did not influence onion stand and onion yield for Sepresto and Regard treatments (treatments 7-12 in Table), although onions treated with Sepresto + Pro-Gro + F300 as a film-coat had low vigor at both evaluations compared to the control. When comparing Cruiser, Cruiser + Regard, and Cruiser + Trigard all had similar stand and yields, although Cruiser + Regard was the only treatment statistically higher than the untreated control (treatments 13-16 in Table).

Table. Influence of 2019 Maggot Treatments on Onion Stand, Onion Vigor, and Bulb Yield

Insecticide Comparison for Maggot Control in Onion

Trt #	Treatment	2-leaf vigor	2-leaf onion stand	7-leaf vigor	Harvest onion stand	Bulb yield
		1-10; 10= best	# of onions/plot	1-10; 10= best	# of onions/plot	tons/acre
1	Penflufen + thiram (control)	6.4 b	403 b	6.4 b	401 b	42.5 c
2	Penflufen + thiram + Regard	7.4 a	597 a	7.4 ab	590 a	54.6 a
3	Penflufen + thiram + Regard + Cruiser	7.4 a	586 a	7.8 ab	587 a	53.4 a
4	Penflufen + thiram + Sepresto	7.4 a	572 a	7.6 ab	578 a	51.8 ab
5	Penflufen + thiram + Trigard	7 ab	454 b	7.6 ab	457 b	45.2 bc
6	Penflufen + thiram + Agri-Mek in-furrow	6.8 ab	407 b	7.2 ab	404 b	42.4 c

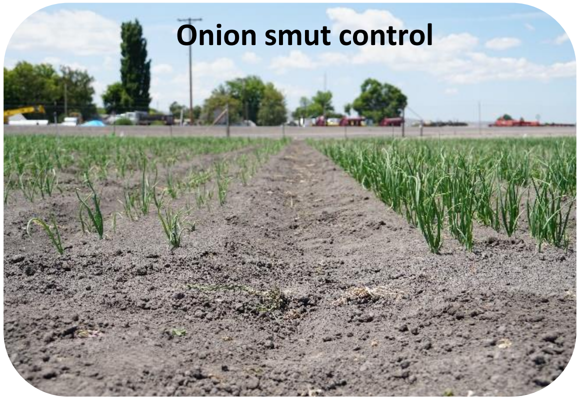
Pellet Vs. Film Coat for Maggot Control in Onion

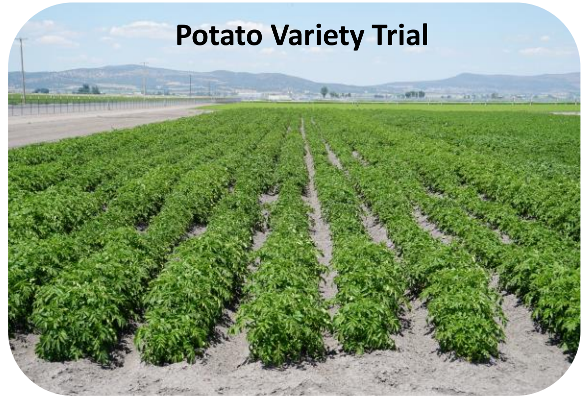
Trt #	Treatment	2-leaf vigor	2-leaf onion stand	7-leaf vigor	Harvest onion stand	Bulb yield
		1-10; 10= best	# of onions/plot	1-10; 10= best	# of onions/plot	tons/acre
7	Sepresto + Thiram + Penflufen (pelleted)	7.8 a	593 a	7.6 ab	596 a	54.6 a
8	Sepresto + Thiram + Penflufen (film-coat)	7.4 ab	605 a	8 a	601 a	55 a
9	Sepresto + Pro-Gro + F300 (pelleted)	7.2 ab	589 a	7.8 a	599 a	53.7 a
10	Sepresto + Pro-Gro + F300 (filmcoat)	6.4 b	568 a	7 b	582 a	52.8 a
11	Regard + Thiram (pelleted)	7.8 a	599 a	7.8 a	602 a	56.8 a
12	Regard + Thiram (film coat)	7.8 a	594 a	7.8 a	585 a	55.3 a

Regard Vs. Trigard for Maggot Control in Onion

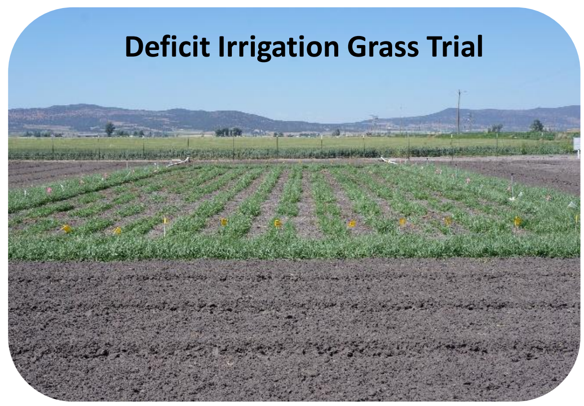
Trt #	Treatment	2-leaf vigor	2-leaf onion stand	7-leaf vigor	Harvest onion stand	Bulb yield
		1-10; 10= best	# of onions/plot	1-10; 10= best	# of onions/plot	tons/acre
13	FarMore 300 (control)	7.8 a	543 a	6.8 a	554 b	62.6 b
14	FarMore F300 + Cruiser	8 a	590 a	7.8 a	606 ab	66.8 ab
15	FarMore F300 + Cruiser + Regard (FI500)	8 a	634 a	7.8 a	660 a	70.2 a
16	FarMore 300 + Cruiser + Trigard	8 a	612 a	7.8 a	624 ab	69.6 ab

Special Thanks: The research team would like to thank the California Garlic and Onion Research Advisory Board for financial support, Alan George Taylor at Cornell University for arranging and applying seed treatment, and Incotec Seed Coating for applying seed treatment.


Onion smut control

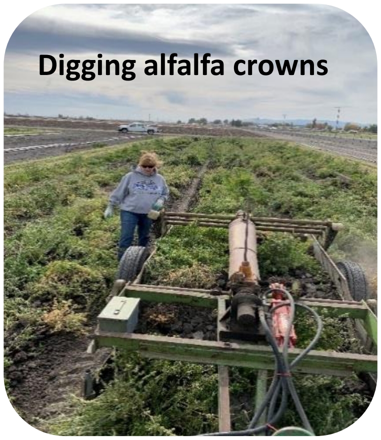

Potato Variety Trial


Plant Growth Regulator Trial


Deficit Irrigation Grass Trial


Mint Variety Trial


Wheat Variety Trial


Digging alfalfa crowns


Hauling mint samples


Oops


Chopping mint samples


Spreading compost


Harvesting wheat plots