2018 Spring Research Update

Intermountain Research and Extension Center

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Agriculture and Natural Resources

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IREC Happenings

The recent cold wet weather is a welcomed break from the warm, dry January and February. I have my fingers crossed the wet weather will continue. A benefit of the recent wet weather is IREC staff found time to finish several reports summarizing 2017 research projects. This research update is an attempt to compile many of these summaries and get the information out before the rapidly approaching field season. Hopefully the report will allow you to digest the information at your leisure in between the many scheduled meeting the next few months. Please contact the office with questions or if you need additional information.

New Multiuse Building Construction. Scheduled Completion Summer 2018

As many of you are already aware, we started construction on a new multi-purpose conference and laboratory building this fall. Construction is progressing nicely, and we hope to have construction complete by our field day scheduled for July 26th. We are extremely excited to have a conference room capable of accommodating large groups and additional laboratory space for research. We also plan to have the latest audio/visual equipment coupled with high-speed internet access, enabling advanced teleconferencing abilities right here in Tulelake. The facility will be available to the local agricultural community and greater Klamath Basin Community. I will be announcing a fund-raising campaign shortly to generate public/private funds for furnishings, lab equipment, and supplies. Stay tuned for details!!

Sincerely,

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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 2016-17 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 2017. Grain yield and quality was measured from these trials and reported on both single-year and multi-year bases on the UC Small Grains website (http://smallgrains.ucanr.edu/Variety/).

Multi-year, multi-trial data tends to produce more reliable estimates of crop productivity potential. For this reason, the UC Small Grain Variety Testing Program emphasizes the multi-year trial data in our reporting, and we recognize that the value from the 2017 trials was augmented by efforts in previous seasons. Indeed, the year-over-year consistency in the trial efforts at IREC helps to create ever-accruing value in the multi-year dataset. To begin to unlock this value for the various clientele who use this data, over the past year, the UC Small Grain Variety Testing Program has developed a dynamic webtool for customizing and sorting the results from the multi-year trial efforts, including for the Intermountain Region trials (http://smallgrainselection.plantsciences.ucdavis.edu/). In addition to these online resources, up-to-date summaries of the performance of commercially released cultivars tested in the Intermountain Region between 2015 and 2017 are provided as an addendum to this document.

Nitrogen (N) Management in Malting Barley

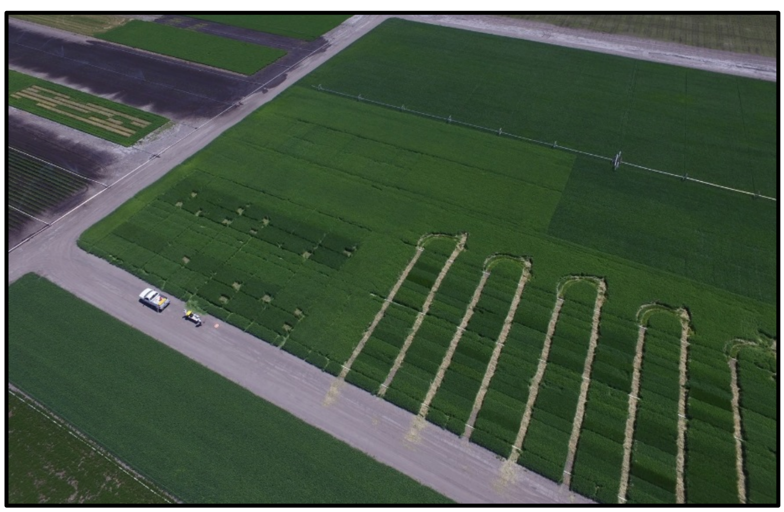

Figure 1. IREC barley variety and N management trials. 30 June, 2017.

Within the quickly expanding California microbrewing industry, there is growing interest in regionally-sourced malting barley. Maltsters desire a fixed protein concentration range (i.e. approximately 9% – 10.5%) and narrow quality parameters for malting barley. Nitrogen (N) fertilizer management for this crop is very important in determining both productivity and quality outcomes, and information related to N management effects on malting barley that is specific to California environments is lacking. In 2017 a multi-site study that included IREC at Tulelake began to explore the effect of N fertilizer rate and timing on malting barley yield and protein. The trial also investigated the ability of proximal sensing devices from handheld instruments and UAVs to guide precision N management in this crop. Preliminary results from this study are included as an addendum to this document. To see full results please visit: http://smallgrains.ucanr.edu/files/280336.pdf

3 year (2015-2017) and 1-year (2017) yield and protein estimates from Intermountain Regions hard spring wheat trials (commercially release varieties only).

Region/Group	Crop Type	Years	Name	3-yr Yield (lb/acre)	3-yr St.Err. Yield (lb/acre)	3-yr Yield Rank	Diff. from overall mean.x	St.Err.Diff. from overall mean.x	P-Value	2017 Yield (lb/acre)	2017 St.Err.Yield (lb/acre)	2017 Yield Rank	3-yr Protein (%)	3-yr St.Err. Protein (%)	3-yr Protein Rank	Diff. from overall mean.y	St.Err.Diff. from overall mean.y	3-yr P-Value	2017 Protein (%)	2017 St.Err.Protein (%)	2017 Protein Rank	Status
InterMnt	HRS	2015-2017	LCS IRON 11 SB 0096	6808	1050	1	817	320	0.05	-	-	-	12.82	0.8	44	0.18	0.63	0.86	-	-	-	Released
InterMnt	HWS	2015-2017	DAYN	6781	1067	6	790	371	0.13	-	-	-	12.29	0.88	63	-0.35	0.73	0.79	-	-	-	Released
InterMnt	HWS	2015-2017	WB HARTLINE	6646	1050	8	656	320	0.14	-	-	-	12.97	0.8	41	0.33	0.63	0.77	-	-	-	Released
InterMnt	HWS	2015-2017	LCS STAR	6603	1018	11	613	192	0.01	7774	230	5	12.53	0.62	55	-0.11	0.38	0.86	11.45	0.22	36	Released
InterMnt	HWS	2015-2017	WB 7566	6453	1026	18	462	231	0.15	7315	174	12	12.6	0.67	51	-0.04	0.45	0.96	12.08	0.16	26	Released
InterMnt	HWS	2015-2017	LCS ATOMO	6413	1018	22	423	192	0.11	6728	230	31	12.43	0.62	58	-0.21	0.38	0.75	12.45	0.22	22	Released
InterMnt	HRS	2015-2017	WB 9518	6316	1018	29	326	192	0.24	6388	230	42	14.03	0.62	6	1.39	0.38	0	14.05	0.22	2	Released
InterMnt	HWS	2015-2017	UI PLATINUM	6294	1018	30	303	192	0.27	6760	230	29	12.11	0.62	71	-0.53	0.38	0.38	11.85	0.22	31	Released
InterMnt	HRS	2015-2017	WB 9200	6257	1025	34	267	227	0.45	6733	230	30	13.63	0.66	12	0.99	0.44	0.12	13.17	0.22	9	Released
InterMnt	HRS	2015-2017	WB 9229	6165	1020	43	175	202	0.57	6654	230	33	13.29	0.63	27	0.65	0.39	0.29	12.65	0.22	21	Released
InterMnt	HWS	2015-2017	WB 7417	6158	1025	45	168	227	0.65	6983	230	22	13.92	0.66	10	1.28	0.44	0.04	13.78	0.22	5	Released
InterMnt	HRS	2015-2017	JEFFERSON	6137	1028	48	146	241	0.68	7184	230	18	13.3	0.68	25	0.66	0.47	0.38	12.8	0.22	16	Released
InterMnt	HRS	2015-2017	BULLSEYE	6039	1029	52	48	242	0.88	-	-	-	13.62	0.68	14	0.98	0.47	0.16	-	-	-	Released
InterMnt	HRS	2015-2017	WB PATRON	5963	1051	56	-27	321	0.95	6826	230	27	13.45	0.8	20	0.81	0.63	0.41	12.93	0.22	14	Released
InterMnt	HRS	2015-2017	SY COHO 04W40292R	5909	1025	58	-81	227	0.79	6647	230	34	13.51	0.66	15	0.87	0.44	0.18	13.03	0.22	11	Released
InterMnt	HRS	2015-2017	WB 9411	5865	1051	60	-126	321	0.78	6728	230	32	13.25	0.8	31	0.61	0.63	0.54	12.73	0.22	20	Released
InterMnt	HRS	2015-2017	SY STEELHEAD	5822	1018	62	-168	192	0.57	6795	230	28	14	0.62	8	1.36	0.38	0	13.92	0.22	4	Released
InterMnt	HRS	2015-2017	UI WINCHESTER	5781	1067	65	-210	371	0.69	-	-	-	13.45	0.88	19	0.81	0.73	0.51	-	-	-	Released
InterMnt	HRS	2015-2017	WB 9668	5773	1051	66	-218	321	0.67	6636	230	35	14.47	0.8	2	1.83	0.63	0.04	13.95	0.22	3	Released
InterMnt	HWS	2015-2017	CLEAR WHITE 515	5754	1067	70	-236	371	0.68	-	-	-	13.22	0.88	32	0.58	0.73	0.61	-	-	-	Released
InterMnt	HRS	2015-2017	WB 9662	5689	1051	72	-301	321	0.57	6552	230	37	13.97	0.8	9	1.33	0.63	0.15	13.45	0.22	8	Released
InterMnt	HWS	2015-2017	UC PATWIN 515HP	5630	1051	74	-361	321	0.46	6493	230	39	13.5	0.8	16	0.86	0.63	0.38	12.98	0.22	12	Released
InterMnt	HRS	2015-2017	YECORA ROJO	5532	1025	79	-458	227	0.15	5886	230	47	14.2	0.66	4	1.56	0.44	0.01	13.78	0.22	6	Released
InterMnt	HRS	2015-2017	ALUM	5474	1025	82	-516	227	0.09	6461	230	41	13.48	0.66	17	0.84	0.44	0.19	13.13	0.22	10	Released
InterMnt	HRS	2015-2017	WB 9350	5449	1051	83	-541	321	0.24	6312	230	43	13.25	0.8	30	0.61	0.63	0.54	12.73	0.22	19	Released
InterMnt	HRS	2015-2017	KELSE	5185	1051	87	-806	321	0.06	6047	230	45	14.27	0.8	3	1.63	0.63	0.07	13.75	0.22	7	Released
InterMnt	HRS	2015-2017	GLEE	5014	1051	90	-977	321	0.02	5876	230	48	13.27	0.8	28.5	0.63	0.63	0.54	12.75	0.22	17	Released
InterMnt	HRS	2015-2017	ANZA	4666	1066	95	-1324	368	0	-	-	-	11.95	0.88	75	-0.69	0.72	0.54	-	-	-	Released

3-year (2015-2017) and 1-year (2017) yield and protein estimates from Intermountain Regions soft spring wheat trials (commercially release varieties only).

Region/Group	Crop Type	Years	Name	3-yr Yield (lb/acre)	3-yr St.Err. Yield (lb/acre)	3-yr Yield Rank	Diff. from overall mean.x	St.Err.Diff. from overall mean.x	P-Value	2017 Yield (lb/acre)	2017 St.Err.Yield (lb/acre)	2017 Yield Rank	3-yr Protein (%)	3-yr St.Err. Protein (%)	3-yr Protein Rank	Diff. from overall mean.y	St.Err.Diff. from overall mean.y	3-yr P-Value	2017 Protein (%)	2017 St.Err.Protein (%)	2017 Protein Rank	Status
InterMnt	SWS	2015-2017	WB 6341	7253	1018	2	1262	192	0	7799	230	3	10.45	0.62	96	-2.19	0.38	0	10.15	0.22	49	Released
InterMnt	SWS	2015-2017	WB 6430	7103	1018	4	1113	192	0	7524	230	8	10.77	0.62	94	-1.87	0.38	0	10.3	0.22	47	Released
InterMnt	SWS	2015-2017	UI STONE	6756	1018	7	766	192	0	7781	230	4	10.81	0.62	93	-1.83	0.38	0	10.13	0.22	50	Released
InterMnt	SWS	2015-2017	ALTURAS	6615	1033	9	625	261	0.08	-	-	-	11.36	0.71	89	-1.28	0.51	0.08	-	-	-	Released
InterMnt	SWS	2015-2017	TEKOA WA 8189	6512	1051	15	521	321	0.26	7375	230	10	11.02	0.8	91	-1.62	0.63	0.07	10.5	0.22	46	Released
InterMnt	SWS	2015-2017	RYAN WA 8214	6496	1051	17	506	321	0.27	7359	230	11	11.45	0.8	88	-1.19	0.63	0.19	10.93	0.22	45	Released
InterMnt	SWS	2015-2017	WB 6121	6384	1022	24	394	212	0.18	7196	230	16	11.93	0.64	76	-0.71	0.42	0.27	11.18	0.22	40	Released
InterMnt	SWS	2015-2017	MELBA	6291	1025	31	300	227	0.37	7193	230	17	10.35	0.66	97	-2.29	0.44	0	9.73	0.22	52	Released
InterMnt	SWS	2015-2017	WHIT	6064	1029	51	74	242	0.83	-	-	-	11.55	0.68	84	-1.09	0.47	0.12	-	-	-	Released
InterMnt	SWS	2015-2017	ALPOWA	5783	1025	64	-208	227	0.57	7463	230	9	11.47	0.66	87	-1.17	0.44	0.07	11.05	0.22	42	Released
InterMnt	SWS	2015-2017	SEAHAWK	5334	1017	85	-656	187	0	7607	230	6	11.91	0.61	77	-0.73	0.37	0.18	10.17	0.22	48	Released
InterMnt	SWS	2015-2017	BAG NEW DIRKWIN HP	5057	1051	89	-933	321	0.02	5920	230	46	12.65	0.8	49	0.01	0.63	0.99	12.13	0.22	25	Released
InterMnt	SWS	2015-2017	LOUISE	4894	1025	93	-1096	227	0	5415	230	51	12.12	0.66	69	-0.52	0.44	0.48	11.03	0.22	43	Released
InterMnt	SWS	2015-2017	DIVA	4318	1018	96	-1672	192	0	5473	230	50	12.13	0.62	67	-0.51	0.38	0.38	11.4	0.22	37	Released

3-year (2015-2017) and 1-year (2017) yield and protein estimates from Intermountain Region winter wheat trials (commercially release varieties only).

Region/Group	Crop Type	Years	Name	3-yr Yield (lb/acre)	3-yr St.Err. Yield (lb/acre)	3-yr Yield Rank	Diff. from overall mean.x	St.Err.Diff. from overall mean.x	P-Value	2017 Yield (lb/acre)	2017 St.Err.Yield (lb/acre)	2017 Yield Rank	3-yr Protein (%)	3-yr St.Err. Protein (%)	3-yr Protein Rank	Diff. from overall mean.y	St.Err.Diff. from overall mean.y	3-yr P-Value	2017 Protein (%)	2017 St.Err.Protein (%)	2017 Protein Rank	Status
InterMnt	SWW	2015-2017	NORTHWEST DUET	7875	1373	4	775	336	0.16	8658	385	11	10.34	1.66	89	-1.1	1.4	1	9.74	2.15	34	Released
InterMnt	SWW	2015-2017	ROSALYN	7770	1357	9	670	267	0.13	8751	385	9	10.62	1.42	84	-0.82	1.11	1	9.74	2.15	35	Released
InterMnt	SWW	2015-2017	BOBTAIL	7722	1357	12	622	267	0.16	8473	385	15	11.11	1.42	53	-0.32	1.11	1	10.32	2.15	18	Released
InterMnt	SWW	2015-2017	MARY	7719	1354	13	619	251	0.13	8783	385	7	11.39	1.37	31	-0.05	1.05	1	10.6	2.15	9	Released
InterMnt	SWW	2015-2017	KELDIN	7698	1382	15	598	373	0.42	-	-	-	11.3	1.79	37	-0.13	1.56	1	-	-	-	Released
InterMnt	SWW	2015-2017	TUBBS 06	7686	1357	16	586	267	0.2	8660	385	10	10.56	1.42	86	-0.88	1.11	1	9.5	2.15	40	Released
InterMnt	SWW	2015-2017	WB 1604	7666	1382	17	566	373	0.46	-	-	-	11.14	1.79	48	-0.3	1.56	1	-	-	-	Released
InterMnt	SWW	2015-2017	LADD	7565	1527	22	465	742	0.81	-	-	-	10.31	3.25	90	-1.12	3.09	1	-	-	-	Released
InterMnt		2015-2017	HUFFMAN	7564	1400	23	464	434	0.62	-	-	-	10.96	2.02	66	-0.48	1.81	1	-	-	-	Released
InterMnt	SWW	2015-2017	SY OVATION	7560	1384	26	460	379	0.57	8606	385	12	10.8	1.81	75	-0.63	1.58	1	9.95	2.15	30	Released
InterMnt		2015-2017	WA 8232	7549	1361	28	449	288	0.44	9525	385	1	10.81	1.49	74	-0.63	1.2	1	9.49	2.15	41	Released
InterMnt	SWW	2015-2017	WB TRIFECTA	7540	1527	29	440	742	0.81	-	-	-	11.08	3.25	56	-0.35	3.09	1	-	-	-	Released
InterMnt	SWW	2015-2017	LCS BIANCOR	7539	1357	30	439	267	0.42	8471	385	16	10.86	1.42	71	-0.57	1.11	1	10.33	2.15	17	Released
InterMnt		2015-2017	JASPER	7456	1361	35	356	288	0.57	8274	385	22	11.02	1.49	60	-0.41	1.2	1	10.03	2.15	27	Released
InterMnt	SWW	2015-2017	LEGION	7445	1373	36	345	336	0.62	8806	385	6	10.83	1.66	73	-0.6	1.4	1	9.6	2.15	38	Released
InterMnt	SWW	2015-2017	TUBBS	7396	1357	38	296	267	0.62	8324	385	21	10.79	1.42	76	-0.64	1.11	1	9.88	2.15	32	Released
InterMnt	SWW	2015-2017	LCS ARTDECO	7256	1357	44	156	267	0.81	8005	385	32	10.89	1.42	70	-0.55	1.11	1	10.1	2.15	26	Released
InterMnt	SWW	2015-2017	WB 1529	7243	1357	45	143	267	0.84	7859	385	36	11.36	1.42	35	-0.07	1.11	1	10.94	2.15	7	Released
InterMnt	SWW	2015-2017	STEPHENS	7196	1357	49	96	267	0.89	7968	385	34	11.39	1.42	29	-0.04	1.11	1	10.54	2.15	12	Released
InterMnt	SWW	2015-2017	UI SPARROW	7178	1357	52	78	267	0.91	8452	385	17	10.97	1.42	65	-0.47	1.11	1	9.6	2.15	39	Released
InterMnt	SWW	2015-2017	SKILES	7145	1527	54	45	742	0.98	-	-	-	10.65	3.25	83	-0.79	3.09	1	-	-	-	Released
InterMnt	SWW	2015-2017	LCS DRIVE	7044	1373	61	-56	336	0.95	7980	385	33	10.98	1.66	64	-0.46	1.4	1	10.28	2.15	19	Released
InterMnt	SWW	2015-2017	NORTHWEST TANDEM	6954	1373	65	-146	336	0.88	8091	385	29	11.23	1.66	41	-0.2	1.4	1	10.23	2.15	21	Released
InterMnt	SWW	2015-2017	KASEBERG	6822	1357	69	-278	267	0.62	8143	385	28	10.68	1.42	82	-0.76	1.11	1	9.62	2.15	37	Released
InterMnt	SWW	2015-2017	BRUNEAU	6650	1527	75	-450	742	0.81	-	-	-	11.29	3.25	38	-0.14	3.09	1	-	-	-	Released
InterMnt	SWW	2015-2017	GOETZE	6250	1527	84	-850	742	0.6	-	-	-	11.38	3.25	33	-0.06	3.09	1	-	-	-	Released
InterMnt	SWW	2015-2017	SY ASSURE	5928	1367	88	-1173	315	0	6983	315	41	12.77	1.58	6	1.33	1.31	1	11.91	1.76	2	Released
InterMnt	SWW	2015-2017	YAMHILL	5011	1365	89	-2089	306	0	6066	545	42	12.05	1.55	15	0.61	1.27	1	11.36	3.04	4	Released
InterMnt		2015-2017	WINCORA	4544	1400	91	-2557	434	0	-	-	-	13.48	2.02	2	2.04	1.81	1	-	-	-	Released
InterMnt		2015-2017	VERDANT	4278	1413	92	-2822	474	0	-	-	-	13.27	2.17	3	1.84	1.97	1	-	-	-	Released

3-year (2015-2017) and 1-year (2017) yield estimates from Intermountain Regions spring barley trials (commercially release varieties only).

Region/Group	Crop Type	Years	Name	3-yr Yield (lb/acre)	3-yr St.Err. Yield (lb/acre)	3-yr Yield Rank	Diff. from overall mean	St.Err.Diff. from overall mean	P-Value	2017 Yield (lb/acre)	2017 St.Err.Yield (lb/acre)	2017 Yield Rank	Status
InterMnt	2RSM	2015-2017	FRANCIN	6038	922	4	1144	301	0	7731	237	2	Released
InterMnt	6RSF	2015-2017	MILLENNIUM	5883	939	6	989	357	0.02	-	-	-	Released
InterMnt	2RSM	2015-2017	OSU FULL PINT	5341	890	17	447	189	0.06	7232	237	5	Released
InterMnt	2RSM	2015-2017	SYNERGY	5219	922	18	325	301	0.48	6912	237	10	Released
InterMnt	2RSM	2015-2017	CONRAD	5100	939	20	206	357	0.81	-	-	-	Released
InterMnt	6RSM	2015-2017	CELEBRATION	5063	971	23	169	432	0.92	-	-	-	Released
InterMnt	2RSM	2015-2017	LCS GENIE	4990	922	27	96	301	0.92	6684	237	17	Released
InterMnt	6RSF	2015-2017	STEPTOE	4988	888	28	93	180	0.85	6237	237	24	Released
InterMnt	2RSF	2015-2017	BARONESSE	4888	888	35	-6	180	0.97	6234	237	26	Released
InterMnt	6RSM	2015-2017	STELLAR ND	4877	939	36	-17	357	0.97	-	-	-	Released
InterMnt	6RSM	2015-2017	LEGACY	4837	939	41	-57	357	0.94	-	-	-	Released
InterMnt	2RSM	2015-2017	UC TAHOE	4720	922	45	-174	301	0.81	6413	237	22	Released
InterMnt	6RSM	2015-2017	TRADITION	4643	939	49	-251	357	0.72	-	-	-	Released
InterMnt	2RSM	2015-2017	HARRINGTON	4590	890	50	-304	189	0.22	6113	267	27	Released
InterMnt	2RSM	2015-2017	AC METCALFE	4575	888	51	-319	180	0.18	5964	237	33	Released
InterMnt	2RSM	2015-2017	CDC FRASER	4398	922	57	-496	301	0.22	6091	237	30	Released
InterMnt	6RSM	2015-2017	QUEST	4330	939	60	-564	357	0.23	-	-	-	Released
InterMnt	2RSM	2015-2017	CDC COPELAND	4253	888	61	-641	180	0	5914	237	35	Released
InterMnt	2RSM	2015-2017	CONLON	3623	971	72	-1271	432	0.01	-	-	-	Released

University of California
Agriculture and Natural Resources
Intermountain Research & Extension Center
RESEARCH REPORT
Number 183, 2018

Use of Palisade Plant Growth Regulator to Prevent Barley and Wheat Lodging in Tulelake

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Introduction: The soils and weather in Tulelake are very favorable for irrigated barley and wheat production. Barley was one of the first crops grown in Tulelake, and growers consistently obtain some of the highest barley and wheat yields reported in California. Growers frequently have a problem with lodging, the bending over of the stems near the ground level. Lodging is caused by several factors including nitrogen, soil moisture, and weather. Plant breeding efforts have reduced the incidence of lodging over the years by developing shorter varieties with stiff straw, but many older varieties in high demand tend to lodge. In 2016 many growers experienced significant yield reduction and harvest problems due to barley lodging. One solution to lodging is to apply a plant growth regulator that shortens the internodes and strengthens the stem through inhibition of cell elongation. This study evaluated the use of the plant growth regulator, Palisade, for mitigating lodging in Tulelake barley and wheat. The study tested the effectiveness of Palisade applied at different timings and rates for reducing barley lodging in Tulelake. The study also documented the yield and quality benefit from using Palisade compared to leaving barley untreated.

Methods: A study site was established at IREC in spring 2017 in Copeland spring brew barley and Alpowa spring white wheat. The study was set up as a RCB design with four replications. Treatments included Palisade alone and in combination with herbicide and fungicide tank-mixes applied at two application times. The trial included an untreated control. Evaluations included plant height, lodging incidence and severity, grain yield, and grain quality.

Results: All Palisade treatments significantly reduced barley height and prevented lodging compared to the control (Table 1). Most Palisade treatments also increased grain yield compared to the control (Table 1). Palisade treatments applied Feekes 7 resulted in higher bushel weights compared to Palisade applied at Feekes 5 (Table 1). Palisade treatments applied at Feekes 7 also resulted in slightly higher protein than many of the Palisade treatments applied at Feekes 5.

Palisade applied alone at both timings significantly reduced Alpowa wheat plant height compared to the untreated control (Table 2). When Palisade was tank-mixed with Weedar64 and/or Quilt wheat plant height did not differ from the control (Table 2). All Palisade treatments reduced lodging compared to the control, although lodging was minimal in all treatments (less than 15%). Palisade tank-mixed with Quilt at the Feekes 7 application timing reduced stripe rust compared to the control and all other Palisade treatments (Table 2). Wheat yield, bushel weight, and protein were similar across all treatments (Table 2).

To see the complete report including all results and pictures, follow the link below: http://irec.ucanr.edu//files/280350.pdf

Table 1. Influence of the growth regulator Palisade (trinexapac-ethyl) on Copeland barley height, lodging, and stripe rust incidence.

				Milk Stage[2]			Harvest[2]		
Trt #	**Treatment**	**Rate/A**	**Application Timing[1]**	**Plant Height (inches)**	**% Lodging**	**% Stripe Rust**	**Grain Yield (ton/A)**	**Bushel Weight (lbs)**	**Protein**
1	Untreated	**	**	47a	59a	58a	3.23b	50.8abc	10.9a
2	Palisade NIS	14 fl oz .25%v/v	Feekes 5	40cd	0b	43a	3.94a	50bcd	10.0bc
3	Palisade Weedar64 NIS	14 fl oz 1 pt/A .25%v/v	Feekes 5	39d	0b	43a	3.68a	48.8d	10.0bc
4	Palisade Weedar64 Quilt NIS	14 fl oz 1 pt/A 14 fl oz .25%v/v	Feekes 5	39d	0b	48a	3.78a	49.5cd	9.7c
5	Palisade NIS	14 fl oz .25%v/v	Feekes 7	44b	0b	38a	3.59ab	51ab	10.6ab
6	Palisade Quilt NIS	14 fl oz 14 fl oz .25%v/v	Feekes 7	42bc	0b	33a	3.87a	51.5a	10.9a

[1]Feekes 5 = Leaf sheaths strongly erect; first node showing on a few plants

Feekes 7 = Second node visible; no flag leaves showing

[2]Treatment means with the same letter within columns are not statistically different (Tukey-Kramer HSD test)

Fig 1. Untreated Control & Palisade + Quit Treatment in Barley

Table 2. Influence of the growth regulator Palisade (trinexapac-ethyl) on Alpowa spring wheat height, lodging, and stripe rust incidence.

				Soft Dough Stage[2]			Harvest[2]		
Trt #	Treatment	Rate/A	Application Timing[1]	Plant Height (inches)	% Lodging	% Stripe Rust	Grain Yield (ton/A)	Bushel Weight (lbs)	Protein
1	Untreated	**	**	40.2a	10a	64a	3.90a	62.54b	9.7a
2	Palisade NIS	14 fl oz .25%v/v	Feekes 5	38.0b	0b	58a	3.97a	62.56b	9.7a
3	Palisade Weedar64 NIS	14 fl oz 1 pt/A .25%v/v	Feekes 5	38.4ab	0b	51a	4.00a	62.72ab	9.9a
4	Palisade Weedar64 Quilt NIS	14 fl oz 1 pt/A 14 fl oz .25%v/v	Feekes 5	38.2ab	0b	43a	4.04a	63.07ab	10.1a
5	Palisade NIS	14 fl oz .25%v/v	Feekes 7	37.0b	0b	63a	3.83a	62.89ab	9.9a
6	Palisade Quilt NIS	14 fl oz 14 fl oz .25%v/v	Feekes 7	38.3ab	0b	19b	4.14a	63.32a	10.3a

[1]Feekes 5 = Leaf sheaths strongly erect; first node showing on a few plants

Feekes 7 = Second node visible; no flag leaves showing

[2]Treatment means with the same letter within columns are not statistically different (Tukey-Kramer HSD test)

Figure 2. Palisade Wheat Trial Just Prior to Harvest in August 2017.

Spring / Winter Dryland Trial Summary

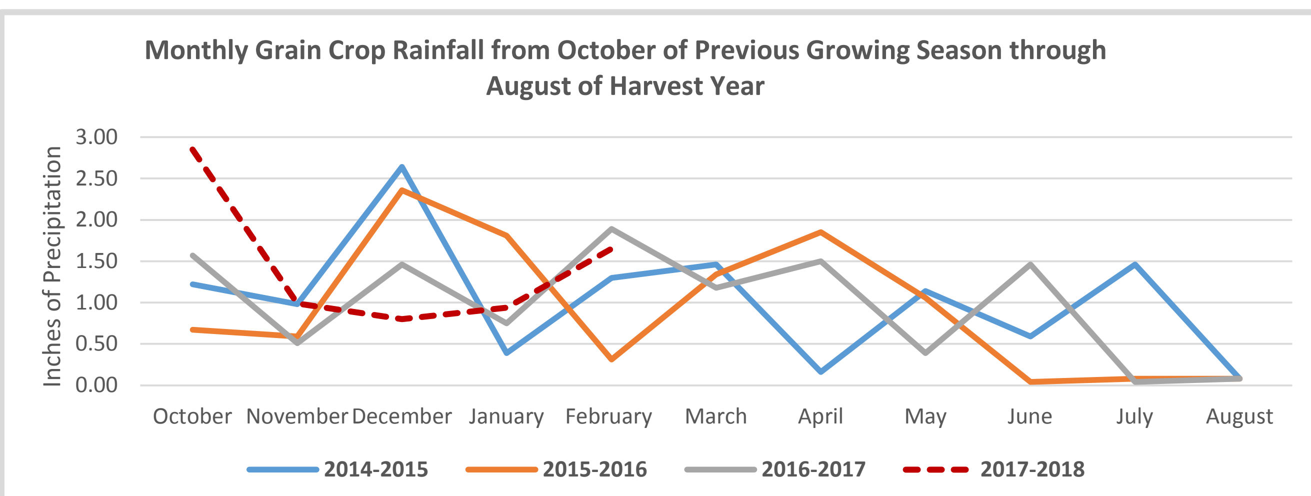
Principle Investigator, Steve Orloff Siskiyou County Farm Advisor. By Rob Wilson, Center Director/Farm Advisor; Darrin Culp, Principal Superintendent of Agriculture; and Skyler Peterson, Staff Research Associate, IREC

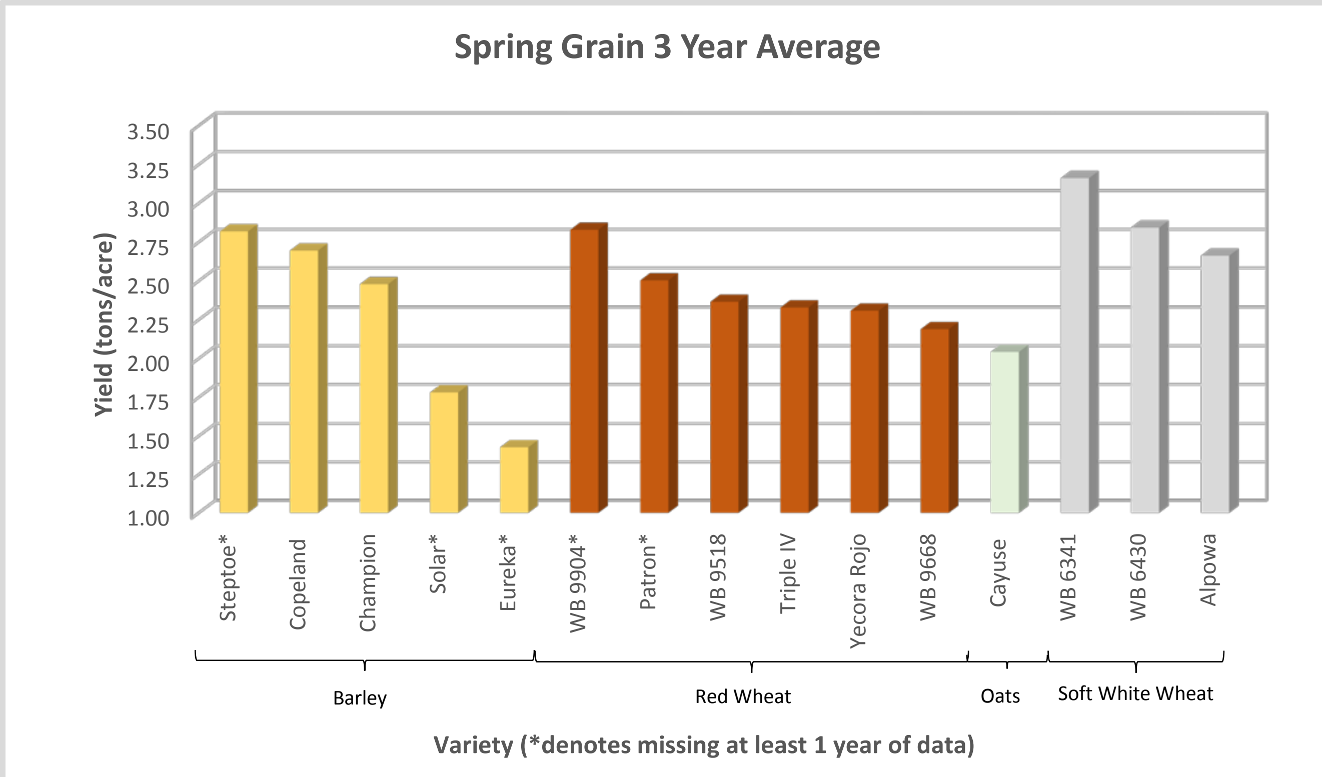
Introduction: The uncertainty of irrigation water availability is a common theme in the Klamath Basin, and growers are likely facing water shortages again this year. The uncertainty of irrigation presents growers with a difficult choice toward the use of their land. If the land is left fallow, wind erosion and weeds are a big concern. Dryland cover crops and small grains are a choice, but which species should growers choose? Another common question is "Is it more profitable to harvest a dryland grain crop for grain or hay?"

To help growers answer many of these questions, a long-term study was established at IREC in the spring of 2015 to better understand the yield potential of different grain species harvested for grain or hay. Spring trials were conducted from 2015-2017 and winter trials were conducted in 2015 and 2016.

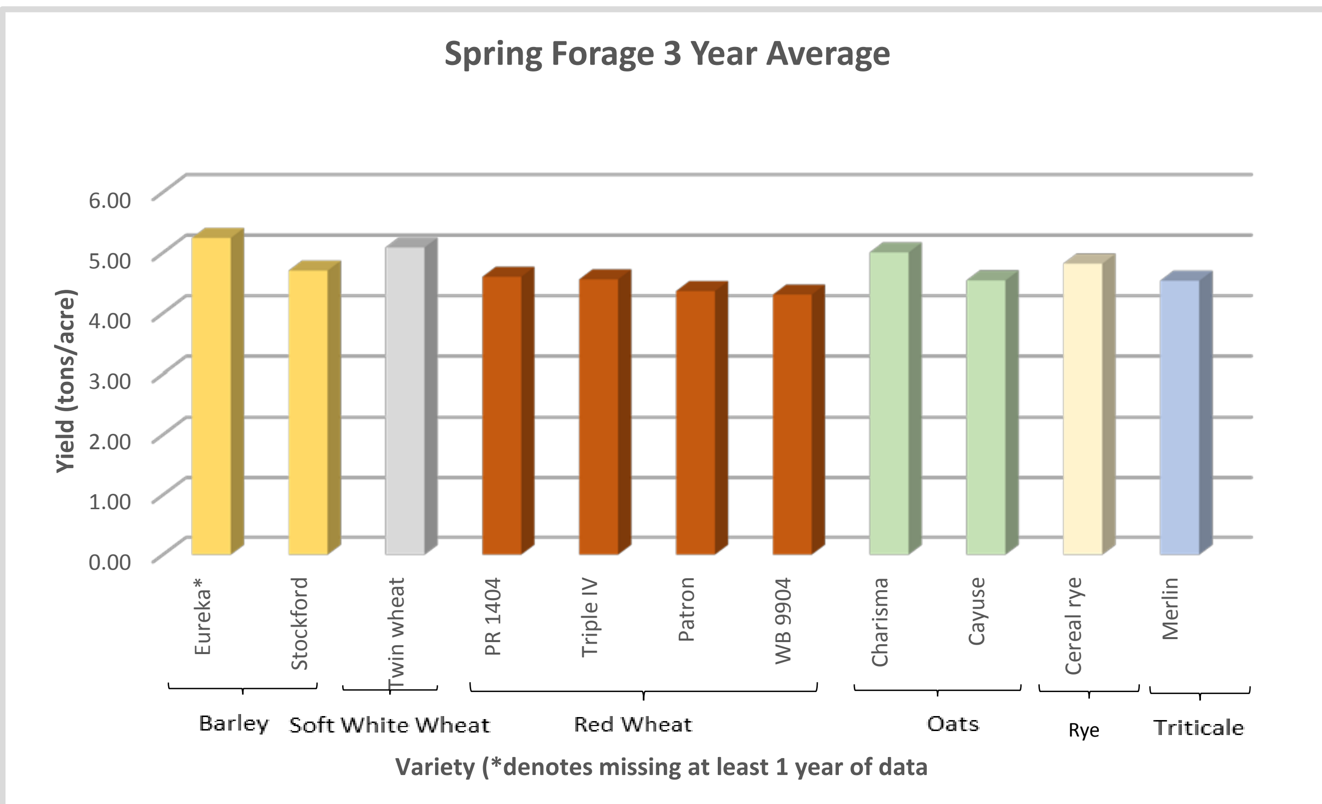
Results: The following graphs depict average 3-year rainfall, 3-year average yield for spring planted grains, and 2-year average yield for winter planted grains. Overall, winter planted small grains harvested for forage and grain out-yielded spring planted grains. Bobtail and SY Ovation were the highest yielding winter soft-white wheat varieties. The highest yielding winter forage producers were triticale varieties, Trical 141 and Trical 719, which both yielded over 9 tons/acre.

Regarding spring planted soft white wheats, WB6341 and WB6430 both out-yielded standard Alpowa. Copeland barley was the best performing barley, and WB9518 was the highest yielding hard red wheat. Spring planted forage yields were similar for all varieties and types, yielding between 4-5 tons/acre.

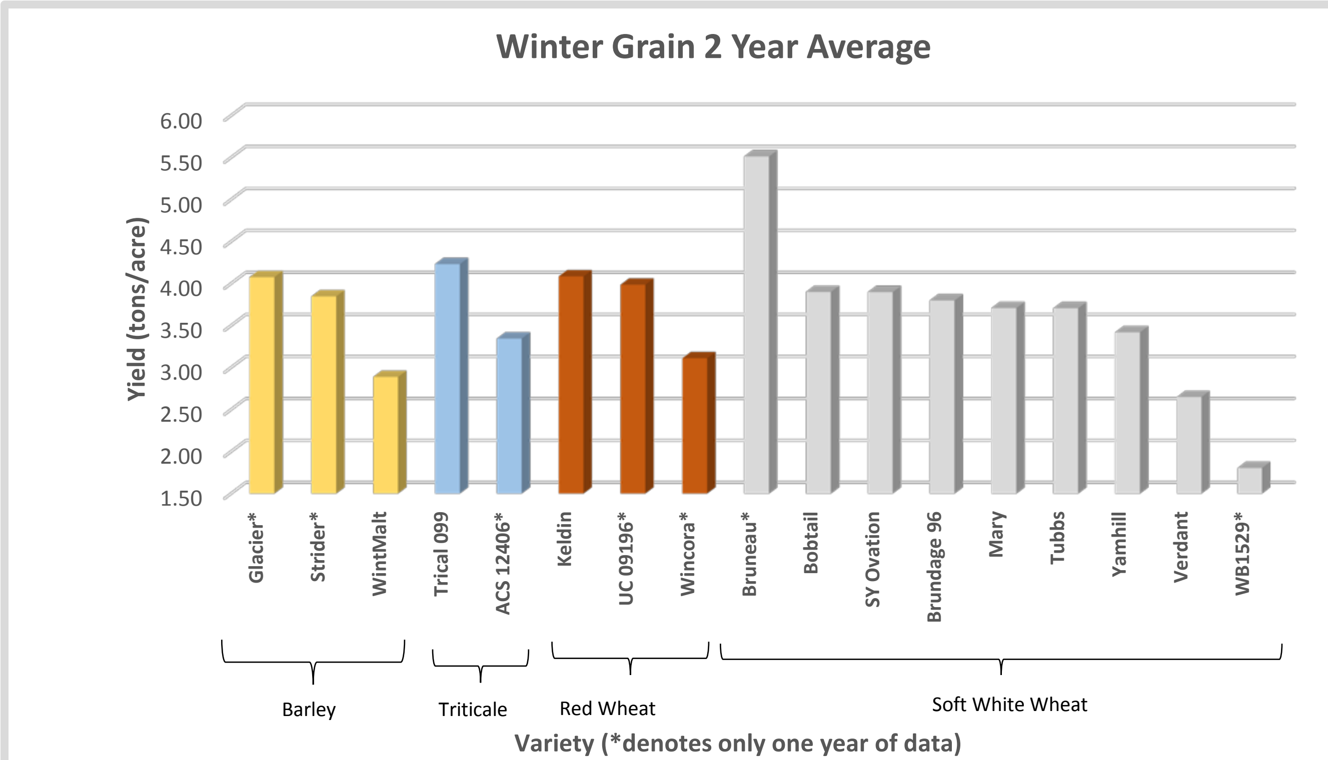


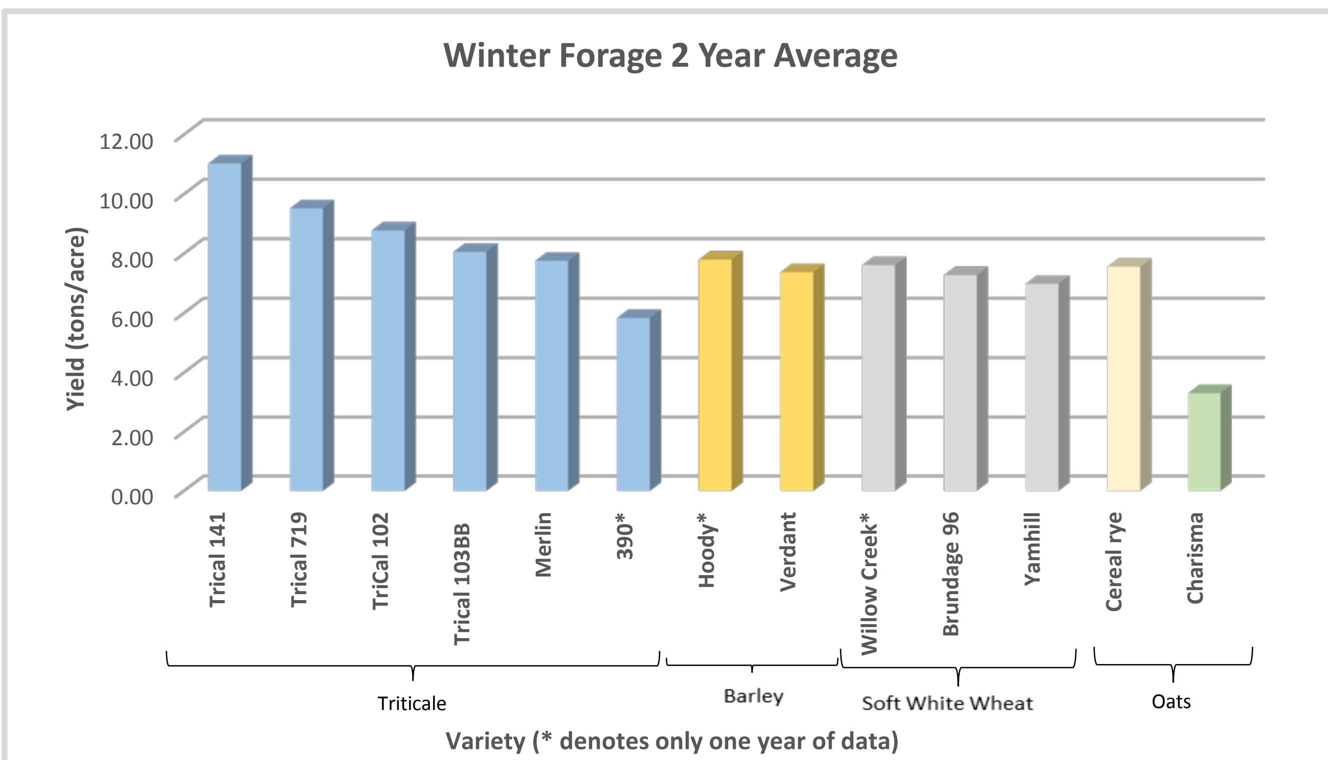


Spring Grain 3 Year Average
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
Yield (tons/acre)
Steptoe*
Copeland
Champion
Solar*
Eureka*
WB 9904*
Patron*
WB 9518
Triple IV
Yecora Rojo
WB 9668
Cayuse
WB 6341
WB 6430
Alpowa
Barley
Red Wheat
Oats
Soft White Wheat
Variety (*denotes missing at least 1 year of data)



Spring Forage 3 Year Average
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Yield (tons/acre)
Eureka*
Stockford
Twin wheat
PR 1404
Triple IV
Patron
WB 9904
Charisma
Cayuse
Cereal rye
Merlin
Barley
Soft White Wheat
Red Wheat
Oats
Rye
Triticale
Variety (*denotes missing at least 1 year of data


Winter Grain 2 Year Average
Yield (tons/acre)
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
Glacier*
Strider*
WintMalt
Trical 099
ACS 12406*
Keldin
UC 09196*
Wincora*
Bruneau*
Bobtail
SY Ovation
Brundage 96
Mary
Tubbs
Yamhill
Verdant
WB1529*
Barley
Triticale
Red Wheat
Soft White Wheat
Variety (*denotes only one year of data)


Winter Forage 2 Year Average
Yield (tons/acre)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Trical 141
Trical 719
TriCal 102
Trical 103BB
Merlin
390*
Hoody*
Verdant
Willow Creek*
Brundage 96
Yamhill
Cereal rye
Charisma
Triticale
Barley
Soft White Wheat
Oats
Variety (* denotes only one year of data)

By Charles H. Pickett, California Department of Food and Agriculture, Sacramento, CA and
Rob Wilson, University of California Intermountain Research and Extension Center, Tulelake, CA

Introduction: Cereal leaf beetle, *Oulema melanopus* (CLB) is a serious pest of small grain crops and forage grasses. Feeding by adults and larvae causes serious damage resulting in up to 25% yield loss if left unchecked. CLB, native to Eurasia, was first reported in North America in 1962 in Michigan. It has since spread throughout most of the country and Canada. However, no findings were reported in California until 2013. It has since spread throughout the Klamath Basin area of northern California, apparently moving south from Oregon. The larval parasitoid, *Tetrastichus julis* (Hymenoptera: Eulophidae) and egg parasitoid *Anaphes flavipes* (Hymenoptera: Mymaridae) were first imported from Europe into mid-western US and provided good to excellent control of this pest in the 1970's. The former parasitoid, introduced into the Pacific Northwest around 2000 has provided excellent control of cereal leaf beetle (Roberts and Rao 2012). The main goal of our ongoing project is to establish nursery sites along the leading edge of the expanding CLB population in northern California. The immediate benefit from this project is the permanent establishment of an excellent biological control agent for the cereal leaf beetle in California. This is the first, but critical, step in achieving successful biological control of the cereal leaf beetle. The benefits of successfully controlling the cereal leaf beetle biologically are numerous: higher yields, significantly lower production costs and substantially lower pesticide use.

Results:

Objective 1. Survey northern California for high concentrations of cereal leaf beetle.

Weekly surveys beginning late May 2017, through late July, in Modoc, Lassen, and Siskiyou Counties were conducted for the presence of CLB (Table 1). The goal of this survey is to find additional release sites for parasitoids of CLB, to determine the southern and western limit of the expanding CLB population, and if released parasitoids have established populations. Sampled grains included wheat, oats, and barley. Modoc, Lassen, and Siskiyou counties were sampled with the help of county staff: Cheryl Lauristen, Lassen Co.; Gary Fensler, Modoc Co.; and Tony Orr, Siskiyou Co. Two to four sets of 50-100 sweeps were made in most fields. Adults and larvae were again found in Modoc County, and for the first time in Siskiyou County, near the town of Macdoel. None have yet been found in the southern bordering county of Lassen. Most locations represented private landowners who might be willing to provide field insectaries for T. julis.

Objective 2. Develop nursery sites for Tetrastichus julis in northeastern California.

Because of the limited availability of CLB in Modoc County during early 2014, we developed a field insectary (Fig. 1) at the University of California Intermountain Research and Extension Center in Tulelake (IREC) following methods developed by Roberts (2016). The insectary is a first step in establishing a robust population of the CLB parasitoid T. julis in this region. It provides a sequential planting of small grains capable of supporting high populations of CLB. The larger the beetle population, the more parasitoids that will be produced for dispersal and release into surrounding small grain farms. Preventing large regional outbreaks of CLB through early releases of T. julis could prevent large-scale spraying of this small grain pest. The design was first implemented spring 2014 and was replanted in 2015, 2016, and 2017. The plot also provides a pesticide-free environment from which to measure changes in the CLB and T. julis populations at this location. This year, 2017, the first planting of oats v. Cayuse was on May 4, the second on May 17 and third on June 12 (Fig. 1). Winter wheat, v. Tubbs was planted on October 24, 2016. Oat and wheat plots were 42 ft by 250 ft.

Fig. 1. Panorama view of UC IREC field insectary, August 2, 2017. Oats1, Oats2, Oats3 refer to the sequence in which oats were plants, Oats1 being first. Respective planting dates, above.

Objective 3. Move parasitoids to additional 'hot spots' of cereal leaf beetle.

A field insectary at the IREC was initiated in 2014 and collections of T. julis were introduced from areas in northern Oregon with known populations of this natural enemy. Monitoring of the insectary which began in 2014, was repeated in 2015, 2016, and 2017. As in the past, most of the CLB collected from the insectary in 2017 were larvae and averaged 62% of the population over the season. Over the summer, CLB (adults and larvae combined) moved from the wheat to the first planting of oats (OAT1) then to subsequent plants (Fig. 2). This can be seen visually by the dominance of CLB first on wheat (purple bars) followed in time by orange, light green, then dark green bars in Figure 2. These results suggest that a particular stage of the plant, i.e. pre- seed filling, is preferred by adults and larvae. The number of larvae per 100 sweeps, averaged over all three oat plots, peaked at slightly over 2.5 in 2017 (Fig. 3), while in 2016 this peak was about 10 per 100 sweeps. The drop in CLB densities follows a trend at the IREC insectary over the last three years (Fig. 4). Seasonal CLB

Fig. 2. Sequential planting of oats, IREC, Tulelake, 2017. OAT1 was the first plot in sequence planted.

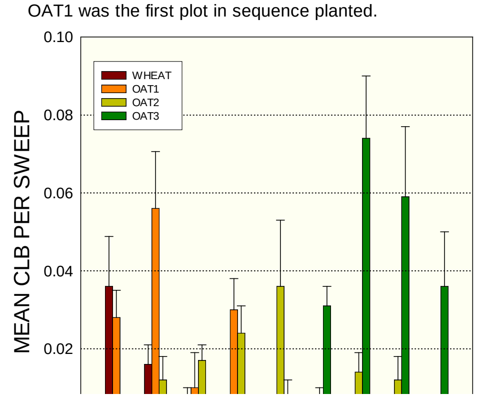
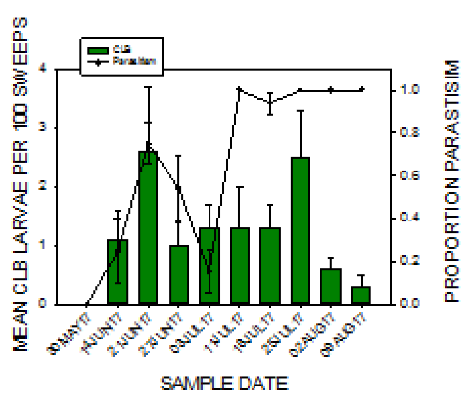
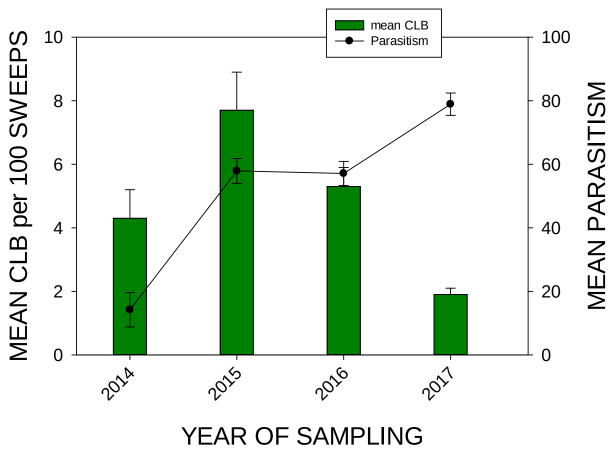


Fig. 3. Parasitism, change in CLB Larvae in Oats, Plots Combined at IREC, Tuleake, Summer 2017.



numbers have decreased since 2015 and parasitism has increased. Taking into account this decline over the last 3 years and the nearly 100% parasitism measured at the IREC field station over the last 5 weeks of sampling in 2017 (Fig. 3), suggests a strong localized density dependent response by T. julis to CLB. Most likely we are seeing the beginning of a regional decline in CLB. The impact of T. julis on the CLB population is so great that this beetle is unable to bounce back in numbers, even though recruitment from outside local sources. Parasitism appeared to have two peaks, June 8 and August 2, reaching above 70% each time (Fig. 4). This bimodal pattern to parasitism has been explained as an uncoupling of the parasitoid and host population as a result of unusually warm periods in early spring (Evans et al. 2012), and causes an increase in CLB numbers in midseason.

Fig. 4. Change in Mean CLB (adults and larvae) and Parasitism, IREC, Insectary Plot, Oats only.



Two releases of T. julis were made summer 2016 and one in 2017, into commercial grain acreage to expand their distribution (Table 2), with parasitoids coming from the IREC CLB field insectary and a commercial field, respectively. The 2017 parasitoids came from a site where they were released in 2016 (Chin ranch). Parasitoids were released as developing larvae, i.e. inside beetle larvae. Parasitoids were released into a wheat field managed by Plant Sciences Inc., near Macdoel, Siskiyou County where CLB was discovered in 2017 for the first time in this County. This release site now represents the western-most population of CLB in northern California. The Macdoel site in Siskiyou County is 29 miles from IREC, and also had small levels of parasitism (22%) at time of release. Since this is the first collection of CLB in Siskiyou County, populations are still relatively low. No CLB were found in the Lower Klamath Wildife refuge and none in the lower end of Butte Valley (waypoint B544, Table 1). It's remarkable that T. julis was able to find its way 29 miles from the IREC, into an area with very low CLB populations (Fig. 5). Another possibility is that it moved across the Oregon border just north of Dorris and Macdoel. But this region is relatively devoid of small grain crops and is dominated by introduced and native grasses, much less preferred host plants to this beetle (pers. obser., Fig. 5).

Summary: A robust CLB field insectary was maintained at the IREC in Tulelake, California. *Tetrastichus julis* successfully overwintered locally and re-established itself at this location. Populations of CLB at the IREC insectary show a significant decline from 2015 through 2017, best explained by an increase in degree of parasitism by T. julis at the same site. Exceptionally high levels of parasitism have been measured at this insectary the last two years, usually exceeding 80%. Parasitoids appear to have already spread some distance, up to 29 miles south and west of the Tulelake IREC. T. julis has been recovered at several previous release sites on commercial farms with parasitism levels between 60 and 100%. These results show that this parasitoid is rapidly spreading through the area and reaching levels of control capable of having a regional, suppressive impact on the CLB population.

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

Introduction: Choosing superior varieties of alfalfa is a significant economic factor for alfalfa growers. A large number of commercial varieties are currently available, enabling a 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

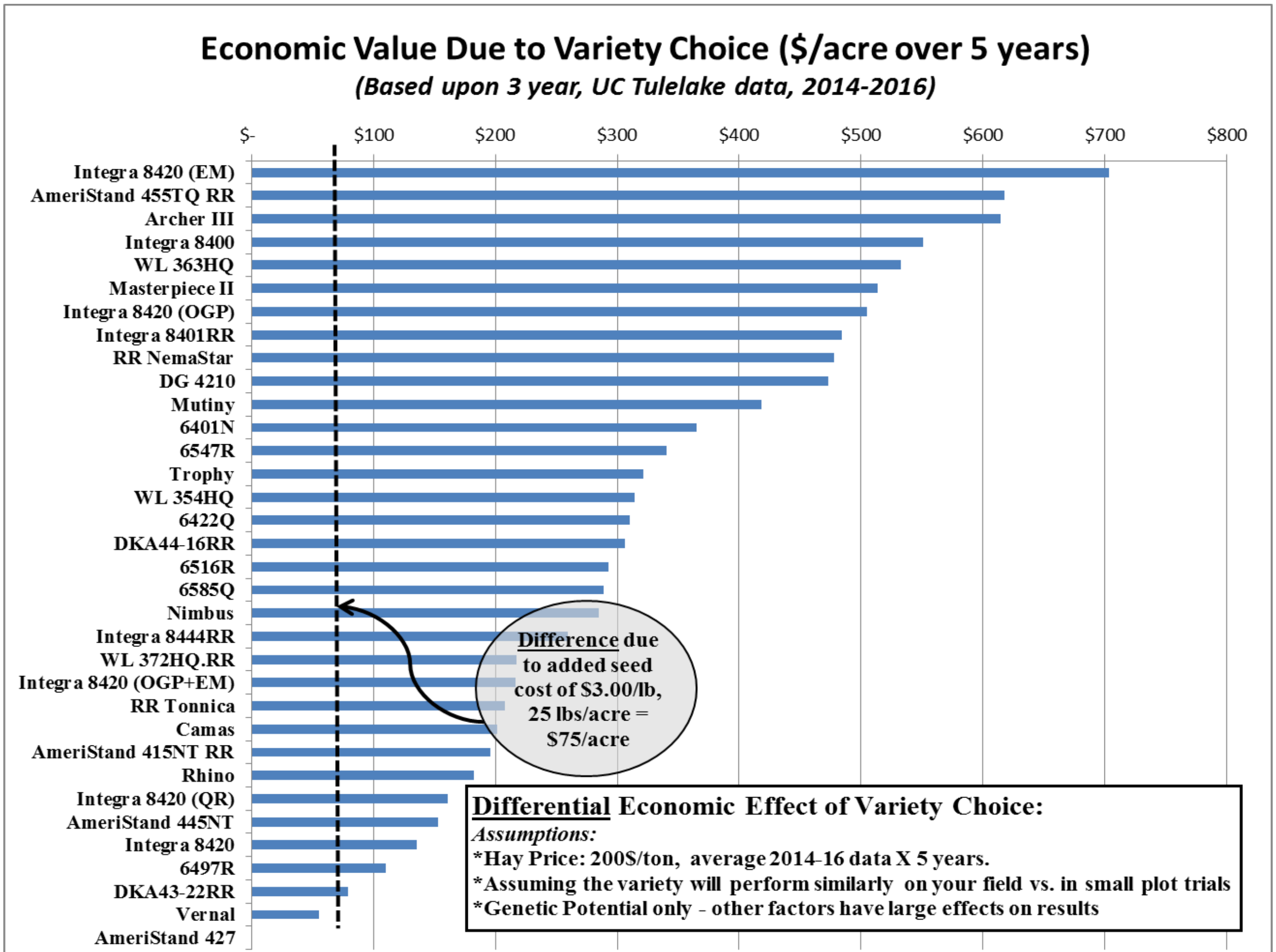
2016 Yield Results: This trial was planted with 42 entries on August 21, 2013. Four cuttings were taken during the 2016 season with the first cutting taking place on June 8, 2016. Single year results from the 2016 harvests are provided in Table 1. The average yield across all varieties was 6.9 tons/acre. The yearly yield averages between high and low varieties varied by approximately one ton or about 15% of the lowest yielding line. Yields averaged over the three-year trial were a little over 8.2 tons/acre (Table 2). The across-the-years yield average between high and low varieties varied 1.4 tons/acre. The CVs were relatively low, indicating control of varieties was stable over each cut in this trial. Also, included in this trial were plots inoculated with 4 seed treatment combinations using alfalfa variety Integra8420. These treatments include: Optimize Gold Plus (OGP), Rhizobia with an LCO promoter; an isoflavinoid (EM-09009); and Quick Roots (QR), a microbial seed inoculant.

2014-2016 YIELDS, TULELAKE ALFALFA CULTIVAR TRIAL. TRIAL PLANTED 8/21/13										
		2014		2015		2016				
		Yield		Yield		Yield		Average		
	FD	Dry t/a								
Released Varieties										
Integra 8420 (EM)	4	10.06	(4)	8.55	(6)	7.36	(2)	8.65	(1)	A
AmeriStand 455TQ R	4	9.99	(8)	8.69	(2)	7.03	(10)	8.57	(3)	A B C
Archer III	5	10.04	(5)	8.48	(7)	7.17	(6)	8.56	(4)	A B C
Integra 8400	4	9.93	(10)	8.55	(5)	7.02	(11)	8.50	(7)	A B C D E F
WL 363HQ	5	10.03	(6)	8.47	(8)	6.95	(18)	8.48	(8)	A B C D E F G
Masterpiece II	4	10.33	(1)	8.45	(10)	6.61	(40)	8.46	(9)	A B C D E F G H
Integra 8420 (OGP)	4	9.93	(9)	8.14	(24)	7.29	(3)	8.45	(10)	A B C D E F G H
Integra 8401RR	4	9.62	(24)	8.22	(18)	7.46	(1)	8.43	(11)	A B C D E F G H I
RR NemaStar	4	10.01	(7)	8.21	(20)	7.06	(8)	8.43	(12)	A B C D E F G H I J
DG 4210	4	9.67	(22)	8.65	(3)	6.95	(16)	8.42	(13)	A B C D E F G H I J
Mutiny	4	9.55	(30)	8.60	(4)	6.95	(17)	8.37	(14)	B C D E F G H I J K
6401N	4	9.79	(15)	8.21	(19)	6.94	(20)	8.31	(16)	B C D E F G H I J K L
6547R	4	9.68	(21)	8.36	(11)	6.84	(30)	8.29	(17)	C D E F G H I J K L M
Trophy	4	9.68	(20)	8.04	(32)	7.09	(7)	8.27	(18)	D E F G H I J K L M N
WL 354HQ	4	9.61	(25)	8.32	(13)	6.86	(26)	8.26	(20)	D E F G H I J K L M N
6422Q	4	9.90	(11)	8.20	(21)	6.68	(35)	8.26	(21)	E F G H I J K L M N
DKA44-16RR	4	9.71	(19)	8.26	(16)	6.81	(31)	8.26	(22)	E F G H I J K L M N
6516R	5	9.59	(26)	8.16	(23)	6.98	(14)	8.24	(23)	E F G H I J K L M N
6585Q	5	9.73	(18)	8.28	(14)	6.71	(33)	8.24	(24)	F G H I J K L M N
Nimbus	5	9.66	(23)	8.05	(31)	6.99	(12)	8.23	(25)	F G H I J K L M N
Integra 8444RR	4	9.57	(28)	8.08	(29)	6.98	(15)	8.21	(26)	G H I J K L M N O
WL 372HQ.RR	4	9.74	(17)	8.12	(26)	6.64	(39)	8.17	(28)	I J K L M N O
Integra 8420 (OGP+E	4	9.47	(33)	7.99	(36)	7.04	(9)	8.17	(29)	I J K L M N O
RR Tonnica	5	9.58	(27)	8.23	(17)	6.67	(37)	8.16	(30)	I J K L M N O
Camas	4	9.35	(38)	8.26	(15)	6.85	(28)	8.15	(31)	J K L M N O
AmeriStand 415NT RI	4	9.45	(34)	8.14	(25)	6.85	(27)	8.15	(32)	K L M N O
Rhino	4	9.43	(36)	8.10	(27)	6.87	(25)	8.13	(33)	K L M N O
Integra 8420 (QR)	4	9.56	(29)	7.86	(39)	6.91	(22)	8.11	(34)	K L M N O
AmeriStand 445NT	4	9.55	(31)	8.08	(28)	6.68	(36)	8.10	(35)	K L M N O
Integra 8420	4	9.43	(35)	7.89	(38)	6.94	(21)	8.09	(36)	L M N O
6497R	4	9.50	(32)	8.03	(34)	6.65	(38)	8.06	(37)	L M N O
DKA43-22RR	4	9.18	(41)	8.03	(33)	6.87	(24)	8.03	(38)	M N O
Vernal	2	9.27	(39)	7.85	(40)	6.89	(23)	8.00	(39)	N O
AmeriStand 427	4	9.25	(40)	7.82	(41)	6.79	(32)	7.95	(40)	O
Experimental Varieties										
FG 49W202	5	10.28	(2)	8.73	(1)	6.70	(34)	8.57	(2)	A B
SW4332	4	10.07	(3)	8.33	(12)	7.21	(5)	8.54	(5)	A B C D
FG 49W201	5	9.88	(12)	8.45	(9)	7.22	(4)	8.52	(6)	A B C D E
SW4351	4	9.80	(14)	8.19	(22)	6.99	(13)	8.33	(15)	B C D E F G H I J K L
SW4328	4	9.88	(13)	8.08	(30)	6.85	(29)	8.27	(19)	D E F G H I J K L M N
FG R49W215	4	9.75	(16)	7.90	(37)	6.95	(19)	8.20	(27)	H I J K L M N O
FG R57OK217	5	9.36	(37)	8.02	(35)	6.46	(42)	7.94	(41)	O
SW3304	3	7.97	(42)	7.29	(42)	6.51	(41)	7.26	(42)	
MEAN		9.66		8.20		6.91		8.26		
CV		4.44		4.47		5.00		2.82		
LSD (0.1)		0.51		0.44		0.41		0.28		

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. Also, included in this trial were plots inoculated with 4 seed treatment combinations using alfalfa variety Integra8420. These treatments include: Optimize Gold Plus (OGP), Rhizobia with an LCO promoter; An isoflavinoid (EM-09009); and Quick Roots (QR), a microbial seed inoculant.



Economic value of variety choice, Tulelake, CA. Although many factors affect yield, variety choice can have a large effect over time. The Message: Take a few minutes to analyze the genetic potential of varieties.

Influence of Fall Defoliation Height on the Productivity of Three Perennial Grasses

By Leslie Roche, Pasture and Range Specialist, UC Davis and David Lile, County Director and Livestock and Natural Resources Advisor, Lassen County

Introduction: Irrigated pasture and grass hay are important crops in the Intermountain area of northern California. The forage produced on these fields is either grazed by cattle or harvested as high-quality hay, a cash crop sold primarily to feed stores outside the local area. Currently, little attention is paid to the defoliation height of perennial grass fields. Growers seek to utilize as much of the available fall forage as possible to capture as much yield as possible or to delay the onset of winter feeding. This grazable fall forage provides a valuable resource as winter feed. In winter, cattle are often put out on these same irrigated pastures or hay fields, reducing stubble height even further. Other growers, lacking a livestock enterprise, may burn their fields in winter, thus fully removing any remaining stubble. What is the effect of these different management practices and is fall stubble height important for perennial grass production?

Residual stubble may provide microclimate effects that protect buds during cold winter temperatures. Reducing stubble height during the fall/winter period could also negatively impact meristematic tissues of any non-dormant plants, potentially curtailing tiller growth in the spring. Hence, fall stubble height could significantly affect pasture productivity in the subsequent growing season. In this project we are evaluating the effect of residual fall stubble height in addition to severe defoliation or burning over the winter months on the subsequent productivity of three common perennial grass species (tall fescue, orchardgrass and Timothy).

The perennial grass species tall fescue (Tuscany II), orchardgrass (Century) and Timothy (Aurora) were planted in blocks (main plots). Six different fall/winter management practices are imposed on each of the species.

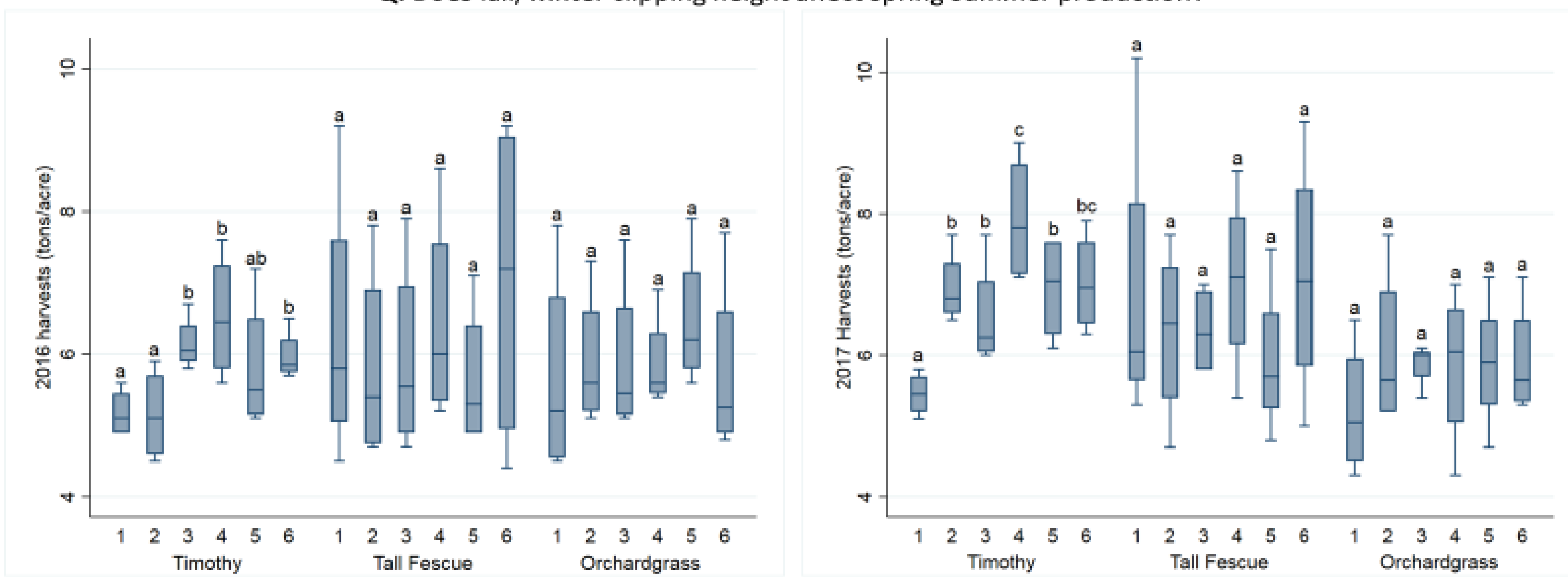
1. Fall harvest height as close to soil surface as possible (approximately 0.5 inch)
2. 2-inch fall harvest height
3. 4-inch fall harvest height
4. 6-inch fall harvest height
5. 4-inch fall harvest height followed by a mid-winter clipping close to the soil surface
6. 4-inch fall harvest height followed by a mid-winter burning

Research Update: Figure 1 shows yield for both 1st and 2nd cutting after fall clipping heights were imposed both years. In the case of timothy, increasing fall cutting height to 4 or 6 stimulated significantly higher hay yield the following season. Conversely, tall fescue and Orchardgrass hay yields were similar across cutting treatments, although there were some apparent yield reductions from lower cutting heights. The second figure shows yield of 1st and 2nd cutting combined with the yield of fall forage harvest from cutting treatments. When considering the fall forage component, yields were generally more similar across cutting treatments suggesting some of the yield lost at 1st and 2nd cutting is regained in the fall with the more intensive harvesting. In the case of tall fescue, preliminary analyses found the shortest fall clipping height produced the highest annual yield across cutting treatments. A formal report will be available at study completion.

Figure 1. 1st and 2nd cutting Hay Yield the Year after Fall Defoliation Treatments. Within each perennial grass species, different letters indicate significant ($p < 0.05$) differences between. Individual boxplots depict the 95th, 75th, 50th (median), 25th, and 5th percentiles.

1st and 2nd harvests combined

Q: Does fall/winter clipping height affect spring summer production?



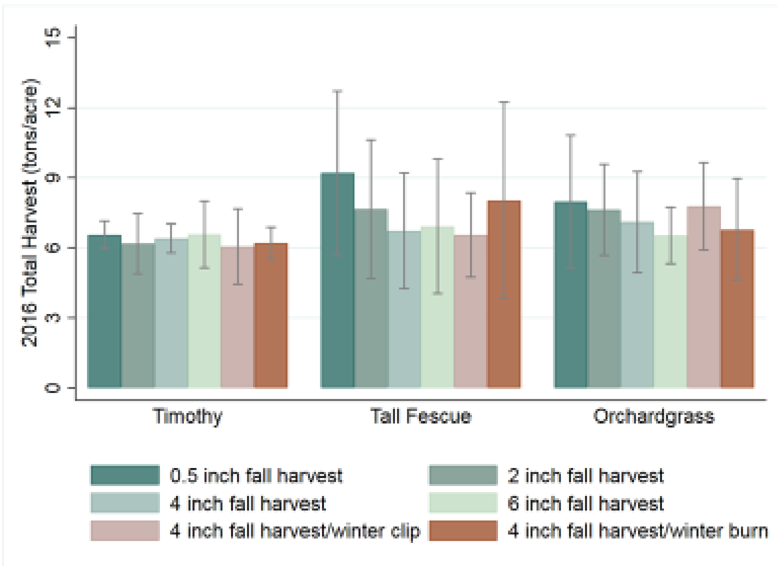
Management Treatments

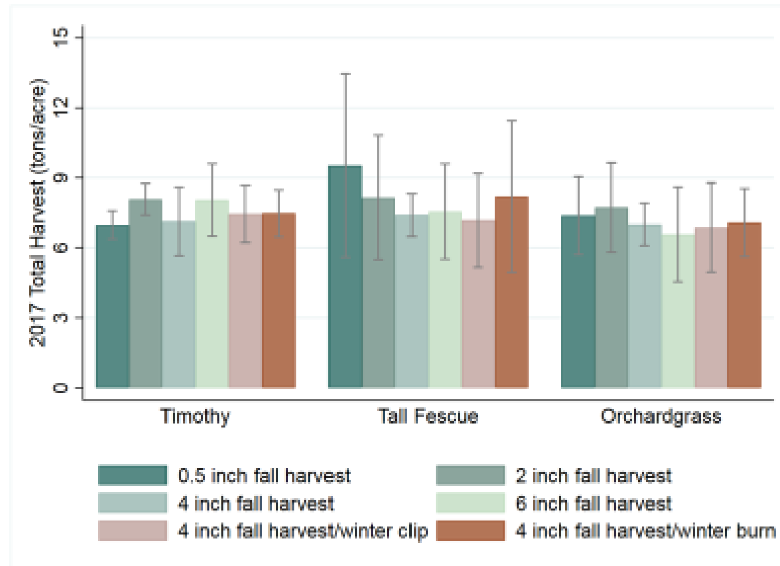
1	Fall harvest height as close to soil as possible	4	6 inch fall harvest height
2	2 inch fall harvest height	5	4 inch fall harvest height followed by a mid-winter clipping
3	4 inch fall harvest height	6	4 inch fall harvest height followed by a mid-winter burning

Figure 2. Total Annual Yield (1st Cutting, 2nd cutting, and Fall Forage Yield) after Fall Defoliation Treatments. Bars are one SE of mean.

1st and 2nd harvests and treatment harvest combined (total annual yield)

Q: Do any potential gains in spring/summer production from less intensive harvest treatments (e.g., 4 and 6 inch fall harvests) off-set forage left unharvested in fall (i.e., is total annual yield impacted)?





Blue Alfalfa Aphid and Alfalfa Weevils

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Insect pests in alfalfa have been an increasing problem in the Intermountain area the last couple of years. We have seen severe infestations of blue alfalfa aphid (BAA), alfalfa weevil, and clover root curculio. Tulelake producers saw very little aphid damage (likely due to natural predators and unfavorable weather conditions) in 2017. It is unknown the extent of aphid damage in 2018, but if the weather remains mild and dry, aphid populations will likely be worse compared to last year. It is important to scout fields for BAA aphids when alfalfa breaks dormancy and treat fields before aphid populations cause significant crop damage. Research conducted at IREC in 2015 showed large differences in the effectiveness of insecticides for BAA (Figure 1). Some insecticides caused a resurgence in BAA populations that exceeded levels observed in the untreated control plots. The insecticide Sivanto was effective and has now become the most widely used insecticide treatment in the Klamath Basin for aphid control in alfalfa.

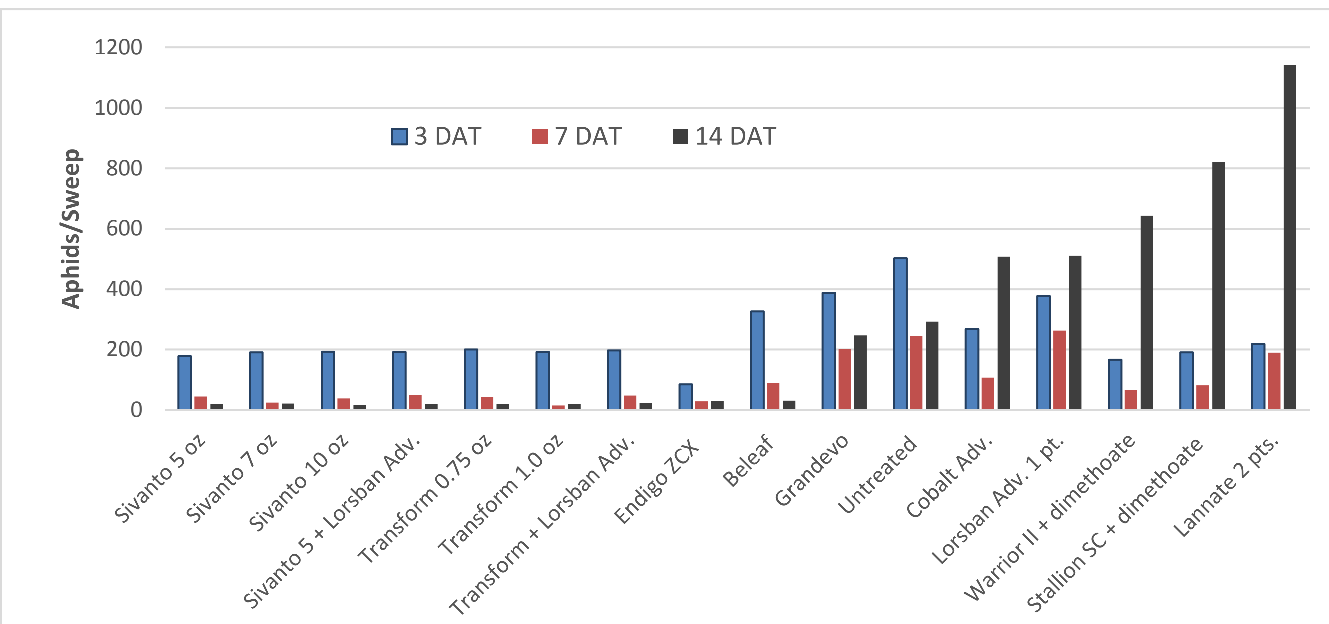

Figure 1. Effect of insecticide treatment on the number of blue alfalfa aphid per sweep 3, 7 and 14 days after treatment. LSD 0.05 = 95, 72 and 166 for the 3, 7 and 14 day evaluations, respectively. IREC, Tulelake, 2015.

Treatment guidelines for aphid species are presented below. If both BAA and pea aphid are present, current recommendations are to use the blue alfalfa aphid treatment levels.

TREATMENT THRESHOLDS (#aphids/stem)

Pest	**Plants less than 10"**	**Plants 10-20"**	**Plants more than 20"**	**Summer**	**Spring**	**After last fall cutting**
Pea aphid	40-50	70-80	100+	—	—	—
Blue alfalfa aphid	10-12	40-50	40-50	—	—	—
Cowpea aphid	10-12	40-50	40-50	—	—	—
Spotted alfalfa aphid	—	—	—	40*	20*	50-70

* Do not treat if there are 4 or more adult lady beetles or 3 or more lady beetle larvae per sweep for every 40 aphids counted per stem (on stubble this ratio is 1 larva/sweep to every 50 aphids/stem).

Alfalfa weevil was a major problem in 2017 throughout the Intermountain area. Weevils have four larval growth stages (instars) in spring. They then pupate and feed for a short time period and subsequently leave the field for more protected areas for summer aestivation. When they return to the field is not well known. There is only one generation per year in this area.

It has been difficult for growers to control alfalfa weevils for the past 3 years, especially in Scott Valley. Part of the problem appears to be a very prolonged hatch. In addition to a prolonged hatch, Scott Valley growers are not achieving acceptable control. Steve Orloff was concerned that weevils may have developed resistance to the insecticides currently used, so he conducted a study in 2016 in cooperation with UC Davis entomologists to evaluate resistance to pyrethroid insecticides. The study clearly showed weevils in Scott Valley were resistant to pyrethroid insecticides especially in fields where pyrethroids had been used repeatedly. Poor control has been noted in other areas in the Intermountain Region and a resistant population may also be present.

Pyrethroids are the most popular insecticide treatment in the Intermountain area, but the resistance problem in Scott Valley highlights the importance of rotating insecticide mode of action. Effective insecticides for alfalfa weevil control that are not pyrethroids include indoxacarb (Steward EC) and chlorpyrifos (Lorsban). Steward is often the preferred option as it can provide slightly better extended control and it is safer on beneficial insects compared to chlorpyrifos.

Armyworms: Did They Devour Your Fields?

Tom Getts, Weed Ecology and Cropping Systems Advisor, UC Cooperative Extension, Lassen, Modoc, Sierra, and Plumas Counties

True armyworm larvae

In the fall of 2017 there were serious armyworm outbreaks in California's Intermountain Region. Many pastures and hay fields were overtaken by this pest, especially in Siskiyou, Shasta, Modoc, and Lassen counties. While armyworms are only occasionally a problem in the Intermountain Area, when the numbers are high, the amount of damage can be devastating. Entire fields can be eaten down to the ground seemingly overnight!

Armyworms are not a pest that plagues the Intermountain Region each year. The climate is not conducive to their lifecycle, as freezing temperatures will kill most worms. As such, adult armyworm moths need to migrate in from warmer lower elevations to lay eggs and establish populations. Certain years, wet conditions in lower elevations can lead to lots of vegetation growth, and a buildup of adult moth populations to migrate up into higher elevations in search of habitat. The intolerance of cold is why the pest rears its ugly head later in the growing season. Typically, there are only two generations of armyworms in the Intermountain Region which is much cooler than lower elevations. The first generation larvae can be problematic, eating the flag leaves in small grain fields during development, where the second generation larvae can cause major yield reductions in pastures and hay production.

True armyworm moth and pupa collected from pastures in the Intermountain Region 2017.

True armyworm (*Mythimna unipuncta*), and western yellowstriped armyworm (*Spodoptera praefica*) are two of the most common species in the Intermountain Region. While both have yellow stripes, true armyworms are lighter in color than western yellowstriped armyworms. True armyworms roll their eggs up in blades of grass, and western yellowstriped armyworms lay them on the tops of leaves covering them in a cottony material. Eggs deposited hatch within a few days and larvae mature in 2-3 weeks through 6-7 instars before they pupate. Development of the pest is dependent on temperature, with warmer weather leading to faster development. The worms can grow quite large, typically up to 1-1.5 inches. During maturation extensive feeding occurs, but most of the foliage consumed is in the last couple of days before they pupate. A study estimated that armyworms eat 80 percent of the total plant matter they consume in just in their last instar, or within the last 4-5 days of feeding. This is why crops seem to be eaten "overnight" as once maturation occurs large worms march through fields trying to quell their insatiable appetites.

While these insects can be devastating in certain years, their populations are typically cyclical. There are many natural enemies of the larvae from spiders and lacewings, to parasitoids such as the caterpillar parasitic wasp (Hyposoter exiguae*)*. Viral diseases can also affect armyworms under certain conditions associated with high moisture, turning the caterpillar bodies limp. Most years in the Intermountain Region these natural predators and pathogens help keep populations in check. Unfortunately, 2017 wasn't one of those years, with large outbreaks occurring in many producers' fields.

Monitoring is the name of the game when dealing with armyworms. Monitor early and often, as the worm populations can really sneak up on you. The larvae are more active in low light, so early morning, evening, and cloudy days are the best times to monitor. Scouting for the worms requires getting down on your hands and knees in the fields at least once a week, looking low near the crowns of the plants, in the cracks of the soil, and under dirt clods. While the larvae may be up in the foliage, they are typically down low. Economic thresholds for California are only set in alfalfa, where other states have thresholds between 2-4 armyworm larvae/sq. ft. for grass pastures. It is very important to catch the worms before they get larger than ½ inch, as larger worms are the ones that cause extensive damage. Likewise, it is important not just to monitor for the worms, but also to determine if they are parasitized. Parasitized worms will die before they grow to the last instar, so insecticide applications may not be necessary if the majority of worms are parasitized. It is a "fun job" checking worms for parasites! The worm needs to be pulled apart, and the innards inspected for a little green larvae which if found, means the worm is parasitized. There is a great video from UC Advisor Racheal Long on You Tube detailing this process for monitoring in alfalfa.

Treatment options vary by crop, and organic treatments are limited. In alfalfa and grass hay fields, one cultural method which can reduce damage is cutting the field early. Often you will find armyworms under the windrows hiding from the light, but, in general, cutting will diminish their populations. However, cutting early isn't always the right option as yields can be reduced, and it may be an economic decision. Some literature sources indicate if larvae pass thresholds, a producer should cut or spray within two days. Treatment with insecticides is often justified, especially when the damage exceeds the cost of control.

XenTari® or Agree WG® (*Bacillus thuringiensis* BT) are labeled for organic production but are mainly effective on the 1st to 2nd instars of the armyworm larvae, and multiple applications may be needed for control. BT products typically do not harm beneficial insects. Both crop group 17 (grass forage, fodder, hay, range/pasture, excluding cereals) and 18 (non-grass animal feeds, forage fodder straw and hay) are on the XenTari® label.

In conventional production, Intrepid 2f® (*methoxyfenozide*) and Coragen® (*chlorrantraniliprole*) are effective armyworm products. Both products are also labeled for grass and non-grass forage crops (both crop groups 17 and 18). Steward EC® (*indoxacarb*) is an effective insecticide choice for alfalfa but is not labeled for grass and other forage crops. While smaller worms are more susceptible to insecticide control, applications of these conventional products to armyworms in their early instars could be counterproductive, as they can negatively impact beneficial insect populations before they have time to do their work. Deciding when to treat is a balancing act between the number of armyworms in the field, not treating too early before beneficial insects can control the population, and not treating too late before the worms grow too large and cause significant crop damage.

While armyworms may not be a problem in the Intermountain Region in 2018, don't risk it. Monitor your fields often so you can catch the pest early, so it doesn't "appear" and eat your fields overnight.

Potato Variety Development

By Rob Wilson, Center Director/Farm Advisor, Darrin Culp, Principal Superintendent of Agriculture; and Kevin Nicholson/Skyler Peterson, Staff Research Associates, 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 23 entries, a Specialty trial with 18 entries, and a Chipping trial with seven 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 for the three trials. To see the complete report including all results and pictures of the entries, follow this link: http://irec.ucanr.edu//files/280346.pdf

Table 1: 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	491.3	47.6	80.6	396.3	3.0	6.2	7.3
Russet Burbank	467.2	54.4	74.5	348.6	2.5	6.9	6.3
Russet Norkotah	421.8	29.0	86.2	364.2	2.9	4.7	8.3
A03141-6	527.0	46.7	88.2	465.3	2.1	4.7	10.6
A06030-23	417.9	79.2	74.0	309.4	3.1	4.9	7.9
A07061-6	568.8	29.1	81.4	463.1	2.4	8.9	6.1
A08009-2TE	539.2	54.2	82.7	446.8	2.9	6.9	7.4
A08433-4VR	576.1	55.7	73.6	425.2	3.1	11.6	5.0
AO03123-2	487.1	53.3	81.2	397.3	3.3	6.4	7.2
AO06191-1	435.2	58.0	79.6	347.6	3.5	5.1	8.2
AOR06070-1KF	516.4	24.6	82.3	424.4	3.0	7.7	6.3
AOR07781-5	482.8	106.9	71.7	348.2	2.8	5.3	8.7
CO08065-2RU	375.6	40.4	76.0	285.8	3.1	5.8	6.4
CO08155-2RU/Y	486.2	43.2	72.3	352.9	2.9	9.0	5.2
CO08231-1RU	453.4	25.1	72.1	327.7	3.1	8.2	5.2
COTX09022-3RuRE/Y	537.1	31.5	84.8	455.3	1.9	7.2	6.9
TX08352-5Ru	471.2	56.4	77.8	367.0	3.1	6.6	6.7
AOTX05043-1RU	408.0	16.7	72.2	294.8	2.8	8.2	4.9
CO09036-2RU	456.5	35.6	73.7	336.7	3.0	7.4	5.7
CO09076-3RU	518.7	114.1	69.5	360.6	1.9	6.2	8.0
CO09165-6W	397.8	22.9	72.3	289.1	2.4	7.3	5.1
CO09205-2RU	425.3	41.6	74.1	316.0	3.3	6.9	5.8
COTX05095-2RU	466.4	51.2	62.8	293.9	2.6	9.3	4.7
Mean	**475.1**	**48.6**	**76.7**	**365.9**	**2.8**	**7.0**	**6.7**

Table 2: Chip Variety Trial

Clone / Variety	Total CWT/Acre	Cull CWT/Acre	Merit (0-5,5= best)	Tubers per Plant	Average Tuber Size (oz)
Atlantic	483.7	56.3	2.6	7.6	6.0
Snowden	447.5	44.1	3.0	7.5	5.6
AC01144-1W	469.4	37.5	3.1	9.6	4.6
AOR09034-3	527.1	64.8	2.9	11.3	4.4
NDA081453CAB-2C	420.8	20.6	3.0	7.1	5.8
NDTX081648CB-13W	449.9	28.1	3.0	7.7	5.5
OR09256-2	487.8	20.9	3.3	8.7	5.2
Mean	**469.4**	**38.9**	**3.0**	**8.5**	**5.3**

Table 3: Specialty Potato Trial

Clone / Variety	Skin Color	Flesh color	Total Yield CWT/Acre	Culls	Merit (1-5, 5=best)	Tubers/ Plant	Average Size (oz)
Chieftan	Red	White/Yellow	606.8	55.7	2.9	8.9	6.4
Red LaSoda	Red	White/Yellow	657.1	211.5	2.5	7.9	8.2
COTX00104-6R	Red	White/Yellow	408.3	47.3	3.0	5.6	7.2
PORTX03PG25-2R/R	Purple	Red	411.8	59.2	1.8	13.4	2.9
AC03534-2R/Y	Red	White/Yellow	614.8	28.8	2.8	16.5	3.6
CO05035-1PW/Y	Purple/Yellow	White/Yellow	629.0	38.6	2.6	8.1	7.5
COA07365-4RY	Red	White/Yellow	483.4	19.6	2.5	13.1	3.6
NDTX059759-3RY/Y Pinto	Red/Yellow	White/Yellow	381.8	52.9	2.4	7.9	4.5
Yukon Gold	Yellow	White/Yellow	415.7	39.2	2.6	6.9	6.0
A06336-2Y	Yellow	White/Yellow	488.4	77.0	2.8	13.2	3.4
A06336-5Y	Yellow	White/Yellow	560.5	27.5	3.3	19.0	2.8
CO09079-5PW/Y	Purple/Yellow	White/Yellow	412.2	22.7	2.3	17.2	2.3
CO09127-3W/Y	Yellow	White/Yellow	462.1	22.2	2.9	12.2	3.7
CO09128-3W/Y	Yellow	White/Yellow	308.1	14.9	2.5	15.6	2.1
CO09128-5W/Y	Yellow	White/Yellow	413.0	11.4	3.0	14.1	2.9
CO09218-4W/Y	Yellow	White/Yellow	397.2	16.5	2.9	12.7	3.2
Purple Majesty	Purple	Purple	499.2	33.2	2.3	15.9	2.9
CO08037-2P/P	Purple	Purple	344.6	18.9	2.4	10.6	3.4
Mean			**471.9**	**44.3**	**2.6**	**12.2**	**4.3**

By Rob Wilson, Center Director/Farm Advisor, Darrin Culp, Principal Superintendent of Agriculture; and Kevin Nicholson/Skyler Peterson, Staff Research Associates, IREC

Introduction: The Klamath Basin has experienced a large increase in organic agriculture in recent years. Last year there were over 10,000 acres of alfalfa, 10,000 acres of wheat and barley, and 2,000 acres of potatoes produced organically on the California side of the Klamath Basin. Organic production offers growers a niche market and price premiums. Conversely, organic production has limited pest management and fertilization options compared to conventional production. Organic producers are pursuing multiple approaches to increase soil fertility and manage pests, but research and data verifying the effectiveness of these practices is limited at the local level. Practices of most interest to potato growers include the use of certified amendments such as composted manures, application of organically approved pesticides (copper, Serenade, Actinovate, etc.) and cover crops/green manure.

A two-year study was established in 2016 to evaluate cover crops managed as a green manure, amendments, and combinations of cover crops and amendments in an organic potato rotation. Cover crops were grown in 2016 and potatoes in 2017. Cover crop trials include a spring planted dryland trial with 9 treatments, a spring planted irrigated trial with 18 treatments, a mid-summer planted irrigated trial with 18 treatments, and a fall planted irrigated trial with 9 treatments. A spring dryland trial was added to gauge if cover crops can be grown effectively without irrigation and to evaluate the effects of irrigation on soil fertility, weeds, and diseases the following year. Mid-summer cover crop treatments included cool-season and warm-season species grown alone, grown in mixes, and grown in combination with fall-applied amendments. Fall planted cover crops were grown at the request of several growers wanting an option to use cover crops after harvesting spring wheat or spring barley for grain. All trials include conventional fertilizer controls to compare cover crop and amendment results to conventional fertilizer.

This report includes a short summary of the results for spring-planted, mid-summer planted, and fall planted cover crops grown in 2016, and the effects of cover crops and amendments on potatoes grown in 2017. A final report will be available later this year.

Results: The amount of nitrogen in cover crops and amendments along with their effect on mineralized soil nitrogen at potato planting are presented in Table 1. Legume cover crops grew well at all planting times and they added over 100 lbs of nitrogen/acre compared to grasses and mustards at all planting times. In case of mustard and grass cover crops, spring plantings were most successful. Poor growth of these species in mid-summer and fall was from nitrogen deficiency caused by double-cropping a grain crop immediately prior. A compromise between choosing individual species was growing a cover crop mix. In soil with low nitrogen, legumes dominated the mix at all plantings. When evaluating weeds in cover crops, spring plantings had the fewest weeds across species and mid-summer plantings had the most weeds. Legume cover crops and chicken manure were most effective at increasing mineralized soil nitrogen for early season potato growth.

Nitrogen benefits from legume cover crops and chicken manure were apparent through the potato growing season as evidenced by potato petiole nitrate during tuber bulking (Tables 2 & 3). In most cases, legume cover crops and chicken manure had similar or higher potato petiole nitrate compared to 150 lbs N/A from conventional nitrogen fertilizer. Interestingly, spring fallow treatments had elevated petiole nitrate during bulking compared to other fallow treatments likely from extended mineralization of soil organic matter from fallowing the soil for an entire growing season.

Potato yields for cover crop and amendments is shown in Table 4. The potato variety used in the study was Yukon Gold. There were few statistical differences in potato yield between treatments with potato yield following the same trend as petiole nitrate.

A common question is, “What is the best time to grow cover crops?”. Table 5 details the influence of 2016 cover crop planting times on the 2017 potato crop. Averaged across species, spring plantings resulted in fewer weeds, more tubers per plant, and higher potato yields compared to mid-summer and fall plantings. Mid-summer and fall plantings had slightly less *Rhizoctonia* black scurf compared to spring plantings, and spring irrigated plantings had slightly less black dot on tubers compared to spring dryland and mid-summer plantings.

Overview photo of the study area.

Table 1: Soil Nitrogen Contribution and Resulting Mineralized Nitrogen Available at Potato Planting

Treatment	Nitrogen Contribution from Green Manures & Amendments				Mineralized Soil Nitrogen Available at Potato Planting at Two Soil Depths			
	SD [1]	SI	MSI	FI	SD	SI	MSI	FI
	lbs total nitrogen/A				lbs mineralized N/A (0-10 inch & 10-20 inch)			
Fallow								
weed controlled with tillage	0 [2]	0	0	0	82 & 97	55 & 69	48 & 48	43 & 42
Manures and Amendments								
wheat & fall chicken manure	* [3]	150	150	*	*	68 & 66	79 & 75	*
wheat & fall compost	*	150	*	*	*	39 & 40	*	*
wheat & fall steer manure	*	150	*	*	*	51 & 49	*	*
wheat & spring chicken manure	*	*	*	150	*	*	*	114 & 81
Grasses								
Twin" spring wheat	88	93	*	*	*	38 & 39	*	*
SX17 sorghum sudangrass	*	*	24	*	*	*	48 & 43	*
Trical 141 spring triticale	*	*	14	*	*	*	47 & 42	*
Trical 102 winter triticale	*	*	*	27	*	*	*	14 & 12
Legumes								
Cowpea	*	*	4	*	*	*	n/a	*
Flex spring field pea	243	306	176	*	*	99 & 109	82 & 75	*
Lana woollypod vetch	196	205	222	196	109 & 106	91 & 115	98 & 91	104 & 59
Nutrigreen winter field pea	*	*	148	156	*	*	85 & 75	83 & 48
Mustards								
Caliente 199 mustard	93	95	19	*	*	66 & 66	42 & 37	*
Nemat arugula	108	98	*	33	*	*	*	*
Mustard & fall chicken manure	*	245	*	*	*	101 & 105	*	*
Fall chicken manure & arugula	*	*	*	183	*	*	*	32 & 21
Radish								
Defender oilseed radish	*	110	12	*	*	*	53 & 42	*
50/50 Mixes								
Arugula & spring field pea	205	178	*	*	*	*	*	*
Mustard & spring field pea	*	187	99	*	*	82 & 94	63 & 55	*
Radish & spring field pea	*	*	112	*	*	*	72 & 59	*
Mustard & woolypod vetch	*	*	150	*	*	*	69 & 61	*
Triticale & winter field pea	*	*	*	107	*	*	*	31 & 20
Triticale & woolypod vetch	*	*	*	190	*	*	*	91 & 40

[1] SD = Spring planted dryland trial; SI = Spring planted irrigated trial; MS = Midsummer planted irrigated trial;
FI = fall planted irrigated trial.

[2] Fallow treatments are represent nitrogen mineralization potential of Tulelake soils at different times under bare soil conditions.

[3] * = data not available; treatment was not tested in the trial

Table 2: 2017 Potato Petiole Nitrate at Mid-bulking

Treatment	Petiole Nitrate			
	SD [1]	SI	MSI	FI
	NO3-N (ppm)			
Fallow				
weed controlled with tillage	21,836abc	19,907bcd	7,289fgh	15,789bc
Conventional N Fertilizer				
75 lbs N/A at planting	18,499abc	15,784cdef	17,187bcde	*
150 lbs N/A at planting	24,890ab	24,424ab	23,165b	28,245a
225 lbs N/A at planting	*	29,978a	32,129a	*
Manures and Amendments				
wheat & fall chicken manure 1/2 rate	*	16,786bcde	*	*
wheat & fall chicken manure	*	22,163abcd	19,148bcd	*
SX17 sorghum-sudan & fall chicken manure			16,801bcde	
wheat & fall compost	*	7,308g	*	*
wheat & fall steer manure	*	9,236efg	*	*
wheat & April chicken manure	*	*	*	24,679ab
wheat & May chicken manure	*	*	*	*
wheat & May bloodmeal	*	24,551ab	*	
Grasses				
Twin" spring wheat	8,816d	7,422g	*	*
SX17 sorghum sudangrass	*	*	4,235gh	*
Trical 141 spring triticale	*	*	3,906gh	*
Trical 102 winter triticale	*	*	*	1,913d
Legumes				
Cowpea	*	*	7,346fgh	*
Flex spring field pea	21,390abc	25,110ab	19,140bcd	*
Lana woollypod vetch	25,340a	24,336ab	20,098bc	25,022ab
Nutrigreen winter field pea	*	*	19,521bcd	21,210ab
Mustards				
Caliente 199 mustard	15,621cd	17,166bcde	2,713h	*
Nemat arugula	18,069bc	19,489bcd	*	*
Mustard & fall chicken manure	*	23,570abc	*	*
Fall chicken manure & arugula	*	*	*	7,319cd
Radish				
Defender oilseed radish	*	14,893defg	2,646h	*
50/50 Mixes				
Arugula & spring field pea	21,272abc	21,691abcd	*	*
Mustard & spring field pea	*	20,950bcd	10,182efg	*
Radish & spring field pea	*	*	12,515def	*
Mustard & woolypod vetch	*	*	14,076cdef	*
Triticale & winter field pea	*	*	*	4,794d
Triticale & woolypod vetch	*	*	*	19,539ab

[1] SD = Spring planted dryland trial; SI = Spring planted irrigated trial;

MS = Midsummer planted irrigated trial; FI = Fall planted irrigated trial

[2] * = data not available; treatment was not included in trial.

Table 3: 2017 Potato Petiole Nitrate at Mid-bulking for Amendment Trial	
Treatment	**Petiole Nitrate**
	Amendment trial
	NO3-N (ppm)
Wheat & Fallow	
No amendment	9,439a
Wheat and Fall Applied Manure (150 lb N/A)	
1.85-2-2 dried chicken manure disk incorporated	14,468a
1.85-2-2 dried chicken manure applied to soil surface	12,771a
Wheat and Spring (April) Applied Manure (150 lb N/A)	
1.85-2-2 dried chicken manure disk incorporated	13,408a
1.85-2-2 dried chicken manure applied to soil surface	13,599a
Nutri-Rich 4-3-2 pelleted chicken manure applied to soil surface	13,264a
TrueOrganic 4-4-2 applied to soil surface	14,273a
Perfect Organic Blend 4-4-4 applied to soil surface	16,441a
Wheat and Late Spring (mid-May) Applied Manure (150 lb N/A)	
1.85-2-2 dried chicken manure disk incorporated	11,918a

Aerial drone photo of 2017 potato crop within the study area. Note the differences in crop vigor and color between amendment and cover crop treatments.

Table 4: Total Potato Yield Following Cover Crop and Amendment Application

Treatment	Total Yield			
	SD [1]	SI	MSI	FI
	CWT per acre			
Fallow				
weeds controlled with tillage	382.9a	387abc	341.4a	340.7bc
Conventional N Fertilizer				
75 lbs N/A at planting	399.1a	366.8bc	350a	*
150 lbs N/A at planting	412.6a	391.2abc	340.4a	374.7ab
225 lbs N/A at planting	*	379.5abc	363.1a	*
Manures and Amendments				
wheat & fall 1/2 rate chicken manure	*	382.5abc	*	*
wheat & fall chicken manure	*	394.3abc	*	*
SX17 sorghum-sudan & fall chicken manure	*	*	384a	*
wheat & fall compost	*	369.4abc	*	*
wheat & fall steer manure	*	397.7ab	*	*
wheat & April chicken manure	*	*	*	387.3a
fallow & chicken manure	*	*	369.6a	*
wheat & May bloodmeal	*	376.6abc	*	*
Grasses				
Twin" spring wheat	393.3a	358.2c	*	*
SX17 sorghum sudangrass	*	*	326a	*
Trical 141 spring triticale	*	*	370.9a	*
Trical 102 winter triticale	*	*	*	314.1c
Legumes				
Cowpea	*	*	348a	*
Flex spring field pea	394.9a	382.1abc	367.3a	*
Lana woollypod vetch	391.1a	392.4abc	373.8a	352.3ab
Nutrigreen winter field pea	*	*	368.5a	366.1ab
Mustards				
Caliente 199 mustard	393.4a	396abc	330.6a	*
Nemat arugula	393.9a	395abc	*	*
Mustard & fall chicken manure	*	388.4abc	*	*
Fall chicken manure & arugula	*	*	*	363.2ab
Radish				
Defender oilseed radish	*	406.4a	338.6a	*
50/50 Mixes				
Arugula & spring field pea	394.7a	392.8abc	*	*
Mustard & spring field pea	*	388.1abc	358.8a	*
Radish & spring field pea	*	*	370.1a	*
Mustard & woolypod vetch	*	*	343.6a	*
Triticale & winter field pea	*	*	*	324.4bc
Triticale & woolypod vetch	*	*	*	360.9ab

[1] SD = Spring planted dryland trial; SI = Spring planted irrigated trial; MS = Midsummer planted irrigated trial; FI = Fall planted irrigated trial

[2] * = data not available; treatment was not included in trial.

Table 5. Influence of Cover Crop Planting (averaged across species) on Potato Production the Following Growing Season.

	Potato vigor		Weed severity in potatoes	Rhizoctonia incidence on tubers	Rhizoctonia severity on tubers	Black dot severity on tubers	Tubers per Plant	Average Tuber Size	Total potato yield	Cull potatoes
	2-Aug	28-Aug								
Treatment	0-10; 10=best		0-5; 5=worst	% Infected	0-5; 5=worst	0-5; 5=worst	#	oz	CWT/A	% of total CWT/A
Spring Dryland Cover Crops	7.1	6.2ab	0.6b	29a	2.72a	3.25a	6.52a	6.29a	395a	5.6a
Spring Irrigated Cover Crops	7	5.9b	0.3b	24a	2.39ab	2.62b	6.55a	6.19a	385a	3.3c
Mid-summer Irrigated Cover Crops	7	5.8b	2.1a	15b	2.16b	3.04a	6.27b	6.01b	355b	4.6b
Fall Irrigated Cover Crops	6.6	6.4a	1.5a	10b	1.61c	2.81ab	6.19b	6.07ab	356b	4.3b

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University of California
Agriculture and Natural Resources
Intermountain Research & Extension Center
RESEARCH REPORT
Number 182, 2018

Use of Nematicides Alone and in Combination with Metam Sodium for Suppression of Columbia Root Knot Nematodes in Fresh-Market Russet Potatoes

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Introduction: Columbia root knot nematode (*Meloidogyne chitwoodi*) CRKN is one of the most damaging pests for Tulelake potato growers. Infested potato fields run a high risk of significant infection and crop loss. Growers should always practice prevention and adequate crop rotation to minimize crop losses. Fumigation with 1,3-dichoropropene and/or metam sodium are recommended if growers must plant potatoes in infested fields, but fumigation is very expensive and product availability in the case of 1,3-dochoropropene is restricted most years. Growers are looking for alternative nematode controls with lower cost and less environmental risk.

This study was established to evaluate the efficacy and crop safety of new nematicides for CRKN suppression in potatoes. The study was established in a field with a significant population of Columbia root knot nematode that caused crop loss in previous potato crops. Data included live nematode counts in the soil at planting and harvest, post-harvest nematode tuber infection, and tuber yield and quality at harvest. ***Some pesticides listed in this report may not be labeled for use in potatoes grown in CA. Please consult pesticide labels for use instructions.***

2017 Site Information

- **Soil type-** silt loam
- **Growing season-** early May to late September
- **Irrigation –** solid-set sprinklers
- **Potatoes-** 36 inch beds with 10 inch spacing; Russet Norkotah
- **Design-** Split block with 4 blocks (reps)

2017 Study Methods: Metam sodium was applied at 40 GPA using roto-till incorporation 2 1/2 weeks before planting. Nimitz applied pre-plant was roto-till incorporated at the same time as metam sodium. All nematicides applied at planting were applied in-furrow (5-6 inch band) after seed placement and before furrow closure. Potatoes were grown using conventional production practices. Additional nematicides were NOT applied to the trial area except for Vydate at 2.1 pt/A on August 2nd.

Nematode soil sampling consisted of collecting 6 soil cores (2-8 inch depth) in each plot. Samples were analyzed by the UC Davis Nematology Lab for live nematodes. Potato stand and vigor was measured in-season. Potatoes were harvested from the center two rows (4 row plots) and graded for yield, size, and quality. A fifty pound sub-sample was saved at harvest for post-harvest evaluations in December. Tubers were stored at 50 degrees until post-harvest evaluation to encourage nematode development. Twenty five tubers were hand-peeled and evaluated for nematode infection. Tubers with nematode infection were grouped according to their number of infection sites. The percent of tubers with CRKN infection, CRKN tuber infection severity, and the % of CRKN culled tubers was calculated for each plot using established protocol developed by Russ Ingham at Oregon State University. Data was analyzed using a Mixed Model and Tukey's HSD mean comparison.

Results: Metam fumigation used alone and in combination with nematicides did not influence potato stand, vigor, average tuber size, tubers per plant, total yield, and US #1 yield (Table 1). CRKN tuber infection ranged from 68 to 92% and severity of CRKN infection ranged from 0.91 to 2.42, but there were not significant treatment differences likely due to high plot to plot variability (Table 2). Potato pack-out revenue factoring nematode damage was different between treatments (Table 2). Treatments with Vapam and Nimitz applied pre-plant and Nimitz applied in-furrow had the highest pack-out revenue ($4068/A). The untreated control and neem oil in-furrow had the lowest pack-out revenue. CRKN soil counts increased significantly from planting to harvest for all treatments (Table 3). There were no differences between treatments regarding CRKN soil counts likely due to high plot to plot variability.

Special Thanks: The research team would like to thank the UC Davis Nematology Lab, Staunton Farms, Macy's Flying Service, and Product Manufacturers for their support.

To see the complete report, follow the link below:

http://irec.ucanr.edu//files/280348.pdf

Table 1. Potato Production Results for Nematicide Treatments Tested in 2017.

		7/6/2017	8/1/2017	Harvest Evaluation 10/12/17								
		potato stand	mid-season vine vigor	average tuber size	tubers per plant	total yield including culls	US # 1 yield	culls & 2's yield	% US #1 yield	% culls & 2's yield	pack-out potato revenue*
trt #	Treatment	%	0-10 scale	ounces	#	cwt/A	cwt/A	cwt/A	%	%	$/A
1	Untreated	100	7.75	6.4	7.85	548	456	29 ab	67.05	5.22	4302
2	Vapam pre-plant at 40 GPA	97	7.75	6.15	8.25	543	444	31 ab	66.1	5.62	4246
3	Vapam + Velum Prime 6.5 fl. oz in-furrow	99	8	6.7	8.13	603	487	52 a	67.46	6.66	4447
4	Vapam + Vydate C-LV 4.2 pt/A in-furrow	99	8	6.125	7.9	525	429	23 b	64.47	3.4	4182
5	Vapam + Nimitz 5 pt/A roto-incorporated pre-plant	97	8	6.266	8.3	556	462	27 ab	66	5.96	4446
6	Vapam + Nimitz 2.5 pt/A roto-incorporated pre-plant and 2.5 pints/A in-furrow	100	7.5	6.475	7.375	527	443	30 ab	69.87	5.45	4238
7	Velum Prime 6.5 fl. oz/A in-furrow	98	8	6.525	7.675	538	449	26 ab	66.95	5.1	4230
8	Vydate C-LV 4.2 pt/A in-furrow	98	8	6.225	8.35	556	462	25 b	68.07	4.22	4447
9	Nimitz 5 pt/A roto-incorporated pre-plant	99	7.75	6.575	7.675	548	457	30 ab	67.32	5.47	4181
10	Monterey Neem Oil at 1% v/v in-furrow	99	8	6.475	6.975	491	396	36 ab	65.27	7.02	3729
	P-value for treatment ANOVA	NS	NS	NS	NS	NS	NS	0.0426	NS	NS	NS

* Pack-out revenue in this table based on tuber grades without factoring in nematode damage and culls due to nematode damage.

Table 2. Post-Harvest Results for Columbia Root Knot Nematode Tuber Infection in 2017

		11/28-12/1 post harvest			
		CRKN tuber infection rate	Percent of tubers that would fail grade test due to CRKN infection	CRKN infection severity Index	Potato pack-out revenue factoring in culled potatoes due to nematode damage
trt #	Treatment	%	0-10 scale	0-6 scale (6 = worst)	$/acre
1	Untreated	83	35 ab	1.87	2796.17 bc
2	Vapam pre-plant at 40 GPA	81.38	28.89 ab	1.7475	3014.86 ab
3	Vapam + Velum Prime 6.5 fl. oz in-furrow	67.55	11.77 ab	1.0533	3913.15 ab
4	Vapam + Vydate C-LV 4.2 pt/A in-furrow	79	23 ab	1.5	3219.98 ab
5	Vapam + Nimitz 5 pt/A roto-incorporated pre-plant	68	14.66 ab	1.1733	3779.18 ab
6	Vapam + Nimitz 2.5 pt/A roto-incorporated pre-plant and 2.5 pints/A in-furrow	71	4 b	0.91	4068.91 a
7	Velum Prime 6.5 fl. oz/A in-furrow	87	30 ab	1.78	2961.01 ab
8	Vydate C-LV 4.2 pt/A in-furrow	85	17 ab	1.37	3690.91 ab
9	Nimitz 5 pt/A roto-incorporated pre-plant	86	16 ab	1.34	3512.15 ab
10	Monterey Neem Oil at 1% v/v in-furrow	92	53 a	2.42	1752.64 c
	P-value for treatment ANOVA	0.1857	0.0614	0.1046	0.0001

Tubers were stored at 50 degree F for two months to encourage nematode development.
25 tubers were hand-peeled and evaluated for nematode infection.
Tubers with nematode infection sites were indexed based on: 0 = 0, 1 = 1-3, 2 = 4-5, 3 = 6-9, 4 = 10-49, 5 =50-99, 6 = 100 or more infection sites.
% of tubers with CRKN infection, CRKN tuber infection index, & % CRKN culled tubers were calculated used established protocol.
Vydate was chemigation applied at 2.1 pt/A over the entire trial area on August 2nd.

Table 3. Soil CRKN Nematode Counts & % Change in Counts from Planting to Harvest in 2017

*** Negative % change represents a decrease in nematodes from planting to harvest ***

		Harvest Count	% Change in Counts (2-8 inch soil depth) (200 g soil)			
		Melodiogyne (CRKN)	Meloidogyne (CRKN)	Tylenchidae (cyst)	Pratylenchus (lesion)	All Nematodes
trt #	Treatment	# / 200g soil	%			
1	Untreated	2343 a	958 a	-63 a	-76 ab	-25 a
2	Vapam pre-plant at 40 GPA	1666 a	2135 a	-72 a	-6 a	-31 a
3	Vapam + Velum Prime 6.5 fl. oz in-furrow	2623 a	5565 a	-89 a	-76 ab	40 a
4	Vapam + Vydate C-LV 4.2 pt/A in-furrow	2010 a	812 a	-87 a	-87 ab	-45 a
5	Vapam + Nimitz 5 pt/A roto-incorporated pre-plant	1766 a	4864 a	-88 a	-66 ab	40 a
6	Vapam + Nimitz 2.5 pt/A roto-incorporated pre-plant and 2.5 pints/A in-furrow	1670 a	1851 a	-89 a	-92 b	-30 a
7	Velum Prime 6.5 fl. oz/A in-furrow	2116 a	786 a	-79 a	-87 b	-44 a
8	Vydate C-LV 4.2 pt/A in-furrow	2336 a	1083 a	-72 a	-70 ab	-30 a
9	Nimitz 5 pt/A roto-incorporated pre-plant	1711 a	1359 a	-44 a	-68 ab	3 a
10	Monterey Neem Oil at 1% v/v in-furrow	1692 a	4777 a	-79 a	-82 ab	-5 a
	P-value for treatment ANOVA	0.985	0.1398	0.4301	0.051	0.7786

Six soil cores per plot were collected from a 2-8 inch soil depth in the middle two harvest rows immediately before planting and at harvest.
Soil samples collected at planting do not reflect reduction in nematode population caused by pre-plant fumigation

Influence of Herbicides on Weed Control Efficacy and Injury in Peppermint

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

Introduction: Uncontrolled weeds lower mint oil yield and quality and managing weeds represents a major production cost for growers. Groundsel, redroot pigweed, kochia, lambsquarter and Canada thistle are difficult to control weeds in peppermint growing in Northeast California. Several herbicides only provide partial control, so growers must pay hand-weeding crews. Hand-weeding is not a preferred weed control option due to its high cost and negative influence on oil quality. This study was funded by the National Mint Industry Research Council to evaluate the efficacy and benefits of pyridate (Tough) and saflufenacil (Sharpen) compared to normal spray programs. The trial was in an established peppermint (Black Mitcham) field at the Intermountain Research and Extension Center.

Summary: Saflufenacil Results: Dormant applied saflufenacil provided better control of prickly lettuce, dandelion, and tansy mustard compared to gramoxone. Saflufenacil also provided preemergence control of lambsquarter and kochia compared to the untreated control. Saflufenacil at the 4 fl. oz/A product rate caused higher crop injury (stunting) compared to gramoxone and the 2 fl. oz/A rate of saflufenacil when mint was less than 8 inches tall. Injury from saflufenacil at 4 fl. oz/A was not evident after the 8 inch tall evaluation. Peppermint hay yield and peppermint oil yield in saflufenacil plots was similar to the control. Saflufenacil may be a promising alternative or replacement for gramaxone to control susceptible winter weeds and suppress summer annuals when applied to dormant peppermint. **Saflufenacil is not currently registered in peppermint**.

Pyridate Results: Pyridate provided similar control of common lambsquarters compared to terbacil and bromoxynil. Pyridate provided excellent control of kochia, even though a sporadic kochia population in untreated plots prevented significant differences. Pyridate, bentazon, terbacil, and clopyralid displayed good crop safety as they had similar injury ratings compared to the untreated. Bromoxynil and MCPB caused significant crop injury 2, 4, and 7 weeks after application. Herbicide injury from bromoxynil and MCPB was not evident 10 weeks after application but the mint was lodged making visual injury ratings difficult. Pyridate and other postemergence herbicides did not have a significant influence on peppermint hay yield, peppermint oil yield, and % peppermint bloom at harvest.

Table 1. Weed control following herbicide treatments applied to 1-cut peppermint near Tulelake, CA in 2017.

					Weed Control					
					4/3/17 (mint 1 inch tall)			6/15/17 (mint 8 inches tall)		
			Rate		prickly lettuce	dandelion	tansy mustard	kochia	common lambs-quarter	kochia & lambsquarter
trt #	Treatment	Product	Lb ai/A or ae/A	Timing	——weed density per 10 X 30 ft plot——					% control
1	Pyridate + COC	Tough 5 EC	0.94 + 1%	Early POST	n/a	n/a	n/a	0a	10b	91a
2	Bentazon + COC	Basagran (basf)	1 + 1%	Early POST	n/a	n/a	n/a	17a	38a	0d
3	Terbacil + COC	Sinbar (nova source)	0.5 + 1%	Early POST	n/a	n/a	n/a	19a	1b	86ab
4	Bromoxynil + NIS	Buctril (bayer)	0.375 + 0.25%	Early POST	n/a	n/a	n/a	3a	11b	68abc
5	MCPB + NIS	Thistrol	0.5 + 0.25%	Early POST	n/a	n/a	n/a	14a	25ab	66abc
6	Clopyralid + NIS	Transline (dow agro)	0.19 lb + 0.25%	Early POST	n/a	n/a	n/a	1a	53a	40bcd
7	Saflufenacil + COC	Sharpen	0.044 + 1%	Dormant	0.25b	0.75ab	0.13b	0a	26ab	34cd
8	Saflufenacil + COC	Sharpen	0.89 + 1%	Dormant	0b	0.13b	0b	0a	6b	76abc
9	Untreated - Weedy				3.27a	2.23a	1.68a	5a	60a	0d

– Dormant treatments applied on 3/3/17; winter annual weeds were 1-3 inch in diameter. Gramoxone was applied to all treatments except trts 7-8 to control winter weeds.

– Early postemergence treatments applied on 5/22/17. Lambsquarter and kochia were 2-3 inches tall. Kochia density was sporadic in trial area. Mint was 2-4 inches tall.

– Nontreated controls were hand-weeded after weed control evaluations on 4/3/17 and 6/15/17 to prevent weed competition.

– Means with the same letter are NOT significantly different using Fischer's LSD

University of California
Agriculture and Natural Resources
Intermountain Research & Extension Center
RESEARCH REPORT
Number 181, 2017

2017 Tulelake Maggot Research Summary- Insecticide Options for Protecting Spring-Seeded Processing Onions from Seedcorn Maggot and Onion Maggot

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Introduction: Onion maggot, *Delia antiqua*, and seed corn maggot, *Delia platura*, are destructive pests of onions. Larvae of both species feed on young onion plants, often resulting in seedling mortality. Heavy infestations can reduce onion plant populations by more than 50 percent of the desired population, causing crop failure or the need to re-plant. In recent years, seed corn maggot damage has been particularly bad in Tulelake, California, with many growers experiencing more than 15 percent stand loss across field locations.

Seed corn maggot larvae live in the soil and feed on seeds and developing plants of several crops including onions. Tillage of green plants, plant residues and manures attract egg-laying seed corn maggot females, and crop damage can be severe when crops are planted within the first few weeks after tillage. Cool, wet weather and delayed plant emergence are other factors that often promote crop damage from seed corn maggot. Preventative measures include late planting, increasing seeding rates, no-till seeding, and tilling manures and residues three to four weeks before planting. Tillage of green plant residue and manures is the primary event that attracts seed corn maggots.

Onion maggot larvae live in the soil and are specific to onion and related allium crops. Flies lay their eggs on soil near young onion plants. First-generation larvae usually cause the most damage feeding on developing seedlings, but later generations feed on expanding bulbs and can cause significant crop loss. Preventative measures include avoiding successive rotations of onion crops, placing fields at least ¾ mile from last year's fields, removing cull piles, and removing onions left in the field. Growers can monitor temperature degree days using an onion maggot degree day model and delay planting until after the predicted first-generation flight.

The key to managing seed corn maggot and onion maggot is prevention! There are no rescue insecticide options for maggot after onion planting, and it's impossible to recover lost onion plants. If maggots are anticipated, growers should strongly consider insecticide seed treatment or applying an insecticide in-furrow at planting.

For many years, chlorpyrifos applied in-furrow provided good maggot suppression in Tulelake, but growers recently started looking for more effective alternatives to chlorpyrifos due to increased crop damage. Environmental concerns associated with chlorpyrifos also encouraged growers to find alternative insecticides. ***Some pesticides listed in this report may not be labeled for use in onions. Please consult pesticide labels for use instructions.***

2017 Site Information

- **Soil type-** mucky silty clay loam-4.2% OM
- **Growing season-** early May to late September
- **Irrigation –** solid-set sprinklers
- **Onions-** 36 inch beds with 4 seed-lines spaced 6 inches apart; 2-inch seed spacing; Sensient Technologies processing variety
- **Design-** RCB with 6 blocks (reps)

2017 Study Methods: Studies were conducted at the UC Intermountain Research and Extension Center and a commercial field in Tulelake to compare insecticides and insecticide application methods for preventing maggot damage. Seed corn maggot and onion maggot were present at the study sites with seed corn maggot being the dominant pest. Insecticide efficacy was determined by measuring onion plant density and vigor at multiple times during onion establishment and onion plant density and bulb yield at harvest. A big focus for 2017 was evaluating several seed treatment options. A smaller study was conducted at IREC to determine if the duration between initial tillage and onion planting influences maggot damage and resulting onions stands. The primary study goal was determine if delaying onion planting three to four weeks after planting significantly decreased onion loss from maggots.

- **Seed treatments**: filmcoat, encrustment, and full-size (bb-sized) pellets.
- **In-furrow treatments**: 3-inch band of insecticide applied directly over the seed after seed placement but before furrow closure using Teejet even fan 8001 nozzles at 30 psi mounted on the onion planter

Onion Measurements: Onion stand density was measured in each plot by counting the number of green onions in the entire plot at the 2-3 leaf stage, 5 leaf stage, and immediately before harvest. Onion yield was determined by weighing all topped onion bulbs in each plot.

Study Results: The 2017 insecticide study focused on comparing the efficacy of several seed treatment options. Onion stands for most seed treatments were statistically similar and higher than the control (Table 1). The exceptions were Capture LFR applied in furrow, Trigard, and seed not treated with insecticide (control). These treatments had lower stands at one or both sites compared to the top-performing insecticide treatments. When seed treatments were grouped across insecticides, pelleted seed had slightly higher stand and yield compared to encrustment (Table 2). When insecticides were grouped across coatings, OI100, FI500, and Sepresto had similar stand and yield (Table 2). Incotec offers a film-coat option for OI100. Grouped across fungicide packages, film-coated OI100 resulted in higher stands and yield compared to encrustment (Table 3). Yields at IREC were similar across most insecticide treatments except for FarMore 0I100 + ProGro+ Bacillus which was lower than several treatments and similar to the untreated control (Table 4). This treatment may have a negative influence on onion growth as the onion stand associated with the treatment was similar to other FarMore OI100 treatments.

A side study looking at the influence of planting date on onion stand showed delaying onion planting 13 and 21 days after initial tillage increased onion stand compared to planting one day after tillage (Tables 5-7). The most likely cause for the stand increase in delayed planting treatments was maggot larvae resulting from eggs laid at the time of tillage were nearing the end of their lifecycle during onion seedling development. Onion yield increased for the 13 days after tillage planting treatment compared to planting one day after initial tillage treatment. Onion yield for the 21 days after tillage planting treatment was lower than the other treatments. The low yield for the 21 days after tillage treatment was likely related less growing season and early bulbing associated with the variety since onion stands were high. Delayed planting may be an effective non-chemical control strategy for organic growers, but stand benefits must be weighed against a shorter-growing season in cold climates.

Special Thanks: The research team would like to thank the California Garlic and Onion Research Advisory Board for financial support of this research, Alan George Taylor at Cornell University for seed treatment and technical advice, Incotec Seed Coating for seed treatment, and Olam International and Sensient Technologies for donating onion seed.

To see the complete report, follow the link below:
http://irec.ucanr.edu//files/280355.pdf

Table 1. Onion Stands for Insecticide Seed Treatments and In-furrow Insecticides Tested in Tulelake in 2017

Trt#	Treatment	Seed Coating	5-leaf Growth Stage IREC Site	5-leaf Growth Stage Grower Site	5-leaf Growth Stage Average Across Sites	Harvest IREC Site	Harvest Grower Site	Harvest Average Across Sites
			onions per bed ft			onions per bed ft		
14	FarMore OI100 + Thiram	filmcoat	20.4 a	23.8 a	22.1 a	19.7 a	22.3 a	21.0 a
12	FarMore OI100 (no fungicide package)	filmcoat	19.8 abc	23.0 ab	21.4 ab	19.3 a	21.6 ab	20.4 a
6	FarMore FI500	full size-pellet	19.8 ab	22.3 abc	21.1 ab	19.3 a	21.2 ab	20.2 a
5	FarMore FI500	encrustment	19.9 a	22.0 abc	20.9 ab	19.5 a	20.3 ab	19.9 a
4	FarMore OI100 + FarMore 300	full size-pellet	18.5 abcd	22.9 ab	20.7 abc	17.5 ab	21.3 ab	19.4 a
17	FarMore OI100 + FarMore 300 & Fontelis & Capture in-furrow	encrustment	18.9 abcd	22.4 abc	20.7 abc	18.7 ab	20.9 ab	19.8 a
16	FarMore OI100 + FarMore 300 & Fontelis at 24 fl. oz/A in-furrow	encrustment	18.5 abcd	22.3 abc	20.4 abc	18.1 ab	21.2 ab	19.6 a
8	Sepresto 75WS + FarMore 300	full size-pellet	19.5 abc	20.6 bc	20.0 abc	18.7 ab	20.9 ab	19.8 a
10	FarMore OI100 (no fungicide package)	pellet	18.1 abcd	21.2 abc	19.6 abc	18.4 ab	21.0 ab	19.7 a
13	FarMore OI100 + FarMore 300 + ProGro	encrustment	17.5 abcd	21.6 abc	19.6 abc	17.6 ab	21.1 ab	19.3 a
7	Sepresto 75WS + FarMore 300	encrustment	18.1 abcd	21.0 abc	19.5 abcd	18.1 ab	20.4 ab	19.3 a
3	FarMore OI100 + FarMore 300	encrustment	17.7 abcd	20.2 bc	19.0 abcd	17.4 ab	18.9 ab	18.1 ab
11	FarMore OI100 (no fungicide package)	encrustment	17.6 abcd	19.8 bc	18.7 abcd	17.6 ab	19.4 ab	18.4 ab
19	FarMore OI100 + ProGro + Bacillus	encrustment	16.3 abcd	20.7 abc	18.5 abcd	16.8 ab	20.7 ab	18.8 ab
15	FarMore 300 & Capture LFR (bifenthrin) at 8.5 fl. oz/A in-furrow	encrustment	15.2 de	21.4 abc	18.3 bcd	15.3 bc	20.3 ab	17.5 ab
18	FarMore 300 and Bacillus	encrustment	15.7 bcde	20.6 bc	18.1 cd	15.9 abc	20.1 ab	18.0 ab
9	Trigard + FarMore 300	pellet	15.6 cde	20.5 bc	18.1 cd	16.1 abc	20.1 ab	18.1 ab
2	FarMore 300 (no insecticide control)	full size-pellet	15.7 bcde	20.2 bc	17.9 cd	15.8 abc	19.1 ab	17.3 ab
1	FarMore 300 (no insecticide control)	encrustment	12.0 e	19.7 c	15.9 d	12.3 c	18.4 b	15.3 b

Data was analyzed using ANOVA and Tukey-Kramer mean comparison. Treatments with the same letter are not statistically different.

Table 2. Onion Stand & Yield for Encrustment & Pellet Seed Treatments Tested in Tulelake

Treatment	5-leaf stage	Harvest	Harvest
	Onion Stand averaged across sites		Onion Yield at IREC
	– onions per bed ft –		tons per acre
Encrustment seed coating averaged across insecticides	18.5 a	18.2 b	24.2 b
Full-size pellet seed coating averaged across insecticides	19.1 a	19.3 a	25.5 a
FarMore FI500 averaged across coatings	20.7 a	20.1 a	26.3 a
FarMore OI100 (no fungicide package) averaged across coatings	18.6 b	19.1 a	25.5 a
FarMore OI100 + FarMore 300 averaged across coatings	19.0 ab	18.8 a	25.6 a
Sepresto 75WS + FarMore 300 averaged across coatings	19.2 ab	19.5 a	25.1 a
FarMore 300 (no insecticide control) averaged across coatings	16.5 c	16.3 b	21.8 b

Data was analyzed as a Factorial using Student T test and Tukey-Kramer mean comparisons. Treatments with the same letter are not statistically different. Treatment interactions were not significant for all variables.

Table 3. Onion Stand & Yield for OI100 Seed Coatings Tested in Tulelake

Treatment	5-leaf stage	Harvest	Harvest
	Onion Stand averaged across sites		Onion Yield at IREC
	– onions per bed ft –		tons per acre
Film-coat seed coating averaged across fungicide packages	21.0 a	20.7 a	26.7 a
Encrustment seed coating averaged across fungicide packages	18.5 b	18.3 b	25.1 b
Full-size pellet seed coating averaged across fungicide packages	19.1 b	19.6 ab	26.0 ab

Data was analyzed using ANOVA and Tukey-Kramer mean comparison. Treatments with the same letter are not statistically different.

Table 4. Onion Stand and Onion Yield for Insecticide Treatments Tested at IREC in 2017

Trt#	Treatment	Seed Coating	7/10/2017 5-leaf onion stand	9/29/2017 Harvest onion stand	10/5/2017 Onion yield
			onions per bed ft		ton/acre
14	FarMore OI100 + Thiram	filmcoat	20.4 a	19.7 a	26.8 a
6	FarMore FI500	full size-pellet	19.8 ab	19.3 a	26.7 a
12	FarMore OI100 (no fungicide package)	filmcoat	19.8 abc	19.3 a	26.6 a
17	FarMore OI100 + FarMore 300 & Fontelis & Capture in-furrow	encrustment	18.9 abcd	18.7 ab	26.1 ab
4	FarMore OI100 + FarMore 300	full size-pellet	18.5 abcd	17.5 ab	26.0 ab
16	FarMore OI100 + FarMore 300 & Fontelis at 24 fl. oz/A in-furrow	encrustment	18.5 abcd	18.1 ab	25.9 ab
10	FarMore OI100 (no fungicide package)	pellet	18.1 abcd	18.4 ab	25.9 ab
5	FarMore FI500	encrustment	19.9 a	19.5 a	25.9 ab
8	Sepresto 75WS + FarMore 300	full size-pellet	19.5 abc	18.7 ab	25.7 ab
3	FarMore OI100 + FarMore 300	encrustment	17.7 abcd	17.4 ab	25.1 ab
11	FarMore OI100 (no fungicide package)	encrustment	17.6 abcd	17.6 ab	25.1 ab
7	Sepresto 75WS + FarMore 300	encrustment	18.1 abcd	18.1 ab	24.5 ab
13	FarMore OI100 + FarMore 300 + ProGro	encrustment	17.5 abcd	17.6 ab	24.4 ab
9	Trigard + FarMore 300	pellet	15.6 cde	16.1 abc	24.2 ab
18	FarMore 300 and Bacillus	encrustment	15.7 bcde	15.9 abc	23.9 ab
15	FarMore 300 & Capture LFR (bifenthrin) at 8.5 fl. oz/A in-furrow	encrustment	15.2 de	15.3 bc	23.7 abc
2	FarMore 300 (no insecticide control)	full size-pellet	15.7 bcde	15.8 abc	23.4 abc
19	FarMore OI100 + ProGro + Bacillus	encrustment	16.3 abcd	16.8 ab	22.8 bc
1	FarMore 300 (no insecticide control)	encrustment	12.0 e	12.3 c	20.2 c

Data was analyzed using ANOVA and Tukey-Kramer mean comparison. Treatments with the same letter are not statisically different.

Table 5. Influence of Onion Planting Date on Onion Stand at the 5-leaf Stage in 2017

Trt #	Time of Planting Treatment	Sepresto seed	Untreated seed	Average across seed
		—— onions per bed ft ——		
1	Onions planted one day after intitial tillage	14.67	12.33	13.50
2	Onions planted 13 days after intitial tillage	16.54	12.92	14.73
3	Onions planted 21 days after initial tillage	17.69	18.10	17.90

Initial tillage of the field occurred on 5/9/2017. Emerging maggot flies were captured from plots starting 5/25/17 and ending 6/15/17 with the majority being captured during 6/2/17 to 6/8/17 (24 to 30 days after tillage).

Table 6. Influence of Onion Planting Date on Onion Stand at Harvest in 2017

Trt #	Time of Planting Treatment	Sepresto seed	Untreated seed	Average across seed
		—— onions per bed ft ——		
1	Onions planted one day after intitial tillage	15.89	11.13	13.51
2	Onions planted 13 days after intitial tillage	18.54	13.27	15.91
3	Onions planted 21 days after initial tillage	17.25	16.68	16.97

Table 7. Influence of Onion Planting Date on Onion Yield in 2017

Trt #	Time of Planting Treatment	Sepresto seed	Untreated seed	Average across seed
		—— tons per acre ——		
1	Onions planted one day after intitial tillage	17.67	14.77	16.22
2	Onions planted 13 days after intitial tillage	18.49	15.93	17.21
3	Onions planted 21 days after initial tillage	14.51	15.44	14.98

University of California
Agriculture and Natural Resources
Intermountain Research & Extension Center
RESEARCH REPORT
Number 184, 2018

Thrips Insecticide Evaluation in Onions at IREC in 2017

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Study Location: Intermountain Research and Extension Center, Tulelake CA (Siskiyou County)

Plot Size: 18 x 25 feet, 4 replications

Plot Design: Treatments arranged in Randomized Complete Block

Seed Treatment: Onion seed was treated with Sepresto (clothianidin + imidacloprid) for seedcorn maggot control and F300 fungicide package (Dynasty, Maxim and Apron).

Planting Date: 5/10/2017

Onion Variety: Olam International Processing Variety H602

Crop Maintenance Pesticides:

- 5/10/2017 Fontelis @24 fl. oz/ acre
- 5/18/2017 Prowl H2O@ 2 pt./acre and Dacthal 2.5 pt/acre
- 6/15/2017 Goal Tender @ 3 fl. oz/acre
- 6/20/2017 Goal Tender @ 3 fl. oz/acre and Brox 2EC @ 6 fl. oz/acre
- 9/15/2017 Endura @ 6.8 oz/acre

Cultural Practices:

- 50# N/Acre applied in the form of Urea pre-plant 5/5/2017
- 5/9/2017- Cultimulch and roto-shape beds at 36" spacing center to center
- 5/10/2017- Direct seed trial with 4-row planter
- 6 applications of 25# N/acre applied as UAN32 on 7/11/2017, 7/19/2017, 7/27/2017, 8/4/2017, 8/14/2017, and 8/23/2017.

Application Equipment:

- CO2 pressurized backpack sprayer
- Six-nozzle boom (9 ft. spray width) equipped with twin flat fan nozzle (TJ60-8003VS) calibrated for 37 gal/acre @ 40 psi

Application Dates and Environmental Conditions (found at:

- 1st application 7/12/2017 sunny 75 degrees F with wind between 2-4mph

- 2nd application 7/25/2017 partly cloudy 78 degrees F with wind between 4-5mph
- 3rd application 8/16/2017 sunny 75 degrees F with wind between 4-5mph

Insecticide Treatments:

trt #	1st App.	2nd App.	3rd App.
1	Untreated		
2	Movento	Movento	Radiant
3	Agri-Mek	Agri-Mek	Radiant
4	Minecto	Minecto	Radiant
5	Exirel	Exirel	Radiant
6	Radiant	Minecto	Minecto
7	ISM-555	ISM-555	ISM-555
8	ISM-555 + NIS	ISM-555 + NIS	ISM-555 + NIS

	Treatment	Product Rate/A	Adjuvant
1	Untreated		
2	Movento	5 fl oz	MSO
3	Agri-Mek 0.15EC	16 fl oz	MSO
4	Minecto	10 fl oz.	MSO
5	Exirel	20.5 fl oz./A	MSO
6	Radiant	8 fl oz	MSO
7	ISM-555	485 ml/A	None
8	ISM-555 + NIS	486 ml/A	NIS

Evaluations:

- Necrosis/Plant injury (0= no damage, 10= plant death) and plant feeding damage (0= no plant scaring, 10= heavy plant scaring) assessed starting 14 DAT of 2nd application. Ratings continued every 7 days until 8/30/2017.
- The number of immature thrips per plant recorded weekly from 10 plants of middle row from each plot.
- Yield harvest data collected 10/5/2017
- On 8/8/2017, 8/14/2017, & 8/30/2017, 10 onion plant tops from treatment 1 (untreated) and treatment 8 (ISM-555 + NIS) were collected and washed to collect thrips for identification. An unreplicated composite sample was sent to the UC Davis Entomology Lab to identify the number of thrips species.

Sample Dates:

- Pretreatment- 7/12/2017
- 7 DAT- 7/18/2017
- 14 DAT- 7/25/2017
- 7 DAT 2nd Application- 8/2/2017
- 14 DAT 2nd Application- 8/8/2017
- 21 DAT 2nd Application- 8/16/2017
- 7 DAT 3rd Application- 8/23/2017

- 14 DAT 3rd Application- 8/30/2017
- 21 DAT 3rd Application- 9/6/2017

Meteorological:

- Significant hail damage to crop seedlings occurred 5/29/2017 and 6/25/2017.

Crop Water Use:

- Solid-set overhead sprinkler irrigation. Spacing was 42 feet between lines and 30 feet between sprinklers. Nelson wind fighter sprinkler heads with green (7/64") nozzles were used. At 60psi these nozzles apply .21" water/hour at our spacing. Irrigation quantities were applied to meet seasonal onion crop water use. This was calculated based on ET of the crop. Total irrigation applied to trial was 30.11 inches for 2017.
- Rainfall total for the crop from planting 5/10/2017 through harvest 10/5/2017 was 2.18 inches.

Data Analysis: Data was analyzed using ANOVA and Tukeys HSD significant test.

<u>Results:</u>

Insecticide phytotoxicity- Insecticide phytotoxicity was not observed at any evaluation time for all insecticide treatments.

Thrips per Leaf- All insecticides reduced thrips per leaf 14 days after the first insecticide application. (Figure 1). The number of thrips per leaf following the 2nd insecticide application and 3rd application and cumulatively throughout the season differed between insecticides (Figures 1&2). The insecticide treatment program with Movento applied at 1st application, Movento at 2nd application, and Radiant at 3rd application (Movento-Movento-Radiant) and AgriMek-AgriMek-Radiant had significantly lower cumulative thrips per plant compared to the untreated (Figures 2). ISM-555 treatments had similar or higher cumulative thrips per plant compared to the untreated.

Onion Yield- There were no significant differences in onion yield between treatments (Figure 3).

Thrips Injury- Visual thrips injury (scarring) on onion leaves differed on 8/8, 8/16, and 8/30 between treatments (Figure 4). The Movento-Movento-Radiant treatment had the lowest injury rating at all three evaluations.

Thrips Species Identification- On 8/8/2017, 363 onion thrips and 180 Western Flower thrips (WFT) were collected in the untreated control. On 8/14/2017, 761 onion thrips and 299 WFT were collected in the untreated control and 249 onion thrips and 280 WFT were collected in treatment 8. On 8/30/2017, 654 onion thrips and 142 WFT were collected in the untreated and 602 onion thrips and 381 WFT were collected in treatment 8.

To see the complete report, follow the link below:

http://irec.ucanr.edu//files/280356.pdf

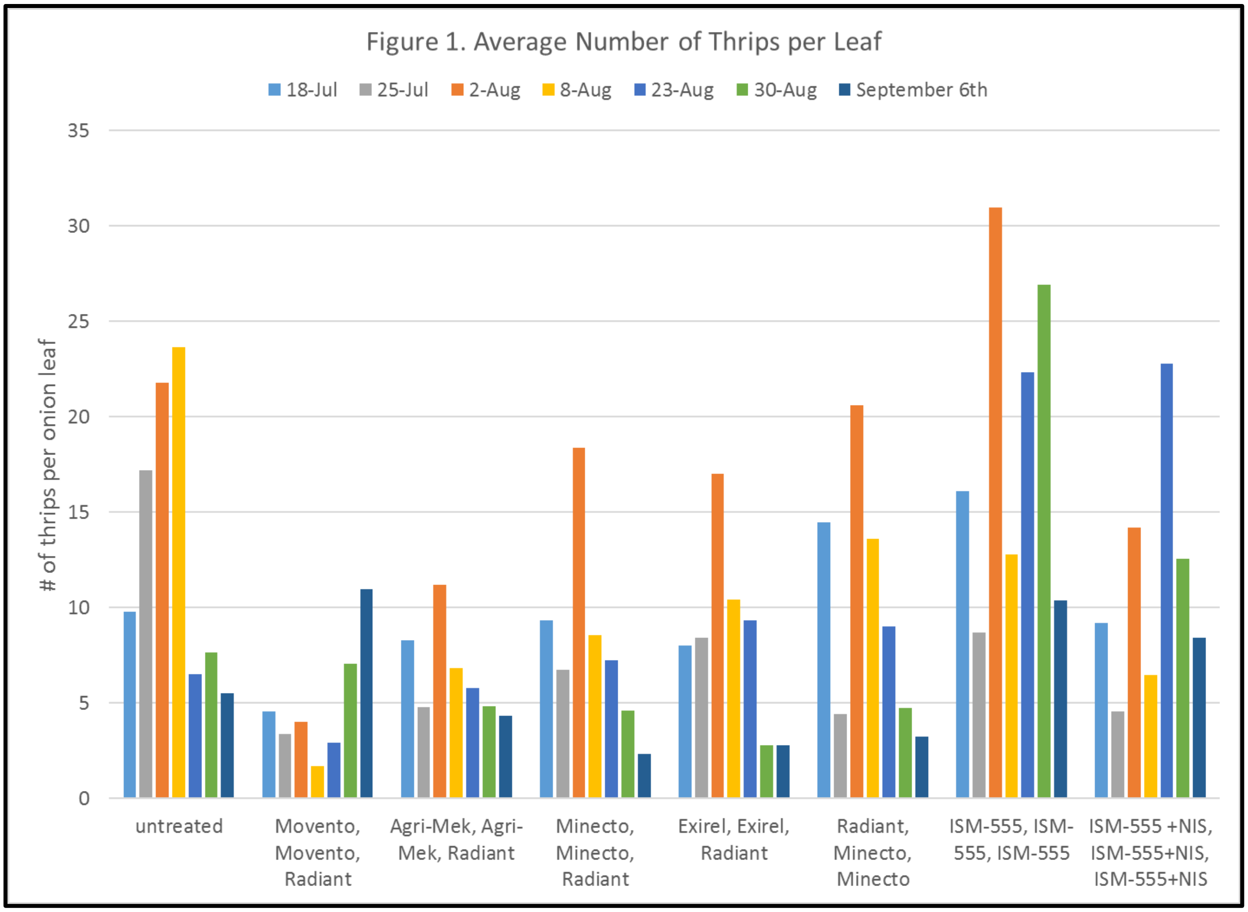
Figure 1. Average Number of Thrips per Leaf
18-Jul
25-Jul
2-Aug
8-Aug
23-Aug
30-Aug
September 6th
# of thrips per onion leaf
35
30
25
20
15
10
5
0
untreated
Movento, Movento, Radiant
Agri-Mek, Agri-Mek, Radiant
Minecto, Minecto, Radiant
Exirel, Exirel, Radiant
Radiant, Minecto, Minecto
ISM-555, ISM-555, ISM-555
ISM-555 +NIS, ISM-555+NIS, ISM-555+NIS

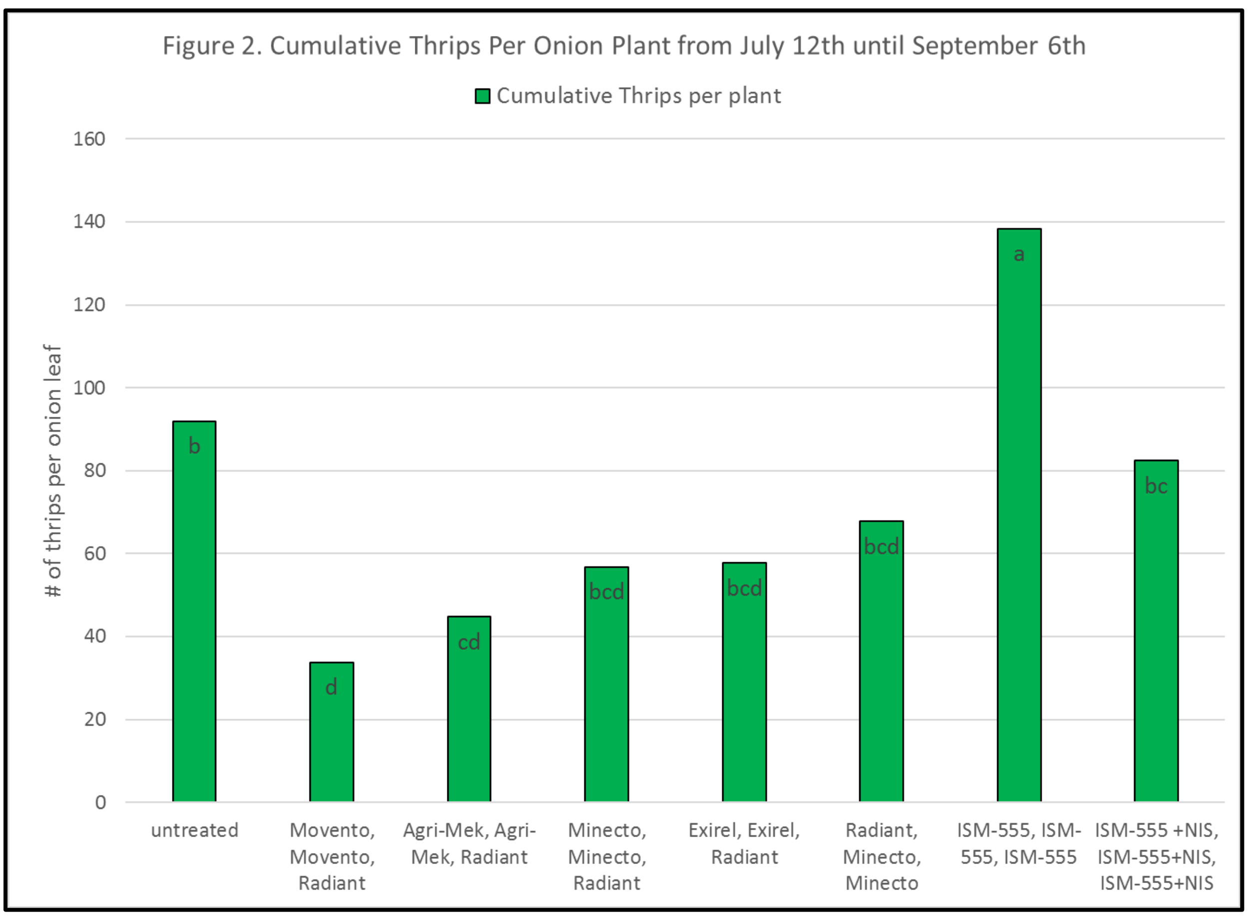
Figure 2. Cumulative Thrips Per Onion Plant from July 12th until September 6th
Cumulative Thrips per plant
# of thrips per onion leaf
160
140
120
100
80
60
40
20
0
b
d
cd
bcd
bcd
bcd
a
bc
untreated
Movento, Movento, Radiant
Agri-Mek, Agri-Mek, Radiant
Minecto, Minecto, Radiant
Exirel, Exirel, Radiant
Radiant, Minecto, Minecto
ISM-555, ISM-555, ISM-555
ISM-555 +NIS, ISM-555+NIS, ISM-555+NIS

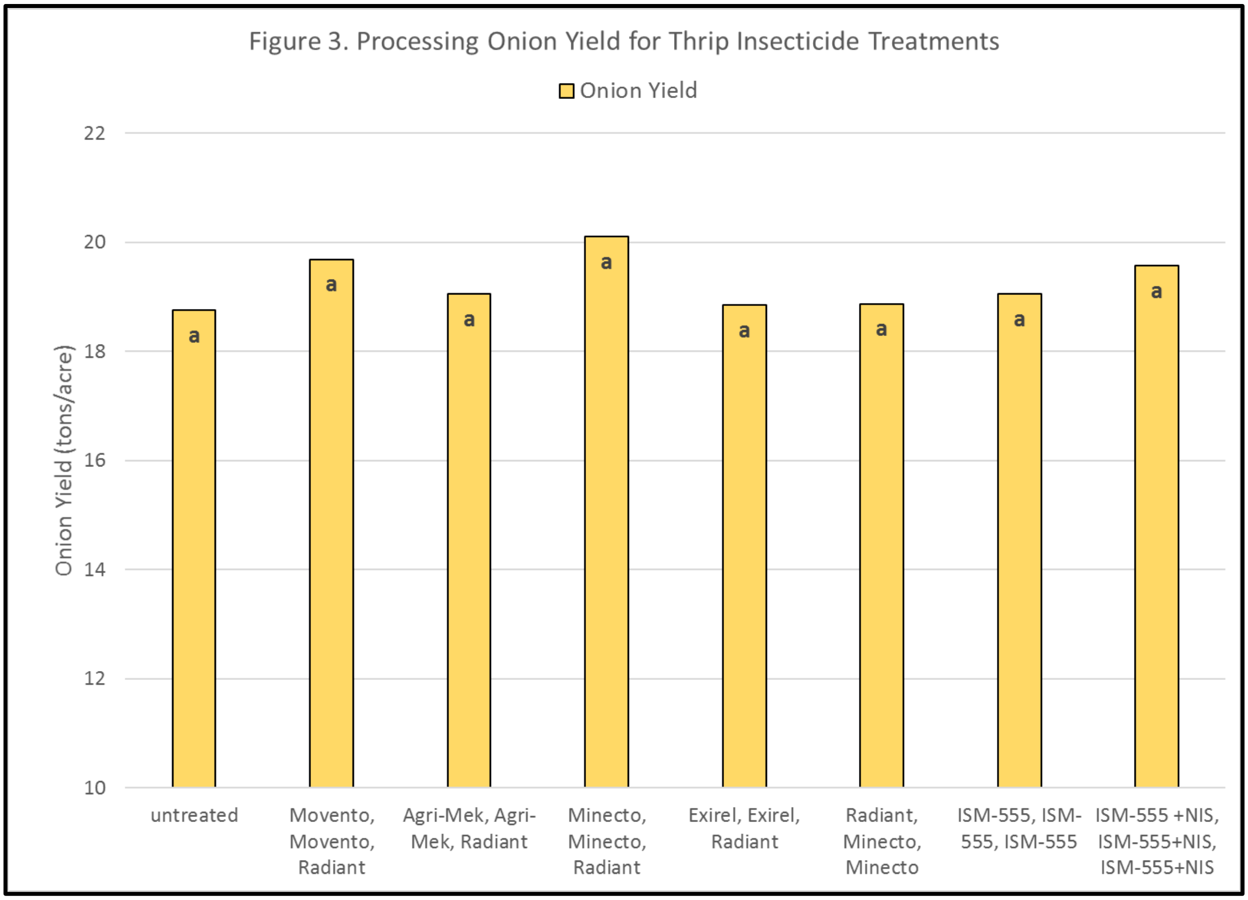

Figure 3. Processing Onion Yield for Thrip Insecticide Treatments
Onion Yield
Onion Yield (tons/acre)
22
20
18
16
14
12
10
a
a
a
a
a
a
a
a
untreated
Movento, Movento, Radiant
Agri-Mek, Agri-Mek, Radiant
Minecto, Minecto, Radiant
Exirel, Exirel, Radiant
Radiant, Minecto, Minecto
ISM-555, ISM-555, ISM-555
ISM-555 +NIS, ISM-555+NIS, ISM-555+NIS

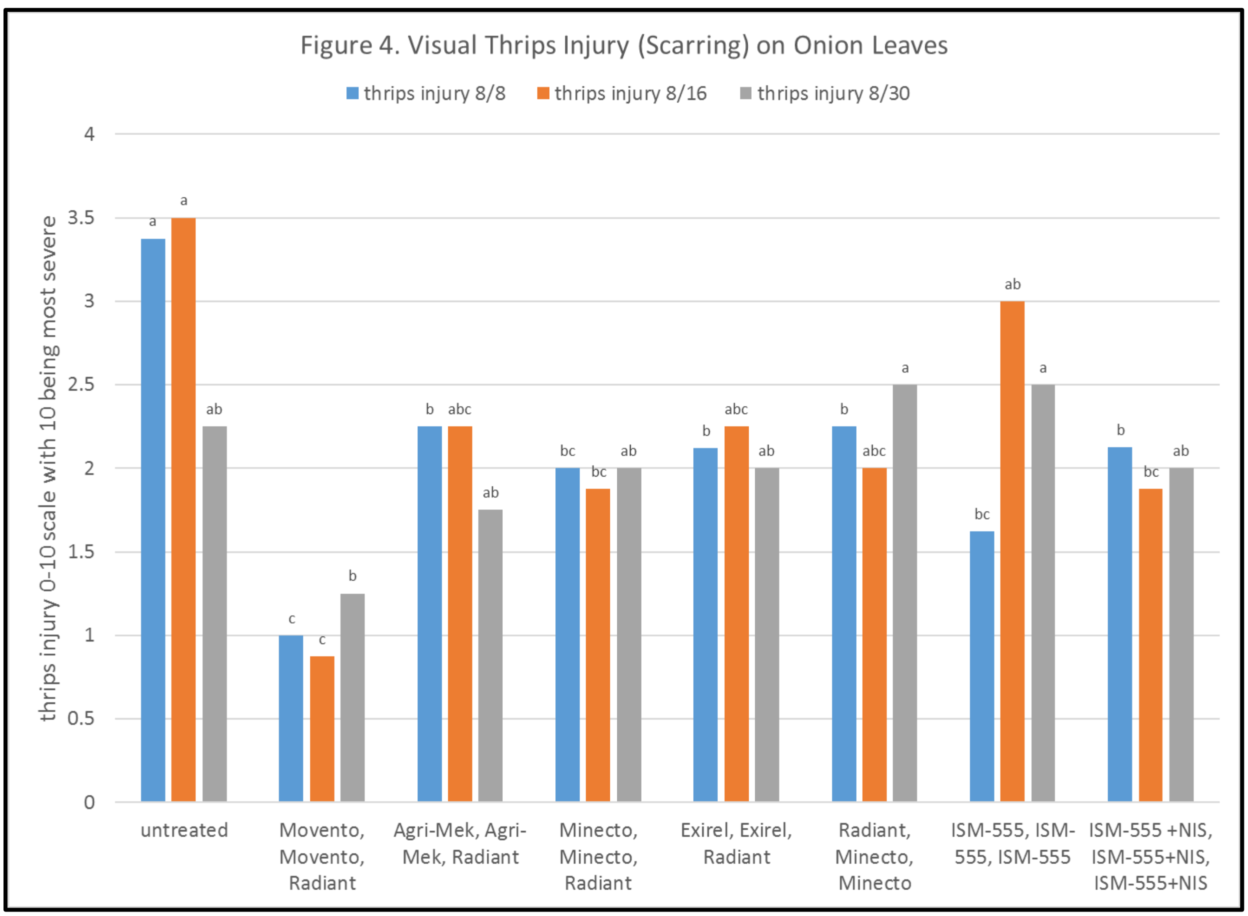

Figure 4. Visual Thrips Injury (Scarring) on Onion Leaves
thrips injury 8/8
thrips injury 8/16
thrips injury 8/30
thrips injury 0-10 scale with 10 being most severe
4
3.5
3
2.5
2
1.5
1
0.5
0
a a ab
c c b
b abc ab
bc bc ab
b abc ab
b abc a
bc ab a
b bc ab
untreated
Movento, Movento, Radiant
Agri-Mek, Agri-Mek, Radiant
Minecto, Minecto, Radiant
Exirel, Exirel, Radiant
Radiant, Minecto, Minecto
ISM-555, ISM-555, ISM-555
ISM-555 +NIS, ISM-555+NIS, ISM-555+NIS

University of California Agriculture and Natural Resources
Intermountain Research & Extension Center
RESEARCH REPORT
Number 185, 2018

Evaluation of New Fungicides for White Rot Suppression in Processing Onions

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Introduction

White rot is a major disease of onion and garlic and is caused by the fungus *Sclerotium cepivorum*. The fungus is spread by small sclerotia produced on decayed bulbs and roots and as few as one sclerotium per liter of soil can result in significant crop losses. Multiple UC experiments over the last 10 years have shown the fungicide tebuconazole (Folicur or Tebustar) is the most effective active ingredient for suppression of white rot. Penthiopyrad (Fontelis), a new fungicide from DuPont, provides similar or slightly less suppression of white rot compared to tebuconazole. The most effective fungicide application method is in-furrow application at planting. Applying fungicides after onion emergence has not improved control of white rot compared to in-furrow application.

In 2017, we evaluated several new fungicides for suppression of white rot including fluopyram (formulated as Velum Prime), solatenol, adepidyn, and fluxapyroxad. Harvest results are not available yet, but in-season leaf dieback ratings collected in September suggest tebuconazole and penthiopyrad (current standards) likely provide similar or superior white rot suppression compared to these new fungicides.

2017 Site Information

- **Soil type-** mucky silty clay loam-4.2% OM
- **Growing season-** early May to late September
- **Irrigation –** solid-set sprinklers
- **Onions-** 36 inch beds with 4 seed-lines spaced 6 inches apart; 2-inch seed spacing; Sensient Technologies processing variety
- **Design-** RCB with 5 blocks (reps)

2017 Study Methods

In early May 2017, the field was tilled and beds were shaped for onion planting. On 5/8/17, white rot sclerotia soil samples were collected to determine sclerotia levels at onion planting. Onions were planted on 5/15/17. Onion beds were spaced 36 inches apart with four seed-lines per bed spaced 6 inches apart. Onion in-row seed spacing was 2 inches. The onion variety was an early maturing Olam processing type. Fungicide treatments were applied in-furrow at planting. In-furrow fungicide was applied using Teejet 8001 EVS nozzles @ 30 psi. The 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 with soil.

Onion stand density was measured in each plot by counting the number of green onions in all seed lines for the center two rows for the entire plot length on 7/7/17. Onion vigor was visually estimated in each plot on 7/7/17 and 8/8/17 using a 0 to 10 scale, with 10 = highest vigor in the trial. Visual leaf die back ratings were taken on 8/29/17, 9/13/17, and 9/21/17. Leaf die back was estimated using a 0 to 100% scale. Onion yield was measured by harvesting all onions in each plot on 10/3/17. All onions were run across a grade-line to remove loose soil and green tops. Onion bulbs were then hand-sorted based on the presence of white-rot symptoms. A total weight was recorded for clean, disease-free onions and onions with white-rot symptoms (decay through 1st scale, mycelium, and sclerotia) in each plot. Decay severity on onion bulbs with white-rot symptoms was visually estimated for each plot using a 1-5 scale with 5 equal to most severe decay.

Results

Onion stand and early season onion vigor did not differ among fungicide treatments and the untreated control suggesting all fungicide treatments did not injure the crop. All fungicides increase mid-season onion vigor compared the untreated control (Figure 1). Several fungicides decreased the percentage of onion plants with late season leaf dieback (symptom of white rot) with Tebustar, Fontelis, and Merivon having the lowest levels of leaf dieback (Figure 2). At harvest, Tebustar, Fontelis, and Merivon had the highest clean (disease-free) onion yield and percentage of clean bulbs (Figures 3 & 4). This study showed some of the new SDHI fungicides have activity on white rot especially Merivon, but none of the newly released fungicides provided improved suppression of white rot compared to tebuconazole.

Special Thanks: The research team would like to thank the California Garlic and Onion Research Advisory Board, BASF, Bayer CropScience, Olam International and Syngenta for financial and in-kind support of this research.

To see the complete report, follow the link below:
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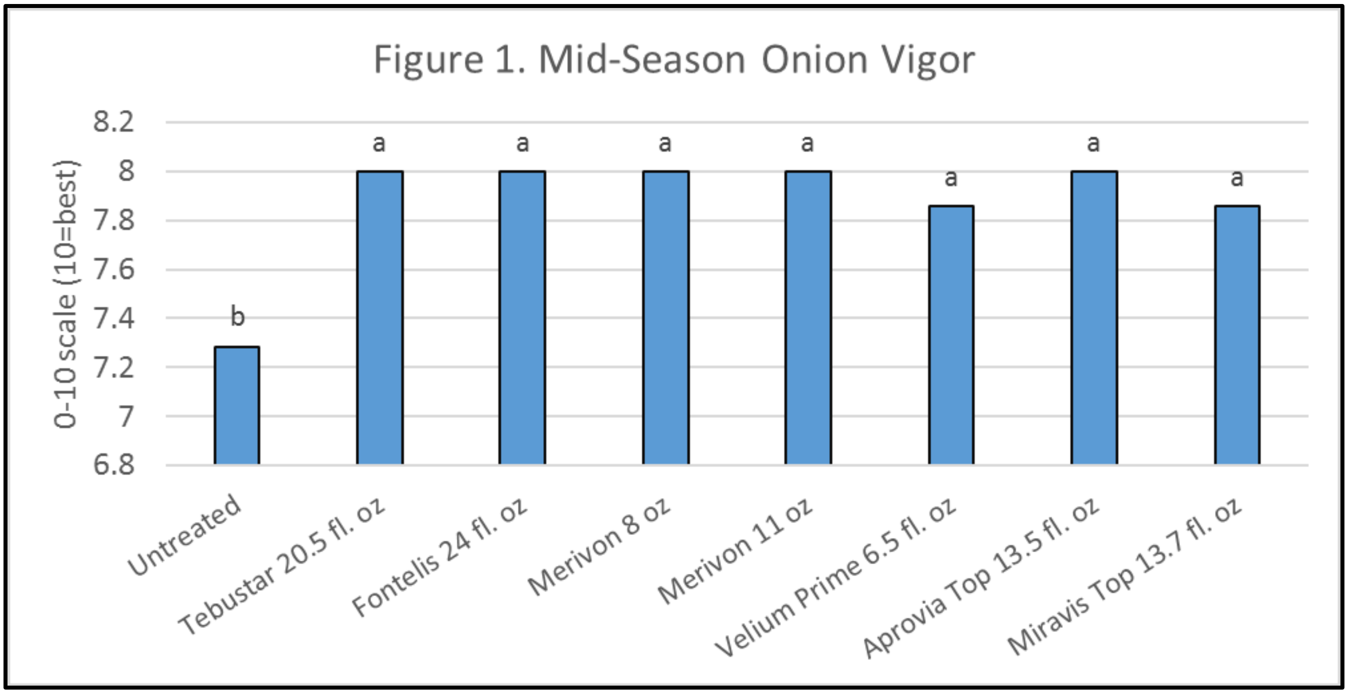
Figure 1. Mid-Season Onion Vigor
0-10 scale (10=best)
8.2
8
7.8
7.6
7.4
7.2
7
6.8
b
a
a
a
a
a
a
a
Untreated
Tebustar 20.5 fl. oz
Fontelis 24 fl. oz
Merivon 8 oz
Merivon 11 oz
Velium Prime 6.5 fl. oz
Aprovia Top 13.5 fl. oz
Miravis Top 13.7 fl. oz

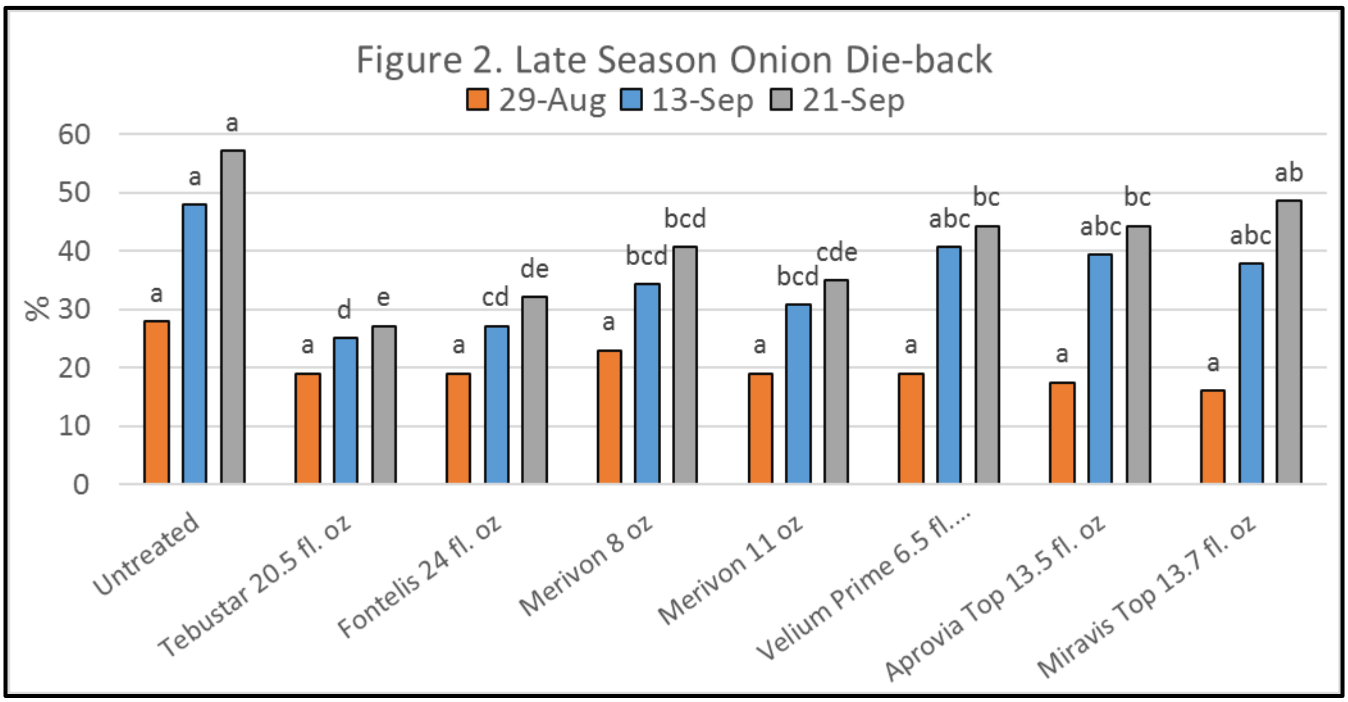
Figure 2. Late Season Onion Die-back
29-Aug
13-Sep
21-Sep
%
60
50
40
30
20
10
0
Untreated
Tebustar 20.5 fl. oz
Fontelis 24 fl. oz
Merivon 8 oz
Merivon 11 oz
Velium Prime 6.5 fl....
Aprovia Top 13.5 fl. oz
Miravis Top 13.7 fl. oz

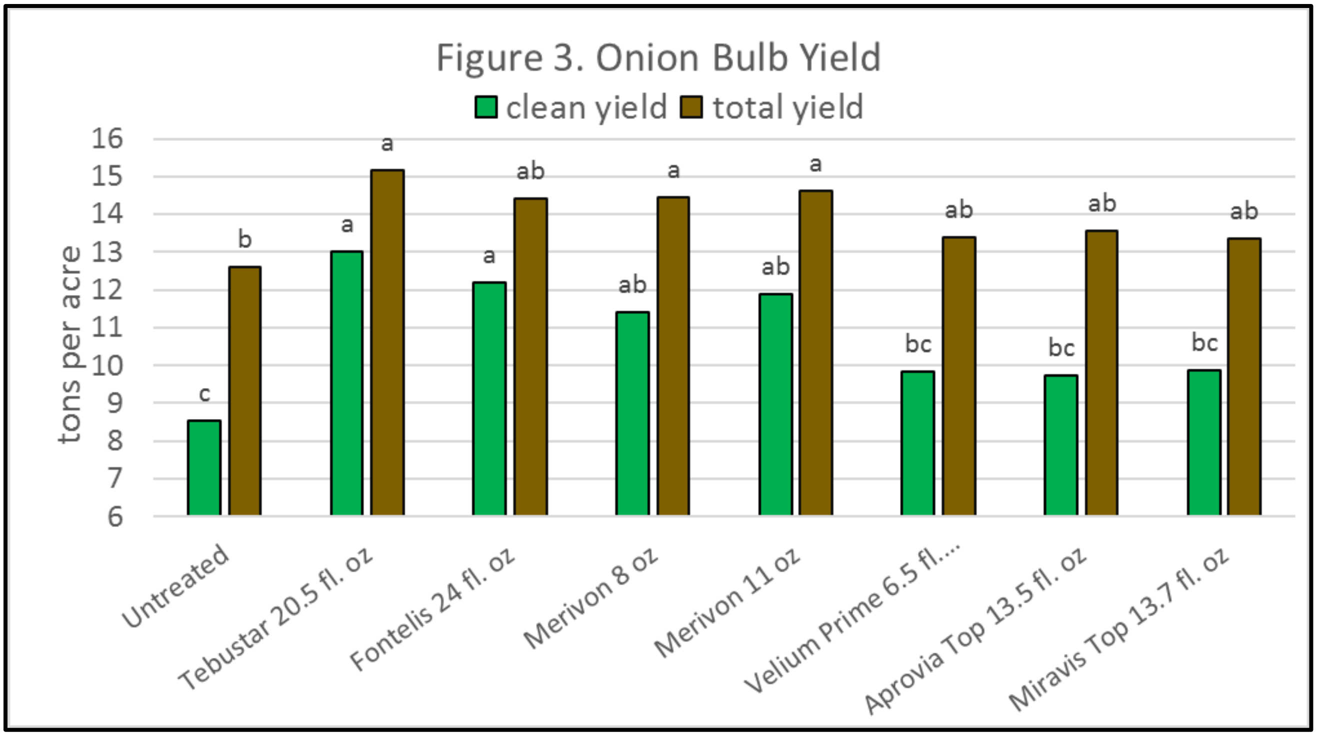
Figure 3. Onion Bulb Yield
clean yield
total yield
tons per acre
16
15
14
13
12
11
10
9
8
7
6
c
b
a
a
a
ab
ab
a
ab
a
bc
ab
bc
ab
bc
ab
Untreated
Tebustar 20.5 fl. oz
Fontelis 24 fl. oz
Merivon 8 oz
Merivon 11 oz
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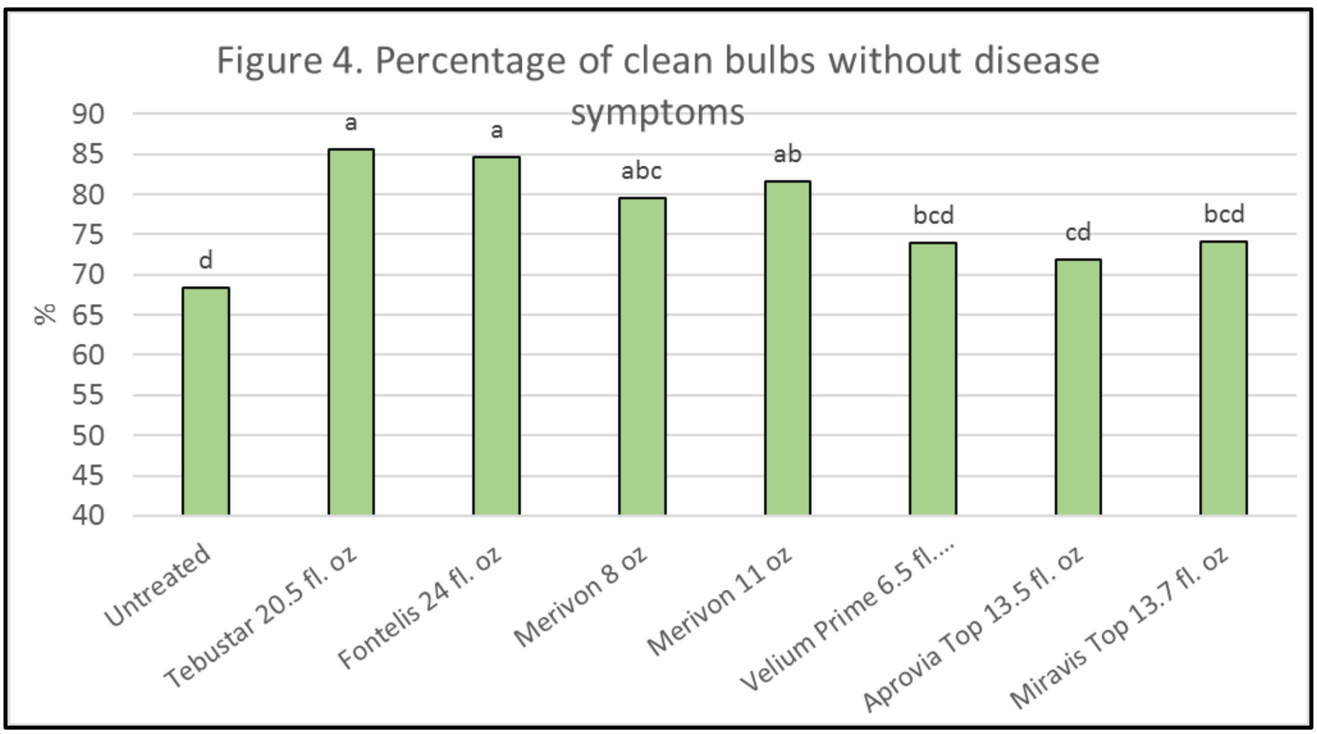


Figure 4. Percentage of clean bulbs without disease symptoms
%
90
85
80
75
70
65
60
55
50
45
40
d
a
a
abc
ab
bcd
cd
bcd
Untreated
Tebustar 20.5 fl. oz
Fontelis 24 fl. oz
Merivon 8 oz
Merivon 11 oz
Velium Prime 6.5 fl....
Aprovia Top 13.5 fl. oz
Miravis Top 13.7 fl. oz

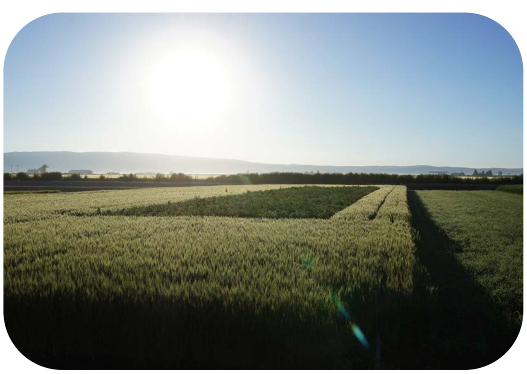
Through the Lens at IREC

Water Quality Study

Perennial Grass Fall Defoliation Height Trial

Winter Burn Treatments on Fall Defoliation Height Trial

Palisade Growth Regulator Trial



Quinoa Variety Trial

Onion White Rot Control Study

Winter Dryland Trial

Pea, Lentil and Garbonzo

Onion Seedlings Hit 2x with Hail

Counting Onion Stand in Onion Seed Maggot Trial

Plant height Measurement in Winter Dryland Trial

BUMMER

2018 IREC FIELD DAY

Save the Date! **Thursday, July 26** See You Here!

University *of* California
Agriculture and Natural Resources

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