

Winterkill Cover Crop Demonstration, CAPMC

Valerie Bullard, PMC Agronomist, NRCS Lockeford Plant Materials Center, CA

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Objective: To conduct a preliminary evaluation of summer cover crops for winterkill potential in California’s Central Valley.

County: San Joaquin

Average Annual Precipitation: 17.24 inches

MLRA: 17

Practice: 340-Cover crop

Dominant Soil Type: Columbia fine sandy loam

Slope: 0-2%

Aspect: N/A

Elevation: 66 feet

Site/Seedbed Preparation: The area was disked and cultipacked prior to planting.

Seeding Dates: 8/17/16; 8/26/16; 9/13/16; 9/29/16; 10/12/16.

Seeding Rate: See Table 1

Seed Cost: N/A

Seeding Method: Great Plains No-Till Drill Cone Seeder

Acres Seeded or Plot Design: Non-replicated demonstration with 5x22 foot plots.

Previous Site History: Not seeded or worked the previous year.

Fertilizer: Potassium nitrate

Irrigation: Overhead sprinkler

Monitoring Date: Aug-Nov 2016



Figure 1. Winterkill cover crop demo with buckwheat in foreground taken on 9/21/16.

Table 1. Seeded Species and Rates.

Scientific Name	Common Name	Cultivar	Recommended lb/ac	Target Seeding Rate (lb/ac)	PLS	Seed Rate PLS lb/ac	Seeds/ft ²
<i>Sorghum bicolor x S.</i>	Sudangrass	Piper	30-50	40	86	47	58
<i>Vigna unguiculata</i>	Cowpea	California Blackeye	30-90	80	74	108	28
<i>Fagopyrum</i>	Buckwheat		50-60	55	95	58	30
<i>Panicum miliaceum</i>	Proso Millet	White	30-40	35	88	40	79
<i>Crotalaria juncea</i>	Sunn Hemp	Tropic Sun	30-50	40	94	43	14

*Legumes were inoculated prior to planting.

Introduction:

A significant limitation to the adoption of cover crops in California’s Central Valley is the concern for delayed planting of high-value row and vegetable crops. Cash crops, such as tomatoes, are planted as early as January or February in some areas of California. If not irrigated, cool season cover crops may not emerge until December or January if an early rainfall does not occur, and then would not mature until late in the spring. If terminated early in their lifecycle, these cool season cover crops can result in less than optimum biomass production. When rainfall is sufficient, high biomass production from cover crops may also pose a problem when planting the subsequent cash crop. Seeding a warm season cover crop directly after harvest could provide a potential alternative for

these cropping systems. This would provide the benefits of a winter cover crop, including soil cover and increased infiltration and water holding capacity, while not delaying planting of the cash crop. The purpose of this demonstration was to conduct a preliminary evaluation of summer cover crops for winterkill potential in California's Central Valley. We wanted to see if these warm season cover crops will die naturally during the winter due to frost or cold temperatures without requiring termination costs (herbicide, rolling or mowing). Summer cover crops that winterkill are compatible with early entry for the growers to plant their cash crops, provided the cover crop residue degrades sufficiently before planting.

The 2016/17 demonstration was drilled into Field 6 at the Lockeford PMC with a Great Plains Cone Seeder. This field was not seeded or worked during the previous year. Over the summer, mechanical and chemical methods were used to control weeds. Soil samples were collected in spring of 2016 and fertilizer was added based on nutrient deficiencies. The field was disked and cultipacked prior to planting. Seeding rates vary depending on species (Table 1). Plots were approximately 22 feet long x 5 foot wide with 9 rows at 7 inch spacing. Blocks were planted on five planting dates in order to look at optimum seeding timing for each species: 8/17/16 (Block 1), 8/26/16 (Block 2), 9/13/16 (Block 3), 9/29/16 (Block 4), and 10/12/16 (Block 5) (Table 2). Irrigation was applied by sprinkler prior to planting and after seeding for each plot.

Results:

Plots were monitored and photos were collected every week from time of first planting to five days after the first frost. All species emerged within 5 to 7 days after planting from mid-August to mid-September. Emergence was delayed by 8 to 14 days after planting from late September to mid-October due to shorter days, and cooler air and soil temperatures.

Visual assessments of the cover crop were conducted at 50% bloom, which is the recommended termination stage of a cover crop. This stage is important because biomass and nitrogen fixation are maximized at 50% bloom. In Blocks 1 and 2, all species reached 50% bloom before they were winterkilled. Buckwheat reached 50% bloom 30 days after planting, millet reached 50% bloom 33 to 48 days after planting, and sudangrass, cowpea, and sunn hemp reached 50% bloom 65 to 69 days after planting. The later into the season the planting date, the more days were required to reach this phenological stage.

The first frost at the PMC was on the night of November 17 and morning of the 18th, when the temperature dropped below 32 °F. Severe damage was seen on all cowpea, buckwheat and sunn hemp plots, where the whole plant was wilted (Figure 2). Moderate damage was seen on millet and sudangrass plots, where outer leaves were burned (Figure 2). The millet and sudangrass died several days later. Growth stages five days prior to winterkill varied widely between plots and species (Table 2).

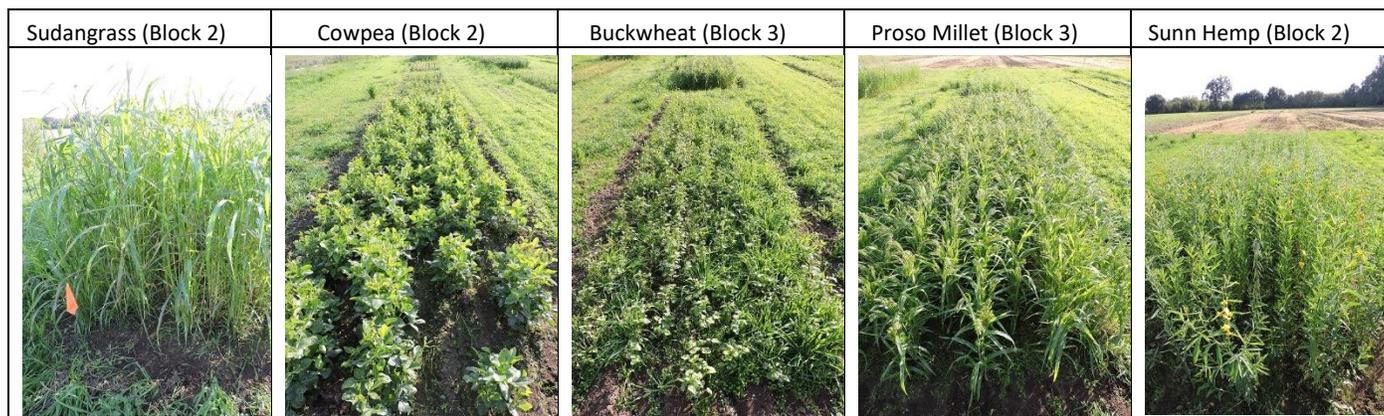
Summary and Discussion:

The planting dates of Blocks 2 and 3 (8/26/16 and 9/13/16) performed the best in terms of optimal biomass production and weed suppression, before they were winterkilled by frost. The cover crops in these blocks came up quickly and covered the ground, outcompeting most of the weeds and providing

some cover crop benefits in the form of green manure and/or nitrogen fixation. Most of the cover crops species planted in Block 1 reached full bloom, surpassing the optimal termination date and potentially causing residue and reseeding issues. The species in Blocks 4 and 5 did not outcompete the weeds and were not large enough to provide much biomass production or nitrogen fixation. Select species, such as buckwheat and proso millet, may have a better fit in a shorter cover crop window of less than 45 days, due to concerns with reseeding potential. More demonstrations on warm season cover crops need to be conducted at the Lockeford PMC in order to find the best-adapted cultivars and species for California’s Central Valley conditions.

Table 2. Warm Season Cover Crop Species Growth Stage and Block Information 11/10/2016 prior to first frost.

Growth Stage at Winterkill					
	Block 1	Block 2	Block 3	Block 4	Block 5
Planted	8/17/2016	8/26/2016	9/13/2016	9/29/2016	10/12/2016
DAP	85	76	58	42	29
Sudangrass	Boot → 50% Bloom	Boot Stage	Growing Point Differentiation	5th Leaf Stage	3rd Leaf Stage
Cowpea	Full bloom	Early Bloom	4 Unrolled Trifoliolate Leaves (V4)	2 Unrolled Trifoliolate Leaves (V2)	Vegetative Cotyledon (VC)
Buckwheat	Peak Flowering	Peak Flowering	Early Flowering	Flower buds visible → Early Flowering	Second Pair of True Leaves → Flower Buds Visible
Proso Millet	Flowering	Flowering	Boot → Flowering	5th Leaf Stage	3rd Leaf Stage
Sunn Hemp	Full Bloom	Early Bloom	Mid-Vegetative	Early Vegetative	Early Vegetative



Photos taken eight days prior to frost on 11/10/16



Photos taken five days after frost on 11/23/16.

Figure 2. Warm season cover crop species in Blocks 2 and 3 before and after winterkill date at the Lockeford Plant Materials Center.