INTERMOUNTAIN RESEARCH & EXTENSION CENTER

2014

ANNUAL FIELD DAY

100 UC Cooperative Extension

University of California
Agriculture and Natural Resources

2014 Intermountain Research & Extension Center Field Day

Welcome to our Annual Field Day. We sincerely appreciate your attendance and support. This year marks the 100th anniversary of UC Cooperative Extension. IREC staff, visiting researchers, and Siskiyou and Modoc County UCCE offices have joined together to celebrate this historic year. During the tour, we will highlight past and present research at IREC and UCCE programs in Siskiyou and Modoc County. Please feel free to ask questions and seek out a side conversation with researchers during breaks and lunch. If you would like additional information on IREC research or UCCE programs, ask a staff member, stop by the office, or send us an email at anrimrall@ucanr.edu .

Please enjoy the tour.

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
Shanna Done	Office Manager
Laurie Askew	Cooperative Extension Coordinator
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
Jacob Walden	Student Intern

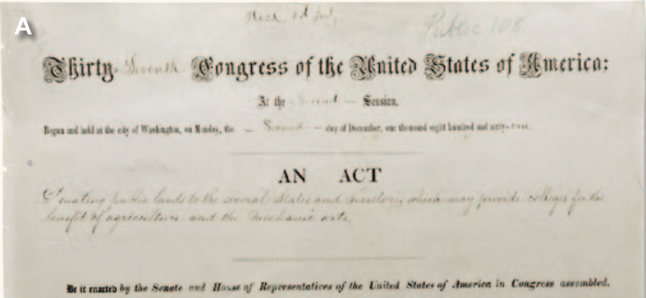
HISTORY OF IREC EMPLOYEES

Farm Advisor	Center Director	Center Superintendent	Research Assistants	Mechanics	Ag Techs	Office Managers	County	Farm Laborers
	Burt Hoyle		L W George		Ernie Kucera			
Ken Baghott				Ernie Kucera	Ronald Peterson		Jeanne Perry	Harold Stewart
Roger Benton		Wayne Osborne	Norma Haug	George Bauer				Don Brissenden
		E.P. Cowan	Mildred Dingler		Lew Blake			Richard Carroll
	Paul Puri			Joe Watkins	Joe Watkins			Larry Miles
Harry Carlson								A E Stewart
		Jerry Smalley	Trudy Eastman					Douglas Fitch
			Eddie Nedbalek					Paul White
								Joseph Leonard
								Randy Darrow
			Josephine Fogle					Billey Stepp
	Harry Carlson		Robert Fensler					Bill Schey
					Don Kirby			Eric Casey
								Dennis Camden
					Allan Taylor			Wayne Mall
								Jerry Lousignont
			Don Kirby		Greg McCulley		Cynthia Campbell	Kathy Martinez
							Gail Quick	Jeff Bowen
					Ron Baley	Linda Woodley		Marla Cross
	Interim Don Kirby		Marla Jerzykowski					Josh McCollam
					Tom Tappan		Joyce Guthrie	Scott Carroll
	Harry Carlson		Michael Bell		Charlotte Barks		Kim Baley	Lonnie Lemus
			Jessica Dubois					Cristina San Juan
		Don Kirby		**Greg McCulley**			Jennifer Engel	Craig Byrum
			Corey Thompson	**Tom Tappan**	**Seferino Salazar**	Jennifer Engel	Nancy McCollam	Ryan Olivier
Rob Wilson	**Rob Wilson**		Brooke Kleiwer			**Shanna Done**	**Laurie Askew**	**Leopoldo Reyes**
			Kevin Nicholson					Maria Miranda
			Darrin Culp					**Josefina Vallejo**
								Robbie Carver
		Darrin Culp						Matt Barber
			Skyler Peterson					**Jake Walden**

Denotes Current Employee s

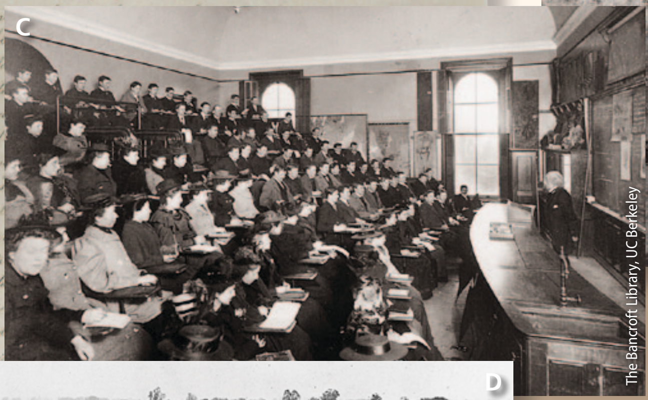
Donating public lands to the several States and Te… benefit of agriculture and the mechanic arts

1862–1918


Thirty-Seventh Congress of the United States of America:
At the Second Session,
AN ACT
Donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts.
Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That …

National Archives

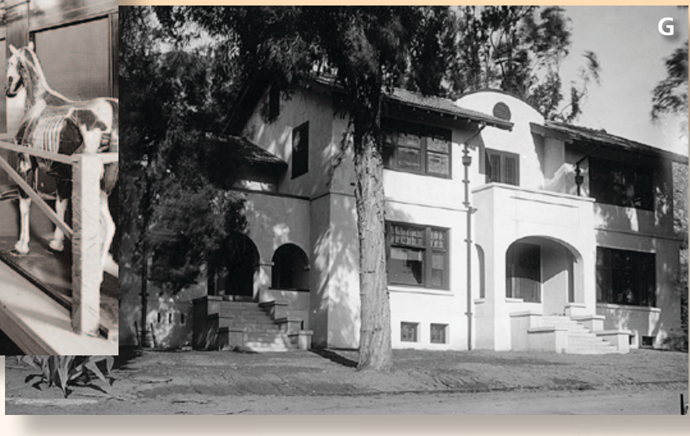

The Bancroft Library, UC Berkeley


The Bancroft Library, UC Berkeley


Special Collections, General Library, UC Davis/uap-01650


Special Collections, General Library, UC Davis/uap-01650


The Bancroft Library, UC Berkeley/UARCPIC 15:19c


Special Collections & Archives, UC Riverside Libraries

Early days: 1862–1918

A. The Morrill Act was signed into law by President Lincoln in 1862.

B. Among the first UC buildings was South Hall (left), first home of the College of Agriculture; it still stands on the UC Berkeley campus, just east of the Campanile. The 1873 image shows South and North Halls, looking west toward the San Francisco Bay.

C. A lecture classroom in South Hall, shown in 1898, was filled with students. The College of Agriculture was in the basement.

D. The University Farm was situated on 776 acres in Davisville, Yolo County — 75 miles north of Berkeley. Three buildings from this image, circa 1910, are still in use at UC Davis: North Hall, South Hall and the Cottage.

E. Since its inception in 1909, when the University Farm invited the community to view its new dairy barn, Picnic Day in Davis has grown into the largest student-run event in the nation. Shown is a cow parade, circa 1920.

F. From its earliest days, UC extended agricultural knowledge throughout California. In 1909, an agricultural demonstration train toured the state with animal husbandry displays.

G. After citrus growers, including John Henry Reed, lobbied for a research station, California established the Citrus Experiment Station in 1907 on 23 acres at the base of Mount Rubidoux, overlooking Riverside.


Special Collections, General Library, UC Davis/uap-01722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Research takes root: 1919–1945

A. A Picnic Day parade float at the University Farm in Davis featured a farm electrification demonstration, circa 1920.

B. From 1922 to 1934, Thomas Tavernetti, in a field of millet, was assistant dean of agriculture at the University Farm, which was designated as UC Davis in 1959.

C. At UC Berkeley, Ansel F. Hall constructed a relief model of Yosemite Valley in 1921. Hall went on to become the first park naturalist of Yosemite National Park.

D. In the 1930s, a researcher in the Citrus Experiment Station's Division of Plant Pathology studied citrus fruit quality. The station became UC Riverside in 1954.*

E. The 1920s are often considered the "golden age" for extension, with outreach helping many families achieve better livelihoods. In San Diego County, a farm advisor posed in his Model T.

F. UC Berkeley's Division of Forestry was established in 1913, with field camps in the Sierra Nevada. In 1926, advisors visited Whitaker's Forest; the image was taken by Woodbridge Metcalf, UC Berkeley forestry faculty from 1914–1956.

G. During the 1930s, chemical methods to control citrus pests were tested in a large fumigator at the Citrus Experiment Station in Riverside.

* Corrected by *California Agriculture* April 13, 2012, after press run: "in 1954" not "in 1959."


Fritz-Metcalf Collection/UC Berkeley/lib.berkeley.edu/BIOS/fmpc


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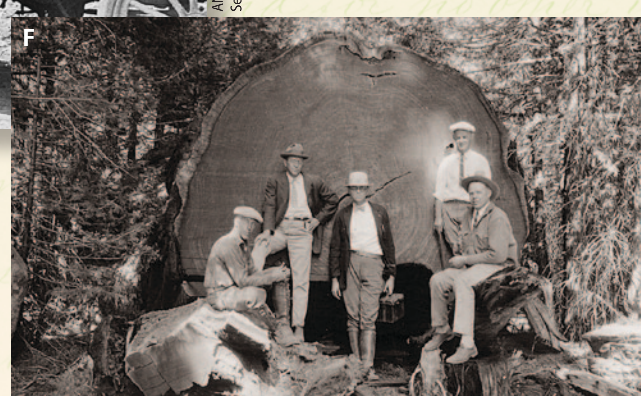
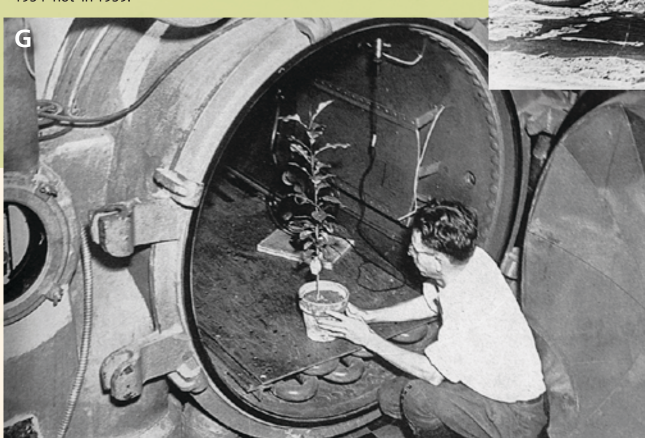
ANR Communication Services


Fritz-Metcalf Collection/UC Berkeley/lib.berkeley.edu/BIOS/fmpc


Golden Book of California: 1860–1936

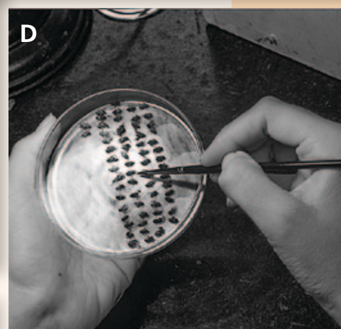
Donating public lands to the several States and Te... benefit of agriculture and the mechanic arts.

1946–2000

Ansel Adams Fiat Lux Collection, UCR/CMP

Special Collections, General Library, UC Davis

Ansel Adams Fiat Lux Collection, UCR/CMP



Ansel Adams Fiat Lux Collection, UCR/CMP

Ansel Adams/Special Collections, General Library, UC Davis

Jack Kelly Clark/UC Statewide IPM Program

Jack Kelly Clark

Gary Andersen

Postwar years: 1946–2000

A. The School of Veterinary Medicine was the first professional school at UC Davis; the first classes were in September 1948.

B. Extension enologist George Cooke is seen in the distance (in 1966)* in the cellars of the enology building at UC Davis, where research and outreach has been instrumental in building the state's $18.5 billion wine industry.

C. In 1966†, watershed experiments were conducted at Hopland Research and Extension Center, one of 10 RECs operated by UC ANR. The centers represent the state's diverse growing conditions and natural ecosystems.

D. UC Riverside entomology professor Vern Stern made critical contributions to IPM science; in 1966, lygus bugs, an important cotton pest, were segregated in his lab.

E. UC Berkeley and UC Davis biologist and geneticist G. Ledyard Stebbins (center) led an agricultural field trip, circa 1967.

F. UC Davis entomology professor Frank Zalom directed the UC Statewide IPM Program for 16 years; circa 1990, he placed a trap to monitor for oriental fruit moth.

G. The IMPACT (Integrated Management of Production in Agriculture using Computer Technology) system was established at UC Davis in 1979 (shown in 1981).

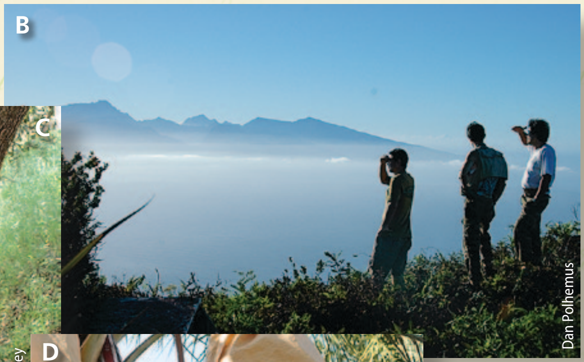
H. In 1987, UC Berkeley plant pathologist Steven Lindow received permission to field-test genetically altered *Pseudomonas syringae* (known as "ice minus" bacteria) as a frost-preventive on potatoes in the Tulelake area.

I. UC has published peer-reviewed research and news in *California Agriculture* journal continuously since 1946.

* Corrected by California Agriculture April 13, 2012, after press run: "(in 1966)" not "(in 1960)."
† Corrected by California Agriculture April 13, 2012, after press run: "In 1966" not "In 1960."

Research highlights


James Block


Dan Polhemus


Matteo Garbelotto Lab, UC Berkeley


Carlos Puma/ UCR Strategic Communications

Recent research highlights

A. Peggy Lemaux (second from right) examines sorghum in a UC Berkeley greenhouse; Lemaux was named the nation's first biotechnology advisor in 1990.

B. Botanists led by Jean-Yves Meyer (center) look out from Mt. Tohiea on the Polynesian island of Moorea, during a plant-collecting expedition. UC Berkeley researchers are barcoding an entire tropical ecosystem on Moorea.

C. Matteo Garbelotto, forest pathology specialist at UC Berkeley, co-discovered the agent responsible for sudden oak death and is working to stem its spread.

D. UC Riverside entomology professor Thomas Perring investigates carob moth, a key pest of ripening date fruit.

E. UC Riverside entomologist Beth Grafton-Cardwell's work targets IPM and biocontrol solutions for citrus pests.

F. Carole Meredith, professor emerita of viticulture and enology at UC Davis, uses DNA analysis to determine the heritage of wine grape varieties.

G. Medical ecologist Rob Atwill, who leads the Western Institute for Food Safety at UC Davis, tests water samples for disease-causing microbes that could be transferred between livestock, wildlife and humans.

H. UC Davis plant scientist Abhaya Dandekar and colleagues have fused two genes to engineer resistance to Pierce's disease of grapevines.

I. UC school garden studies, curricula and projects have introduced thousands of students across the state to important science and health concepts. The California Master Gardener Handbook, published by ANR Communication Services, is a top seller.


Carlos Puma/ UCR Strategic Communications


UC Davis


Karin Higgins


Gregory Urquiaga


Suzanne Paisley

CHRONOLOGICAL LIST OF IREC EVENTS

1947 Cooperative Agreement entered into by the Bureau of Reclamation (BOR), Tulelake Growers Association and the University of California (UC) to "establish a demonstration farm consisting of approximately eleven acres of land in the vicinity of Tulelake, California." Burt Hoyle was the first Center Director.

1948 Sugar beet cost study reveals a net return of $24.95 per acre.

1949 Experiments examined soil fertility, weed control, reclaiming alkali soil, straw decomposition, and frost control using airplane smoke. First temperature records were kept.

1950 Office building enlarged. Full time Farm Advisor, Ken Baghott, hired. First strawberry trials.

1951 Alfalfa yield on 3-year old stands with 3 cuttings yielded between 5.5 – 7.1 ton/a. Potato storage built.

1953 First horseradish projects to determine planting spacing and root position. "Hand vs. Mechanical Potato Harvest" study reveals "the cost of the hand harvesting was 4 times more expensive than the mechanical."

1954 Alkali Soil Reclamation Tests show improvements in soil after treating with gypsum.

1955 Field Day includes "Peppermint Production." Chipping potatoes added to potato variety testing.

1956 Proceedings begin to acquire title from BOR. New office built.

1957 Study investigates feeding alfalfa pellets to cattle, sheep and hogs.

1959 Cost of irrigating twelve acres $45.

1961 More than 5,000 varieties of barley have been grown in Station test plots.

1962 Alfalfa cost study shows the cost to produce one ton of alfalfa was $22.80.

1964 Station research leads to the development of the only specific, named variety of horseradish, "Tulelake Number 1".

1969 Average peppermint oil yield is 50# oil/acre. Mint was baled and hauled to Lakeview for distillation.

1975 Sunflower oil trial thwarted by bird damage.

1978 Cal Qualset breeds the first public variety of triticale released in the United States. The aptly name "Siskiyou" variety is best adapted to the northern California county from which it comes.

1979 Study of Genetically Altered (Ice-Minus) Bacteria for Frost Protection in Potatoes begins.

1981 Harry Carlson begins 28 year career at IREC.

1984 IREC Field Day project titles include: "Feed the Crop, Not the Weed," "New Potato Varieties Eyed," "If Nematodes Could Read." Jerusalem artichokes, fodder beets, milo and chicory grown and evaluated for biomass conversion to alcohol.

1986 EPA joins in Ice-Minus study, monitoring aerosol bacterial applications.

1989 Automated CIMIS weather station unveiled on Station.

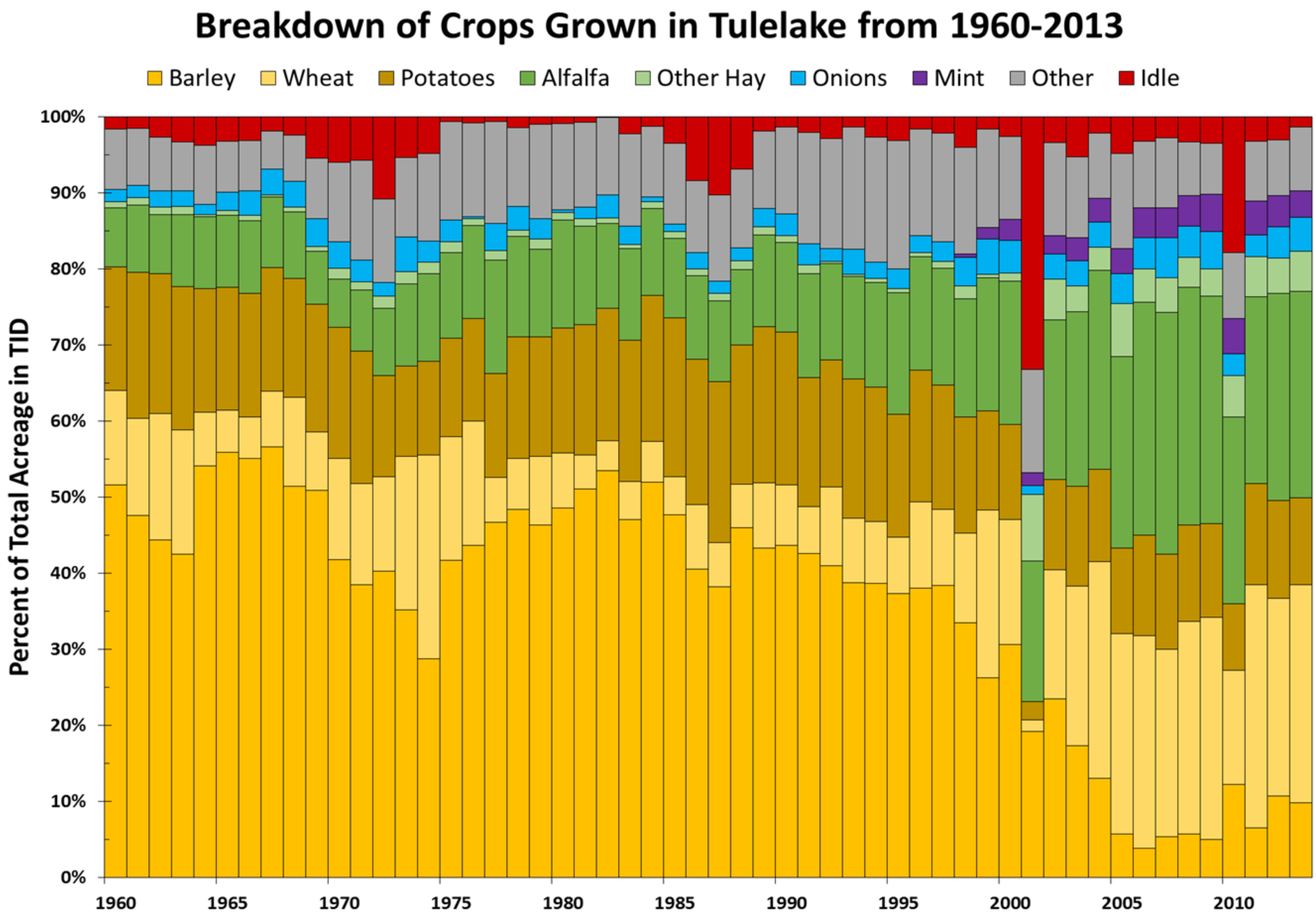
1996 Field Day activities include "Taste Test of Baked Potatoes from Experimental Plots." Field Day sponsors include Holly Sugar Company and Spreckles Sugar.

2001 Of 140 acres at IREC, only seven were available for research due to water shut-off. Stress-management techniques for farmers were reviewed at Field Day.

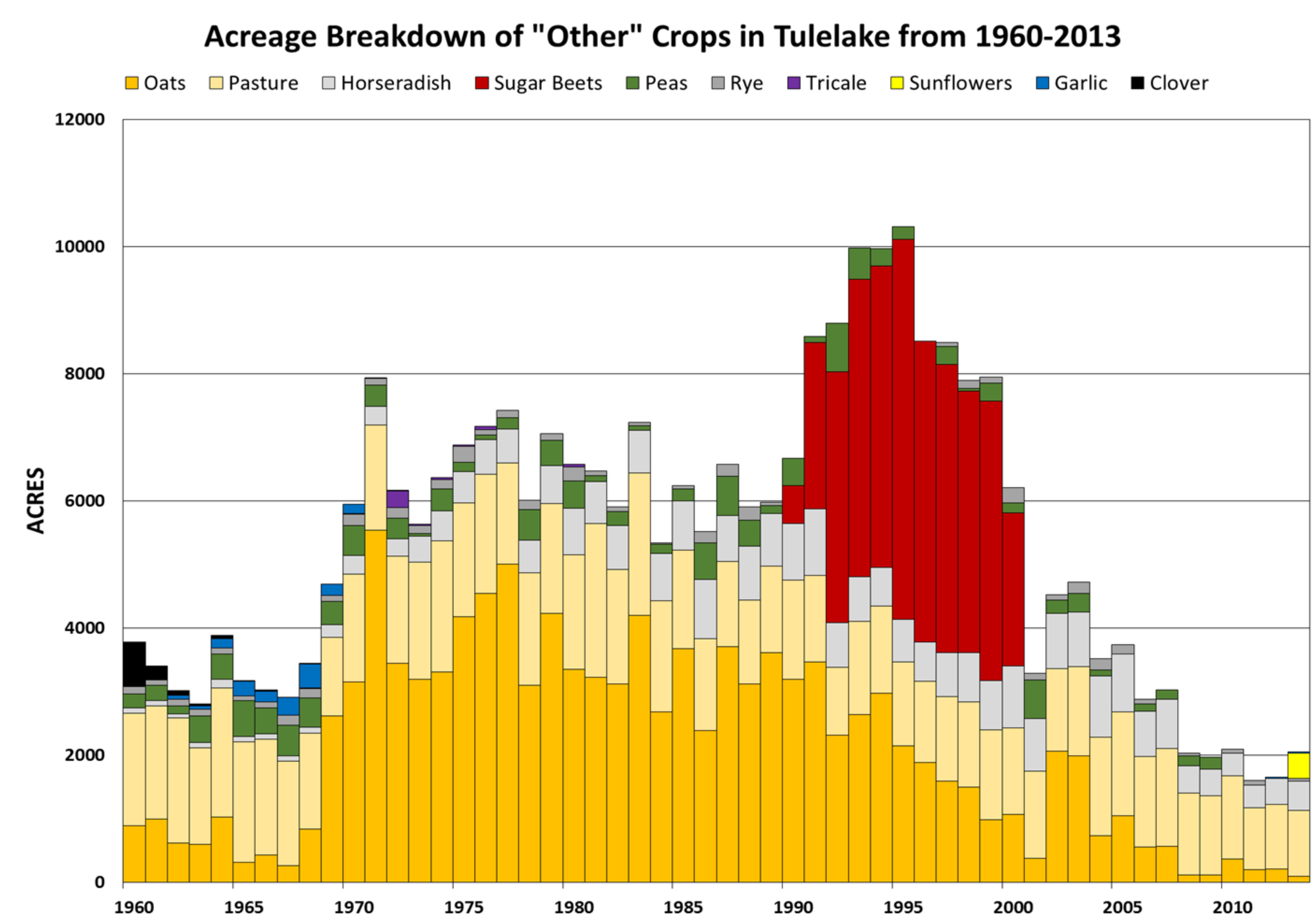
2004 Peppermint mini still built in cooperation with Tulelake Mint Growers and Oregon State University.

2006 Almond and grape trials were planted at IREC.

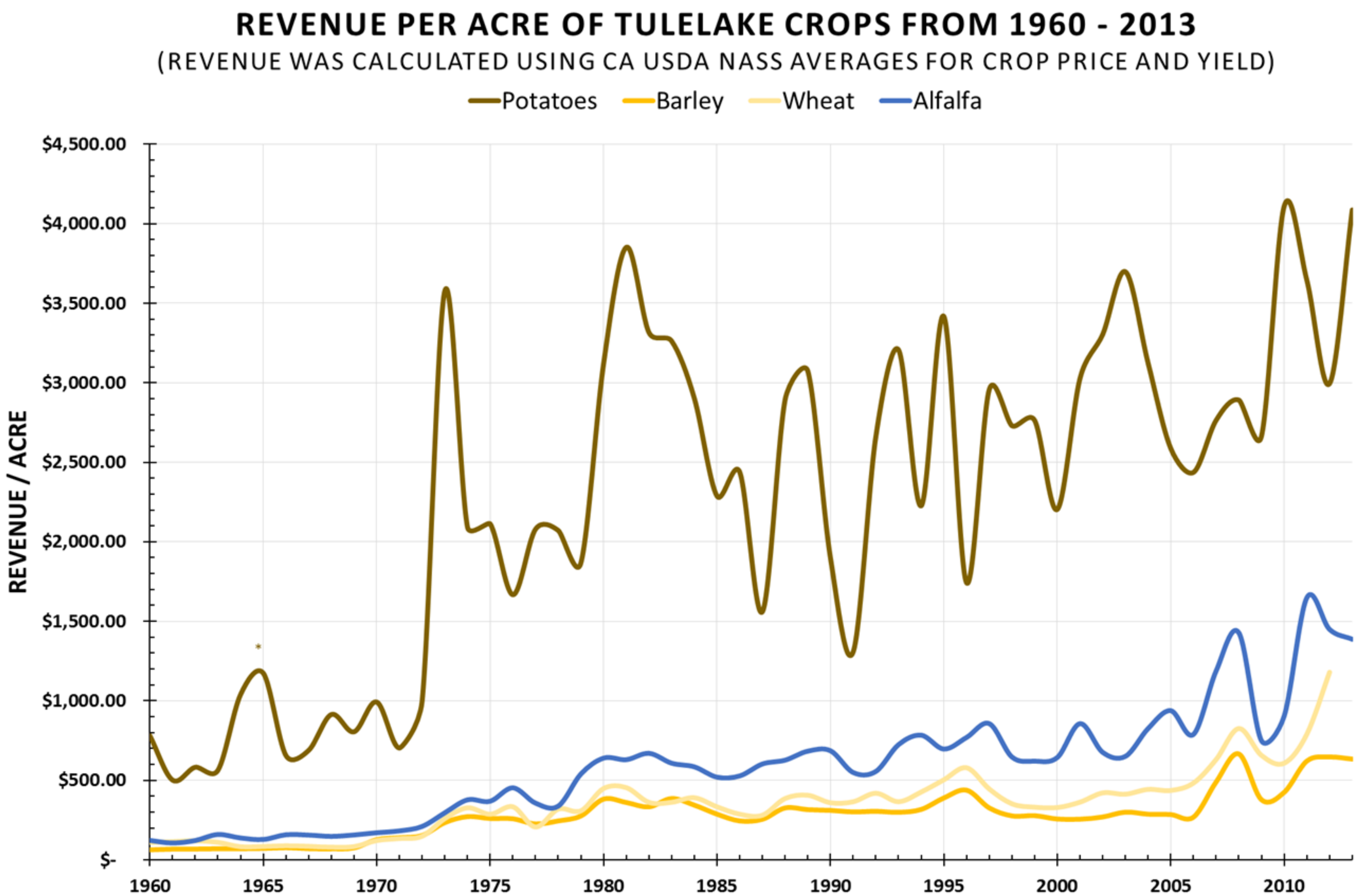
2013 Eddy Covariance Tower installation was completed to capture a wealth of atmospheric and eco-informatics data for researchers.



Breakdown of Crops Grown in Tulelake from 1960-2013
Barley
Wheat
Potatoes
Alfalfa
Other Hay
Onions
Mint
Other
Idle
Percent of Total Acreage in TID
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010



Acreage Breakdown of "Other" Crops in Tulelake from 1960-2013
Oats
Pasture
Horseradish
Sugar Beets
Peas
Rye
Tricale
Sunflowers
Garlic
Clover
ACRES
12000
10000
8000
6000
4000
2000
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010



* Siskiyou County Crop Report potato price was used for 1965 due to a missing value in USDA NASS Reporting; Before 1985 potato revenue was calculated using the statewide CA average potato price; From 1985-present ,potato revenue relfects the CA average fall - harvested potato price.

Barley revenue was calculated using the CA average barley price averaged across malting/feed uses

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

Make a Gift

About Us:

Learn about the history of IREC

Get to know the IREC staff

Check out our facilities

Get directions to IREC

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

Current Research Projects at Intermountain Research & Extension Center

Potato Research

132 Potato Variety Selection Evaluation & Development
Principle Investigator and Cooperators: Rob Wilson, Center Director, 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

1. 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.

133 Disease Management in Potatoes
Principle Investigator and Cooperators: Rob Wilson, Center Director, UC Intermountain Research & Extension Center; Brian Charlton, Cropping Systems Specialist, Oregon State University, Klamath Basin Research and Extension Center

1. Compare the efficacy and crop safety of fungicides for preventing in-season *Rhizoctonia* and *Colletotrichum* root infection and post-harvest tuber blemish.
2. Determine the efficacy of biological and organic-approved products for controlling *Rhizoctonia* and *Colletotrichum.*

134 Nightshade Control In Potatoes
Principle Investigator and Cooperators: Rob Wilson, Center Director, UC Intermountain Research & Extension Center; Brian Charlton, Cropping Systems Specialist, Oregon State University, Klamath Basin Research and Experiment Center

1. Determine the best pre-emergence and post-emergence herbicide programs for controlling hairy nightshade;
2. Examine the influence of adjuvants and herbicide application timing for nightshade control.
3. Evaluate the influence of hairy nightshade treatments on other weed species including lambsquarter, pigweed, and kochia.

146 Cultural Management of New Potato Varieties
Principle Investigator and Cooperators: Rob Wilson, Center Director, 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

1. 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.

149 Influence of Nematicides on Root-Lesion Nematode and Potato Early-dying

Principle Investigator and Cooperators: Rob Wilson, Center Director, UC Intermountain Research and Extension Center; Becky Westerdahl, Cooperative Extension Specialist, Dept. of Nematology, UC Davis; R. Michael Davis, Cooperative Extension Specialist, Dept. of Plant Pathology, UC Davis.

1. Determine nematicide treatments' efficacy for suppression of potato early-dying and root lesion nematode.
2. Compare the efficacy of nematicides to metam sodium (Vapam) fumigation for suppression of potato early-dying.
3. Evaluate nematicides when growing potato varieties with varied susceptibility to potato early-dying.
4. Conduct a simple economic analysis comparing costs and revenue for tested nematicide and fumigation programs.

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

Principle Investigator and Cooperators: Rob Wilson, Center Director, 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

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

Small Grain Research

238 Wheat Genetic Resources & Mapping Experiments

Principle Investigator and Cooperators: 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

1. To grow and make observations on agronomic and disease resistance on advanced breeding and genetic lines
2. To make the genetic resources available to any researchers who have interest for their breeding or research
3. To genetically characterize two populations of recombinant inbred lines for morpho-physiologic and agronomic traits
4. 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

239 Improving Spring Barley for Northern Intermountain Areas
Principle Investigator and Cooperators: Lynn Gallagher, Researcher, Department of Plant Sciences, UC Davis; Dr. Pat Hayes, Barley Breeder, Dept. of Crop & Soil Science, OSU Corvallis, Oregon

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

253 Seeding Rate & Planting Date Effects on Spring Wheat
Principle Investigator and Cooperators: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka

1. Determine the effect of seeding rate on the yield of four commonly grown hard red and soft white spring wheat
2. Assess the impact of planting date on productive tiller production, kernel number, bushel weight and yield
3. Quantify the interaction between seeding rate and planting date

255 Effect of Nitrogen Fertilization Practices on Spring Wheat Protein Content
Principle Investigator and Cooperators: 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

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

260 Development of Wheat Varieties for California
Principle Investigator and Cooperators: 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:

1. Introduces new germplasm for evaluation and breeding
2. Develops breeding populations through hybridization, selection and evaluation
3. 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
4. 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

281 Planting Date and Cultivar Effects on Winter Wheat Yield
Principle Investigator and Cooperators: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka

1. Compare the yield potential of several leading cultivars of soft white winter wheat and hard red winter wheat.
2. Determine the effect of four different planting dates on the yield of eight different winter wheat cultivars.

Alfalfa Research

331 Evaluation of Sharpen (saflufenacil) Use in Established Alfalfa
Principle Investigator and Cooperators: Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka

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

340 Alfalfa Experimental Germplasm and Cultivar Adaptation and Evaluation
Principle Investigator and Cooperators: 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

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

343 Characterizing N Fertilizer Requirements of Crops Following Alfalfa
Principle Investigator and Cooperators: Dan Putnam, Extension Agronomist, Department of Plant Sciences, UC Davis; Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka

1. To determine the impacts of rotation with alfalfa on the N fertilization needs of wheat, to develop an “N Credit” recommendation for management of N fertilizers in non-legumes rotated with alfalfa. Since wheat is a highly responsive crop to N fertilizers, estimates will be made on wheat that can be extrapolated to other crops

345 Cutting Schedule Effects on Reduced Lignin & Conventional Alfalfa
Principle Investigator and Cooperators: Steven Orloff, County Director/Farm Advisor, Siskiyou County, Yreka; Dan Putnam, Extension Agronomist, Department of Plant Sciences, UC Davis

1. 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
2. Determine the appropriate cutting management schedule for low-lignin alfalfa compared with conventional non-genetically engineered alfalfa

397 Alfalfa Germplasm Evaluation-Fall Dormancy

Principle Investigator and Cooperators: Larry Teuber, Professor, Department of Plant Sciences, UC Davis; Carla E. Rivera, SRA, Department of Plant Sciences UC Davis; Steve Orloff, County Director/Farm Advisor, Siskiyou County, Yreka

1. To determine fall dormancy reaction of cultivars and experimental cultivars that have potential for marketing in California
2. To determine stability of fall dormancy reactions of check cultivars across years and locations
3. To assess the interregional stability of cultivars and a recently adopted set of standard check cultivars
4. To evaluate winter injury and follow the relationship between winter injury and fall dormancy

779 Determining Efficacy & Cost of Pocket Gopher Control Practices in Alfalfa

Principle Investigator and Cooperators: Steve Orloff, Cooperative Extension Director, Siskiyou County; Roger Baldwin, Vertebrate Pest IPM Advisor, Kearny Agricultural Center

1. Compare the effectiveness of four different gopher control measures including trapping, baiting with strychnine using an artificial burrow builder, fumigation with aluminum phosphide, and carbon monoxide injection using the PERC unit
2. Quantify the time, labor requirement and material cost associated with each control practice
3. Estimate the overall cost effectiveness for each control measure

Onion Research

451 Application of Diallyl Disulfide (DADS) and Fungicides for the Control of White Rot on Garlic and Onions

Principle Investigator and Cooperators: R. Michael Davis, Cooperative Extension Specialist, Dept. of Plant Pathology, UC Davis; Rob Wilson, Center Director, UC Intermountain Research & Extension Center

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

456 Onion Weed Control

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

1. Evaluate crop and weed response to varied rates and timings of pre-emergence applications of Prowl H20 and Dacthal.
2. Develop UC recommendations and California specific herbicide labels for weed control in onions.

Peppermint Research

566 Integrated Pest Management of Insect and Mite Pests of Mint
Principle Investigator: Larry Godfrey, Cooperative Ext. Specialist, Entomology CAES, UC Davis

1. Investigate the relationship between spider mite numbers and mint yield and quality.
2. Determine and compare the cost-effectiveness of registered miticides for spider mite control in mint. Study the use of releases of predatory mites for spider mite management in mint in California.
3. Investigate the use of reduced risk insecticides for management of mint root borer larvae.

569 Weed Control in Peppermint
Principle Investigator: Rob Wilson, Center Director, UC Intermountain Research & Extension Center

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

Other Research:

703 Medusahead Management Project
Principle Investigator and Cooperators: Joseph DiTomaso, UC Davis, Rangeland & Wild Land Weed Specialist; Rob Wilson, Center Director, UC Intermountain Research & Extension Center

1. Demonstrate the effectiveness of herbicides for large scale control of Downy Brome and Medusahead
2. Determine the utility of using herbicides and reseeding in sage grouse habitat for re-establishing desirable native species
3. Consider alternative methods of control with and without re-seeding and determine the best seeding method when active restoration practices are necessary

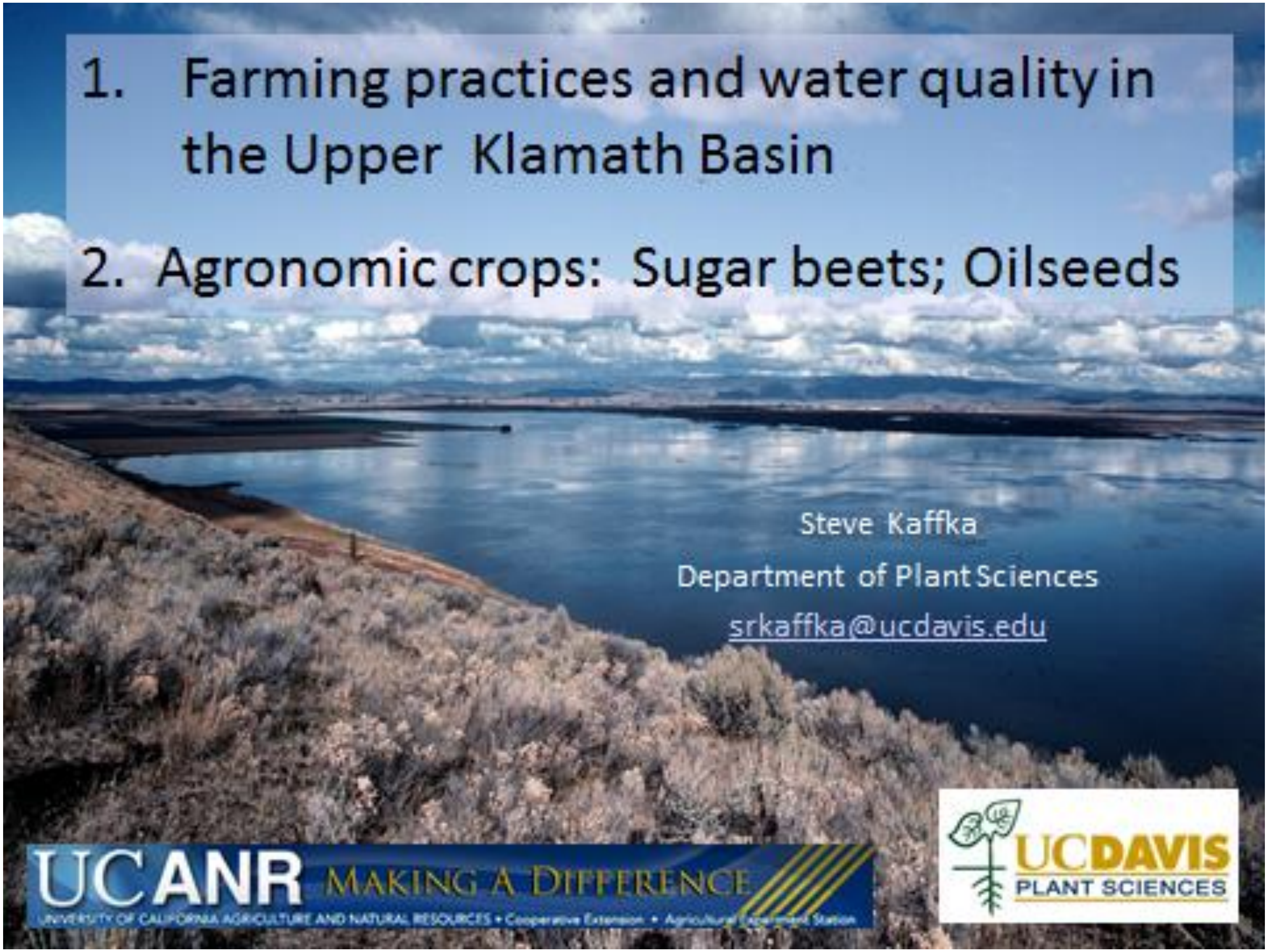
784 Influence of Fall Defoliation Height on the Productivity of Three Perennial Grasses
Principle Investigator and Cooperators: Steve Orloff, Farm Advisor/County Director, Siskiyou County, Yreka; David Lile, Farm Advisor/County Director, Lassen County, Susanville

1. Compare the yield potential of the three most commonly grown perennial grass species in the Intermountain Region.
2. Evaluate the effect of three different fall herbage heights on the subsequent growth of tall fescue, Orchardgrass and Timothy.
3. 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.
4. 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.

988 Oilseed as Alternative Crops for California

Principle Investigator and Cooperators: Stephen Kaffka, Extension Agronomist, Dept. of Plant Sciences, UC Davis; Nicholas Alexander George, Visiting Assistant Project Scientist, UC Davis

1. Identify the best oilseed species and varieties for California in diverse locations and cropping systems
2. Conduct agronomic experiments to determine regionally-specific best management practices
3. Use trial data and eco-physiological measurements to validate the crop model APSIM and use the model to estimate the productivity, water and nitrogen use of the oilseeds under different rainfall and irrigation regimes, locations throughout the state, and alternative future climate scenarios
4. Use variety performance and agronomic data to parameterize a previously-developed whole farm economic model to evaluate the potential for increased oilseed production in California. The model will help identify price and yield goals for new oilseed crops in diverse regions in the state
5. Use yield and agronomic data to create California oilseed production guides
6. Carry out extension and outreach activities at the county and regional level to support adoption of new crops
7. Create publications for California Agriculture


1. Farming practices and water quality in the Upper Klamath Basin
2. Agronomic crops: Sugar beets; Oilseeds
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Department of Plant Sciences
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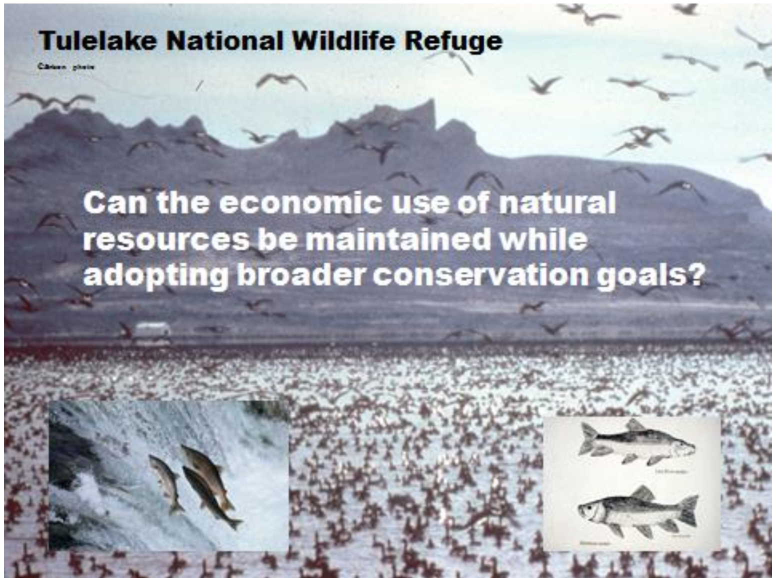
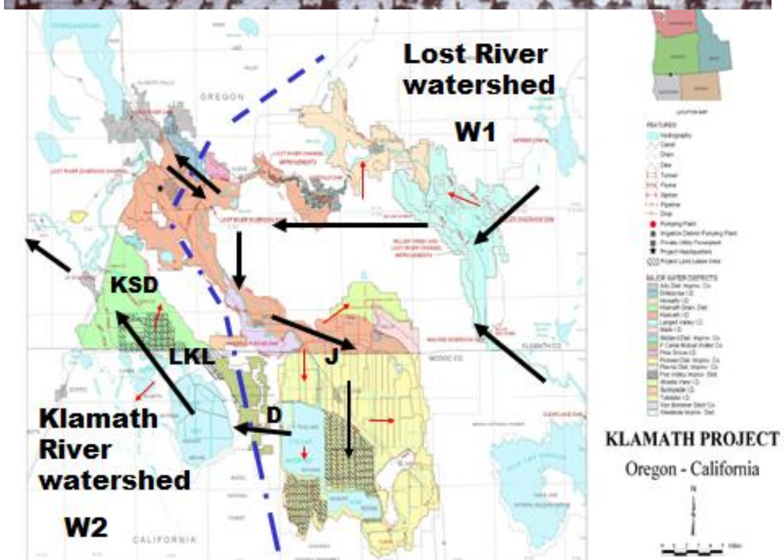
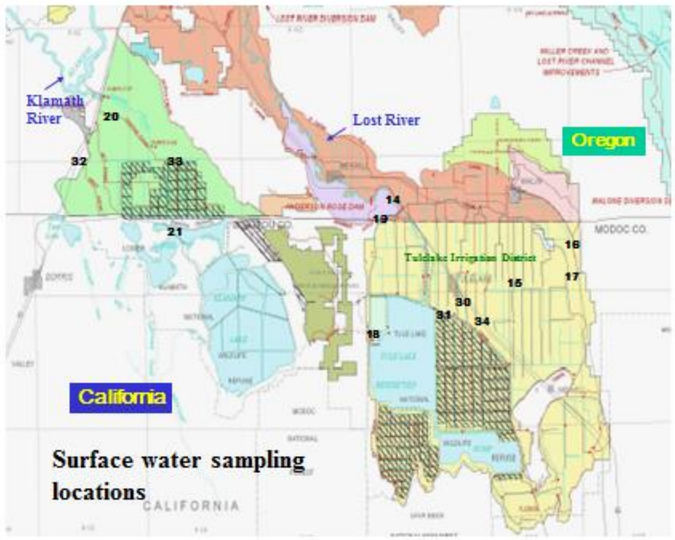
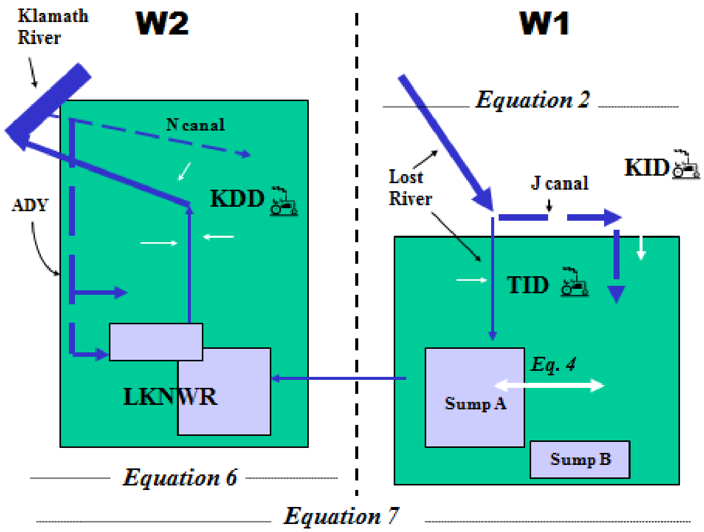




Approach

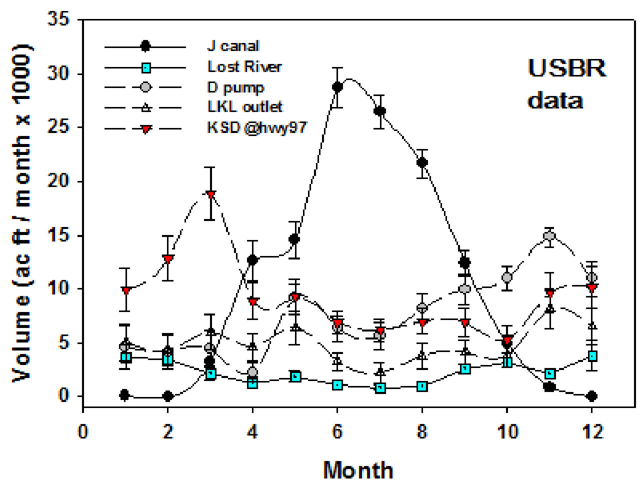
1. Collect and analyze water samples at important surface water transfer locations, representative water distribution points and agricultural subsurface tile drains.
2. Calculate water and nutrient mass balances based on concentrations and flows.
3. Survey farmers and fertilizer dealers about farm fertilizer use.
4. Develop hypotheses linking farming with surface water quality.





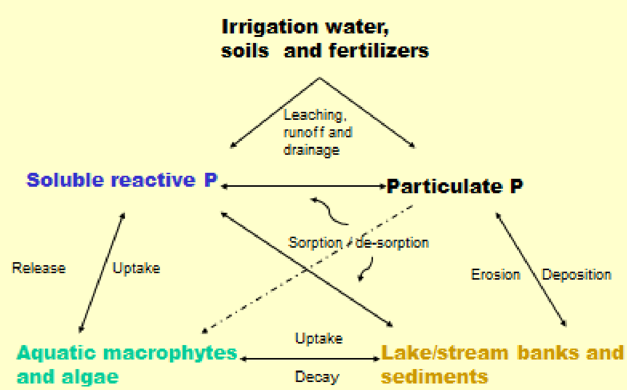
Water balance equations and symbols.

Description	Equation
Watershed 1 (W1)	$I_{LR} + I_J + I_{KID} + P_{W1} + C_{W1} = ET_{c\text{-}TID} + ET_S + ET_{d\text{-}TID} + O_D$
Tulelake Sumps	$I_{LR} + I_S + P_S + C_S = ET_S + O_S + O_D$
TID crop land	$I_J + I_{KID} + O_S + P_{TID} = ET_{c\text{-}TID} + ET_{d\text{-}TID} + I_S + C_{TID}$
Water Use Efficiency in the TID	$WUE = (ET_{c\text{-}TID} / (I_J + I_{KID} + O_S + P_{TID}))*100$
Watershed 2 (W2)	$O_D + I_{ADY} + I_N + P_{W2} + C_{W2} = ET_{W2} + O_{KSD}$
W1 + W2	$I_{LR} + I_J + I_{KID} + I_{ADY} + I_N + P_{W1} + P_{W2} + C_{W1} + C_{W2} = ET_{c\text{-}TID} + ET_S + ET_{d\text{-}TID} + ET_{W2} + O_{KSD}$

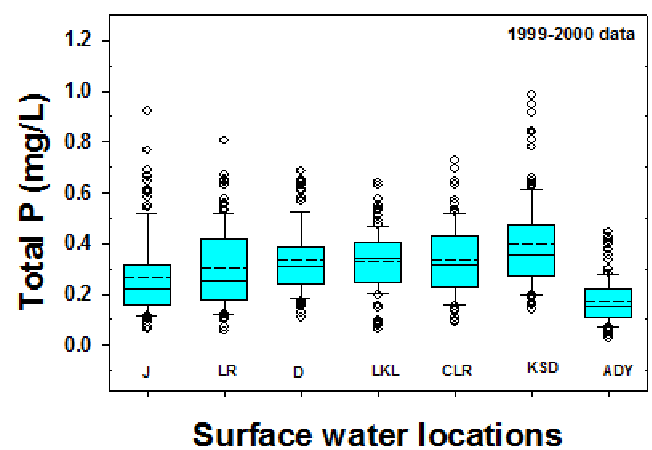


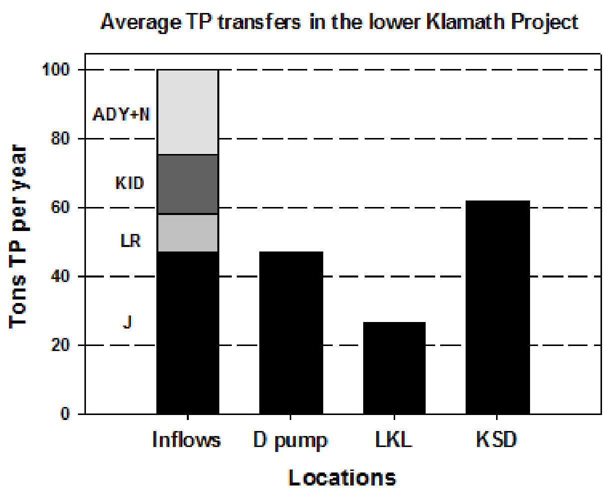
Estimated crop nutrient balances (TID)

Crop	N applied (kg/ha)	N removed (kg/ha)	P applied (kg/ha)	P removed (kg/ha)
Barley	90	112	12	25
Wheat	150	135	11	30
Potatoes	225	157	112	45
Onions	225	157	67	24
Sugar beets	110	200	45	26



Phosphorus transformations during transfer from agricultural to aquatic systems (adapted from Sharpley et al., 1995)





Results

- Salinity (TDS), N, and P concentrations in surface water samples increase as water moves through the watershed.
- The quantity of N and P leaving the lower Klamath Project at the Klamath Straits Drain is less than the amount entering the project in irrigation water and other sources.

Hypotheses

- TN and TP concentrations in water may reflect the dynamics of nutrient cycling in shallow surface waters in the UKB more than the influence of nutrients lost from farming and other human uses.
- The exception may be the transfer of water from farmland to the Tule Lake Sumps in autumn.
- Higher nutrient concentrations at specific times of the year may be correlated in part with the volume of water transferred (turbulence) rather than inherent ecosystem processes.

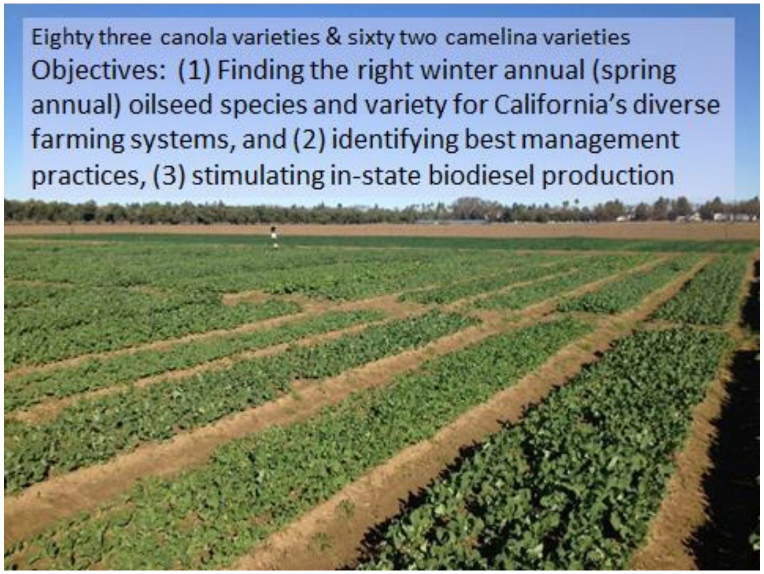
Hypotheses

- Surplus P fertilizer appears to be accumulating in soils and sediments within the project, despite apparent over-fertilization on average.
- Nitrates are lost from tile drains despite apparent under-fertilization on average. Some nitrate loss is unavoidable when farming soils high in organic matter.
- Some modification of fertilization practices can be achieved, but the effects on surface water quality are unlikely to be significant.

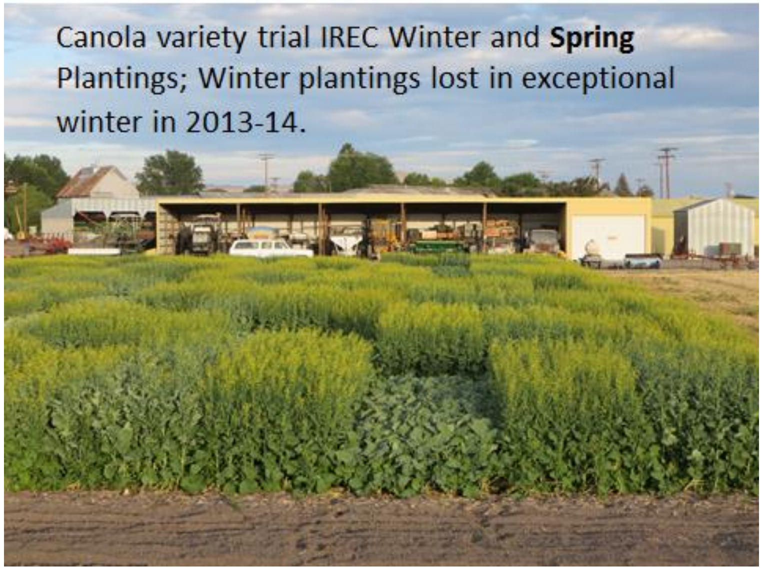
ANR funded research:

Oilseed research at the IREC

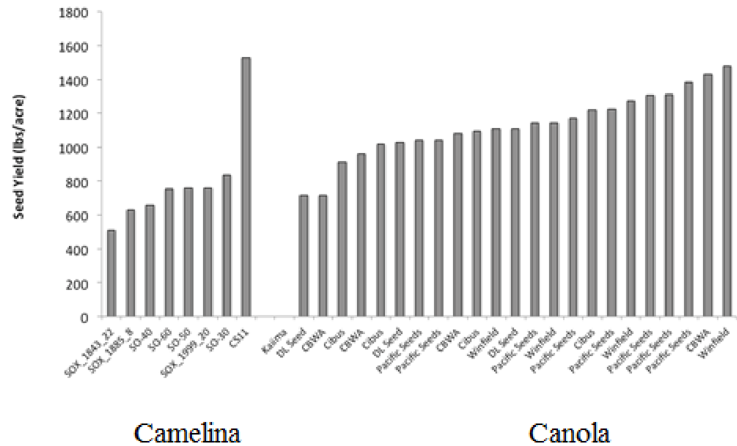
Nic George, Rob Wilson, Darren Culp, Steve Kaffka

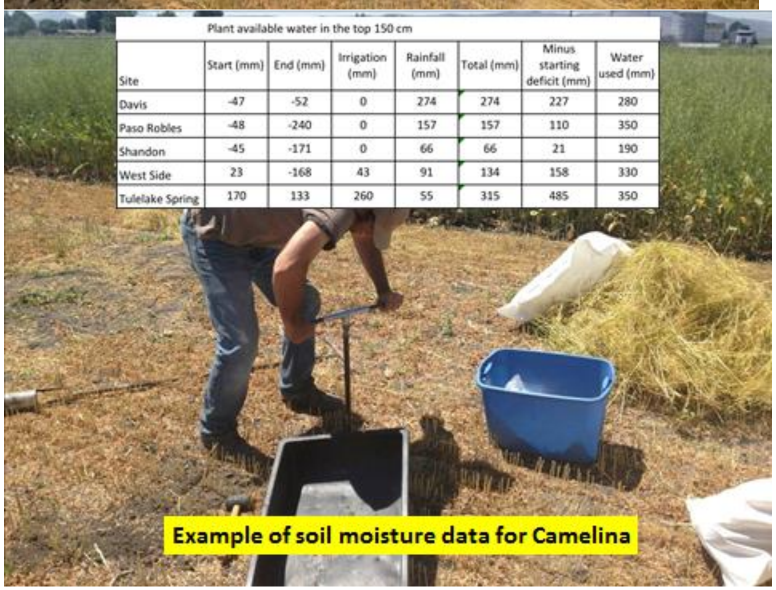


Research sites located across the state



IREC yields spring planted crop 2013





Plant available water in the top 150 cm

Site	Start (mm)	End (mm)	Irrigation (mm)	Rainfall (mm)	Total (mm)	Minus starting deficit (mm)	Water used (mm)
Davis	-47	-52	0	274	274	227	280
Paso Robles	-48	-240	0	157	157	110	350
Shandon	-45	-171	0	66	66	21	190
West Side	23	-168	43	91	134	158	330
Tulelake Spring	170	133	260	55	315	485	350

Example of soil moisture data for Camelina

Reports/Publications

- Kaffka, Lu and Carlson. 1995. An Assessment of the Effects of Agriculture on Water Quality in the Tulelake Region. Research progress Report 108. (IREC).
- Kaffka, Peterson, and Kirby. 1998. Earlier irrigation cutoff for sugarbeets conserves water. *California Agriculture* 52(1):21-24. DOI: 10.3733/ca.v052n01p21. January-February 1998.
- Danosky and Kaffka, 2002. Farming Practices and Water Quality in the Upper Klamath Basin, Final Report to the California State Water Resources Control Board. http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/100927/staff_report/05_Ch4_Pollutant_Source_Analysis.pdf
- Kaffka, S.R, Dhawan, A., and Kirby, D. (2002). Irrigation, agricultural drainage, and nutrient loading in the Upper Klamath Basin. Proc. International Ecosystem Health Congress., Sacramento, California. August 1999. Lewis/CRC press.
- Kaffka, S.R., and Dhawan, A. (2002). Farming practices and water quality in the upper Klamath Basin. In: Stephens, L. (ed.) Helping Irrigated Agriculture Adjust to TMDLs. Pg 9-22 In: McGahan, J. C. and Anderson, S.S. (Eds.) Proceedings of the U. S. Committee on Irrigation and Drainage. October 23-26. 2002. Sacramento, CA.

Progression of Alfalfa Production in the Klamath Basin and Harvest Management Studies in Alfalfa

Steve Orloff, UCCE Farm Advisor & County Director, Yreka, CA
Dan Putnam, UCCE Forage Specialist, UC Davis

Alfalfa is a dominant crop throughout the intermountain area of Northern California, representing a significant percent of the acreage in every agricultural high mountain valley. Historically, alfalfa has not been nearly as important in the Klamath Basin as it is today. In recent years according to Tulelake Irrigation District (TID) data, alfalfa acreage has climbed to nearly four times what it was in the 1960's (Figure 1).

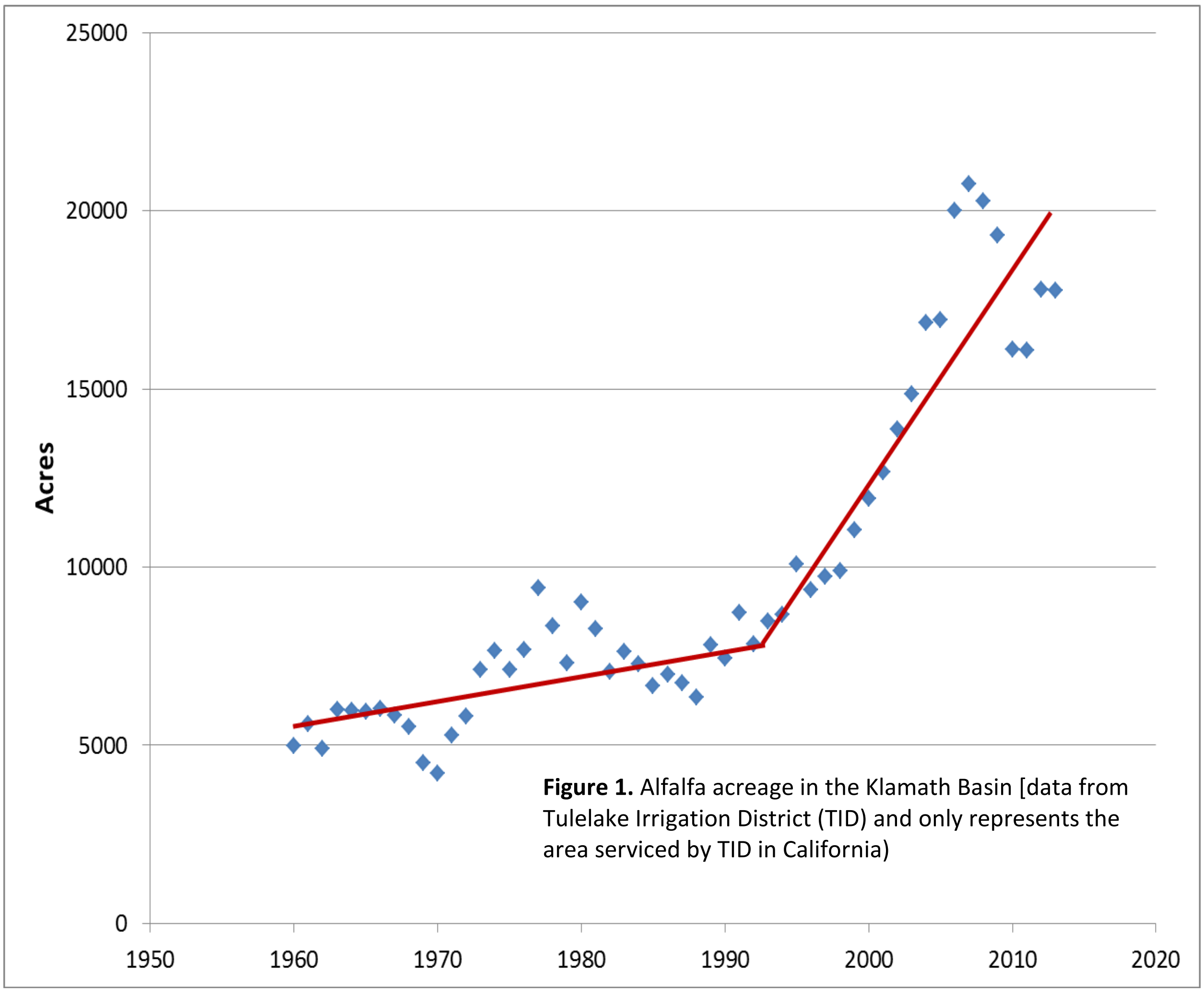


Figure 1. Alfalfa acreage in the Klamath Basin [data from Tulelake Irrigation District (TID) and only represents the area serviced by TID in California)

Alfalfa is an attractive crop choice because of the relatively low volatility of the market, high prices as of late, cash flow advantages (sales made throughout most of the year) and the yield levels possible in the Klamath Basin. Alfalfa prices have continued to climb, and we may have reached a new plateau in alfalfa prices (Figure 2). Current prices are approaching 10 times what they were in the early 1960's and double what they were in the 1990's. This can't be said for other commodities produced in the Klamath Basin which have not seen the steady increase in prices and experience far greater year-to-year volatility. For example, potato prices were nearly the same in 1985 as they were in 2013. Onion prices can be volatile as well. In addition, alfalfa yields in the Klamath Basin are relatively high. Because of the restricted growing season, total seasonal yield in the intermountain area are lower but yields per cutting surpass those of any other alfalfa production region in the state.

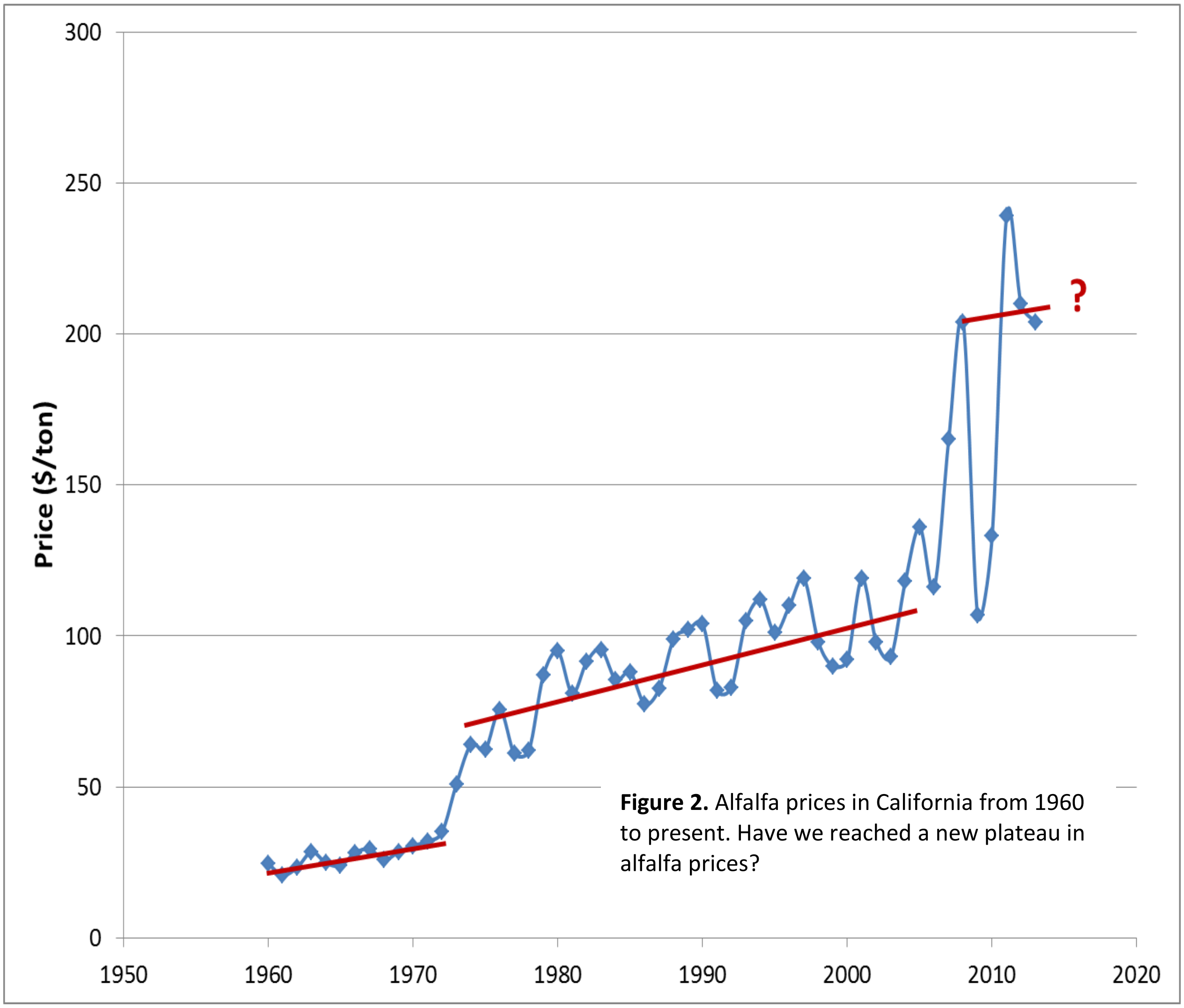


Figure 2. Alfalfa prices in California from 1960 to present. Have we reached a new plateau in alfalfa prices?

Intermountain-grown alfalfa also has the reputation of being high quality. This is not necessarily the case, as the grower's cutting schedule can have a greater influence on forage quality than the environment. Cutting frequency, or more precisely the maturity of the alfalfa when it is cut, affects forage quality and yield more than any other single factor under growers' control. Yield increases with advancing plant maturity, but forage quality decreases. This phenomenon is often referred to as the Yield/Quality Tradeoff and it has profound effects on the profitability of an alfalfa operation.

Because of the importance of the Yield/Quality relationship in terms of yield, quality, stand persistence and ultimately profitability, considerable research has been conducted at IREC and the intermountain area in general over the years to help alfalfa producers with harvest management decisions.

Quantification of the Yield/Quality Tradeoff

Knowing how much yield increases each day and forage quality decreases can help intermountain alfalfa producers with their harvest management decisions. Research conducted over several areas and years showed that on average first cutting alfalfa yield increases approximately 80 pounds per day. Forage quality declined, averaging a 0.33 percentage point
increase in ADF (0.22 percentage point decrease in TDN) and a 0.2 percentage point decline in CP per day. The yield increase and quality decrease were significantly more rapidly for second cutting. Yield increased 112 pounds per day for second cutting while ADF increased 0.4 percentage points per day on second cutting (21% more rapid decline than first cutting). This equates to a 0.27 percentage point loss in TDN per day delay. The drop in CP on second cutting was 0.34 percentage points per day. Together with market information, knowing the rate of change in yield and quality can help growers with harvest management timing decisions.

Intermountain Quality Prediction Stick

Forage quality has a profound effect on alfalfa price, especially for hay destined for the dairy market. The problem is that growers don't know the forage quality (ADF or TDN) of the standing crop in the field—the hay is tested post-harvest but by then it is too late. Growers often fall just short of making "dairy quality" alfalfa. A tool to predict the quality of the standing crop was needed. An alfalfa quality prediction stick (the first in the U.S.) was developed using a data set from the intermountain area combined with data from Idaho using the PEAQ (predictive equations for alfalfa quality) technique.

Staggered versus Sequential Cutting Sequence

Even if an "optimum" cutting schedule could be developed, growers would not be able to apply it for the entire farm because for most producers it can take 3 weeks or longer to harvest a single cutting for all their fields. Research was conducted over several years and locations to evaluate the concept of a staggered cutting schedule whereby the order in which different fields are cut would vary from cutting to cutting rather than cutting all the fields in the same order. In so doing 'Quality' harvests are alternated with 'Yield' harvests. A field cut first on first cutting will not be cut first one on second cutting. A field that was cut in the middle of the sequence on first cutting will be the first one cut on second cutting. This helps assure that the alfalfa in the first fields cut will be immature enough to test dairy quality even in midsummer. Using this altered cutting sequence, fields cut first on first cutting have a longer interval between first and second cutting. These fields will obviously not test dairy quality. The intent is to maximize yield on these fields and give the plants an opportunity to recover from being cut at an immature growth stage on first cutting.

In addition to demonstrating the benefits of a staggered cutting approach, this research also showed that the most cutting schedule was one where the second cutting was delayed to maximize yield while leaving less growing time for the third cutting so this cutting was more likely to meet dairy quality standards.

Fall Harvest Management

The timing of the last cutting of the year affects the level of carbohydrate reserves in the alfalfa root, which in turn can influence the vigor of the alfalfa, winter survival, and alfalfa yield the following spring. Research was conducted at IREC over multiple years to compare three versus four cuttings per year and to determine the effect the timing of the last cutting of a 4-cut harvest schedule. Whether a 3 or 4-cut schedule resulted in higher yield depended on the weather conditions that year and the length of the growing season. The timing of the last cutting with a 4-cut schedule had a major effect on first cutting yield the following season. In general, it is best to allow ample time after cutting (at least 6 weeks) before a killing frost to allow the plants sufficient time regrow and replenish root reserves or cut late so that there is little regrowth after cutting. Making the last cutting in mid-October tended to yield the highest that year and the following year—this approach allowed for minimal regrowth after the last harvest. The primary concern with cutting so late is weather and the difficulty curing the hay in a timely manner without rain damage.

Reduced Lignin Alfalfa

Lignin is a structural component of the cell wall—strengthening the plant and allowing the vascular system of the plant to transport water without leakage. It has been compared to the rebar in a concrete building. The amount of lignin increases dramatically with advancing alfalfa maturity. The drawback with lignin is that it is indigestible and because it binds to the cellulose, it reduces digestion of the cellulose in the rumen.

A cutting schedule trial was established in August 2012 at IREC with similar trials at UC Davis with Forage Specialist Dan Putnam and in Wisconsin with Forage Specialist Dan Undersander. Four high yielding well adapted conventional varieties were selected to compare with four recently developed genetically engineered low-lignin lines. Each variety is being evaluated under 3-cut and 4-cut harvest management regimes.

Yield and quality data were collected in 2013 and have continued into this year. It is not surprising that the 4-cut scheduled resulted in higher crude protein (CP), lower fiber (higher TDN) and higher fiber digestibility than the 3-cut schedule. Preliminary results indicate that the low lignin lines have consistently higher fiber digestibility—on average they had lower acid detergent lignin (ADL) and significantly higher neutral detergent fiber digestibility (NDFD) and digestible NDF (dNDF). This indicates that if the varieties are harvested on the same harvest schedule, the low lignin varieties would have higher quality than the conventional varieties. An alternative way to consider these results is that the low lignin varieties would have the same NDFD as conventional varieties harvested earlier. The potential practical ramifications are that when commercial low lignin varieties become available, producers may be able to delay harvest and maintain forage quality. Delaying harvest will increase the yield for that cutting and potentially it may be feasible to reduce the number of cuttings per year from 4 to 3, improving yield while still producing dairy-quality alfalfa. A longer interval between cuttings may also increase the level of carbohydrate root reserves improving plant vigor and stand persistence.

Low-lignin alfalfa varieties could have a dramatic effect on alfalfa harvest management and transform our understanding of the yield quality tradeoff as it currently exists. Data on yield and quality changes with advancing maturity for new GE low-lignin alfalfa cultivar is needed to understand the impact this technology might have on alfalfa production as well as animal nutrition.

A change in the way we quantify alfalfa forage quality in California will likely need changing before these low lignin varieties are commercially available. The current system of analyzing ADF to predict TDN will not adequately reflect the improvement in fiber digestibility and feeding value that is possible with low lignin alfalfa. Our preliminary data suggest that the use of genetic engineering to develop low-lignin varieties should result in a greater and faster improvement in forage quality than what has occurred in previous breeding efforts using conventional plant breeding methods.

Management of White Rot with Sclerotia Germination Stimulants and Fungicides

Intermountain Research and Extension Center, Tulelake, Field Day
Mike Davis and Rob Wilson
August 13, 2014

White rot, caused by the soilborne fungus *Sclerotium cepivorum*, is a significant threat to the profitable production of onions, garlic, and other *Allium* crops. The pathogen propagates by the production of round, poppy seed-sized sclerotia produced on the roots of decayed host plants. Sclerotia spread in mass movement of soil or water, on animals, and especially on infested plant parts. Once introduced into an area, *S. cepivorum* is gradually spread on contaminated equipment or planting materials, and slowly the production of garlic and onions in the entire region is threatened. Garlic culture is perhaps the principal mode of movement since it is propagated vegetatively, and garlic bulbs and cloves are sufficiently large that an infestation might go unnoticed. Despite efforts to prevent further introduction into production areas, the number of infested fields is growing every year.

The severity of white rot is directly related with the number of sclerotia of the pathogen in the soil at planting. Surprisingly few sclerotia can result in great crop losses. For example, economic losses to white rot can occur at inoculum densities as low as one sclerotium per 10 quarts of soil yet in many locally infested fields, populations may be as high as 200 or more sclerotia per quart. Once a field is infested, it will remain so for at least 40 years and probably longer since sclerotia of the fungus remain dormant indefinitely in the absence of *Allium* plants.

White rot is a disease limited to *Allium* crops. The fungus successfully colonizes only *Allium* plants and sclerotia germinate only in response to exudation by *Allium* roots. These exudates contain alkyl and alkenyl-L-cysteine sulphoxides, which are metabolized by the soil microflora to yield a range of volatile thiols and sulfides that activate the dormant sclerotia. The specific reaction between sclerotia and sulphoxides or their breakdown products suggests a possible use of these sclerotial germination stimulants for controlling white rot disease. If these thiols can be applied to the ground in the absence of an *Allium* crop, the sclerotia may be “tricked” into germinating. In the absence of a host, the mycelium from germinating sclerotia persists for periods ranging from a few days to several weeks depending on the soil temperature, then die after exhausting nutrient reserves. Based on earlier work, a product containing diallyl-disulfide, called DADS, which was a byproduct of petroleum distillation, was registered for use as a sclerotial germinator. Although soil treatment with DADS reduced sclerotia populations by over 90%, the relatively few sclerotia that survived treatment resulted in unsatisfactory crop loss. Thus, it was clear that sclerotial germination stimulants alone were inadequate for the production of a profitable crop in a white rot-infested field, especially if inoculum densities were high, and a fungicide was needed to provide additional control of white rot.

While we conducted research on the efficacy of various fungicides to manage white rot, DADS become unavailable to the industry. Our research at IREC was then directed on evaluating the efficacy of replacements for DADS. Fortunately, garlic juice, a natural sclerotia germination stimulant available from the garlic and onion dehydrator industry, turned out to be a viable alternative. Although not quite as effective as DADS in reducing sclerotia in soil, garlic juice is clearly a good alternative. Future work will concentrated on rates of garlic juice to boost efficacy. We also studied the efficacy of fungicides for white rot control with and without germination stimulants. Some fungicides, especially tebuconazole, were highly effective in white rot control, especially where sclerotia populations are low to moderate. Today, we have progressed to a point where we believe a profitable *Allium* crops can be grown with a combination of stimulant and fungicide or in some cases, a fungicide application alone, dependent on disease pressure.

In our recent research at IREC, a single application of fungicides at planting provided excellent control of white rot when coupled with a pre-plant DADS or garlic juice treatment (Tables 1 and 2).

Table 1. Effect of sclerotial stimulants on white rot symptoms and onion yield

Germination Stimulant	Fungicide	Bulbs with symptoms (%)	Marketable yield (tons/A)
None	none	71 c	3.8 c
None	tebuconazole	69 c	5.1 c
None	fludioxonil	79 c	2.5 c
DADS (1 gal/A)	none	51 b	8.5 bc
DADS (1 gal/A)	tebuconazole	32 a	14.1ab
DADS (1 gal/A)	fludioxonil	26 a	14.6 a

Means in each column followed by the same letter are not significantly different according to the Tukey-Kramer multiple comparison test, $P \leq 0.05$.

Table 2. Effect of sclerotial stimulants on white rot symptoms and onion yield

Germination Stimulant	Fungicide	Bulbs with symptoms (%)	Marketable yield (tons/A)
None	none	78 e	3.6 a
None	tebuconazole	32 b	16.4 bc
None	fludioxonil	50 cd	10.7 ab
DADS (1 gal/A)	none	53 d	9.3 ab
DADS (1 gal/A)	tebuconazole	12 a	24.2 c
DADS (1 gal/A)	fludioxonil	34 bc	15.4 bc
Garlic juice (1 gal/A)	none	66 de	5.7 a
Garlic juice (1 gal/A)	tebuconazole	21 ab	20.3 c
Garlic juice (1 gal/A)	fludioxonil	53 d	9.4 ab

Means in each column followed by the same letter are not significantly different according to the Tukey-Kramer multiple comparison test, $P \leq 0.05$.

Effect of Nitrogen Fertilization Practices on Spring Wheat Protein Content

Steve Orloff, UCCE, Siskiyou County
Steve Wright, UCCE, Tulare and Kings Counties
Mark Lundy, UCCE, Colusa, Sutter and Yuba Counties
Robert Hutmacher, CE Specialist and West Side REC Director

Small grains are important to the agricultural economy of the Klamath Basin. The acreage of small grains has declined by about a third over the last 50 years and the relative proportion of wheat, barley and oats have changed (Figure 1.). Barley and oat acreage have declined while wheat acreage has increased significantly.

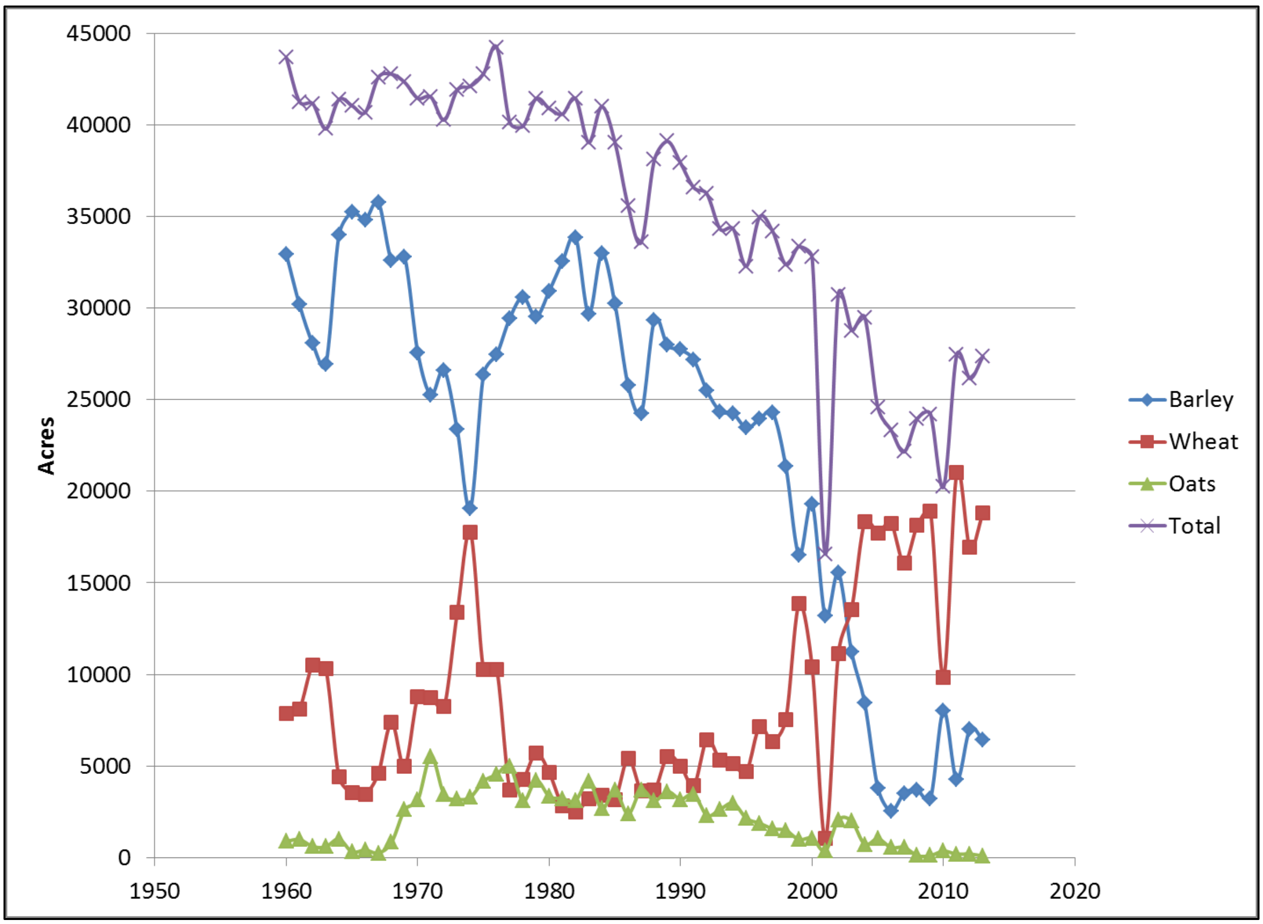


Figure 1. Acreage of small grain crops in the Klamath Basin [data from Tulelake Irrigation District (TID) and only represents the area serviced by TID in California)

Wheat yields in the Klamath Basin are higher than anywhere else in the Intermountain Region. In most intermountain areas a 3-ton grain yield is considered a high yield, while in the Klamath Basin, grain yields of 4 or even 5 tons per acre occur, rivaling the highest production areas of the state. However, achieving high yield is only part of the story. Protein content is nearly as important as yield because the price a grower receives is determined by the grain protein content with a discount for wheat with less than 14% for grain marketed in the Pacific Northwest. Other areas of

California have a lower protein requirement. The primary factors that influence protein content are variety selection, yield level, and nitrogen fertility management. Yield and protein content are somewhat inversely related, and it is difficult to achieve both, especially without optimum nitrogen fertility management.

The total amount of N applied is important, but the timing of the application is critical as well, especially when it comes to the protein content of the wheat kernel. Adequate N during vegetative growth stages is essential to maximize yield, but does not ensure an acceptable grain protein concentration. A late-season N application may be required to reach protein goals because only after most of the N required for yield is supplied will additional N applications increase grain protein content. Nitrogen applications made from the boot stage up to 2 weeks after flowering have proven effective for increasing grain protein. Applying the total amount of N believed to be needed for both yield and protein goals pre-plant may still result in insufficient N available at heading to achieve the desired protein level because there is risk of excessive vegetative growth and lodging and higher potential for N leaching. The amount of N needed is a function of the desired protein concentration, the yield level and the wheat cultivar (varieties differ in their ability to accumulate N). The amount of N typically applied with a late-season application intended for protein enhancement is in the neighborhood of 30 to 50 pounds of N per acre. The higher the yield, the more N required to increase the protein content.

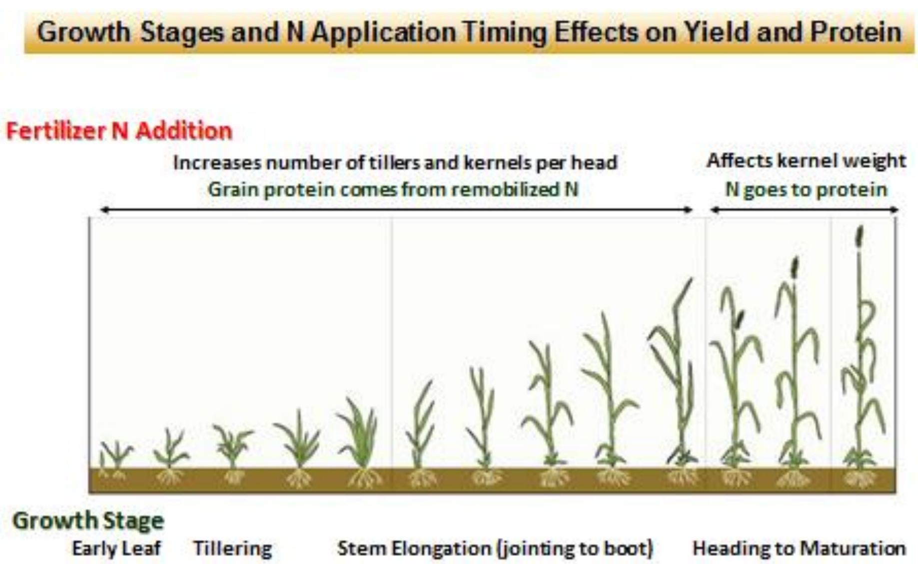


Figure 2. Cereal growth stages and N application timing effects on yield and protein.

It has been common in the intermountain area to apply all the nitrogen pre-plant. Research we have conducted at IREC showed that a pre-plant application alone at the rates tested was insufficient, and a split application of N was needed to achieve acceptable yield, and especially to meet protein goals. If only a pre-plant application of N is applied, the rate needed to meet the protein goal of 14 percent is extremely high on an N deficient soil (Figure 3.). Further research is needed to fine tune N fertilization practices, and especially N application timing, to achieve desired yield and protein levels.

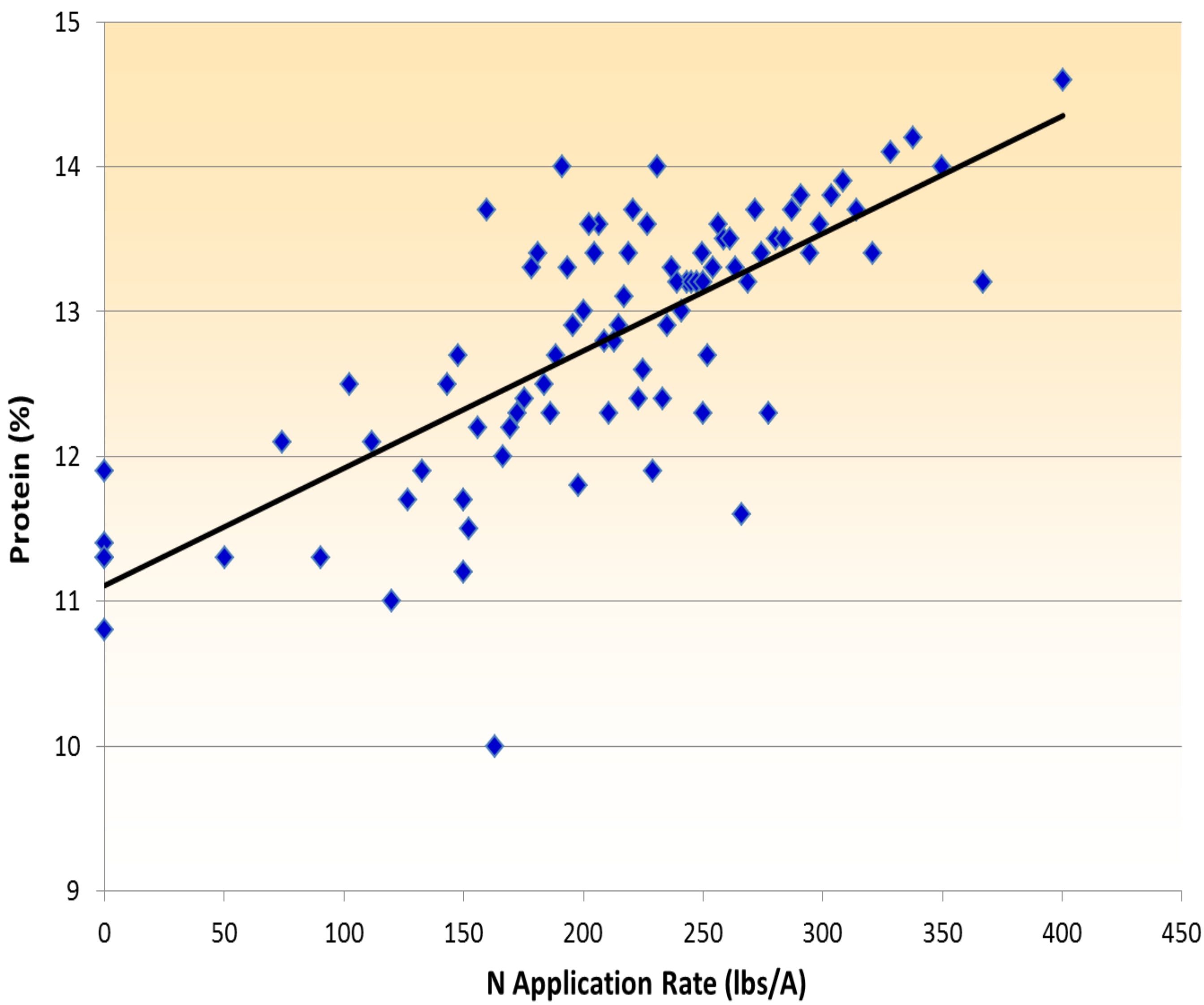


Figure 3. Relationship between pre-plant N application rate and grain protein content. Yecora Rojo wheat, IREC 2013

Current Research Projects

Three different wheat nitrogen management projects are being conducted at IREC during the 2014 season. One trial is in cooperation with the late Michael Tarter, Emeritus Statistics Professor at UC Berkeley, to evaluate different plant sampling techniques to determine which one is most predictive of the protein content at harvest. Plant sampling techniques include stem nitrate concentration, flag leaf total N, and the total N concentration of the penultimate leaf (leaf below the flag leaf). The purpose of this research is to assess whether any of these measurements or combination of measurement would be useful to determine the need for a late-season application of nitrogen fertilizer to attain protein goals. A total of 88 different nitrogen rates were applied to individual plots. The sampling methods listed above were conducted when the wheat was at the 50 percent heading growth stage.

Two additional trials are being conducted in cooperation with Farm Advisors Steve Wright (Tulare and Kings Counties) and Mark Lundy (Colusa, Sutter and Yuba Counties) and Specialist Bob Hutmacher. One project (conducted at IREC and WSREC in Fresno) is to evaluate the interaction between N rate and wheat cultivar with four different wheat cultivars (the cultivars in the IREC study are Yecora Rojo, Hank, WB 9668 and WB 9518). Nitrogen treatments applied to all four varieties are shown in Table 1.

Table 1. Nitrogen rates and timings.

Treatment	Pre-plant Application (lbs. N/acre)	Tillering Application (lbs. N/acre)	Boot Stage Application (lbs. N/acre)	Total N Applied (lbs./acre)
1	0	0	0	0
2	70	40	40	150
3	110	60	55	225
4	150	75	75	300

Results from this trial will indicate the yield potential of the different cultivars and whether some varieties are better than others at accumulating N to improve grain protein.
The third project evaluates the most efficient time to apply nitrogen to wheat. Specifically, what proportion of the total nitrogen should be applied at each growth stage? Can nitrogen-use-efficiency be improved by applying N at timings that more closely match periods of peak crop uptake? As mentioned above, most wheat growers in the Intermountain Region apply all or nearly all of the N fertilizer pre-plant. Research was needed to determine if nitrogen use efficiency could be improved by applying less of the N at planting and more of the N later in the season closer to peak uptake.

Treatments in this study included an untreated control with no fertilizer, a series of treatments with a total of 150 pounds of N per acre, a series of treatments with a total of 250 pounds of N per acre, and a single treatment with 350 pounds of N per acre. The 150 pound per acre rate represents a typical application rate for the Intermountain region and the 250 pound per acre rate represents a rate that is more likely needed to achieve maximum yield and protein based on our previous research. Different proportions of the total amount of nitrogen fertilizer were applied at each of four application timings (pre-plant, tillering, boot and flowering). The fertilizer treatments were applied to a single variety, Yecora Rojo, which is the most popular variety in the area. The N was applied as urea at all treatment timings.

Results clearly show that nitrogen application timing has a significant effect on grain yield. It appears that an adequate supply of N at tillering stage (beginning of maximum N uptake) is critical. Across both rates (150 and 250 lbs./A total N) and both years, the highest yielding treatment was the treatment where no N was applied pre-plant, 80 percent at tillering and 20 percent at flowering. Yield was reduced when too high a proportion of the N was not applied until boot stage or later (Figure 4.).

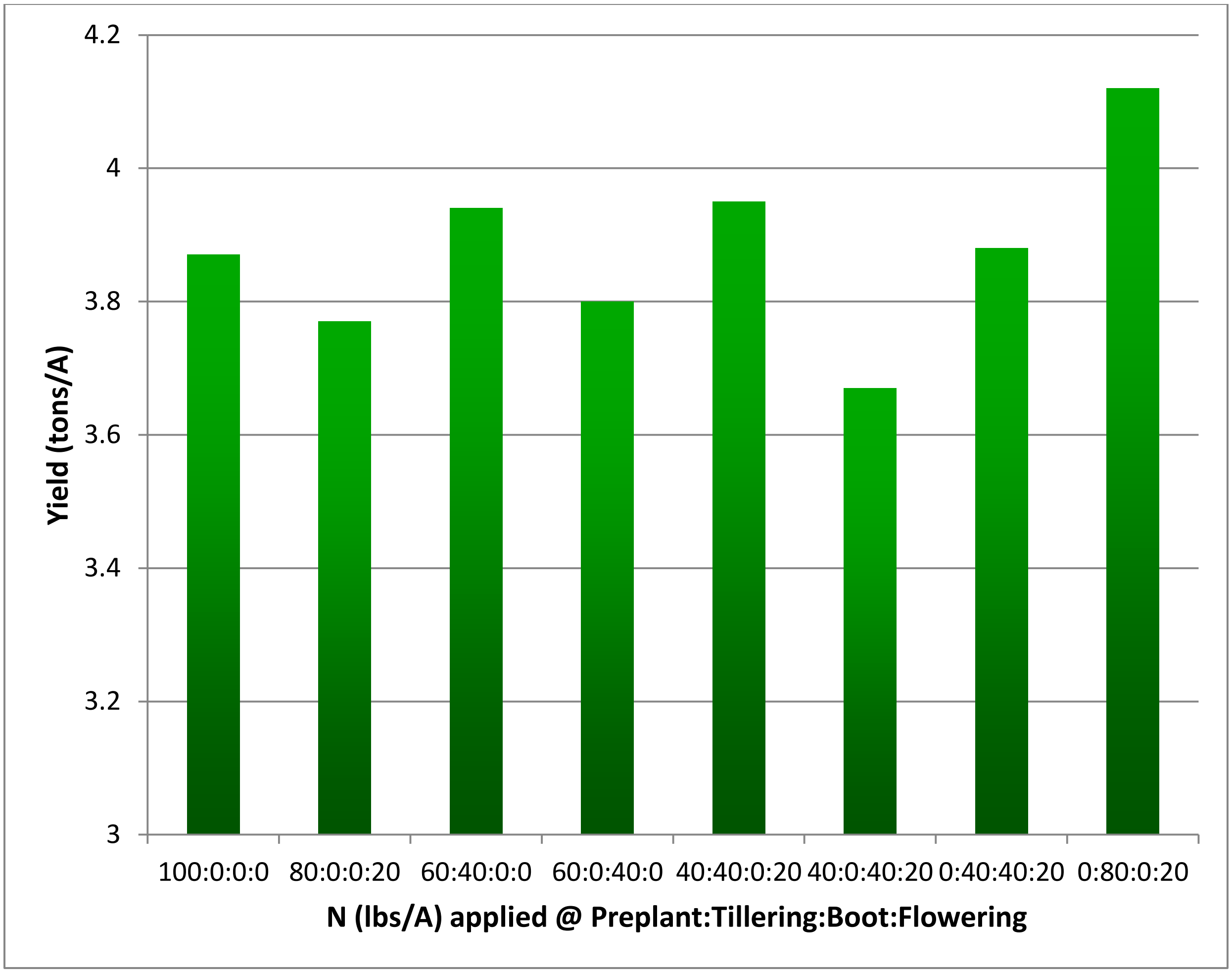


Figure 4. Effect of nitrogen application timing (percent of total applied pre-plant, tillering, boot or flowering) on grain yield averaged over 2 years and 2 N rates (150 or 250 lbs. N/A).

Nitrogen fertilization practices had a large impact on grain protein. There was nearly a 6 percentage point difference in protein between the control and the most effective treatment in 2012 and 4 percentage point difference in 2013. The wheat growth stage when most of the N is applied also had a profound effect on grain protein content. In some years, there was over a 3 percentage point difference in protein content for the same rate of N just depending on when the N was applied. Pre-plant applications alone resulted in poor protein contents. Protein content improved markedly when a higher proportion of the total N was applied later in the season (boot or flowering).

Table 2. Effect of N application timing (percent applied pre-plant, tillering, boot or flowering) and rate (150 or 250 lbs. N/A) on protein content.

% N applied	**2012**	**2013**	**2012**	**2013**
Pre-plant: tillering: boot: flowering	**150 lbs. N/A**		**250 lbs. N/A**	
	% protein			
Unfertilized	9.9	11.4	9.9	11.4
100:0:0:0	12	11.7	13.4	12.6
80:0:0:20	12.4	12.3	13.8	13.7
60:40:0:0	12.1	11.9	13.2	13.1
60:0:40:0	12.7	14.8	14.2	14.6
40:40:0:20	12.7	13	14.2	13.8
40:0:40:20	14.3	15.7	14.5	15.8
0:40:40:20	13.7	15.2	15.3	15.1
0:80:0:20	13.2	13.5	14.1	14.1

Based on these results, we expanded our effort in 2014 and trials are being conducted at WSREC in Fresno, at UC Davis and at IREC. Three different total rates of N (150, 225, and 300 lbs. N/A) are being evaluated at six different N timings (similar timings to those evaluated at IREC in 2012 and 2013). In addition to yield and protein data, we are collecting soil nitrate data post-harvest at one-foot increments down to 8 feet. With these data we will better be able to assess N uptake and N use efficiency.

In addition to this effort, we are developing in-field diagnostic methodologies to produce site-specific information in real-time about crop N status. Led by Farm Advisor Mark Lundy, we are calibrating a suite of low-cost, field-based instruments to quantify the N status of the crop to predict the need for additional applications of N to attain desired yield and protein goals. These newer technologies are being compared with more costly, established and/or lab-based methodologies. We will be quantifying the ability of each instrument to predict N availability and requirement at various stages of crop development.

Conclusion

A pre-plant N application alone has been a common fertilizer program for many growers in the intermountain area. However, our data suggest that shifting away from high pre-plant applications and applying more of the N later in the season may have merit for both yield and protein improvement. Applying most of the N at tillering followed by an application at boot or flowering resulted in higher yield and much improved protein content—high enough to avoid dockage.

New Oat Varieties for California:
UC 113, UC 125, UC 128, UC 129 (Mac), UC 132, UC 130, UC 142 (Howard) and UC 148

Cal Qualset
Department of Plant Sciences, Davis

Oat [*Avena sativa* L.] is a minor crop in the California agricultural scene, but it is grown throughout the state. Often relegated to marginal, rainfed production sites, the statewide annual yields are far below the biological potential for biomass production. Oat has diverse uses, including grain for food and feed, dried and green forage for livestock, and to a limited extent, as a cover crop. Oat is grown as a rotation crop with other more profitable ones. Only about 10% of the acres planted are harvested for grain and the remainder harvested for forage uses or abandoned. Often the seed supply of locally grown oat is limited and seed is imported from other states, mostly from Oregon or Washington.

Of interest at the Intermountain Research and Extension Center is the potential for the Tulelake region to become an oat seed producing area to supply lower California with its seed needs. One reason seed retailers may favor Tulelake production is that the crop is grown from April to August, affording the opportunity of making projections of seed needed for the fall/winter plantings in the spring and organize seed production in Northern California for late summer harvest to meet that projected need.

California oat varieties have been bred or introduced since early in the 20th century, but the activity has been limited and sporadic. An early introduction, California Red, is basically a landrace that has had minimal improvement, but is still grown throughout the state. Suneson[1] et al. [1959] discussed the oat varieties extant in the 1950s, including Kanota, Palestine, Ventura, Indio, and Coast Black. C.A. Suneson, a USDA scientist located at UC Davis (retired in 1968), bred several varieties which improved the general oat variety picture for California growers. First, he introduced Curt in 1958, the first short-statured cereal crop released in the U.S. Later, he exploited hybrids of cultivated *Avena sativa* varieties with wild oat, *Avena fatua,* and released the varieties Sierra (1961) and Montezuma (1968)[2]. Varieties, such as Ogle, have been introduced from the Midwest US, Cayuse from the Pacific Northwest, and Swan from Australia. Zwer[3] et al. [1984] reviewed the oat production and improvement situation in California and suggested the need for more aggressive oat breeding in California.

California Red and Montezuma are still the mainstay varieties grown in California. Both are fraught with foliar diseases and agronomic deficiencies that limit productivity and reduce grain and forage quality. A new short-statured plant type was introduced from the oat breeding program in Western Australia and released in California in 1994 with the name Pert [Qualset[4] et al. 1994]. Pert had

[1] Suneson, C.A., M.D. Miller, and B.R. Houston. 1959. Oats for grain and forage. Circular 481. Division of Agricultural Sciences, University of California, California Agricultural Experiment Station.
[2] Suneson, C.A., C.O. Qualset, J.D. Prato, J.T. Feather, and W.H. Isom. 1969. Montezuma oat variety produces high test weight, and good yields. California Agriculture 23(2):6-7.
[3] Zwer, P., C.O. Qualset, H.E. Vogt, and L.F. Jackson. 1984. Oat improvement in California. University of California, Davis, Agronomy Progress Report No. 146.
[4] Qualset, C.O., H.E. Vogt, P.K. Zwer, J.H. Heaton, L.C. Federizzi, L.F. Jackson, R. McLean, P. Portman, and A.L. McKendry. 1994. Pert and Bates-89: Two oat varieties released for grain and forage production in California. University of California, Davis, Agronomy Progress Report No. 246.

measured grain yields up to 50% higher than California Red or Montezuma, but it matures later and this was seen as a disadvantage to some growers. Its acceptance by some growers was minimal because the variety had thick culms and believed not to be acceptable to the horse hay market. The variety was not publicized and marketed aggressively. Bates-89 was introduced from Missouri because of it BYD tolerance and desirable forage traits, unfortunately, Bates-89 tends to lodge and its grain yield is lower and affected by propensity for shattering.

UC Davis has conducted a limited-scale oat breeding program under the leadership of Cal Qualset since 1967 with the main objective to discover resistance to the barley yellow dwarf virus. Limited success was recorded in this effort, but USDA and University of Illinois workers achieved measurable success and several of their breeding lines were introduced to the California breeding program. Ogle was a popular variety with BYD resistance from the Illinois program that has been useful in California. The Quaker Oat Company sponsored the International Oat Nursery that included breeding lines from oat breeding programs from the US and South America. Quaker Oats provided small grants to the California oat breeding program during the years 1987-93 in exchange for conducting BYD screening of the entries in the international nursery. All lines in that nursery are available for use by breeders, upon agreement with the clauses of the Code of Ethics for oat breeders. One of the varieties released 2007, UC 129, was selected from the International Oat Nursery. It was developed at Texas A & M University, hence joint release of the variety with Texas A & M is appropriate. In 1992, the Northrup-King and Company donated a collection of lines to the USDA National Plant Germplasm System [NPGS] that were developed by Coker's Pedigreed Seed Company that Northrup-King had purchased. These lines were made available by the USDA National Small Grains Collection to breeders and some 200 lines were evaluated at UC Davis for several years beginning in 1993.

Pamela Zwer, who provided leadership under the guidance of Qualset for the oat breeding program while she was a graduate student at UC Davis, used the Western Australian short-statured lines in crosses with California and Illinois varieties and breeding lines. Luiz Federizzi, oat breeder at the University of Rio Grande do Sul in Brazil, studied the genetics of plant height reduction in oat at UC Davis for his Ph.D. dissertation. He studied several sources of dwarfness, including a mutant from the variety Palestine, called Palestine Dwarf, and OT 207, a short-statured mutant derived after gamma ray irradiation of seeds at the Agriculture Canada oat program at Ottawa, Ontario. One of the varieties released (UC 132) resulted from this cross. Pamela Zwer (until 1986), John Heaton (until 1995), Herb Vogt, and Cal Qualset, carried out the selection and evaluation of early generation lines that eventually resulted in the varieties released in 2007.

Thus, the UC oat breeding program utilized germplasm from several sources: Western Australia, Canada, Texas A & M University, University of Illinois, and the USDA National Small Grains Collection. The program was conducted in the facilities of the Department of Agronomy and Range Science (cum Plant Sciences Department) and the UC Genetic Resources Conservation Program during the period 1968 to 2008. Over the years of the program, financial support was received from the Quaker Oats Company, 1982-93 and the California Crop Improvement Association Cereal Research Fund, 1984-93.

The goals of the breeding program were:

- To expand the genetic diversity of the California oat crop by introducing several divergent variety types to California growers.
- To breed and distribute oat varieties with disease resistance, good agronomic traits, high grain and forage yield and acceptable end-use quality, especially forages for livestock uses.
- To innovate and implement a system of seed multiplication and distribution to insure that new varieties would be widely available to California growers.

The breeding program was successful in all of its goals. Eight varieties were released in 2007 which greatly enhanced the options for California growers when they consider oat in their farming systems. Some of the descriptive and performance data for the 8 varieties are summarized and compared to local standard varieties in Tables 1-3.

A new method was devised to establish the marketability of these varieties. This method was needed because often public varieties are released and not aggressively marketed to farmers. A brief description of the method used is given below.

The UC Division of Agriculture and Natural Resources Test Agreement process [Administrative Manual, DANR, Section 485] was used to explore the potential of seven of the eight varieties for seed production performance and adaptation on growers fields. Since it was a goal of the breeding program to structure the evaluations in such a way that seed companies could determine whether the varieties meet a market niche that could be exploited by aggressive advertisement and marketing, all of the major oat seed marketing companies were offered, by letter, the opportunity to participate in the test program. Three seed companies responded and arranged for field-scale (5 or more acres) production of the varieties with growers. The production tests were conducted during 2005-07 by Baglietto Seed Company [UC 113, UC 128, and UC 148], Resource Seeds, Inc. [UC 125, UC 130, and UC 142], and Mezger Bros. Seed [UC 129]. Each of these companies was supplied by the breeder with Breeders Seed for the test plantings. Westbred LLC did not arrange for test production of a new variety, but based on test data, expressed interest in UC 132. None of the varieties were requested by more than one company. After the results of the test plantings, the companies expressed interest in a marketing arrangement that would provide them exclusive use of the varieties that they had tested. This was desirable because the companies need assurance that their marketing efforts will not be exploited by others. By this means, the varieties will become known to the growers through marketing efforts that have not been applied in the past by the UC Foundation Seed Service or UC research and extension specialists. Other states have been confronted with similar situations and have devised mechanisms for granting the exclusive marketing agreements with seed companies of new varieties released by public plant breeding programs.

Oat varieties and other small grain crops will not provide a substantial source of royalty income to the University of California if protected by USDA Plant Variety Protection (PVP) certificates because of the relatively high cost of the PVP process, low volume of seed sales, and the legal provision that growers may self-save planting seed of PVP-protected varieties that they have grown on their farms. For these reasons, and a fourth one, that UC releases varieties developed by other public programs with minimal genetic modifications for which UC ownership cannot be claimed. Two of the oat varieties included in the request for CCIA certification, Mac and Howard, fall into this category.

From 1974 until recently, the UC Office of Technology Transfer determined that the financial returns to UC for protection of wheat, oat, barley, triticale, and rye varieties released by UC breeders were not cost effective and PVP was not advantageous, nor pursued by OTT. But the seed companies interested in marketing the present roster of new oat varieties need assurance that their investments in producing, advertising, and marketing oat varieties will be protected. Hence, the concept of exclusive licensing was adopted by the UC Office of Technology Transfer. In this arrangement, each company desiring an exclusive marketing arrangement was asked to contribute to the USDA fees and costs to the University for obtaining a PVP certificate. The companies agreed to pay the approximate $5,000 USDA and University fees. Many other states have developed means for granting exclusive marketing privileges for publicly developed crop varieties.

This program was successful in marketing of four of the six varieties that received PVP certificates. Baglietto Seed Company markets UC 113, UC 128, and UC 128 and Barkley Seed Company markets UC 132. Resources Seeds, an early participant in the program, supported PVP of UC 125 and UC 130, but when the company changed ownership, oat seed marketing was not continued. These two varieties are available for marketing via communications with the UC Office of Technology Transfer.

Table 1. Grain yields, lb/acre, and as percentage of Montezuma over years at five locations. Cooperative Extension trials, except Tulelake.

Variety	Davis lb/acre	Davis % Mont	Santa Clara lb/acre	Santa Clara % Mont	Butte lb/acre	Butte % Mont	San Benito lb/acre	San Benito % Mont	Tulelake lb/acre	Tulelake % Mont	All locations % Mont	Number location-years
UC 113	3900	152	3580	129	4950	198	3060	106	6260	113	145	14
UC 125	3765	147	3320	120			3120	108	6210	112	128	11
UC 130	3240	127	3970	144			3280	114	5580	101	127	11
UC 132	3170	124	3690	133			2140	74	5560	100	116	11
UC 142	2665	104	3090	112			2400	83	4670	84	96	11
UC 148	3290	129	3920	142			2640	92	5120	92	114	11
UC 128	3340	131	4100	148			2820	98	6460	117	127	11
UC 129	2920	114	4340	157			3320	115	6360	115	129	11
Montezuma	2560	100	2760	100	2500	100	2880	100	5540	100	100	14
Bates 89	1920	75	1740	63	3080	123	2320	80	5640	102	91	14
Pert	3670	143	3060	111	4770	191	2960	103	5990	108	135	14
Sierra	2740	107	3470	125	3610	145					125	9
Years evaluated	1997 1998 2001 2002		2001 2002		1991 1992 1993		2004		2000 2002 2004 2005			

Table 2. Agronomic and disease data from UC Cooperative Extension trials at Davis for the years 1997, 1998, 2001, and 2002. Means over years are presented, with the number of years indicated for each trait.

Variety	*Test wt. lb/bu*	*Kernel wt. mg*	*Plant height inches*	*Lodg. score*	*Head. days from 3/1*	*Mat. days from 3/1*	*Crown rust score*	*Powd. mild. score*	*Leaf blotch score*	*BYDV*
UC 113	36.9	37.4	41	3.4	68	109	1.9	2.5	1.5	3.4
UC 125	36.8	35.8	44	3.5	67	108	2.2	2.5	2.0	3.2
UC 130	34.6	30.0	44	4.8	65	95	1.5	1.4	1.3	1.2
UC132	34.6	30.2	40	3.4	64	91	1.0	1.0	3.8	2.3
UC 142	36.0	26.2	37	4.6	61	93	1.0	1.0	1.0	1.6
UC148	38.3	35.7	48	6.0	60	101	1.0	1.0	1.3	1.5
UC 128	35.8	30.2	58	4.9	66	96	1.0	1.0	1.0	1.9
UC 129	36.2	29.9	54	5.3	67	96	1.0	1.0	1.0	1.6
Montezuma	34.8	36.8	45	7.0	48	88	6.6	1.0	1.0	2.6
Bates 89	37.7	26.3	59	5.9	67	96	1.8	1.2	1.0	1.8
Pert	36.5	36.4	44	3.9	68	109	2.6	3.0	1.5	2.6
Sierra	31.7	35.9	48	6.8	56	91	5.3	1.0	4.0	2.9
Kanota	36.2	29.0	52	7.4	53	89	4.8	1.2	1.0	3.2
Swan	37.4	43.4	54	5.6	50	93	439	1.5	2.5	3.1
No. years	4	4	3	4	4	2	2	2	1	2

Code for disease (visual estimated area affect of flag leaf – 1, penultimate leaf) scores and lodging: 1= 0-3, 2= 4-14, 3= 15-29, 4= 30-49, 5= 50-69, 6= 70-84, 7= 85-95, 8= 96-100% for the expression of the trait. BYDV was scored using the above scale as the visually estimated percentage of plants showing foliar symptoms. Fungal diseases were generally scored at soft dough stage of kernel development; BYDV generally scored post-heading.

Table 3. Three-year (1999, 2000, 2001) mean forage yield (ton/acre @ 15% moisture) at three harvest stages (Feekes scale) and grain yield (lb./acre) at Davis. Yields also expressed as % of Montezuma.

Variety	*Forage t/acre 10.6-7*	*Forage t/acre 10.7-8*	*Forage t/acre 10.8-9*	*Forage mean t/acre*	*Forage % Montezuma*	*Grain lb/acre*	*Grain % Montezuma*
UC 113	8.65	8.30	8.81	8.59	111	5170	153
UC 125	8.12	9.00	9.65	8.92	114	5600	166
UC 130	7.65	8.86	9.27	8.59	111	4420	131
UC 132	8.83	8.91	8.37	8.71	112	4850	144
UC 142	6.23	8.38	7.65	7.42	96	4590	136
UC 148	8.85	8.72	9.64	9.07	115	4690	139
UC 128	9.72	10.61	10.35	10.23	132	4270	127
UC 129	8.53	10.56	10.47	9.85	127	4300	128
Montezuma	8.52	7.39	7.34	7.75	100	3370	100
Calif. Red	7.93	7.63	8.17	7.91	102	2120	63
Pert	8.19	9.29	9.65	9.05	117	5170	153

Past and Present Potato Research at IREC

Rob Wilson, IREC Director/Farm Advisor

Potatoes played a considerable role in shaping Tulelake history. Early potato production relied on simple hand tools and hand-labor creating numerous jobs and business opportunities. By 1936, potatoes returned nearly five million dollars or nearly half the crop revenue of the Klamath Basin. Over years potato production became mechanized with tractors, power harvesters, and post-harvest machines, but potatoes still play a large role today in creating local jobs and supporting Tulelake's rural economy.

University of California researchers have studied potatoes in Tulelake since IREC's establishment in 1947. In 1974, California growers and CDFA established the California Potato Research Program paving the way for stable research funding and continued development of California potato markets. A statewide research emphasis for the last 30 years is selection of new varieties for California's diverse environments. The variety development program is directed at several market classes including fresh market russets, reds, chippers, and specialty types. Dr. Ron Voss, Extension Vegetable Crops Specialist at UC Davis was instrumental in leading this statewide research effort for 29 years until he retired in 2004. Several new potato cultivars were developed including CalWhite, CalRed, Sierra, and Tejon under his leadership. Evaluation of clones and cultivars has continued at two locations, Tulelake (fall harvest) and Kern County (spring harvest) since Ron's retirement. Entries come from breeders and researchers from Colorado State University, Texas A&M, Oregon State University, University of Idaho, USDA-ARS, and Washington State University as part of regionally coordinated field trials.

A long-standing potato research effort at Tulelake is development of cultural management recommendations for new potato varieties. Potato cultivars vary greatly in their response to cultural management practices such as irrigation, fertilizer, and harvest methods. IREC cultural management studies help growers successfully produce new varieties and avoid unforeseen pitfalls. Recent accomplishments include identifying differences in new Russet's response to fertilizer and irrigation, developing best practices for seed spacing and harvest timing of organic Klamath Pearls, and establishing seed spacing recommendations for chip varieties.

Potato pest management is another research topic commonly investigated in Tulelake. Past projects investigated control of root knot nematodes and white mold. Current research projects are investigating nightshade (problem weed) control in Russet potatoes, alternatives to fumigation for management of nematodes and Verticillium wilt, and control of *Rhizoctonia solani* in conventional and organic potatoes.

All potato research is conducted with the direct support of the IREC staff, equipment, and facilities. Experimental results are shared annually with growers at one or more regional winter meetings and in annual research progress reports. Annual progress reports and final reports are available for free on the IREC website: http://irec.ucanr.edu/ . Hard-copies are also available upon request at the IREC office.

Monitoring and management of major insect pests of peppermint in northern California

Jhalendra Rijal[1], Rob Wilson[2] and Larry Godfrey[1]
UC Davis, Department of Entomology and Nematology, Davis, CA
UC- Intermountain REC, Tulelake, CA

Exp. 1: Evaluation of different bio-insecticides against major root feeding insects in peppermint
Materials and Methods

- Targeted root feeding insects: mint root borer (MRB), strawberry root weevil (SRW), mint flea beetle (MFB)
- Study is being conducted at IREC, Tulelake
- Plot size: 20 ft. × 20 ft.
- 10 different treatments were applied two times (24th July and 7th August)
- 4 blocks/replications in RCBD
- The Rhizome damage by individual target insects will be evaluated after the harvest of the mint (mid-to late Sept.)

Treatment details:

Treatments	**Dose**
Control	
Coragen	5 oz./A
Bt	5 lbs./A
CoStar (also a Bt product)	2 lbs./A
Met52 EC	2 qt/A
BotaniGard SC	1 qr/A
EPN *Sc*	1 billion IJ/A
EPN *Hb*	1 billion IJ/A
EPNs (*Sc*+*Hb*)	1 billion IJ/A (half of each Hb and Sc)
PFR-97	1 lb./A

EPN=Entomopathogenic nematode
Hb= Heterorhabditis bacteriophora
Sc= Steinernema carpocapsae
PFR, Met52, BotaniGard=Entomopathogenic fungus-based products

Rhizome damage evaluation:

- Rhizome sampling for MRB, MFB and SRW
- Sample 5 rhizomes ~10 cm long from each of three, 1ft^2 areas per plot.
- Collect rhizomes by using a garden tool and place in a labeled plastic bags.
- Look for damage in rhizomes using a dissecting microscope.
- Calculate percentage damage in each plot and present the effects of treatments on damage reduction compared with control.

Exp. 2: Testing efficacy of reduced-risk pesticides in two-spotted spider mite management in peppermint

Materials and methods:

- Treatments were applied when spider mite counts were 2.01 mites/leaf.
- 4 blocks/replications in RCBD
- For evaluating the performance of individual treatments, 10 sample stems will be collected randomly from individual plots leaving ~1ft border. Collected stems will be placed into a brown paper bag, which will be placed inside a plastic bag (zip-lock). Those samples will be transported to the laboratory in a cooler with ice packs. Sample will then be stored at 6C until processing.
- Spider mites sampling will be conducted weekly for 4 weeks.

SN	Treatments
1	Control
2	Acramite 4SC 24 fl oz.
3	Agri-Mek SC 2.0 fl oz.
4	Fujimite XLO 12 fl oz.
5	Oberon 2SC 12 fl oz.
6	Oberon 2SC 16 fl oz.
7	Omite 6E 44 fl oz.
8	Onager 20 fl oz.
9	PFR-97 (2 lbs./A in sufficient vol. of water)
10	Trilogy (2% tank mix, i.e. mix 1 quart Trilogy with 12.5 gallon water to make 2% concentration)
11	Zeal 3 oz.

Exp. 3: Pest monitoring and assessment of infestation by major insects in peppermint

Root feeding insect infestation evaluation: Experimental plots (small portion, size: 75ft × 75ft, one corner of the mint field) in growers field (4 sites) and in IREC mint plots (2 sites) were selected. The sites should not be treated with any soil insecticides. From that plot, we will conduct after-harvest rhizome sampling (i.e. 90 sample points in a square grid pattern of 2m × 2m) to assess the degrees of infestation by strawberry root weevil, mint flea beetle, and mint root borer. Rhizome sampling will be conducted after mint harvest in September. This grid-based sampling will be used to characterize within-field spatial distribution of the infestation.

Monitoring of MRB adults were conducted in all 6 sites (IREC and growers fields as mentioned above) using pheromone-baited delta traps. Two traps were deployed in each field during the second week of June. Weekly moth captures were conducted throughout the moth emergence period. Similar monitoring were conducted in McArthur area in Shasta Co. as well.

Spider mite infestation evaluation: Experimental plots (small portion, size: 75ft × 75ft, one corner of the mint field) in growers field (3 sites) were selected. From that plot, we conducted visual counts of eggs and motile spider mites, and motile predatory mites (i.e. 90 sample points in a square grid pattern of 2m × 2m) to assess the degrees of infestation by spider mites and presence of predatory mites. This grid-based sampling will be used to characterize within-field spatial distribution of the infestation. Similar monitoring were conducted at 4 sites in McArthur area in Shasta Co. as well.

2014 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 desert.

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2014 IREC Field Day Agenda
Wednesday, August 13, 2014
Tulelake, CA

7:45 am *Registration Opens*

8:20 am *Tour Starts*

8:30 am *Introduction, Centennial Celebration, and Opening Remarks*
Rob Wilson, IREC Center Director/Farm Advisor, Tulelake, CA

8:40 am *100 years of UCCE*
Barbara Allen-Diaz, Vice President UC ANR

8:50 am *4-H Then and Now*
Jacki Zediker, UCCE 4-H Youth Development Program Representative, Siskiyou County, Yreka, CA

9:00 am *Links Between Agriculture and Water Quality and Biofuel Research*
Steve Kaffka, Dept. of Plant Sciences, UC Davis

9:25 am *Progression of Alfalfa Production in the Klamath Basin and Current Management Studies in Alfalfa*
Steve Orloff, UCCE County Director and Farm Advisor, Yreka, CA

9:50 am *Management Strategies for Suppressing White Rot Disease in Processing Onions*
Mike Davis, Dept. of Plant Pathology, UC Davis

10:15 am *Break and Refreshments*

10:30 am *Nitrogen Management in Wheat to Maximize Yield & Profitability*
Steve Orloff, UCCE County Director and Farm Advisor, Yreka, CA

10:50 am *Small grains in the Tulelake Basin: A Retrospective View and Current Opportunities for Oat Production*
Cal Qualset, Emeritus Dept. of Plant Sciences, UC Davis

11:15 am *Past and Present Potato Research at IREC*
Rob Wilson, IREC Center Director/ Farm Advisor, Tulelake, CA

11:35 am *Management of Pests in Peppermint*
Rob Wilson, IREC Center Director/ Farm Advisor, Tulelake, CA

12:00 pm Lunch