University of California Agriculture and Natural Resources
Cooperative Extension
UC Davis Department of Agricultural and Resource Economics

ESTIMATED COSTS FOR A WINTER COVER CROP IN AN ANNUAL CROP ROTATION

Lower Sacramento Valley
2022

Prepared By

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ESTIMATED COSTS AND POTENTIAL BENEFITS FOR A WINTER COVER CROP IN AN ANNUAL CROP ROTATION

Lower Sacramento Valley - 2022

CONTENTS

INTRODUCTION AND GENERAL DESCRIPTION

This cost study models the planting and management of a winter cover crop in a summer crop rotation planted in the lower Sacramento Valley of California. The rotation may include processing tomatoes, corn, sunflower, safflower, sorghum, and/or dry beans, as well as other summer annual crops. This study models a field following harvest of processing tomatoes in the fall and a planned rotation into a spring planted field crop.

The most commonly grown cover crop species are selected from three plant families: Leguminosae (such as bell beans, peas, clover, and vetch), Brassicaceae (such as mustard, turnip, and radish), and Poaceae (such as barley, oats, wheat, rye, and triticale). A mix of vetch, peas, and rye were used for this cost study.

Cover crops are plant species selected and grown for their protective and beneficial contributions to soil quality and function. They are not intended or managed as a cash crop and provide an alternative to fallowing. No consideration of an economic return is included in this cost study. A wide diversity of cover crop species and mixes are available for a variety of soil and crop health benefits. This cost study models the planting and management of a cover crop during the winter fallow period in an annual rotation on a per acre basis.

Compared to a fallow field, cover crops improve soil health. In the short term, the potential benefits of a cover crop are to minimize top soil loss from erosion, suppress weed growth, improve water penetration and infiltration, slow surface water runoff, add diversity to crop rotations, increase soil nitrogen, and provide food for pollinators, beneficial insects and soil fauna. After several years of repeated cover cropping increased soil organic matter, increased water holding capacity, and improved soil structure can be expected.

In annual crop rotations in the lower Sacramento Valley, cover crops are commonly planted from October to December, grown during winter with soil moisture provided by rainfall and sometimes irrigation, and terminated and incorporated into the soil from late February through April.

For an explanation of calculations used in the study, refer to the section titled Assumptions. For more information contact the Department of Agricultural and Resource Economics, at 530-752-4651, destewart@ucdavis.edu. The local UC Cooperative Extension office contacts are Sarah Light, selight@ucanr.edu and Margaret Lloyd, mglloyd@ucanr.edu.

Sample Cost of Production studies for many commodities are available and can be downloaded from the website, coststudies.ucdavis.edu. Archived studies are also available on the website.

Costs and Returns Study Program/Acknowledgements. A cost and returns study is a compilation of specific crop data collected from meetings with professionals working in production agriculture from the area the study is based. The authors thank the farmer cooperators, UC Cooperative Extension, and other industry representatives who provided information, assistance, and expert advice. **The use of trade names and farming practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices**. *The University is an affirmative action/equal opportunity employer.*

ASSUMPTIONS

The following is a description of general assumptions pertaining to the cover crop practice in this study.

Overview. Estimated costs for the planting and management of the cover crop in this study are presented in the tables. More detailed information for the representative cost is included in Table 1 (establishment and cultural operations), Table 2 (materials), and Table 3 (operations with equipment and materials). In-kind contributions from federal and other local assistance programs may be available to offset direct expenses assumed by the farmers and ranchers adopting this conservation practice (but were not included in this study). Land ownership and rental rates are specific to each operation (and based on land rental in this study, but not assigned to the cover crop). Cost for labor, materials, and custom or contract services are based on current figures.

Production Operations
Soil Preparation, Planting, Management, and Termination

Soil Preparation. After tomato harvest, land is prepared by discing and rolling the field twice, ripping the furrows, and landplaning the field. The cover crop is seeded into dry soil using a grain drill. Some growers apply compost in the fall prior to cover crop planting or in the spring before the soil preparation operations.

Planting. A mix of 30% bell bean, 30% field pea, 20% vetch, and 20% oats by weight is sown at 75 lb./acre in the fall. Rhizobium inoculum for legume seed is mixed with the seed at planting at 1 lb./100 lb. of seed.

Irrigation. Cover crops can be seeded into dry soil following land preparation in the fall with germination initiated by a rain event. Cover crop germination and growth are dependent on rainfall as the cover crop is typically not irrigated. However, variation in annual winter rainfall amount and timing is increasingly common. Irrigation of the cover crop is included every third year as two irrigations at six acre-inches each (12" total). The irrigation is charged at four acre inches per year, one-third of the three year total. Water and labor costs are detailed for a sprinkler irrigation system.

Integrated Pest Management (IPM). Discing weeds along field edges is completed one time in winter months. Cover crops are generally grown without pest control.

Termination. The cover crop is terminated early to late spring, depending on winter rainfall, soil moisture, and planting schedule of the following cash crop. The cover crop is flail mowed once, then disced twice to incorporate the cover crop residue into the soil. The soil is then left undisturbed for a short period of time, typically a minimum of two weeks, allowing the cover crop residue to decompose prior to corn planting.

Then the soil is prepared for planting for the subsequent cash crop. Associated costs are located on Tables 1, 2, and 4.

Potential Benefits and Drawbacks of Production

Farmers, ranchers, and landowners should evaluate a cover crop for potential benefits and drawbacks with respect to their own operation.

Benefits. Cover cropping can provide diverse benefits. Cover crops help keep ground productive in the long term by physically protecting the soil from erosion and building soil tilth and fertility. Above and below ground, cover crop biomass builds soil organic matter, which can improve nutrient cycling and retention, water holding capacity, water penetration and infiltration. Both cover crop residue and roots provide essential sources of food for soil macrofauna and microbial life. Soil microbial communities contribute toward disease suppression and nutrient cycling, especially nitrogen. Soil organisms are also essential for building and maintaining soil structure including aggregate stability and soil porosity. Improved soil structure in the form of better soil water holding capacity may reduce irrigation applications in future years.

Cover crops can increase soil workability, reducing labor and fuel costs for field work. Planted in rotation or in otherwise fallow fields, cover crops can suppress winter weeds. Cover crop weed suppression benefits may reduce the need for winter herbicide sprays saving up to $65 per acre including materials, fuel, and labor. Cover crops can capture residual soil nitrogen to reduce nutrient runoff and leaching. This may ultimately contribute to the maintenance and protection of downstream water quality while simultaneously contributing nitrogen to the soil through cover crop biomass. When cover crops such as legumes or "green manures" are managed for the contribution to soil nitrogen, growers may be able to reduce applied nitrogen fertilizer rates. Nitrogen savings will vary depending on needs of the cash crop planted and field history. In this study we estimate that 100 pounds of nitrogen are fixed per acre by the cover crop, and that 30 percent of this nitrogen mineralizes and becomes available to the following crop in the first season. Thus, 30 Lbs. per acre of nitrogen are attributed as a return from the cover crop.

Drawbacks. Historically, most winter cover crops are exclusively rainfed. However, rainfall varies and results in varied success in cover crop establishment and biomass production. This can affect competitiveness of the cover crop with weeds and amount of nitrogen contributions to the soil, among other aspects. In addition, cover crops can modify spring soil moisture dynamics depending on the amount and timing of precipitation. These dynamics can influence when to terminate the cover crop and whether to pre-irrigate the subsequent crop, among other management decisions.

The timing of cover crop termination is a key management consideration. Dry winters or late winter rains may affect optimal timing of cover crop termination, which can interfere with cash crop planting and available soil moisture. It is important to consider the amount of time needed between cover crop termination and cash crop planting to ensure sufficient decomposition of the cover crop. While the duration varies, growers report waiting between 10-30 days after cover crop termination to plant the following cash crop with the most common waiting period being 14 days.

Resources focused on cover crops can be found on the Western Cover Crop Council website at https://westerncovercrops.org/resources/. UC Agricultural and Natural Resources (UC ANR) publications catalog website at https://ucanr.edu/ and on the UC Sustainable Agriculture Research and Education Program (UC SAREP) at https://sarep.ucdavis.edu/ have resources under cover crops, as does the United States Department of Agriculture (USDA) Sustainable Agriculture Network website at https://www.sare.org/resources/cover-crops/. ANR publication catalogs and other resource materials are also available at your local UC Cooperative Extension office. You may also call or visit your local USDA Natural Resource Conservation Service (USDA NRCS) or Resource Conservation District office. California specific varietal information can be found at the USDA NRCS Plant Materials Center site at https://www.nrcs.usda.gov/wps/portal/nrcs/main/plantmaterials/pmc/west/capmc/. This resource from the

Pacific Northwest estimates nitrogen contribution from cover crops: catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw636.pdf.

Labor and Equipment

Labor. Hourly wages for workers are $18.00 per hour for machine operators and $15.00 per hour for non-machine labor. Adding 47 percent for the employer's share of federal and state payroll taxes, insurance, and other possible benefits increases the labor rates shown at $26.46 per hour for machine labor and $22.05 for non-machine labor. Overhead includes the employer's share of federal and California state payroll taxes, workers' compensation insurance for field crops and a percentage for other possible benefits. Workers' compensation insurance costs will vary among growers. The cost is based on the average industry rate as of September 2022. Labor for operations involving machinery are 20 percent higher than the operation time to account for the extra labor involved in equipment set up, moving, maintenance, worker breaks, and field repair.

Farm Management Costs. Although farm manager time is used for the cover crop, farm management wages and/or costs are assumed to be associated with cash crop production and are not included in this study. Overhead costs are also not included.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life, and repair coefficients formulated by the American Society of Agricultural and Biological Engineers (ASABE). Fuel and lubrication costs are also determined by ASABE equations based on maximum power takeoff (PTO) horsepower and fuel type. Average prices for on-farm delivery of gasoline and red-dyed diesel, based on September 2022 data from the Energy Information Administration, are $4.10 and $5.00 per gallon, respectively. The cost includes a 13.0 percent sales tax and $0.36/gal excise tax on diesel fuel, and a 10.17 percent sales tax and $0.42/gal excise tax on gasoline. It is noted that federal and state excise taxes are refundable for on-farm use when filing the farm income tax return.

The fuel, lube, and repair cost per acre for each operation are determined by multiplying the total hourly operating cost for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10 percent higher than implement time for a given operation to account for hookup, and travel between fields.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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UC COOPERATIVE EXTENSION
AGRICULTURAL AND RESOURCE ECONOMICS, UC DAVIS
TABLE 1. ESTABLISHMENT AND CULTURAL OPERATING COSTS PER ACRE TO PRODUCE COVER CROPS
Lower Sacramento Valley - 2022

Operation	Equipment Time (Hrs./Ac)	Cash and Labor Costs per Acre: Labor Cost	Fuel	Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
*Pre-Plant:								
Rip Furrows	0.00	0	0	0	0	0	0	
Disc & Roll 2x	0.00	0	0	0	0	0	0	
Landplane 2x	0.00	0	0	0	0	0	0	
TOTAL PRE-PLANT COSTS								
Plant:								
Plant Cover Crop (Seed Mix)	0.18	6	8	4	50	0	69	
TOTAL PLANT COSTS	0.18	6	8	4	50	0	69	
Cultural:								
Irrigate 2x (1/3Yrs.)	0.00	22	0	0	22	0	44	
Mow Cover Crop	0.20	6	9	5	0	0	21	
Disc Cover Crop 2x	0.23	7	11	4	0	0	22	
*List/Shape Beds	0.00	0	0	0	0	0	0	
TOTAL CULTURAL COSTS		35	20	9	22	0	87	
TOTAL OPERATING COSTS/ACRE	0.61	42	29	13	72	0	156	

*These operating costs are included in model management operations though the costs are not attributed to the cover crop.

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TABLE 2. MATERIAL COSTS PER ACRE TO PRODUCE COVER CROPS
Lower Sacramento Valley - 2022

	Quantity/ Acre	Unit	*Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Fertilizer (Lbs. of N)	30	Lbs.	1.20	36	
TOTAL GROSS RETURNS				36	
OPERATING COSTS					
Seed:				**50**	
Cover Crop Seed (mix)	75.00	Lbs.	0.56	42	
Inoculum	0.75	Lbs.	11.25	8	
Irrigation:				**22**	
Water (Sprinklers)	4.00	AcIn	5.42	22	
Labor				**42**	
Equipment Operator Labor	0.74	Hrs.	26.46	20	
Irrigation Labor	1.00	Hrs.	22.05	22	
Machinery				**42**	
Fuel-Gas	0.00	Gal	4.10	0	
Fuel-Diesel	5.71	Gal	5.00	29	
Lube				4	
Machinery Repair				9	
TOTAL OPERATING COSTS/ACRE				156	

*Price is based on current cost per pound of nitrogen.

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TABLE 3. OPERATIONS WITH EQUIPMENT & MATERIALS
Lower Sacramento Valley – 2022

Operation	Operation Month	Tractor	Implement	Labor Type/ Material	Rate/ acre	Unit
*Rip Furrows	Oct					
*Disc & Roll 2x	Oct					
*Landplane 2x	Oct					
Plant Cover Crop	Oct	157 HP4WD Tractor	Grain Drill 15'	Equipment Operator Labor	0.22	hour
				Cover Crop Seed (mix)	75.00	Lbs.
				Inoculum	0.75	Lbs.
Irrigate 2x (1/3Yrs.)	Dec			Irrigation Labor	0.50	hour
				Water	2.00	AcIn
	Feb			Irrigation Labor	0.50	hour
				Water	2.00	AcIn
Mow Cover Crop	Mar	157 HP4WD Tractor	Flail Mower 15'	Equipment Operator Labor	0.24	hour
Disc Cover Crop 2x	Mar	157 HP4WD Tractor	Disc-Residue 15' Ring Roller 15'	Equipment Operator Labor	0.28	hour
*List/Shape Beds	Mar					

*These operating costs are included in model management operations though the costs are not attributed to the cover crop.

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TABLE 4. MONTHLY COSTS PER ACRE TO ESTABLISH AND PRODUCE COVER CROPS
Lower Sacramento Valley – 2022

Operations	OCT	NOV	DEC	JAN	FEB	MAR	Total
*Pre-Plant:							
Rip Furrows							0
Disc & Roll 2x							0
Landplane 2x							0
TOTAL PRE-PLANT COSTS							0
Plant:							
Plant Cover Crop (Seed Mix)	69						69
TOTAL PLANT COSTS	69						69
Cultural:							
Irrigate 2x (1/3Yrs.)			22		22		44
Mow Cover Crop						21	21
Disc Cover Crop 2x						22	22
*List/Shape Beds							0
TOTAL CULTURAL COSTS	0		22		22	43	87
TOTAL OPERATING COSTS	69	0	22	0	22	43	156

*These operating costs are included in model management operations though the costs are not attributed to the cover crop.

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TABLE 5. HOURLY EQUIPMENT COSTS
Lower Sacramento Valley – 2022

Description	Cover Crop Hours Used	Capital Recovery	Cash Overhead		Operating			Total Costs/Hr
			Insurance	Taxes	Lube & Repairs	Fuel	Total Operating	
Disc-Residue 15'	12	0.02	0.00	0.00	0.01	0.00	0.01	0.02
Grain Drill 15'	9	13.28	0.06	0.67	7.74	0.00	7.74	21.75
Flail Mower 15'	10	8.79	0.04	0.44	10.47	0.00	10.47	19.74
Ring Roller 15'	12	9.67	0.04	0.49	3.14	0.00	3.14	13.34
157 HP4WD Tractor	34	14.30	0.08	0.96	13.48	42.08	55.56	70.90