USDA

United States Department of Agriculture

Natural Resources Conservation Service

Plant Materials Program

2013 Technical Report

Lockeford Plant Materials Center

Lockeford, California

Lockeford Plant Materials Center
21001 N. Elliott Road
Lockeford, CA 95237

June 2014

Lockeford Plant Materials Center

PO Box 68

21001 N. Elliott Road

Lockeford,CA 95237

Phone: (209) 727- 5319

Fax (209) 727- 5923

Email: Margaret.Smither-Kopperl@ca.usda.gov

Web-page: http://plant-materials.nrcs.usda.gov/capmc/

Table of Contents

Contents	Page
Personnel	5
Introduction	7
Studies	11
National Soil Health Study	13
Drought Tolerant Cover Crops	21
Cover crop component demonstrations	25
Pollinator Meadows	29
Sainfoin and Grass Seeding Trial	45
Biofuel Oilseed Study: Camelina Variety Trial	49
Inter-Center Strain Trials	51
Observational Planting of Roemer's Fescue for Corvallis PMC	53
Evaluation of springbank clover	57
Demonstration planting of 'Windbreaker' sacaton	61
Seed and Plant Production	65
Seed Production	67
Reimbursable Projects	69
Bureau of Land Management	
Native Plants Development	71
National Park Service	
Sequoia and Kings Canyon	77

	Yosemite	79
Outreach		81
	Trainings at the Lockeford PMC	83
	SLEWS and FARMS Restoring Riparian Habitat on the Mokelumne River	85
	Indigenous Stewardship Methods and California Indian Outreach	87
	Peoples Garden	89
	Publications	91
	Presentations	93

USDA-NRCS Lockeford Plant Materials Center

Center Staff 2013

Margaret Smither-Kopperl, Manager
Dennis Frommelt, Gardener
Shirley Fowler, Biological Science Technician
Shawn Vue, Admin Asst, Seed Tech
Larry Sell, Farm Asst (1/2 time)

Plant Materials Specialist

Vacant

California Plant Materials Committee

Tom Hedt, State Resource Conservationist
Ceci Dale Cesmat, State Rangeland Management Specialist
Dennis Chessman, State Resource Agronomist
Thomas Moore, State Biologist
Stephen Smith, State Forester
Jennifer Cavanaugh,
Area 1 – RaeAnn Dubay
Area 2 – Lisa Shanks, Alyson Aquino
Area 3 – Rob Roy, Joe Williams
Area 4 –Brooks Englhardt, Shea Valero
Anita Brown, Director of Public Affairs
Hue Dang, Resource Conservationist,
Greg Norris, State Conservation Engineer
Sid Davis, Assistant State Soil Scientist

Lockeford PMC Staff: Margaret Smither-Kopperl,

Other *ad hoc* members:
John Englert, National PM Manager
Jim Briggs, West Region PM Specialist
Bruce Munda, AZ Plant Materials Specialist
Dan Ogle, ID Plant Materials Specialist
Kathy Pendergrass, OR Plant Materials Specialist
Manuel Rosales, Tucson PMC Manager
Erik Eldredge, Fallon PMC Manager
Kathy Pendergrass, Acting Corvallis PMC Manager

INTRODUCTION

The Lockeford Plant Materials Center (CAPMC) is a federally owned and operated facility, currently under the administration of the California State Office of the USDA Natural Resources Conservation Service. The California Plant Materials Program began February 1935 with the Soil Conservation Service Plant Materials Nursery at Santa Paula, CA. In 1939 a 60-acre Plant Materials Center was established at Pleasanton, CA and in September 1973 was moved to the current site at Lockeford, CA.

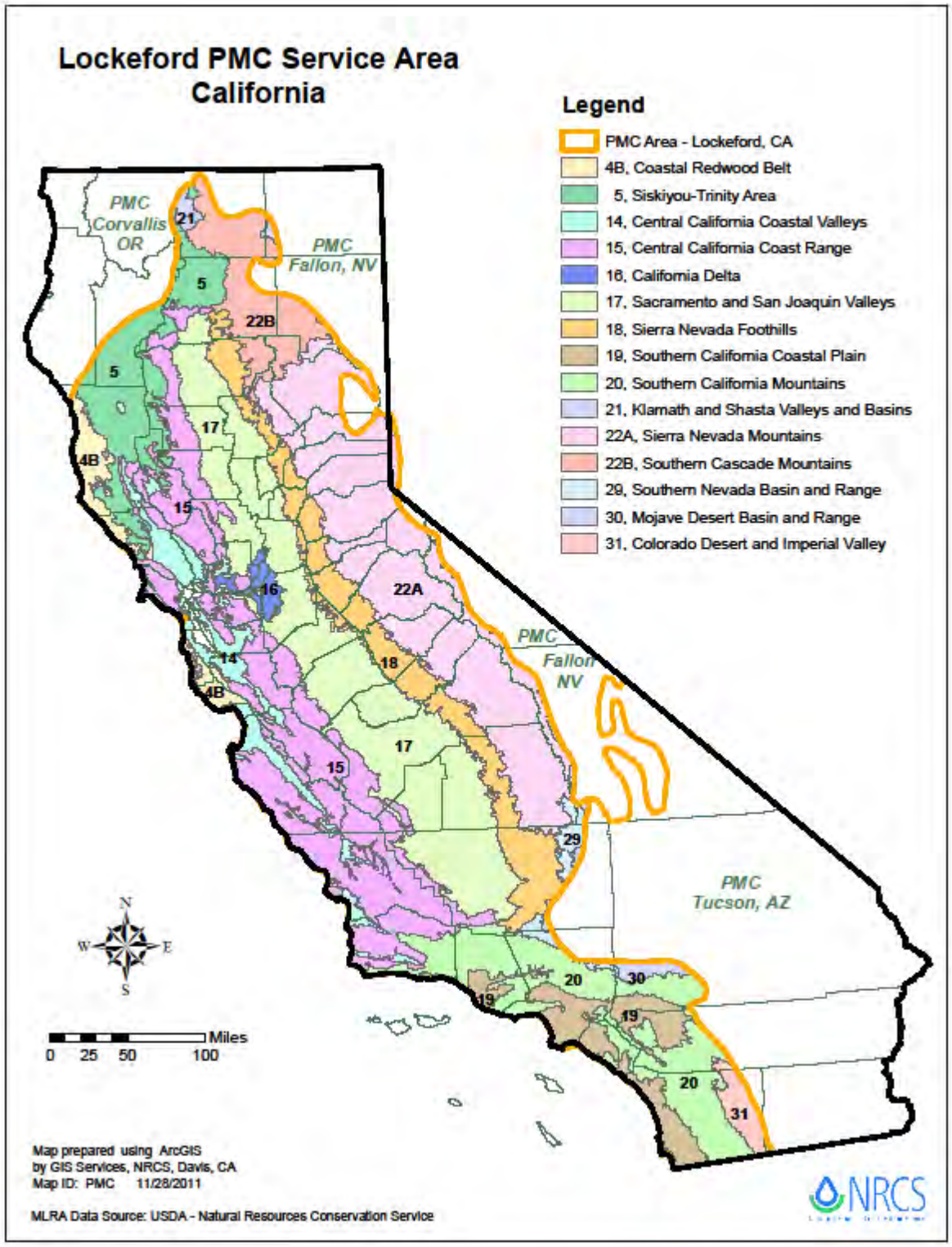
The current CAPMC service area covers close to 62 million acres (96,700 mi^2) and includes 11 Major Land Resource Areas (MLRAs) (Figure1). The area served by the California Plant Materials Center is characterized by a Mediterranean climate with six month dry season in the summer, and six-month rainy season in the winter. The area has a very complex pattern of soils. The topography consists of broad valleys, rolling foothills, upland plateaus and rugged mountains. Elevation extremes are from 47 feet below sea level to 14,400 feet above sea level. Agriculture in the service area is extremely diversified, including fruits and vegetables, rangeland with extensive livestock production, dairies, and timber production. We continue to develop plant technologies to promote conservation to address resource concerns within our service area.

The CAPMC is 106.7 acres of prime farmland located along the Mokelumne River near Lockeford, California. Soils at the CAPMC are primarily Columbia fine sandy loam and Vina fine sandy loam. The levee is an Egbert silty clay loam. Soil pH ranges from 6.7 to 7.0, Irrigation water is available to all fields at the CAPMC as surface irrigation, and also with a new pressurized irrigation system installed at the CAPMC in 2012. The irrigation systems allow us to access all fields with up to date irrigation systems including sprinkler, through hand and wheel line and subsurface drip irrigation.

The service area has a complex topography composed of broad valleys, including the Central Valley, rolling foot-hills, upland plateaus, and rugged mountains. The CAPMC's conservation plant releases include native releases: purple needlegrass, California brome, blue wildrye, sulfur flower buckwheat, inland saltgrass, and fourwing saltbush. Our non-native releases include Berber orchard grass used for range and pasture enhancement, and 'Lana' woollypod vetch with utility for cover crops.

The mission of the CAPMC is to develop technology and plant materials to address the resource concerns of California. The majority of our work focuses on species that are native to California. The CAPMC is responsible for seed increase plantings of potentially valuable plant species and for the maintenance of seed stock of California cooperative releases. We work with NRCS field offices, public agencies, universities, conservation organizations, tribes, and commercial seed producers and nurseries. We continue to develop plant technology for addressing resource concerns, which in California includes soil health, water quality and quantity, air quality, wildlife habitat especially pollinators and land restoration.

Figure 1. Service Area Map for the Lockeford Plant Materials Center showing Major Land Resource Areas

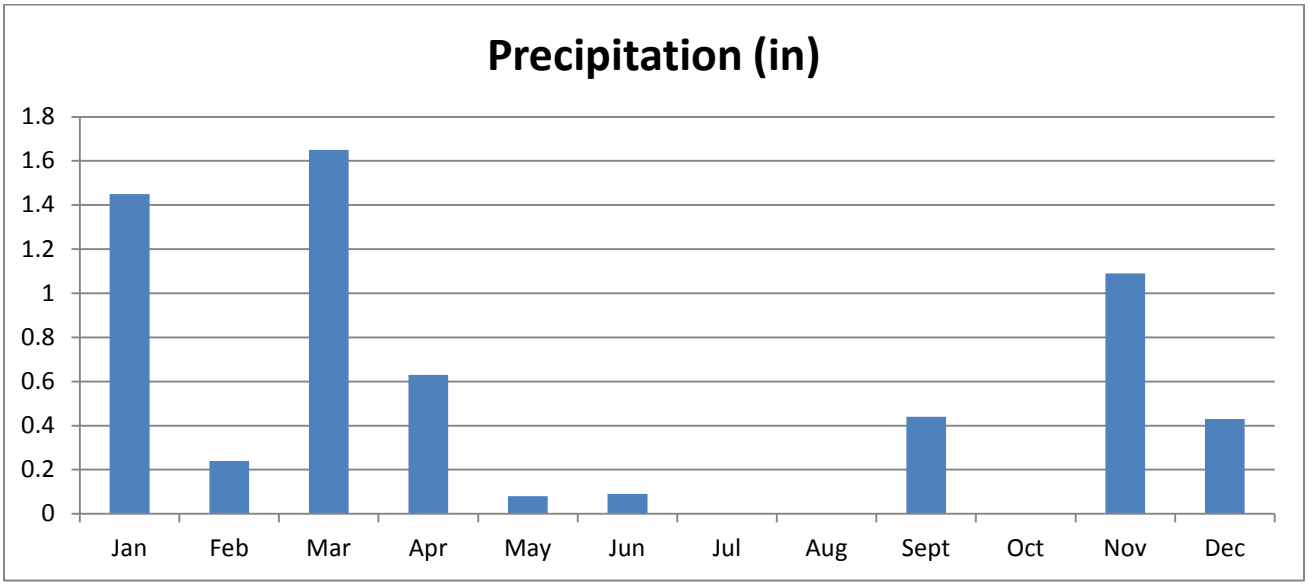


Lockeford Plant Materials Center (PMC)
Irrigation System Map

4/30/2012

The average precipitation at the Lockeford Plant Materials Center is 19 inches, as the area has a Mediterranean climate the majority of the rain falls over the winter. The year 2013 was an historic drought year as only 6 inches of rain fell for the entire year.

Figure 3.. Rainfall at the Lockeford PMC during 2013.



A major challenge during 2013 was the limited scientific staff at the Lockeford PMC. This was ameliorated through the assistance of staff at the State Office including Ceci Dale-Cesmat, Dennis Chessman, Tom Moore, Jacqui Gaskill, Dan Johnson, Greg Norris and Sid Davis who helped with planning and implementation of studies.

Studies

Effects of Mixed Species Cover Crop on Soil Health

USDA-NRCS California Plant Materials Center
CAPMC-T-1208-CP

Annual Progress report prepared by Shirley Fowler and Margaret Smither-Kopperl

Introduction

Soil health is critical as a natural resource for crop production. The Lockeford Plant Materials Center (CAPMC) is participating in a national Plant Materials Program Study, with six other PMCs around the US, to evaluate the effects of cover crops on soil health. The CAPMC is the only PMC situated in California and with a Mediterranean climate. The first year of the study was planted in fall of 2012. The CAPMC is evaluating three different seeding rates and mixes of six plant species to observe their impact on soil health. Cover crops planted each fall and sweet corn is planted each summer as an example of a commodity crop. At multiple times during the life of the cover crop, the CAPMC will collect above-ground data to determine the consequences of treatments on plant cover, species composition, and total biomass. Analysis on soil properties, fertility, and biological activity are taken at cover crop planting and termination. This report is a preliminary analysis of data from the first year study and conclusions are subject to change with further data from the next two years.

Information gathered in this study will help us determine the effectiveness of these cover crop species to the Central Valley of California and their effects on soil health, as well as their effect on commodity crop performance.

Summary of Preliminary Results

- % Cover averaged over seeding rates after 60 days was 95% for the 6-component mix, 90% for the 4-component mix and 85% for the 2-component mix.
- % Cover averaged over diversity after 60 days increased with seeding rate, at 60 days it was 95% for 60 seeds/ft^2, 90% with 40 seeds/$ft^2$and 85% with 20 seeds/ft^2.
- Above ground biomass in the 4- and 6-component mixes was almost double the 2-component mix at cover crop termination.
- Weed suppression occurred. Weed biomass was higher with the 20 seeds/ft^2 seeding rate, especially in the 2-component mix. Weed biomass was lowest (below 10% cover) in plots containing tillage radish at seeding rates of 40 and 60 seeds/ft^2.
- Canola was not competitive as it was not found within the 6-component mix.
- Total nitrogen and the soil health index were not significantly different between treatments, but had decreased after the sweet corn harvest prior to planting the cover crop for the second year.
- Below ground radish biomass was not significantly different between the 4- and 6-component mixes; dry matter averaged 1.05 ton/acre and 0.8 ton/acre respectively.
- Corn yields were significantly higher in the 4- and 6-component mix, compared to the control and 2-component mix.
- Tillage radish was the variable associated with increased corn yield.

Methods and Materials

Cover crop mixes were planted October 18-19, 2012 onto a cultivated clean seed bed in a field of Vina fine sandy loam. No irrigation was applied as 4 inches of rainfall fell in the two months following planting in 2012, ensuring good germination and early growth. The experimental design was a randomized complete block with four blocks and 2 factors; cover crop diversity and seeding rate. There were three seeding mixes representing increasing diversity with combinations of rye, crimson clover, radish, hairy vetch, canola, and oats. (Table 1). The second factor was seeding rates of 20, 40 and 60 seeds per ft^2. In addition to these 9 treatments there was a control plot in each block.

Table 1. Planting mixes for soil health study.

Mix	Grasses	Legumes	Brassicas
2-component	50% cereal rye	50% crimson clover	
4-component	45% cereal rye	22.5% crimson clover	10% tillage radish
		22.5% hairy vetch	
6-component	22.5% cereal rye	22.5% crimson clover	5% tillage radish
	22.5% oats	22.5% hairy vetch	5% canola

The cover crop was terminated on March 27 using the roller crimper. Biomass samples using designated protocols were taken prior to rolling the plots. Soil temperatures and moisture levels were recorded at cover crop termination. This time was chosen as the tillage radish seeds were close to maturity. However the grasses, rye and oats were still leafy and immature and were not killed by the roller-crimper. A spray of glyphosate was applied to all plots to kill the cereals and weeds and the ground was left fallow prior to planting.

Sweet corn (cultivar Bodacious) was planted on May 13, 2013 using a modified Truax range drill, to give an approximate 32 in row spacing. Irrigation was applied using sprinkler irrigation prior to seeding and after planting until the corn plants were approximately 2 feet tall. After this time irrigation was applied using the buried drip lines set-up prior to planting in fall of 2012. Sweet corn was harvested on July 26, 2013. The corn was mowed prior to planting in cover crops again in fall of 2013 for the second year of the study.

Results and Discussion

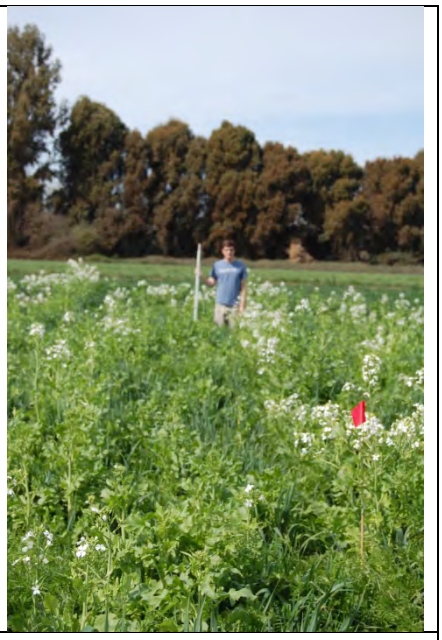
Above Ground Growth from Cover Crop Planting

After planting the seeds germinated and grew rapidly to provide cover over the soil, by 30 days cover was between 40 and 50% for all plots (Figure 1 and 2). After 60 days, cover was 85% for the 2-component mix, 90% for the 4-component mix, and 95% for the 6-component mix. Seeding rate also affected % cover at 60 days it was 85% with 20 seeds/ft^2, 90% for 40 seeds/ft^2, and 95% for 60 seeds/ft^2. The canopy cover closed at about 90 days for all treatments.

Figure 1. Plot photos of 2, 4, and 6 component mixes of cover crops in 18 March 2013, nine days prior to cover crop termination. The seeding rate was 40 seeds/ft2.

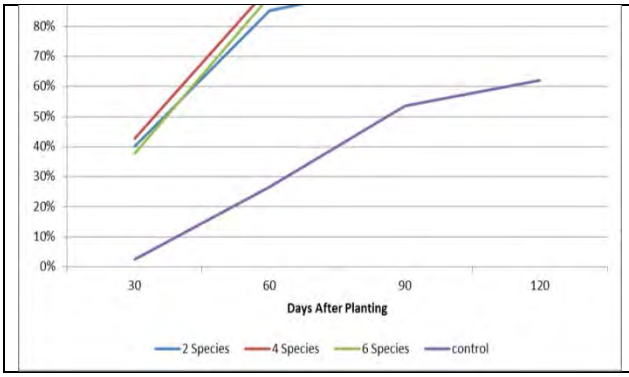
a. Two component mix

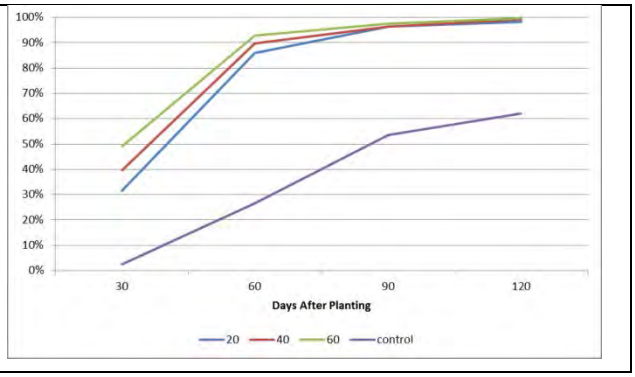
b. Four component mix



c. Six component mix

Figure 2. Effect of three cover crop mixes with 2, 4 and 6 species and three seeding rates on % cover during 2012 and 2013 season.





Soil moisture at cover crop termination was similar in all plots at 20 – 21 % volumetric water content as measured using the HydroSense II. Soil temperatures also were similar between treatments at cover crop termination at 45 – 47 ^{o}F. These temperatures were too cold to plant sweetcorn so planting was delayed until May.

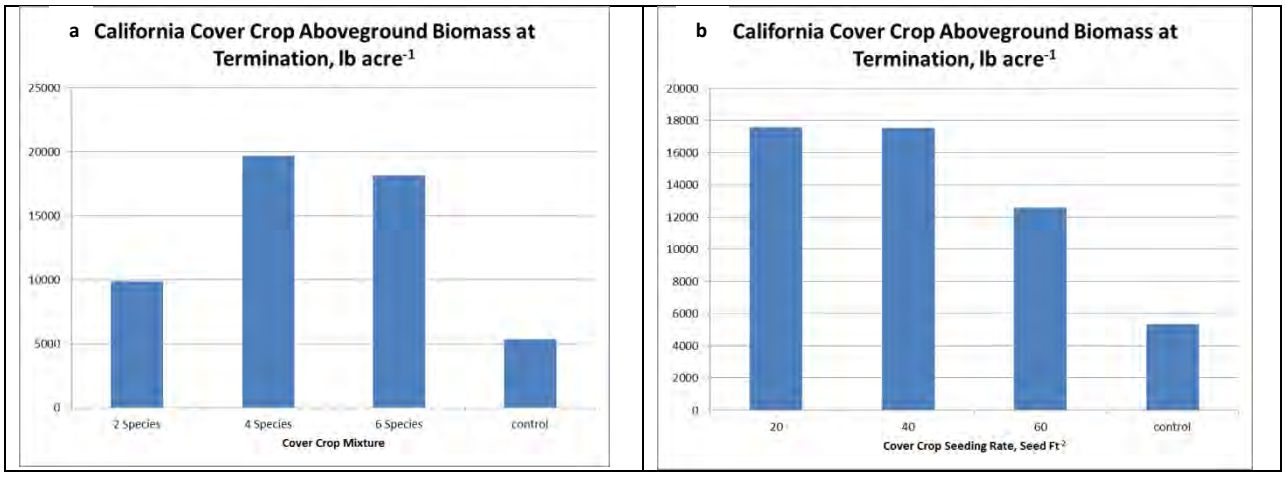
Cover crop termination was carried out when the radish was approaching maturity, although the grains were still immature. Dry matter from above ground biomass was lowest in the control plots and the 2-component mix (Table 1, Figure 3a). The highest biomass values were in the 4- and 6-component mixes, which were almost double the two component mix.

Table 2. Above ground biomass of cover crops at termination and % composition of three cover crops mixes and three seeding rates. Values within the same column followed by the same letter are not significantly different in Tukey HSD means comparisons at α = 0.05.

Cover crop diversity	Seeding rate (seeds/ft^2)	Dry matter (lb/acre)	Grass (rye and oats) %	Legumes (clover and vetch) %	Brassicas (tillage radish) %	Weeds %
2-component	20	927 c	39 ab	22 a	-	40 b
	40	1127 bc	55 a	22 a	-	24 bc
	60	908 c	54 a	26 a	-	20 bc
4-component	20	2241 a	28 b	22 a	35 a	15 c
	40	2191 a	29 b	22 a	40 a	9 c
	60	1467 abc	28 b	25 a	39 a	9 c
6-component	20	2107 a	36 b	19 a	30 a	14 c
	40	1939 ab	40 ab	22 a	29 a	9 c
	60	1405 abc	28 b	25 a	38 a	8 c
Control	0	510 c	=	-	-	99 a

The effect of seeding rates averaged across diversity treatments, indicated that the 20 and 40 seeds/ft^2 seeding rate had higher biomass than the 60 seeds/ft^2 seeding rate (Figure 3b). Presumably the higher seeding rate caused competition between plants reducing total biomass. As these plots were terminated prior to maturity of the grain crops, results could have changed significantly if termination had been delayed.

Figure 3. Effect of three cover crop mixes with 2, 4 and 6 species and three seeding rates on above ground biomass at cover crop termination on March 27, 2013 (Dry matter lb/acre)

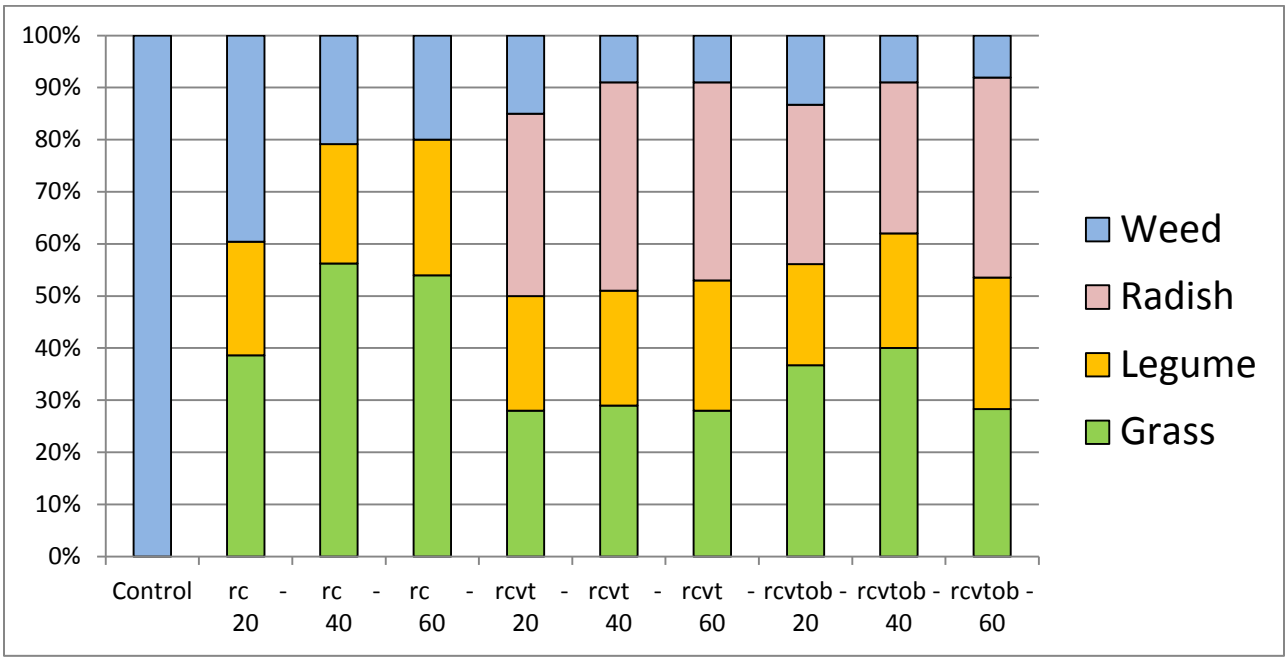


A comparison of the plant composition across treatments finds that the proportion of legumes, crimson clover and hairy vetch, varied between 19 and 26% (Table 2, Figure 4). Rye made up a higher proportion of the 2-component mix than the 4-component mix, which was similar to the 6-component mix. Oats and rye were not separated in the 6-component mix. Canola planted in the six component mix was not competitive, only one canola plant was noted in the entire trial at termination. Tillage radish germinated rapidly, the seedlings were

very vigorous and continued to dominate their plots until cover crop termination (Figure 1 and 4). Weeds comprised less than 10% of total biomass in the 4- and 6- component cover crop plots at the 40 and 60 seeds/ft^2 seeding rates, significantly lower than other treaments.

The most serious weed problem in our plots during 2013 – 2014 was cheeseweed *Malva* spp. a perennial weed that grows through the year in the Central Valley.

Figure 4 . Botanical Composition of Above Ground Biomass at Cover Crop Termination.



Measured at cover crop termination, the botanical composition of above ground biomass for; weeds, tillage radish, legumes, combined crimson clover and vetch, and grass, combined rye and oats. Treatments were rye (r), crimson clover (c), hairy vetch (v), tillage radish (t), oats (o), and brassica, canola (b), at 20, 40 and 60 seeds/ft2. The canola plants were not competitive, none were found in the plots.

Below Ground Biomass and Soil Health

As documented above, tillage radish germinated rapidly and grew strongly from the fall to spring and effectively suppressed weeds (Figure 4 and 5). Below ground biomass of harvested radish roots were not significantly different between treatments (Table 3) although the proportion of seeds planted were 10% in the 4-component mix and 5% in the 6-component mix. The highest weights were in the 4-component mix planted at 20 and 40 seeds/ft^2. The average water content of the harvested roots across treatments was highly variable from 7.5 – 39%, although the average was 16.9%. Radish roots provide a moisture reservoir within the soil following cover crop termination. Based on data presented here, assuming a 1 ton/acre presence of radish roots at 10% moisture, then the amount of water present in radish roots would me 9 ton/acre and as I ton is equivalent to 239.65 gal, this is equivalent to 2157 galls/acre. This is probably insignificant from the perspective of providing moisture to the commodity crop, but the drying radish roots would provide a pathway to enable infiltration of water from the initial sprinkler irrigation within the soil profile.

Figure 5 Developmental stage of tillage radish in plots on 2/21/2013.

a. Radish with root protruding from soil

b. Radish root removed from soil.

Table 3. Below ground biomass of tillage radish at termination and values for total water extractable nitrogen and the Soil Health Calculation.

Cover crop diversity	Seeding rate (seeds/ft^2)	Radish DM (lb/acre)	Total Nitrogen* (lb/acre)		Soil Health Calculation[#]	
			2012	**2013**	**2012**	**2013**
2-component	20		194	171	12.7	9.6
	40		245	119	12.5	8.9
	60		206	122	11.9	8.8
4-component	20	2220	209	157	11.4	8.9
	40	2386	234	186	15.1	9.0
	60	1790	269	193	10.4	8.9
6-component	20	1717	259	140	12.7	10.3
	40	1450	225	188	14.6	10.2
	60	1632	202	210	13.8	9.5
Control	0		211	129	13.5	10.5

**Total water extractable nitrogen.*

[#]Soil Health Calculation from tool developed by Dr. Rick Haney USDA-ARS caluculated from one day CO^2 release divided by the organic C:N ratio plus weighted organic C and N additions.

Soil analysis was provided by Dr. Rick Haney (USDA-ARS, Temple, TX). Data is presented here for total water extractable nitrogen and a Soil Health Indicator Value. The Soil Health Calculation was developed as a tool to assess soil health, and combines five measurements of soil biological properties into one. Values are on a scale of 0 to 50, and should increase over time if the soil is being sustainably managed. In this case there were no significant differences between treatments, and the values for both following the corn crop and prior to planting the second years cover crop were lower than the previous year.

Commodity Crop - Sweet Corn

Corn germination was similar for all treatments, but it became apparent during the growing season that there were large differences between blocks (Figure 6). Block 4 exhibited poor growth for all treatments and was almost certainly the consequence of issues with the buried drip line. The three remaining plots were ripped prior to setting the lines.

The sweet corn had reached maturity by July 27, 2013 and the plots were harvested by sampling according the Soil Health protocol.

Figure 6. Growth of sweet corn by 7/8/2013 showing differences in establishment between blocks.

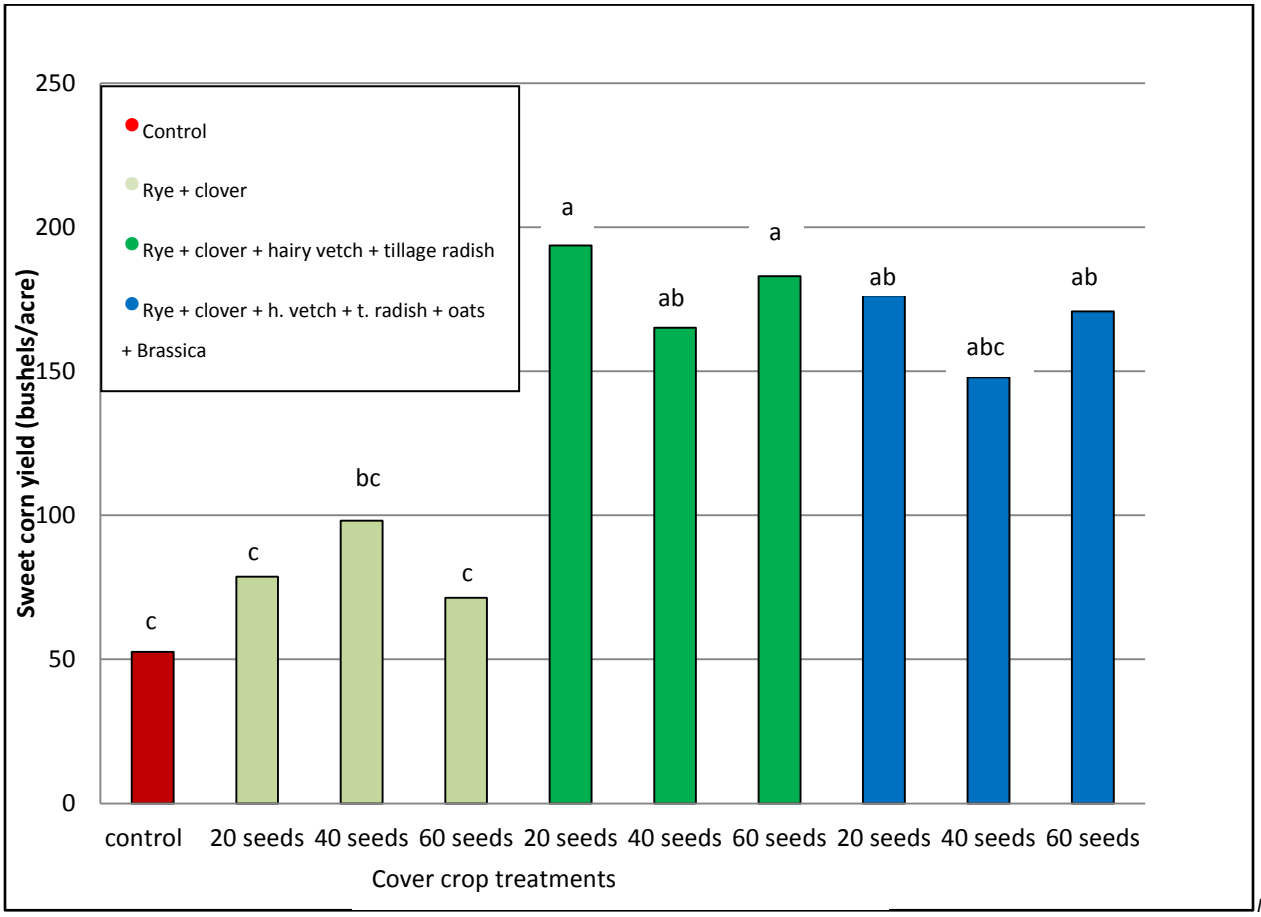
a. Typical growth of sweet corn in Block 1

b. Typical growth of sweet corn in Block 4

Yields were significantly higher in the 4- and 6- component mixes, the highest yielding treatment was the 4-species mix seeded at 20 seeds/ft^2, with 194 bushels/acre (5.4 tons/acre) (Figure 7). This yield is below the average sweet corn yield for San Joaquin County of 8 tons/acre, but was achieved without the addition of fertilizer, a less than optimal irrigation set up, and use of a modified range drill as a planter. There were large differences between blocks due to some problems with installation of the subsurface drip irrigation.

The Mediterranean climate of California poses particular challenges to the increased use of cover crops. This first years study indicates that use of a cover crop can improve yields in a commodity crop, although soil health improvements are not documented so far. The target of keeping a live root in the soil is hard to maintain under the summer droughts of California and with these two crops there were periods in spring and fall with no crop and so no live root in the soil. As we continue with the study we anticipate seeing improvements in soil health.

Figure 7. Average sweet corn yield (bushels/acre) following one season of cover cropping with three cover crop mixes (2- 4- and 60 component mix) and 3 seeding rates (20, 40, 60 seeds/ft^2) at Lockeford PMC in 2013.



Means with the same letter above the bar are not significantly different in LSD comparison at α=0.05.

As there were no significant differnces in fertility, as measured by total nitrogen and the soil health calculation, between treatments it appears that the increased yields in sweet corn is associated with the radish as a component of the mix. It seems probable that this may be linked to increased moisture in the soil and improved water infiltration at depth.

References

Clark, A., editor. 2007. Managing cover crops profitably, 3rd ed. National SARE Outreach Handbook Series Book 9. National Agric. Laboratory, Beltsville, MD. http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition

Evaluation of Drought Tolerant Cover Crops for Adaptation to California's Central Valley

CAPMC-T-1402-CP

Margaret Smither-Kopperl

Partner: Dennis Chessman , State Agronomist

Introduction

Cover crops are increasingly used in US agriculture due to the benefits which include improved soil quality and enhanced nutrients, increased water infiltration and water holding capacity, competitive suppression of weeds and fewer insect pests. Consequent crops may have lower requirements for fertilizer, herbicides and pesticides and greater drought tolerance.

Even with these benefits, winter cover crops are grown infrequently by farmers in California's Central Valley. Summers are hot and dry and rainfall over the fall, winter and spring, varies greatly from year to year. Extended dry periods are common over the fall, winter and spring. California farmers who grow summer crops such as tomatoes, peppers, cotton and corn frequently leave fields fallow over the winter instead of planting cover crops. The potential requirement for irrigation during a dry year serves as a barrier to increased implementation of cover crops.

The purpose of this study is to test potential cover crops for drought tolerance and adaptability to California's Central Valley. Two PMC releases, 'Cucamonga' California brome and 'Blando' brome have been extensively tested in California, are commercially available and perform well under drought conditions. These species will be tested against the local standard triticale,and as mixtures with a drought tolerant legume 'Scimitar' burr clover and 'Bracco' white mustard, both of which have performed well at the PMC.

Triticale, a wheat/rye hybrid is frequently planted as a cover crop in California's Central Valley because it performs well under the drought conditions. The variety used was 888 selected because of the early lateral growth, from seed grown at the CAPMC in 2013.

'Cucamonga' California brome (*Bromus carinatus*) was a release from the California Plant Materials Program in 1949. The source of the release was near Cucamonga, San Bernardino County, in Southern California since then the release has been extensively used for critical area plantings and as a cover crop in vineyards and tree crops. It is commercially available.

Soft brome (*Bromus hordeaceus* ssp*. hordeaceus)* is an introduced species naturalized through the western states of the US. 'Blando' soft brome was collected from San Ramon in Contra Costa County in 1940 and released in 1954. 'Blando' brome is used as a cover crop in orchards and vineyards for erosion control, ground cover, and adding organic matter to the soil and for seeding in critical areas to control erosion.

'Scimitar' Spineless Burr Medic (*Medicago polymorpha*) was developed in western Australia as a drought tolerant legume. It performs well under drought conditions. This cultivar has been grown previously at the Lockeford PMC.

'Bracco' white mustard (*Sinapsis alba)* was selected for its drought tolerance, good early growth and weed suppression, and its ability to control diseases and nematodes in soil. This cultivar has been grown previously at the Lockeford PMC.

This trial is preliminary and will be repeated with the best performing plants along with other potential candidates in future.

Materials and Methods

The trial area was prepped by disking and cultipacking. Irrigation was applied by wheel line in stages during October with 2 X 1 inch applications to germinate surface weed seeds that were then treated with glyphosate to ensure a clean seed bed. . Planting occurred on November 26, 2013, using a Truax range drill with a planting rate of 50 seeds/ft^2 for all treatments (Figure 1). Seed of triticale, 'Blando' and 'Cucamonga' bromes were grown at the PMC while 'Bracco' mustard and 'Scimitar' burr clover were obtained from Kamprath seed. There were 12 seed treatments in all: triticale, 'Blando', 'Cucamonga', 'Scimitar' and 'Bracco' as single species plantings, and triticale, 'Blando', and 'Cucamonga' in combination with 'Scimitar', and 'Scimitar' and 'Bracco'. The experimental design was a randomized block design with 3 replications (Table 1). Individual plots were a single pass of the range drill 5 x 400 feet, the length of the field. The field was cultipacked again after planting.

Figure 1. Planting Drought Tolerant Cover Crop Study on November 27 2013, planted plots are in foreground with planting carried out using Truax range drill.

Moisture readings were taken using a Hydrosense II monitoring unit at three locations in each plot on a 15 day schedule after seeding. No irrigation was applied to these plots following planting. A photographic record of individual plots was taken at 30 day intervals after planting.

Table 1. Experimental Layout – Randomized with 3 blocks

Planting rate was 50 seeds per square foot for all treatments/

Block	Plot #	Treatment	Plot Length = 400 feet		
	1	6	Triticale	Scimitar	
	2	1	Triticale		
	3	7	Blando'	Scimitar	
	4	8	Cucamonga	Scimitar	
1	5	12	Scimitar	Bracco	
	6	3	Cucamonga		
	7	4	Scimitar		
	8	9	Triticale	Scimitar	Bracco
	9	5	Bracco		
	10	11	Cucamonga	Scimitar	Bracco
	11	2	Blando'		
	12	10	Blando'	Scimitar	Bracco
	13	4	Scimitar		
	14	9	Triticale	Scimitar	Bracco
	15	5	Bracco		
	16	2	Blando'		
	17	6	Triticale	Scimitar	
	18	11	Cucamonga	Scimitar	Bracco
2	19	10	Blando'	Scimitar	Bracco
	20	1	Triticale		
	21	7	Blando'	Scimitar	
	22	12	Scimitar	Bracco	
	23	3	Cucamonga		
	24	8	Cucamonga	Scimitar	
	25	7	Blando'	Scimitar	
	26	10	Blando'	Scimitar	Bracco
	27	3	Cucamonga		
	28	4	Scimitar		
3	29	11	Cucamonga	Scimitar	Bracco
	30	6	Triticale	Scimitar	
	31	12	Scimitar	Bracco	
	32	9	Triticale	Scimitar	Bracco
	33	8	Cucamonga	Scimitar	
	34	2	Blando'		
	35	5	Bracco		
	36	1	Triticale		

Results

The only rainfall during December was 0.43 inches that fell on December 6 and 7. The moisture levels in the soil 5 days later and 15 daysafter planting varied between 8 and 12 % moisture .

Figure 2. Germination and growth of grass species in individual plots on December 31, 2013

		
Tritcale seedlings were most vigorous.	'Blando' brome had germinated but not vigorous.	'Cucamonga' brome, germinating plants clearly visible.

Figure 3. Germination and growth 'Scimitar' and 'Bracco' in individual plots on December 31, 2013

	
'Scimitar' burr medic, no germination observed	'Bracco' mustard, seedlings clearly visible.

By December 31, approximately 5 weeks after planting, the triticale was performing well under the drought conditions (Figure 2). 'Blando' and 'Cucamonga' brome had both germinated and 'Cucamonga' brome was performing most vigorously. The 'Bracco' brassica seedlings had also germinating but the ;Scimatar' bur medic had not germinated at this time(Figure 3).

References

Clark, A., 2012 Managing Cover Crops Profitably - 3rd Ed. SARE

Cover Crop Component Demonstration s

CAPMC-T-1303-CP and CAPMC-T-1403

Margaret Smither-Kopperl

Partners: Dennis Chessman, State Agronomist
Tom Johnson, Kamprath Seed

Cover crops have many advantages including improving soil quality, prevention of erosion, enhanced moisture and nutrient availability, competition and reduction of weed species and better control of insect pests with an increase in on-farm biodiversity. There is a substantial body of research into cover crops going back decades, but the adaptability and suitability of a particular cover crop to a specific area needs to be tested locally.

Field Office staff in the process of advising farmers may not have a clear idea of the types of cover crops available, the timing of growth and growth habits of different cover crop components. In collaboration with Tom Johnson of Kamprath Seed, this demonstration has been planted each fall since 2011. The demonstration includes common components currently used as cover crops and as components of cover crop mixes including small grains, brassicas, large and small seeded legumes and more exotic species such as flax, lentils and safflower. Native wild flowers, with cover crop potential and benefits as pollinators were included. (Table 1).

Soil was harrowed and cultipacked prior to planting. No fertilization was applied. The plots 25 feet long by 4 feet wide, were planted with 6 plant lines per plot, alleys were 4 feet wide all around the plot, grassed and planted with perennial ryegrass for access. Planting was accomplished using a Planet Junior on November 15, 2012. Emergence was noted on November 20. Rainfall was adequate, in excess of 4 inches in November and December 2012 and no supplemental irrigation was required. No irrigation was added to the plots during 2013 even though it was a dry spring. The area had previously been fallow with some weed pressure in the area, plots were weeded as cheeseweed, *Malva* spp. is the most serious weed problem.

A record of growth was maintained by taking photographs of individual plots every 15 days over the course of the trial through April, 2012. The growth morphology of the different cover crop components can be tracked over the growing season, the plots are shown below (Figure 1-4).

Table 1. Cover crop plantings - Plot Layout

Bracco mustard		Nemfix mustard		Oriental mustard		Canola		Daikon radish
Cayuse white oats		Montezuma Red oats		Swan Oats		Kanota Oats		UC142 oat
Bunker Triticale		888 Triticale		Pacheco Triticale		Weave Triticaler		Yamhill wheat
Merced Rye		Fall Rye		AGS 104 Rye		Saia black oat		Dirkwin wheat
UC 937 Barley		Veradant Barley		Belford Barley		Hayes beardless barley		Hard Red wheat
'Blando' brome		'Zorro' fescue		Com Annual Rye		Annual Hairgrass		Tetraploid Ryegrass
Scimitar Medic		Rose clover		Frontier Balansa Clover		Flax		Safflower
Jester Medic		Losa subclover		Anta subclover		Campeda		Denmark
Lupine		Berseem Clover		Lighting Persian clover		Nitro Persian clover		Crimson clover
Lentil		Com Vetch		Purple vetch		Hairy vetch		'Lana' woolypod vetch
Biomaster pea		Dundale pea		Austrian winter pea		Frosty pea		Faba bean

(North)

Alleys and headlands are planted with perennial ryegrass blend

NRCS Field office staff appreciates the opportunity of examining the growth patterns of the different cover crop components. The cover crop component plantings at the PMC were viewed by NRCS staff at the CAPMC Open Day in March 2013. In addition the plantings were used to demonstrate root growth of different plant species at the Irrigation 'Boot camp' training at the PMC in May, 2013.

Figure 1. Demonstration Plots January 2, 2013 looking south.

Figure 2. Demonstration Plots February 3, 2013 looking north.

Figure 3. Demonstration Plots March 3, 2013 looking south.

Figure 4. Demonstration Plots April 1, 2013 looking south. Plots labelled for the Open House in March.

For the 2013-2014 Cover Crop Demonstration, the site was prepared by irrigating, as it was a dry fall, applying glyphosate to kill geminating weeds, harrowing and cultipacking to produce a clean, firm seedbed. The demonstration. was planted on November 14, 2013 with enough soil moisture for germination. No further irrigation was applied during 2013.

Demonstration Pollinator Meadows

Progress Report 2013

CAPMC-T-1203

Shirley Fowler, Margaret Smither-Kopperl

Partners: Thomas Moore, State Biologist
Jessa Kay Cruz, The Xerces Society for Invertebrate Conservation
Kimiora Ward, UC Davis Department of Entomology

Introduction

Pollinator restoration plantings are typically designed to support a diverse community of native bees by providing a variety of floral resources that bloom throughout the growing season. Early efforts to sow wildflower seed mixes in agricultural settings have been largely successful in terms of establishing native plant cover, but have shown that establishing and maintaining a diverse mixture of native plants can be challenging. Different germination requirements, weed encroachment and competition among target native plants can all limit the diversity of species that eventually take hold.

The purpose of this planting was to demonstrate and test four wildflower seed mixes for their establishment success, for native bee attractiveness, and their compatibility with typical agricultural practices in California. This planting also provides the opportunity to test our ability to manipulate plant species composition by tailoring the seeding rate[1] of each species in the mix, or by using carefully timed management activities. For example, valley gum plant (*Grindelia camporum*) has been overly competitive in prior plantings installed by the Xerces Society and NRCS plantings so the seeding rate of this species in mixes was reduced. Limiting the spread of this plant by mowing plots prior to its seed set is another potential management technique. Based upon plot success, a management plan was to be developed for the pollinator meadows. The seasonality of the Xerces Almond Orchard mix was to be addressed by the plan, because of concerns that this plot may be vulnerable to weed invasion when the plants die back after spring.

Materials and Methods

The pollinator meadows study was planted in the fall of 2011 at the NRCS Lockeford Plant Materials Center (Figure 1); on Columbia fine sandy loam soil. There were four demonstration plots, each plot was approximately 0.3 acres, with length ranging from 180-196 feet (55-60 m) and width from 75-82 feet (23-25 meters) and there was a 5 feet grass strip between plots and a 10 feet grass border, planted to the annual grass *Hordeum depressum*. The four mixtures are described below.

Plot 1: Simplified NRCS Mix. The Simplified NRCS Mix is comprised of seven species and includes a subset of the best-performing species in trials planted at the PMC and by the Neal Williams Lab of University of California at

Davis at several sites in Yolo County (Tables 1&2). Species were chosen to provide bloom throughout the year, and also provide a simplified plant palette, which would be reasonably priced. Narrow-leaved milkweed was included to provide larval host plant material for the rapidly declining western monarch butterfly *(Danaus plexippus)*

Plot 2: Williams Lab (UC Davis) Species Trial Mix. This mix was designed to test native plant species that are preferred by wild bees in natural settings (Neal Williams, unpublished data) for their ability to successfully establish and compete with weeds without over-dominating the mix (Tables 3 & 4). This mix included 17 species and was planted at a higher seeding rate than others. Many of these species have very small seeds and are unusual so it was unknown how readily they would become established.

Plot 3: Xerces/ Hedgerow Farms Central Valley Pollinator Mix. The Central Valley mix is designed to provide both foraging and nesting resources for pollinators by incorporating both wildflowers and native bunch grasses (Tables 5 & 6). The 14 species include both annuals and perennials and provide floral resources from spring through fall. Narrow-leaf milkweed was also included because it is the larval host plant for western monarch butterflies.

Plot 4: Xerces/Hedgerow Farms Almond Orchard Mix. Plot 4 was planted to Almond Orchard mix. This seed mix is designed to provide pollen and nectar resources for pollinators in almond orchards, but can also be used in other orchard types (such as apples and stone fruits) and is an excellent nitrogen-fixing cover crop. The mix consists of early-blooming annual native wildflowers and non-native clover which provide excellent forage for both honey bees and native bees, before and after almond bloom. The species in this mix are low in stature, so should not increase the risk of frost damage during bud swell or bloom. Because the species are all annuals and are generally done blooming by late spring or early summer, they should be easy to clear away from the orchard floor in plenty of time for harvest.

This seed mix is designed to provide supplemental forage for wild and managed bees adjacent to California almond orchards (Tables 7 & 8). The six annual species bloom immediately after almond to extend pollen and nectar resources for honey bees and blue orchard bees (*Osmia lignaria)* after the almond trees have finished flowering. It is also comprised of only low-growing annuals,

<u>Maintenance and Monitoring</u>

No irrigation was applied to the plots over the course of the trial, this included during 2013, which was a year of severe drought.

The most severe weed problem was due to 'Lana' woollypod vetch (*Vicia varia* subsp. *varia*); this is a non-native legume, which is very competitive in early spring, although it is a good nitrogen fixer and pollinator. Control was attempted with herbicide (glyphosate applied by spray and wicking), hand pulling and by mowing.

Plots were monitored biweekly during the season for abundance and bloom phenology. Photo points were established to monitor bloom over this period and notes were taken on weed status and maintenance needs.

Figure 1 Lockeford PMC Pollinator Plantings Fall 2011

Legend

- Corners of proposed planting
- Proposed plot outline
- Existing pollinator plots

1 = PMC Simple Mix
2 = UC Davis Mix
3 = Xerces/Hedgerow Farms Central Valley Mix
4 = Xerces/Hegerow Farms Almond Mix
border = grass border (designed by Margaret S-K)

N
W E
S

100 50 0 100 Feet

Table 1. Pollinator Meadow Monitoring for Bloom – PMC Simple Mix Plot 1- 2013

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Asclepias fascicularis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eschscholzia californica	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	2
Grindelia camporum	1	1	0	0	0	0	0	0	0	1	1	2	2	2	2	2	2	2	2
Helianthus bolanderi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Lupinus succulentus	2	2	2	2	2	2	3	3	3	2	1	1	2	0	0	0	0	0	0
Nemophila menziesii	3	3	3	3	3	3	3	3	3	2	0	0	0	0	0	0	0	0	0
Phacelia californica	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	2	2

0 = Absent 1 = sparse 2 = Present 3 = Abundant

Table 2. Pollinator Meadow Monitoring for Bloom – PMC Simple Mix Plot 1-

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Asclepias fascicularis																			
Eschscholzia californica						1	4		4	3	2	2	1	1	1	1	1	1	1
Grindelia camporum												1	1	2	3	1	3	2	2
Helianthus bolanderi															1	1	2	4	3
Lupinus succulentus						1	1	4	3	2	1	1							
Nemophila menziesii					1	2	4		4	3	1								
Phacelia californica								1	2	3	2	2	1	1	1	1	1	1	1

Percent Bloom over entire planting 1%-25% 26%-50% 51%-75% 76%-100%

Table 3-Pollinator Meadow Monitoring for Abundance – Williams Lab UC Davis Mix Plot 2- 2013

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Aster chilensis	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Castilleja exserta	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Clarkia purpurea	0	0	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Clarkia unguiculata	3	2	3	3	2	3	2	2	2	2	1	1	1	0	0	0	0	0	0
Collinsia heterophylla	2	2	2	2	3	2	2	3	2	2	1	0	0	0	0	0	0	0	0
Eriophyllum lanatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eschscholzia californica	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	2	2
Heliotropium curassavicum	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	2	2	2	2
Layia chrysanthemoides	0	1	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0
Lupinus nanus	0	1	2	2	1	3	0	1	1	0	0	0	0	0	0	0	0	0	0
Lupinus succulentus	2	1	1	2	2	3	3	3	2	1	1	1	2	0	0	0	0	0	0
Monardella villosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phacelia californica	3	2	3	3	3	3	3	3	3	3	3	2	3	2	2	1	1	1	1
Phacelia imbricata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phacelia ciliata	2	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phacelia tanacetifolia	2	2	2	3	2	3	3	2	1	1	0	0	0	0	0	0	0	0	0
Salvia columbariae	1	1	1	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Trichostema lanceolatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Triphysaria versicolor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0 = Absent 1 = Sparse 2 = Present 3 = Abundant

Table 4. Pollinator Meadow Monitoring for Bloom – Williams Lab UC Davis Mix - 2013

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Aster chilensis										1									
Castilleja exserta							1	1	1										
Clarkia purpurea										1	1								
Clarkia unguiculata										1	1	1	1						
Collinsia heterophylla								1	4	1									
Eriophyllum lanatum																			
Eschscholzia californica						1	4	4	4	3	3	2	1	1	1	1	1	4	1
Heliotropium curassavicum														1	4	4	4	4	4
Layia chrysanthemoides							1	1	1										
Lupinus nanus							4	1	1										
Lupinus succulentus						1		4	4	3	1	1	1						
Monardella villosa									1										
Phacelia californica								1		4	3	2	1	1	1	1	1	1	1
Phacelia imbricata																			
Phacelia ciliata							4												
Phacelia tanacetifolia								4											
Salvia columbariae																			
Trichostema lanceolatum															1	2	1	1	2
Triphysaria versicolor																			

Percent Bloom over entire planting	1%-25%	26%-50%	51%-75%	76%-100%

Table 5.-Pollinator Meadow Monitoring for Abundance – Xerces/Hedgerow Farms Central Valley Mix Plot 3- 2013

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Asclepias fascicularis	0	0	0	0	0	0	0	0	0	0	0	1	2	1	1	1	1	1	1
Clarkia gracilis 'Tracyi'	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Eschscholzia californica	3	3	3	3	3	3	3	3	3	3	3	2	3	1	1	1	2	3	2
Grindelia camporum	0	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	2	1	1
Helianthus bolanderi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Lasthenia glabrata	0	0	0	0	0	1	2	1	1	1	1	0	0	0	0	0	0	0	0
Lupinus densiflorus	3	1	2	2	2	2	2	2	2	3	3	0	1	0	0	0	0	0	0
Lupinus succulentus	2	1	1	1	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
Madia elegans	3	3	3	3	3	3	3	2	2	3	3	3	3	2	3	3	3	3	3
Muhlenbergia rigens	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nassella pulchra	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Oenothera elata	2	2	0	1	1	1	1	0	0	0	0	2	2	1	1	2	2	2	2
Phacelia californica	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	2	2	2
Trichostema lanceolatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0 = Absent 1 = Sparse 2 = Present 3 = Abundant

Table 6. Pollinator Meadow Monitoring for Bloom – Xerces/Hedgerow Farms Central Valley Mix Plot 3 - 2013

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Asclepias fascicularis														1	1	4	4	4	1
Clarkia gracilis 'Tracyi'																			
Eschscholzia californica						1	4	4	4	4	3	2	1	1	1	1	2	4	1
Grindelia camporum												1	1	1	1	3	2	1	1
Helianthus bolanderi																		1	4
Lasthenia glabrata							1												
Lupinus densiflorus								1	2	1	1	1	1						
Lupinus succulentus							1	1	1	1	1	1							
Madia elegans														1	4	4	3	2	1
Muhlenbergia rigens																			
Nassella pulchra																			
Oenothera elata																2	3	2	2
Phacelia californica								1	2	3	2	2	1	1			1	1	1
Trichostema lanceolatum																			1
Percent Bloom over entire planting	1%-25%			26%-50%			51%-75%				76%-100%								

Table 7. -Pollinator Meadow Monitoring for Abundance – Xerces/Hedgerow Farms Almond Orchard Mix Plot 4- 2013

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Collinsia heterophylla	2	2	3	3	3	2	3	3	3	2	2	0	0	0	0	0	0	0	0
Eschscholzia californica	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	0	1	1	2
Lupinus bicolor	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Nemophila maculata	3	3	3	2	2	3	3	2	0	0	0	0	0	0	0	0	0	0	0
Nemophila menziesii	2	3	2	2	2	3	3	3	2	1	0	0	0	0	0	0	0	0	0
Phacelia campanularia	0	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0

0 = Absent | 1 = Sparse | 2 = Present | 3 = Abundant

Table 8. Pollinator Meadow Monitoring for Bloom – Xerces/Hedgerow Farms Almond Orchard Mix - 2013

	3-Jan	15-Jan	29-Jan	12-Feb	26-Feb	12-Mar	26-Mar	9-Apr	23-Apr	8-May	23-May	7-Jun	18-Jun	2-Jul	16-Jul	30-Jul	13-Aug	24-Aug	10-Sep
Collinsia heterophylla								1	4	3	1								
Eschscholzia californica						1	4	4	4	4	3	2	1	1	1		1	2	1
Lupinus bicolor							2	2											
Nemophila maculata					1	1	3	4											
Nemophila menziesii					1	2	4	4	3	2									
Phacelia campanularia																			

Percent Bloom over entire planting | 1%-25% | 26%-50% | 51%-75% | 76%-100%

Results

The results for abundance of plants and bloom phenology for the four plots are described below (Tables 1 –8). The overall development of plants and flowers in the plots for spring and summer can be tracked in Figures 2 – 7.

The most troublesome weed was woollypod vetch, which was controlled by a combination of herbicide application, hand weeding and mowing. The wicking was ineffective, spraying was effective but also killed non-target plants and left bare patches that tended to be colonized by summer weeds such as prickly lettuce (*Lactuca serriola*), pigweed (*Amaranthus* spp.) and lambsquarters (*Chenopodium album*). Hand pulling was somewhat effective, but not cost-effective because it was very labor intensive. Mowing was fairly effective in reducing immediate competition from the vetch and reducing the seed bank, and was relatively low-maintenance. Timing was important, and it needed to be done 2 or 3 times in the early and mid-spring.

Plot 1: Simplified PMC Mix. The most abundant plants over the year were California poppy (*Eschscholzia californica*) and California phacelia (*Phacelia californica*). Narrow leaved milkweed (*Asclepias fascicularis*) was not detected (Table 1). Early bloomers were California poppy (*Eschscholzia californica*), baby blue eyes (*Nemophila menziesii*), and annual lupine (*Lupinus succulentus*). Diversity was much reduced compared to 2012 (Table 2).

Plot 2: Williams Lab (UC Davis) Species Trial Mix. The most abundant plants over the year were again California poppy (*Eschscholzia californica*) and California phacelia (*Phacelia californica*). Planted species that were not detected or found at very low levels included owls clover (*Triphysaria versicolor*), Pacific aster (*Symphotrichum chilensis*), and coyote mint (*Monardella villosa*) (Table 3). Prolific early bloomers were annual lupine (*Lupinus succulentus*) and miniature lupine (*Lupinus nanus*), and the annual tansy phacelia (*Phacelia tanacetifolia*) (Table 4). Salt heliotrope (*Heliotropium curassavicum*) bloomed consistently through June, July and August and vinegarweed (*Trichostema lanceolatum*) bloomed in August and September.

Plot 3: Xerces/ Hedgerow Farms Central Valley pollinator mix. The most abundant plants over the year were California poppy (*Eschscholzia californica*), common madia (*Madia elegans*), and California phacelia (*Phacelia californica*) (Table 5). Common madia was less dominant during this summer than during 2012 (Table 6, Figure 6). Good bloom was noted for California poppy (*Eschscholzia californica*), annual lupine (*Lupinus succulentus*), California phacelia (*Phacelia californica*). Vinegarweed (*Trichostema lanceolatum*) bloomed in August and September only in the cleared areas around the plots (Table 6).

Plot 4: Xerces/Hedgerow Farms Almond Orchard Mix. All 6 species in the mix were still present in the mix in 2013. All bloomed early fulfilling the purpose of the mix. California poppy (*Eschscholzia californica*) and baby blue-eyes (*Nemophila menzieii*) were most abundant. Phacalia campanularia, although present was not detected to bloom, this is probably a sampling error due to a lower frequency of this species (Table 7 and 8).

Figure 2. Plots from photo points on March 26, 2013

	
Plot 1. Simplified NRCS Mix	Plot 2. Williams Lab Trial Mix
	
Plot 3. Xerces/Hedgerow Farms Central Valley Mix	Plot 4. Xerces/Hedgerow Farms Almond Orchard Mix

Figure 3. Appearance of plots from photo points on April 23, 2013

Plot 1. Simplified NRCS Mix

Plot 2. Williams Lab Trial Mix

Plot 3. Xerces/Hedgerow Farms Central Valley Mix

Plot 4. Xerces/Hedgerow Farms Almond Orchard Mix

Figure 4. Appearance of plots from photo points on May 23, 2013

Plot 1. Simplified NRCS Mix

Plot 2. Williams Lab Trial Mix

Plot 3. Xerces/Hedgerow Farms Central Valley Mix

Plot 4. Xerces/Hedgerow Farms Almond Orchard Mix

Figure 5. Appearance of plots from photo points on June 18, 2013

	
Plot 1. Simplified NRCS Mix	Plot 2. Williams Lab Trial Mix
	
Plot 3. Xerces/Hedgerow Farms Central Valley Mix	Plot 4. Xerces/Hedgerow Farms Almond Orchard Mix

Figure 6. Appearance of plots from photo points on July 16, 2013

	
Plot 1. Simplified NRCS Mix	Plot 2. Williams Lab Trial Mix
	
Plot 3. Xerces/Hedgerow Farms Central Valley Mix	Plot 4. Xerces/Hedgerow Farms Almond Orchard Mix

Figure 7. Appearance of plots from photo points on Aug 13, 2013

	
Plot 1. Simplified NRCS Mix	Plot 2. Williams Lab Trial Mix
	
Plot 3. Xerces/Hedgerow Farms Central Valley Mix	Plot 4. Xerces/Hedgerow Farms Almond Orchard Mix

Note that the Almond Orchard Mix was mowed

Sainfoin adaptation to California using varieties Remont, Eski, Shoshone 2012 –2014 Trial - Progress Report 2013

CAPMC-T-1302-PA-(ONVI)

Study Leader: Ceci Dale-Cesmat, State Rangeland Management Specialist

Introduction

Sainfoin (*Onobrychis viciifolia*) is a legume from Eurasia that has been used in the upper mid-west and high elevation rangelands of the west as a non-bloat forage source. The species is reported to be drought tolerant and a good pollinator plant. Sainfoin has not been used in California, but ranchers have asked about its ability to be used as a component in range seedings or as a forage in pasture mixes. This lack of knowledge led to this seeding trial so that their adaptation and potential use for pasture and rangeland plantings can be evaluated.

The land use of concern is rangeland and pasture, with both non-irrigated and irrigated pasture used as grazing for livestock. The Vegetative Practice under consideration is 550, range planting, and the resource concerns that are important include Forage Quality and Quantity, Carbon Sequestration, Soil Quality, Pollinator Species, and Upland Wildlife Habitat.

Two cultivars used in the seeding trails (Remont, Eski) were released by Montana Agricultural Experiment Station in 1971 and Montana State University in 1964, respectively. Shoshone was released by University of Wyoming in 2006. The grasses included in the trial were native purple needle grass and introduced 'Berber' orchardgrass. Purple needle grass (*Nassella pulchra*) is a perennial grass, which was widely distributed through California's perennial grassland areas. 'Berber' orchardgrass (*Dactylis glomerata*) originated from the Mediterranean region and is a release from the Lockeford Plant Materials Center and the California Agricultural Experiment Station in 1981. It is widely available in the commercial seed production market and is used for range improvement.

List Of Plants used in sainfoin trial

Sainfoin	Remont	9105960
Sainfoin	Shoshone	9105961
Sainfoin	Eski	9105977
Introduced grass	'Berber' orchard grass, *Dactylis glomerata*	
Native grass	Purple needlegrass, *Nassella pulchra*	
Legume	Alfalfa - *Medicago sativa*	

Objectives and Description: The objective of this project is to study the persistence of Sainfoin and its ability to survive California's hot summer conditions. The cultivars were planted alone and with a native grass, *Nassella pulchra*, purple needlegrass and a non-native, 'Berber' orchard grass, *Dactylis glomerata*. Summer survival, growth habits and adaptation under irrigated and non-irrigated conditions were to be examined over 2 years.

Experimental Design: The layout of the study is shown in Figure 1. Sainfoin plots were10'x100' with three replications for each variety, one set under irrigation and one set non-irrigated. The three treatments included Sainfoin alone, Sainfoin with Berber Orchardgrass and Sainfoin with Purple Needlegrass. Alfalfa was used as a control. Sainfoin was seeded in the plots in a north/south direction while grass seed was planted in an east/west direction.

Materials and Methods:

Sainfoin seed (Eski) was obtained from D and D Seed in Klamath Falls Oregon, and Remont and Shoshone varieties were obtained from Bighorn Sainfoin Seed Company, Clark, Wyoming. Seed was delivered in 2010 and stored in a cool dry seed storage container.

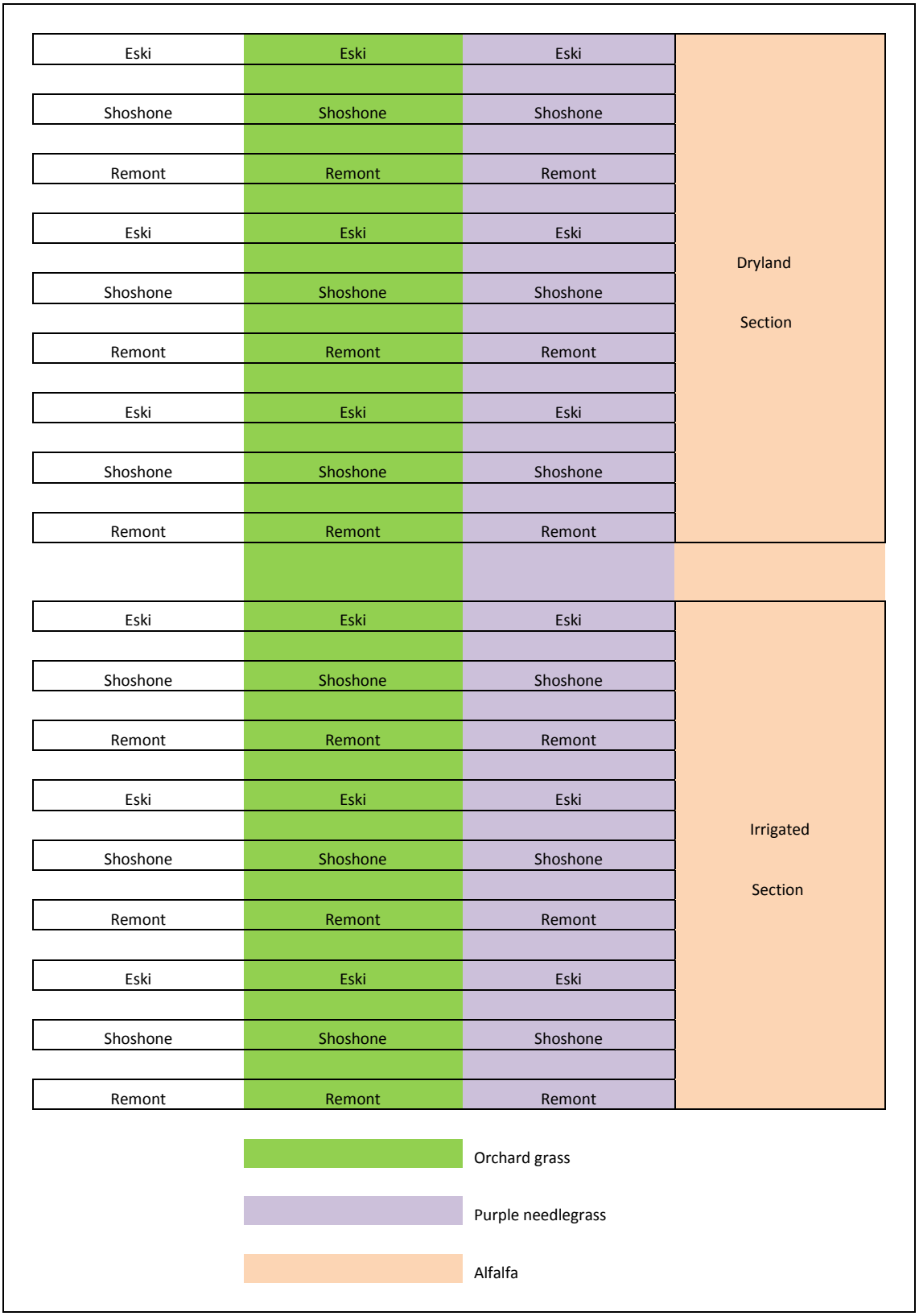
The soil type for the planting is a Vina fine sandy loam. The area was clean cultivated in the fall of 2012 prior to planting on November 6 & 7 2012. Plantings were direct seeded using a Truax range drill. Seeding rates were 34 lbs/acre for all Sainfoin plots, 8 lbs/acre for Orchardgrass and 10 lbs/ac for Purple Needlegrass/Sainfoin plots. Rainfall after planting in 2012 was 8 inches and plant establishment was good.

Weeds were controlled by cultivation in the unplanted areas. There was no other weed control apart from mowing. The most prolific weed was cheeseweed *Malva* spp. which had germinated in abundance during the wet fall of 2012.

Irrigation was applied via wheel-line starting to the irrigated block only starting on May 22, 2013 and 7 in was applied over the summer.

Data was collected according to the National Plant Material Observational Planting recommendations on seedling germination rates, total biomass production, in the spring at peak growth and in mid-summer on regrowth post-harvest and again in the late fall to determine over summer survival rates.

Figure 1. Plot Layout for Sainfoin Trial.



Results and Discussion

All three varieties of sainfoin established well in the fall of 2012 and grew well into the spring of 2013. The orchard grass and purple needlegrass also established well, as did the alfalfa. Data was recorded over 2013 and will be analyzed together for the final report and development of a Tech Note.

Weeds continued to be a problem in the fallow areas and were controlled by cultivation and mowing. No herbicides were applied to the plots.

Figure 2a. Open House March 27 2013, Ceci Dale-Cesmat, left explains the trial to NRCS Field Office staff and the public.

Figure 2b. Sainfoin in bloom May 3, 2013

Final Evaluations: Final Evaluations will be done in the fall of 2014 and a Tech Note will be developed.

Background Literature:

Sainfoin Plant Guide USDA PLANTS Database. http://plants.usda.gov/plantguide/pdf/pg_onvi.pdf. Accessed 2/12/14

'Shoshone' sainfoin, 2008. **http://uwadmnweb.uwyo.edu/UWplant/Publications/Shoshone_Sainfoin.pdf**

Peel, Michael. D., Kay H. Asay, Douglas A. Johnson, and Blair L. Waldron, 2004. Forage Production of Sainfoin across an Irrigation Gradient. Crop Sci. 44: 614-619.

Wofford, D.S., F.A. Gray, and J.W. Eckert. 1987. Evaluation of cultivars, experimental lines and plant introduction collection of sainfoin for resistance to the northern root-knot nematode. J. Nematol. 19:30-37.

Biofuel Oilseed Study: Camelina and Canola Variety Trials

CAPMC-P-1401-BF

Partners: **Jacqui Gaskill, State Energy Specialist, NRCS**
Nic George, UC Davis,
Steve Kafka, Director, California Biomass Collaborative,

Goals and Objectives

Crop production for biofuels is included in NRCS responsibilities for Energy, with programs such as BCAP providing incentives for farmers to grow oil-seed crops. Energy Specialist Jacqui Gaskill has worked with the PMC, and Nic George and Steve Kafka Director of the California Biomass Collaborative to install studies of camelina, *Camelina sativa* and canola *Brassica napus* at the CAPMC in 2013. This follows a similar trial with camelina planted at the PMC in 2011.

Camelina (*Camelina sativa*) and canola (*Brassica napus*) are both annual oilseed crops in the Brassica Family. They originate in Europe and have been cultivated there for centuries, and in recent years have been widely grown around the world. Depending on the location camelina may be spring or fall planted. It requires minimal inputs, and is tolerant of drought.

Planting of camelina and canola plots 11/25/13. Nic George (UC Davis) is driving and State Energy Specialist Jacqui Gaskill planting the seeds.

Intercenter Strain Trials

Observational Planting of Roemer's Fescue for Corvallis PMC

CAPMC-P-1201-NA

Margaret Smither-Kopperl

Roemer's fescue [*Festuca roemeri* (Pavlick) E. B. Alexeev; synonym: *F. idahoensis* var. *roemeri* Pavlick] is an important native grass of upland prairie and oak savanna plant communities within its natural range of western Oregon, western Washington, and northwestern California. It is a native cool season perennial bunchgrass with variable longevity and mostly basal foliage. It is short, fine textured, and densely tufted, and has stiff culms that grow 35-100 cm tall. The panicle (seed head) is open and 5-20 cm long. Leaves are often glaucous (covered with a whitish waxy coating) and color varies throughout a wide spectrum of greens and blues. Stem color ranges from light green to dark purple or red.

The objective of his observational planting was to assess the adaptability of five germplasm releases from Corvallis Oregon to conditions at the Lockeford PMC, MLRA 17 in the Central Valley of California.

Materials and Methods

Seed of four accessions of *F. roemeri* var *roemeri* and one *F. roemeri* var *klamathensis* was provided by Corvallis PMC, OR (Table 1). Plantings were established onto 42 inch x 220 ft beds with 2 buried sub-surface drip lines. The planting date was November 4, 2011. Emergence was noted on November 21, 2011. Irrigation was applied after planting and through February 2012, after this no irrigation was applied during 2012 or 2013. The plots were weeded in spring and fall to remove both grass weeds, knotweed (*Polygonum* spp.) and horsetail (*Conyza* spp).

Table 1. Accessions from Corvallis planted at the Lockeford PMC.

Accession Number	Scientific Name	Common Name	Release
9079511	*Festuca roemeri* var *klamathensis*	Klamath Roemer's fescue	Siskiyou Germplasm
9079484	*Festuca roemeri* var *roemeri*	Roemer's fescue	Coast Germplasm
9079512	*Festuca roemeri* var *roemeri*	Roemer's fescue	Puget Germplasm
9079513	*Festuca roemeri* var *roemeri*	Roemer's fescue	San Juan Germplasm
9079510	*Festuca roemeri* var *roemeri*	Roemer's fescue	Willamette Valley Germplasm

Results and Discussion

During 2012 the plants were not irrigated over the summer and all appeared similarly vigorous. With respect to plant height and base width the Siskiyou gerplans *F. roemeri* var *klamathensis* was shorter and broader than the of *F. roemeri* var *roemeri* releases (Figure1). No insect or disease problems were noted. Gemplasm releases did not flower during 2012. Growth slowed and stopped over the summer due to lack of water. The plants resumed active growth as soon as the rains came in November of 2012.

Figure 1. Growth of *Festuca roemeri* germplasm releases by August 28,2012

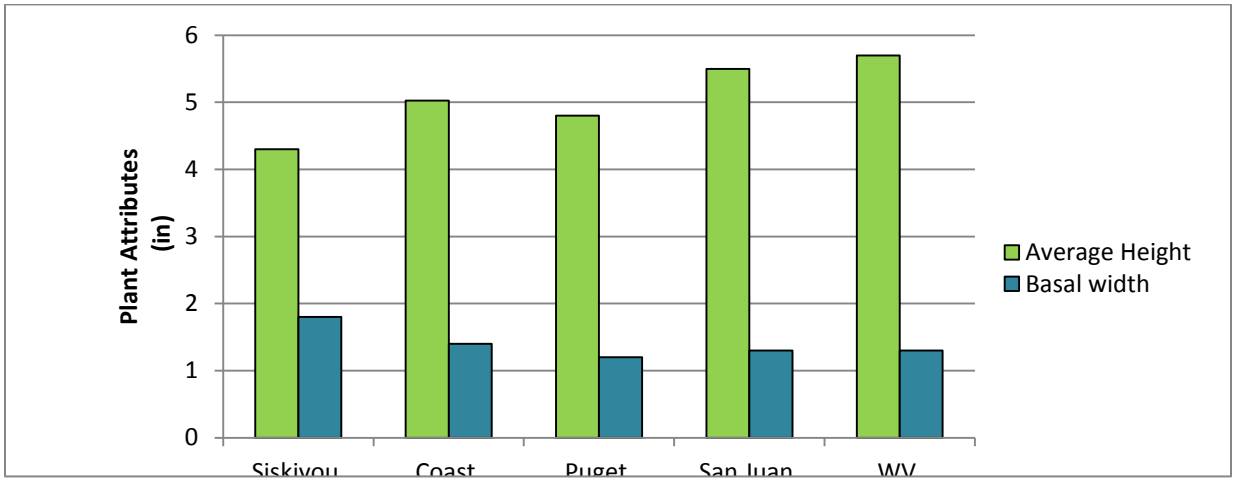
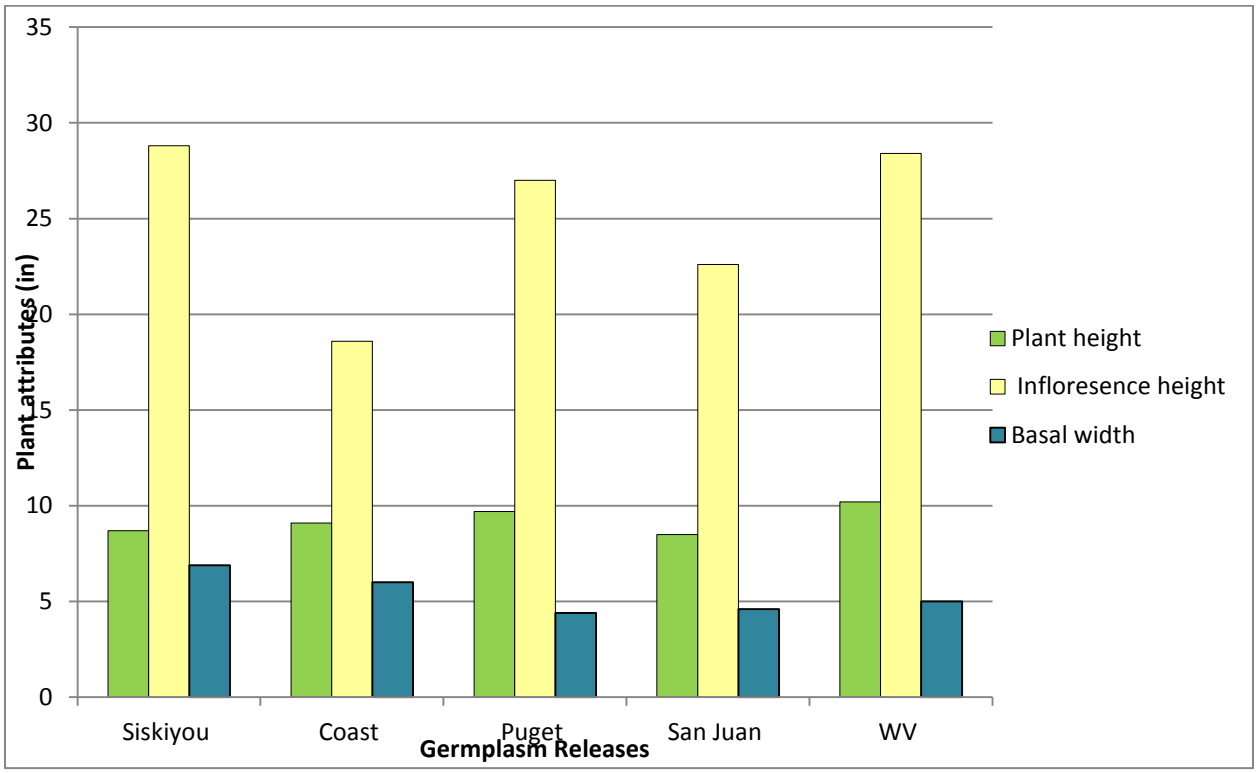


Figure 3. Growth of Roemer's fescue germplasm on March 11 2013

2013 was a drought year, with only 4 inches of rainfall in the first 6 months of the year. Even so there was good survival and growth of the five releases through the spring and early summer with the plants greening up well and maintaining a compact growth habit.(Figure 2). The trend of good growth as determined by plant height and basal width continued from 2012 into 2013 the greatest basal with on the Siskiyou germplasm (Figure3).

Figure 3. Comparison of height and base width for Roemer's fescue germplasm releases 2013



The Siskiyou germplasm also bloomed earlier and more vigorously than the other accessions in 2013 (Figure 4).

Siskiyou germplasm was collected from the closest geographical location to the California PMC and appears to be the best adapted. However, all five grasses grew well and survived the drought conditions from 2012 to 2013.

Literature Cited

1. Roemer's fescue germplasm for the Pacific Northwest
   Festuca roemeri (Pavlick) E.B. Alexeev Corvallis Plant Materials Center,
2. Roemer's fescue *Festuca roemeri* (Pavlick) E.B. Alexeev Plant Fact Sheet Plant Materials http://plant-materials.nrcs.usda.gov/

Figure 4. Phenology of Roemer's fescue accessions growing at the CAPMC. May 29 2013

Klamath Roemer's fescue - Siskiyou Germplasm

Roemer's fescue - Coast Germplasm

Roemer's fescue - Puget Germplasm

Roemer's fescue - San Juan Germplasm

Roemer's fescue - Willamette Valley Germplasm

Evaluation of springbank clover as a native leguminous cover crop

Study No. ORPMC-T-1203 (2012 – 2015) ~ 2013 Progress Report

Annie Young-Mathews and Margaret Smither-Kopperl

The purpose of this study was to perform an initial evaluation of springbank clover (*Trifolium wormskioldii* Lehm.) for use as a native perennial cover crop in Oregon and California. Our objectives were to: 1) evaluate germination and establishment (1st year), phenology, rate of spread and stand persistence over three years; 2) quantify wet and dry biomass accumulation over the course of the growing season over three years with no supplemental management (irrigation will be applied at CAPMC); 4) identify insect and disease susceptibility of the species; and 5) evaluate ability of the species to compete with and/or suppress weeds. Two common, non-native cover crop species, white clover (*T. repens*) and strawberry clover (*T. fragiferum*), were used as controls to compare their establishment and productivity to those of *T. wormskioldii* under simulated cover crop conditions.

The trial was set up as a randomized complete block design with 6 treatments (3 species seeded at two different seeding rates, 60 and 120 seeds/ft^2) and 4 replicated blocks at both the Corvallis, OR PMC and the Lockeford, CA PMC. Corvallis PMC plots were broadcast seeded on 9 October 2012, cover, height, and plant density data were collected on 9 April 2013, and plots were mowed twice (April and July?) to keep down weed biomass and prevent weeds from going to seed. Statistical analysis was performed using a factorial AOV and Tukey HSD means comparisons at $P<0.05$ in Statistix 8.1.

At six months after planting, both clover plant density and percent cover were significantly affected by seeding rate and species in the Corvallis planting (Table 1). Clover plant density was nearly double in plots seeded at the higher rate (mean of 8 plants/ft^2 at 60 seeds/ft^2 vs. 15 plants/ft^2 at 120 seeds/ft^2). Overall, strawberry and white clover plots had greater plant densities than the springbank clover plots (averages of 15 and 13 vs. 7 plants/ft^2, respectively), perhaps because of a greater percentage of hard seed or other dormancy in the springbank clover.

Table 1. Cover, height, and plant density data for three clovers seeded at two rates in the Corvallis PMC cover crop trial collected on 9 Apr. 2013 (6 months after planting). Means in each column followed by the same letter are not different at P<0.05 in Tukey HSD tests.

Species	Seeding rate (seeds/ft^2)	Clover density (plants/ft^2)	Clover height (cm)	Clover cover	Weed cover	Bare ground
Springbank clover	**60**	3.4 c	1.0 b	0.0% c	97.3% a	2.7% a
	120	9.6 bc	0.9 b	0.0% c	99.0% a	0.0% a
White clover	**60**	9.2 bc	8.0 a	10.7% b	88.3% a	1.1% a
	120	15.8 ab	7.5 a	22.9% a	76.0% b	0.5% a
Strawberry clover	**60**	12.1 ab	7.2 a	5.4% bc	93.1% a	1.6% a
	120	17.9 a	8.3 a	10.6% b	88.8% a	0.5% a

Figure 2. Cover in plots on 9 April 2013 (182 days after planting): springbank clover overrun by weeds (left), white clover (middle), and strawberry clover (right), all seeded at 120 seeds/ft^2.

Percent cover of the planted clover was highest in the white clover plots seeded at the higher rate and lowest in the springbank clover plots, with the lower rate of white clover and the strawberry clover plots having intermediate percent cover (Table 1, Figure 1). Springbank clover plants averaged only 1 cm tall, while the white and strawberry clover plants were about 8 cm tall, and were wider and leafier. Cover data points were collected every 6 inches along diagonal transects in the plots, so the size difference among the three species of clovers probably accounts for the lack of springbank clover cover since the weeds were bigger than the springbank clover so we never hit any of them on the transects (Figure 2). There was less weed cover in the white clover plots seeded at 120 seeds/ft^2 than all the other treatments, probably due to the quick establishment of the relatively broadleaved white clovers.

Figure 3 ***Springbank clover seedling (circled in red) surrounded by weeds on 9 April 2013 in one of the plots in the cover crop trial at the Corvallis PMC.***

By mid-May the white and strawberry clover plots had filled in more and begun to flower (Figure 3), while the springbank clover plants remained small and overwhelmed by the weeds. The white and strawberry clovers continued to flower throughout the summer, but the springbank clover remained vegetative. By late September, plots seeded at both rates of white and strawberry clover appeared to have reached well over 50% cover by visual observations, but vole damage was beginning to be apparent. The vole damage was quite extensive in some plots by early December (Figure 3).

At the Lockeford PMC, there were no significant differences between the three species which were all planted at the 60 seeds/ft^2 seeding rate (Table 2). The plant density varied between 2 and 2.8 seeds/ft2 for springbank and strawberry clovers respectively with white clover intermediate. White clover appeared to be the most vigorous, reaching a height of 17 cm compared to 5.7 cm for springbank and 9.7 cm for strawberry clovers. This vigor resulted in the greatest cover for white clover with 79% clover cover 13% weed cover and 9% bare ground. The spring bank clover achieved only 34% cover and had the highest proportion of weeds at 26% cover.

Figure 3. *White clover in plot 4-2 seeded at 120 seeds/ft^2 at the Corvallis PMC: beginning to flower on 13 May 2013 (left), with good cover but some vole damage on 25 Sept. 2013 (middle), and showing areas of extensive vole damage on 5 Dec. 2013 (right).*

The main pest problem was deer which grazed on the plants but appeared to graze equally on each species. No other pests or diseases were noted on the clover plants.

Growth of the clover plants was dependent upon irrigation with 7 inches applied as sprinkler irrigation over the late spring and summer, during which time there was no rainfall. No additional irrigation was applied in the fall of 2013.

Figure 4. *Clover plantings at the Lockeford PMC April1, 2013.*

Table 2. Cover, height, and plant density data for three clovers seeded at the Lockeford PMC cover crop trial in 2012. Data collected on 14 may 2013 (6 months after planting). There were no significant differences between the species.

Species	Seeding rate (seeds/ft^2)	Clover density (plants/ft^2)	Clover height (cm)	Clover cover	Weed cover	Bare ground
Springbank clover	60	2.0	5.7	34%	41%	26%
White clover	60	2.5	17	79%	13%	8%
Strawberry clover	60	2.8	9.4	56%	33%	10%

Demonstration planting of 'Windbreaker' big sacaton

CAPMC-T-1207-WI

Margaret Smither-Kopperl

Partners: Johnnie Siliznoff, NRCS Air Quality Specialist

'Windbreaker' big sacaton (*Sporobolus wrightii* Munro ex Scribn) is a recent release from NRCS, USDA and New Mexico State University (NMSU) Agricultural Science Center at Los Lunas[1]. 'Windbreaker' big sacaton is a native, warm-season grass for the southwestern United States. 'Windbreaker' produces on a per acre basis more than 8,000 lbs of biomass, 200 bulk lbs. of seed, and can grow more than 10 feet in height. The plant is readily consumed by livestock and wildlife in spring and early summer. It has demonstrated in New Mexico and Arizona to be an excellent choice for use in wind strips protecting cropland from wind erosion. Big sacaton is endemic in southern California, but not the Central Valley[2].

The objective of this preliminary observational study was to examine the growth phenology of 'Windbreaker' big sacaton at the California PMC to assess its potential for use in the Central Valley of California. Air quality is a major resource concern in the southern Central Valley. Although big sacaton is not considered a weedy species or invasive species we planned to allow the plants to produce seed and to determine whether weediness was likely to be a concern under the conditions at the California PMC.

Materials and Methods

Seed of 'Windbreaker' big sacaton, Accession number 9066790 was provided to the CAPMC by the Los Lunas PMC in 2011. On February 22, 2012, seed was sown into two plug trays with 192 cells with Sunshine mix # 5. The trays were watered well and placed in the greenhouse , at temperatures of 60 F night and max 80 F day. Germination was noted on March 5, 2012. Plants were transferred into D16 Deepots (2" in diameter x 7" tall, 16 cubic inch) on April 12, 2012. Plants were placed in a lathe house in May and maintained with weekly fertilization and daily watering prior to planning on July 3, 2012

Transplanting of 'Windbreaker' big sacaton plugs was into a 42 inch width raised bed with two buried drip lines. Prior to planting the plants were clipped to 5 inches in height. (Figure 1.). Planting was in a double row with a 5 foot spacing staggered along the beds. Initially water was applied every other day. No irrigation was applied over the winter of 2012 and 2013 when the plants became dormant. During the spring of 2013 it was discovered that small rodents had destroyed the buried drip lines in the 'Windbreaker' planting. As it was a very dry spring it was determined that the simplest way to irrigate the row of grasses was to make a furrow along either side of the row and apply water via gated pipe. Water was applied to the furrows on a monthly basis.

Results and Discussion

Transplants of 'Windbreaker' big sacaton established well and grew rapidly in 2012. There was no loss of plants at transplanting. However, some plants were lost due to damage inflicted by deer grazing on the rapidly growing plants including pulling some plants out of the ground. No diseases were noted on the plants. By late September plants were a meter in height. Growth slowed in the fall and the plants were left with no additional irrigation over the winter (Figure 1).

Figure 1. Establishment and growth of 'Windbreaker' sacaton after planting in 2012.

Plug Planting, 7/3/2012

Growth after four weeks in the field 7/31/12

By late September plants were robust and 1 m in height. 9/13/12

The 'Windbreaker' sacaton plants were dormant over the winter of 2012 and 2013. There was some concern that the grass might not survive the winter as it is not native to this area of California, but the plants all survived the winter and resumed growth in the spring of 2013.

Figure 2. Furrow Irrigation of 'Windbreaker' sacaton summer 2013 .

Growth of the 'Windbreaker' sacaton plants was robust over the summer of 2013 (Figures 3 and 4). The plants grew well and attained a height of approximately 2 m. The plants initiated flowering in June and produced inflorescences and seeds. Seed was not harvested..

Figure 3. Base of "Windbreaker sacaton plants August 27, 2013

Figure 4. Row of 'Windbreaker' sacaton Plants at the CAPMC.

Big sacaton is not considered a weedy species or invasive species, but introducing a new, even if native species into an area is always cause for concern in case the plant could spread to adjoining vegetative communities under ideal environmental conditions. During 2012, greenhouse studies of seeding directly into soil in the lath house did not produce any viable plants, while transplanted seedlings grew well in the field. A limited amount of seed was produced by the field transplants in 2012, but no volunteer seedlings were noticed during 2013. The seeds are small and require high temperatures and moisture levels to germinate. Our observations confirm those of New Mexico, that weediness with this species is not likely to be a problem,

Air quality is a major resource concern in California, the dry summers mean that dust is produced from traffic on dirt roads and from farm operations such as tillage and nut harvesting. 'Windbreaker sacaton is a quick growing large grass that could assist in windbreakers and along roads, especially in the southern Central Valley.

Literature cited

[1]Conservation Release Brochure for 'Windbreaker' big sacaton (*Sporobolus wrightii)*. USDA-Natural Resources Conservation Service Los Lunas Plant Materials Center, Los Lunas, NM 87031. Published September 2011. http://plant-materials.nrcs.usda.gov/nmpmc/releases.html

[2]**Jepson Flora Project: Jepson Interchange for California Floristics,** *Sporobolus wrightii* Munro ex Scribn. http://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?SPWR2. Accessed May 14, 2013.

Seed Production

Seed Production at the CAPMC during 2013

PLANTS Code	Species	Release name	Common name	Accession #	Bulk Weight (lbs)	PLS	Date tested
CAPMC Release							
BRCA5	*Bromus carinatus*	Southern Cal 2600	California brome	9083079	5.5		
BRCA5	*Bromus carinatus*	Northern Cal 40		9083087	7.2		
ELGL	*Elymus glaucus*	'Mariposa'	Blue wildrye	9032907	20.0		
ERUM	*Eriogonum umbellatum*	Sierra	Sulphur-flower buckwheat	421013	104 g		
SPAI	*Sporobolus airoides*		Alkali sacaton	9083032	30.0		
VIVIV8	*Vicia villosa*	Lana	Winter vetch	117430	-		
Other Production							
ELEL5	*Elymus elymoides*	BLM	Squirreltail	9105974			
ELGL	Elymus glaucus	BLM	Blue wildrye	9105972	18.0	73%	10/21/13
FECA	Festuca californica	BLM	California Fescue	9105975	1.8	19%	10/29/13
NAPU4	Nassella pulchra	BLM	Purple tussockgrass	9105969	10.0	78%	4/13/14
NAPU4	Nassella pulchra	BLM		9105970	9.0	77%	5/13/13
LUBI	Lupinus bicolor	NPS	Miniature lupine	9105998	5.3		
ELGL	Elymus glaucus	NPS	Blue wildrye	9105995	2.5	79%	4/14/14
BRCA5	Bromus carinatus	NPS	California brome	9105993	6.0	94%	4/13/14
		888	Triticale	9107566	6,088.00	92%	10/13/13

Reimbursible Projects

California Plant Materials Center

Native Plant Materials Development IGA Final Report 2013

September 30, 2013

The long-term objective of this project is to increase the information and the availability of locally adapted native plant species for revegetation. The NRCS California Plant Materials Center (CAPMC) and the California office of the Bureau of Land Management (BLM) have entered into an agreement to collect native plant species in coordination with the Seeds of Success (SOS) Program. The SOS Program supports the systematic collection and development of native species, related native species research and provides the initial seed stock for commercial seed/plant increase efforts, products from which are used for revegetation of sites following disturbance.

Collection efforts followed the Seeds of Success Protocol (available at: www.nps.gov/plants/sos/). Seeds of all species collected under this agreement will be cleaned and stored at the Bend Seed Extractory and/or the USDA-ARS Western Regional Plant Introduction Station, Pullman, WA. Seed collections were made during 2010, 2011 and 2012. No collections were scheduled during 2013, as the emphasis had shifted to seed production at the CAPMC,

This agreement also provided for the CAPMC to produce containerized plant material and increase seed stock of select species. Seed for propagation and increase was supplied by seed collected for the SOS Program by PMC staff and in some cases by Field Office staff.

Tasks Accomplished during 2012- 2013

Task 1: *Elymus glaucus* (blue wildrye), *Elymus elymoides* (squirreltail), *Festuca californica* (California fescue) and two accessions of *Nassella pulchra* (purple needlegrass) plantings made in 2011 are being maintained for seed production.

The first field increase plantings were established in the spring of 2011 and included one accession each of blue wildrye (*Elymus glaucus)*, squirreltail (*Elymus elymoides*), California fescue (*Festuca californica*) and two accessions of purple needlegrass (*Nassella pulchra*). These grasses were established as plug plants on rows with buried drip irrigation to aid establishment. The first harvest was made in 2012 with the seed cleaned and stored at the CAPMC. Plants were

Figure 4. Purple needlegrass Oak Slough planting at the PMC starting active growth in fall 2012.

maintained for continued seed production. Seed plantings were maintained with routine cultural practices including weeding and fertilization. No irrigation was required during the autumn of 2012 as annual rainfall was 9 inches from October through December, more than adequate for growth and seed production.

These accessions are enrolled in the California Crop Improvement Association (CCIA) Foundation Seed Program under a tentative 'Source Identified' designation.

Seed was harvested from the grasses in May and June 2013. The harvesting method varied with species, California fescue and purple needlegrass were harvested using the flail vac. Blue wild rye was combined and a swather was used to harvest the squirreltail and spike bentgrass.

Figure 6. Harvest of squirreltail *Elymus elymoides* .

Seed cleaning proceeded over the remainder of the summer and is now complete, apart from squirrel tail, which is still in process.

These perennial plantings will continue to produce seed in future years under appropriate maintenance.

Task 2: Collaborate with Cosumnes River Preserve on seed collection, seed increase and/or container production of species of interest for the Cougar Wetland Restoration. Maintain plantings made in fall of 2012 of *Agrostis exarata* (spike bentgrass), *Eryngium articulatum* (Bee thistle), *Grindelia camporum* (gumweed), *Phyla nodiflora* (lippia) and harvest seed.

Seed of all four species were planted in 200 foot raised beds with buried drip lines in fall of 2012. The *Agrostis exerata*, spike bentgrass was the only species to germinate and establish well. Plants were maintained and harvested during late summer in 2013 (Figure 4). The seed heads matured at different times, as can be seen in the figure and mature seed heads were harvested twice by hand prior to the final harvest using a hand swather.

As *Grindelia camporum* did not start from seed in the beds, additional plugs were started from seed. These were planted out in the beds during the late spring, and have established well. Limited seed will be harvested from these plants during 2013, and as they are a perennial species additional seed can be harvested in following years.

Eryngium articulatum did germinate but very limited and growth was poor.

Figure 4 Spike bentgrass planting at the Lockeford PMC. Photos, 5/30 and 7/8/2013.

Task 3: Plantings of five grass species, *Leymus cinereus, Achnatherum thurberianum*, *Agrostis stolonifera*, *Festuca idahoensis*, and *Pseudoroegneria spicata*.

In the fall of 2012 plantings of seed were made for five species of grasses. As the seed was received too late to produce plugs for fall planting, these were direct seeded with a Kincaid research drill in October 2012. The species planted were *Leymus cinereus* (400 ft row) and 4 x

400 ft rows each of *Achnatherum thurberianum, Agrostis stolonifera, Festuca idahoensis*, and *Pseudoroegneria spicata.* Unfortunately these plantings were not successful.

The remaining seeds were planted as plugs for seed increase, these plants are being maintained in the greenhouse and lathe house. They will be ready for planting in fall 2013 and will be established on beds with drip lines..

Figure 5. Five grass planting in fall 2012.

Figure 6. Flats of grasses in lath house ready for fall planting at the PMC.

Task 4: Clean all seed harvested at the CAPMC from BLM plantings, obtain purity and germination information. Maintain seed in storage until requested by BLM, then provide all cleaned seed to the BLM.

A record of seed harvested during 2012 and 2013 is shown in Table 1. Generally seed yields in 2013 were larger than 2012 reflecting increased maturity of the grasses. All seed is stored under controlled atmosphere conditions at the PMC until requested by the BLM.

Figure 7. Purple needlegrass seed harvested and placed in bins prior to cleaning.

Figure 8. Shawn Vue holds cleaned blue wildrye harvested in 2013 and stored in controlled atmosphere cooler.

Table 1. Seed harvested and stored at the CAPMC during 2012 and 2013

Scientific Name	Common Name	Origin	2012			2013		
			Seed clean (lb)	PLS amount [1]	Date tested	Seed clean (lb)	PLS amount [2]	Date tested
Elymus elymoides	Squirrel Tail	Ukiah Petray Mine	45 g			In process		
Elymus glaucus	Blue wildrye	Ukiah Eaton Springs	2.5	2.2	4/17/2013	18		
Festuca californica	California fescue	Redding Trail 27	226.9 g			1.8		
Nassella pulchra	Purple needlegrass	Redding Oak Slough	7	3	4/17/2013	10		
Nassella pulchra	Purple needlegrass	Redding Coyote Pond	4.5	2.9	4/17/2013	9		
Agrostis exerata	Spike bentgrass	Cosumnes Preserve				2		

[1]Purity and germination obtained only on larger seed lots.
[2]Seed sent for testing, waiting on results.

SEQUOIA AND KINGS CANYON NATIONAL PARK

2013 Annual Report
Prepared by
Margaret Smither-Kopperl

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
LOCKEFORD, CALIFORNIA

INTRODUCTION

In 2011, the Lockeford California Plant Materials Center (PMC) entered into an agreement with Sequoia and Kings Canyon National Park (SEKI) to produce seed of two grasses, California brome (*Bromus carinatus*), and blue wild rye (*Elymus glaucus*) and one forb species, miniature lupine (*Lupinus bicolor*). Under the contract there is a specification for delivery of 12 lb. of seed for both grass species and 10 lb. for the miniature lupine, delivered over the period of the contract. In addition, seed of six additional species was delivered for cleaning and storage. The agreement will run through 2014.

The National Park Service requires that restoration of native plants be accomplished using germplasm from populations as closely related genetically and ecologically as possible to park populations. The PMC was chosen due to its ability to clean, propagate and produce the desired amounts of high quality seed within the required time frame. The PMC is also able to conduct studies to determine adaptation and cultural requirements for establishment and seed production.

ACCOMPLISHMENTS

California brome, blue wildrye and miniature lupine planted during the fall of 2011 were harvested in 2012 and 2013. Seed of all three species were provided by SEKI and cleaned at the PMC. Miniature lupine was planted using weed mat, but this blew away during a winter storm. Seed was hand harvested and then plants were cut using a sicklebar mower, and spread on tarps for seed release. California brome and blue wildrye were harvested with a Flailvac which allowed more than one harvest,. The amounts of harvested seed obtained after cleaning during 2012 and 2013 is shown in Table 1.

Seed of miniature lupine, 0.1 acre was planted in fall 2012 from seed harvested in 2012 using weed mat established on 0.1 acre and irrigated during a dry fall with sprinkler irrigation. Seed germination was good through the weed mat. Seeds were pre-treated with fungicide prior to planting as fungal diseases have killed previous lupine plantings into weed mat at the PMC.

Additional seed lots of 12 species were cleaned at the PMC during 2013 and are being maintained in storage.

Table 1. Seed harvested under contract to SEKI during 2012 and 2013.

Code	Common Name	Area (acres)	Seed bulk (lb)	PLS (lb)	Date tested*	Seed bulk (lb)	PLS (lb)	Date tested
Year			**2012**			**2013**		
BRCAC8	California brome	0.25	11.00			6	5.64	4/13/14
ELGLG	Blue wildrye	0.25	4.25			2.5	2.0	4/13/14
LUBI	Miniature lupine	0.25	8.00			5.3		

*Seed of 2012 collected seed was tested for PLS last year. There were some issues with the seed testing company and they are to be re-tested.

Rows of California brome in May, seed heads are growing, but still immature.

Shawn Vue, seed technician, cleaning seed of SEKI California brome.

YOSEMITE NATIONAL PARK

2013 Annual Report
Prepared by
Margaret Smither-Kopperl

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
LOCKEFORD, CALIFORNIA

INTRODUCTION

In 2013, the Lockeford California Plant Materials Center (PMC) entered into an agreement with Yosemite National Park (YOSE) to produce seed of western needlegrass, *Achnatherum occidentale* for restoration of native vegetation along the Tioga Pass. Under the original contract there was a specification for planting 1 acre for seed production. This needed to be amended because there was insufficient seed and a low rate of germination precluding plug plant production.

The contract was amended for the production of a Propagation Protocol for western needlegrass, and seed production of two additional species; blue wildrye, *Elymus glaucus*, and naked buckwheat, *Eriogonum nudum* with seed provided by Yosemite. Seed of these species will be harvested and the agreement will run through 2015.

The National Park Service requires that restoration of native plants be accomplished using germplasm from populations as closely related genetically and ecologically as possible to park populations. The PMC was chosen due to its ability to clean, propagate and produce the desired amounts of high quality seed within the required time frame. The PMC is also able to conduct studies to determine adaptation and cultural requirements for establishment and seed production.

ACCOMPLISHMENTS

Achnatherum occidentale seed (99 g) collected by the NPS in 2013 was provided to the CAPMC. In addition the PMC had additional seed of *A. occidentale* collected at Yosemite in 2012 and stored at the PMC. Both of these seed lots were used for germination studies and kept separate during trials. The first planting sowed seed into flats of Sunshine mix #4 and had approximately 1% germination in both old and new seed lots.

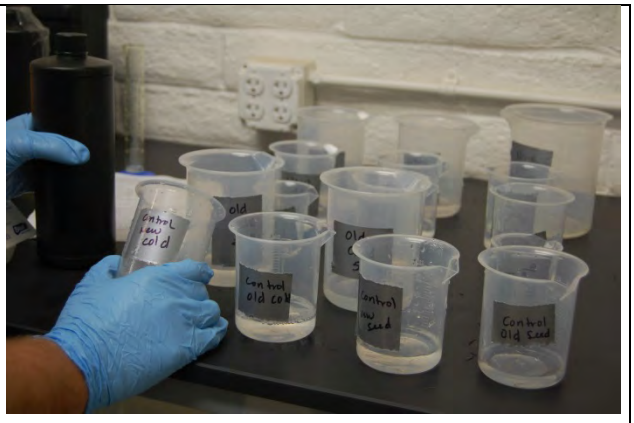
The first strategy investigated several treatments with cold stratification and freezing for limited times. Seeds were then cold stratified at 2 temperatures, one flat was held at 40^{o}F for 4 weeks, and another was frozen at 10^{o}F for 4 weeks. Seeds began to germinate about 2 weeks after removal from cold when placed in a germination chamber held at 65^{o}F. The cooler

treatment did not affect germination, but the freeze treatment increased germination to about 3-4%.

A second more successful treatment strategy was performed using a form of electrolyzed water called neutral anolyte, which has a near neutral pH and free chlorine ions that sanitize the seed. This anolyte was 500ppm and was diluted into three treatment groups. A control of distilled water was used, then 500ppm anolyte, 250ppm anolyte diluted with distilled water, and 125ppm anolyte diluted with distilled water. Seed from 2012 and 2013 lots were treated in separate groups to determine if seed age or dormancy is playing a role in low germination rates. The seeds were soaked in the neutral anolyte for approximately 45 minutes then removed using filter paper and allowed to dry for 2 hours. The seeds were then soaked in Catholyte solution, which is alkaline water with surfactant properties that cleanses the seed and provides antioxidants to soften the seed coat and imbibe the seed with water. Seeds were soaked overnight for approximately 16 hours. After 2 weeks the highest germination rate (15%) was in the 2012 seed treated with 250ppm anolyte solution.

The final treatment was a smoke water treatment, as a literature survey indicated that this could substantially increase germination. Many species are fire adapted and thus have a mechanism triggered by a chemical produced by the burning of vegetation. Smoke water was produced by burning leaves of oak and sucking the smoke through a shop vac and blowing it into a large bucket of water to bubble it through, for about 45 minutes. This water was then used to soak 2012 and 2013 seeds separately for 2 hours. The highest germination rate with a smoke water treatment was 16%.

Initial germination of *Achnatherum occidentale* seedlings



Lab studies with the electrolyzed water treatments.

Seed of blue wildrye, *Elymus glaucus* provided by Yosemite was planted in December of 2013 by direct seeding ¼ acre. These plants germinated well under sprinkler irrigation and are growing well. An additional five flats were planted in the greenhouse in case the direct seeding failed, these were to be transplanted next to the direct seeded plants.

Outreach

Trainings at the Lockeford PMC 2013

The PMC Open House was held on March 27, 2013 and was an opportunity for State Office Staff to provide information to 80 attendees, including NRCS Field Office staff, RCD staff and the public including farmers and growers.

Dennis Chessman, State Agronomist discusses soil health and cover crops at the CAPMC Open House.

State Biologist Tom Moore stands in front of a Pollinator Meadow at the PMC Open House.

Irrigation 'Boot Camp' was held at the PMC April 30 to May 2 2013. This was organized by Dan Johnson, State Water Management Engineer and Greg Norris, Assistant State Engineer. The objective was to provide NRCS Field Office staff with basic information about various irrigation systems and to allow them to work with these systems. In this training, 30 NRCS staff participated and worked in three groups. All of the activities were "hands-on" to give Field Office staff experience of irrigation systems that will be invaluable as they interact with farmers. Margaret Smither-Kopperl, PMC Manager gave a field presentation on Plant root structure and irrigation needs, and Dennis Frommelt, Farmer provided information on farm implements and there use.

NRCS Field Office staff learn about the well pump for field irrigation at the "Irrigation Bootcamp."

Students from five local High Schools as part of the FARMS leadership program learn about riparian restoration.

There were two trainings for Orientation for New Employees to the PMC, on March 14 and June 20. The students learned about the Plant Materials Program and received a tour of the PMC.

SLEWS and FARMS-Restoring Riparian Habitat on the Mokelumne River

The Center for Land-Based Learning in Winters CA leads the SLEWS and FARMS program. SLEWS (Student and Landowner Education and Watershed Stewardship) to engage high school students in habitat restoration projects that enhance classroom learning, develop leadership skills and result in real habitat restoration, while FARMS (Farms, Agriculture Resource Management and Sustainability) Leadership Program engages students from local High Schools. The mission is to inspire and motivate people of all ages, especially youth, to promote a healthy interplay between agriculture, nature, and society through their actions and as leaders in their communities.

Both SLEWS with students from Lodi High School, and FARMS with students from five local high schools, worked on a Mokelumne River restoration project, with funding from the National Fish and Wildlife Foundation. The area along the levee at the PMC chosen for this activity was overgrown with Himalayan blackberry and some clearing of blackberries and sedge planting was carried out in the fall of 2012.

Sites for seeding perennial grasses and forbs along the restoration area by the Mokelumne River.

Wood duck sitting on eggs in a duck box constructed by SLEWS students and set up along the Mokelumne River.

SLEWS students visited three times in 2013. The students planted 'Rio' beardless wild rye plugs that they had sown from seed the previous year. In collaboration with the Audubon Society, the students constructed wood duck boxes. Three of the five boxes were occupied by wood ducks by early summer .

In the fall of 2013 the FARMS leadership group visited the PMC on November 19 2013 and planted additional seed of 'Rio' beardless wildrye and dwarf barley along the levee.

Indigenous Stewardship Methods and California Indian Outreach

Our collaboration with California Native American tribes continued during 2013 as we work to support their interest in promoting plants of cultural significance. California has the highest population of Native Americans of any state; they face significant challenges including access to land and native plants.

The PMC allows tribal members to gather plant materials, with prior arrangement and at appropriate times during the year. We held three events during the year with the assistance of NRCS Tribal Liaison Reina Rogers.

A Tribal Workday was held on January 28, with participants assisting in gathering willow for basketry and planting soap root plants which had been propagated in containers.

Planting soap root at the PMC.

Sharing seed information with some interested students.

A Native Youth Summer Field Day was held on June 26 with over 60 students attending from several local tribes including the Buena Vista Rancheria, Ione Band of Miwok, Sheep Ranch Rancheria, and the Sierra Native Alliance. There were tours of the facility with stations for individuals to learn about different topics from invited tribal elders. Students learned about several topics on native uses of plants, as well as a picnic lunch was held under the trees with samplings of traditional native foods.

A Tribal Gathering and Workshop for Tribal members was held in November 13 at the CAPMC. The event featured gathering of acorns and grapes along the levee and discussion of propagation of local plants for tribal nurseries and gardens. The acorn harvest was large during 2013 and participants collected acorns along the levee from mature Valley Oaks. Acorn was a staple food for the local Miwok tribes. Discussions were carried out on stewardship activities and management for culturally significant plants

Acorns in abundance for gathering during out fall gathering.

USDA People's Garden

The California Plant Materials Center maintains a Sustainable and Pollinator garden adjacent to the buildings of the PMC. For the past two years we have maintained a vegetable garden over the summer donating vegetables to local food banks. During 2013, the increased number of studies ongoing at the CAPMC combined with a cut in staff meant that we were unable to grow a separate vegetable garden. Our native and drought tolerant plantings were maintained and visited by several groups of school children, and our local Mokelumne Watershed Committee.

Sonia Miller , Soil Conservation Technician and Jessie Samson , Soil Conservationists from the Stockton Field office assist with sweet corn harvest in August 2013.

In addition, 2750 lb of sweet corn harvested by local Field Office staff as part of the National Soil Health Study was donated to local food banks.

Publications for CAPMC

Listing

Fiscal Year 2013

Patrick Nicholson 2013. Woolly Milkweed Plant Guide. Lockeford Plant Material Center, Lockeford. September, 2013. 3p.

Marc Bliss 2013. Great Valley Gumweed Plant Guide. Lockeford PMC, Lockeford, CA. 2013. 4p.

M.Smither-Kopperl 2013. Progress Report of Activities, 2012. Lockeford PMC, Lockeford, CA. December 2012. 4p.

M. Smither-Kopperl 2013. Technical Report of Activities 2012. Lockeford Plant Materials Center, Lockeford, CA. 2012. 123p.

M Smither-Kopperl 2013. Native Plant Materials Deveropment IGA Final Report 2013. Lockeford PMC, Lockeford CA. September 30, 2013. 9p.

Gomes, A., Smither-Kopperl, M. 2012. Propagation protocol for vegetative production of container Baccharis pilularis DC. plants (Rooted male vegetative cuttings in 1/2 gallon containers.); USDA NRCS - Lockeford Plant Materials Center, Lockeford, California.. http://www.nativeplantnetwork.org/Network/ViewProtocols.aspx?View=Print&ProtocolID=3923, Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.. 23 October 2012. 2p.

CAPMC 2013. 'Berber' orchardgrass Release brochure. Lockeford PMC, Lockeford, CA. September 2013. 2p.

CAPMC 2013. 'Casa' Quailbush Release Brochure. Lockeford PMC, Lockeford, CA. September 2013. 2p.

CAPMC 2013. 'Marana' fourwing saltbush Release Brochure. Lockeford PMC, Lockeford, CA. September, 2013. 2p.

Presentations for CAPMC

Listing

Date presented: 2/26/2013
Title: Field Trip to the NRCS Plant Materials Center.
Presenter: Margaret Smither-Kopperl **Location:** PMC

Date presented: 3/14/2013
Title: Plant Materials Program and Lockeford PMC Activities
Presenter: Margaret Smither-Kopperl **Location:** Lockeford PMC

Date presented: 3/27/2013
Title: Open House Lockeford PMC 2013
Presenter: Margaret Smither-Kopperl, **Location:** Lockeford PMC

Date presented: 4/30/2013
Title: Plants and Soil
Presenter: Margaret Smither-Kopperl **Location:** Lockeford PMC

Date presented: 4/30/2013
Title: Farm equipment
Presenter: Dennis Frommelt **Location:** Lockeford PMC

Date presented: 5/2/2013
Title: Plants and Soil additonal
Presenter: Margaret Smither-Kopperl **Location:** Lockeford PMC

Title: The role of the Lockeford Plant Materials Center in promoting Biodiversity
Presenter: Margaret Smither-Kopperl **Location:** Heritage Vineyard, Woodbridge Road, CA

Date presented: 6/20/2013
Title: Plant Materials Program and the Lockeford PMC
Presenter: Margaret Smither-Kopperl **Location:** Lockeford PMC

Date presented: 6/26/2013
Title: Native Plants od Cultural Significance
Presenter: Margaret Smither-Kopperl **Location:** Lockeford PMC

Presentations for CAPMC

Listing

Date presented: 11/9/2013

Title: Ecological Restoration along Mokelumne River

Presenter: Margaret Smither-Kopperl **Location:** Lockeford Plant Materials Center

---

Date presented: 11/13/2013

Title: Tribal Fall Gathering and Propagation Workshop

Presenter: Margaret Smither-Kopperl, **Location:** Lockeford PMC

Date presented: 11/15/2013

Title: Lockeford Plant Materials Center: Providing materials for urban and rural restoration.

Presenter: Margaret Smither-Kopperl **Location:** Napa, CA

Date presented: 11/19/2013

Title: Working at the PMC, careers and conservation.

Presenter: PMC Staff **Location:** Lockeford PMC
