2017 Annual Field Day

Intermountain
Research and Extension Center

RECS | University of California
Agriculture and Natural Resources

Welcome to our Annual Field Day!

This Field Day event is a collaborative effort involving all of the Center Staff, visiting researchers, and many growers and grower groups in the region. The general purpose of the tour is to allow participants a chance to see the research IREC is conducting and interact with Center researchers.

We sincerely appreciate the opportunity to share these research programs with members of the community, many of whom have helped sponsor the research and this event.

During the tour, please feel free to ask questions. Researchers are also available during breaks, after the tour, and during lunch for more information on any project. Additional information on research projects is available at the office.

We hope you enjoy the tour, the lunch and the conversation.

Thanks for coming!

Sincerely,

The IREC Staff

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Intermountain Research & Extension Center Current Staff

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Darrin Culp	Superintendent of Agriculture
Laurie Askew	Business Officer
Athena Chiladakis	Administrative Assistant
Kevin Nicholson	Staff Research Associate II
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Tom Tappan	Farm Machinery Mechanic
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Leopoldo Reyes Pedroza	Seasonal Farm Worker
Robert Carver	Seasonal Farm Worker
Johnathan Rohrbacker	Student Intern

http://irec.ucanr.edu

We've redesigned our website! Below is a list of some information available.
Thanks for bookmarking!

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Get to know the IREC staff

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Get directions to IREC

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Learn how to submit a proposal

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Read about the Center activities

Peruse our newsletters and Field Day booklets

Watch IREC videos

Study our cost studies

Weather, Physical & Biological Data:

Check out Tulelake weather and CIMIS

Use the Crop Water Use Table

Alfalfa Projects

Windrow Manipulation to Accelerate Alfalfa Drying Rate

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka.

- Monitor and evaluate the drying conditions (environmental factors) at IREC compared with conditions in the Midwest to determine if there is an environmental reason why hay curing is accomplished faster in the Midwest, or if the primary driving factor is swath/windrow width.
- Compare the drying rate of alfalfa cured under standard practices used in the intermountain area with those often used in the Midwest to determine if wider swaths can be used to accelerate curing.
- Compare the drying rate for different cuttings using standard practices versus wider windrows for spring and summer cuttings
- Evaluate alfalfa drying rate and "green-up" after cutting at IREC versus Scott Valley

Evaluations of Seed Coatings in Alfalfa

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; Dan Putnam, Extension Agronomist, Dept. of Plant Science, UC Davis.

- Evaluate the effect of different seed coating versus raw seed or fungicide-only treated seed on seedling vigor, initial stand, and early-season vigor.
- Determine the effect of the various seed treatments mentioned above on alfalfa stand after the first season.
- Evaluate the impact of these seed treatments on forage yield over the first and second production years.
- Assess the economic value of seed-coating treatments

Evaluation of Sharpen (saflufenacil) Use in Established Alfalfa

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka

- Evaluate the safety of Sharpen to alfalfa.
- Determine whether crop phytotoxicity could be reduced with different application timings.
- Evaluate the efficacy of Sharpen for controlling the spectrum of weeds encountered in Intermountain alfalfa fields.

Alfalfa Variety Evaluation in Mountain Valleys of Northern California

Investigator: Dan Putnam, Extension Agronomist, Dept. of Plant Science, UC Davis; Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; Craig Giannini, UC SRA, UC Davis

- Evaluate certified cultivar differences in alfalfa forage yield, quality, and persistence, and to communicate these results to clientele
- Develop and provide forage yield and performance data on alfalfa experimental germplasm to public and private alfalfa scientists

Cutting Schedule Effects on Reduced Lignin & Conventional Alfalfa

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; Dan Putnam, Extension Agronomist, Department of Plant Sciences, UC Davis

- Determine the effect of a 3-cut versus 4-cut harvest schedule on rate of forage quality change of genetically engineered low lignin alfalfa compared to the null that does not carry the trait and compared with a commercial standard
- Determine the appropriate cutting management schedule for low-lignin alfalfa compared with conventional non-genetically engineered alfalfa

Alfalfa Germplasm Evaluation-Fall Dormancy

Investigator: Charles Brummer, Director, Plant Breeding Center, UC Davis; Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; Dan Putnam, Extension Agronomist, Department of Plant Science, UC Davis.

- To develop a measurement method to assess dormancy in swards.
- To evaluate fall dormancy of the standard check cultivars and selected other modern cultivars in both swards using the new protocol and in spaced plants using the current protocol.

Investigation of Glyphosate Injury to Roundup Ready Alfalfa

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; Rob Wilson, Director/Farm Advisor, IREC, Tulelake.

- To better understand the conditions (environmental and management) that give rise to crop phytotoxicity from glyphosate.
- To determine the effect of application timing, alfalfa growth stage, and age of the stand on alfalfa injury level.
- To evaluate the effects of the degree of the frost, frost frequency, and the timing of the frost relative to the glyphosate application on the severity of the injury.
- To evaluate whether these injury symptoms can occur in fall as well as spring.
- To compare the susceptibility of different RR alfalfa cultivars.
- To develop management practices that can be employed to avoid injury.

Forage Projects

Evaluation of Forage Plantain

Investigator: David Lile, County Director/Farm Advisor, Lassen County, Susanville; Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka.

To compare stand establishment, persistence, and production of two varieties of plantain, two varieities of chicory, and Kura clover in comparison with Ladino clover.

- To determine seasonal forage quality and mineral nutrient availability.
- To assess practicality of tested varieties as potential forages in intermountain irrigated pasture systems.

Investigation of Indaziflam for Invasive Annual Grass Control and Perennial Grass Establishment

Investigator: Tom Getts, Weed Ecology & Cropping Systems Advisor, Lassen County, Susanville.

- To determine effectiveness of invasive annual grass control after indaziflam and aminocyclopyrachlor application.
- To assess secondary weed invasion after annual grass herbicide applications.
- To determine perennial species herbicide tolerance, and establishment potential.

Kura Clover Project

Investigator: Dan Putnam, Extension Agronomist, Dept. of Plant Science, UC Davis; Steve Orloff, UCCE, Siskiyou Co.; Charlie Brummer, UC Davis; N. Ehlke, C. Sheaffer, Univ. Minnesota; Oli Bacchi, UCCE, El Centro; Chris DeBen, UC Davis; Khaled Bali, UCCE El Centro.

- To determine preliminary seed and forage yield possibilities at 3 different locations in California.

Assessing Efficacy of Zinc Phosphide-Coated Cabbage for Belding's Ground Squirrel Control

Investigator: Roger Baldwin, Vertebrate Pest IPM Advisor, Kearny Agricultural Center; Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka.

- To determine efficacy of zinc phosphide cabbage bait using different mixing strategies.
- To determine what species consume bait.
- To determine peak time of day for bait consumption.
- To assess cost for bait application.

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

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; David Lile, County Director/Farm Advisor, Lassen County, Susanville

- Compare the yield potential of the three most commonly grown perennial grass species in the Intermountain Region.
- Evaluate the effect of three different fall herbage heights on the subsequent growth of tall fescue, orchardgrass and Timothy.
- Determine the effect of fall herbage height on water soluble carbohydrates the following spring and determine the relationship between water soluble carbohydrates and pasture growth.
- Estimate the biomass and nutritive value of fall/winter harvested forage of each treatment (using #1 as benchmark) to demonstrate how much fall forage producers would have to forego to implement higher stubble-height management strategy.

Onion Projects

Thrips Control in Onions

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka.

- Evaluate the effectiveness of Minecto Pro and Exirel on thrips in the Klamath Basin
- Evaluate thrips control using different insecticide sequences
- Determine if an early application using a low initial threshold is beneficial or detrimental
- Determine the impact of insecticide treatment on yield

Management of White Rot of Onions with Fungicides

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center

- Demonstrate the effectiveness of DADS in lowering soil levels of white rot sclerotia.
- Demonstrate fungicidal control of white rot in onions and garlic in plots with reduced soil sclerotia levels.

Onion Weed Control

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center

- Evaluate crop and weed response to varied rates and timings of pre-emergence applications of Prowl H2O and Dacthal.
- Develop UC recommendations and California specific herbicide labels for weed control in onions.

Management of Seedcorn Maggot and Onion Maggot in Processing Onions

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center; Kevin Nicholson, Staff Research Assistant, UC Intermountain Research & Extension Center

- To evaluate different seed treatment options for applying spinosad to onion seed.
- To test new active ingredients applied as a seed treatment and in-furrow spray.

Other Research

Evaluating the Potential for Quinoa and Amaranth Grain Production in the Klamath Basin

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center.

Determination of the feasibility of growing quinoa and amaranth under Tulelake's unique climate and soils

Microbial Water Quality Survey on the Klamath and Modoc National Forests

Investigator: Kenneth W. Tate, Ph.D. Professor and Rangeland Watershed Specialist, Department of Plant Sciences, UC Davis; Leslie Roche Ph.D., Assistant Cooperative Extension Specialist, Department of Plant Sciences; Carissa K. Rivers, Livestock/Natural Resources Advisor, Siskiyou County; Laura Snell, Livestock and Natural Resources Advisor, Cooperative Extension, Modoc County.

Qualtify *E.coli* concentrations in surface waters at 6 key grazing areas in the Modoc (n=3) sites) and Klamath (n=5 sites) National Forests for 30 days before (n=5 samples per site) and 30 days after (n=3 samples per site) annual livestock introduction.

Peppermint Projects

Weed Control in Peppermint

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center

- Investigate winter dormant herbicides for control of groundsel in peppermint.
- Investigate winter dormant herbicides efficacy for providing pre-emergent control of summer annual weeds.
- Investigate spring post-emergent herbicides for control of emerged pigweed.

Potato Projects

Evaluation of Certified Organic Control for Columbia Root Knot Nematode in Organic Potatoes

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center.

- Test the efficacy and crop safety of several organic approved nematode controls in Russet Potatoes.

Potato Variety Selection Evaluation & Development

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center; David Holm, Professor of Horticulture, Colorado State University; Julian Creighton Miller, Professor of Horticulture, Texas A & M University; Brian Charlton, Cropping Systems Specialist, Oregon State University, Klamath Basin Research and Experiment Center

- Evaluate new russet, specialty, and chip cultivars developed by public and private breeding programs for adaptation and suitability to Tulelake's unique soil, climate and marketing conditions.

Cultural Management of New Potato Varieties

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center; Joe Nunez, Farm Advisor, Kern County, Bakersfield; David Holmes, Professor of Horticulture, Colorado State University; Julian Creighton Miller, Professor of Horticulture, Texas A & M University; Brian Charlton, Cropping Systems Specialist, Oregon State University, Klamath Basin Research and Experiment Center

- Develop cultivar-specific cultural management recommendations appropriate for the successful introduction of new cultivars in Northern California. Continuing in 2017, the research focus will be evaluation of new varieties yield and bruise response to different vine kill durations.

Comparison of Nitrogen-Fixing Cover Crops and Organic Amendments for Nitrogen Fertilization in Organic Potatoes

Investigator: Rob Wilson, Center Director/Farm Advisor, Intermountain Research and Extension Center; Darrin Culp, Principal Superintendent of Agriculture, Intermountain Research and Extension Center; Brian Charlton, Cropping Systems Specialist, Oregon State University, Klamath Basin Research and Extension Center

- Determine which nitrogen-fixing cover crops are best suited for Northern California potato production.
- Estimate the nitrogen credit to spring-planted potatoes from nitrogen-fixing cover crops.
- Estimate the nitrogen credit to spring-planted potatoes from fall-applied chicken manure, steer manure and compost.
- Determine the influence of fall-incorporated manures and fall-incorporated nitrogen fixing cover crops on potato yield and potato quality.

Small Grains Projects

Use of Palisade PGR to Prevent Barley Lodging in Tulelake

Investigator: Rob Wilson, Center Director/Farm Advisor, UC Intermountain Research & Extension Center

Test different rates and timings of Palisade to determine the PGR's influence on Barley lodging, barley yield, and barley grain quality.

California Small Grain Variety Selection Trial

Investigator: Mark Lundy, UC Specialist, Dept. of Plant Sciences, Davis; Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka.

- To determine productivity, phenological information and disease incidence for small grains relevant to the intermountain region.

Wheat Genetic Resources & Mapping Experiments

Investigator: Calvin O. Qualset, Professor Emeritus, Department of Plant Sciences, UC Davis; Shiaoman Choa, USDA/ARS Research Geneticist, Fargo ND; Bryce Falk, Department of Plant Pathology, UC Davis

- To grow and make observations on agronomic and disease resistance on advanced breeding and genetic lines
- To make the genetic resources available to any researchers who have interest for their breeding or research
- To genetically characterize two populations of recombinant inbred lines for morpho-physiologic and agronomic traits
- To host the annual meeting of wheat workers in the Western Region, if the group is interested, for discussions of various current research topics and to view the field plantings of widely diverse wheat genetic materials

Improving Spring Barley for Northern Intermountain Areas

Investigator: Lynn Gallagher, Researcher, Department of Plant Sciences, UC Davis; Dr. Pat Hayes, Barley Breeder, Dept. of Crop & Soil Science, OSU Corvallis, Oregon

- The project objective is to increase grain yield and disease resistance in spring barley adapted to the Klamath Basin

Development of Wheat Varieties for California

Investigator: Dr. Jorge Dubcovsky, Assistant Professor, Department of Plant Sciences, UC Davis; Oswaldo Chicaiza, Research Assistant, Department of Plant Sciences, UC Davis; John Heaton, Department of Plant Sciences, UC Davis; Lee Jackson, Extension Agronomist, Department of Plant Sciences, UC Davis

- Introduces new germplasm for evaluation and breeding
- Develops breeding populations through hybridization, selection and evaluation
- Develops information on the inheritance of characters important to quality and yield in California production environments and finds molecular markers to assist the introgression of these characters into adapted breeding lines, and finally
- Produces Breeders Seed for multiplication as new varieties and germplasm for distribution to breeders and researchers. Specific goals are to introduce and maintain disease resistance, maintain or increase grain yield potential and improve end-use characteristics

Evaluation of Small Grain Species and Varieties Under Dryland Conditions

Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka.

- Compare the performance of different small grain species and varieties under drought conditions.
- Evaluate the economics of harvesting small grains for grain versus hay under non-irrigated conditions.

Cereal Leaf Beetle Parasitoid Support

Investigator: Charlie Pickett, Staff Environmental Research Scientist (Entomology), CDFA, Sacramento; Rob Wilson, Director/Farm Advisor, IREC; Darrin Culp, Supt. of Ag, IRE

- To provide an area for the survival and production of parasitic wasps.
- To maintain a high population of CLB eggs and larvae throughout the spring and summer as food for the wasps.
- To provide a low-cost, effective alternative to controlling cereal leaf beetle infestations in our local area.
- To provide a supply of parasitic wasps for redistribution to infested areas.

Evaluation of Alternatives to Soil Fumigants and Diallyl Disulfide for the Management of White Rot

Jeremiah K.S. Dung[1], Plant Pathology Assistant Professor; Thomas A. Turini[2], Advisor; & Robert G. Wilson[3], Director & Advisor. [1]Department of Botany & Plant Pathology, Central Oregon Agricultural Research Center, Oregon State University, Madras, OR; [2]University of California Cooperative Extension, Fresno, CA; [3]Intermountain Research and Extension Center, University of California, Tulelake, CA

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. Control of white rot is difficult because sclerotia can survive in fields for over 20 years, remaining dormant in the absence of *Allium* hosts. Today, thousands of acres are infested with white rot in CA. White rot is also a major problem for onion and garlic seed and bulb production in the Pacific Northwest and the *Allium* industry in the western U.S. is threatened by white rot. White rot-resistant cultivars of garlic and onion are not currently available and growers lack effective control options.

Sclerotia germination stimulants offer great potential for managing white rot. White rot is a disease limited to *Allium* crops because sclerotia germinate only in response to sulfur-containing compounds released from *Allium* roots. If these compounds can be applied to the soil in the absence of an *Allium* crop, the sclerotia will germinate, exhaust their energy reserves without a host, and die. Soil treatment with diallyl-disulfide (DADS) were shown to reduce sclerotia populations by over 90%, but unfortunately the small number of remaining sclerotia were often still sufficient to cause unacceptable disease levels at harvest. A commercial product containing DADS was registered for use as a sclerotia germination stimulant in 1992 but is no longer available for various reasons, including high product cost and unreliability in satisfactory disease control. Research using natural or synthetic *Allium* compounds as sclerotia germination stimulants has become a high priority since DADS is no longer commercially available.

Several University of California (UC) experiments over the last decade evaluated the efficacy and crop safety of fungicides for white rot control in onions. The majority of the studies evaluated different fungicides, fungicide rates, and fungicide application times. The fungicide tebuconazole was the most effective active ingredient for suppression of white rot. Penthiopyrad provided similar or slightly less suppression of white rot compared to tebuconazole. Tank mixing both fungicides had a slight additive effect on white rot suppression compared to using either product individually in multiple UC trials. The most effective fungicide application method was in-furrow at planting and results consistently showed fungicides increase onion yield and decrease the incidence and severity of white rot on harvested onion bulbs. Unfortunately, fungicides alone did not consistently suppress white rot at a level that prevents economic loss, especially in soils with high sclerotia populations.

Fungicides and sclerotia germination stimulants used individually have not reduced white rot symptoms to a point that a profitable crop (<15% bulbs showing symptoms) can consistently be produced in infested soil, especially if soil inoculum densities are high. For this reason, it was decided to test a twoprong approach using germination stimulants to reduce soil inoculum density the year before growing onions and a fungicide applied in-furrow when planting the onion crop. Results from several years of UC experiments at Tulelake's Intermountain Research and Extension Center were quite promising, often resulting in significant reductions in white rot symptoms on onion bulbs treated with DADS and tebuconazole compared to the non-treated control. Additionally, marketable yields were often increased to levels (24 tons/A) that would be acceptable to many growers, especially in white rot infested ground.

Collaborative research projects between UC and Oregon State University (OSU) are currently underway to evaluate the efficacy and feasibility of using *Allium* byproducts as white rot sclerotia germination stimulants. Rob Wilson (UC), Tom Turini (UC), and Jeremiah Dung (OSU) are testing a garlic juice, garlic oil, and other potential germination stimulants at rates much greater than previous tests to determine if high rates can provide similar efficacy compared to DADS. We are also evaluating new fungicides for their ability to suppress white rot. Concurrently, Dr. Michael Qian (OSU) is analyzing and screening sulfur compounds present in different *Allium* byproducts to identify potentially new germination stimulants and establish the dose-response relationships. Our long-term goal is to develop an IPM strategy for managing white rot in onions and garlic that will allow growers to produce a profitable *Allium* crop on land infested with white rot. These projects are funded by the California Garlic and Onion Research Advisory Board and the California Department of Pesticide Regulation.

Will Spectral Reflectance from UAS Predict In-Season Barley Nitrogen Status?

Taylor Nelsen, Nicholas George, Michael Rodriguez, Mark Lundy
Department of Plant Sciences, University of California, Davis, CA 95616

INTRODUCTION & HYPOTHESIS

Given the new nitrogen (N) regulations in California,[1,2] a growing demand for regionally-sourced, high quality malting barley,[3,4] and the need for better agronomic interpretations of emerging proximal sensing devices,[5] this research seeks to improve quality and yield outcomes for malting barley by optimizing the timing and rate of N fertilizer management. **We hypothesize that if there is a relationship between N content in biomass and the spectral signature recorded by proximal sensing devices as well as a correlation between N content and the resulting yield and quality of the malting barley, then the spectral signature from proximal sensing devices can be used to guide real-time management of N in a site-specific manner.**

This research addresses the growing need to calibrate and validate the relationships between proximal sensing devices and agronomic parameters,[5] and responds to the call for support of “drones at scale throughout UC and California” in the February, 2017 issue of California Agriculture.[6] The expansion of these tools and technologies has the potential to improve precision N management for malting barley, which has important regulatory, economic and biological consequences. In addition, the methods of analysis and interpretation of proximal sensing data developed in the course of this research will contribute to the broader understanding of these tools and their utility in cropping systems throughout California and beyond. Ultimately, the results of this research will be integrated into decision support tools for growers and consultants to make better site-specific, real-time N management decisions.

GOALS & OBJECTIVES

The goal of this research is to develop N rate recommendations for malting barley that adjust for site-specific conditions. To accomplish this goal we will:
1) Quantify the effect of different N fertilizer rates and application times on malting barley yield and quality.
2) Quantify the relationship between proximal sensing measurements and established methods of soil and plant analysis related to crop N status.
3) Quantify the ability of the suite of in-season proximal sensing measurements to predict site-specific yield and quality outcomes for malting barley using a combination of classification, regression, linear and non-linear models.
4) Translate the results of this research into decision support tools that leverage the use of site-specific proximal sensing data.

METHODS

This research is being conducted on multi-site small-plot trials. We have planted malting barley varieties bred for California environments (UC 1409--TAHOE & UC 1390) in fields with low residual N (< 2-4 ppm NO3-N). Plots will be treated with different N amounts ranging from 0 lb N/ac to 140 lb/ac N with different ratios between pre-plant and tillering with 4 replicates at each site. The whole trial will be conducted in at least two sites per year over the course of two seasons.

SUMMARY

1) Nitrogen amount and timing effects the yield and quality of malting barley; 2) Drones can give us high resolution spatial and temporal data; 3) Drone data can be used to predict nitrogen demand in-season

PRELIMINARY RESULTS

Fig. 1a. An overhead shot of the malting barley nitrogen trial gives a good sense of the scope of the project. This picture is a regular color photograph like you would take with a digital camera.

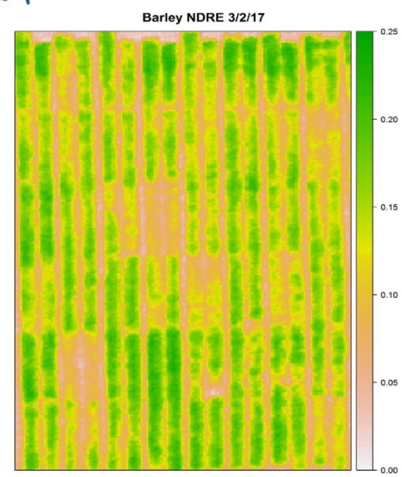

Fig. 1b. The drone carries 4 other cameras that take pictures at different wavelengths that record information we cannot easily see with the naked eye. The reflectance values of close to 1500 pixels per plot are recorded.

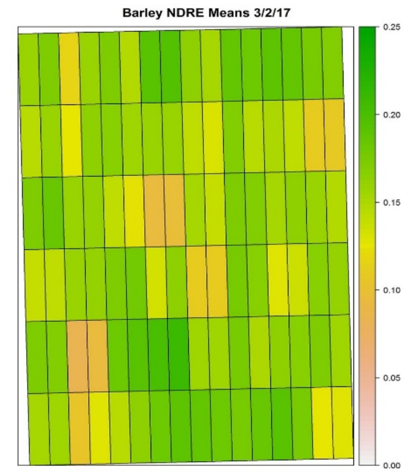

Fig. 1c. The means of each plot are taken from a 1x16ft strip in the middle of each plot. The mean of each plot is used to create the graphs below.

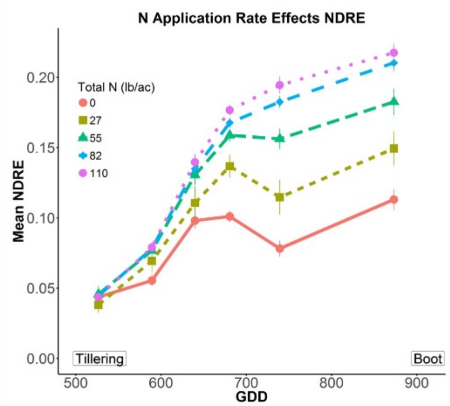

Fig. 2a. Temporal change of NDRE tracked over the course of the season using UAS imagery.

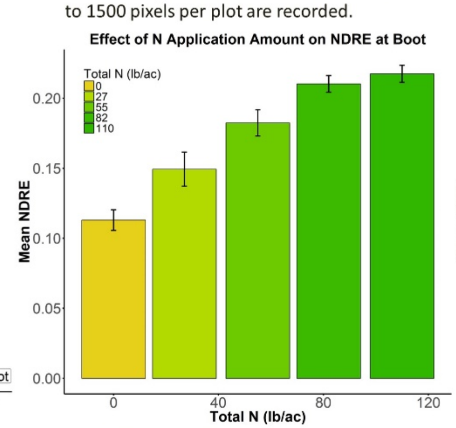

Fig. 2b. Displays NDRE differences at boot between treatments that received 0 - 110 lb/ac N at tillering.

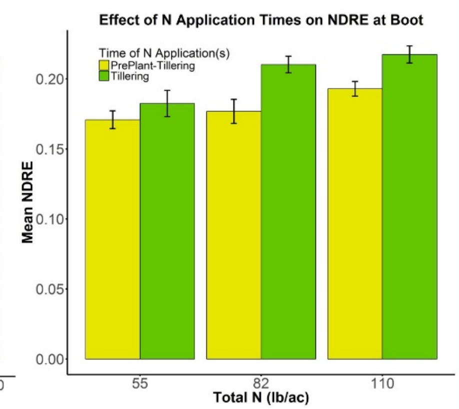

Fig. 2c. Application of all N at tillering lead to higher NDRE values at boot in all comparable treatments.

SELECTED REFERENCES

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4. Lee, C. 2016. Craft malting could spark new interest in barley, Daily Democrat.
5. Ballesteros, R., J.F. Ortega, D. Hernández, and M.A. Moreno. 2014. Applications of georeferenced high-resolution images obtained with unmanned aerial vehicles. Part I: Description of image acquisition and processing. Precision Agriculture 15:579-592.
6. Kelly, M. 2017. Drones in California research and extension. California Agriculture 71:4.

ACKNOWLEDGMENTS
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DEPARTMENT OF PLANT SCIENCES
College of Agricultural and Environmental Sciences
University of California
Agriculture and Natural Resources

Relationships between Yield, Fertilizer Applications and In-Season Measurements

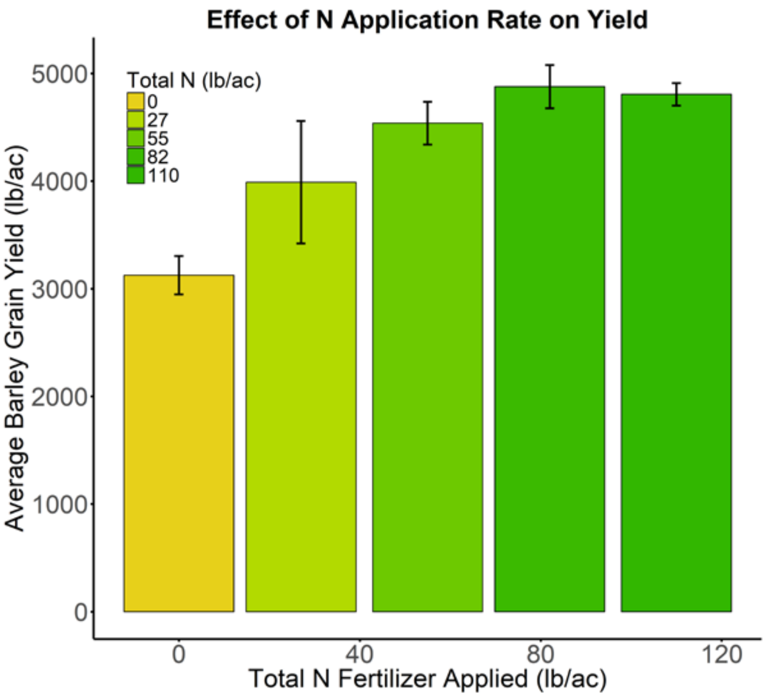

Fig. 3a. The imposed treatments resulted in different yields depending on the total amount of N fertilizer applied. The treatments displayed had between 0-110 lb/ac of N fertilizer applied at tillering.

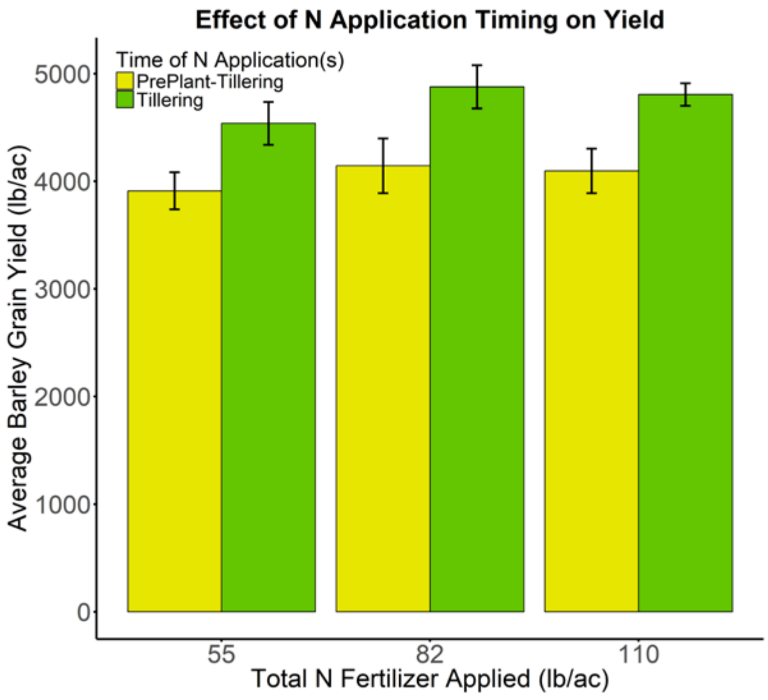

Fig. 3b. Application of N fertilizer at tillering lead to higher yields when compared to treatments where the total N fertilizer was split between pre-plant and tillering.

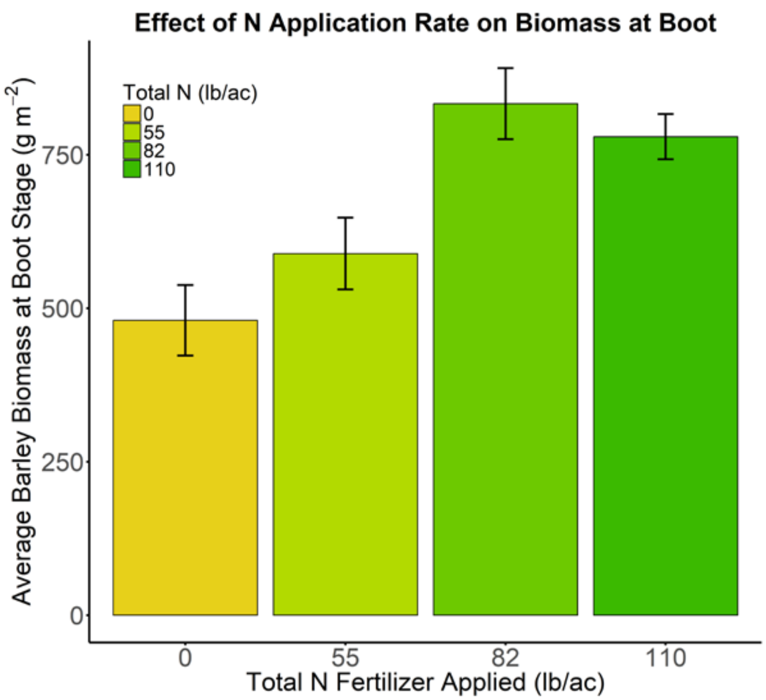

Fig. 3c. The same imposed treatments also resulted in different amounts of biomass at the boot stage depending on the total amount of N fertilizer applied.

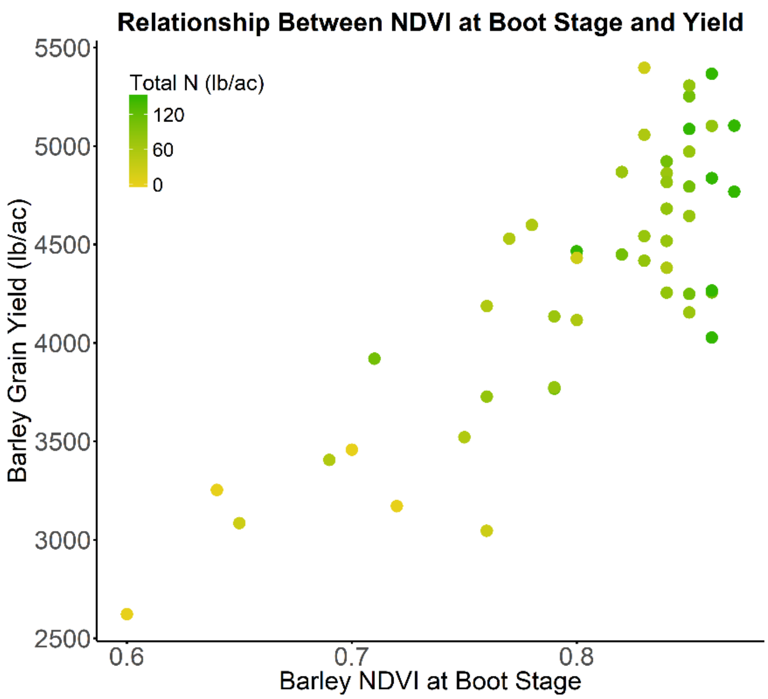

Fig. 3d. NDVI from a Trimble Greenseeker has a relationship with the final yield on a per plot basis. The total N fertilizer applied is also reflected in this figure by the color of the points.

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

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Introduction: The soils and weather in Tulelake are very favorable for irrigated barley production. Barley was one of the first crops grown in Tulelake, and growers consistently obtain some of the highest barley yields reported in California. Growers frequently have a problem with barley 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 reduced the incidence of lodging over the years by developing shorter varieties with stiff straw, but many older brew barley 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 tests the use of a plant growth regulator, Palisade, for mitigating lodging in Tulelake barley. The study tests the effectiveness of Palisade applied at different timings and rates for reducing barley lodging in Tulelake. The study will also document 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 is set up as RCB design with four replications. The study is testing Palisade alone and in combination with herbicide and fungicide tank-mixes applied at two application times. The trial includes an untreated control. The plots are being evaluated for plant height, lodging incidence and severity, barley yield, and barley quality.

Results: Preliminary results showed Palisade significantly reduced barley height and prevented lodging compared to the control (Table). Yield and quality results will be available in fall 2017.

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

trt #	Treatment	Rate/A	Application timing	Milk Stage Plant height (inches)	Milk Stage % lodging	Milk Stage % stripe rust
1	Untreated	**	**	47a	59a	58a
2	Palisade NIS	14 fl oz .25%v/v	Feekes 5	40cd	0b	43a
3	Palisade Weedar64 NIS	14 fl oz 1 pt/A .25%v/v	Feekes 5	39d	0b	43a
4	Palisade Weedar64 Quilt NIS	14 fl oz 1 pt/A 14 fl oz .25%v/v	Feekes 5	39d	0b	48a
5	Palisade NIS	14 fl oz .25%v/v	Feekes 7	44b	0b	38a
6	Palisade Quilt NIS	14 fl oz 14 fl oz .25%v/v	Feekes 7	42bc	0b	33a

Feekes 5 = Leaf sheaths strongly erect; first node showing on a few plants
Feekes 7 = Second node visible; no flag leaves showing

Evaluation of New Pasture Herbs for Irrigated Pasture Production in NE California

David Lile and Steve Orloff

Justification and Background

While irrigated pastures provide an important forage resource in the Intermountain area, there has been relatively little research on new species or varieties that might provide improved yield in quantity and/or quality of grazable livestock forage. Most pastures are comprised of relatively old germplasm, usually an antiquated tall fescue grass variety like Fawn with a varying mix of white clovers. As the value of water and land resources increase, long-term sustainability of irrigated pasture systems will depend on more efficient production of livestock through better yield and better nutritive quality of forages. Hence, there is a need for increased testing of new potential forages that may be suited to the Intermountain area. Relatively new varieties of improved forage plantain and chicory (sometimes referred to as pasture herbs) are commercially available and receive interesting claims of praise from seed companies. Benefits include improved mid- summer growth rate over typical cool-season species, high drought tolerance, winter hardiness, well adapted to low fertility soils, high digestibility and energy content, and high mineral content easily obtained by grazing animals.

An irrigated pasture forage plant with these characteristics would be a good fit in many Intermountain pastures and producers have expressed interest in these species. Similarly Kura clover which has been grown and tested in the Midwest and to a very limited degree in the intermountain area shows strong potential as an irrigated pasture clover and has drawn interest from intermountain growers due to its perceived drought tolerance.

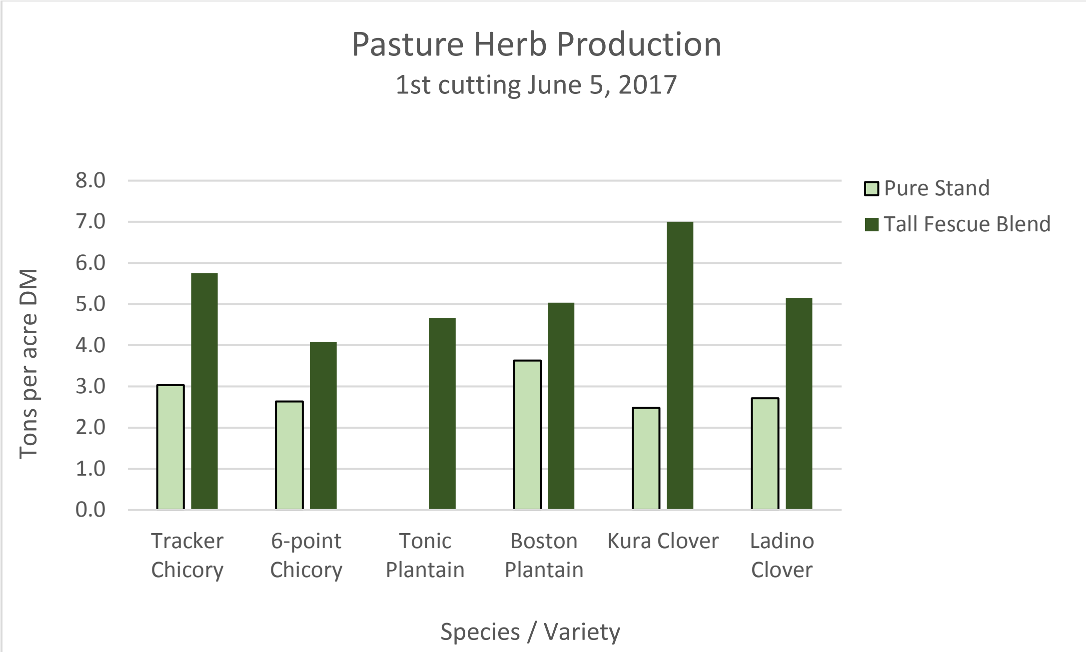
Methods

We propose to a study to assess establishment, persistence, production and forage quality of 2 varieties of forage plantain (Boston and Tonic), 2 varieties of chicory (Tracker and 6-Point) and varieties of clover (Kura and Ladino). Ladino clover is selected to serve as a standard for comparison as it has been widely used for many years in irrigated pasture systems. The six entries will be seeded both in pure stands as well as in a blend with tall fescue.

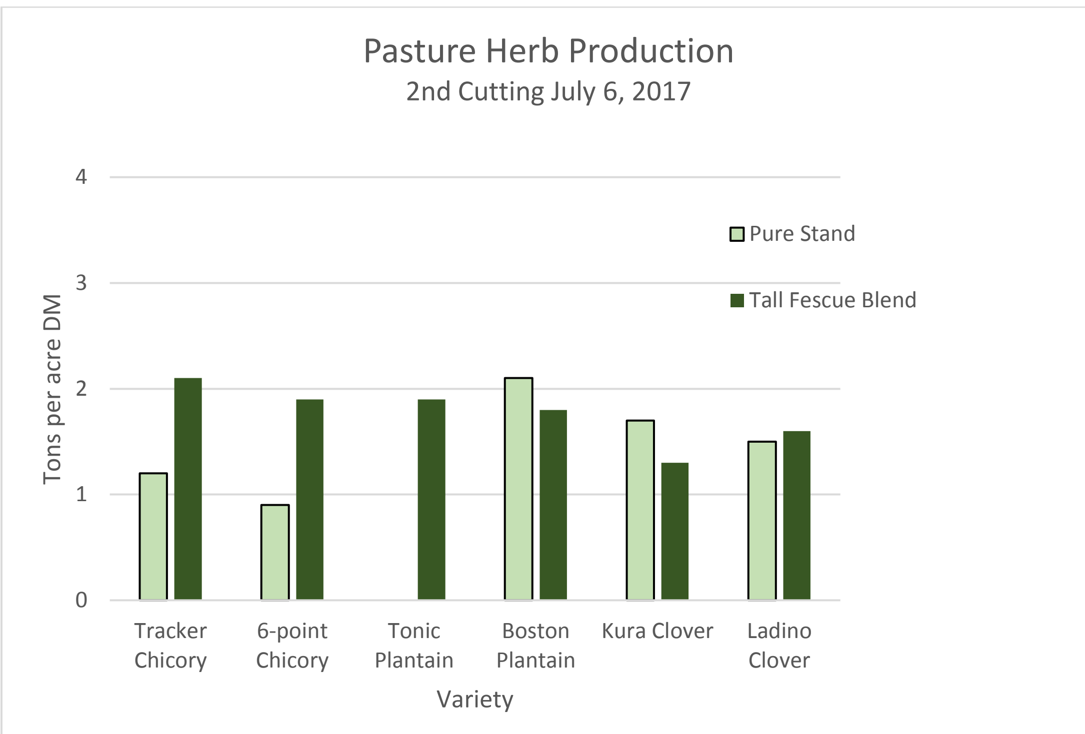
Plots will be harvested early summer, mid-summer and fall to determine yield. Sub-samples to be analyzed for quality analysis will be collected at each harvest.

Results

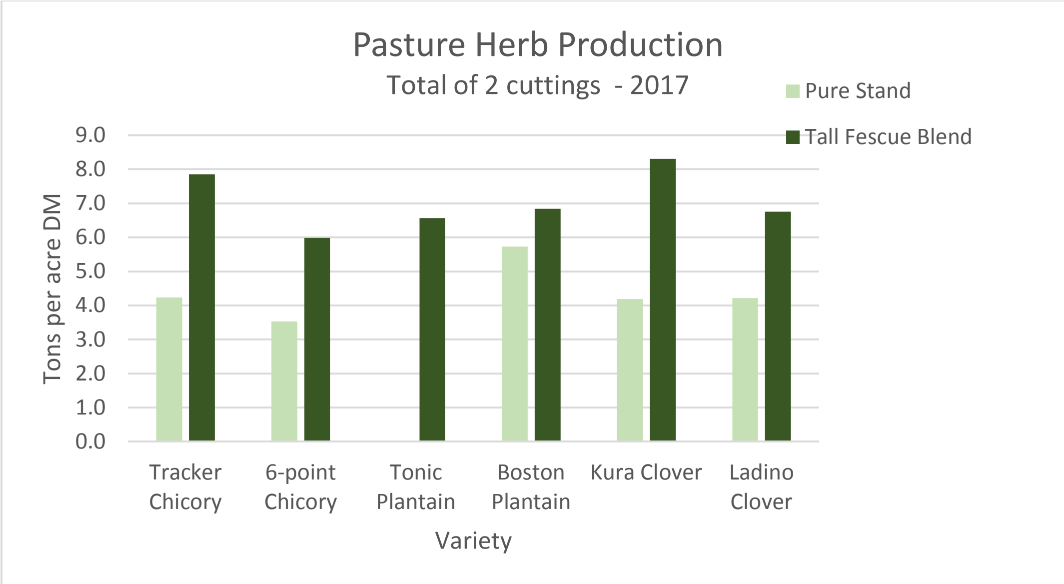
Research plots were established in summer of 2016. Production data from two harvests collected in 2017 are shown in charts below.



Pasture Herb Production
1st cutting June 5, 2017
Tons per acre DM
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Pure Stand
Tall Fescue Blend
Tracker Chicory
6-point Chicory
Tonic Plantain
Boston Plantain
Kura Clover
Ladino Clover
Species / Variety



Pasture Herb Production
2nd Cutting July 6, 2017
Tons per acre DM
4
3
2
1
0
Pure Stand
Tall Fescue Blend
Tracker Chicory
6-point Chicory
Tonic Plantain
Boston Plantain
Kura Clover
Ladino Clover
Variety



Pasture Herb Production
Total of 2 cuttings - 2017
Pure Stand
Tall Fescue Blend
Tons per acre DM
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Tracker Chicory
6-point Chicory
Tonic Plantain
Boston Plantain
Kura Clover
Ladino Clover
Variety

New Crop Introduction: Kura Clover

Dan Putnam, Chris DeBen, UC Davis, Steve Orloff, UCCE Siskiyou County

Introduction. Kura Clover (*Trifolium ambiguum* L.) is a low-growing, spreading perennial pasture legume. It's also called Caucasian, Pellett's or honey clover. Its primary potential use is as a pasture crop, but the first cutting in the spring might be taken as a hay or silage crop. It is unknown how widely adapted Kura might be in California, or its suitability to pastures or hay production. Here at Tulelake, we are examining whether seed can be produced, and whether forage production is of strong interest.

Promises. Kura has a range of characteristics which are quite positive and interesting. Once established it is very persistent, and can contribute to a pasture even under intense grazing—persistence is likely superior to red or alsike clover, or alfalfa. Actually, since it produces vigorous rhizomes, its persistence may improve over time. It reportedly works well in mixtures with grasses such as orchardgrass and reed canarygrass. Additionally, it produces a high quality forage and is very attractive to bees. Its yields are not likely to be superior to alfalfa, but are quite high compared with other clover species. Kura clover produces a lot on N through biological N_2 fixation. Kura also has the potential to contribute to innovative cropping systems, such as perma-seeding (corn with low-growing legume interseeded), organic systems, or soil cover for vineyards or orchard to contribute both biologically-fixed nitrogen as well as stable soil and below-ground biomass.

Limitations. Kura clover is VERY slow to develop and become established. Therefore, weed management is a challenge during establishment. It is highly prostrate and high in moisture, so it is not well suited as a hay crop. Kura is very frost tolerant, but production declines under hot temperatures (though we have produced Kura under Central Valley conditions). Inoculation with the proper strain of Rhizobium bacteria can be problematic and it may take a while for adequate nodulation to occur. One of the main limitations nationwide is the ability to produce seed, which limits the ability to envision a wider role for Kura clover in Midwestern or pasture systems. Because of the environmental conditions here, California may be well-suited for seed production but it's potential has not been evaluated.

Experiments. These trials were instituted to determine forage potential of Kura clover, and the possibility of producing seed in California. Trials were established at Davis, CA, El Centro, CA, and Tulelake, CA. We are working with clover breeders at the University of Minnesota to test their advanced lines and determine:

1. **The forage potential of Kura clover in three environments in California.**
2. **The potential for seed production.**
3. **The potential for Kura clover to be adapted to irrigated pasture in California, as well as a cover crop in orchards, vineyards, etc.**

Kura Clover is primarily a candidate for pasture production throughout the Midwest, but also could have applications in irrigated pastures, especially in Intermountain California. It has been proposed for a 'perma-crop' system with annuals such as corn or with grapes, since it is so persistent and a vigorous N2 fixer (obtains significant nitrogen from biological N2 fixation), as seen in these Wisconsin trials. (photo Ken Albright, Univ. or Wisconsin).

Forage Cereal Breeding Update: A New Hooded Barley

Lynn Gallagher, Cal Qualset, Herb Vogt, Linda Matthews
Plant Sciences, UCD

Winter and spring cereal grains are often used as forage crops for fall or early spring grazing or as green-chop, silage, or hay. There is considerable interest in using several cereal crops in blends for forage use. The blends are prepared by mixing seeds according to the desires of the user or as blends prepared by the seed handler. Awnless varieties are desired for palatability aspects forage use, but in California there are few awnless varieties available in barley, wheat and triticale, thus oat is a favored cereal forage crop. Short-awned triticale varieties are accepted because of the high tonnage produced.

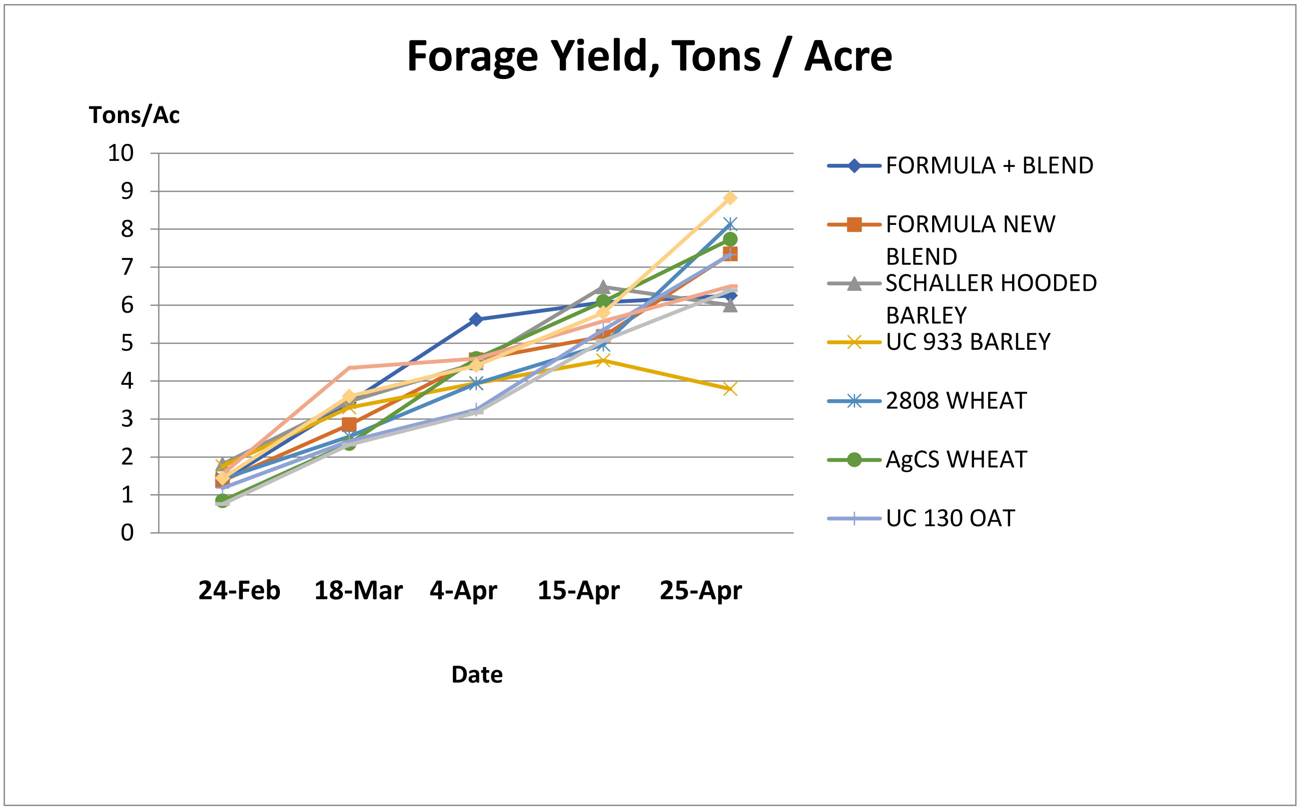
Awnless barley varieties are suitable but not generally available. Hooded barley is very acceptable, but also limited in availability. In hooded barley the awn is replaced by an inverted form of a barley spikelet. In the middle 1950s Schaller and Suneson at Davis developed hooded varieties, for example Hooded Atlas, but they were not popular, probably because their grain yield potential was not high and forage uses were limited. Lynn Gallagher turned to breeding hooded barley as one of the breeding goals in his barley breeding portfolio. He based his breeding on Schaller's 'Hooded Atlas' and used additional parents from the Oregon State Univ. barley breeding program to develop a disease-resistant productive type. He offered seed handlers and farmers the opportunity to select types of interest to them from his breeding nursery. Those who selected materials then sign a 'test agreement' that declared the ownership of the materials by the University of California Agricultural Experiment Station. The materials that proved useful in their farming or sales portfolios would be considered for release by UC, sometimes with exclusive marketing agreements.

'Schaller' hooded barley is an example that is being prepared for formal release. Stanisluas Farm Supply has provided on-farm testing through a test agreement and considers the hooded variety to be a valuable component of their forage blends. Two years of testing have been completed at Davis to determine the forage yields of the blends, Schaller barley, and other varieties. Table 1 shows example data from 2016 for forage yields. The blends are a useful product for the dairy industry and Schaller is a better hooded barley than other hooded varieties available because of its disease resistance, earliness, and reasonably good grain yields.

Winter Cereals Forage Yields Davis, 2016 EXP 16150

Tons/Ac Means (15% moisture) over 4 reps

ENTRY		Harvest Date					
NO.	VARIETY	24-Feb	18-Mar	4-Apr	15-Apr	25-Apr	Mean
1	FV FORMULA ONE+ BLEND	1.38	3.43	5.62	6.08	6.25	4.55
2	FV FORMULA ONE + NEW BLEND	1.38	2.85	4.56	5.18	7.34	4.26
3	SCHALLER HOODED BARLEY	1.82	3.47	4.48	6.48	6.00	4.45
4	UC 933 BARLEY	1.75	3.30	3.94	4.54	3.79	3.46
5	FV 2808 WHEAT	1.42	2.54	3.94	4.95	8.13	4.20
6	UC AgCS WHEAT (Dvorak)	0.85	2.35	4.59	6.09	7.73	4.32
7	UC 130 OAT	1.18	2.42	3.24	5.35	7.33	3.90
8	Trical 116 TRITICALE	1.55	4.35	4.59	5.58	6.49	4.51
9	HOWARD OAT UC 142	0.76	2.32	3.17	5.06	6.39	3.54
10	SWAN OAT	1.44	3.60	4.40	5.79	8.82	4.81
	Mean	1.35	3.06	4.25	5.51	6.83	4.20



Work in Progress: Lynn Gallagher, Linda Mattews, Herb Vogt, Pat McGuire, Mark Lundy, Dan Putnam and Cal Qualset

Small Grain Variety Selection Using UC Statewide Trial Results

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One of the challenges of communicating multi-location, multi-species variety testing information is that trials produce a large amount of information that can be difficult to sort through. In addition, trial results have a variety of users with varying needs from the data produced. The UC statewide small grain variety testing program is implementing some changes related to the analysis and reporting of our annual trial results. The goal of these changes is to provide summaries that meet the objectives of multiple users, while emphasizing the big picture outcomes in the most streamlined manner possible.

Moving forward, we will emphasize variety-specific yield and protein estimates and comparisons that span multiple years and, where appropriate and possible, multiple locations. The statistical models that produce these estimates allow for better 'apples-to-apples' comparisons of relative variety performance, even for varieties that have not been tested in all the trials. Because a subset of our clientele will still be interested in site-specific performance on an annual basis, this information will also still be available. The goal of these changes is to provide more robust information and enhanced tools for making small grain variety selections, whether you are a grower, seed supplier or breeder.

Trial results can be found at the UC Small Grains Research and Information Center:

http://smallgrains.ucanr.edu/Variety/

In addition to the changes to analysis and presentation already incorporated, we are developing web-based tools that we intend to have available for use for the 2017 trial results. These will permit more customizable viewing and interpretation of the trial results. Please stay tuned and keep up-to-date with our program by subscribing to the UC Small Grain Blog:

http://ucanr.edu/blogs/smallgrains/

Table 1. Soft spring wheat yield, protein and agronomic traits from UC trials in Intermountain region locations from 2014-2016.

					Yield									Protein									Agronomic traits				
Region/Group	Crop 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	2016 Yield (lb/acre)	2016 St.Err.Yield (lb/acre)	2016 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	2016 Protein (%)	2016 St.Err.Protein (%)	2016 Protein Rank	Test Wt (lb/bu)	1000 Kernel Wt (g)	Plant Ht (in)	Lodging @ harvest, 50th%tile	Lodging @ harvest, 90th%tile
InterMnt	SPRINGWHEAT	SWS	2014-2016	WB 6430	6306	818	1	1327	311	0	8763	472	2	10.85	0.99	28	-1.07	0.34	0.02	10.45	0.4	16	59.5	29.7	33.6	4	6.5
InterMnt	SPRINGWHEAT	SWS	2014-2016	WB 6341	6146	803	2	1168	271	0	8897	472	1	10.46	0.97	30	-1.46	0.3	0	9.6	0.4	20	58.5	30.5	37.5	2	5.8
InterMnt	SPRINGWHEAT	SWS	2014-2016	YS 602	6094	866	3	1115	407	0.04	8401	472	3	11.15	1.04	25	-0.77	0.45	0.22	10.57	0.4	15	61.8	-	38	6	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	UI STONE	5641	803	4	662	271	0.06	8004	472	7	11.18	0.97	24	-0.74	0.3	0.09	10.35	0.4	17	58.6	34	36.9	6.3	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	ALTURAS	5550	808	5	572	287	0.12	8216	527	5	11.52	0.98	21	-0.4	0.32	0.37	10.33	0.45	18	57.7	32.2	35.8	6	6.5
InterMnt	SPRINGWHEAT	SWS	2014-2016	WA 8189	5404	780	6	426	200	0.1	8217	374	4	12.84	0.95	5	0.92	0.22	0	12.3	0.32	2	59.5	31.6	33.9	4.7	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	IDO851	5393	837	7	415	364	0.44	-	-	-	11.06	1.01	26	-0.86	0.4	0.14	-	-	-	57.2	33.6	35.1	4.7	5.5
InterMnt	SPRINGWHEAT	SWS	2014-2016	WB 6121	5389	839	8	411	365	0.44	7540	624	9	12.21	1.01	11	0.29	0.4	0.6	11.5	0.53	8	59	34.5	34.1	4.8	5.7
InterMnt	SPRINGWHEAT	SWS	2014-2016	12SW052	5364	818	9	385	311	0.43	8014	472	6	12.1	0.99	14	0.18	0.34	0.72	11.02	0.4	12	56.8	35	38.3	7	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	IDO852	5334	956	10	356	572	0.76	-	-	-	11.37	1.13	23	-0.55	0.63	0.57	-	-	-	59.7	35.5	31.8	2.6	3.2
InterMnt	SPRINGWHEAT	SWS	2014-2016	12SW079	5333	892	11	355	474	0.68	-	-	-	12.99	1.06	4	1.07	0.52	0.16	-	-	-	53.1	35.1	34.7	6.3	6.3
InterMnt	SPRINGWHEAT	SWS	2014-2016	12SW068	5231	818	12	253	311	0.66	7560	472	8	11.6	0.99	20	-0.32	0.34	0.57	10.77	0.4	14	56.8	35.9	36.3	6	6
InterMnt	SPRINGWHEAT	SWS	2014-2016	WA8195	5214	956	13	236	572	0.85	-	-	-	11.03	1.13	27	-0.89	0.63	0.35	-	-	-	57	35.1	35	5.7	5.7
InterMnt	SPRINGWHEAT	SWS	2014-2016	M 12001	5180	892	14	201	474	0.85	-	-	-	12.66	1.06	6	0.74	0.52	0.35	-	-	-	54	31.8	35.7	4.3	4.3
InterMnt	SPRINGWHEAT	SWS	2014-2016	MELBA	5167	866	15	189	407	0.85	7475	472	10	10.57	1.04	29	-1.35	0.45	0.02	10	0.4	19	60.2	-	35.5	7	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	WA 8162	5134	956	16	156	572	0.89	-	-	-	12.02	1.13	15	0.1	0.63	0.9	-	-	-	58	35.3	31.8	5	6
InterMnt	SPRINGWHEAT	SWS	2014-2016	WB1035CL+	5089	956	17	111	572	0.91	-	-	-	12.37	1.13	9	0.45	0.63	0.6	-	-	-	56.9	33.8	29.5	1.7	1.7
InterMnt	SPRINGWHEAT	SWS	2014-2016	WHIT	5046	803	18	67	271	0.89	7323	472	11	11.66	0.97	19	-0.26	0.3	0.57	11.17	0.4	10	58.6	36.7	36.2	6	7.1
InterMnt	SPRINGWHEAT	SWS	2014-2016	MERRILL 2	4999	956	19	21	572	0.97	-	-	-	13.14	1.13	1	1.22	0.63	0.17	-	-	-	54.3	31.1	29	2	2
InterMnt	SPRINGWHEAT	SWS	2014-2016	SX908	4904	956	20	-74	572	0.93	-	-	-	13.13	1.13	2	1.21	0.63	0.17	-	-	-	51.6	33	30	1	1
InterMnt	SPRINGWHEAT	SWS	2014-2016	SY 04PN3024 2	4834	866	21	-144	407	0.87	7141	472	12	11.7	1.04	18	-0.22	0.45	0.72	11.12	0.4	11	61.6	-	39	7	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	WA 8214	4627	808	22	-352	287	0.43	6522	527	15	12	0.98	16	0.08	0.32	0.87	11.6	0.45	6	55.9	35.3	34.8	7	7.6
InterMnt	SPRINGWHEAT	SWS	2014-2016	WB 1035 CL+	4485	866	23	-493	407	0.43	6792	472	13	12.25	1.04	10	0.33	0.45	0.6	11.67	0.4	5	60.4	37.5	37.8	1	3.2
InterMnt	SPRINGWHEAT	SWS	2014-2016	14SWW1030	4462	866	24	-516	407	0.43	6769	472	14	12.1	1.04	13	0.18	0.45	0.77	11.52	0.4	7	58.7	-	39.5	7	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	ALPOWA	4240	829	25	-738	329	0.08	6188	472	18	11.43	1	22	-0.49	0.36	0.35	10.92	0.4	13	59.1	34.6	37.6	7	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	LOUISE	4180	829	26	-798	329	0.06	6459	472	16	12.4	1	8	0.48	0.36	0.35	12.25	0.4	3	58.8	38.9	37.4	7	7.5
InterMnt	SPRINGWHEAT	SWS	2014-2016	14SWW1059	3914	866	27	-1064	407	0.05	6222	472	17	11.95	1.04	17	0.03	0.45	0.95	11.37	0.4	9	58.9	-	41	7	7
InterMnt	SPRINGWHEAT	SRS	2014-2016	TX06V7266	3679	956	28	-1299	572	0.08	-	-	-	13.06	1.13	3	1.14	0.63	0.2	-	-	-	54	27.4	28.5	1	1
InterMnt	SPRINGWHEAT	SWS	2014-2016	SEAHAWK	3546	818	29	-1433	300	0	5853	374	19	12.64	0.99	7	0.72	0.33	0.14	12.06	0.32	4	60.7	-	39.5	7	7
InterMnt	SPRINGWHEAT	SWS	2014-2016	DIVA	3467	803	30	-1511	271	0	4397	472	20	12.17	0.97	12	0.25	0.3	0.57	12.45	0.4	1	57.1	38.7	36.9	7	7.6

Table 2. Hard spring wheat yield, protein and agronomic traits from UC trials in Intermountain region locations from 2014-2016.

					Yield									Protein									Agronomic traits				
Region/Group	Crop 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	2016 Yield (lb/acre)	2016 St.Err.Yield (lb/acre)	2016 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	2016 Protein (%)	2016 St.Err.Protein (%)	2016 Protein Rank	Test Wt (lb/bu)	1000 Kernel Wt (g)	Plant Ht (in)	Lodging @ harvest, 50th%tile	Lodging @ harvest, 90th%tile
InterMnt	SPRINGWHEAT	HWS	2014-2016	DAYN	5783	723	1	858	227	0	-	-	-	11.97	0.97	55	-1.06	0.29	0.01	-	-	-	58.4	35.3	34.6	2.3	3.7
InterMnt	SPRINGWHEAT	HRS	2014-2016	LCS IRON 11 SB 0096	5698	737	2	774	255	0.02	8031	250	2	12.88	0.98	36	-0.16	0.32	0.73	12.38	0.26	19	61.9	-	36.8	1	1
InterMnt	SPRINGWHEAT	HRS	2014-2016	WB 9518	5627	715	3	702	190	0	7891	250	7	13.76	0.96	4	0.73	0.24	0.02	13.75	0.26	1	60.7	36.4	33.1	1	1.5
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY BASALT 04W40240R	5617	737	4	693	255	0.04	7950	250	5	12.65	0.98	44	-0.38	0.32	0.48	12.15	0.26	24	61	-	33.5	1	2.4
InterMnt	SPRINGWHEAT	HWS	2014-2016	WB HARTLINE	5536	737	5	612	255	0.07	7869	250	8	13.03	0.98	31	-0.01	0.32	0.98	12.53	0.26	17	61.4	-	39	6	7
InterMnt	SPRINGWHEAT	HRS	2014-2016	WB 9200	5534	737	6	610	255	0.07	7867	250	9	13.63	0.98	7	0.59	0.32	0.23	13.13	0.26	8	63.8	-	38.5	1	1
InterMnt	SPRINGWHEAT	HWS	2014-2016	IDO1203S A	5532	737	7	608	255	0.07	7865	250	10	12.75	0.98	39	-0.28	0.32	0.54	12.25	0.26	22	62.6	-	35.8	6.5	7
InterMnt	SPRINGWHEAT	HWS	2014-2016	LCS ATOMO	5507	708	8	582	167	0	8045	250	1	12.28	0.95	49	-0.76	0.21	0.01	11.73	0.26	28	59.1	33.3	28.4	1	2.4
InterMnt	SPRINGWHEAT	HRS	2014-2016	05SB84	5422	776	9	498	359	0.39	-	-	-	11.87	1.03	56	-1.17	0.45	0.05	-	-	-	55.6	36.3	27	1	1
InterMnt	SPRINGWHEAT	HWS	2014-2016	12SB0146	5390	747	10	465	292	0.29	-	-	-	12	0.99	54	-1.03	0.37	0.03	-	-	-	54.7	30.3	33	4	4
InterMnt	SPRINGWHEAT	HRS	2014-2016	WB 9229	5267	719	11	343	205	0.28	7961	279	3	13.4	0.96	15	0.36	0.26	0.4	13.32	0.29	5	58.6	28.7	32.2	1	1.7
InterMnt	SPRINGWHEAT	HWS	2014-2016	UI PLATINUM	5240	708	12	316	167	0.2	7935	250	6	12.09	0.95	52	-0.94	0.21	0	11.55	0.26	30	59.3	35.4	30.4	1	3.3
InterMnt	SPRINGWHEAT	HWS	2014-2016	LCS STAR	5213	708	13	288	167	0.27	7955	250	4	13	0.95	35	-0.04	0.21	0.91	11.75	0.26	26	56.6	26.4	33.3	5	7
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY SELWAY 04PN3001 2	5184	737	14	260	255	0.62	7517	250	11	13.3	0.98	22	0.27	0.32	0.55	12.8	0.26	14	61	-	39.5	6	6.7
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY BASALT	5177	776	15	253	359	0.75	-	-	-	12.45	1.03	46	-0.59	0.45	0.42	-	-	-	58.1	30.2	28.5	1	1
InterMnt	SPRINGWHEAT	HWS	2014-2016	UC 12013/33	5132	776	17	208	359	0.77	-	-	-	12.76	1.03	38	-0.28	0.45	0.67	-	-	-	56.7	32.2	30	3.3	3.3
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY 04PN3051 9	5129	737	18	204	255	0.75	7462	250	12	14.13	0.98	2	1.09	0.32	0.01	13.63	0.26	3	64	-	40.8	3	4
InterMnt	SPRINGWHEAT	HRS	2014-2016	12SB0199	5097	737	19	173	255	0.75	7430	250	13	12.18	0.98	51	-0.86	0.32	0.04	11.68	0.26	29	60.5	-	35.5	1	1.7
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY 04W40292R	5095	723	20	170	227	0.75	-	-	-	13.3	0.97	23	0.26	0.29	0.54	-	-	-	56.6	37.3	31.2	3.6	5.5
InterMnt	SPRINGWHEAT	HWS	2014-2016	WB 7417	5086	737	21	162	255	0.75	7419	250	14	13.6	0.98	8	0.57	0.32	0.23	13.1	0.26	9	62.6	-	40	1	3.8
InterMnt	SPRINGWHEAT	HRS	2014-2016	11SB0096	5073	723	22	148	227	0.75	-	-	-	12.52	0.97	45	-0.51	0.29	0.23	-	-	-	56.1	33.4	31.7	1.3	1.9
InterMnt	SPRINGWHEAT	HRS	2014-2016	HRS 3504	5051	719	23	126	205	0.75	7368	279	17	13.11	0.96	30	0.08	0.26	0.84	12.8	0.29	13	57.1	30.1	35.5	2.5	3.7
InterMnt	SPRINGWHEAT	HRS	2014-2016	IDO862E	5043	723	24	118	227	0.79	-	-	-	13.44	0.97	12	0.4	0.29	0.4	-	-	-	59.3	37.5	33.4	4	5.6
InterMnt	SPRINGWHEAT	HWS	2014-2016	UC 12013 22	5041	723	25	116	227	0.79	-	-	-	13.29	0.97	24	0.26	0.29	0.54	-	-	-	55.7	32.7	29.9	2	3.8
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY 06PN3015 08	5038	737	26	113	255	0.82	7371	250	16	12.68	0.98	43	-0.36	0.32	0.49	12.18	0.26	23	62.1	-	35	5.5	6.7
InterMnt	SPRINGWHEAT	HWS	2014-2016	YS 601	5030	747	27	105	292	0.82	-	-	-	12.72	0.99	41	-0.31	0.37	0.55	-	-	-	55.1	29.4	33.7	1	1
InterMnt	SPRINGWHEAT	HWS	2014-2016	UC 12013/34	5001	723	28	76	227	0.83	-	-	-	13.35	0.97	19	0.32	0.29	0.49	-	-	-	55.9	31.2	33	4.2	6.2
InterMnt	SPRINGWHEAT	HRS	2014-2016	BULLSEYE	4990	708	29	66	167	0.82	7075	250	21	13.43	0.95	13	0.39	0.21	0.23	13.23	0.26	7	60.9	33.9	32.3	7	7.3
InterMnt	SPRINGWHEAT	HRS	2014-2016	YS 802	4980	747	30	55	292	0.9	-	-	-	13.65	0.99	6	0.61	0.37	0.27	-	-	-	57.7	34.4	39.7	4.3	4.3
InterMnt	SPRINGWHEAT	HWS	2014-2016	IDO1202S	4973	708	31	48	167	0.85	7391	250	15	13.27	0.95	25	0.23	0.21	0.49	12.5	0.26	18	59.1	35.1	36.6	6	7
InterMnt	SPRINGWHEAT	HRS	2014-2016	IDO862T	4969	723	32	44	227	0.9	-	-	-	13.33	0.97	20	0.29	0.29	0.51	-	-	-	59.3	36.9	32.4	2.7	3.2
InterMnt	SPRINGWHEAT	HRS	2014-2016	YECORA ROJO	4932	737	33	7	255	0.99	7265	250	18	14.15	0.98	1	1.12	0.32	0.01	13.65	0.26	2	63.5	-	31	1	1
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY COHO 04W40292R	4924	737	34	-1	255	1	7257	250	19	13.53	0.98	9	0.49	0.32	0.34	13.03	0.26	10	60	-	34.2	7	7
InterMnt	SPRINGWHEAT	HRS	2014-2016	UC 12014/35	4917	723	35	-8	227	0.99	-	-	-	12.71	0.97	42	-0.32	0.29	0.49	-	-	-	54.6	31	31.2	1.8	2.5
InterMnt	SPRINGWHEAT	HRS	2014-2016	JEFFERSON	4839	723	36	-86	227	0.82	-	-	-	13.2	0.97	26	0.16	0.29	0.69	-	-	-	58.1	34	34.1	5.3	6.9
InterMnt	SPRINGWHEAT	HRS	2014-2016	12SB0197	4806	751	37	-118	292	0.82	7137	279	20	12.27	1	50	-0.77	0.37	0.16	11.75	0.29	27	59	-	37	1	1
InterMnt	SPRINGWHEAT	HWS	2014-2016	12SB0131	4806	747	38	-118	292	0.82	-	-	-	12.36	0.99	48	-0.67	0.37	0.23	-	-	-	54.7	31.6	34.3	4.7	4.7
InterMnt	SPRINGWHEAT	HRS	2014-2016	WA 8217	4713	747	39	-212	292	0.75	-	-	-	13.38	0.99	16	0.34	0.37	0.54	-	-	-	55.6	31.7	34.7	6	6
InterMnt	SPRINGWHEAT	HRS	2014-2016	WB 9879 CLP	4707	737	40	-218	255	0.73	7040	250	22	13.45	0.98	10	0.42	0.32	0.42	12.95	0.26	11	61.9	-	34.8	1	3.8
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY STEELHEAD	4707	708	41	-218	167	0.42	6915	250	23	13.72	0.95	5	0.69	0.21	0.01	13.3	0.26	6	60.6	27.9	36.9	4.3	5.5
InterMnt	SPRINGWHEAT	HRS	2014-2016	GLEE	4682	776	42	-242	359	0.75	-	-	-	12.75	1.03	40	-0.29	0.45	0.67	-	-	-	61.5	40.8	31.5	4	4
InterMnt	SPRINGWHEAT	HRS	2014-2016	SY 3001 2	4673	747	43	-252	292	0.73	-	-	-	13.02	0.99	33	-0.02	0.37	0.98	-	-	-	55.5	35.4	36.3	6	6
InterMnt	SPRINGWHEAT	HWS	2014-2016	CLEAR WHITE 515	4617	723	44	-308	227	0.4	-	-	-	13.01	0.97	34	-0.03	0.29	0.98	-	-	-	54.5	30.4	31.8	2.6	3.7
InterMnt	SPRINGWHEAT	HRS	2014-2016	HRS 3530	4583	747	45	-342	292	0.5	-	-	-	13.16	0.99	28	0.12	0.37	0.83	-	-	-	56.7	32.8	37.7	5.7	5.7
InterMnt	SPRINGWHEAT	HRS	2014-2016	UI WINCHESTER	4563	723	46	-362	227	0.29	-	-	-	13.42	0.97	14	0.39	0.29	0.42	-	-	-	56.2	34.3	32.8	6.7	7.5
InterMnt	SPRINGWHEAT	HRS	2014-2016	12SB0224	4498	751	47	-426	292	0.35	6898	279	24	12.37	1	47	-0.67	0.37	0.23	11.88	0.29	25	60.4	-	33.3	2	2.8
InterMnt	SPRINGWHEAT	HRS	2014-2016	10SB0087 B	4452	708	48	-473	167	0.03	6466	250	27	13.03	0.95	32	-0.01	0.21	0.98	12.33	0.26	20	57.5	32.2	31.8	5.8	7
InterMnt	SPRINGWHEAT	HRS	2014-2016	YS 802 1	4416	737	49	-508	255	0.17	6749	250	25	14.08	0.98	3	1.04	0.32	0.01	13.58	0.26	4	63.7	-	40.5	1	1
InterMnt	SPRINGWHEAT	HRS	2014-2016	HRS 3419	4343	715	50	-582	190	0.02	6423	250	28	12.78	0.96	37	-0.26	0.24	0.49	12.28	0.26	21	58.4	27	37.6	2	4.2
InterMnt	SPRINGWHEAT	HRS	2014-2016	BUCK PRONTO	4332	776	51	-592	359	0.28	-	-	-	13.44	1.03	11	0.41	0.45	0.54	-	-	-	58.9	36.2	32.5	3.8	5
InterMnt	SPRINGWHEAT	HRS	2014-2016	ALUM	4240	737	52	-685	255	0.04	6573	250	26	13.38	0.98	17	0.34	0.32	0.49	12.88	0.26	12	60.5	-	40.5	4	6
InterMnt	SPRINGWHEAT	HRS	2014-2016	HRS 3361	4117	719	53	-808	205	0	6109	279	30	13.18	0.96	27	0.14	0.26	0.69	12.64	0.29	16	57.9	29.6	38.3	1	3.1
InterMnt	SPRINGWHEAT	HRS	2014-2016	HRS 3100	3974	737	54	-950	255	0	6307	250	29	13.15	0.98	29	0.12	0.32	0.82	12.65	0.26	15	60.6	-	40.5	1.5	2
InterMnt	SPRINGWHEAT	HRS	2014-2016	YS 801	3756	747	55	-1168	292	0	-	-	-	13.31	0.99	21	0.27	0.37	0.61	-	-	-	56.7	27.3	35	5	5
InterMnt	SPRINGWHEAT	HRS	2014-2016	ANZA	3556	751	56	-1368	292	0	5886	279	31	12	1	53	-1.03	0.37	0.03	11.5	0.29	31	59.7	-	41.7	7	7

Table 3. Winter wheat yield, protein and agronomic traits from UC trials in Intermountain region locations from 2014-2016.

					Yield									Protein									Agronomic traits				
Region/Group	Crop 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	2016 Yield (lb/acre)	2016 St.Err.Yield (lb/acre)	2016 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	2016 Protein (%)	2016 St.Err.Protein (%)	2016 Protein Rank	Test Wt (lb/bu)	1000 Kernel Wt (g)	Plant Ht (in)	Lodging @ soft dough, 90th%tile	Lodging @ harvest, 90th%tile
InterMnt	WINTERWHEAT	SWW	2014-2016	LOR 092	7659	1641	1	1869	632	0.05	-	-	-	9.75	1.33	103	-2.21	0.57	0	-	-	-	54.8	34.7	43.5	1	1.3
InterMnt	WINTERWHEAT	SWW	2014-2016	WB EXP 1030 CL+	6779	1641	2	989	632	0.48	-	-	-	13.09	1.33	4	1.13	0.57	0.34	-	-	-	53.9	28	39	1	1.7
InterMnt	WINTERWHEAT	SWW	2014-2016	ORI2101841	6577	1535	3	787	260	0.04	9954	540	1	11.66	1.22	74	-0.3	0.23	0.58	9.78	0.57	43	57.6	38.2	36.8	1	1.1
InterMnt	WINTERWHEAT		2014-2016	IDN 07 28017B	6560	1558	4	771	373	0.3	9579	540	3	11.85	1.25	54	-0.11	0.33	0.87	10.2	0.57	25	59.9	-	38.2	-	1.5
InterMnt	WINTERWHEAT	SWW	2014-2016	LOR 833	6544	1641	5	754	632	0.67	-	-	-	11.29	1.33	90	-0.68	0.57	0.59	-	-	-	50.7	28.7	35.5	1	1.3
InterMnt	WINTERWHEAT		2014-2016	SY 04PN005 25	6483	1558	6	694	373	0.41	9503	540	5	11.79	1.25	60	-0.18	0.33	0.84	10.14	0.57	30	58.9	-	40.7	-	5.5
InterMnt	WINTERWHEAT		2014-2016	SY 04PN062 18	6457	1558	7	667	373	0.45	9476	540	6	11.55	1.25	84	-0.41	0.33	0.58	9.9	0.57	40	60.2	-	37.1	-	3
InterMnt	WINTERWHEAT	SWW	2014-2016	ORI2101841 2 GENE	6450	1641	8	660	632	0.7	-	-	-	10.93	1.33	100	-1.04	0.57	0.39	-	-	-	58.6	35.8	35.8	-	5.2
InterMnt	WINTERWHEAT	SWW	2014-2016	BOBTAIL	6446	1539	9	657	285	0.25	9623	540	2	11.78	1.23	64	-0.19	0.25	0.82	10.21	0.57	24	55.6	27.6	35.6	1	2.4
InterMnt	WINTERWHEAT		2014-2016	OR2121086	6446	1558	10	656	373	0.45	9465	540	7	10.87	1.25	101	-1.1	0.33	0.03	9.21	0.57	46	59.9	-	40.7	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	WB EXP 1038 CL	6395	1641	11	605	632	0.7	-	-	-	11.79	1.33	61	-0.18	0.57	0.87	-	-	-	53.2	29.2	35.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	KELDIN	6388	1539	12	598	285	0.3	9098	540	23	11.74	1.23	67	-0.23	0.25	0.78	10.68	0.57	6	60.6	38.2	38.6	4.7	3.7
InterMnt	WINTERWHEAT	SWW	2014-2016	ROSALYN	6388	1539	13	598	285	0.3	9383	540	10	11.39	1.23	88	-0.58	0.25	0.22	9.98	0.57	38	56.7	29.9	36.7	1	1.4
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2090473	6377	1578	14	587	446	0.62	-	-	-	11.43	1.27	87	-0.54	0.4	0.58	-	-	-	54	31.8	34.2	1	1.6
InterMnt	WINTERWHEAT		2014-2016	ARS06134 57C	6375	1558	15	585	373	0.48	9394	540	9	11.8	1.25	58	-0.17	0.33	0.84	10.14	0.57	28	59.1	-	38.6	-	6.5
InterMnt	WINTERWHEAT		2014-2016	LWW14 71195	6349	1558	16	559	373	0.5	9368	540	12	11.82	1.25	57	-0.15	0.33	0.84	10.16	0.57	26	58.1	-	37.6	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	IDN 06 18102A	6346	1546	17	556	321	0.45	9365	540	13	12.08	1.24	42	0.11	0.29	0.85	10.3	0.57	22	56.1	25.2	39.2	2	5.4
InterMnt	WINTERWHEAT	SWW	2014-2016	03 29902A	6337	1578	18	547	446	0.67	-	-	-	11.18	1.27	97	-0.79	0.4	0.34	-	-	-	56.3	31.7	36.8	1	1.9
InterMnt	WINTERWHEAT		2014-2016	JASPER	6335	1558	19	545	373	0.51	9354	540	15	12.01	1.25	46	0.05	0.33	0.93	10.36	0.57	15	59.3	-	41.3	-	4
InterMnt	WINTERWHEAT	SWW	2014-2016	WB 1529	6287	1546	20	497	321	0.48	9113	540	22	11.64	1.24	78	-0.33	0.29	0.62	10.15	0.57	27	59.6	34	37.4	1.3	4.4
InterMnt	WINTERWHEAT	SWW	2014-2016	WB 1604	6280	1546	21	490	321	0.49	9147	540	21	11.85	1.24	55	-0.12	0.29	0.84	10.32	0.57	19	58.8	29.2	39.3	1	2.4
InterMnt	WINTERWHEAT	SWW	2014-2016	SY 96-2 EXP	6279	1641	22	489	632	0.77	-	-	-	11.23	1.33	94	-0.73	0.57	0.58	-	-	-	51.7	30	37	3.7	6.7
InterMnt	WINTERWHEAT	SWW	2014-2016	MARY	6276	1531	23	486	241	0.3	9375	540	11	11.96	1.22	50	-0.01	0.22	0.98	10.09	0.57	33	55.8	30.9	35.4	1	4.2
InterMnt	WINTERWHEAT	SWW	2014-2016	IDN 04 00405B	6260	1641	24	470	632	0.77	-	-	-	12.09	1.33	40	0.12	0.57	0.91	-	-	-	52.6	26	30.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	TUBBS 06	6258	1539	25	468	285	0.48	9540	540	4	11.65	1.23	76	-0.32	0.25	0.58	10.07	0.57	35	56.6	35.3	41.5	1	5
InterMnt	WINTERWHEAT	SWW	2014-2016	IDN 02 29001A	6252	1539	26	462	285	0.48	9222	540	17	12.08	1.23	43	0.11	0.25	0.84	10.33	0.57	18	57.5	29.8	36.8	1.7	5.4
InterMnt	WINTERWHEAT	SWW	2014-2016	IDN 02 08806A	6245	1641	27	455	632	0.77	-	-	-	12.11	1.33	38	0.14	0.57	0.9	-	-	-	53.8	28	32	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	WB 1070 CL	6230	1641	28	440	632	0.77	-	-	-	11.87	1.33	52	-0.1	0.57	0.91	-	-	-	59.2	38.9	33	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	LOR 913	6209	1641	29	419	632	0.77	-	-	-	11.6	1.33	79	-0.36	0.57	0.82	-	-	-	50.6	29.9	37.5	1.7	3
InterMnt	WINTERWHEAT	SWW	2014-2016	IDN 01 10704A	6197	1578	30	407	446	0.7	-	-	-	11.17	1.27	98	-0.8	0.4	0.34	-	-	-	51.5	27.8	37	2	3.7
InterMnt	WINTERWHEAT	SWW	2014-2016	BRUNDAGE 96	6175	1641	31	385	632	0.79	-	-	-	12.5	1.33	17	0.53	0.57	0.75	-	-	-	53.3	28.8	31	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2110526	6174	1546	32	384	321	0.67	9434	540	8	11.79	1.24	62	-0.18	0.29	0.82	9.95	0.57	39	57.2	27.6	37.2	1	4.4
InterMnt	WINTERWHEAT		2014-2016	ORLD113092	6173	1558	33	383	373	0.7	9192	540	18	11.78	1.25	63	-0.19	0.33	0.84	10.13	0.57	31	59.7	-	44.5	-	5.5
InterMnt	WINTERWHEAT	SWW	2014-2016	LCS BIANCOR	6162	1539	34	372	285	0.62	9361	540	14	11.25	1.23	93	-0.72	0.25	0.08	9.73	0.57	44	55	27.7	31.2	1	1.3
InterMnt	WINTERWHEAT	SWW	2014-2016	TUBBS	6156	1539	35	367	285	0.62	9092	540	24	11.65	1.23	77	-0.32	0.25	0.58	9.87	0.57	41	56.4	32.2	40.1	1	6
InterMnt	WINTERWHEAT		2014-2016	HUFFMAN	6139	1558	36	349	373	0.7	9158	540	19	11.75	1.25	65	-0.21	0.33	0.82	10.1	0.57	32	60	-	41.7	-	6.5
InterMnt	WINTERWHEAT		2014-2016	SY 04PN096 2	6137	1558	37	347	373	0.7	9156	540	20	12.28	1.25	25	0.31	0.33	0.75	10.62	0.57	8	60.8	-	36.6	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	PUMA WA 8134	6124	1641	38	334	632	0.82	-	-	-	11.21	1.33	96	-0.76	0.57	0.58	-	-	-	50.5	28.4	38	4.3	7.3
InterMnt	WINTERWHEAT	SWW	2014-2016	LCS ARTDECO	6118	1539	39	328	285	0.68	9233	540	16	11.27	1.23	91	-0.69	0.25	0.08	9.99	0.57	37	56	33.1	35	1.7	1
InterMnt	WINTERWHEAT	SWW	2014-2016	WESTBRED 528	6105	1641	40	315	632	0.84	-	-	-	11.73	1.33	68	-0.24	0.57	0.84	-	-	-	54.8	31.8	33.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	YS 221	6092	1578	41	302	446	0.77	-	-	-	11.48	1.27	86	-0.49	0.4	0.58	-	-	-	56.1	29.4	36.7	1	2.3
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2080641	6075	1578	42	285	446	0.78	-	-	-	11.65	1.27	75	-0.31	0.4	0.82	-	-	-	54.1	34.5	36.7	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	STEPHENS	6066	1539	43	276	285	0.7	9033	540	26	12.17	1.23	35	0.2	0.25	0.82	10.31	0.57	20	56.7	38.8	37.6	1.3	6.3
InterMnt	WINTERWHEAT		2014-2016	EXPBZ6W09 489	6059	1558	44	269	373	0.77	9078	540	25	11.91	1.25	51	-0.06	0.33	0.91	10.25	0.57	23	61.1	-	37.8	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	LWW 11 431	6039	1641	45	249	632	0.9	-	-	-	11.6	1.33	81	-0.37	0.57	0.82	-	-	-	51.6	27.1	40.5	1	2.3
InterMnt	WINTERWHEAT	SWW	2014-2016	LADD	6037	1578	46	247	446	0.82	-	-	-	11.37	1.27	89	-0.6	0.4	0.58	-	-	-	55.6	36.4	33.3	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	WB TRIFECTA	5995	1578	47	205	446	0.85	-	-	-	11.87	1.27	53	-0.1	0.4	0.9	-	-	-	52.5	30.6	34.8	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	LWW 04 4009	5970	1641	48	180	632	0.95	-	-	-	11.25	1.33	92	-0.72	0.57	0.58	-	-	-	56.5	34.2	30.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	COLONIA	5970	1641	49	180	632	0.95	-	-	-	12.09	1.33	41	0.12	0.57	0.91	-	-	-	52.3	28.8	29.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	ORI2101840 2 GENE	5924	1558	50	134	373	0.92	8943	540	27	12.01	1.25	47	0.04	0.33	0.93	10.35	0.57	16	59.5	39.5	40	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	IDN 06 033038	5919	1641	51	129	632	0.95	-	-	-	12.66	1.33	11	0.7	0.57	0.58	-	-	-	48.8	27.5	37.5	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	BRUNEAU	5907	1578	52	117	446	0.95	-	-	-	11.23	1.27	95	-0.74	0.4	0.39	-	-	-	55.6	30.9	37.8	2.7	5.4
InterMnt	WINTERWHEAT	SWW	2014-2016	YS 343	5900	1641	53	110	632	0.96	-	-	-	11.6	1.33	82	-0.37	0.57	0.82	-	-	-	58.6	30.4	33.8	-	1.7
InterMnt	WINTERWHEAT	SWW	2014-2016	SKILES	5892	1578	54	102	446	0.95	-	-	-	11.57	1.27	83	-0.4	0.4	0.71	-	-	-	55.2	35.7	34.2	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	LWW 12 7105	5880	1578	55	90	446	0.95	-	-	-	11.15	1.27	99	-0.82	0.4	0.34	-	-	-	48	28.3	29.5	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	DAS 004	5854	1641	56	64	632	0.97	-	-	-	12.1	1.33	39	0.13	0.57	0.9	-	-	-	50	27.8	37	1	1.7
InterMnt	WINTERWHEAT		2014-2016	LWW14 73163	5844	1558	57	54	373	0.96	8863	540	28	11.79	1.25	59	-0.17	0.33	0.84	10.14	0.57	29	59.4	-	39.9	-	1
InterMnt	WINTERWHEAT		2014-2016	LWW12 7105	5843	1558	58	53	373	0.96	8862	540	29	11.72	1.25	72	-0.25	0.33	0.82	10.06	0.57	36	57.6	-	31.9	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	ORCF 103	5830	1641	59	40	632	0.97	-	-	-	12.18	1.33	33	0.21	0.57	0.85	-	-	-	56.8	35.1	36	-	7.3
InterMnt	WINTERWHEAT	SWW	2014-2016	AP BADGER	5825	1641	60	35	632	0.97	-	-	-	11.71	1.33	73	-0.26	0.57	0.84	-	-	-	55.8	36.6	32.5	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	DAS 003	5824	1641	61	34	632	0.97	-	-	-	12.74	1.33	9	0.78	0.57	0.58	-	-	-	48.7	25.8	36	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	AP 700 CL	5820	1641	62	30	632	0.97	-	-	-	12.13	1.33	37	0.16	0.57	0.89	-	-	-	56.9	40.7	36	-	1.7
InterMnt	WINTERWHEAT	HRW	2014-2016	AZIMUT	5775	1641	63	-15	632	0.98	-	-	-	12.27	1.33	26	0.3	0.57	0.84	-	-	-	49.2	23	27	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	LWW 10 1073	5755	1578	64	-35	446	0.97	-	-	-	12.23	1.27	31	0.27	0.4	0.82	-	-	-	53	29.6	38	1	1.3
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2090533	5750	1641	65	-40	632	0.97	-	-	-	12.64	1.33	13	0.67	0.57	0.59	-	-	-	50.5	25.6	31.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	EXCEDE	5700	1641	66	-90	632	0.96	-	-	-	12.61	1.33	15	0.64	0.57	0.62	-	-	-	50.5	27.3	25.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	IDO1108	5697	1539	67	-93	285	0.94	8411	540	35	12.07	1.23	44	0.1	0.25	0.84	10.61	0.57	9	56.7	31.6	41	2.3	6.3
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2100937	5660	1641	68	-130	632	0.95	-	-	-	12.37	1.33	22	0.4	0.57	0.82	-	-	-	51.2	28.6	28.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	SIETTE CERROS	5655	1641	69	-135	632	0.95	-	-	-	10.4	1.33	102	-1.57	0.57	0.08	-	-	-	55.8	27.5	35	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	LOR 978	5649	1641	70	-141	632	0.95	-	-	-	12.77	1.33	8	0.81	0.57	0.58	-	-	-	49.9	29.9	36.5	1	1.7
InterMnt	WINTERWHEAT	SWW	2014-2016	LEGION	5627	1578	71	-163	446	0.92	-	-	-	12.38	1.27	21	0.41	0.4	0.7	-	-	-	53.3	35.5	38.2	1.7	6.8
InterMnt	WINTERWHEAT	SWW	2014-2016	SY 107	5605	1546	72	-184	321	0.81	8816	540	30	11.82	1.24	56	-0.15	0.29	0.84	9.69	0.57	45	57.8	36.1	38.2	2.7	7
InterMnt	WINTERWHEAT		2014-2016	EXPBZ6W09 471	5534	1558	73	-255	373	0.77	8553	540	31	12.32	1.25	23	0.35	0.33	0.69	10.66	0.57	7	59.7	-	40.6	-	4
InterMnt	WINTERWHEAT	SWW	2014-2016	GOETZE	5495	1578	74	-295	446	0.77	-	-	-	11.72	1.27	71	-0.25	0.4	0.82	-	-	-	53	31.3	34.7	1	1.3
InterMnt	WINTERWHEAT	SWW	2014-2016	WB EXP 458	5485	1641	75	-305	632	0.84	-	-	-	12.99	1.33	6	1.02	0.57	0.39	-	-	-	53.1	31	31	-	-
InterMnt	WINTERWHEAT		2014-2016	OR2121252	5473	1558	76	-317	373	0.73	8492	540	32	11.74	1.25	66	-0.23	0.33	0.82	10.09	0.57	34	58.7	-	39.3	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	YS 9568 A	5449	1641	77	-341	632	0.82	-	-	-	11.73	1.33	69	-0.24	0.57	0.84	-	-	-	49.8	26.2	35	1	1.3
InterMnt	WINTERWHEAT	SWW	2014-2016	ORCF 102	5425	1578	78	-365	446	0.75	-	-	-	12.61	1.27	14	0.64	0.4	0.55	-	-	-	55.3	34.7	36.5	1	1
InterMnt	WINTERWHEAT		2014-2016	SY 04PN066 7	5405	1558	79	-385	373	0.7	8424	540	33	12.25	1.25	28	0.28	0.33	0.81	10.59	0.57	10	57.8	-	39.2	-	4
InterMnt	WINTERWHEAT		2014-2016	LWW14 71032	5404	1558	80	-386	373	0.7	8423	540	34	12.25	1.25	29	0.28	0.33	0.81	10.59	0.57	11	60.2	-	43.8	-	5.5
InterMnt	WINTERWHEAT	SWW	2014-2016	ORI2101840	5395	1641	81	-395	632	0.78	-	-	-	12.14	1.33	36	0.17	0.57	0.89	-	-	-	53.5	29.3	32	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	LWW10 1018	5382	1558	82	-408	373	0.7	8401	540	36	11.96	1.25	49	0	0.33	0.99	10.31	0.57	21	59.3	42.8	36.8	-	2
InterMnt	WINTERWHEAT	SWW	2014-2016	WB 436	5355	1641	83	-435	632	0.77	-	-	-	11.72	1.33	70	-0.25	0.57	0.84	-	-	-	54.9	32	28.5	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	KASEBERG	5332	1539	84	-458	285	0.48	8116	540	39	11.6	1.23	80	-0.37	0.25	0.58	9.8	0.57	42	56	27.2	35.4	1	6
InterMnt	WINTERWHEAT	SWW	2014-2016	LOR 334	5324	1641	85	-466	632	0.77	-	-	-	12.29	1.33	24	0.33	0.57	0.84	-	-	-	47	25.4	33	1	1.3
InterMnt	WINTERWHEAT	SWW	2014-2016	ORCF 101	5315	1578	86	-475	446	0.7	-	-	-	13.04	1.27	5	1.07	0.4	0.08	-	-	-	51.2	29.2	32.8	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	YS 261	5277	1578	87	-513	446	0.68	-	-	-	12.54	1.27	16	0.57	0.4	0.58	-	-	-	50.9	29.3	33.5	1.3	1.7
InterMnt	WINTERWHEAT		2014-2016	ORLD112334	5261	1558	88	-529	373	0.54	8280	540	37	11.99	1.25	48	0.03	0.33	0.96	10.34	0.57	17	57.2	-	40.2	-	1
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2100267	5240	1641	89	-550	632	0.72	-	-	-	12.8	1.33	7	0.83	0.57	0.58	-	-	-	52.1	26.1	33	-	-
InterMnt	WINTERWHEAT	HRW	2014-2016	NORWEST 554	5230	1641	90	-560	632	0.72	-	-	-	12.25	1.33	27	0.28	0.57	0.84	-	-	-	56.1	26.1	29	-	-
InterMnt	WINTERWHEAT	SWW	2014-2016	WA 8169	5209	1641	91	-581	632	0.7	-	-	-	12.66	1.33	12	0.7	0.57	0.58	-	-	-	47.4	28.3	38.5	1	2.3
InterMnt	WINTERWHEAT	CLUB	2014-2016	CARA	5165	1641	92	-625	632	0.7	-	-	-	12.06	1.33	45	0.09	0.57	0.91	-	-	-	54.7	27.6	33.8	-	3.7
InterMnt	WINTERWHEAT	SWW	2014-2016	WB EXP 1028 CL+	5159	1641	93	-631	632	0.7	-	-	-	13.66	1.33	3	1.7	0.57	0.06	-	-	-	50.4	24	34	1	1
InterMnt	WINTERWHEAT	SWW	2014-2016	SY 71-4 EXP	5149	1641	94	-641	632	0.7	-	-	-	11.54	1.33	85	-0.42	0.57	0.82	-	-	-	49	27	35.5	1.3	2.3
InterMnt	WINTERWHEAT	HRW	2014-2016	WINCAL 09196	5094	1546	95	-696	319	0.3	8121	540	38	12.48	1.23	18	0.52	0.29	0.39	11.09	0.57	3	60.5	25.9	30.3	-	1
InterMnt	WINTERWHEAT		2014-2016	WA 8206	5026	1558	96	-763	373	0.3	8045	540	40	12.17	1.25	34	0.21	0.33	0.82	10.52	0.57	13	59.9	-	41.6	-	5.5
InterMnt	WINTERWHEAT		2014-2016	WA 8232	4885	1558	97	-904	373	0.2	7905	540	41	12.24	1.25	30	0.27	0.33	0.82	10.58	0.57	12	59.5	-	40.7	-	7
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2101043	4740	1546	98	-1049	321	0.02	7796	540	42	12.4	1.24	20	0.43	0.29	0.58	10.44	0.57	14	55.7	25.7	39.2	1	6
InterMnt	WINTERWHEAT	SWW	2014-2016	OR2080637	4714	1641	99	-1076	632	0.46	-	-	-	12.23	1.33	32	0.26	0.57	0.84	-	-	-	54.2	34.5	35	1	1.6
InterMnt	WINTERWHEAT	SWW	2014-2016	YAMHILL	3607	1546	100	-2182	321	0	6474	540	44	12.67	1.24	10	0.7	0.29	0.15	10.8	0.57	4	57.3	35.1	42.8	4.3	6.3
InterMnt	WINTERWHEAT		2014-2016	20060126 35C	3489	1558	101	-2301	373	0	6508	540	43	12.42	1.25	19	0.45	0.33	0.58	10.76	0.57	5	60.4	-	43.7	-	6.5
InterMnt	WINTERWHEAT		2014-2016	WINCORA	3118	1558	102	-2672	373	0	6137	540	45	14.27	1.25	1	2.31	0.33	0	12.62	0.57	1	62	-	31.2	-	1
InterMnt	WINTERWHEAT		2014-2016	VERDANT	2854	1567	103	-2935	406	0	5863	571	46	14.17	1.26	2	2.2	0.36	0	12.51	0.58	2	52	-	47.7	-	5.6

Table 4. Spring barley yield and agronomic traits from UC trials in Intermountain region locations from 2014-2016.

					Yield									Agronomic traits				
Region/Group	**Crop 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**	**2016 Yield (lb/acre)**	**2016 St.Err.Yield (lb/acre)**	**2016 Yield Rank**	**Test Wt (lb/bu)**	**1000 Kernel Wt (g)**	**Plant Ht (in)**	**Lodging @ soft dough, 90th%tile**	**Lodging @ harvest, 90th%tile**
InterMnt	BARLEY	6RSF	2014-2016	UC 1337	6703	434	1	2903	309	0	7477	337	2	51.7	-	43.2	-	5.7
InterMnt	BARLEY		2014-2016	UC 1278	5630	434	2	1830	309	0	6404	337	3	51	-	45	-	3.7
InterMnt	BARLEY	6RSF	2014-2016	UC 1341	5503	360	3	1703	204	0	7532	337	1	46.5	37	34.1	5.3	6.3
InterMnt	BARLEY	2RSF	2014-2016	BZ509 216	5047	676	4	1247	600	0.19	-	-	-	52.8	42.7	31	-	1.3
InterMnt	BARLEY		2014-2016	UTSB10905 72	4953	434	5	1153	309	0	5727	337	5	51.7	-	43.5	-	6.7
InterMnt	BARLEY		2014-2016	BUTTA 12	4903	434	6	1103	309	0.01	5677	337	6	53.1	-	38.8	-	6.7
InterMnt	BARLEY	2RSM	2014-2016	2AB08 X05M010-82	4687	676	7	887	600	0.46	-	-	-	52	39.5	33	-	6.7
InterMnt	BARLEY	6RSF	2014-2016	UC 1365	4662	360	8	862	204	0	5902	337	4	48.4	34.9	37.2	4.7	7
InterMnt	BARLEY	2RSF	2014-2016	10WA 106 19	4627	676	9	827	600	0.5	-	-	-	52.9	46.5	28	-	1.7
InterMnt	BARLEY		2014-2016	11WA 107 20	4515	434	10	715	309	0.14	5290	337	8	51.2	-	44.5	-	7
InterMnt	BARLEY	2RSF	2014-2016	10WA 113 16	4407	676	11	607	600	0.72	-	-	-	52	42.9	22	-	3
InterMnt	BARLEY	6RSF	2014-2016	MILLENNIUM	4403	401	12	603	275	0.17	-	-	-	47.6	37.3	31.7	1.3	1.3
InterMnt	BARLEY	2RSM	2014-2016	2AB07 X031098 31	4347	676	13	547	600	0.76	-	-	-	54.5	41.8	31	-	6.3
InterMnt	BARLEY	2RSF	2014-2016	09WA 203 24	4347	676	14	547	600	0.76	-	-	-	53.6	43.6	31	-	5.3
InterMnt	BARLEY	2RSM	2014-2016	2ND28065	4336	409	15	536	274	0.21	5260	337	9	53.3	41.9	38.7	-	6.8
InterMnt	BARLEY	2RSM	2014-2016	2AB07 X04M219-46	4307	676	16	507	600	0.78	-	-	-	51.6	37.8	33.5	-	7.2
InterMnt	BARLEY	2RSM	2014-2016	2B09 3425	4217	676	17	417	600	0.79	-	-	-	50.9	38.6	30	-	6.2
InterMnt	BARLEY	2RSF	2014-2016	10WA 105 33	4217	676	18	417	600	0.79	-	-	-	52.1	42.2	24	-	1.3
InterMnt	BARLEY	6RSF	2014-2016	UC 10B	4209	401	19	409	275	0.46	-	-	-	47.3	37.2	32.4	3.7	5.6
InterMnt	BARLEY	2RSM	2014-2016	MERIT 57	4195	401	20	395	275	0.47	-	-	-	48.8	37.8	32.8	3	6.3
InterMnt	BARLEY	2RSF	2014-2016	BARONESSE	4191	354	21	391	193	0.19	4856	337	12	50.4	40.1	33.8	6	7
InterMnt	BARLEY		2014-2016	FULL PINT	4170	390	22	370	252	0.46	5363	337	7	50.8	48	31.5	-	6.5
InterMnt	BARLEY	6RSF	2014-2016	STEPTOE	4169	354	23	369	193	0.22	4989	337	10	47.7	41.7	35.6	5.3	5
InterMnt	BARLEY		2014-2016	08ARS116 91	4114	434	24	315	309	0.72	4889	337	11	51.4	-	41	-	7
InterMnt	BARLEY	2RSM	2014-2016	2AB04 X01084 27	4067	676	25	267	600	0.82	-	-	-	51.3	42.4	24	-	3
InterMnt	BARLEY		2014-2016	BZ509 601	4037	434	26	237	309	0.79	4812	337	13	52.8	-	40.2	-	7
InterMnt	BARLEY		2014-2016	UTSB10902 91	4026	434	27	226	309	0.79	4800	337	14	48.3	-	42.8	-	7
InterMnt	BARLEY	2RSF	2014-2016	11MQ71	4009	434	28	209	309	0.79	4783	337	15	52.3	-	44	-	3.4
InterMnt	BARLEY	2RSF	2014-2016	09WA 228 13	4007	676	29	207	600	0.87	-	-	-	54	44.3	32.5	-	5.6
InterMnt	BARLEY		2014-2016	MT124555	3997	434	30	197	309	0.79	4771	337	16	53	-	44.5	-	6
InterMnt	BARLEY		2014-2016	MT090182	3953	434	31	153	309	0.82	4727	337	17	52	-	42	-	7
InterMnt	BARLEY	2RSF	2014-2016	MT100120	3928	409	32	129	274	0.82	4718	337	18	52.1	42	40.5	-	7
InterMnt	BARLEY	6RSF	2014-2016	UC 1393	3918	360	33	118	204	0.79	4414	337	26	47	39.8	37.9	5.7	7
InterMnt	BARLEY	6RSF	2014-2016	UC TL20	3915	401	34	115	275	0.84	-	-	-	46	36.7	32.6	7.3	4.5
InterMnt	BARLEY	2RSM	2014-2016	2ND27705	3907	676	35	107	600	0.91	-	-	-	51.9	41.8	35.5	-	6.3
InterMnt	BARLEY	2RSM	2014-2016	CONRAD	3875	401	36	75	275	0.91	-	-	-	49.5	39.1	32	6	7.9
InterMnt	BARLEY	6RSF	2014-2016	UC 1395	3865	401	37	65	275	0.91	-	-	-	46.4	35.7	33	6.3	5.9
InterMnt	BARLEY		2014-2016	08ARS112 75	3857	434	38	58	309	0.91	4632	337	19	51.2	-	41.5	-	7
InterMnt	BARLEY	2RSF	2014-2016	BZ509 448	3857	676	39	57	600	0.96	-	-	-	51.6	44.7	23	-	1
InterMnt	BARLEY		2014-2016	MT090190	3856	409	40	57	274	0.91	4581	337	21	52	40.5	38.7	-	7
InterMnt	BARLEY	2RSF	2014-2016	MT100126	3851	409	41	52	274	0.91	4582	337	20	51.6	39.8	40.3	-	7
InterMnt	BARLEY	2RSF	2014-2016	MT090180	3847	676	42	47	600	0.96	-	-	-	50.9	41.5	34.5	-	3.7
InterMnt	BARLEY	6RSF	2014-2016	UC 4B	3839	523	43	39	427	0.96	-	-	-	44.4	36.9	30.6	-	1.6
InterMnt	BARLEY	2RSM	2014-2016	2B10 4378	3784	409	44	-16	274	0.96	4452	337	24	51.2	41.4	36.4	-	7
InterMnt	BARLEY	2RSF	2014-2016	09WA 231 5	3767	676	45	-33	600	0.96	-	-	-	55.5	39.1	30.5	-	6.5
InterMnt	BARLEY	2RSM	2014-2016	PINNACLE	3731	401	46	-69	275	0.91	-	-	-	50.9	47.2	34	2.3	5.4

InterMnt	BARLEY		2014-2016	08ARS028 20	3726	434	47	-74	309	0.91	4500	337	23	52.3	-	39.5	-	6.7
InterMnt	BARLEY	6RSM	2014-2016	LEGACY	3722	460	48	-78	357	0.91	-	-	-	48.1	34.7	39	5.3	5.9
InterMnt	BARLEY	6RSM	2014-2016	RASMUSSON	3684	523	49	-116	427	0.91	-	-	-	50.2	38.6	32.1	-	6.5
InterMnt	BARLEY	2RSM	2014-2016	AC METCALFE	3681	354	50	-119	193	0.79	4568	337	22	50.9	39	38.2	6	7
InterMnt	BARLEY	6RSF	2014-2016	UC 1339	3677	401	51	-123	275	0.82	-	-	-	45.5	36.4	32.8	6.3	5.3
InterMnt	BARLEY		2014-2016	11WA 107 58	3659	434	52	-140	309	0.82	4434	337	25	51.8	-	42.8	-	7
InterMnt	BARLEY	6RSF	2014-2016	TLB 148	3634	523	53	-166	427	0.84	-	-	-	43.7	39.5	30.2	-	1.7
InterMnt	BARLEY	2RSM	2014-2016	2B11 4949	3634	409	54	-166	274	0.79	4160	337	29	50.4	40	36.8	-	6.6
InterMnt	BARLEY	2RSM	2014-2016	HARRINGTON	3630	368	55	-169	217	0.79	4244	337	27	50.6	41.6	37.3	6	8
InterMnt	BARLEY	6RSF	2014-2016	UC 960	3621	401	56	-179	275	0.79	-	-	-	45.8	38.3	28.3	3.3	3.5
InterMnt	BARLEY	6RSM	2014-2016	STELLAR ND	3601	401	57	-199	275	0.79	-	-	-	48.9	38.1	34	4.3	5.5
InterMnt	BARLEY	6RSF	2014-2016	UC 1377	3599	523	58	-201	427	0.82	-	-	-	51	42	29.3	-	3.2
InterMnt	BARLEY	6RSF H	2014-2016	UC 1396	3574	523	59	-226	427	0.81	-	-	-	49.7	37	26.5	-	1.3
InterMnt	BARLEY	2RSM	2014-2016	2B11 5166	3567	409	60	-233	274	0.78	4152	337	30	49.9	41.7	37.6	-	7
InterMnt	BARLEY	6RSM	2014-2016	CELEBRATION	3564	424	61	-236	305	0.79	-	-	-	48.9	35.3	34.3	6	5.2
InterMnt	BARLEY	2RSM	2014-2016	2ND30724	3557	676	62	-243	600	0.84	-	-	-	51.2	49.9	27	-	1.7
InterMnt	BARLEY	6RSF H	2014-2016	UC 1387	3549	523	63	-251	427	0.79	-	-	-	52	38	28	-	1.7
InterMnt	BARLEY	6RSF	2014-2016	UC 1372	3539	523	64	-261	427	0.79	-	-	-	48	38.5	30.1	-	3.5
InterMnt	BARLEY	2RSM	2014-2016	2B10 4162	3536	409	65	-264	274	0.74	4148	337	31	51.5	43.2	36.8	-	7
InterMnt	BARLEY	2RSM	2014-2016	UC 1390	3529	523	66	-271	427	0.79	-	-	-	52.4	53.1	25.5	-	1.3
InterMnt	BARLEY	6RSM	2014-2016	TRADITION	3529	460	67	-271	357	0.79	-	-	-	48.9	36.5	40.3	4.7	6.2
InterMnt	BARLEY	2RSM	2014-2016	UC 1335	3494	523	68	-306	427	0.79	-	-	-	50.9	45.2	27.4	-	2.8
InterMnt	BARLEY	6RSF	2014-2016	UT2136 96	3477	676	69	-323	600	0.81	-	-	-	49.3	34.5	26	-	1
InterMnt	BARLEY	2RSM	2014-2016	UC 1389	3474	523	70	-326	427	0.79	-	-	-	52.2	53.9	25.5	-	2.3
InterMnt	BARLEY	2RSF	2014-2016	10WA 106 18	3458	409	71	-342	274	0.54	4013	337	33	51.3	43.1	39.6	-	7
InterMnt	BARLEY	6RSF H	2014-2016	UC 1332	3457	401	72	-343	275	0.54	-	-	-	47.6	36	30.3	4.3	4.9
InterMnt	BARLEY	6RSF H	2014-2016	UC 1386	3429	523	73	-371	427	0.78	-	-	-	51	35.5	22.5	-	1
InterMnt	BARLEY	2RSF-H	2014-2016	2AB09 X06F084-51	3394	409	74	-406	274	0.46	3970	337	35	51.4	42.7	37.8	-	7
InterMnt	BARLEY		2014-2016	UC 1410/UC MP179	3389	434	75	-411	309	0.51	4163	337	28	49.3	-	34.5	-	7
InterMnt	BARLEY	6RSF	2014-2016	UC 1292	3389	523	76	-411	427	0.74	-	-	-	48.1	37.8	29.8	-	2.6
InterMnt	BARLEY		2014-2016	11WA 107 43	3358	434	77	-442	309	0.47	4132	337	32	51.2	-	39.8	-	7
InterMnt	BARLEY	2RSF	2014-2016	BZ502 265	3274	523	78	-526	427	0.54	-	-	-	49.8	39.4	31.2	-	4.6
InterMnt	BARLEY	2RSM	2014-2016	CDC COPELAND	3249	360	79	-550	204	0.06	3562	337	38	49.6	40.3	35.9	4.7	7.1
InterMnt	BARLEY	6RSM	2014-2016	QUEST	3247	401	80	-553	275	0.19	-	-	-	49.6	36.2	36.3	6.3	7.1
InterMnt	BARLEY	6RSF H	2014-2016	UC 1388	3244	523	81	-556	427	0.52	-	-	-	52.9	35.1	24.5	-	1.7
InterMnt	BARLEY	6RSF H	2014-2016	UC 1397	3234	523	82	-566	427	0.51	-	-	-	50	35.5	25	-	1.3
InterMnt	BARLEY	2RSF	2014-2016	10WA 117 17	3211	434	83	-588	309	0.22	3986	337	34	49.6	-	39	-	7
InterMnt	BARLEY		2014-2016	12WA 120 14	3126	434	84	-673	309	0.17	3901	337	36	51	-	40	-	7
InterMnt	BARLEY	6RSF	2014-2016	UT2183 85	3117	676	85	-683	600	0.62	-	-	-	50.1	37.8	28	-	1
InterMnt	BARLEY	2RSF	2014-2016	10WA 117 24	2971	434	86	-829	309	0.06	3745	337	37	49.8	-	39.5	-	7.7
InterMnt	BARLEY	2RSM	2014-2016	UC 1392	2934	523	87	-866	427	0.19	-	-	-	51	48.8	24.5	-	1.7
InterMnt	BARLEY	2RSM	2014-2016	UC 1398	2889	523	88	-911	427	0.18	-	-	-	51.8	46.1	27.5	-	2.3
InterMnt	BARLEY	2RSM	2014-2016	UC 1391	2839	523	89	-961	427	0.16	-	-	-	52.5	45.7	26.5	-	1
InterMnt	BARLEY		2014-2016	2B12 5582	2750	434	90	-1050	309	0.01	3524	337	39	48.6	-	40	-	7
InterMnt	BARLEY	2RSM	2014-2016	UC 1394	2644	523	91	-1156	427	0.06	-	-	-	50	45.4	28	-	2
InterMnt	BARLEY		2014-2016	2ND30837	2636	434	92	-1164	309	0	3410	337	40	48.6	-	42.8	-	7
InterMnt	BARLEY	2RSM	2014-2016	CONLON	2503	524	93	-1297	435	0.03	-	-	-	48.4	46.7	35.3	6.7	3.9
InterMnt	BARLEY	2RSF H	2014-2016	2AB09 X06F058HL-31	2430	409	94	-1370	274	0	3100	337	41	54.3	38	39	-	7

Comparison of Spring, Summer, and Fall-planted Cover Crops for Use in Organic Potato Production

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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 summarizes results for spring-planted, mid-summer planted, and fall planted cover crops grown in 2016. Data on the effects of cover crops and amendments will be available in fall 2017 when potatoes are harvested for yield and quality.

Methods: Five trials are being conducted at IREC in a 4.5 acre field with low residual soil nitrate. The field was planted to wheat in 2014 and sudangrass in 2015. The sudangrass did not receive fertilizer in 2015 to reduce soil nitrogen levels. Herbicides were applied in 2014 and 2015 to control weeds; No pesticides were applied in 2016. On April 1 2016, soil properties (0-10 inch soil depth) in the trials were: pH=6.4-6.8; EC=0.33-0.43mmho/cm; OM%=5.7-5.8; Olsen phosphorus= 51-62 ppm; potassium= 170-226 ppm; sulfate sulfur= 22-23 ppm; nitrate nitrogen= 7.5-11.2 ppm; ammonium nitrogen= 2.7-4.2 ppm. Treatments were arranged in a randomized complete block with four replications.

Planting date, harvest dates, and applied water for the cover crop trials are shown in Table 1. Cover crop seeding rates are shown in Table 2. Cover crops were drill seeded at ½ - ¾ inch depth using a research cone planter with 6-inch row spacing. The seeding depth worked well for all cover crops except arugula. The spring seeding of arugula was too deep for uniform emergence and spring arugula plots were reseeded at ¼ inch. Arugula was seeded in the fall trial at ¼ inch using the cone planter. Cover crops were grown until plants reached 50% to 100% flowering. They were then chopped with a flail mower and disked into the soil (green manure). Cover crop biomass yield was estimated in each plot by harvesting a 5ft by 10ft quadrat shortly before incorporation. Sub-samples were pulled from harvested biomass to estimate total nitrogen content and moisture content. Other data on cover crops included % stand, visual early- and mid-season vigor, visual weed suppression, and plant height. Soil samples were collected from select cover crop treatments at the time of planting, in fall 2016, and spring 2017 to estimate plant available nitrogen at 0-10 inches and 10-20 inches.

Potatoes were planted in June 2017 and will be harvested in early October 2017. Data collected in 2017 will assess treatment effects on potato yield, potato quality, soil nutrients, and potato petiole nitrate. Differences in weed, insect, and disease pressure will also be evaluated.

Results:

Table 1. Planting and Harvest Dates and Applied Water for Spring Dryland (SD), Spring Irrigated (SI), and Mid-summer irrigated (MSI), & Fall Irrigated (FI) trials.

	Spring Dryland (SD)	Spring irrigated (SI)	Mid-summer irrigated (MSI)[1]	Fall irrigated (FI)
Planting Date:	4/8/16	4/20/16	7/27/16	9/13/16
Total Applied Water (precipitation + irrigation)	4.38 inches	11.74 inches	6.2 inches	3.4 inches
Harvest Date:	6/21/16	6/30/16 & 7-6-16	10/11/16	5/2/17
Days to harvest:	74	71 [1] or 77	76	231

[1] Vetch, mustard, radish , arugula and all mixes were harvested 71 days after planting. Field pea and wheat were harvested 77 days after planting

Table 2. Cover Crop Seeding Rates

Cover Crop	Seeding Rate
Grasses	
Twin spring wheat	70 lbs/a
SX 17 sorghum sudangrass	30 lbs/a
Trical 141 spring triticale	90 lbs/a
Legumes	
Cowpea	40 lbs/a
Flex spring field pea	10 seed/ft^2
Lana woollypod vetch	60 lbs/a
Nutrigreen winter field pea	10 seed/ft^2
Mustards	
Caliente 199 mustard	10 lbs/a
Nemat arugula	6 lbs/a
Radish	
Defender oilseed radish	15 lbs/a

Cover Crop	Seeding Rate
50/50 Mixes	
Arugula & spring field pea	
Nemat arugula	3 lbs/a
Flex spring field pea	5 seed/ft^2
Mustard & spring field pea	
Caliente 199 mustard	5 lbs/a
Flex spring field pea	5 seed/ft^2
Radish & spring field pea	
Defender oilseed radish	7.5 lbs/a
Flex spring field pea	5 seed/ft^2
Mustard & woolypod vetch	
Caliente 199 mustard	5 lbs/a
Lana woollypod vetch	30 lbs/a

Table 3. Cover Crop Stand, Vigor, and Weed Suppression.

Cover crop	Stand[1]			Early Season Vigor[2]			Late Season Vigor			Weed Suppression[3]		
	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI
	%			1-10; 10=most vigorous						1-10; 10=best		
Grasses												
Twin" spring wheat	86	90	-[4]	8.9a[5]	8.4a	-	8.4ab	7.9a	-	8.0ab	7.0a	-
SX17 sorghum sudangrass	-	-	89	-	-	7.6bc	-	-	0.0g	-	-	5.0c
Trical 141 spring triticale	-	-	90	-	-	7.0cd	-	-	5.8ef	-	-	4.8c
Legumes												
Cowpea	-	-	73	-	-	5.0e	-	-	0.0g	-	-	2.8d
Flex spring field pea	80	81	83	8.4a	7.0b	7.4bc	8.9ab	7.1bc	8.6a	8.0ab	7.0a	8.5a
Lana woollypod vetch	79	89	89	8.5a	8.0a	7.0cd	9.0ab	8.0ab	7.5bc	8.5ab	7.3a	8.0ab
Nutrigreen winter field pea	-	-	79	-	-	6.3d	-	-	7.0cd	-	-	7.0b
Mustards												
Caliente 199 mustard	80	89	94	7.0b	6.6b	7.1bcd	8.1bc	7.1c	6.5de	7.5b	7.0a	8.8a
Nemat arugula	49	31	-	5.8c	4.8c	-	6.3d	5.8d	-	6.5c	5.0c	-
Radish												
Defender oilseed radish	-	89	93	-	8.0a	8.1ab	-	7.9abc	5.0f	-	7.3a	8.5a
50/50 Mixes												
Arugula & spring field pea	40 & 30	38 & 21	-	6.9b	6.8b	-	7.6c	6.0d	-	7.8ab	6.0b	-
Mustard & spring field pea	-	35 & 45	70 & 50	-	7.0b	7.9abc	-	7.3abc	8.3ab	-	6.9a	9.0a
Radish & spring field pea	-	-	73 & 54	-	-	8.6a	-	-	7.8bc	-	-	8.8a
Mustard & woolypod vetch	-	-	73 & 61	-	-	7.6abc	-	-	7.8bc	-	-	9.0a

[1] % Stand was a visual estimation of plant density in drill rows in the plot.

[2] Vigor was a visual estimation of plant growth in the plot. Taken roughly 1 month after planting for early season, and 2 weeks prior to harvest for late season.

[3] Weed suppression was a visual estimation of weed denisty and growth in the plot. 10= best suppression and lowest weed density.

[4] - = species were not included in the trial

[5] Means were compared using Tukey's HSD test. Means with the same letter are not statistically different. Means can be compared within columns.

Table 4. Cover Crop Height, Biomass, Nitrogen content, and Incorporated Nitrogen in Green Manure at the Time of Incorporation.

Cover crop	Plant height			Crop biomass			Nitrogen content in green manure			Incorporated nitrogen in green manure		
	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI
	inches			ton/acre[1]			% total N			lbs N/acre[2]		
Grasses												
Twin spring wheat	31	34	-[3]	2.6a[4]	2.9ab	-	1.7c	1.6e	-	88c	93d	-
SX17 sorghum sudangrass	-	-	17	-	-	0.6de	-	-	2.2ef	-	-	24d
Trical 141 spring triticale	-	-	13	-	-	0.4de	-	-	1.7fg	-	-	14d
Legumes												
Cowpea	-	-	4	-	-	0.1e	-	-	3.4bc	-	-	4d
Flex spring field pea	40	48	28	2.6a	3.4a	2.2ab	4.6a	4.5ab	4.1ab	243a	306a	176b
Lana woollypod vetch	34	43	26	2.1ab	1.9cd	2.4a	4.7a	5.3a	4.6a	196b	205b	222a
Nutrigreen winter field pea	-	-	21	-	-	1.6c	-	-	4.5a	-	-	148bc
Mustards												
Caliente 199 mustard	48	57	27	2.0b	2.3bcd	0.8de	2.3bc	2.1de	1.2g	93c	95d	19d
Nemat arugula	32	40	-	1.8b	1.6d	-	2.9b	3.2cd	-	108c	98d	-
Radish												
Defender oilseed radish	-	55	5	-	2.7abc	0.4de	-	2.1e	1.6fg	-	110cd	12d
50/50 Mixes												
Arugula & spring field pea	38*	39 & 42	N/A	2.6a	1.8d	-	4.4a	5.0ab	-	205ab	178bc	-
Mustard & spring field pea	-	57 & 45	38 & 29	-	2.2bcd	2.0abc	-	4.2bc	2.6de	-	187b	99c
Radish & spring field pea	-	-	10 & 26	-	-	1.7bc	-	-	3.2cd	-	-	112c
Mustard & woolypod vetch	-	-	37 & 28	-	-	2.3ab	-	-	3.3cd	-	-	150bc

[1] Biomass yield was determined by harvesting a 5ft by 10ft quadrat in each plot.

[2] Added lbs N/A was calculated by multiplying the above ground biomass yield by the % nitrogen of the biomass. The calculation does not take into account the small amount of nitrogen in below ground cover crop roots.

[3] - = species were not included in the trial

[4] Means were compared using Tukey's HSD test. Means with the same letter are not statistically different. Means can be compared within columns.

Table 5. Fall Irrigated Cover Crop Growth and Harvest Results

Cover crop	Stand[1]	Early Season Vigor[2]	Late Season Vigor	Weed Suppression	Plant Height	Crop Biomass	Nitrogen Content in Green Manure	Incorporated Nitrogen in Green Manure
	%	1-10; 10=most vigorous	1-10; 10=most vigorous	1-10; 10=best	inches	ton/acre	% total N	lbs N/acre
Grasses								
Trical 102 triticale	80	7	5.9	9.0	13	1.03c	1.32d	27c
Legumes								
Lana woollypod vetch	82	7	9.1	9.4	17	2.08a	4.71a	196a
Nutrigreen winter field pea	80	7.8	7.8	8.0	11	1.59b	4.83a	156a
Mustards								
Nemat arugula	83	6.5	6	8.5	14	0.69c	2.36c	33c
50/50 Mixes								
Triticale & winter field pea	45 & 45	8.1	7.4	9.0	15 & 12	1.58b	3.41b	107b
Triticale & woollypod vetch	46 & 45	8.2	9.4	9.5	19 & 19	2.26 a	4.23a	190a

Table 6. Mineralized Nitrogen in the Soil on October 10th for Select Cover Crops

Cover crop	0 to 10 inch soil depth									10 to 20 inch soil depth								
	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI	SD	SI	MSI
	NH_4-N			NO_3-N			Total mineral N[1]			NH_4-N			NO_3-N			Total mineral N[1]		
	ppm			ppm			ppm			ppm			ppm			ppm		
Trical 141 spring triticale	-[2]	-	.33b[3]	-		3.56b	-	-	3.89b	-	-	1.4	-	-	3.6b	-	-	4.9b
Lana woollypod vetch	-	0.4	1.07a	-	64.6a	4.49b	-	65a	5.56b	-	1.1	1.5	-	30.1a	3.7b	-	31.2a	5.2b
Caliente 199 mustard	-	0.2	.11b	-	27.6c	3.29b	-	27.8c	3.4b	-	0.5	1.4	-	15.2c	2.9b	-	15.8c	4.2b
50/50 mix mustard & spring field pea	-	0.2	.34b	-	44.6b	2.55b	-	44.8b	2.89b	-	0.5	0.8	-	22.8b	2.8b	-	23.3b	3.6b
Fallow	0.21	0.1	.63ab	34.38	39.7b	14.36a	34.59	39.9b	14.99a	0.8	0.6	1.3	33.5	29.3a	13.9a	34.3	29.8a	15.2a

[1] Total mineral N = ammonium + nitrate.

[2] - = Species was not included in the trial.

[3] Means comparsions used Tukey's HSD test. Means with the same letter are not significantly different. Means can be compared within columns.

Table 7. Calculated Pounds of Mineralized Nitrogen Per Acre on October 10th for Select Cover Crops.

Cover crop	Mineralized nitrogen 0 to 20 inch soil depth		
	SD	SI	MSI
	lbs N/acre		
Trical 141 spring triticale	-[1]	-	37b[2]
Lana woollypod vetch	-	399a	45b
Caliente 199 mustard	-	181c	32b
50/50 mix mustard & spring field pea	-	283b	27b
Fallow	286	290b	125a

[1] - = Species was not included in the trial.

[2] Means comparsions used Tukey's HSD test. Means with the same letter are not significantly different. Means can be compared within columns.

Table 8. 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 9. 2017 Potato Stand for Cover Crop and Amendment Treatments

Treatment	Potato Stand			
	SD [1]	SI	MSI	FI
	% stand			
Fallow				
weed controlled with tillage	86a	88a	84a	82a
Conventional N Fertilizer				
75 lbs N/A at planting	89a	88a	85a	*
150 lbs N/A at planting	92a	87a	89a	88a
225 lbs N/A at planting	*	85a	88a	*
Manures and Amendments				
wheat & fall chicken manure	* [2]	89a	87a	*
wheat & fall compost	*	89a	*	*
wheat & fall steer manure	*	88a	*	*
wheat & April chicken manure	*	91a	*	81a
wheat & May chicken manure	*	84a	*	*
Grasses				
Twin" spring wheat	89a	89a	*	*
SX17 sorghum sudangrass	*	*	88a	*
Trical 141 spring triticale	*	*	85a	*
Trical 102 winter triticale	*	*	*	92a
Legumes				
Cowpea	*	*	88a	*
Flex spring field pea	89a	88a	92a	*
Lana woollypod vetch	90a	90a	88a	87a
Nutrigreen winter field pea	*	*	87a	91a
Mustards				
Caliente 199 mustard	84a	88a	88a	*
Nemat arugula	88a	89a	*	
Mustard & fall chicken manure	*	89a	*	*
Fall chicken manure & arugula	*	*	*	89a
Radish				
Defender oilseed radish	*	90a	86a	*
50/50 Mixes				
Arugula & spring field pea	91a	85a	*	*
Mustard & spring field pea	*	84a	85a	*
Radish & spring field pea	*	*	86a	*
Mustard & woolypod vetch	*	*	87a	*
Triticale & winter field pea	*	*	*	86a
Triticale & woolypod vetch	*	*	*	89a

[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.

Protecting Onions from Seed Corn 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 of tillage in these conditions. 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, as surface residues in no-till corn and soybean do not attract large populations of egg-laying flies.

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 in onions is prevention! There are no rescue insecticide options for maggot after 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.

Methods: Studies are being 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 are present at the study sites with seed corn maggot being the dominant pest. Insecticide efficacy will be 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 is the performance of several seed treatment options. A smaller study is being conducted at IREC to determine if the duration between initial tillage and onion planting influences maggot pressure and resulting onion stands. The primary study goal is to determine if delaying onion planting three to four weeks after planting significantly decreases onion loss from maggots.

Results: Seed treatment with spinosad (FarMore OI100 and FI500) or clothianidin (Sepresto) have been the most effective insecticide option for minimizing onion stand loss from maggots in previous studies. Onions treated with either seed treatment had a higher onion plant population compared to chlorpyrifos applied at the maximum labeled rate in-furrow.
Treating seed with FarMore OI100, FarMore FI500 or Sepresto is more expensive than applying chlorpyrifos in-furrow, but the improved maggot suppression and higher onion yield obtained from seed treatment compared to chlorpyrifos usually covers the additional cost of seed treatment, especially in fields with heavy maggot pressure. Applying chlorpyrifos in combination with seed treatment did not improve onion stands compared to using seed treatment alone, thus growers can save money by forgoing chlorpyrifos use when using treated seed.

Preliminary results from the 2017 studies are presented in Tables 1 and 2. A final report including onion stand and yield at harvest will be available this fall.

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

Trt#	Treatment	Seed Coating	IREC Site	Grower Site	Average Across Sites
			Onions per bed ft		
14	FarMore OI100 + Thiram	filmcoat	20.42 a	23.76 a	22.09
12	FarMore OI100 (no fungicide package)	filmcoat	19.77 abc	22.96 ab	21.37
6	FarMore FI500	full size-pellet	19.83 ab	22.28 abc	21.06
5	FarMore FI500	encrustment	19.85 a	22.04 abc	20.95
4	FarMore OI100 + FarMore 300	full size-pellet	18.46 abcd	22.88 ab	20.67
17	FarMore OI100 + FarMore 300 & Fontelis & Capture in-furrow	encrustment	18.88 abcd	22.44 abc	20.66
16	FarMore OI100 + FarMore 300 & Fontelis at 24 fl. oz/A in-furrow	encrustment	18.48 abcd	22.28 abc	20.38
8	Sepresto 75WS + FarMore 300	full size-pellet	19.48 abc	20.60 bc	20.04
10	FarMore OI100 (no fungicide package)	pellet	18.10 abcd	21.16 abc	19.63
13	FarMore OI100 + FarMore 300 + ProGro	encrustment	17.50 abcd	21.64 abc	19.57
7	Sepresto 75WS + FarMore 300	encrustment	18.08 abcd	21.00 abc	19.54
3	FarMore OI100 + FarMore 300	encrustment	17.73 abcd	20.24 bc	18.98
11	FarMore OI100 (no fungicide package)	encrustment	17.65 abcd	19.84 bc	18.74
19	FarMore OI100 + ProGro + Bacillus	encrustment	16.33 abcd	20.72 abc	18.53
15	FarMore 300 & Capture LFR (bifenthrin) at 8.5 fl. oz/A in-furrow	encrustment	15.19 de	21.36 abc	18.27
18	FarMore 300 and Bacillus	encrustment	15.67 bcde	20.56 bc	18.11
9	Trigard + FarMore 300	pellet	15.60 cde	20.52 bc	18.06
2	FarMore 300 (no insecticide control)	full size-pellet	15.69 bcde	20.20 bc	17.94
1	FarMore 300 (no insecticide control)	encrustment	12.04 e	19.68 c	15.86

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

Table 2. Influence of Onion Planting Date on Onion Stands at IREC in 2017

		Sepresto seed	Untreated seed	Average across seed
Trt #	Time of Planting Treatment	—— 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).

UC Alfalfa Cultivar Testing….

Does Variety Selection Make Any Difference?

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

See: http://alfalfa.ucdavis.edu for current variety information

What about Economics? It's actually a little difficult to determine whether variety selection makes an economic difference just by looking at a variety in a large field. Likewise, it cannot be assessed at a given point in time (a single cut) in a variety trial. Alfalfa varieties look almost identical in the field. However, looking at data over time reveals significant genetic differences in yield as well as gross revenue. This can make a significant difference in profitability to the produce, due simply to variety choice.

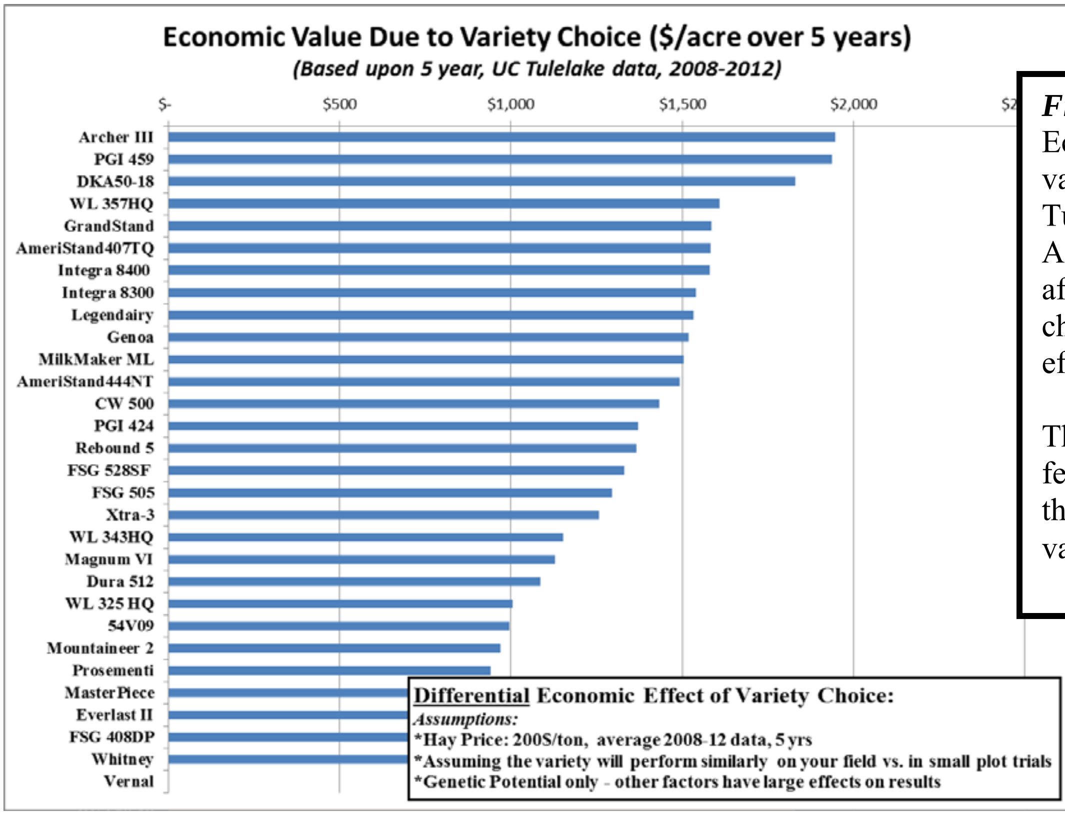
Here is the analysis. The differences in performance among varieties provide an idea of the economic return associated with variety selection (Figures 1 & 2). The maximum differences between varieties in seed costs might be $75/acre (e.g. the lowest cost seed might be $2.50 and the highest cost $5.50/lb at 25 lb./a, not counting biotech traits, which is a different calculation). This difference in seed cost is typically easily paid for with higher performance, often in the first production year. This yield improvement is in addition to other characteristics like pest resistance or quality.

What are the most important Characteristics of an Alfalfa Variety??

I. Fall Dormancy effects:

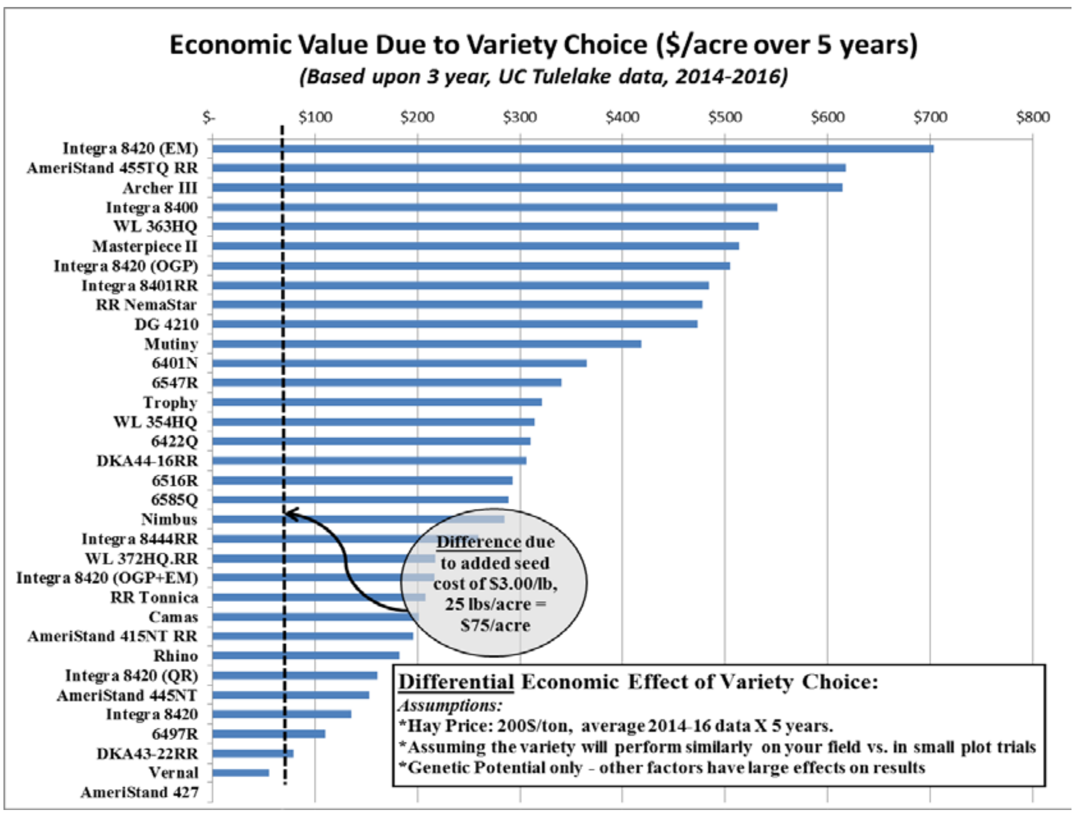
- **Yield**
- **Quality**
- **Persistence (hardiness)**
- **Flooding tolerance**

Recommendation—range is likely 3-5, but take into account soil type, harvest schedules. Consider a diversity of FD for harvest schedules. Can't harvest all fields at the same time and it may be advantageous to have more fall dormant varieties for the fields cut last in the cycle.



Figures 1 & 2. 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..



II. Yield Potential.

Varieties may vary from a small amount to a lot in yield. However, do you KNOW whether the variety limits your yield in a large field? A good starting point is to use university data, followed by your own strip trials on-farm:

2014-2016 YIELDS, TULELAKE ALFALFA CULTIVAR TRIAL. TRIAL PLANTED 8/21/13

		2014 Yield		2015 Yield		2016 Yield		Average		Significance groups
	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.

III. Pest Resistance. An alfalfa variety is a 'population' consisting of a range of plant types in a single variety. Thus, alfalfa varieties typically have more variation within a variety than most other crop plants – both an advantage and a disadvantage. Thus, when a variety has a high level of resistance to a pest, it's not 100%, but >51% of the plants that are resistant.

Resistance Abbreviations		Percent resistance[1]
HR	Highly Resistant	>51%
R	Resistant	31-50%
MR	Moderately Resistant	15-30%
LR	Low Resistant	6-14%
S	Susceptible	<5%

General Minimum Recommendations for Intermountain Area:

Fall Dormancy:	3-5 Rating
Winter Survival	2
Spotted Alfalfa Aphid (SAA):	S
Pea Aphid (PA)	R-HR*
Blue Alfalfa Aphid (BAA):	R-HR*
Pythopthora Root Rot (PRR).	R
Bacterial Wilt (BW):	R
Fusarium Wilt (FW):	HR
Stem Nematode:	HR
N. Root Knot Nematode:	R
Verticillium Wilt (VW)	R-HR

****Higher resistance is likely necessary in Klamath Basin and Lassen Co., less so in parts of central and W. Siskiyou Co. Yellow shading indicates the typically most important traits.***

REMEMBER:

- *Resistance is not absolute (described by % of plants in a population)*
- *Even highly resistant varieties can be overwhelmed by a pest (example is stem nematode).*
- *Pest Resistance is often the <u>only</u> economic measure against some pests.*
- *Think of Pest Resistance as you do auto insurance—not important every year, but can be very important in those years with severe pest pressure.*

IV. Biotech Traits – The most widely-used biotech trait is currently glyphosate resistance (Roundup Ready). A second biotech trait is reduced lignin (HarvXtra®) which confers lower lignin, higher digestibility, and greater flexibility: Are either of these right for you?

Roundup Ready Trait considerations:

- Your current weed pressure & control strategy success—
- Can you justify the cost? (compare Roundup strategy vs. conventional weed control costs, not just variety cost)
- Do you have Roundup-resistant weeds? Weed shifts?
- Should use mixed strategy of occasional conventional residual herbicide with Roundup for hard-to-control weeds and to prevent weed shifts/resistance
- Do your markets accept GE crops? (organic, no – export, currently mostly no, but may change soon)
- Coexistence with neighbors – don't impact neighbors who may be sensitive to GE traits.

HarvXtra Trait Considerations:

- Approved in 2014.
- Data shows that HarvXtra train may confer higher quality at a similar harvest schedule, or may allow delay of harvest while maintaining quality.
- Mostly dormant varieties are currently available (FD 3-4), but some FD 5-8 coming.
- *HarvXtra* (FGI International) which is genetically engineered are distinct from the *Hi-Gest* lines (Alforex, Dow AgroSciences), which are non-GM
- **LOOK AT COMPARITIVE DATA** – e.g. from the 2016 California Alfalfa Symposium where both companies presented their products. See Powerpoints at: http://alfalfa.ucdavis.edu/+symposium/2016/index.aspx - not all 'low lignin' products are the same.
- Will your markets reward quality? As measured?
- Cost/benefit – impacts on yield as well as quality?
- Will your market accept GE traits (organic, no, exports currently no)

V. Forage Quality. Even without *HarvXtra* trait, varieties differ to some degree in forage quality. Forage quality is of great importance in a low-price year, such as 2015-17, but tends to be less important to growers in a high price year. Remember:

- Yields are more important economically than quality, even in down years
- More dormant varieties generally higher in quality than non-dormant lines.
- Cutting schedules are a much more powerful method to impact quality than variety.
- In general, it is probably better to choose varieties first for yield and pest resistance characteristics, biotech traits, then consider relative quality.

Cutting Schedule Effects on Reduced Lignin and Conventional Alfalfa

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The *Yield/Quality Tradeoff* in alfalfa is well known and is the scourge of the alfalfa grower. As the alfalfa plant matures yield increases but forage quality decreases. Much of the yield increase and quality decrease with advancing maturity is attributed to increased stem yields. Stems are not nearly as nutritious and digestible as leaf material. An increase in stem yield increases the concentration of lignified cell wall material in the whole plant and greatly reduces digestibility. Growers seek to find the best balance to maximize profits but this is difficult to achieve. In recent years the price premium for quality hay has been greater than we have ever seen. In fact, last year in California there were times when *Supreme* quality sold for twice that of *Fair* quality alfalfa. This provides a significant incentive for alfalfa growers to produce high quality alfalfa but yield suffers as a consequence. Past efforts to improve the forage quality of alfalfa through plant breeding have only had moderate success. For example, multi-leaflet alfalfa varieties (with more than three leaflets per leaf) were promoted at one time, but oftentimes did not result in a significant increase in leaf:stem ratio and a measurable improvement in forage quality. However, a new trait, reduced lignin, shows promise for a dramatic enhancement in the nutritive value of alfalfa.

Lignin is a structural component of the cell wall. It is analogous to the rebar in a concrete building strengthening the plant and allowing the vascular system of the plant to transport water without leakage. The drawback with lignin is that it is indigestible and reduces the ability of ruminant animals to digest fiber. This is because lignin molecules fill the spaces between the cellulose, hemicellulose and pectins in the cell wall, and as the plant matures it binds to the cellulose. This then reduces digestion of the cellulose in the rumen. Lignin content of alfalfa increases greatly with advancing alfalfa maturity.

Reduced Lignin Cultivar Development

In a collaborative effort scientists at Forage Genetics International, The Samuel Robert Noble Foundation and U.S. Dairy Forage Research Center altered the lignin content in alfalfa through genetic modification, resulting in the recent commercial release of the HarvXtra® alfalfa. Alfalfa breeders at Alforex Seeds used conventional breeding to select for reduced lignin and released Hi-Gest alfalfa varieties. Both HarvXtra and Hi-Gest alfalfa varieties are now commercially available in the marketplace.

Previous and Current Research with Reduced Lignin Alfalfa

We have conducted several years of research at the UC Intermountain Research and Extension Center (IREC), Davis and other parts of the country to evaluate reduced lignin alfalfa and quantify the potential benefits. The new trial planted this spring is now the fourth trial we have conducted at IREC with reduced lignin alfalfa. The trials we have conducted at IREC are listed below in chronological order.

1. Single year spaced planting with early germplasm and plots hand-clipped

2. 2 year trial evaluating four advanced reduced lignin lines compared with four standard varieties under two cutting regimes (an ***Early*** cutting regime with 4 cuts per year and a ***Late*** cutting regime with 3 cuts per year). Trials at IREC and Davis.
3. Field trials were established in six states (CA, KS, MI, OH, PA, WI) in spring 2015 to evaluate yield and nutritive value over time of the genetically engineered HarvXtra-008 alfalfa compared with conventional varieties. **Experiment A:** Hand clipped in spring, summer and fall on day 20, 23, 27, 30, 34, and 37 of regrowth from the previous harvest. PA and CA trials included Hi-Gest. **Experiment B:** Compare alfalfa yield and quality for alfalfa cut on 28-day, 33-day, and 38-day cutting intervals.
4. New trial planted in this spring. Varieties include a High Yielding conventional check (Pioneer 54QR04), a High Quality conventional check (WL356HQ.RR), two experimental HarvXtra cultivars, Hi-Gest 360, and a 3 Fall Dormancy check cultivar NexGrow 6305Q. There will be two cutting schedules (28- and 35-day).

Results with Reduced-Lignin Alfalfa

Research conducted at IREC and other locations in the US have clearly demonstrated some of the advantages of reduced-lignin alfalfa. These alfalfa lines have consistently had higher fiber digestibility— lower Acid Detergent Lignin (ADL) and significantly higher Neutral Detergent Fiber Digestibility (NDFD). We found no difference in yield between the reduced lignin and standard alfalfa varieties in the trial at Tulelake but a slight yield reduction has been observed at other locations.

Results in the Second Trial mentioned above showed that averaged over all four alfalfa varieties of each type (standard and low lignin), there was no statistical difference in Crude Protein (CP), Acid Detergent Fiber (ADF which is used to calculate TDN), or Neutral Detergent Fiber (NDF). However, there was a dramatic improvement in lignin concentration (ADL or Acid Detergent Lignin) and Neutral Detergent Fiber Digestibility (NDFD). The lignin concentration for the late-cut reduced lignin varieties on average was the same as the standard varieties cut on the four cut-schedule. And, the NDFD percentage (higher is better) was actually higher for the reduced lignin varieties cut on the *Late* schedule than the standard varieties cut on the *Early* cutting schedule. Expressed as a percentage, the reduced lignin varieties resulted in 17.2 percent decrease in lignin concentration and an 8.5 percent improvement in NDFD.

The results of the multi-state trial (Trial 3 above) were very encouraging. There is significant power and confidence when results can be analyzed over so many locations (6 states) and the results are similar. HarvXtra-008 was consistently higher in nutritive value compared with the other two conventional varieties (lower ADL and NDF, higher NDFD, RFQ and CP).

Table 1. Forage nutritive value of three alfalfa varieties averaged of six sampling dates and two growth cycles (summer and fall) in the establishment year (6-state average).

Variety	ADL %	NDFD %	NDF %	RFQ	CP %
HarvXtra-008	4.0 b	55.5 a	26.7 c	297 a	26.4 a
WL 355 RR	4.9 a	51.0 b	28.7	262 b	25.8 b
54RO2	5.0 a	50.1 b	30.5	243 c	25.0 c
	19%	+9%		+13%	
		+11%		+22%	

Values followed by the same letters are not significantly different at *P*=0.05

As expected, forage quality declined for all varieties as the number of days since the last cutting increased from 20 to 37 days (Figure 1). In terms of NDFD, HarvXtra-008 maintained about a 10-day advantage over the other two varieties tested. For example, the NDFD of HarvXtra-008 was approximately the same on day 37 after the last cut as the other two varieties on day 27. Although forage quality did not decline as rapidly for the fall cutting time period, there was still approximately a 10-day difference in forage quality (HarvXtra had the same NDFD as the other two varieties 10 days later).

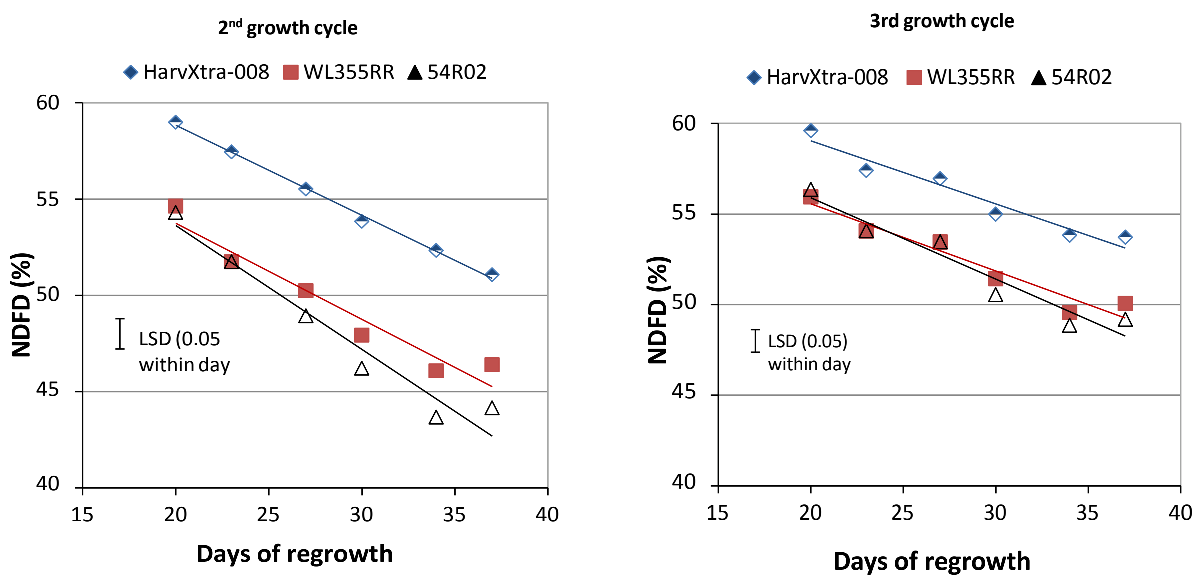


Figure 1. NDFD of three alfalfa cultivars in 2nd and 3rd growth cycle (summer and fall) in 2015 (6 location average)

The variety Hi-Gest 360 was only planted at two of the trial locations (the trial at IREC and the trial in Pennsylvania). Hi-Gest 360 was lower in nutritive value compared with HarvXtra-008 (Table 2) for most forage quality parameters. The lignin content of HarvXtra-008 was 12.5% less than that of Hi-Gest 360 and 17.3% lower than the other two varieties (Table 2). The ranking of the varieties was consistent across all 12 sampling dates.

Table 2. Forage nutritive value of four alfalfa varieties averaged of six sampling dates and two growth cycles (summer and fall) in the establishment year (CA and PA only).

Variety	ADL %	NDFD %	NDF %	RFQ	CP %
HarvXtra-008	4.2 b	56.2 a	27.3 c	284 a	26.2 a
Hi-Gest 360	4.8 a	52.5 b	28.3 bc	265 ab	26.0 a
WL 355 RR	5.0 a	51.5 b	29.1 b	254 bc	25.8 a
54RO2	5.1 a	50.7 b	30.7 a	237 c	24.9 a

Values followed by the same letters are not significantly different at *P*=0.05.

The results of Experiment B (Harvest Schedule Trial) confirmed the results of the first experiment. HarvXtra had lower ADL than the other two varieties across sites, cutting schedules and cuttings. NDFD and RFQ were both greater for HarvXtra-008 than for the other two varieties. HarvXtra-008 cut on a 38-day interval had equivalent or better forage quality values for ADL, RFQ, NDF, and NDFD than the other varieties cut on a 28-day interval. The data from 2016 for the California trial are shown in Figure 3.

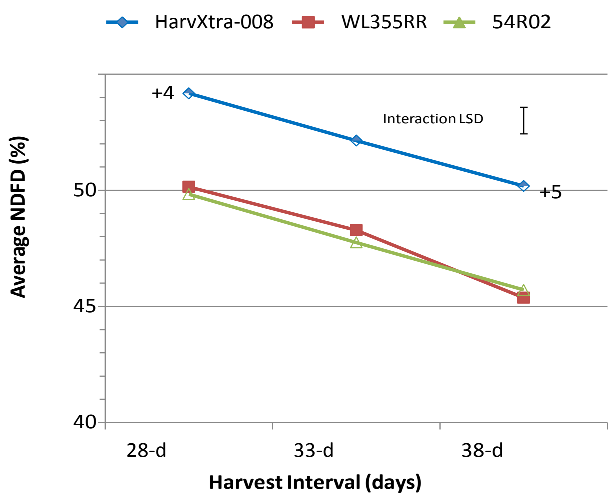
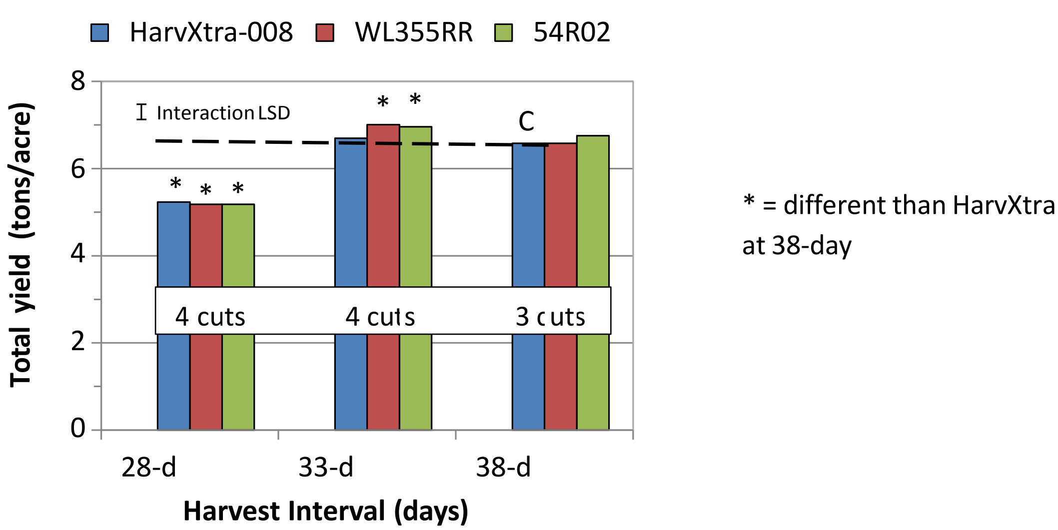


Figure 3. Effect of harvest schedules (28-, 33- and 35-days between cuts) on NDFD in 2016 (CA only 2016).

There was a significant different in total season yield due to the cutting interval. The 28-day schedule yielded significantly less than the 33- or 38-day schedule (Figure 4). HarvXtra-008 yielded lower than some of the other varieties on some of the cutting schedules and at some of the locations. However, there was not a significant difference in yield among varieties at the CA location.



Potential Practical Ramifications

These results suggest that HarvXtra will provide a longer harvest window for producing high quality alfalfa. Producers may choose to cut on the same cutting schedule they currently use and have improved forage quality. Or, alternatively, they can delay harvest and maintain forage quality (as measured by NDFD or RFQ but not ADF or NDF). Delaying harvest will increase the yield for that cutting and likely for the season. If these results hold true in commercial fields it is likely that growers in the Intermountain areas will be able to reduce the number of cuttings per year from 4 to 3, and in so doing improve yield while hopefully still producing dairy-quality alfalfa. A longer interval between cuttings may also increase the level of carbohydrate root reserves thereby improving plant vigor and stand persistence.

Many people speculate as to what impact this technology will have on alfalfa production practices and whether growers will choose to continue with their current cutting schedule and produce higher quality or will delay to produce the same quality but increase yield. The author believes it is not an either/or decision and that most growers will choose to do both. With their current cutting schedule, growers have a difficult time making dairy quality alfalfa on all cuttings (especially summer cuttings). This technology should help to make this possible on the same cutting schedule used now. Also, with the acreage many growers have, it can take 3 weeks or longer to cut all their fields. Fields cut at the end of the cycle typically have poorer quality and often fall short of dairy quality standards. Reduced lignin alfalfa can help with this situation. Growers will not likely convert the entire farm to reduced lignin alfalfa all at one time. Therefore, it may be logical to take advantage of the technology and harvest reduced lignin alfalfa fields later in the cycle. For all these reasons, it is likely that most producers will not just “go for yield” or “go for improved quality” as they adapt their cutting schedules with reduced lignin varieties, but instead will reach the appropriate compromise between the two and use this new technology to their advantage.

A key point to keep in mind is that with the forage quality parameters currently used to market alfalfa in California (i.e. TDN, which is predicted from ADF), we will not be able to detect the improvement in forage digestibility that the reduced lignin alfalfa varieties can offer. How we assess and value alfalfa forage quality in California will need to change before we can fully capture the difference between reduced lignin and standard varieties. We will need to move toward a different digestibility measurement in like NDFD, an index like Relative Forage Quality (RFQ), or some other analytical method that incorporates digestibility measurements before we can fully capture of the value of reduced lignin in the marketplace.

Reduced-lignin alfalfa varieties could have a dramatic effect on alfalfa harvest management and transform our understanding of the yield quality tradeoff as we know it now. Data on yield and quality changes with advancing maturity for new low-lignin alfalfa cultivars is needed to understand the impact this technology will have on alfalfa production as well as animal nutrition. It is an exciting time to be growing alfalfa!

2017 IREC Field Day Sponsors

We would like to take this opportunity to sincerely thank the following sponsors. The support they provide allows us to offer the morning refreshments, the informational publication, and the excellent catered lunch and dessert.

- Basin Fertilizer & Chemical Co.
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- JW Kerns Irrigation
- Macy's Flying Service
- Northwest Farm Credit Service
- Sensient Natural Ingredients, LLC
- Syngenta Crop Protection, LLC
- Winema Elevators, LLC
- Umpqua Bank

2017 IREC Field Day

Wednesday, July 26 Tulelake, CA

8:00 am *Registration Opens*

8:20 am *Introductions and Opening Remarks*
Rob Wilson, IREC Center Director/Farm Advisor, Tulelake, CA

8:30 am *UC ANR Updates and Initiatives*
Glenda Humiston, Vice President, University of California – Agriculture and Natural Resources, Oakland, CA

8:40 a.m. *Pacific Power Wattsmart Business Program and Irrigation Upgrades*
Matt Smeraglio, Pacific Power Project Engineer, Portland, OR

8:50 am *Tour Starts*

8:55 am **Stop 1** *Evaluation of Alternatives to Soil Fumigants and Diallyl Disulfide for Management of White Rot*
Rob Wilson, IREC Director & Advisor, Tulelake, CA

9:05 am **Stop 2** *Improving Malting Barley Nitrogen Management using Drone Measurements*
Taylor Nelsen, Graduate Student Davis, CA

9:25 am **Stop 3** *Use of Palisade PGR to Prevent Barley Lodging in Tulelake*
Rob Wilson, IREC Director & Advisor, Tulelake, CA

9:45 am **Stop 4** *Alternative Grazing Forages /New Crop Introduction:Kura Clover*
David Lile, UCCE-Lassen County Director & Livestock Advisor, Susanville, CA
Dan Putnam, Extension Agronomist & Forage Specialist, UC Davis, CA

10:05 am **Stop 5** *Evaluation of Small Grains Grown under Dryland Conditions*
Steve Orloff, UCCE-Siskiyou County Director & Farm Advisor, Yreka, CA

10:15 am *Break and Refreshments*

10:25 am **Stop 6** *Forage Barley Breeding Update*
Cal Qualset, Emeritus Dept. of Plant Sciences, UC Davis, CA

10:35 am **Stop 7** *Development of Small Grain Varieties in California*
Mark Lundy, Extension Grain Cropping Systems Specialist, UC Davis, CA

10:55 am **Stop 8** *Integrating Cover Crops into Organic Potato Production*
Rob Wilson, IREC Director & Farm Advisor, Tulelake, CA

11:05 am **Stop 9** *Preventing Maggot Damage in Processing Onions*
Rob Wilson, IREC Director & Farm Advisor, Tulelake, CA

11:15 am **Stop 10** *Alfalfa Variety Development*
Dan Putnam, Extension Agronomist & Forage Specialist, UC Davis, CA

11:35 am **Stop 11** *Low Lignin Alfalfa and Roundup Ready Alfalfa Updates*
Steve Orloff, UCCE-Siskiyou County Director & Farm Advisor, Yreka, CA

Noon *Lunch*