2016 ANNUAL FIELD DAY

Thursday, August 4
8 a.m. to Noon

Join us early for coffee, donuts and good conversation. Ride the IREC field shuttle as you tour our research plots. Learn from our researchers. Have a fantastic lunch. Enjoy the day!

RECS

POTATOES

CEREAL GRAINS

ALFALFA

ONIONS

PEPPERMINT

FORAGES

Intermountain Research and Extension Center

2816 Havlina Road
Tulelake, CA

www.irec.ucanr.edu

530/667-5117

Welcome to our Annual Field Day.

This 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 research being conducted on our Center and interact with Center researchers. We sincerely appreciate the opportunity to share our research programs with members of the community, many of whom have helped sponsor the research and this event.

During the tour, please ask questions freely. If you would like additional information on any project, please seek out a side conversation with the researcher during breaks or over lunch. Additional information on all our research projects is available at the office.

Please enjoy the tour, the lunch and the conversation.

Thanks for coming!

Sincerely,

The IREC Staff

Table of Contents

Intermountain Research & Extension Center
Current Staff

Rob Wilson	Center Director / Farm Advisor
Darrin Culp	Superintendent of Agriculture
Laurie Askew	Administrative Assistant
Kevin Nicholson	Staff Research Associate II
Skyler Peterson	Staff Research Associate II
Greg McCulley	Senior Farm Machinery Mechanic
Tom Tappan	Farm Machinery Mechanic
Seferino Salazar	Senior Agricultural Technician
Josefina Vallejo	Seasonal Farm Worker
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!

Home:

Welcome to IREC and Tulelake

Stay current with upcoming IREC events

Subscribe to and read our blog

About Us:

Learn about the history of IREC

Get to know the IREC staff

Check out our facilities

Get directions to IREC

Research:

Learn how to submit a proposal

Keep up on current research

Read results of past research

Extension, Outreach & Education:

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

Evaluation of Sharpen (saflufenacil) Use in Established Alfalfa

Principle 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

Principle 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

Principle 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

Assessment of Alfalfa Irrigation Needs in the Klamath Basin

Principle Investigator: Steve Orloff, County Directory/Farm Advisor, Siskiyou County, Yreka; Daniele Zaccaria, Extension Water Management Specialist, UC Davis.

- Determine the effect of irrigation quantity on alfalfa yield in the Klamath Basin.
- Evaluate the need for one versus two irrigations per cutting
- Measure the contribution from dew to alfalfa ET over the growing season.
- Compare soil moisture readings with Watermark sensor versus newer technology from Acclima.

Alfalfa Germplasm Evaluation-Fall Dormancy

Principle 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

Principle 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.

Cereal Projects

Building the Oregon Malting Barley Brand in the Klamath Basin

Principle investigator: Richard Roseberg, Research Agronomist, Dept. of Crop & Soil Science, Oregon State University, Klamath Basin Research Center.

- To generate agronomic, malting and brewing performance data for spring 2-row varieties in order to establish the Oregon malting barley variety "brand."

Wheat Genetic Resources & Mapping Experiments

Principle 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

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

- To increase grain yield and disease resistance in spring barley adapted to the Klamath Basin

Nitrogen in Wheat

Principle Investigator: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; Steve Wright, Farm Advisor–Tulare/Kings Counties; Rob Wilson, Center Director, UC Intermountain Research & Extension Center

- Compare the protein content of the most popular hard red spring wheat varieties
- Assess the effectiveness of late-season N applications to increase protein in different spring wheat varieties
- Evaluate controlled-and slow-release N fertilizers for improving both grain yield and protein
- Evaluate N application practices and soft white wheat varieties to obtain high yield with low protein content (approximately 10 percent)

Development of Wheat Varieties for California

Principle 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

- To produce new varieties & improved germplasm and distribute them to growers, breeders and other researchers. A multi-objective project will be conducted which:
- 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

Principle 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

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

- 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.

California Small Grain Variety Selection Trial

Principle 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.

Forage Projects

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

Principle 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.

Kura Clover Project

Principle 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.

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

Principle 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.

Evaluation of Forage Plantain

Principle 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.

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

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

- Determine the growth and yield potential of 3 varieties of quinoa and 1 variety of amaranth in Tulelake and document any potential pest problems and pitfalls associated with quinoa production in Tulelake including native/introduced insect pests, weeds, and diseases.

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

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

- To compare the yield potential of the three most commonly grown perennial grass species in the Intermountain Region.
- To evaluate the effect of three different fall herbage heights on the subsequent growth of tall fescue, orchardgrass and Timothy.
- To 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.
- To 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

Management of White Rot of Onions with Fungicides

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

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

Onion Weed Control

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

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

Management of Seedcorn Maggot and Onion Maggot in Processing Onions

Principle 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.

Peppermint Projects

Weed Control in Peppermint

Principle 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

Potato Variety Selection Evaluation & Development

Principle 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

Principle 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. For 2014, 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

Principle 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.

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

Principle 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.

Managing Belding's Ground Squirrel

Roger A. Baldwin, UCCE Wildlife Specialist, UC Davis

Steve B. Orloff, UCCE Farm Advisor and County Director, Siskiyou and Modoc Counties

UCCE University of California Cooperative Extension

UC DAVIS UNIVERSITY OF CALIFORNIA

Biology

- Emerge from hibernation between late Jan and mid Feb.
- Hibernate between July and Sept.
- Belding's ground squirrel have one litter per year (ave 7).

Background/Extent of Problem

- Belding's ground squirrel causes substantial damage to alfalfa, grain crops, and rangelands in Northern CA.
- Loss of forage estimated between 17.1% and 65.9% from consumption and burrow destruction.
- Burrowing activity also causes damage.

Some Control Options

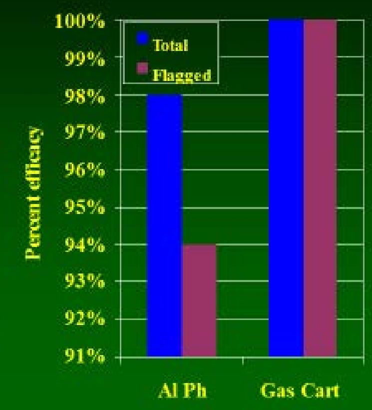
- Historically, Belding's GS was controlled with 1080-coated cabbage.
- Grain-based baits do not work.
- Trapping not practical
- Shooting primary tool currently in use.

Burrow Fumigation

Burrow Fumigation—Efficacy

Al Ph
- 1,725 burrows treated
  34 dug out (98% control)
- 51 treated burrows flagged
  3 dug out (94% control)

Gas Cartridge
- 297 burrows treated
  0 dug out (100% control)
- 12 treated burrows flagged
  0 dug out (100% control)



Carbon Monoxide Machines

Species	Device	Authors	# of fields	Efficacy
Pocket gopher	PERC	Orloff	3	56%
Pocket gopher	PERC	Baldwin & Orloff	3	62%
Pocket gopher	PERC	Baldwin & Orloff	2	68%
Belding's GS	PERC	Orloff	2	76%
California GS	PERC	Baldwin	2	66%
California GS	PERC	Baldwin	2	100%
California GS	Cheetah	Baldwin	3	-7%

Treatment Costs

	Per application			
	Time	Material cost	Labor cost	Total cost
Al Ph	3 min, 58 s	$0.39	$0.66	$1.05
Gas cart	7 min, 28 s	$1.67	$1.25	$2.92

Should You Fumigate?

	Tons/ha	Price ($)/ton	% loss/ha	Revenue loss ($)/ha
1st cutting	5.6	$221	35%	$433
2nd cutting	4.5	$221	15%	$149
			Total:	$582

- For Al Ph, up to 554 burrows/ha ($1.05/application) could be treated.
- For gas cartridges, up to 199 burrows/ha ($2.92/application) could be treated.
- Although minimal, data from Whisson et al. (1999) suggest that around 34% damage is the threshold (546 burrows/ha) for Al Ph given current prices.

Zinc Phosphide Cabbage Bait

- In 2014, zinc phosphide-coated cabbage was approved for use on Belding's GS in Oregon.
- A 24c has recently been approved for CA.
- Ambiguity exists about efficacy of bait.
- Research in NV showed limited efficacy against Townsend's GS (42%).


Department of Pesticide Regulation

RESTRICTED USE PESTICIDE

Zinc Phosphide Concentrate

KEEP OUT OF THE REACH OF CHILDREN
DANGER-PELIGRO
POISON

DIRECTIONS FOR USE

Zinc Phosphide Cabbage Bait

Benefits
- Potentially more effective
- Potentially cheaper
- Little secondary toxicity risk

Concerns
- Uncertain palatability
- Potential primary toxicity risk
- Bait mixing concerns
  - Quality control

Objective—Efficacy

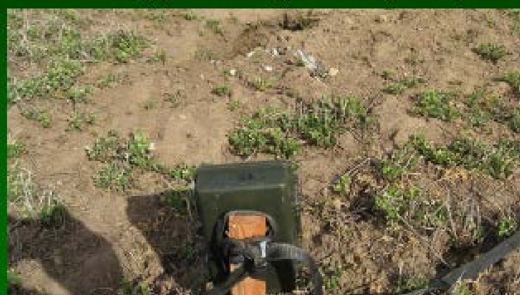
Location	Pre-count	Post-count	Efficacy
Alturas 1	28	18	36%
Alturas 2*	30	8	73%
Butte Valley 1*	7	2	71%
Butte Valley 2*	56	5	91%
Tulelake 1	53	20	62%
Tulelake 2	64	12	81%

* Pre-baited

- May not be as effective on Alturas populations.
- Pre-baiting may increase efficacy, but is unclear yet.
- There appears to be some benefit to this product, but efficacy is highly variable.

Objective—Peak Time of Consumption

- Remote-triggered cameras were placed on non-toxic bait to determine what species consume bait.
- We will determine optimal bait timing through use of remote-triggered cameras.
- Camera data also may provide insight into long-term palatability.



Objective—Cost

- Total amount of bait applied will be calculated.
- Total hours required to mix bait, pre-bait, and bait will be determined.
- Material and labor costs will be used to estimate expense of a baiting program.

LABELING ACCEPT

Department of Pesticide Regulation

Brian R Leahy
D1rector

Edmund G. Brown Jr.
Governor

March 16, 2015

RESTRICTED USE PESTICIDE

Due to Acute Oral, Dermal, and Inhalation Hai.ards to Humans and Hazards to Nontarget Species.

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's Certification.

FIFRA 24(c) Special Local Need Label (SLN)
For Distribution and Use only in the Counties of Lassen, Modoc, and Siskiyou in the State of California

For use on Alfalfa, Pasture, Rangeland, Non-Crop Area for control of Belding Ground Squirrels.

Zinc Phosphide Concentrate

EPA Reg. No.: 56228-6 SLN # CA-150001

Firm Name: U.S. Dept. of Agriculture
Animal and Plant Health Inspection Services
Riverdale, Maryland 20737-1237

KEEP OUT OF THE REACH OF CHILDREN
DANGER-PELIGRO
POISON

This label expires and shall not be distributed or used in accordance with this SLN registration after December 31, 2020.

DIRECTIONS FOR USE

- It is a violation of Federal law to use this product in a manner inconsistent with this labeling.
- This state-specific Section 24(c) labeling must be in the possession of the user at the time of application .
- Follow all applicable directions, restrictions, and precautions on the EPA registered label for Zinc Phosphide Concentrate (EPA Reg. No. 56228-6) and this label.

Crop/Site/Commodity: Alfalfa, Pasture, Rangeland, and Non-Crop Area

Target Pest/Problem: Belding's Ground Squirrel

Dosage: Use 1.14 ounces of product per 10 pounds of cabbage. A maximum of 20 pounds of bait per acre per year.

To prepare treated bait: Cut cabbage into 2 to 6 inch lengths, at least *Yi* inch wide. Mix 10 pounds of cut cabbage with l to 2 fluid ounces of vegetable oil. Next add 1.14 ounces of Zinc Phosphide Concentrate to mixture and blend thoroughly by manually stirring or by use of a mechanical tumbling type mixer. Continue mixing until cabbage, oil, and concentrate are evenly mixed. Use an implement to mix cabbage, oil and zinc phosphide concentrate, Do Not Use Your Hands.

Method of Application: Spot Treatment by Ground Application Only

Frequency/Timing of Application: Apply only from January through May.

Restricted Entry Interval (REI): NA

Preharvest Interval (PHI): 30 days

Specific Use Restrictions:

1. Only spot baiting of active infested area.
2. Do not broadcast treated cabbage.
3. Do not bait if non-target birds/animals are feeding, nesting, etc. in the area to be treated.
4. Do not apply in rain or on snow.
5. Do not apply in urban areas.
6. Do not allow domestic animals to graze fields treated within the last 60 days.
7. Do not apply by air.
8. Do not allow hunting in treated fields during application period.
9. Fields to be treated and treated fields must be monitored daily for non-target species.
10. Properly dispose of dead rodents.
11. If migratory birds are present, hazing must be accomplished before and after applications to prevent non-target exposure.
12. Collect and bury any spilled bait, unused prepared bait, and uneaten bait. Gloves must be worn per the Personal Protective Equipment (PPE) statement on the label for Zinc Phosphide Concentrate (EPA Reg. No. 56228-6).
13. Apply when daytime temperatures are above freezing.
14. Any dead animals found in the treated areas must be immediately reported to the local county Agricultural Commissioner's office.

Valid until withdrawn, suspended or cancelled by the United States Environmental Protection Agency (USEPA), the manufacturer, the 24(c) registrant, or the Department of Pesticide Regulation, or expires.

<u>This product is both Federally-Restricted and California-Restricted.</u>

A restricted materials permit must be obtained from the county agricultural commissioner prior to this use. This does not constitute a recommendation of the Department of Pesticide Regulation and will not prevent quarantine action if illegal residues are found on or in the crop.

To the extent consistent with applicable law, neither the Department nor the county agricultural commissioner, makes any warranty of merchantability, fitness of purpose, or otherwise, expressed or implied, concerning the use of a pesticide in accordance with these provisions. The <u>user and/or grower acknowledge the preceding disclaimer.</u>

Do not use in mixture with other pesticides unless provided for in the labeling. Trial on a small area to check out unanticipated problems is suggested.

24(c) Registrant: Modoc County
Agricultural Commissioner
202 West 4th Street
Alturas, Califomia 96101
(530) 233-6401

USEPA SLN No.: CA-150001

John E. Inouye
Senior Environmental Scientist
Pesticide Registration Branch
(916) 324-3538
E-mail: jinouye@cdpr.ca.gov

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

Steve Orloff, Farm Advisor/County Director, Siskiyou County
Leslie Roche, Pasture and Range Specialist, UC Davis
David Lile, County Director and Livestock and Natural Resources Advisor, Lassen County

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

Unlike alfalfa and other perennial legumes, perennial grasses do not store significant carbohydrate reserves in their roots. Most of the carbohydrates and sugars needed for growth after defoliation and winter survival can be found in the stubble (typically, as fructans in tiller bases) rather than the roots. Reducing stubble height during the fall/winter period could also negatively impact meristematic tissues of any non-dormant plants, as well as expose buds to cold temperatures, potentially curtailing tiller growth in the spring. Hence, fall stubble height could significantly affect pasture productivity in the subsequent growing season. In this project we are evaluating the effect of residual fall stubble height in addition to severe defoliation or burning over the winter months on the subsequent productivity of three common perennial grass species (tall fescue, orchardgrass and Timothy).

The perennial grass species tall fescue (Tuscany II), orchardgrass (Century) and Timothy (Aurora) were planted in blocks (main plots). Six different fall/winter management practices are imposed on each of the species. They involve four fall cutting heights and a winter grazing or burning treatment applied to the 6 inch fall stubble height.

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

The yield of the fall harvest with the different clipping heights imposed was determined. It is not surprising that leaving a higher stubble in the fall affects yield of that cutting because less of the base of the plant is harvested. The reduction in yield we observed by leaving a higher stubble height varied depending on the grass species. The data are shown in Figure 1. There was a decline in forage yield associated with each incremental increase in stubble height. The difference was greatest for tall fescue, which had the overall highest yield when harvested as close as possible (approximately 0.5 inch stubble height). Timothy had the lowest overall yield and there was essentially nothing to harvest when a 6-inch stubble height was used. Timothy is typically only cut twice per year. The 4-inch stubble treatments that were subsequently mowed or grazed over the winter (red bars) had the same yield as the 4 inch stubble height treatment, as all three of these treatments were essentially the same at the time of cutting.

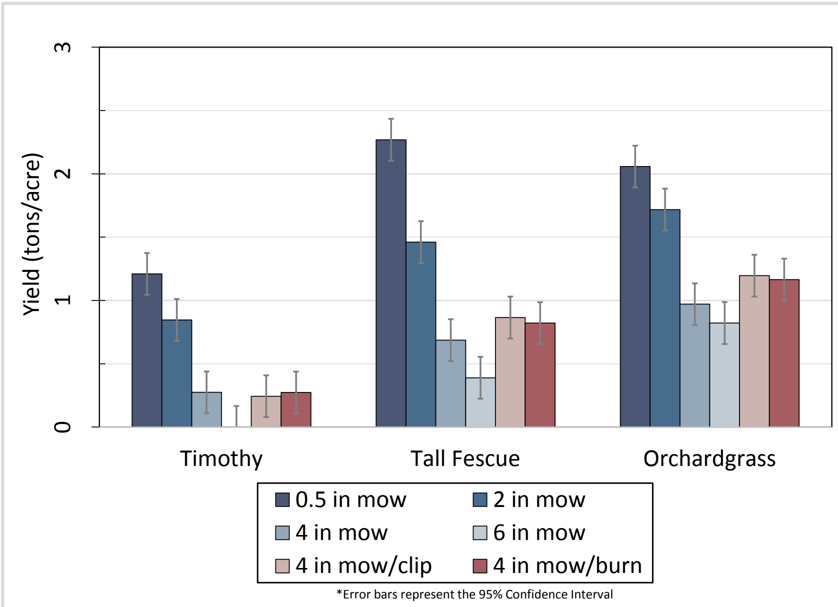


Figure 1.
Effect of fall stubble height after mowing on yield of fall harvest for Timothy, tall fescue and orchardgrass.

The number of tillers per unit area were counted the following spring on March 1, 2016 (Figure 2) shortly after the plants started to green-up and then again on March 16 (Figure 3). It is interesting to note that there tended to be more tillers per unit area when the plants were cut leaving a higher stubble height in the previous fall. Although not always statistically significant, there did appear to be a gradual increase in number of tillers with each incremental increase in fall stubble height. These differences were less apparent by the second evaluation on March 16th and had largely disappeared for tall fescue and especially orchardgrass.

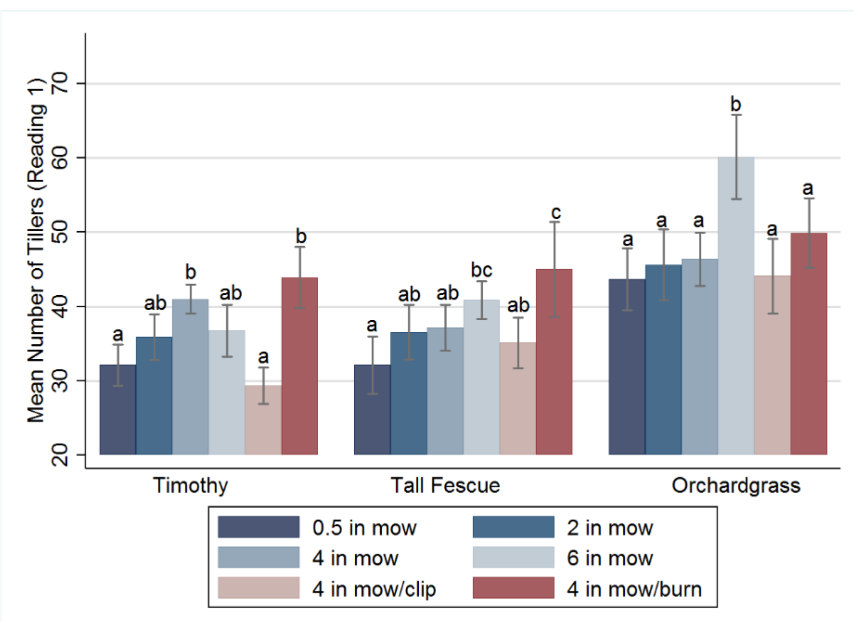


Figure 2.
Effect of fall stubble height after mowing and winter clipping or burning on spring tiller counts on March 1 for Timothy, tall fescue and orchardgrass.

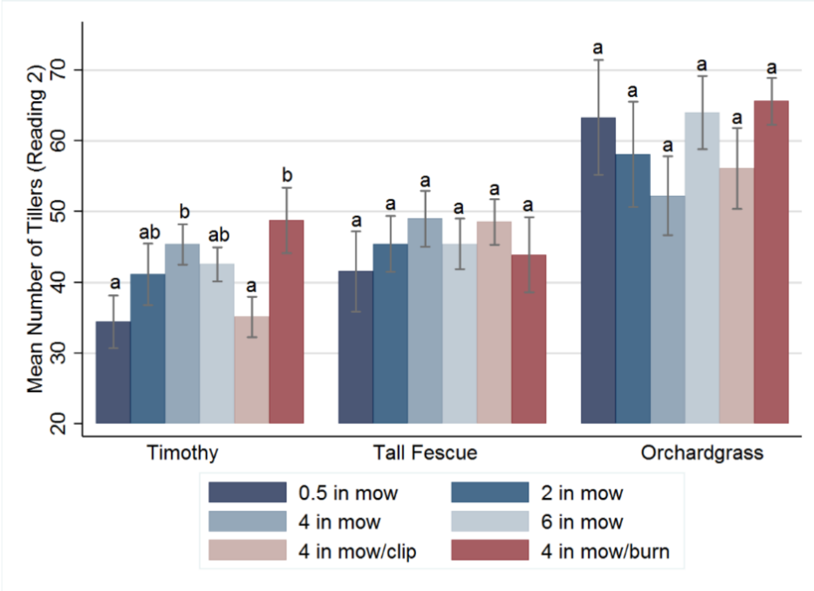


Figure 3.
Effect of fall stubble height after mowing and winter clipping or burning on spring tiller counts on March 16 for Timothy, tall fescue and orchardgrass.

First cutting yield the spring after the fall cutting height treatments were imposed was measured on June 2 (Figure 4). Of the three perennial grasses, Timothy was most affected by fall cutting height. This may be due to the fact that unlike the other grasses, Timothy produces a corm, a bulb-like storage structure where many of the sugars and water soluble carbohydrates needed for growth and tiller development are stored. Timothy has few basal leaves for energy storage so cutting height is more critical. For this reason, Timothy is less tolerant of frequent cutting than is tall fescue or orchardgrass. Tall fescue was less affected. Interestingly, the burning treatment had the highest numerical yield. There was no difference in yield for orchardgrass across the different fall stubble height and winter management treatments.

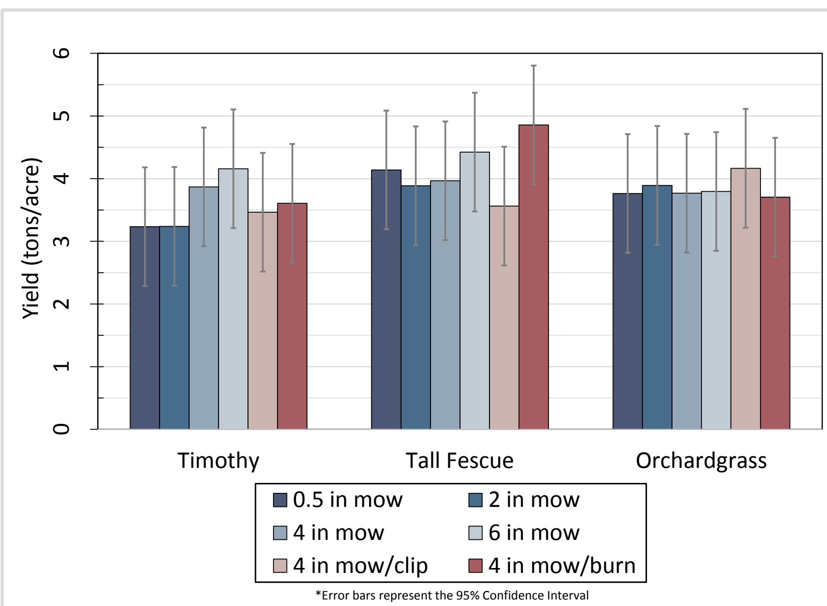


Figure 4.
Effect of fall stubble height after mowing and winter clipping or burning on first cut yield of Timothy, tall fescue and orchardgrass.

At the time this article was written, only first cutting yield had been harvested. There are visual differences in the growth of the plots heading into second cutting. Therefore, the effect of fall harvest height and winter clipping or burning may extend beyond the initial first cutting in spring and have a significant effect on seasonal yield. As noted earlier, a higher fall cutting height improved yield of Timothy and tended to have an effect on tall fescue yield. However, the yield data collected to date indicate that the improvement in first cutting yield is offset by the reduction in fall harvest by using a higher cutting height. This may change, however, after second cut yield is determined.

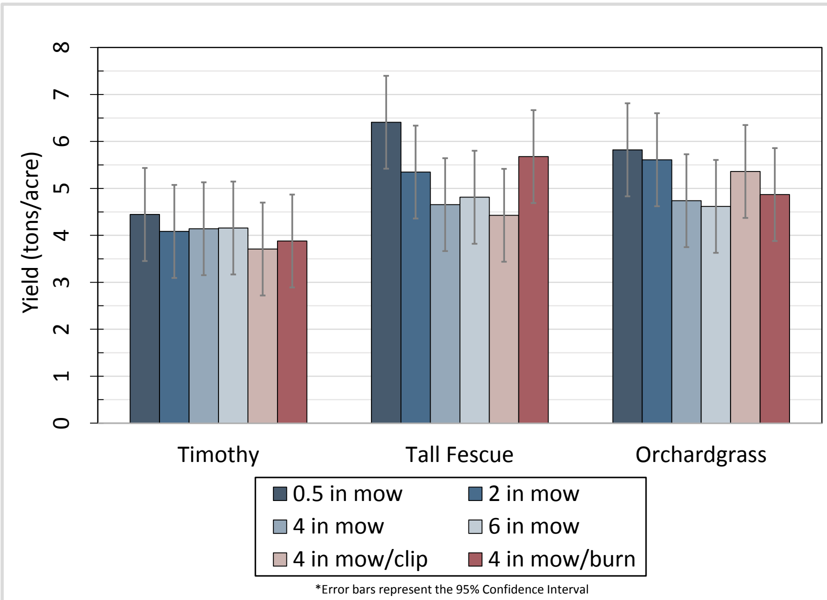


Figure 5.
Effect of fall stubble height after mowing and winter clipping or burning on the combined yield of the fall harvest and the first spring cut for Timothy, tall fescue and orchardgrass.

For livestock producers who graze tall fescue pastures in the fall, the fall feed may be of greater value and therefore worth a slight yield penalty in the spring. However, it is premature to draw conclusions from the limited data we have to date. This trial will be continued for at least an additional two growing seasons. It will be interesting to see if the yield differences observed among the different species due to cutting height and winter management will have a compounding effect over time and if the trends we observed are consistent across years.

Building the Oregon (Craft) Malting Barley Brand

Klamath Basin trials, 2015. IREC, Tulelake, CA

Managed by Rich Roseberg and Tom Silberstein
OSU – Klamath Basin Research and Extension Center

Darrin Culp and Rob Wilson
UC ANR – Intermountain Research and Extension Center

Rationale:

- **Oregon and the PNW lead the world in craft brewing and distilling.**
- **Currently, most Oregon craft beers and spirits are brewed/distilled from malt made from barley grown somewhere besides Oregon.**
- **Oregon farmers could profit from the demand for Oregon-grown malting barley with craft quality.**

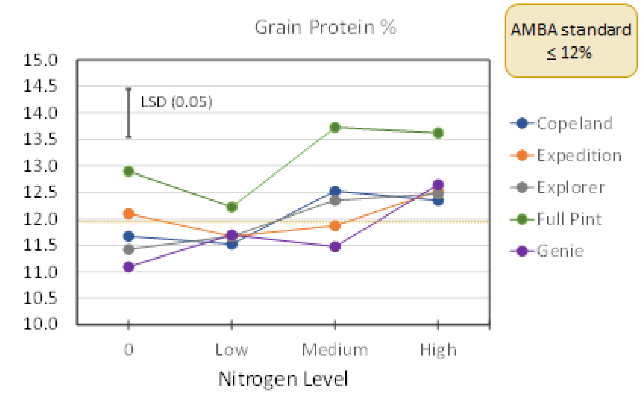
Objectives:

- **Determine Oregon's potential for producing high quality malting barley by generating data on agronomic performance and quality –in terms of malt and beer.**

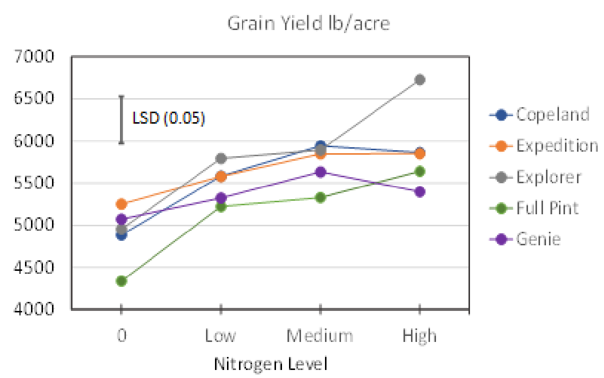
Means for Varieties, Tulelake

Variety	Plant Height inches	Grain Yield lb/acre	Protein %	Plump %	Test Weight lb/bu
Copeland	33.52	5567	12.02	94.1	50.50
Expedition	28.27	5631	12.04	88.7	49.73
Explorer	25.34	5842	11.98	94.2	49.91
Full Pint	26.00	5131	13.12	83.2	48.80
Genie	26.91	5356	11.73	92.4	49.12
Mean	28.01	5506	12.18	90.5	49.61
LSD (0.05)	0.89	279	0.45	2.1	0.61
CV%	9.15	14.58	5.27	3.22	1.74

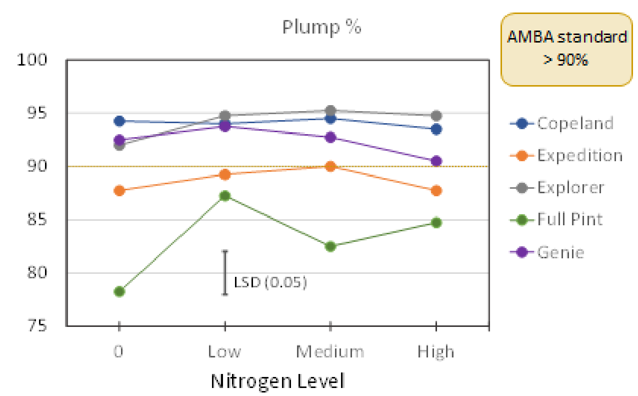
Grain Protein - Tulelake



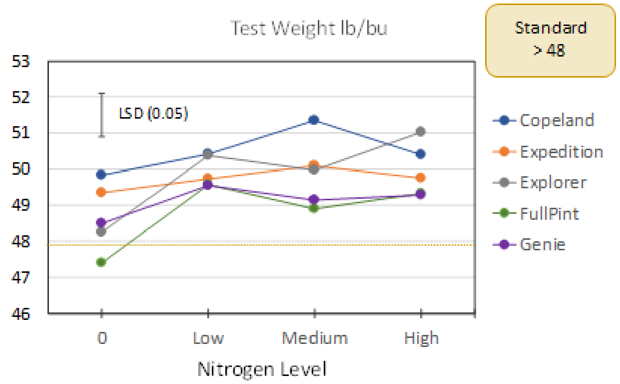
Grain Yield - Tulelake



Plump Grain – Tulelake



Test Weight – Tulelake



Comparisons at the 3 regional sites

Location	Grain Yield lb/acre	Protein %	Plump %	Test Weight lb/bu
Willamette Valley	5903	9.25	89.8	52.5
Grande Ronde	4799	10.14	98.6	52.4
Klamath Basin	5506	12.18	90.5	49.61

The Klamath Report- 2015

- Explorer had the highest average yield (avg. 5842 lb/acre), Full Pint the lowest yield (5131 lb/acre); other varieties had comparable yields.
- Grain protein levels were, on average, moderate to high.
- Average % plump values were acceptable to nearly acceptable, except of Full Pint.
- Test weights were good, except for Full Pint at 0 N.
- Increasing N increased plant height, grain yield, protein content, and test weight. The increase in protein % was linear across N levels, but other traits showed a curvilinear response.
- This irrigated environment could be a suitable growing area but nitrogen management and variety choice will be key considerations.

Varieties entered for 2016

- ***Copeland***: Developed by the Crop Development Center, University of Saskatoon. Widely available. Sponsored by Great Western Malting. Contact: Kevin Anderson
- ***Explorer***: Secobra. Contact: Jarislav VonZitzewitz
- ***Full Pint***: Developed by The Barley Project, Oregon State University. Contact: Pat Hayes
- ***Francin***: Czech variety. Columbia River Seeds – Importer. Contact: Paul Hedgpeth

Wheat Varieties Released by the University of California, Davis Wheat Breeding Program

Oswaldo Chicaiza, UC Davis Wheat Breeding Program

LASSIK

Lassik is a hard red spring wheat. It was developed by the University of California, Davis and released in 2007. Lassik was derived from the cultivar Anza. Three independent backcrossing programs were used to introgress several genes into Anza that were then combined into Lassik. The three backcrossing programs were as follows: Madsen/6*Anza to introgress the 2NS-2AS chromosome translocation from Ae. Ventricosum carrying leaf rust resistance gene Lr37, stripe rust resistance gene Yr17, and stem rust resistance gene Sr38; Glupro-GPC/6*Anza to introgress the high grain protein gene Gpc-B1and the stripe rust resistance gene Yr36; Glupro-Glutenins/6*Anza to improve Anza gluten strength by replacing two high molecular weight glutenin (HMWG) alleles known to be associated with weak gluten with the Glu-A1'1' allele and the Glu-D1 '5+10' allele from Glupro. Lassik has medium late maturity, averages about 37 inches in plant height, and has fair straw strength. At the time of release Lassik was resistant to stripe rust, leaf rust and powdery mildew, and moderately resistance to Septoria tritici leaf blotch and BYD.

PATWIN-515

Patwin 515 is a hard white wheat. It was developed by the University of California, Davis and released in 2013. Stripe rust resistance genes Yr5 and Yr15 were introgressed by five backcross generations into the UC Davis resistant cultivar Patwin (from the cross Madsen/2*Express) and then combined using marker assisted selection. Patwin 515 also has the Ae. Ventricosum 2NS translocation carrying resistance genes to stripe rust Yr17, stem rust Lr37and stem rust Sr38. Patwin 515 has high yield potential as well as excellent bread making quality. It has medium-late maturity and excellent straw strength. It is resistant to stripe rust, leaf rust, moderately resistant to Septoria tritici leaf blotch and BYD, and moderately susceptible to powdery mildew.

YUROK

Yurok is a hard red spring wheat variety developed from the cross UC1110/UC1037 Gpc-B1-Glu-D1d,2NS_trans. The variety was developed by the University of California, Davis wheat breeding program and released in 2015. Yurok is a semidwarf variety with and intermediate heading time similar to Lassik. Yurok is resistant to all current races of stripe rust present in California and shows good tolerance for BYDV and septoria. Yurok showed excellent bread making quality in evaluations performed by the quality Laboratory at the California Wheat Commission and the milling industry at the California Wheat Collaborator Program.

PATWIN 515HP

The new hard white spring variety Patwin-515HP has significantly higher grain protein content than the parental line Patwin-515 due to the introgression of the functional high grain-protein gene GPC-B1. This variety has excellent bread making quality and good yield potential. This variety is derived from previous UC Davis variety Patwin-515, which was used as recurrent parent in the introgression of the high grain-protein gene GPC-B1 and the linked stripe rust resistance gene Yr36 by marker assisted backcross selection for six generations. Patwin_Patwin-515HP carry the stripe rust resistance genes Yr5 and Yr15, which are currently resistant to all races of stripe rust reported in the US.

Yield performance (lb/a) of the UC Davis wheat varieties evaluated in the Intermountain Spring Elite Yield Trial

	Lassik			**Patwin-515**			**Yurok**			**Patwin-515HP**	
Year	Lassen	Tulelake	Siskiyou	Lassen	Tulelake	Siskiyou	Lassen	Tulelake	Siskiyou	Lassen	Tulelake
2010	5040	4860									
2011	4330	7130	6600								
2012	2750	6790	6090	2490	7230	5450					
2013	3270	6720		3150	7590						
2014							2920	6440	4680	2900	5810
2015							4260	4520	3050		
Mean	3847	**6375**	**6345**	2820	**7410**	**5450**	3590	**5480**	3865	2900	**5810**

Table 1. Hard spring wheat productivity for varieties grown during 2013, 2014 and 2015 in the Intermountain Region of California at three locations. Averages represent least squares means.

Name	**Yield (lb/acre)**					**Protein (%)**		**Type**	**Source**
	Overall Average		Site-effect on yield			Overall Average			
		±	Tulelake	Lassen	Siskiyou		±		
Dayn	5513	661	1642	-1307	-1006	11.47	1.08	HWS	WSU
08SB0658-B	5214	728	1642	-1307	-1006	10.91	1.16	HRS	LCS
IDO694C	5184	728	1642	-1307	-1006	11.15	1.16	HWS	UI
*** WB 9518**	**5177**	**661**	1642	-1307	-1006	12.46	1.08	HRS	WB
UC 12013/22	5174	661	1642	-1307	-1006	11.77	1.08	HWS	UCD
05SB84	5171	726	1642	-1307	-1006	11.2	1.16	HRS	LCS
12 SB 0146	5120	697	1642	-1307	-1006	11.28	1.13	HWS	LCS
LCS Atomo	5080	672	1642	-1307	-1006	11.62	1.1	HWS	LCS
SY Bullseye	5066	726	1642	-1307	-1006	11.95	1.16	HRS	AgriPro
UC 12010/13	4999	728	1642	-1307	-1006	12.8	1.16	HRS	UCD
SY Basalt	4926	726	1642	-1307	-1006	11.78	1.16	HRS	AgriPro
11SB0096	4880	661	1642	-1307	-1006	12.1	1.08	HRS	LCS
Patwin 515	4859	728	1642	-1307	-1006	11.75	1.16	HWS	UCD
SY 04W40292R	4832	672	1642	-1307	-1006	12.6	1.1	HRS	AgriPro
UC 1744	4828	672	1642	-1307	-1006	12.69	1.1	HWS	UCD
Bullseye	4804	672	1642	-1307	-1006	12.35	1.09	HRS	AgriPro
Cabernet	4799	728	1642	-1307	-1006	11.6	1.16	HRS	AgriPro
LNR10-0551	4799	728	1642	-1307	-1006	11.43	1.16	HRS	LCS
HRS 3504	4794	697	1642	-1307	-1006	12.2	1.13	HRS	WIN/LOL
IDO 862E	4766	661	1642	-1307	-1006	12.64	1.08	HRS	UI
YS 601	4760	697	1642	-1307	-1006	12	1.13	HWS	WAG
IDO 1202 S	4750	661	1642	-1307	-1006	12.84	1.08	HWS	UI
YS 802	4710	697	1642	-1307	-1006	12.93	1.13	HRS	WAG
WB 9229	4704	697	1642	-1307	-1006	12.28	1.13	HRS	WB
UI Platinum	4688	672	1642	-1307	-1006	11.43	1.1	HWS	UI
IDO 862T	4686	661	1642	-1307	-1006	12.47	1.08	HRS	UI
Jefferson	4627	661	1642	-1307	-1006	12.53	1.08	HRS	UI
LCS Star	4622	672	1642	-1307	-1006	12.89	1.1	HWS	LCS
^ WB 9668	4568	672	1642	-1307	-1006	**13.45**	**1.1**	HRS	WB
12 SB 0131	4537	697	1642	-1307	-1006	11.64	1.13	HWS	LCS
Lassik	4484	728	1642	-1307	-1006	11.7	1.16	HRS	UCD
10SB0087-B	4444	672	1642	-1307	-1006	12.49	1.1	HRS	LCS
WA 8217	4444	697	1642	-1307	-1006	12.66	1.13	HRS	WSU
UC 1745	4442	672	1642	-1307	-1006	11.85	1.1	HRS	UCD
^ SY Steelhead	4426	661	1642	-1307	-1006	**13.21**	**1.08**	HRS	AgriPro
HRS 3419	4410	697	1642	-1307	-1006	12.06	1.13	HRS	WIN/LOL
SY 3001-2	4404	697	1642	-1307	-1006	12.3	1.13	HRS	AgriPro
Clearwhite515	4354	672	1642	-1307	-1006	12.31	1.1	HWS	UCD
Kelse	4349	728	1642	-1307	-1006	12.75	1.16	HRS	WSU
^ UC 1743	4331	726	1642	-1307	-1006	**13.93**	**1.16**	HWS	UCD
HRS 3530	4314	697	1642	-1307	-1006	12.44	1.13	HRS	WIN/LOL
WB 9879 CL+	4304	728	1642	-1307	-1006	12.6	1.16	HRS	WB
UI Winchester	4300	672	1642	-1307	-1006	12.72	1.1	HRS	UI
Buck Pronto	4280	681	1642	-1307	-1006	12.82	1.11	HRS	LCS
Glee	4172	681	1642	-1307	-1006	11.89	1.11	HRS	WSU
UC 12010/30	4154	728	1642	-1307	-1006	12.55	1.16	HWS	UCD
HRS 3361	4127	697	1642	-1307	-1006	12.5	1.13	HRS	WIN/LOL
UC 12014/15	4084	728	1642	-1307	-1006	11.66	1.16	HWS	UCD
WA 8166	3749	728	1642	-1307	-1006	12.39	1.16	HRS	WSU
YS 801	3487	697	1642	-1307	-1006	12.59	1.13	HRS	WAG

*** Varieties have significantly higher yield than average AND NOT significantly lower protein than average in these trials.**
^ Varieties have significantly higher protein than average AND NOT significantly lower yield than average in these trials.

Table 2. Soft spring wheat productivity for varieties grown during 2013, 2014 and 2015 in the Intermountain Region of California at three locations. Averages represent least squares means.

Name	**Yield (lb/acre)**					**Protein (%)**		**Type**	**Source**
	Overall Average		Site-effect on yield			Overall Average			
		±	Tulelake	Lassen	Siskiyou		±		
***WB 6430**	**5764**	**743**	1624	-1186	-1314	9.96	1.11	SWS	WB
***WB 6341**	**5480**	**691**	1624	-1186	-1314	10.14	1.04	SWS	WB
IDO 852	5367	721	1624	-1186	-1314	10.73	1.08	SWS	UI
UI Stone	5264	691	1624	-1186	-1314	10.6	1.04	SWS	UI
IDO 854	5210	783	1624	-1186	-1314	11.27	1.16	SWS	UI
IDO 851	5063	691	1624	-1186	-1314	10.52	1.04	SWS	UI
WA 8195	5025	783	1624	-1186	-1314	10.46	1.16	SWS	WSU
WA 8189	4999	691	1624	-1186	-1314	10.83	1.04	SWS	WSU
WA 8162	4997	721	1624	-1186	-1314	11.46	1.08	SWS	WSU
12 SW 079	4990	743	1624	-1186	-1314	12.34	1.11	SWS	LCS
Alpowa	4987	721	1624	-1186	-1314	11.12	1.08	SWS	WSU
Alturas	4959	691	1624	-1186	-1314	10.9	1.04	SWS	UI
Babe	4940	783	1624	-1186	-1314	11.32	1.16	SWS	WSU
WB1035	4882	721	1624	-1186	-1314	11.74	1.08	SWS	WB
12 SW 068	4860	743	1624	-1186	-1314	11.29	1.11	SWS	LCS
WB 6121	4854	691	1624	-1186	-1314	11.68	1.04	SWS	WB
M 12001	4837	743	1624	-1186	-1314	12.01	1.11	SWS	UI
Merrill 2	4810	783	1624	-1186	-1314	12.57	1.16	SWS	Lewis
WA 8214	4800	743	1624	-1186	-1314	11.09	1.11	SWS	WSU
Whit	4779	691	1624	-1186	-1314	11.05	1.04	SWS	WSU
SX908	4715	783	1624	-1186	-1314	12.56	1.16	SWS	AG SERVICE SEEDS
12 SW 052	4564	743	1624	-1186	-1314	12.11	1.11	SWS	LCS
Louise	4227	721	1624	-1186	-1314	11.36	1.08	SWS	WSU
Diva	4121	691	1624	-1186	-1314	10.84	1.04	SWS	WSU
JD	4030	783	1624	-1186	-1314	11.75	1.16	SWS-Club	WSU
Tx06V7266	3490	783	1624	-1186	-1314	12.49	1.16	SRS	AG SERVICE SEEDS

*** Varieties have significantly higher yield than average in these trials.**

Table 3. Winter wheat productivity for varieties grown during 2013, 2014 and 2015 in the Intermountain Region of California at two locations. Averages represent least squares means.

Name	Yield (lb/acre)				Protein (%)		Type	Source
	Overall Average		Site-effect on yield		Overall Average			
		±	Tulelake	Siskiyou		±		
*** LOR 092**	**6934**	**1029**	1183	-1183	9.64	1.37	SWW	OSU/Lima
YS 434	6149	1029	1183	-1183	10.42	1.37	SWW	Yieldstar
WB 1529	6139	1029	1183	-1183	11.03	1.37	SWW	WB
OR2080926	6119	1029	1183	-1183	10.58	1.37	SWW	Adv 1 -19
WB EXP 1030 CL+	6054	1029	1183	-1183	12.98	1.37	SWW	WB
WB 1604	6009	1029	1183	-1183	11.36	1.37	SWW	WB
OR2071071	5959	1029	1183	-1183	10.56	1.37	SWW	DS
OR08047P94	5929	1029	1183	-1183	11.13	1.37	SWW	DS
UI/WSU Huffman	5824	1029	1183	-1183	10.33	1.37	SWW	U of I
LOR 833	5819	1029	1183	-1183	11.17	1.37	SWW	OSU/Lima
YS 221	5757	947	1183	-1183	11.33	1.28	SWW	Yieldstar
03-29902A	5719	1029	1183	-1183	11.64	1.37	SWW	U of I
Rosalyn	5633	969	1183	-1183	10.93	1.3	SWW	OSU
IDN 06-18102A	5619	1029	1183	-1183	12.34	1.37	SWW	U of I
SY Ovation	5582	947	1183	-1183	11.61	1.28	SWW	Syngenta
IDO 1108	5573	947	1183	-1183	11.38	1.28	SWW	U of I
OR2080641	5563	947	1183	-1183	11.46	1.28	SWW	DS
SY 96-2 (Exp)	5554	1029	1183	-1183	11.12	1.37	SWW	Syngenta
WB EXP-1038 CL	5537	1028	1183	-1183	11.71	1.37	SWW	WB
IDN 02-29001A	5536	969	1183	-1183	12.13	1.3	SWW	U of I
WA 8151	5519	1029	1183	-1183	11.57	1.37	SWW	WSU
OR2100940	5511	969	1183	-1183	11.74	1.3	SWW	OSU
TUBBS	5491	969	1183	-1183	11.74	1.3	SWW	UC
OR2080924	5484	1029	1183	-1183	11.51	1.37	SWW	DS
LOR 913	5484	1029	1183	-1183	11.49	1.37	SWW	OSU/Lima
KELDIN	5450	947	1183	-1183	11.35	1.28	HRW	WB
OR2090473	5443	947	1183	-1183	11.43	1.28	SWW	OSU
99-06202A	5424	1029	1183	-1183	11.57	1.37	SWW	U of I
Bobtail	5418	969	1183	-1183	11.55	1.3	SWW	OSU
IDN 01-10704A	5406	969	1183	-1183	11.08	1.3	SWW	U of I
IDN 04-00405B	5402	1028	1183	-1183	12.02	1.37	SWW	U of I
Puma (WA 8134)	5399	1029	1183	-1183	11.09	1.37	SWW	WSU
IDN 02-08806A	5387	1028	1183	-1183	12.03	1.37	SWW	U of I
WA 8153	5344	1029	1183	-1183	11.83	1.37	SWW	WSU
WA 8143 - 2gene El	5329	1029	1183	-1183	11.08	1.37	SWW	WSU
BRUNDAGE 96	5317	1028	1183	-1183	12.42	1.37	SWW	U of I
LWW 11-431	5314	1029	1183	-1183	11.48	1.37	SWW	LCS
WB Junction	5301	968	1183	-1183	11.46	1.3	SWW	WB
LWW04-4009	5294	1029	1183	-1183	10.8	1.37	SWW	LCS
YS 461	5289	1029	1183	-1183	11.25	1.37	SWW	Yieldstar
Mary	5282	947	1183	-1183	12.19	1.28	SWW	OSU
IDN 03-29902A	5267	1028	1183	-1183	11.84	1.37	SWW	U of I
Stephens	5250	947	1183	-1183	12.25	1.28	SWW	OSU
WESTBRED 528	5247	1028	1183	-1183	11.66	1.37	SWW	WB
Tubbs-06	5240	947	1183	-1183	11.44	1.28	SWW	OSU
Bruneau	5203	947	1183	-1183	11.23	1.28	SWW	U of I
WB Trifecta	5203	969	1183	-1183	11.77	1.3	SWW	WB
IDN 06-033038	5194	1029	1183	-1183	12.55	1.37	SWW	U of I
ORCF-103	5188	968	1183	-1183	11.78	1.3	SWW	FSD

*** Varieties have significantly higher yield than average in these trials.** **PAGE 1 of 2**

AP 700 CL	5183	968	1183	-1183	11.91	1.3	SWW	Syngenta
DAS 004	5129	1029	1183	-1183	11.98	1.37	SWW	DOW
ORCF-101R	5119	1029	1183	-1183	12.22	1.37	SWW	FSD
COLONIA	5112	1028	1183	-1183	12.01	1.37	SWW	LCS
LWW 04-4009	5112	1028	1183	-1183	11.17	1.37	SWW	LCS
LCS Biancor	5101	969	1183	-1183	10.94	1.3	SWW	LCS
DAS 003	5099	1029	1183	-1183	12.63	1.37	SWW	DOW
LWW 12-7105	5088	969	1183	-1183	11.05	1.3	SWW	LCS
AP Badger	5081	968	1183	-1183	11.48	1.3	SWW	Syngenta
Ladd	5068	947	1183	-1183	11.62	1.28	SWW	OSU
02-10606A	5054	1029	1183	-1183	11.14	1.37	SWW	U of I
YS 343	5042	1028	1183	-1183	11.52	1.37	SWW	Yieldstar
LCS Artdeco	4993	947	1183	-1183	10.96	1.28	SWW	LCS
Skiles	4975	947	1183	-1183	11.65	1.28	SWW	OSU
Legion	4965	947	1183	-1183	12.13	1.28	SWW	Syngenta
LWW 10-1073	4963	969	1183	-1183	12.14	1.3	SWW	LCS
LWW10-1018	4934	1029	1183	-1183	11.35	1.37	SWW	LCS
LOR 978	4924	1029	1183	-1183	12.66	1.37	SWW	OSU/Lima
AZIMUT	4917	1028	1183	-1183	12.19	1.37	HRW	LCS
ORI2101840 - 2 gen	4909	1029	1183	-1183	11.84	1.37	SWW	CEFF
OR2090533	4892	1028	1183	-1183	12.57	1.37	SWW	OSU
SY 107	4869	968	1183	-1183	12.16	1.3	SWW	Syngenta
Kaseberg	4853	947	1183	-1183	11.59	1.28	SWW	OSU
EXCEDE	4842	1028	1183	-1183	12.53	1.37	SWW	ASS-L
ORI2101841	4822	1028	1183	-1183	11.93	1.37	SWW	OSU
OR2100937	4802	1028	1183	-1183	12.29	1.37	SWW	OSU
SIETE CERROS	4797	1028	1183	-1183	10.33	1.37	SWW	UC
ORCF-102	4762	947	1183	-1183	12.21	1.28	SWW	FSD
YS 9568-A	4724	1029	1183	-1183	11.61	1.37	SWW	Yieldstar
OR2110526	4724	1029	1183	-1183	12.2	1.37	SWW	OSU
WB EXP-458	4627	1028	1183	-1183	12.92	1.37	SWW	WB
LOR 334	4599	1029	1183	-1183	12.18	1.37	SWW	OSU/Lima
Cara	4563	968	1183	-1183	12.19	1.3	Club	WSU
ORI2101840	4537	1028	1183	-1183	12.06	1.37	SWW	OSU
OR2080637	4531	968	1183	-1183	11.85	1.3	SWW	Adv 1 -13
ORCF-101	4523	969	1183	-1183	12.95	1.3	SWW	OSU
BOUNDARY	4499	1029	1183	-1183	11.09	1.37	HRW	IDAHO
Goetze	4498	947	1183	-1183	11.7	1.28	SWW	OSU
WB 436	4497	1028	1183	-1183	11.65	1.37	SWW	WB
YS 261	4486	969	1183	-1183	12.45	1.3	SWW	Yieldstar
WA 8169	4484	1029	1183	-1183	12.55	1.37	SWW	WSU
ARROWHEAD	4479	1029	1183	-1183	12.87	1.37	HRW	WB
ORI2101841 - 2 gen	4459	1029	1183	-1183	12.36	1.37	SWW	CEFF
Trifecta	4439	1029	1183	-1183	12.31	1.37	SWW	WB
WB EXP 1028 CL+	4434	1029	1183	-1183	13.55	1.37	SWW	WB
SY 71-4 (Exp)	4424	1029	1183	-1183	11.43	1.37	SWW	Syngenta
OR2100267	4382	1028	1183	-1183	12.72	1.37	SWW	OSU
Exp 427 - Stephens	4274	1029	1183	-1183	13.01	1.37	SWW	WB
WHETSTONE	4264	1029	1183	-1183	12.32	1.37	HRW	Syngenta
NORWEST 553	4248	968	1183	-1183	12.5	1.3	HRW	OSU
WINCAL 09196	4212	1028	1183	-1183	11.62	1.37	HRW	UC
WB 1070 CL	4143	968	1183	-1183	12.63	1.3	SWW	WB
RIMROCK	3999	1029	1183	-1183	12.62	1.37	HRW	WB
Exp 458	3999	1029	1183	-1183	12.68	1.37	SWW	WB
OR2101043	3904	1029	1183	-1183	13.19	1.37	SWW	OSU
YAMHILL	3811	968	1183	-1183	12.46	1.3	SWW	
ARS 010669-2C	3364	1029	1183	-1183	12.3	1.37	Club	ARS
GALGALOS	819	1029	1183	-1183	15.82	1.37	SWW	

*** Varieties have significantly higher yield than average in these trials.** **PAGE 2 of 2**

Table 4. Spring barley productivity for varieties grown during 2013, 2014 and 2015 in the Intermountain Region of California at three locations. Averages represent least squares means.

Name	Yield (lb/acre)					Type	Source
	Overall Average		Site-effect on yield				
		±	Tulelake	Lassen	Siskiyou		
BZ509-216	5125	724	817	-478	-1016	2RSF	HSG
2Ab08-X05M010-82	4765	724	817	-478	-1016	2RSM	USDA-ARS
10WA-106.19	4705	724	817	-478	-1016	2RSF	WSU
2B11-4949	4705	724	817	-478	-1016	2RSM	BARI
*** UC 1341**	**4646**	**460**	817	-478	-1016	6RSF	UCD
*** UC 1365**	**4563**	**460**	817	-478	-1016	6RSF	UCD
*** MILLENNIUM**	**4496**	**460**	817	-478	-1016	6RSF	USU
10WA-113.16	4485	724	817	-478	-1016	2RSF	WSU
*** UC 1337**	**4466**	**460**	817	-478	-1016	6RSF	UCD
10WA-106.18	4415	724	817	-478	-1016	2RSF	WSU
2B11-5166	4405	724	817	-478	-1016	2RSM	BARI
UCD 1367	4366	586	817	-478	-1016	6RSF	UCD
UCD 1370	4316	586	817	-478	-1016	6RSF	UCD
UCD 10B	4314	460	817	-478	-1016	6RSF	UCD
10WA-105.33	4295	724	817	-478	-1016	2RSF	WSU
TLB 148	4285	502	817	-478	-1016	6RSF	UCD
2B10-4378	4285	724	817	-478	-1016	2RSM	BARI
2Ab09-X06F084-51	4265	724	817	-478	-1016	2RSF-H	USDA-ARS
Steptoe	4259	448	817	-478	-1016	6RSF	WSU
Baronesse	4242	448	817	-478	-1016	2RSF	WB
UCD 1376	4236	586	817	-478	-1016	6RSF	UCD
UCD 1377	4235	502	817	-478	-1016		UCD
UCD 1342	4211	586	817	-478	-1016	6RSF	UCD
2Ab07-X031098-31	4203	585	817	-478	-1016	2RSM	USDA-ARS
UC 1393	4200	482	817	-478	-1016	6RSF	UCD
UCD 1368	4196	586	817	-478	-1016	6RSF	UCD
09WA-203.24	4193	585	817	-478	-1016	2RSF	WSU
UCD-TL20	4149	460	817	-478	-1016	6RSF	UCD
2Ab04-X01084-27	4145	724	817	-478	-1016	2RSM	USDA-ARS
UCD 1329	4121	586	817	-478	-1016	6RSF-H	UCD
X06G07-T43	4112	724	817	-478	-1016	2 row	WSU
UCD 1372	4110	502	817	-478	-1016	6RSF	UCD
UCD 1366	4041	586	817	-478	-1016	6RSF	UCD
MERIT 57	4020	460	817	-478	-1016	2RSM	BARI
UCD 1335	4015	502	817	-478	-1016	2RSM	UCD
UCD 4B	4015	502	817	-478	-1016	6RSF	UCD
2B09-3425	3988	585	817	-478	-1016	2RSM	BARI
UCD 1339	3981	460	817	-478	-1016	6RSF	UCD
BZ502-265	3977	502	817	-478	-1016	2RSF	WB
UCD 1369	3951	586	817	-478	-1016	6RSF	UCD
BZ509-448	3935	724	817	-478	-1016	2RSF	HSG
UCD 1395	3924	482	817	-478	-1016	6RSF	UCD
CONRAD	3923	460	817	-478	-1016	2RSM	BARI
UT6R2120-14	3892	724	817	-478	-1016	6 row	USU
UCD 1374	3856	586	817	-478	-1016	6RSF	UCD
UC 960	3843	460	817	-478	-1016	6RSF	UCD
RASMUSSON	3835	502	817	-478	-1016	6RSM	MN
UCD 1375	3831	586	817	-478	-1016	6RSF	UCD
Harrington	3821	501	817	-478	-1016	2RSM	SAS

*** Varieties have significantly higher yield than average.** **PAGE 1 of 2**

09WA-231.5	3808	585	817	-478	-1016	2RSF	WSU
UCD 1292	3785	502	817	-478	-1016	6RSF	UCD
PINNACLE	3773	460	817	-478	-1016	2RSM	NDSU
UCD 1330	3771	586	817	-478	-1016	6RSF-H	UCD
UCD 1363	3746	586	817	-478	-1016	6RSF	UCD
LEGACY	3737	532	817	-478	-1016	6RSM	BARI
UCD 1332	3736	460	817	-478	-1016	6RSF-H	UCD
UCD 1396	3699	586	817	-478	-1016	6RSF-H	UCD
2ND28065	3688	585	817	-478	-1016	2RSM	NDSU
UCD 1387	3674	586	817	-478	-1016	6RSF-H	UCD
Copeland	3667	460	817	-478	-1016	2RSM	ID
CELEBRATION	3659	470	817	-478	-1016	6RSM	BARI
UCD 1390	3654	586	817	-478	-1016	2RSM	UCD
2ND30724	3635	724	817	-478	-1016	2RSM	NDSU
09WA-228.13	3608	585	817	-478	-1016	2RSF	WSU
UCD 1389	3599	586	817	-478	-1016	2RSM	UCD
AC Metcalfe	3563	448	817	-478	-1016	2RSM	AG Canada
UT2136-96	3555	724	817	-478	-1016	6RSF	USU
UCD 1386	3554	586	817	-478	-1016	6RSF-H	UCD
TRADITION	3543	532	817	-478	-1016	6RSM	BARI
STELLAR-ND	3504	460	817	-478	-1016	6RSM	NDSU
UCD 1371	3486	586	817	-478	-1016	6RSF	UCD
UCD 1328	3406	586	817	-478	-1016	6RSF-H	UCD
UCD 1388	3369	586	817	-478	-1016	6RSF-H	UCD
UCD 1397	3359	586	817	-478	-1016	6RSF-H	UCD
2B10-4162	3358	585	817	-478	-1016	2RSM	BARI
UCD 1362	3351	586	817	-478	-1016	6RSF	UCD
FULL PINT	3342	587	817	-478	-1016	2RSM	OSU
2Ab08-X04M282-48	3332	724	817	-478	-1016	2 row	USDA-ARS
2Ab07-X04M219-46	3298	585	817	-478	-1016	2RSM	USDA-ARS
MT090180	3253	585	817	-478	-1016	2RSF	MSU
MT100120	3218	585	817	-478	-1016	2RSF	MSU
Harrington	3202	724	817	-478	-1016	2RSM	USDA-ARS
UT2183-85	3195	724	817	-478	-1016	6RSF	USU
MT100126	3193	585	817	-478	-1016	2RSF	MSU
QUEST	3193	460	817	-478	-1016	6RSM	MN
UCD 1373	3136	586	817	-478	-1016	6RSF	UCD
X05013-T1	3112	724	817	-478	-1016	2 row	WSU
08ID2661	3092	724	817	-478	-1016	2 row	USDA-ARS
UCD 1392	3059	586	817	-478	-1016	2RSM	UCD
2ND27705	3048	585	817	-478	-1016	2RSM	NDSU
MT090190	3033	585	817	-478	-1016	2RSF	MSU
UCD 1398	3014	586	817	-478	-1016	2RSM	UCD
UCD 1391	2964	586	817	-478	-1016	2RSM	UCD
2Ab09-X06F058HL-31	2925	724	817	-478	-1016	2RSF-H	USDA-ARS
2Ab08-X05M010-82	2902	724	817	-478	-1016	2RSM	USDA-ARS
UT2170-16	2812	724	817	-478	-1016	6 row	USU
UCD 1394	2769	586	817	-478	-1016	2RSM	UCD
09WA-249.9	2752	724	817	-478	-1016	2 row	WSU
UCD 1364	2716	586	817	-478	-1016	6RSF	UCD
2B10-4480	2672	724	817	-478	-1016	2 row	BARI
09WA-203.26	2602	724	817	-478	-1016	2RSF	WSU
CONLON	2512	587	817	-478	-1016	2RSM	NDSU
2ND25276	2452	724	817	-478	-1016	2 row	NDSU
2Ab09-X06F058HL-21	2342	724	817	-478	-1016	2RSF	USDA-ARS
2B10-4465	2162	724	817	-478	-1016	2 row	BARI
2Ab08-X04M278-35	2092	724	817	-478	-1016	2 row	USDA-ARS

*** Varieties have significantly higher yield than average.**

Table 5. 2015 Oregon Spring Elite Yield Trial (OSEYT) Yield Summary

Numbers in parentheses indicate relative rank in column.
Individual results are available in the single location summaries

Entry	Name	All Locations Yield (lbs/acre)	Tulelake Yield (lbs/acre)	Lassen Yield (lbs/acre)	Siskiyou Yield (lbs/acre)
1	WA 8217	4090 (34)	4890 (31)	4020 (27)	3350 (33)
2	Bullseye	4480 (15)	4980 (29)	5230 (2)	3220 (35)
3	SY Steelhead	4040 (38)	5220 (26)	3770 (37)	3130 (36)
4	SY 04W40292R	4600 (12)	5390 (21)	4370 (13)	4030 (11)
5	SY 3001-2	4050 (36)	4590 (36)	3890 (30)	3660 (25)
6	11 SB 0096	4430 (20)	6050 (7)	3630 (41)	3600 (26)
7	10 SB 0087-B	4130 (32)	4150 (41)	4270 (15)	3980 (13)
8	WB 9518	5090 (3)	6920 (1)	4020 (27)	4340 (5)
9	WB 9668	4440 (17)	5480 (20)	3770 (37)	4070 (8)
10	WB 9229	4350 (25)	5950 (8)	3670 (39)	3420 (31)
11	Jefferson	4080 (35)	4800 (33)	3630 (41)	3810 (20)
12	UI Winchester	3970 (39)	3700 (44)	4190 (21)	4020 (12)
13	IDO 862 E	4730 (7)	5760 (11)	3880 (32)	4550 (2)
14	IDO 862 T	4510 (14)	5520 (18)	4250 (17)	3770 (23)
15	UC 1745	3940 (41)	4520 (37)	4260 (16)	3050 (39)
16	HRS 3419	4050 (36)	5210 (27)	3880 (32)	3070 (38)
17	HRS 3504	4440 (17)	5940 (9)	3840 (35)	3530 (28)
18	HRS 3530	3960 (40)	5490 (19)	3510 (45)	2870 (43)
19	HRS 3361	3770 (44)	4470 (39)	3890 (30)	2950 (40)
20	YS 801	3130 (46)	4030 (42)	2940 (46)	2420 (46)
21	YS 802	4350 (25)	5080 (28)	3850 (34)	4130 (7)
22	Dayn	4970 (4)	5780 (10)	4580 (11)	4550 (2)
23	LCS Atomo	4790 (5)	6620 (2)	3840 (35)	3900 (17)
24	LCS Star	4210 (28)	5390 (21)	3670 (39)	3570 (27)
25	12 SB 0146	4760 (6)	6360 (5)	4080 (24)	3850 (18)
26	12 SB 0131	4180 (30)	4390 (40)	4210 (19)	3940 (15)
27	Clear White 515	3940 (41)	4710 (35)	3590 (43)	3530 (28)
28	UC 12013-22	4720 (8)	5620 (16)	4240 (18)	4300 (6)
29	UC 1744	4440 (17)	5240 (25)	4160 (23)	3910 (16)
30	UI Platinum	4450 (16)	5330 (23)	4050 (25)	3980 (13)
31	IDO 1202 S	3830 (43)	3960 (43)	4430 (12)	3110 (37)
32	YS 601	4400 (22)	6300 (6)	4010 (29)	2900 (42)
33	Alturas	4430 (20)	5320 (24)	4170 (22)	3790 (22)
34	Diva	3650 (45)	3600 (46)	3530 (44)	3810 (20)
35	Whit	4210 (28)	4520 (37)	4050 (25)	4050 (9)
36	WA 8214	4340 (27)	3660 (45)	4810 (8)	4540 (4)
37	WA 8189	4150 (31)	4870 (32)	4830 (6)	2750 (44)
38	12 SW 079	4530 (13)	5610 (17)	5030 (4)	2940 (41)
39	12 SW 052	4100 (33)	4740 (34)	5040 (3)	2520 (45)
40	12 SW 068	4400 (22)	4980 (29)	4820 (7)	3390 (32)
41	WB 6121	4690 (10)	5700 (13)	4320 (14)	4040 (10)
42	WB 6341	5300 (1)	6540 (3)	5650 (1)	3720 (24)
43	UI Stone	4700 (9)	5630 (15)	4620 (10)	3840 (19)
44	M 12001	4370 (24)	5690 (14)	4200 (20)	3230 (34)
45	IDO 851	4640 (11)	5740 (12)	4700 (9)	3480 (30)
46	WB 6430	5300 (1)	6370 (4)	4840 (5)	4690 (1)
	MEAN	4350	5240	4180	3640

Table 6. 2015 Oregon Winter Elite Yield Trial (OWEYT) Yield Summary

Entry	Name	All Locations Yield (lbs/acre)	Tulelake Yield (lbs/acre)	Siskiyou Yield (lbs/acre)
1	Stephens	4930 (25)	5250 (3)	4600 (40)
2	Tubbs-06	4560 (36)	3880 (29)	5240 (27)
3	Goetze	3610 (24)	2730 (48)	4490 (43)
4	Skiles	4510 (29)	3870 (30)	5140 (31)
5	Mary	4840 (22)	4210 (24)	5460 (19)
6	Kaseberg	3990 (23)	2770 (47)	5200 (28)
7	Ladd	4930 (37)	4480 (18)	5370 (21)
8	Rosalyn	5340 (18)	4730 (12)	5940 (9)
9	Bobtail	5340 (42)	4750 (10)	5930 (11)
10	IDN 02-29001A	4810 (2)	4290 (23)	5330 (22)
11	IDN 01-10704A	4770 (9)	4340 (21)	5200 (28)
12	UI/WSU Huffman (IDN	5180 (20)	4490 (17)	5870 (12)
13	IDN 06-18102A	4980 (9)	4630 (15)	5320 (23)
14	IDN 06-033038	4550 (11)	3630 (33)	5470 (18)
15	IDO 1108	4710 (12)	4520 (16)	4900 (36)
16	LCS Artdeco	4660 (28)	2800 (46)	6510 (2)
17	LCS Biancor	4680 (40)	3000 (42)	6350 (4)
18	LWW 10-1073	3970 (26)	3900 (28)	4040 (52)
19	LWW 12-7105	4850 (16)	3090 (39)	6600 (1)
20	LWW 11-431	4670 (48)	3760 (31)	5580 (16)
21	YS 221	4490 (7)	4880 (8)	4100 (49)
22	YS 261	3380 (35)	2710 (49)	4050 (51)
23	YS 9568-A	4080 (30)	3010 (41)	5150 (30)
24	WB Trifecta	4900 (41)	3950 (27)	5850 (13)
25	WB 1529	5500 (3)	5140 (5)	5850 (13)
26	WB 1604	5370 (52)	5210 (4)	5520 (17)
27	Legion	3550 (49)	3000 (42)	4100 (49)
28	SY 107	3660 (6)	2490 (50)	4830 (37)
29	SY Ovation	5470 (32)	4710 (13)	6220 (5)
30	SY 96-2 (Exp)	4910 (19)	5020 (6)	4800 (38)
31	SY 71-4 (Exp)	3780 (47)	3310 (37)	4250 (48)
32	Puma (WA 8134)	4760 (50)	4920 (7)	4590 (41)
33	WA 8169	3840 (32)	3410 (36)	4270 (47)
34	DAS 003	4460 (51)	3490 (35)	5420 (20)
35	DAS 004	4490 (44)	4440 (19)	4530 (42)
36	ORCF-101	3670 (34)	2950 (44)	4390 (45)
37	ORCF-102	4020 (12)	3050 (40)	4990 (35)
38	WB EXP 1028 CL+	3790 (5)	2330 (52)	5250 (26)
39	WB EXP 1030 CL+	5410 (55)	4740 (11)	6080 (7)
40	OR2080641	4590 (14)	4040 (25)	5140 (31)
41	OR2090473	5510 (31)	4650 (14)	6360 (3)
42	OR2100940	5070 (39)	4030 (26)	6100 (6)
43	OR2080637	3350 (53)	2900 (45)	3790 (53)
44	OR2101043	3260 (45)	2080 (53)	4440 (44)
45	OR2110526	4080 (16)	2360 (51)	5800 (15)
46	LOR 978	4280 (26)	3550 (34)	5010 (34)
47	LOR 913	4840 (4)	4400 (20)	5280 (24)
48	LOR 833	5180 (8)	4340 (21)	6010 (8)
49	LOR 334	3960 (54)	3160 (38)	4750 (39)
50	LOR 092	6290 (37)	6640 (1)	5940 (9)
51	TUBBS	4930 (1)	4830 (9)	5020 (33)
52	BRUNEAU	4010 (15)	3650 (32)	4370 (46)
53	YAMHILL	2700 (21)	2070 (54)	3320 (54)
54	KELDIN	5640 (43)	6020 (2)	5260 (25)
	MEAN	4540	3900	5170

Numbers in parentheses indicate relative rank in column.
Individual results are available in the single location summaries.

Table 7. 2015 Spring Barley Yield Summary

Name	Tulelake Yield (lbs/acre)	Lassen Yield (lbs/acre)	Siskiyou Yield (lbs/acre)
STEPTOE	4170 (13)	4430 (8)	3510 (5)
HARRINGTON	3760 (22)	4390 (10)	2820 (13)
BARONESSE	4710 (3)	4350 (12)	2500 (18)
UC 960	3870 (19)	4140 (17)	2990 (11)
MILLENNIUM	4490 (6)	4840 (4)	4600 (1)
CONRAD	4200 (11)	4830 (5)	2550 (17)
TRADITION	3900 (17)	4150 (16)	2160 (20)
LEGACY	4810 (2)	3960 (20)	2020 (22)
AC Metcalfe	4120 (15)	4050 (19)	2180 (19)
CDC COPELAND	3930 (16)	4430 (8)	2680 (16)
CONLON	2830 (26)	2790 (26)	-
MERIT 57	4640 (4)	4570 (7)	3170 (7)
PINNACLE	3730 (23)	3670 (25)	3130 (8)
CELEBRATION	4190 (12)	4310 (13)	-
STELLAR-ND	3900 (17)	3880 (22)	3130 (8)
QUEST	3830 (21)	4140 (17)	1300 (23)
OSU-FULL PINT	3370 (24)	3910 (21)	-
UCD-TL20	3850 (20)	4240 (15)	2720 (15)
UCD 10B	4580 (5)	4960 (3)	3500 (6)
UCD 1332	3040 (25)	3820 (24)	2810 (14)
UCD 1337	4460 (7)	5030 (2)	4280 (2)
UCD 1339	4170 (13)	3860 (23)	2850 (12)
UCD 1341	5040 (1)	5210 (1)	3080 (10)
UCD 1365	4270 (9)	4650 (6)	4100 (3)
UCD 1393	4430 (8)	4380 (11)	3670 (4)
UCD 1395	4250 (10)	4290 (14)	2130 (21)
MEAN	4098	4280	2951

Numbers in parentheses indicate relative rank in column.
Individual results are available in the single location summaries.

Oat Seed Production in the Tulelake Basin: Supporting California's Oat Seed Needs

Cal Qualset
Department of Plant Sciences, UC Davis

Oat production in California is primarily used as a forage for animal feed, usually dairy cattle and horses. Growers of oat hay generally do not harvest any of their crop for seed for planting the next crop. Hence, there is a need for oat seed. The needs are not very great, but a few seed companies can profitably supply the needs. The planted acreage is not estimated very well and the CDFA statistics are based on acreage harvested for grain. That is probably about 10% of the planted acreage, so a few hundred thousand acres are planted each year. Oat is also used in forage blends with barley, wheat and triticale. The amount of this usage is unknown. Finally, another use for oat is in vineyards where it is turned under as green manure. This usage is small, but oat also appears in blends.

The Tulelake Basin is a highly productive environment for spring-planted small grain crops. Yields of 4-5 tons/acre are common. This area may be a seed production area for oat production in lower California. We have conducted yield trials with oat varieties over the past few decades. Recently, we have completed, and have in progress, a small replicated study using varieties released in 2007 along with old standard varieties. With the seed production goal in mind we have used several seeding rates because in some instances the seed supply may be limited, as with a new variety, and low seeding rates would be desired if the production was sufficient.

The results from one study done in 2005 and one in 2007 at IREC are summarized in Tables 1 and 2, respectively. These results show grain yield performance. Information about forage yields are presented in an Agronomy Progress Report[1]. The varieties included in the studies are relevant for California production. Both tall and short-statured varieties have been recently released and generally show an advantage over the older check varieties, California Red and Montezuma.

In 2005 the low seeding rate was comparable or even a little better than the higher seeding rate. In 2007 there was a progressive increase in grain yield with increasing seeding rate. It is noteworthy that the low seeding rate, 10 to 20 seeds/ft^2 or 10 to 25 lb/acre, produced grain yields exceeding 2 t/acre. If seed supply is limited, these seeding rates would result in a substantial multiplication of seed supply. Such low seed rates may cause some management problems, such as weed control. The customary seed rate of 100 lb/acre resulted in the highest yields for all of the new varieties and Montezuma. The advantage over 50 lb/acre seed rate was small, suggesting that reducing seed rate from 100 lb/acre may be considered.

[1] Qualset, C.O., P.K.Zwer, L. Federizzi, J. Heaton, H.E. Vogt, L.F. Jackson, and D. Putnam. 2012. *Enhancing diversity and productivity of the California oat crop:Eight new varieties*. Agronomy Progress Report No. 305. University of California, Department of Plant Sciences, Davis, CA. 27 p.

TABLE 2. GRAIN YIELD AND PLANT HEIGHT FOR OAT VARIETIES PLANTED AT FOUR SEEDING RATES*

Variety	GRAIN YIELD, lbs/ac						Plant Height
	Seeding Rate*						
	10	25	50	100	Mean	% Mtza	inches
Montezuma (Mtza)	3120	3680	3980	4700	3800	100	43
Cal Red	1960	2520	2940	2980	2600	68	46
UC 128	3700	4320	4740	5500	4560	118	43
UC 129 (Mac)	3120	4480	4700	4880	4300	111	42
UC 130	3620	4580	4700	5280	4540	117	38
UC 148	3100	4140	4560	4980	4200	108	36
UC 113	4240	5200	4520	5180	4780	120	34
UC 125	3980	5220	4980	5200	4840	125	34
UC 142 (Howard)	2980	3640	3980	4420	3760	97	32
UC 132	3260	4400	4640	4960	4320	111	29
Mean	3300	4220	4380	4800	4180		

*Seeding Rates 10, 25, 50 and 100 lb/acre = 5, 10, 20, 40 seeds/ft^2 at IREC 2007

Exp. 07201, Tulelake 2007, means of 3 replications.

TABLE 1. GRAIN YIELD, HEIGHT, AND LODGING FOR OAT VARIETIES PLANTED AT TWO SEEDING RATES*

Variety	GRAIN YIELD, lbs/ac				Plant Height	Lodging
	Seeding Rate: seeds/ft^2*					
	20	40	Mean	% Mtza	inches	%
UC 113	7840	6660	7250	131	39	0
UC 125	7190	7090	7140	129	40	0
UC 128	6630	6510	6570	118	48	3
UC 129 (Mac)	6510	6110	6310	114	48	0
UC 130	5540	5430	5480	99	38	0
UC 132	5150	4020	4580	82	32	0
UC 142 (Howard)	5780	5320	5550	100	36	47
UC 148	5670	5230	5450	98	38	0
Cal Red	3970	4500	4240	76	56	58
Montezuma (Mtza)	5570	5530	5550	100	48	25
Pert	6770	6720	6740	121	42	0
Bates 89	5670	5370	5520	99	47	0
Cayuse	6720	6270	6500	117	47	20
Mean	6080	5750	5920			

*Planted at two seeding rates (20 seeds/ft^2 = 50 lbs/ac; 40 seeds/ft^2 = 100 lbs/ac) at IREC 2005

Exp. 05202, Tulelake 2005, means of 4 replications.

Influence of Cover Crops and Organic Amendments on Nutrient Levels and Pests in Organic Potatoes

Rob Wilson, Intermountain REC Director/Farm Advisor

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 growers have few pest management and fertilization options compared to conventional production. Organic producers often take two approaches to increase soil fertility and manage pests in potatoes. One approach is to apply certified amendments such as organically approved fertilizers and organically approved disease controls shortly before planting and during the growing season. The other approach is to grow cover crops to increase nutrient levels and decrease pest levels before potato planting.

Amendments offer growers the advantage of continually harvesting cash crops before potatoes, but they have the disadvantage of being expensive. Cover crops offer a holistic set of soil benefits, but cover crops require growers to incorporate crop residues instead of harvesting them as a cash crop. In many situations, land and water in California is too valuable to rationalize growing cover crops, but limited surface water availability and low commodity crops in recent years has many producers comparing the benefits of cover crops to the cash value of crops.

This study is designed to evaluate different cover crops and determine which ones are best adapted to California potato production under irrigated and non-irrigated conditions. Studies will estimate the nutrient credits from cover crops grown with and without irrigation. Studies will also estimate the influence of cover crops on potato weeds and diseases. A study was conducted at IREC in 2014-15 with a singular focus of estimating the nitrogen credit from cool-season cover crops and organic amendments. The 2014-15 study identified several nitrogen fixing cover crops that added more than 150 lbs of nitrogen per acre in the soil (Figures 1, 2, and 3). Potatoes responded favorably when grown in cover crop residues, and potato petiole nitrate levels and potato yields for many cover crop and amendment treatments were similar to the conventional fertilizer controls (Figures 4 - 7). Preliminary yields from spring cover plots are presented in Figure 8.

Study objectives for 2016-2017:

- Continue to evaluate promising cool-season cover crops investigated in 2014-15 and expand the scope of investigations to include dryland vs. irrigated production and the influence of cover crops on weeds and potato diseases
- Evaluate warm-season legumes such as cowpeas
- Evaluate disease suppressing cover crops such as mustards and radishes used alone and combination with legumes
- Compare cover crop and organic amendment treatment effects on soil fertility, potato yield, potato quality, and potato pests

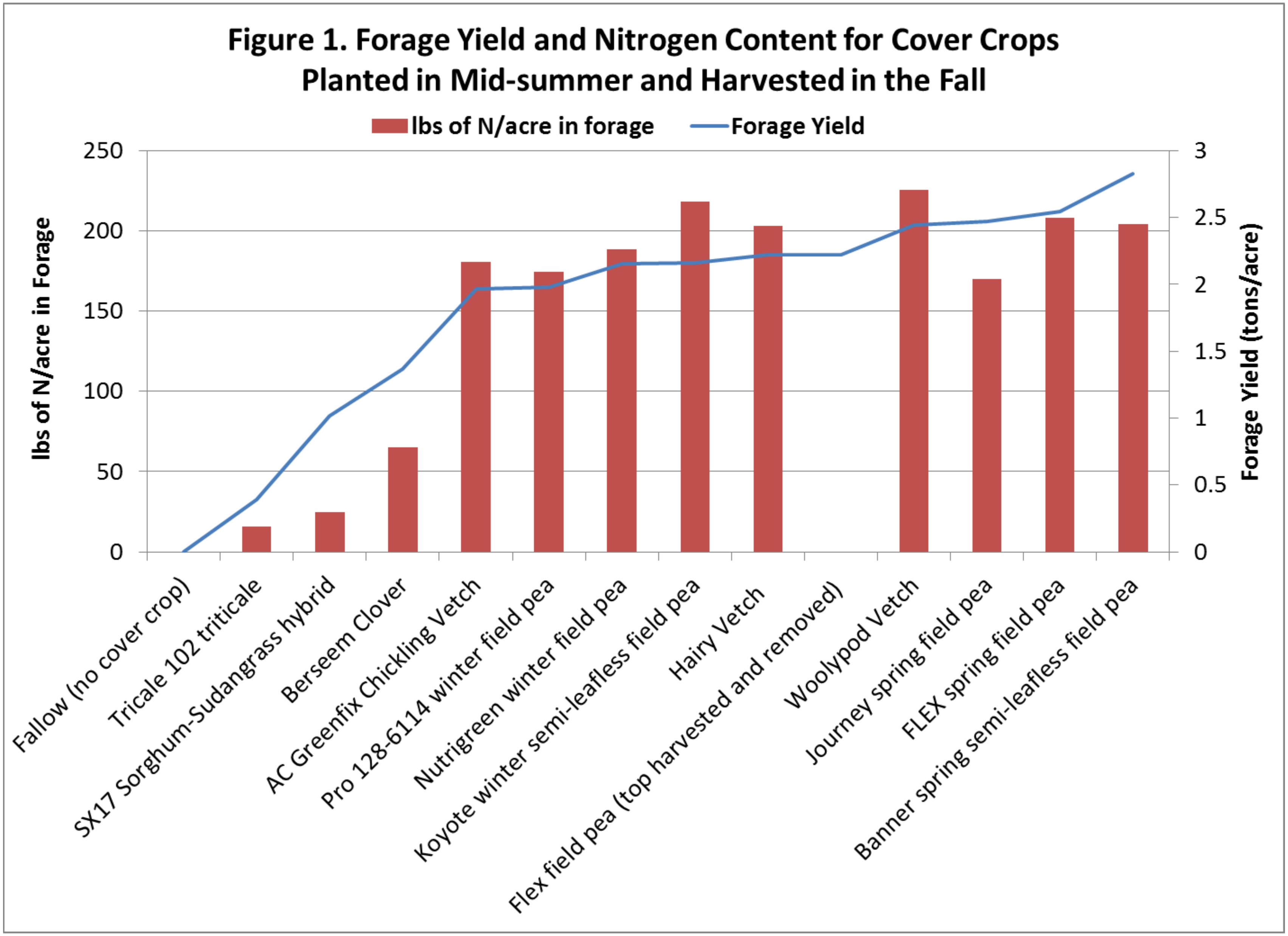


Figure 1. Forage Yield and Nitrogen Content for Cover Crops Planted in Mid-summer and Harvested in the Fall
lbs of N/acre in forage
Forage Yield
lbs of N/acre in Forage
Forage Yield (tons/acre)
250
200
150
100
50
0
3
2.5
2
1.5
1
0.5
0
Fallow (no cover crop)
Tricale 102 triticale
SX17 Sorghum-Sudangrass hybrid
Berseem Clover
AC Greenfix Chickling Vetch
Pro 128-6114 winter field pea
Nutrigreen winter field pea
Koyote winter semi-leafless field pea
Hairy Vetch
Flex field pea (top harvested and removed)
Woolypod Vetch
Journey spring field pea
FLEX spring field pea
Banner spring semi-leafless field pea

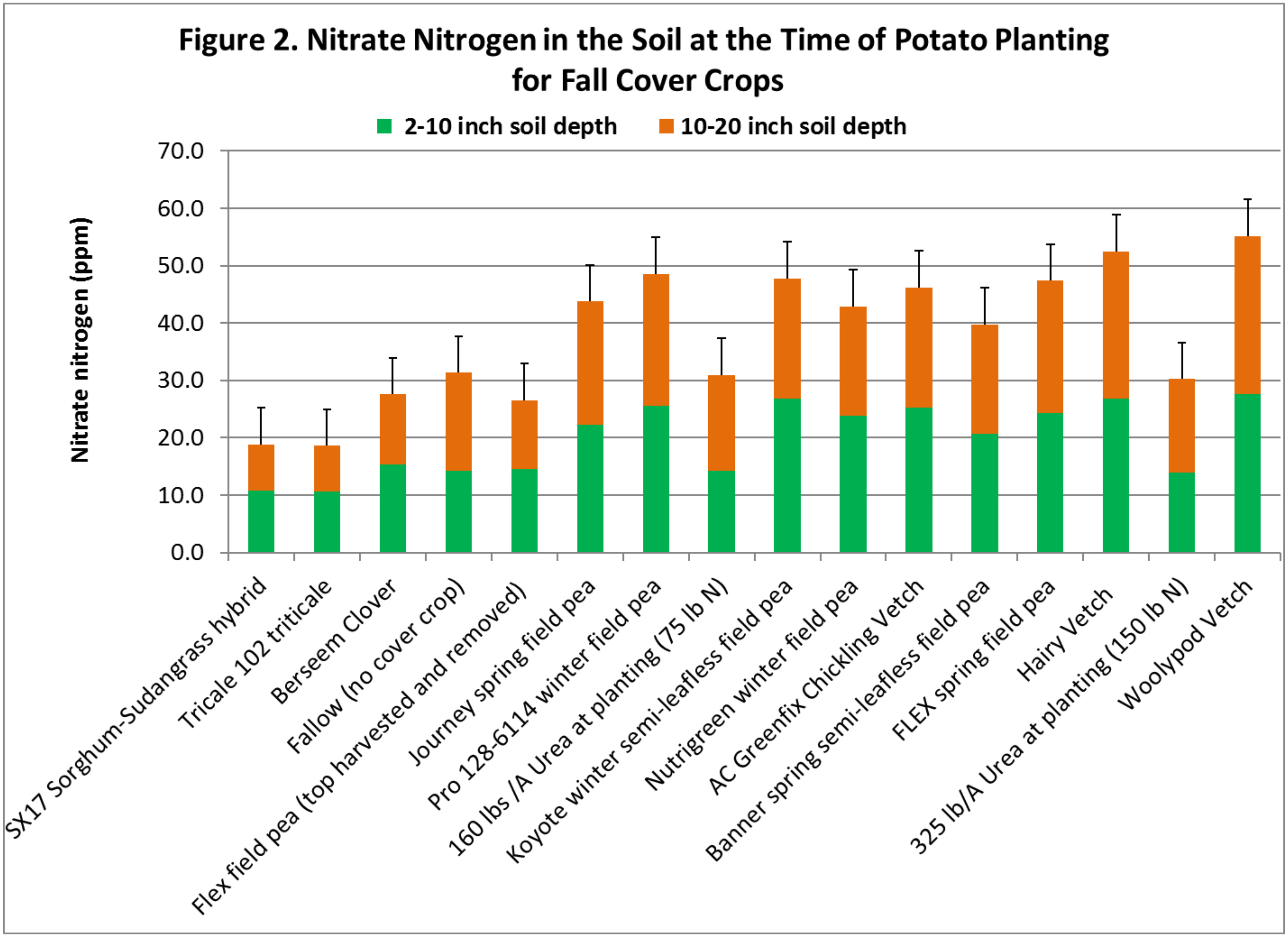


Figure 2. Nitrate Nitrogen in the Soil at the Time of Potato Planting for Fall Cover Crops
2-10 inch soil depth
10-20 inch soil depth
Nitrate nitrogen (ppm)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
SX17 Sorghum-Sudangrass hybrid
Tricale 102 triticale
Berseem Clover
Fallow (no cover crop)
Flex field pea (top harvested and removed)
Journey spring field pea
Pro 128-6114 winter field pea
160 lbs /A Urea at planting (75 lb N)
Koyote winter semi-leafless field pea
Nutrigreen winter field pea
AC Greenfix Chickling Vetch
Banner spring semi-leafless field pea
FLEX spring field pea
Hairy Vetch
325 lb/A Urea at planting (150 lb N)
Woolypod Vetch

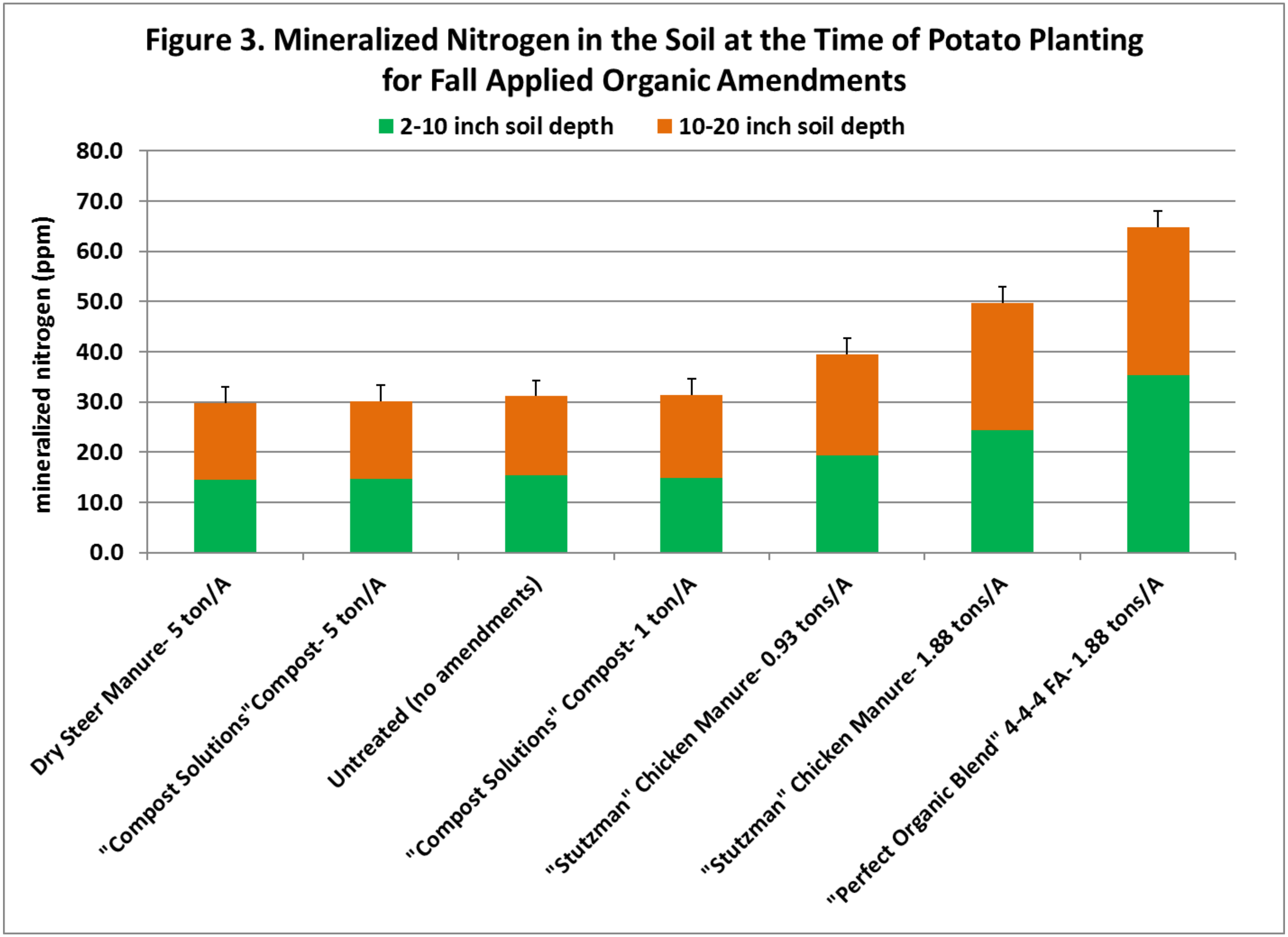


Figure 3. Mineralized Nitrogen in the Soil at the Time of Potato Planting for Fall Applied Organic Amendments
2-10 inch soil depth
10-20 inch soil depth
mineralized nitrogen (ppm)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Dry Steer Manure- 5 ton/A
"Compost Solutions"Compost- 5 ton/A
Untreated (no amendments)
"Compost Solutions" Compost- 1 ton/A
"Stutzman" Chicken Manure- 0.93 tons/A
"Stutzman" Chicken Manure- 1.88 tons/A
"Perfect Organic Blend" 4-4-4 FA- 1.88 tons/A

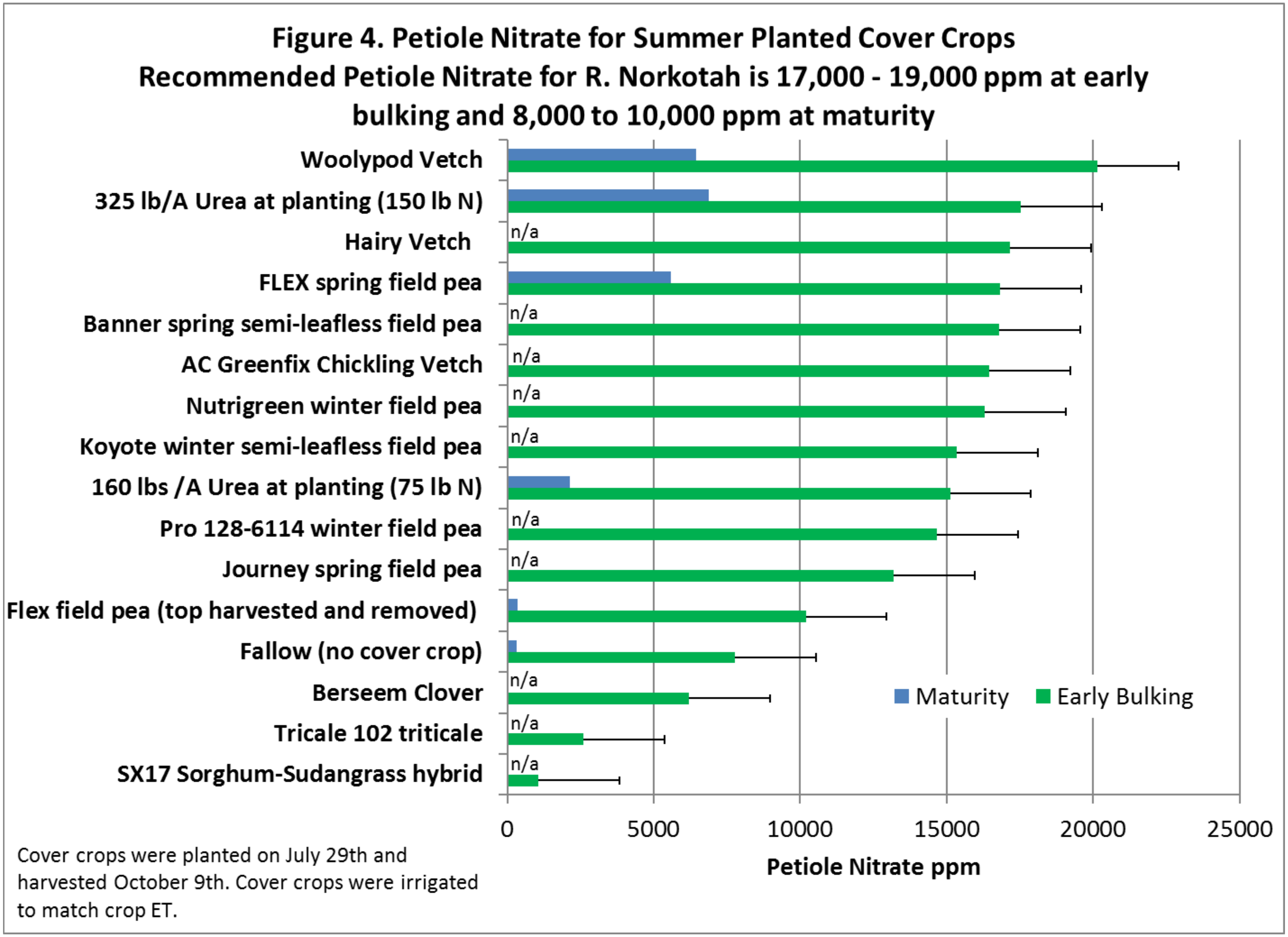


Figure 4. Petiole Nitrate for Summer Planted Cover Crops
Recommended Petiole Nitrate for R. Norkotah is 17,000 - 19,000 ppm at early bulking and 8,000 to 10,000 ppm at maturity
Woolypod Vetch
325 lb/A Urea at planting (150 lb N)
Hairy Vetch
FLEX spring field pea
Banner spring semi-leafless field pea
AC Greenfix Chickling Vetch
Nutrigreen winter field pea
Koyote winter semi-leafless field pea
160 lbs /A Urea at planting (75 lb N)
Pro 128-6114 winter field pea
Journey spring field pea
Flex field pea (top harvested and removed)
Fallow (no cover crop)
Berseem Clover
Tricale 102 triticale
SX17 Sorghum-Sudangrass hybrid
n/a
Maturity
Early Bulking
0
5000
10000
15000
20000
25000
Petiole Nitrate ppm
Cover crops were planted on July 29th and harvested October 9th. Cover crops were irrigated to match crop ET.

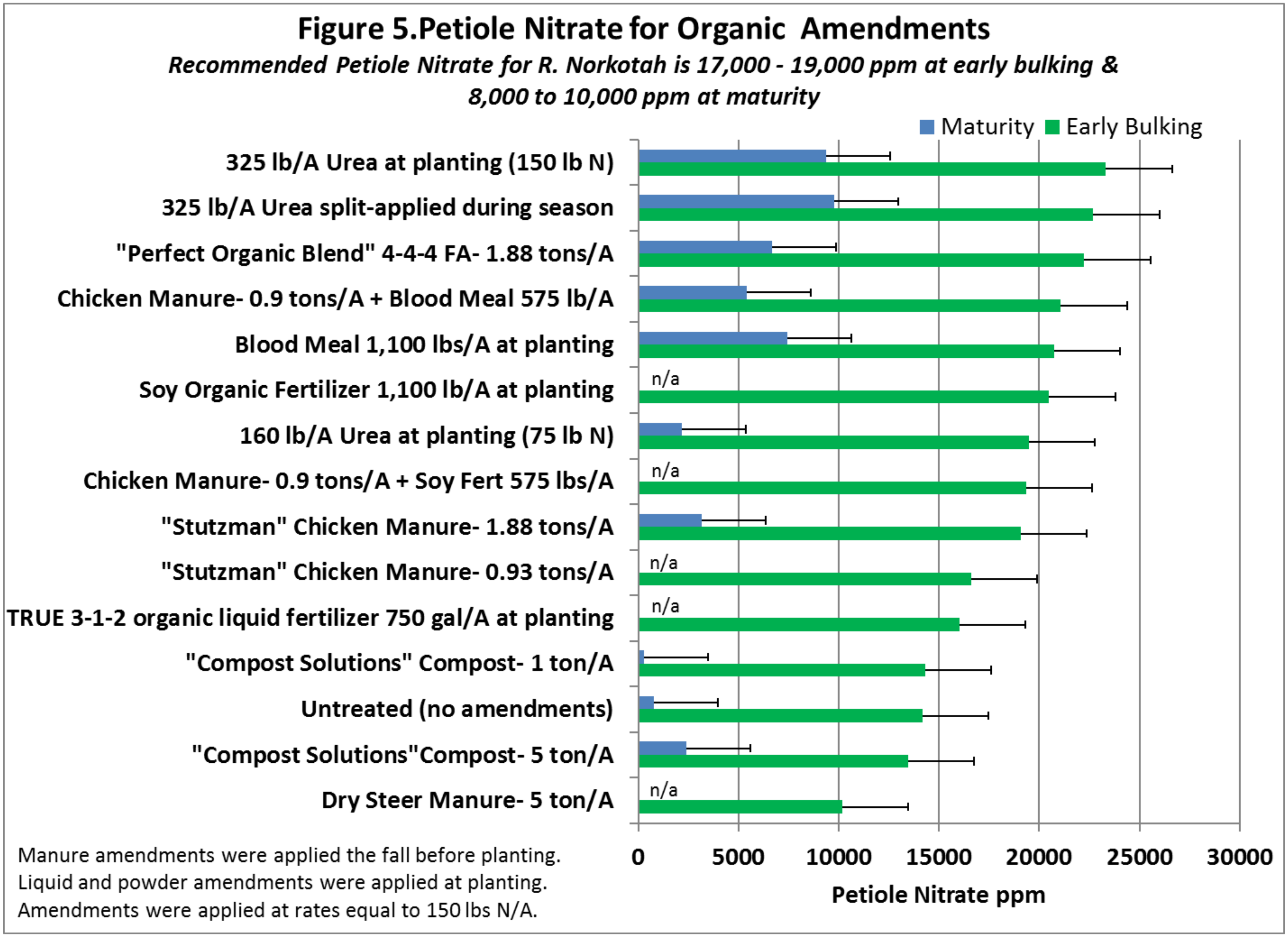
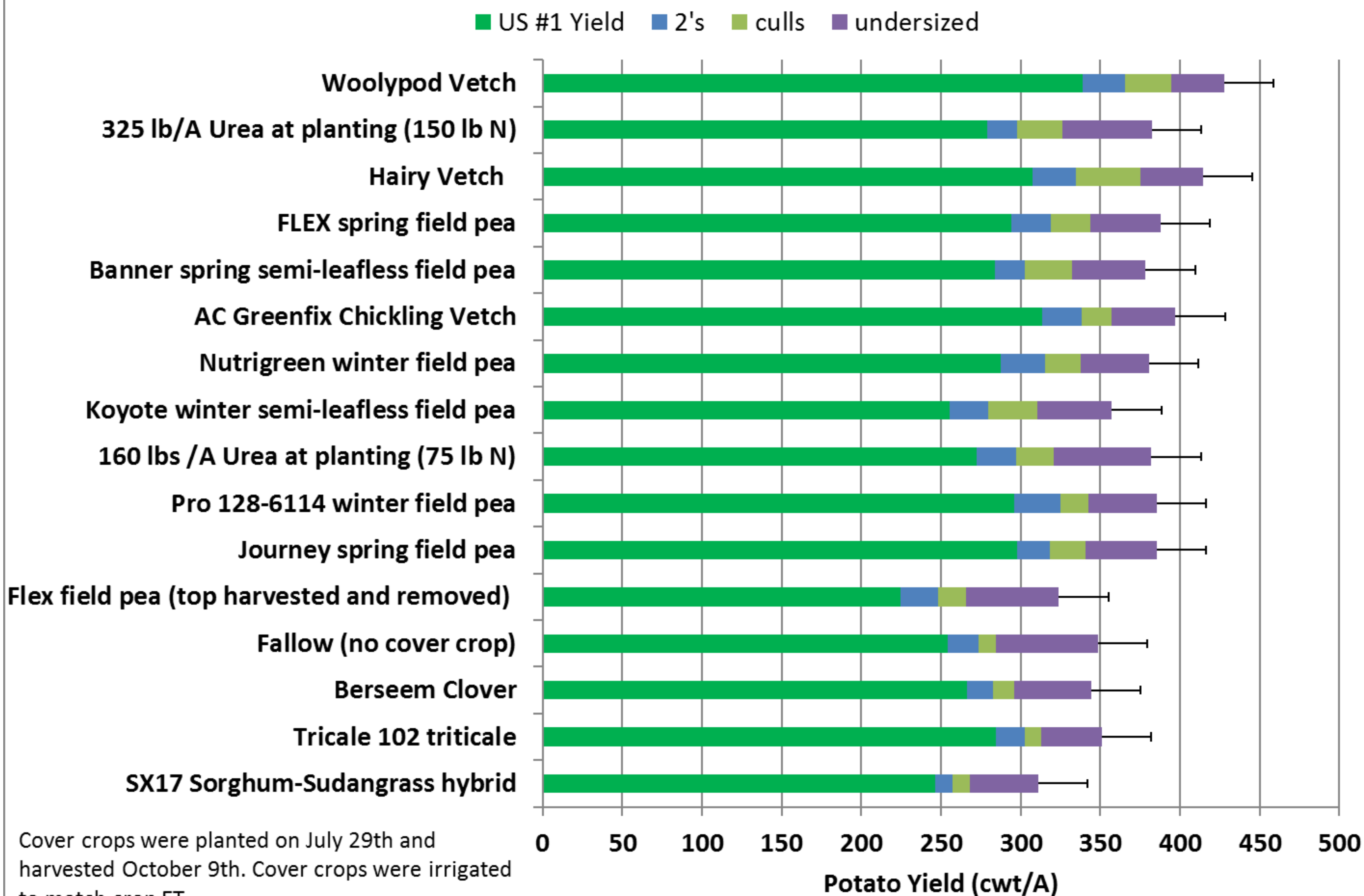


Figure 5.Petiole Nitrate for Organic Amendments
Recommended Petiole Nitrate for R. Norkotah is 17,000 - 19,000 ppm at early bulking &
8,000 to 10,000 ppm at maturity
Maturity
Early Bulking
325 lb/A Urea at planting (150 lb N)
325 lb/A Urea split-applied during season
"Perfect Organic Blend" 4-4-4 FA- 1.88 tons/A
Chicken Manure- 0.9 tons/A + Blood Meal 575 lb/A
Blood Meal 1,100 lbs/A at planting
Soy Organic Fertilizer 1,100 lb/A at planting
160 lb/A Urea at planting (75 lb N)
Chicken Manure- 0.9 tons/A + Soy Fert 575 lbs/A
"Stutzman" Chicken Manure- 1.88 tons/A
"Stutzman" Chicken Manure- 0.93 tons/A
TRUE 3-1-2 organic liquid fertilizer 750 gal/A at planting
"Compost Solutions" Compost- 1 ton/A
Untreated (no amendments)
"Compost Solutions"Compost- 5 ton/A
Dry Steer Manure- 5 ton/A
n/a
n/a
n/a
n/a
n/a
0
5000
10000
15000
20000
25000
30000
Petiole Nitrate ppm
Manure amendments were applied the fall before planting.
Liquid and powder amendments were applied at planting.
Amendments were applied at rates equal to 150 lbs N/A.

Figure 6. Potato Yield for Summer Planted Cover Crops



Cover crops were planted on July 29th and harvested October 9th. Cover crops were irrigated to match crop ET.

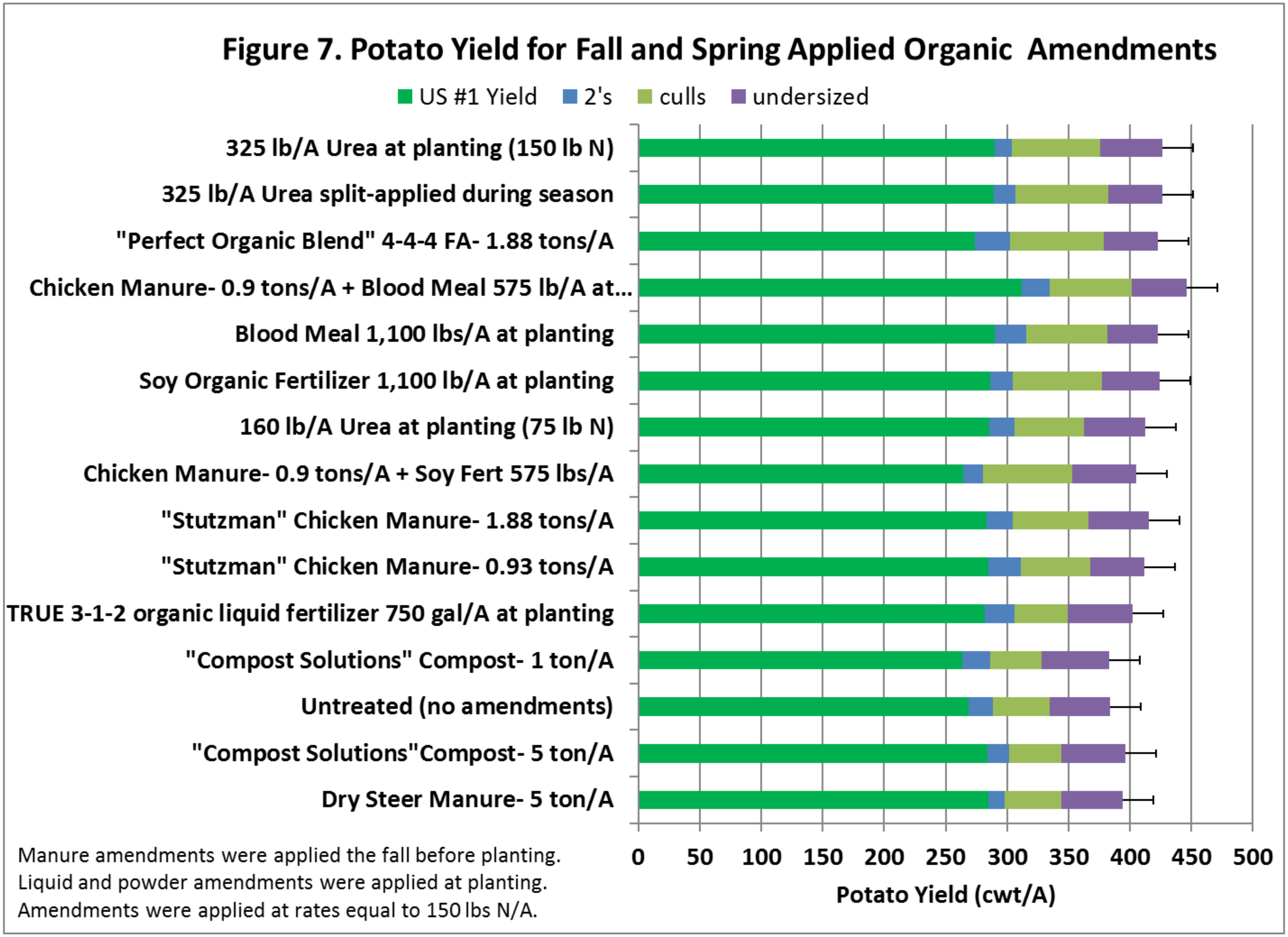


Figure 7. Potato Yield for Fall and Spring Applied Organic Amendments
US #1 Yield
2's
culls
undersized
325 lb/A Urea at planting (150 lb N)
325 lb/A Urea split-applied during season
"Perfect Organic Blend" 4-4-4 FA- 1.88 tons/A
Chicken Manure- 0.9 tons/A + Blood Meal 575 lb/A at...
Blood Meal 1,100 lbs/A at planting
Soy Organic Fertilizer 1,100 lb/A at planting
160 lb/A Urea at planting (75 lb N)
Chicken Manure- 0.9 tons/A + Soy Fert 575 lbs/A
"Stutzman" Chicken Manure- 1.88 tons/A
"Stutzman" Chicken Manure- 0.93 tons/A
TRUE 3-1-2 organic liquid fertilizer 750 gal/A at planting
"Compost Solutions" Compost- 1 ton/A
Untreated (no amendments)
"Compost Solutions"Compost- 5 ton/A
Dry Steer Manure- 5 ton/A
0
50
100
150
200
250
300
350
400
450
500
Potato Yield (cwt/A)
Manure amendments were applied the fall before planting.
Liquid and powder amendments were applied at planting.
Amendments were applied at rates equal to 150 lbs N/A.

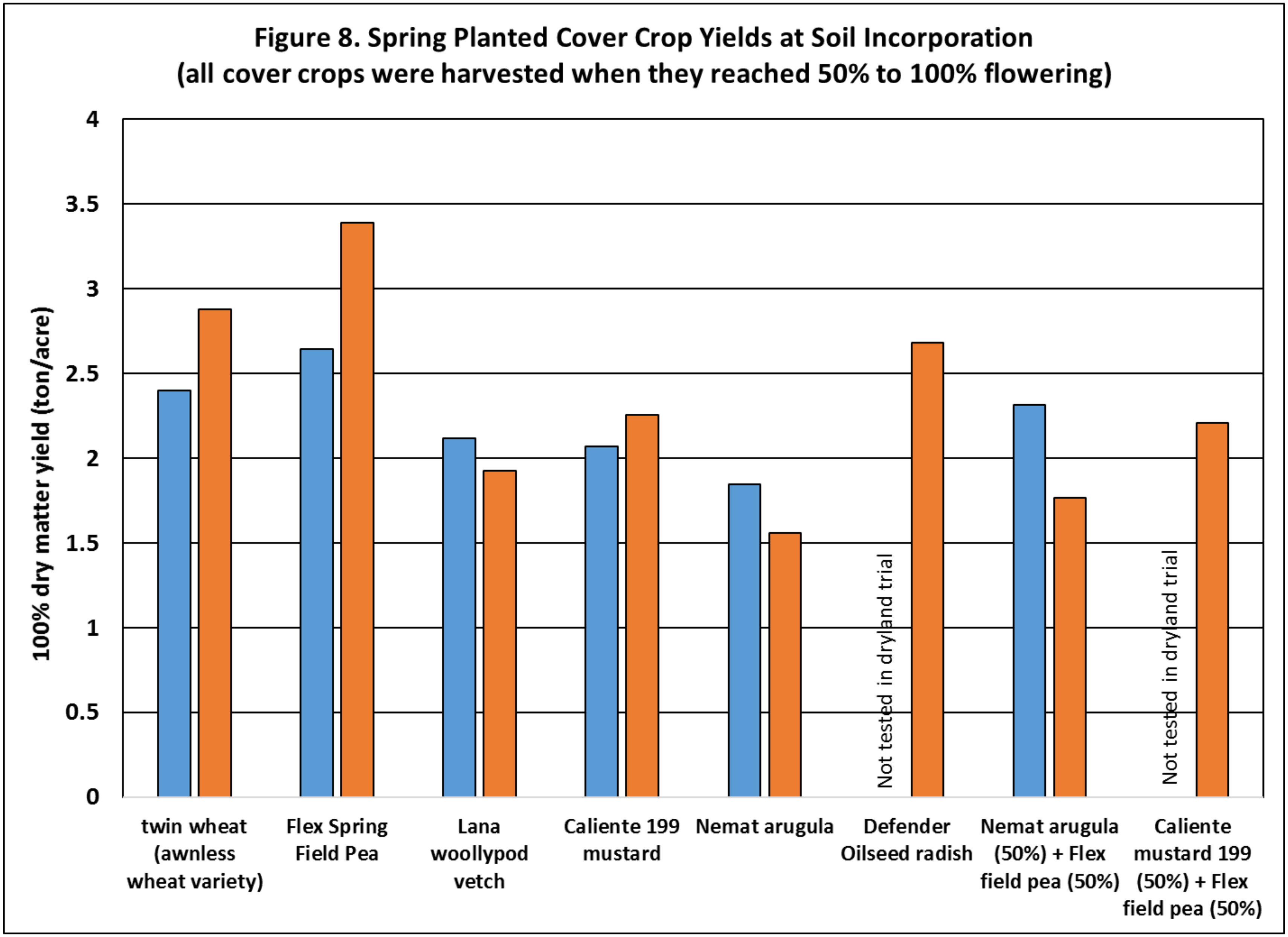


Figure 8. Spring Planted Cover Crop Yields at Soil Incorporation
(all cover crops were harvested when they reached 50% to 100% flowering)
100% dry matter yield (ton/acre)
4
3.5
3
2.5
2
1.5
1
0.5
0
Not tested in dryland trial
Not tested in dryland trial
twin wheat (awnless wheat variety)
Flex Spring Field Pea
Lana woollypod vetch
Caliente 199 mustard
Nemat arugula
Defender Oilseed radish
Nemat arugula (50%) + Flex field pea (50%)
Caliente mustard 199 (50%) + Flex field pea (50%)

Management of Seedcorn Maggot and Onion Maggot in Processing Onions

Rob Wilson, Intermountain REC Director/Farm Advisor

Maggots (the larval stage of flies) including the onion maggot, *Delia antiqua*, and the seed corn maggot, *Delia platura*, are perennial pests in Klamath Basin onion fields. Larvae attack seedlings and young onion plants feeding on the developing epicotyls and roots. A single maggot can kill up to 10 seedlings, and high maggot populations can result in greater than 50% onion stand loss. Seedcorn maggot damage was particularly bad in 2015 and 2016, and many growers experienced greater than 15% stand loss regardless of insecticide choice or field location.

Insecticide application at planting via seed treatment or in-furrow spray is the most effective control option. From 2011 to 2013, IREC staff conducted multiple insecticide trials evaluating different insecticides and insecticide application methods for controlling maggots in onion. Onion stands were less than 30% of the onion seeding rate every year in the untreated control. Conversely, onion stands were 50% to 60% of the onion seeding rate when chlorpyrifos (Lorsban) was applied in-furrow. Spinosad and clothianidin seed treatments provided the best protection from maggot stand loss with onion stands 65% to 75% of the onion seeding rate.

Results from the 2011-2013 clearly showed insecticide treatments protect onions from maggot feeding. They also showed seed treatments with spinosad or clothianidin were the most effective treatment option. Clothianidin became commercially available for processing onions in early 2016. Spinosad has been available for several years. Both insecticide seed treatments are very expensive for processing onion growers ($150+/acre) which has limited grower adoption. Early adopters of insecticide seed treatments have also complained some seed treatment formulations cause planter problems.

A maggot control study was started in 2016 at the Intermountain Research and Extension Center with funding support from the California Garlic and Onion Research Board. The first objective is to evaluate different spinosad seed treatment methods to determine if there are better methods for applying spinosad than those currently used in Tulelake. The second objective is to test new active ingredients in California for maggot control in onions. Chlorpyrifos (Lorsban) use in California is restricted or banned in multiple locations, and US EPA is considering additional chlorpyrifos use restrictions due to environmental concerns. The 2016 study is evaluating four unregistered active ingredients spinetoram, abamectin, cyantraniliprole, and bifenthrin. These insecticides have shown promise for maggot control in other research studies. The preceding crop at the study site was alfalfa which was rototilled a couple months before planting the onions. The abundant decaying organic matter after alfalfa stand removal created optimal conditions to attract maggot flies. During May and June, sticky traps placed throughout the trial area captured high numbers of seed corn maggot and low numbers of onion maggot flies in 2016.

Preliminary onion stand results from the 2016 study are presented in the Table below. Insecticide seed treatments with clothianidin or spinosad provided the best protection from maggot related onion stand loss. Bifenthrin was the top-performing insecticide for in-furrow application. Unfortunately, this insecticide is not currently labeled in California onions. An interesting result from 2016 is the significant difference in onion stand between different spinosad seed treatment methods. Spinosad encrustment treatments had higher onion stand compared to both min-pellet and full-size pellet spinosad treatments. Onion yield and final onion stand at harvest data will be collected this fall.

Improving Insecticide Control of Maggots in Tulelake Onions- 2016 IREC trial

			1-leaf stage		3-leaf stage	
Trt#	Insecticide and in-furrow application rate	Application Method	Onion Stand plants/plot	% of total seeding rate	Onion Stand plants/plot	% of total seeding rate
4	Cornell FI500 without fungicide package (spinosad + thiamethoxam + thira	Seed treatment (encrustment)	803	67 %	871	73 %
8	Cornell Sepresto (imidacloprid + clothinidin + thiram)	Seed treatment (encrustment)	801	67 %	820	68 %
2	Commercial OI100 (spinosad + thiram)	Seed treatment (encrustment)	820	68 %	813	68 %
9	Commercial Sepresto (imidacloprid + clothinidin +thiram)	Seed treatment (mini-pellet)	758	63 %	813	68 %
5	Commercial FI500 (Spinosad, thiamethoxam, syngenta fungicide package)	Seed treatment (encrustment)	754	63 %	812	68 %
13	Commercial Sepresto + Lorsban 32 fl. oz/A	Seed treatment (mini-pellet) and Lorsban In-furrow	803	67 %	803	67 %
20	Capture LFR (bifenthrin)	Thiram seed & Capture In-furrow	789	66 %	791	66 %
1	Cornell OI100 (spinosad + thiram)	Seed treatment (encrustment)	756	63 %	775	65 %
14	Lorsban liquid 32 fl. oz/A	Thiram seed & Lorsban post-plant soil drench	746	62 %	775	65 %
11	Commercial OI100 + Lorsban 32 fl. oz/A	Seed treatment (encrustment) & Lorsban in-furrow	761	63 %	761	63 %
10	Lorsban liquid (chlorpyrifos) 32 fl. oz/A	Thiram seed & In-furrow	777	65 %	738	61 %
3	Commercial OI100 (spinosad + thiram)	Seed treatment (mini-pellet)	709	59 %	733	61 %
7	Commercial FI500 (Spinosad, thiamethoxam, syngenta fungicide package)	Seed treatment (full-pellet)	706	59 %	728	61 %
17	Agri-Mek (abamectin) 3.5 fl. oz/A	Thiram seed & Agri-Mek in-furrow	728	61 %	718	60 %
16	Radiant (spinetoram) 20 fl. oz/A	Thiram seed & Radiant in-furrow	667	55 %	695	58 %
19	Verimark (cyantraniliprole) 13.5 fl. oz/A & Exirel (cyazypyr) 20 oz/A	Thiram seed & Verimark in-furrow & Exirel soil drench	664	55 %	691	58 %
6	Commercial FI500 (Spinosad, thiamethoxam, Syngenta fungicide package)	Seed treatment (mini-pellet)	690	57 %	687	57 %
21	Thiram Check	Thiram seed	679	57 %	674	56 %
15	Radiant (spinetoram) 10 fl. oz/A	Thiram seed & Radiant in-furrow	665	55 %	667	56 %
12	Commercial F1500 + liquid Lorsban	Seed (minipellet) & Lorsban in-furrow	673	56 %	658	54 %
18	Verimark (cyantraniliprole) 13.5 fl. oz/A	Thiram seed & Verimark in-furrow	628	52 %	657	55 %
		95% Confidence Interval	**72**	**6 %**	**70**	**6 %**

* Commercial seed treatments were provided by Skagitt Seed Services. All commercial seed treatments were tested for % germination and there were no treatment differences at the time of planting. Cornell seed treatments were provided by Alan Taylor using the same protocol as treatments applied at IREC from 2011-2013.

** Yellow sticky traps were placed on the field edge and changed weekly from planting until maggot fly counts reached minimal numbers. Seed corn maggot flies were captured in high numbers during onion establishment. Onion maggot flies were also captured in lower numbers during establishment.

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

Rob Wilson, Intermountain REC Director/ Farm Advisor

White rot, caused by the soilborne fungus *Sclerotium cepivorum*, is a devastating disease of garlic and onion in California that threatens the sustainability of California's onion and garlic industry without effective controls. The pathogen propagates by the production of round, poppy seed-sized sclerotia produced on the roots of decayed host plants. Growers lack effective management options for white rot except avoiding infested fields and preventing the spread of the disease. Soil fumigants are no longer available or affordable for onion and garlic production. Diallyl-disulfide (DADS) is a sclerotial germination stimulant that induces sclerotia to germinate without a suitable host and can reduce sclerotia by 90%. Recent research suggests that combining DADS and in-furrow fungicide application can achieve commercially acceptable control of white rot. DADS is no longer available and an alternative is needed by the industry. Garlic byproducts including juice, oil, and compost are potential alternatives to DADS. The goal of this project is to identify effective germination stimulant alternatives to DADS that can used with in-furrow fungicides for IPM of white rot.

In 2015, the research team was awarded a $172,500 grant award from the California Department of Pesticide Regulation Pest Management Research Grant Program. Replicated field trials are being conducted in white rot infested plots located at the UC Intermountain Research and Extension Center and a naturally-infested commercial field in Fresno County. Tom Turini, UC ANR farm advisor, is managing the site in Fresno. All experiments are arranged as a split-plot design. Main-plot treatments include sclerotial germination stimulants and fumigants. Germination stimulant treatments are being applied in 2016 one year before growing onions. A non-host crop, wheat, was planted shortly after spring germination stimulant application. Subplot treatments are fungicides applied in-furrow at the time of planting onions in 2017. Several UC experiments conducted over the last 10 years evaluated the efficacy and crop safety of fungicides for white rot control in onions. Tebuconazole and penthiopyrad applied in-furrow at planting are the most effective labeled fungicide treatments for suppressing white rot; these fungicides and an untreated control will be the sub-plot treatments.

<u>Germination Stimulant and Fumigant Treatments being tested at IREC in 2016</u>

1. Untreated Control
2. Spring-applied DADS – 1gal/A
3. Spring-applied commercial garlic juice – 103 gal/A
4. Spring and fall-applied commercial garlic juice – 103 gal/A
5. Spring-applied Sigma garlic oil blend -2 gal/A
6. Spring and fall-applied Sigma garlic oil blend- 2 gal/A
7. Fall-applied metam sodium (Vapam)- 75 gal/A
8. Fall-applied AITC (Dominus)- 10 gal/A
9. Spring-applied Sigma garlic oil blend + fall-applied AITC

The number of white rot sclerotia in the soil are being quantified in each plot several times during the experiment to determine treatment effects on the white rot population. Lab analysis is being performed by Jeremiah Dung at Oregon State University. At crop maturity, onions will be harvested, sorted, and examined to determine yield, white rot severity, the percentage of bulbs not acceptable for fresh and processing food uses due to white rot. Results will be presented at local and regional grower meetings, field tours, and organized trainings when preliminary results are available.

Is Glyphosate Injury to Roundup Ready Alfalfa Possible?

Steve Orloff, Farm Advisor and County Director, Siskiyou County
Rob Wilson, IREC Director and Farm Advisor
Tom Getts, Farm Advisor, Lassen County
Brad Hanson, Weed Science Specialist, UC Davis

Roundup Ready (RR) alfalfa is a popular weed management strategy for Western alfalfa producers. Aside from issues related to exporting a RR alfalfa crop to some countries, most growers seem pleased with the technology. The primary advantages are improved weed control, ease-of-use, and avoidance of crop injury. However, during the spring of 2014, we were surprised to see what appeared to be significant crop injury in commercial RR alfalfa fields in Scott Valley (Figure 1). A portion of a field where wheel-lines were anchored for the winter was left untreated and the alfalfa growth was significantly taller in that area compared with the treated portions of the field.

This was a real mystery as previous research and grower experience after years of RR alfalfa use had not indicated an injury problem. Logical potential causes for poor growth in the Roundup-treated area such as spray-tank contamination, a bad batch of glyphosate, or non-herbicide related management practices (fertilization, irrigation, pest management, etc.) were systematically ruled out. A test plot was conducted in the untreated strip using Roundup from different sources and two rates with and without surfactant to see if the injury could be duplicated. No injury symptoms or effect on alfalfa growth was observed in any of the plots.

Figure 1. Untreated alfalfa on the left compared with glyphosate-treated alfalfa on the right appearing chlorotic and necrotic. Up to a 10 inch difference in height was observed in a commercial field in Scott Valley in 2015.

This left us perplexed as to what could possibly be the cause for the injury. We initially thought the effect may be an unexplainable single-year aberration, but then the same type of injury reoccurred in the spring of 2015. After considerable deliberation, the theory was developed that cold temperatures after an application of glyphosate was a key contributing factor. This would explain why some fields were affected and others were not and why we did not observe any symptoms in the test plot that was conducted in 2014 (no frosts occurred after the late date when the application was made).

In 2015, yield was monitored in three affected commercial RR alfalfa fields in the Scott Valley by harvesting treated and untreated areas with a plot harvester. In the most severely affected field, a first cutting yield reduction of 0.8 tons/acre was observed (alfalfa recovered by second cutting). A replicated field experiment was conducted in the spring of 2015 at IREC. Compared to Scott Valley, alfalfa growth in Tulelake is delayed in the spring and late-spring frosts are more commonplace. Alfalfa was treated with 22 and 44 ounces of Roundup PowerMax per acre and cold temperatures followed within a few days. A reduction in height was observed as well as a yield reduction of 0.3 and 0.4 tons/acre for the 22 and 44 ounce rates of Roundup, respectively. Injury did not carry over into second cutting.

An additional field trial was conducted during the summer of 2015 in the same commercial field with significant injury in the spring. The same rates used in the spring trial in Tulelake (22 and 44 ounces of Roundup PowerMax) were applied after 1st cutting to 6-8 inch tall alfalfa. The plots were carefully inspected after the application and no injury symptoms were ever observed on the alfalfa and there was no difference in alfalfa yield the following cutting with any of the treatments, again confirming that cold weather after application was required for injury to occur.

Additional trials were conducted in the fall of 2015. While fall is not a time of year when growers ordinarily treat fields with Roundup, a frost sometime after application is virtually guaranteed, enabling us to further evaluate the theory that cold temperatures after application can result in injury. Alfalfa was treated on weekly intervals at the same rates as the studies mentioned above from mid-September through October. Within a week after treatment, the same injury symptoms that were observed in the spring were found in some of the trials (Figure 2). These fall studies suggested that injury was related to the height of the alfalfa (taller alfalfa around 10 inches was more susceptible than shorter alfalfa), the age of the stand (older fields were more susceptible than a field that was planted within a few months), and higher Roundup rates resulted in more injury.

Figure 2. Typical injury symptoms observed when a frost even followed an application of glyphosate. The tips of affected shoots droop in a "shepherd's crook". At first they appear wilted, then often turn chlorotic or yellowish in color and eventually become necrotic.

Sixteen field trials were conducted this past spring throughout the intermountain area of Northern California and Central Oregon. Two trials were conducted in Tulelake at IREC and with a grower cooperator, two trials in Lassen County, a trial in Butte Valley, a trial in Christmas Valley, OR and 10 trials in Scott Valley. The same two rates of Roundup described for other experiments were evaluated at all sites. The objective of the experiments was to evaluate the effect of glyphosate on RR alfalfa under different climatic and environmental conditions and to determine the effect of plant height on the occurrence of plant injury. Some injury symptoms were observed in all 16 of the trials but one. Overall, injury was less than what had been observed the previous two years, most likely due to more mild nighttime lows in 2016 (especially the first half of April) compared with the previous 2 years. Alfalfa height at the time of application had a profound effect on crop injury. Again, taller alfalfa had far more injury.

Initial greenhouse studies at UC Davis support field observations indicating that injury is possible when freezing temperatures occur after application. More research is needed and is currently underway to determine the actual underlying mechanism for this interaction between a glyphosate application and cold temperatures. Proposed theories need further investigation before an explanation can be offered, but research to date does show that freezing or near freezing temperatures after application are a key factor. Applications under warmer conditions have not caused injury.

It appears that growers in areas prone to spring frosts, like the Intermountain area of northern California, should pay attention to application timing relative to cold events. There is still a lot we have to learn about this phenomenon. We don't yet know how soon after an application cold temperatures must occur for there to be crop injury. We also don't know the precise temperature range at which injury is most pronounced. However, from what we have observed so far, the most effective mitigation strategy to avoid the possibility of injury is to treat alfalfa when it is relatively short in the spring rather than waiting until it is 6 inches or taller unless you are confident near freezing temperatures are over for the season. In many intermountain areas of the West spring temperatures are so variable that early treatment is probably the safer option. It can be extremely difficult to predict the occurrence of late-spring frosts with any accuracy. These research results do not question the value of the RR technology, but demonstrate the need to pay attention to weather conditions and alfalfa growth status at the time of application in colder intermountain areas prone to late spring frosts.

Alfalfa Insect Pest Update

Steve Orloff, Larry Godfrey, Kevin Goding, Nicole Stevens and Rob Wilson

Insect pests in alfalfa have been an increasing problem in the intermountain area the last couple of years. We have seen severe infestations of blue alfalfa blue alfalfa aphid (BAA), alfalfa weevil, and clover root curculio. Last year (2015) we experienced the worst blue alfalfa aphid population and damage we have perhaps ever experienced in the intermountain area. This insect was previously not considered a significant pest in the intermountain area and it was generally thought that its primary host range was further south in the warmer production areas. An increasing problem with BAA had been observed in the Central Valley of California the previous 2 years (2013 and 2014) and in the Imperial Valley all 3 years (2013, 2014, and 2015). Research conducted at IREC in 2015 showed large differences in the effectiveness of insecticides (Figure 1). Some insecticide treatments caused a resurgence in BAA populations that exceeded levels observed in the untreated control plots. The insecticide Sivanto, which was registered in California last year, was effective and has now become the most widely used insecticide treatment in the Klamath Basin for aphid control in alfalfa.

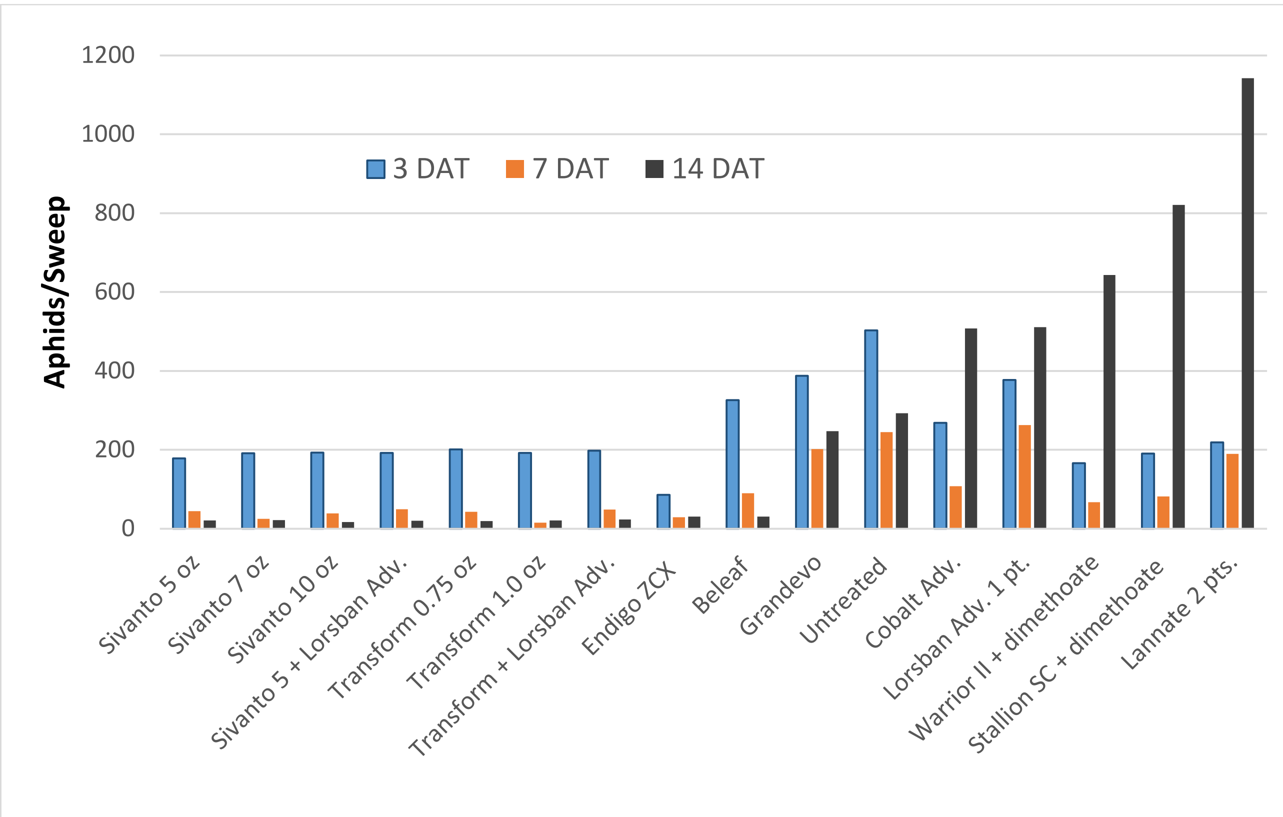


Figure 1. Effect of insecticide treatment on the number of blue alfalfa aphid per sweep 3, 7 and 14 days after treatment. LSD 0.05 = 95, 72 and 166 for the 3, 7 and 14 day evaluations, respectively. IREC, Tulelake, 2015.

In 2015, alfalfa plants were heavily infested with BAA soon after breaking dormancy in the spring. The population peaked before first cutting, beneficial insect populations increased, and the BAA was not a significant problem after first cutting. With the high BAA populations and damage observed last year, growers and PCA's were on high alert coming into the 2016 growing season—ready to take action if needed. However, 2016 was a far different season. The weather this year was much wetter in the spring and almost no BAA were present in fields in early spring. However, the population started to build as first cutting approached. Many fields were treated for alfalfa weevils, a significant problem (discussed in more detail below) throughout the Intermountain Region in 2016. In some cases weevil treatment seemed to exacerbate the BAA situation going into first cutting—especially if a pyrethroid insecticide was used. Beneficial insects can play a large role in keeping aphid populations in check and some insecticides are especially damaging to beneficial insect populations. This year aphid populations seemed to build under the windrows especially if rain and/or cool weather occurred while the hay was curing in windrows. Unlike last year, aphids have been a problem after first cutting and into summer. Weather likely affected the BAA population in spring and as aphid numbers increased in early summer, there were insufficient beneficial insects to keep the BAA population in check. Overall, the summer aphid population has not caused the injury we observed last spring—most likely due to faster alfalfa growth in summer.

There is still a lot we have to learn about this BAA population. Some speculate that it may be a new biotype that is more tolerant to insecticides and to warmer weather. There are a number of different aphid species that can infest alfalfa. The key for managers is to identify the aphid species because treatment threhsholds vary depending on the species. The easiest way to differentiate BAA from pea aphid is to examine the antennae. The pea aphid has dark bands at the end of each segement, whereas the antennae of the BAA are uniformly colored. The treatment guidelines for aphid species are presented below. If both BAA and pea aphid are present, current recommendations are to use the blue alfalfa aphid treatment levels.

TREATMENT THRESHOLDS (#APHIDS/STEM)

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

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

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

It has been difficult for growers in the Scott Valley to control alfalfa weevils for the past 2 years and especially this year. Part of the problem was what appeared to be a very prolonged hatch. In addition to the prolonged hatch, growers were not achieving acceptable control. We were concerned that weevils may have developed resistance to the insecticides currently used.

A study was conducted to evaluate resistance to pyrethroid insecticides. The procedure used is as follows:

- Collected alfalfa weevil from five fields
    - o Field using organic production methods (no pyrethroids used)
    - o Four other fields with various intensities of pyrethroid use in recent years
- In lab exposed weevils to Warrior or Baythroid – resistance to all pyrethroids should occur simultaneous
- Small shoots of alfalfa in centrifuge tubes (Figure 2).
- Then dipped shoots in stock solutions, and put those in our sample cups (which are urine sample cups).
- Let them air dry for half an hour no lids in fume hood after dipping.
- Added 5 adults to each cup, and put the lid on, the lids have holes for air flow drilled into them.

	% Weevil Mortality				
	0.25X rate	**0.5X rate**	**recommended field rates 1X**	**2X rate**	**4X rate**
Organic field	62%	65%	92%	82%	88%
Conventional Field 1	5%	8%	5%	10%	23%
Conventional Field 2	0	5%	10%	13%	23%
Conventional Field 3	23%	3%	3%	10%	35%
Conventional Field 4	0	0	15%	8%	23%

Figure 2. Experimental set-up to evaluate alfalfa weevil resistance to pyrethroid insecticides at UC Davis.

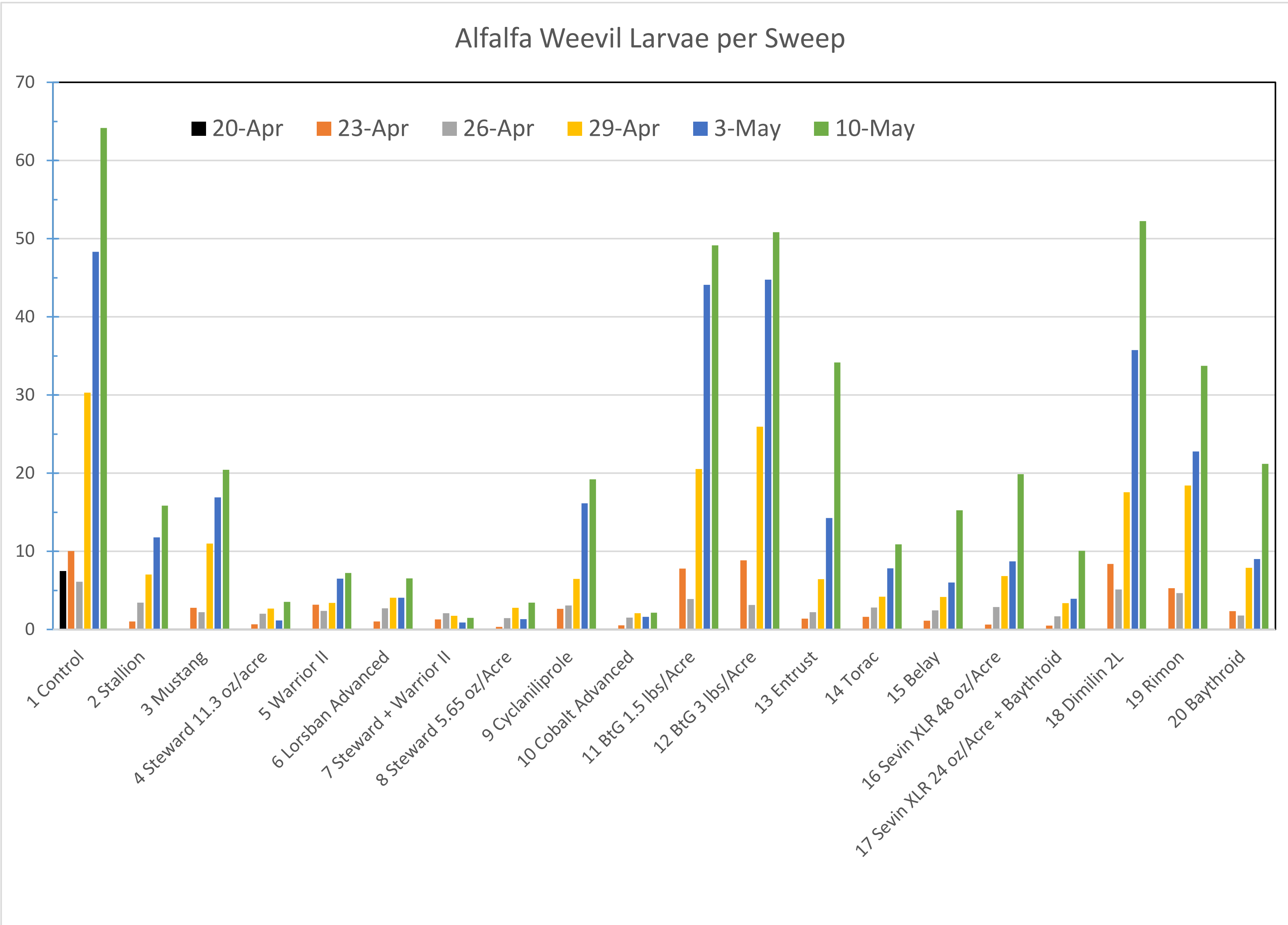
This is the first documentation of alfalfa weevil resistance to pyrethroid insecticides in California. Poor control has been noted in other areas and a resistant population may also be present. Further evaluation of the resistance status of the alfalfa weevil statewide is planned.

Pyrethroids have become the most popular insecticide treatment in the intermountain area. There are relatively few alternative insecticide treatments for weevil control. A trial was conducted in the spring of 2016 to evaluate several insecticides and insecticide combinations including materials approved for organic alfalfa production. The insecticides evaluated and their rate are presented in the table below.

Weevil Control Trial in Scott Valley, 2016

	Product	**Rate per Acre**	**Not registered (alf.)**
1	Untreated Check	---	
2	Stallion SC	11.75	
3	Mustang EW	4.3	
4	Steward EC	11.3	
5	Warrior II	1.92	
6	Lorsban Advanced	32	
7	Steward EC + Warrior II	5.65 + 0.96	
8	Steward EC	5.65	
9	Cyclaniliprole 50SL	22	X
10	Cobalt Advanced	38	
11	*Bacillus thuringiensis galleriae* 85%WDG *	1.5	X
12	*Bacillus thuringiensis galleriae* 85%WDG *	3	X
13	Entrust 80%	1.25	
14	Torac 15EC	21	X
15	Belay	5	X
16	Sevin XLR PLUS	48	
17	Sevin XLR PLUS + Baythroid XL	24 + 1.4	
18	Dimilin® 2L **	2.0	X
19	Rimon® 0.83EC **	12	X
20	Baythroid XL	2.8	

0.25% v/v added to all treatments
* two applications 1 week apart
** two applications 2 weeks apart


Alfalfa Weevil Larvae per Sweep
20-Apr
23-Apr
26-Apr
29-Apr
3-May
10-May
0
10
20
30
40
50
60
70
1 Control
2 Stallion
3 Mustang
4 Steward 11.3 oz/acre
5 Warrior II
6 Lorsban Advanced
7 Steward + Warrior II
8 Steward 5.65 oz/Acre
9 Cyclaniliprole
10 Cobalt Advanced
11 BtG 1.5 lbs/Acre
12 BtG 3 lbs/Acre
13 Entrust
14 Torac
15 Belay
16 Sevin XLR 48 oz/Acre
17 Sevin XLR 24 oz/Acre + Baythroid
18 Dimilin 2L
19 Rimon
20 Baythroid

Medusahead Control and Perennial Grass Seeding

Tom Getts - Advisor, Lassen, Modoc, Sierra and Plumas Counties
Rob Wilson - IREC Director and Farm Advisor, Tulelake
Laura Snell - Livestock and Natural Resource Advisor, Modoc County

Medusahead is an invasive winter annual grass which has invaded many rangelands in the western United States. It produces undesirable forage with high silica content and seed heads which can be injurious to livestock mouths. Research on medusahead control and revegetation has been ongoing for decades. Techniques such as fire, grazing, and herbicide application, have been investigated alone and in combination with varying degrees of success depending on location and climate. Esplanade (indaziflam), a relatively new pre-emergence herbicide, has been successful at controlling cheatgrass, and releasing remnant perennial grasses in other western states. The objectives of this research are to (1) Determine medusahead control and broadleaf weed control of herbicide treatments, and (2) Assess establishment potential of perennial grasses in areas treated.

Two study locations dominated by medusahead were selected in northeastern California: one south of Adin and one adjacent to Goose Lake. In the third week of March 2016, twelve herbicide treatments were applied at both study sites using a CO2 backpack sprayer in a carrier volume of 20 gal/acre. One pint of Accord (glyphosate) was included with all herbicide treatments to control actively growing medusahead, as some herbicides tested did not have foliar activity. Treatment two, which was treated with 16oz of Accord in March, consisted of a split application, where an additional 16oz of Accord was applied on April 18th, 2016 (for a total of 32 oz of Accord being applied within that treatment). Initial medusahead control was visually assessed seven weeks later on May 12th, 2016.

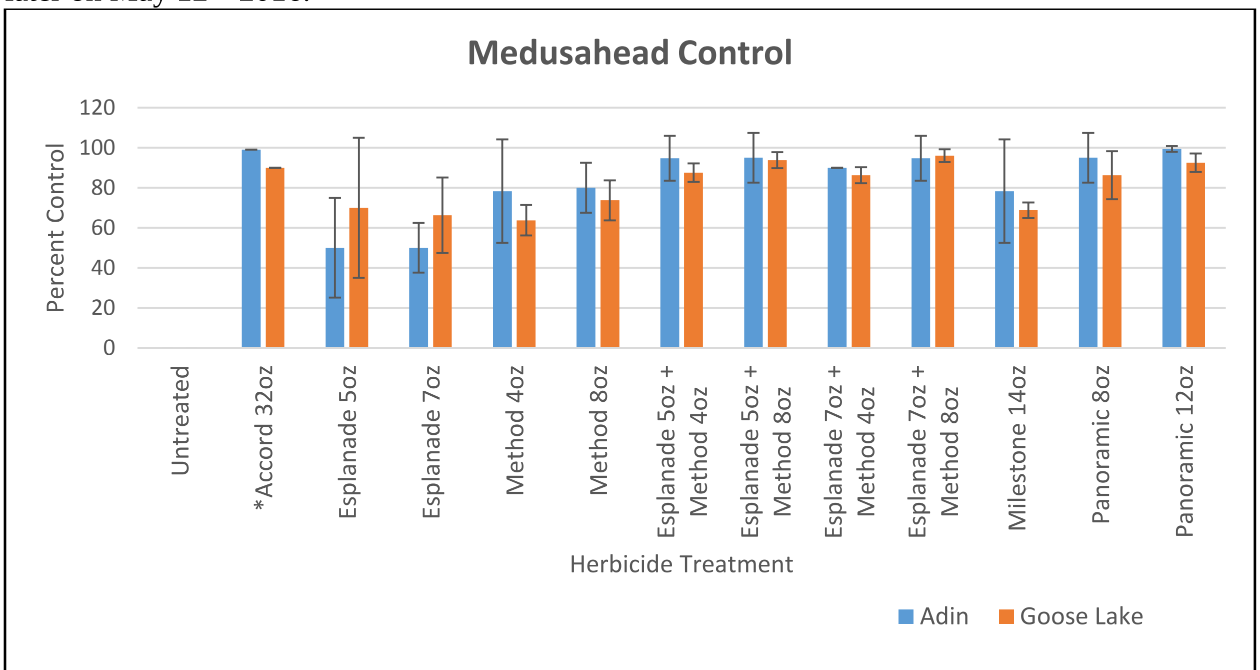


Figure 1: Initial medusahead visual control rating in May of 2016 at both sites. Adin is represented by blue bars, and Goose lake is represented by orange bars. Error bars are 95% confidence intervals for each study site. All herbicide treatments included 16oz of Accord for the March application and a non-ionic surfactant at .25% v/v. (*Treatment application split, 16oz in March and 16oz applied in April.)

At the initial medusahead visual assessment, no treatment provided 100% control at either study site. However, many treatments offered very good medusahead control. Panoramic (imazapic) at 12oz, a combination of Esplanade 7oz + Method 8oz (aminocyclopyrachlor) , or Accord 32oz (*split application) provided at least 95% control at both study sites. Applications of Method 4oz, Method 8oz and Milestone 14oz (aminopyralid) all resulted in between 60% and 80% medusahead control. Esplanade (with Accord) applied at both the 5 oz and 7 oz application rate only resulted in 50% to 70% percent medusahead control.

Large differences between treatments were not expected, as Accord was included in all herbicide treatments to control medusahead that was actively growing in March. Complete medusahead control was not achieved with the March herbicide applications. One possibility for lack of complete control was the thick litter layer which may have shielded seedling medusahead from coming in contact with the Accord applications. After the May control ratings were taken, an additional 16oz of Accord was applied to all herbicide treatments. This application was made to kill the medusahead not controlled initially, to prevent medusahead seed set within the 2016 growing season. Medusahead control evaluations made from this point forward, will be to test the residual control from the other herbicide treatments.

In late fall of 2016 eight perennial grass species (Squirreltail, Great Basin Wildrye, Creeping Wildrye, Bluebunch Wheatgrass, Intermediate wheatgrass, Crested wheatgrass, Tall Wheatgrass, and Russian Wildrye) will be no till drilled through the herbicide treatments by IREC personnel at each of the study sites. Density data of seeded species will be collected in the spring of 2017 and 2018 to determine germination and establishment potential through spring applied herbicide residue. Future assessments of medusahead control, and broadleaf weed cover will continue to be taken over 2016, 2017, and 2018.

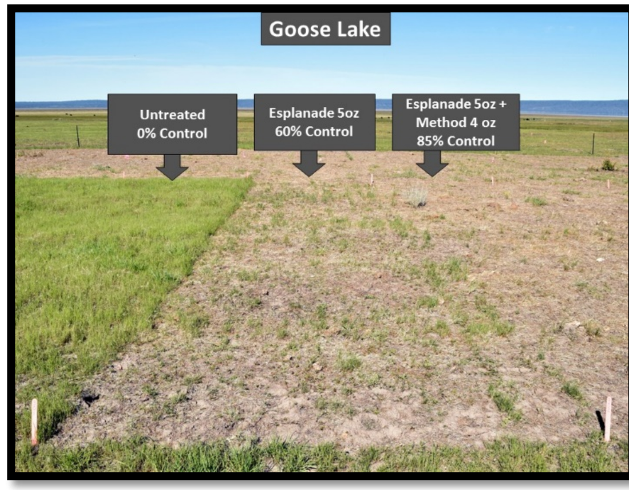


Figure 2: Picture of the Goose lake study site. Untreated check on the left, Esplanade 5oz in middle, Esplanade 5 oz + Method 4 oz on right

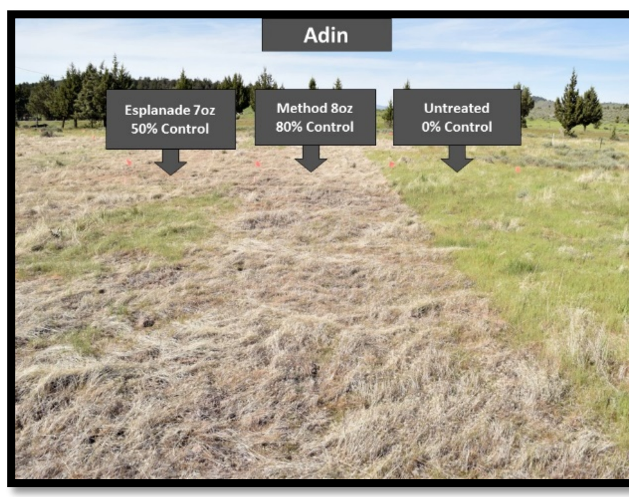


Figure 3: Picture of the Adin study site. Esplanade 7 oz on the left, Method 8oz in the middle, Untreated check on the right

2016 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.

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2016 IREC Field Day
Thursday, August 4
Tulelake, CA

8:00 am		*Registration Opens*
8:20 am		*Introduction and Opening Remarks* Rob Wilson, IREC Center Director/Farm Advisor, Tulelake, CA
8:30 am		*Tour Starts*
8:40 am	**Stop 1**	*Assessing the Efficacy of Zinc Phosphide-Coated Cabbage for Belding Ground Squirrel Control* Roger Baldwin, Human-Wildlife Conflict Resolution Cooperative Extension Specialist, UC Davis
9:05 am	**Stop 2**	*Influence of Fall Defoliation Height on the Productivity of Three Perennial Grasses* Steve Orloff, UCCE-Siskiyou County Director and Farm Advisor, Yreka, CA
9:30 am	**Stop 3**	*Oregon State University Malting Barley Research* Rich Roseberg and Thomas Silberstein, OSU KBREC, Klamath Falls, OR
9:50 am	**Stop 4**	*UC Davis Wheat Breeding Update and Importance of Stripe Rust Resistance* Oswaldo Chicaiza, UC Davis Wheat Breeding Program
10:00 am	**Stop 5**	*Oat Seed Production in the Tulelake Basin to Support California's Oat Seed Needs and Overview of Stripe Rust Resistance in Small Grains* Cal Qualset, Emeritus Dept. of Plant Sciences, UC Davis
10:20 am		*Break and Refreshments*
10:40 am	**Stop 6**	*The Use of Cover Crops and Manures in Organic Potato Production* Rob Wilson, IREC Center Director/Farm Advisor, Tulelake, CA
11:00 am	**Stop 7**	*Onion Research Updates- Controlling Maggots and White Rot* Rob Wilson, IREC Center Director/Farm Advisor, Tulelake, CA
11:20 am	**Stop 8**	*Is Injury to Round Up Ready Alfalfa from Glyphosate Possible?* Steve Orloff, UCCE-Siskiyou County Director and Farm Advisor, Yreka, CA
11:40 am	**Stop 9**	*Alfalfa Insect Pest Updates- Weevils, Aphids, and Clover Root Curculio* Steve Orloff, UCCE-Siskiyou County Director and Farm Advisor, Yreka, CA & Rob Wilson, IREC Center Director/Farm Advisor, Tulelake, CA
Noon		Lunch