Sacramento Valley Vegetable Crops Newsletter
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University of California
Agriculture and Natural Resources | Cooperative Extension

In This Issue

Submitted by:

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Winter Cover Crop Performance in the Sacramento Valley

Amber Vinchesi-Vahl and Sarah Light

University of California
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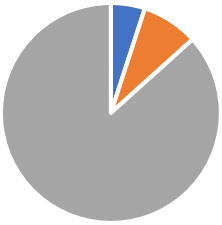
Winter cover crop species were planted into dry soil (4 rows/60" bed) on 10/24/2019 in Meridian, CA and irrigated by rainfall. On 3/17/2020, the following data were collected from each plot: cover crop height at 3 points in the plot; percent cover (proportion of cover crops, weeds, and bare soil) in three 20x20 cm quadrats; and biomass in three 20x20 cm quadrats. Biomass in the sampling area (including cover crop and weeds) was analyzed for total carbon (C) and nitrogen (N). All data are calculated on a per acre basis.

Percent Cover Key (averages of three quadrats): Gray=Cover Crop. Orange=Weeds. Blue=Bare Soil

Grasses: Merced Ryegrain

Pounds C: 4,715
Pounds N: 162



Average Height: 48 in

Grasses: OK Ryegrain

Pounds C: 2,411
Pounds N: 143

Average Height: 27 in

Grasses: UC 937 Barley

Pounds C: 2,407
Pounds N: 114

Average Height: 25 in

Grasses: 2700 Triticale

Pounds C: 2,970
Pounds N: 178

Average Height: 19 in

All seed was donated by Kamprath Seed. Thank you to Tom Johnson and Kamprath Seed for supporting this work.*

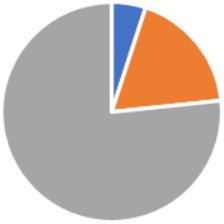
Grasses: Trios Triticale

Pounds C: 880
Pounds N: 61

Average Height: 16 in

Grasses: Cayuse Oats

Pounds C: 2,189
Pounds N: 90



Average Height: 22 in

Legumes: Hairy Vetch

Pounds C: 2,025
Pounds N: 183

Average Height: 13 in

Legumes: Common Vetch

Pounds C: 1635
Pounds N: 126

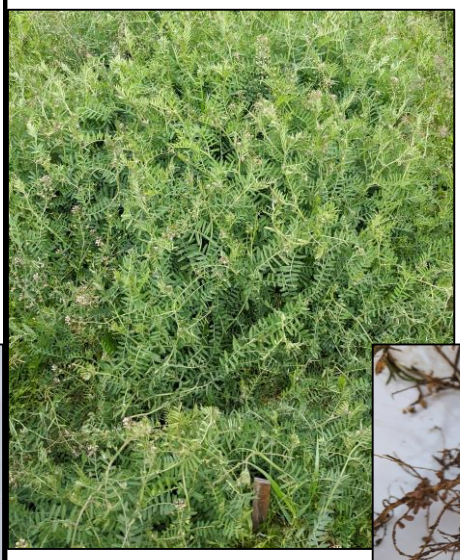
Average Height: 15 in

Legumes: Purple Vetch

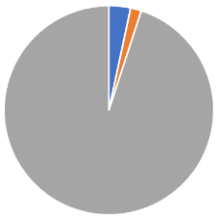
Pounds C: 1,161
Pounds N: 100

Average Height: 13 in

Legumes: Woollypod Vetch



Pounds C: 1,823
Pounds N: 168



Average Height: 19 in

Percent Cover Key (averages of three quadrats): Gray=Cover Crop. Orange=Weeds. Blue=Bare Soil

Legumes: Lentils

Pounds C: 858
Pounds N: 67

Average Height: 8 in

Legumes: Faba Beans

Pounds C: 2,225
Pounds N: 169

Average Height: 20 in

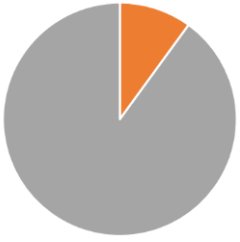
Legumes (peas): Weaver Winter Pea 290

Pounds C: 1,057
Pounds N: 91

Average Height: 14 in

Legumes (peas): Austrian Winter Pea

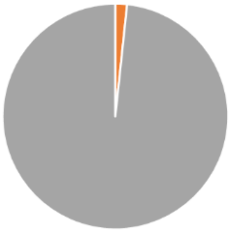
Pounds C: 1,001
Pounds N: 102



Average Height: 16 in

Legumes (peas): Arvika Peas

Pounds C: 3,282
Pounds N: 224



Average Height: 26 in

Legumes (peas): Yellow Peas

Pounds C: 963
Pounds N: 61

Average Height: 22 in

Percent Cover Key (averages of three quadrats): Gray=Cover Crop. Orange=Weeds. Blue=Bare Soil

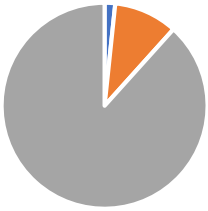
Legumes (peas): Biomaster Peas

Pounds C: 2,652
Pounds N: 205

Average Height: 25 in

Legumes (peas): 4010 Peas

Pounds C: 2,126
Pounds N: 165



Average Height: 32 in

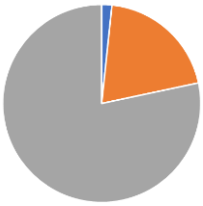
Brassicas: Yellow Mustard

Pounds C: 3,301
Pounds N: 168

Average Height: 51 in

Brassicas: Bracco Mustard

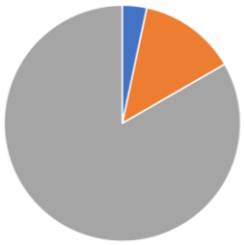
Pounds C: 5,035
Pounds N: 249



Average Height: 51 in

Brassicas: Brown Mustard

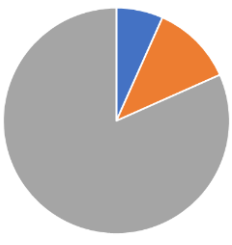
Pounds C: 4,923
Pounds N: 359



Average Height: 42 in

Brassicas: Nemafix Black Mustard

Pounds C: 3,008
Pounds N: 167

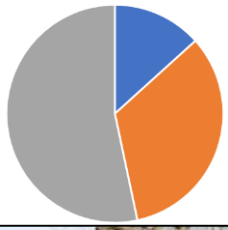


Average Height: 43 in

Percent Cover Key (averages of three quadrats): Gray=Cover Crop. Orange=Weeds. Blue=Bare Soil

Brassicas: Canola

Pounds C: 2,267
Pounds N: 95



Average Height: 37 in

Brassicas: Daikon Radish

Pounds C: 3,969
Pounds N: 186

Average Height: 37 in

Percent Cover Key (averages of three quadrats): Gray=Cover Crop. Orange=Weeds. Blue=Bare Soil

All seed was donated by Kamprath Seed. Thank you to Tom Johnson and Kamprath Seed for supporting this work.

Healthy Soils Demonstration Project Results: Winter Cover Crops in Annual Rotations

Amber Vinchesi-Vahl and Sarah Light, UCCE Farm Advisors

University of California
Agriculture and Natural Resources | Cooperative Extension

Project Summary: Replicated plots of purple vetch were planted at two rates in December 2018 (70 lb seed/A (T1) and 140 lb seed/A (T2)) and November 2019 (35 lb seed/A (T1) and 70 lb seed/A (T2)) alongside a fallow control. The field was coming out of wheat and then planted to tomato in 2019 and rice in 2020. Cover crop termination began on 4/12/19 and 3/20/20. Soil samples were collected annually and greenhouse gas samples were collected throughout project duration around field and irrigation events (see Veronica Suarez Romero handout).

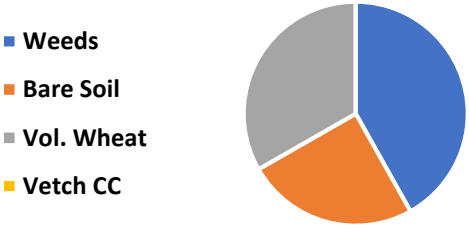
Challenges: The cover crop was planted at twice the intended rate in 2019, due to an error with the planter. The first-time equipment is used to plant a cover crop, consider calibrating and doing a test run to accommodate cover crop seed size. The ground was worked heavily in fall 2018 and needed moisture to protect the integrity of the beds so that beds would not collapse when the cover crop was drill seeded. However, once it began raining, the rain continued heavily for weeks. Thus, planting was delayed to the end of December 2018. Some growers plant cover crops before there is rain forecasted and let seeds to sit in the ground to germinate after first rainfall. Minimizing tillage, when possible, will maintain soil structure and may allow for more flexibility in fall cover crop planting. In addition, the very heavy winter and spring rains meant termination was delayed by 3 weeks (originally scheduled for mid-March 2019).

For all results, values denoted by different letters indicate significant differences between treatments.

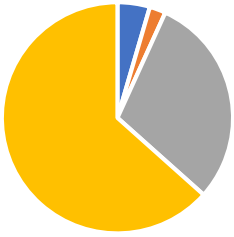
Percent Cover 2019 (data collected March 18th) : Five 1-m^2 areas of each plot were randomly evaluated for total weeds, bare soil, volunteer wheat (in 2019), and vetch. Both rates of the vetch cover crop had significantly lower weed cover and bare soil compared to the fallow control. There were no significant differences in wheat cover between treatments in 2019. Maintaining soil coverage throughout the year is an important practice for improving soil health.

2019 Average % Cover			
	Fallow Control	Low (T1)	High (T2)
Weeds	42 a	5 b	3 b
Wheat	33 a	30 a	22 a
Vetch	0 b	63 a	73 a
Bare Soil	25 a	2 b	2 b

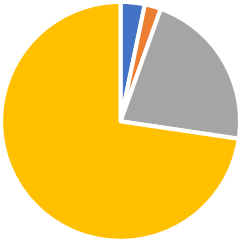
Control (volunteer wheat + weeds)



T1 (vetch low rate)



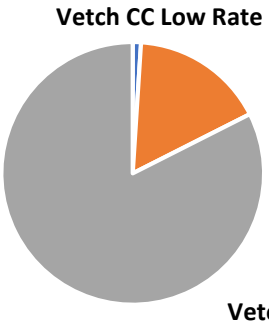
T2 (vetch high rate)



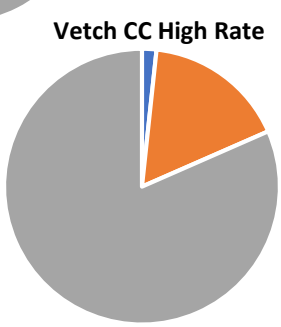
The 2017 Healthy Soils Demonstration Project is funded by Greenhouse Gas Reduction Funds and is part of California Climate Investments, a statewide program that puts billions of Cap-and-Trade dollars to work reducing GHG emissions, strengthening the economy, and improving public health and the environment.

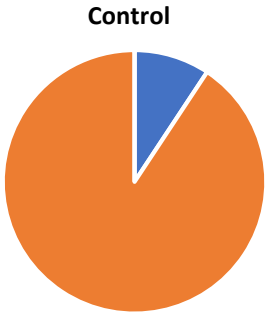
California Climate Investments — Cap and Trade Dollars at Work

Percent Cover 2020 (data collected March 16th):



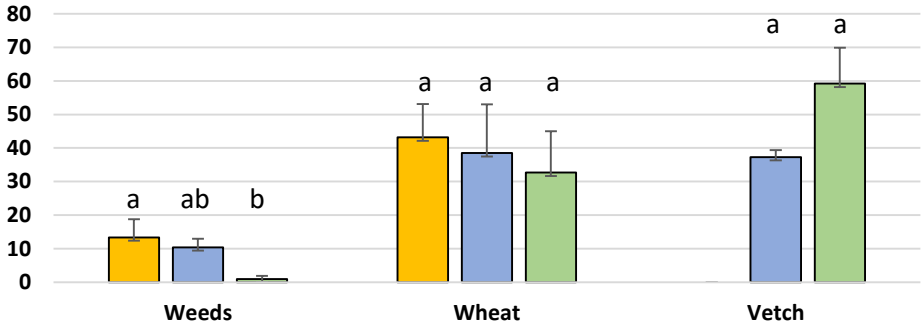
2020 Average % Cover	Fallow Control	Low (T1)	High (T2)
Weeds	91 a	16 b	9 b
Vetch	0 b	81 a	82 a
Bare Soil	9 a	1 b	2 b



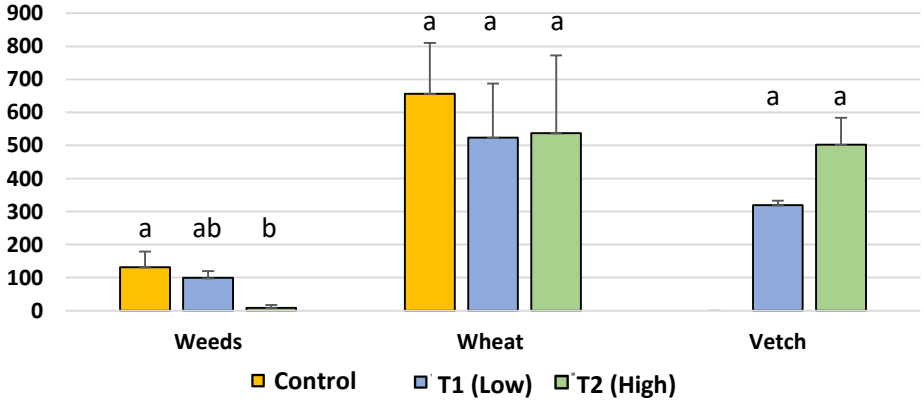


Biomass Samples 2019: Three 1 m^2 areas were randomly removed from each plot on 3/18/19, dried, and sent to the lab for analysis. One sample from each plot was separated into weeds, wheat, and vetch and those samples were run separately. Wet soil conditions delayed cover crop termination, and on 4/16/19 biomass samples were collected again from a portion of the field that remained. The field was planted in the T1 (low) rate. Vetch contributed more C and N at the higher planting rate.

Total lbs/A of Nitrogen from Biomass samples separated by Weeds, Wheat and Vetch

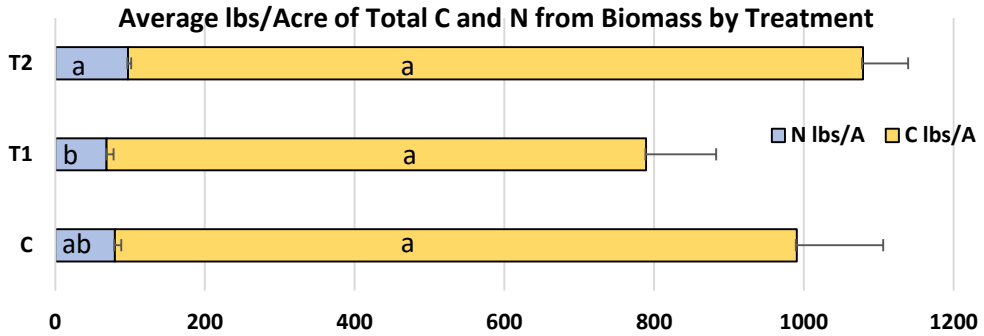


Total lbs/A of Carbon from Biomass samples separated by Weeds, Wheat and Vetch

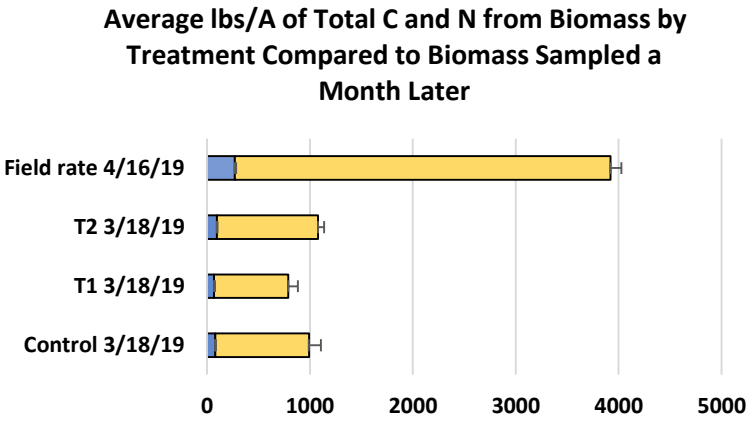


<u>Biomass Samples 2019</u>: *Where the N and C is coming from*: Although the volunteer wheat and weeds contribute N and C, vetch is higher in %N and contributes more N per lb biomass (the table below provides the breakdown from one plot of each rate as an example). Volunteer wheat was sampled when still green, so N hadn't been moved into the seed. While wheat may mine residual soil N from depth, it won't fix N.

	Type	Dry Wt (lbs)	N (%)	N (lbs/ac)	C (%)	C (lbs/ac)
T1 (Low)	weeds	0.16	2	15	21	133
T1 (Low)	wheat	0.40	4	58	44	706
T1 (Low)	vetch	0.20	5	41	42	336
T2 (High)	weeds	0.00	3	0	40	0
T2 (High)	wheat	0.56	2	56	44	993
T2 (High)	vetch	0.24	4	38	35	340

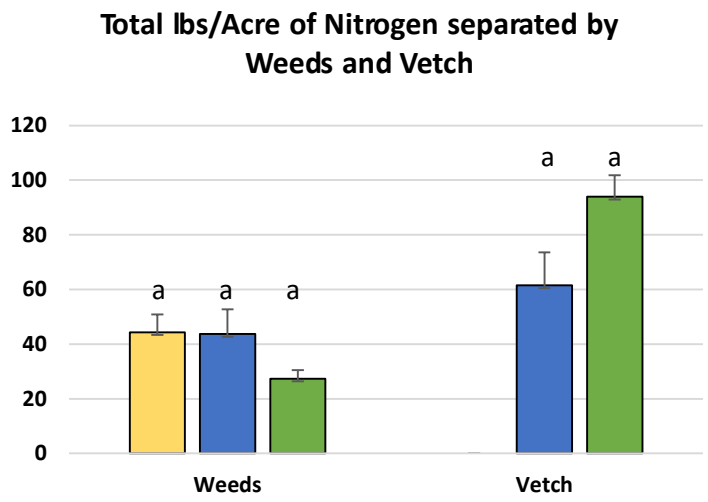


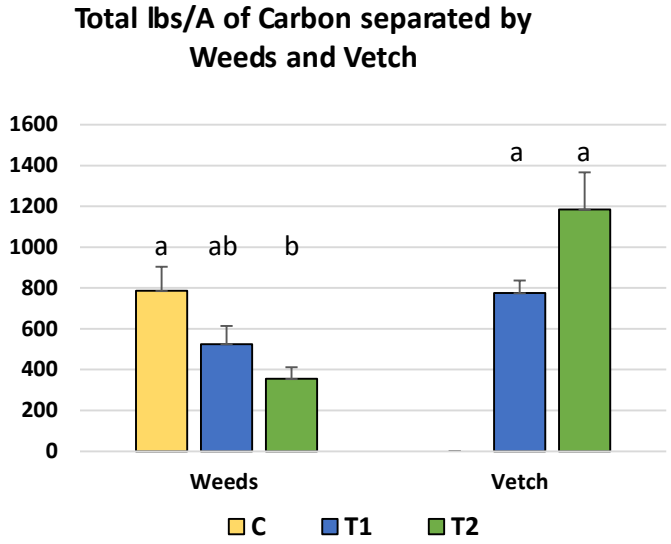
The difference a (warm) month makes: The comparison of the T1 samples collected on 3/18 to the field rate (same planting rate) samples collected on 4/16 indicate that the cover crop total N increased by almost a factor of 4 (69 lb N/A compared to 271 lb N/A) in the last month of growth (Figure to right). Similarly, total C increased by a factor of 5 (from 721 lb C/A to 3651 lb C/A). (photos below). For reference, on 3/18/19, control plots averaged 910 lb C/A and 80 lb N/A and T2 averaged 981 lb C/A and 97 lb N/A.



Difference between vetch cover crop on 3/18/19 (L) and 4/11/19 (R).

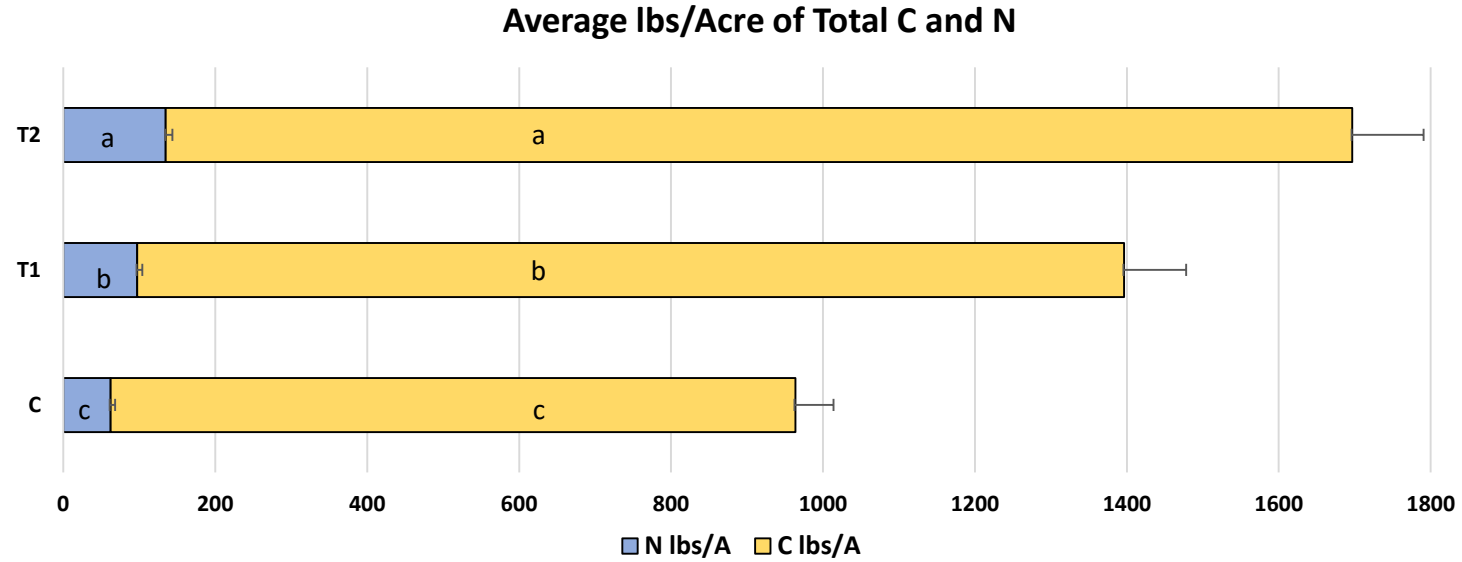
Biomass Samples 2020: Biomass samples were collected and analyzed using the same procedures as 2019, except that no wheat was collected from separated samples, only vetch and weeds. Samples were collected the same week as cover crop termination.



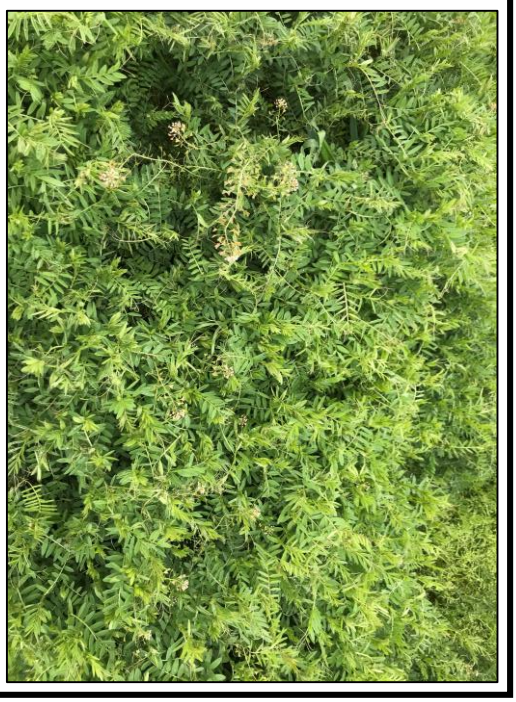


The higher rate of vetch contained more nitrogen in lbs/A (135) than the lower rate of vetch (97) and both treatments were significantly higher than the control plots (62), which only contained weeds. Both treatments also contained more carbon in lbs/A (T1: 1299, T2: 1562) than the control plots (902), though were not significantly different from each other. Again, vetch contributes more N per pound biomass because it is higher in %N (the table below provides the breakdown from one plot of each rate).

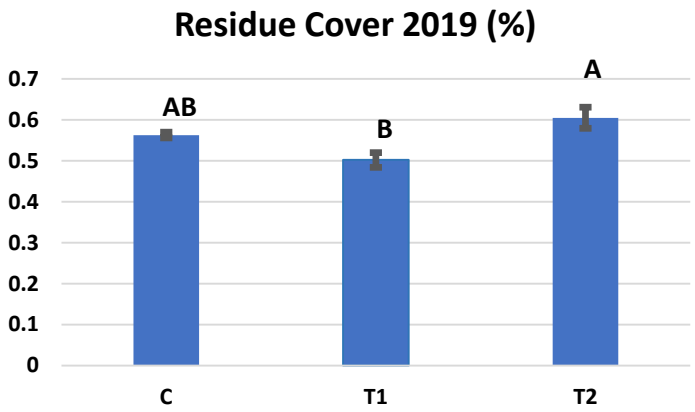
Trmt.	Dry Weight (lbs)	N (%)	N (lbs/A)	C (%)	C (lbs/A)
Control Weeds	0.64	2	54	36	927
T1 (Low) Weeds	0.25	4	29	38	374
T1 (Low) Vetch	0.54	3	86	41	899
T2 (High) Weeds	0.31	2	31	37	456
T2 (High) Vetch	0.85	3	92	37	1256

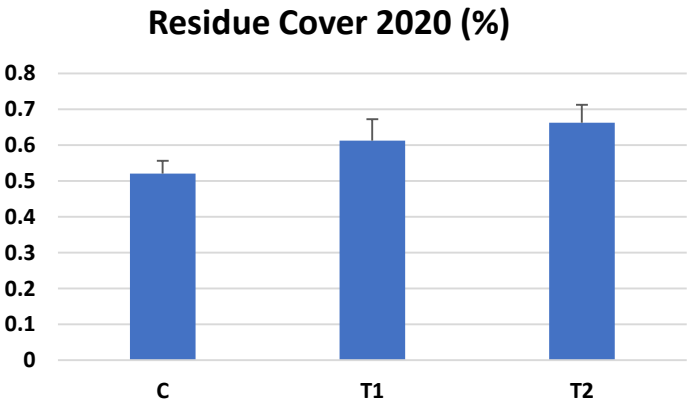


2020 Photos (L-R): Control, T1 (low rate) and T2 (high rate) on 3/16/20. Plot scale above and close-up.

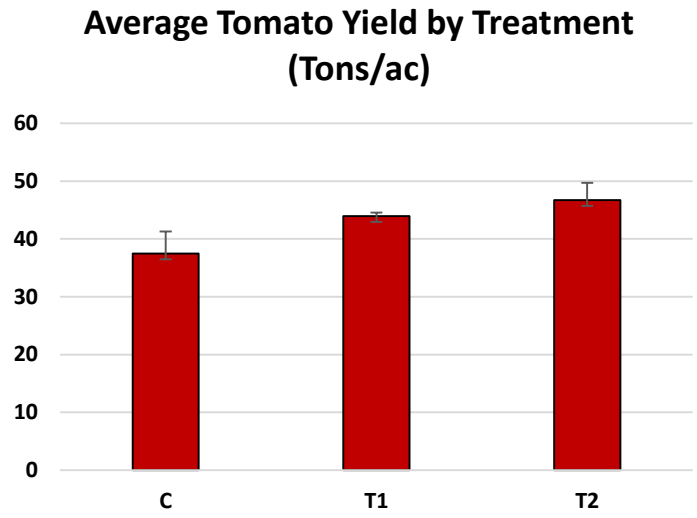


Residue Cover: Residue cover can improve water infiltration and reduce loss of topsoil to erosion, among other things. On 5/16/19 and 3/23/20, tape was placed in a transect of each plot and at 6-inch intervals the absence or presence of residue on the soil surface was counted. Total points with residue were converted to a percent. In 2019, T1 (low) had significantly less residue cover than T2 (high) or Control plots. In 2020, there were no significant differences between treatments.





Yield data 2019: On 8/9/19, 15-foot lengths of tomatoes from a middle bed of each plot were hand harvested, sorted for red, green, and culled fruit, and evaluated for quality (Brix, hue, and pH). There were no statistically significant differences in yield or quality. However, a variety trial was planted in two of the plots, which may have affected the results.



Is a higher seeding rate worth it?

While there was a difference in residue cover between the two seeding rates in year one, the main difference between the two seeding rates was with regard to total nitrogen. Total N with the higher seeding rate was significantly higher both years, while total carbon was only higher in year two. Both treatment rates provided the benefit of out-competing weeds and reducing bare soil. When selecting a seeing rate, growers can make decisions on cost per unit N in cover crop residue with regard to additional seed costs based on the ability to apply other N sources and total budget.

Acknowledgements:

Thank you to Vincent Andreotti and Oryza Partnership, CDFA Healthy Soils Program, Technicians UCCE—Gerry Hernandez, Puja Upadhayay, and Ryan Hall. UC Davis Graduate Students Veronica Suarez Romero and Geoff Koch. Project Co-PIs: Jeff Mitchell, Michelle Leinfelder-Miles, Brenna Aegerter, Scott Stoddard, Gene Miyao, and Will Horwath. Thanks also to all the speakers at our field days!

Equipment to Manage Cover Crops in Annual Rotations

Brian Park, Park Farming Organics
Sarah Light, UCCE Agronomy Advisor, Sutter-Yuba and Colusa Counties

One of the challenges with incorporating cover crops into annual rotations is uncertainty about which equipment can be used to manage them, specifically around cover crop termination. Last year UCCE Farm Advisors Sarah Light and Amber Vinchesi-Vahl hosted an equipment showcase field day specifically for cover crop management. One of the presenters was Brian Park from Park Farming Organics. Brian has been managing cover crops for many years and shared some of his experience with the equipment they use. In this article we share photos and descriptions of some of that equipment for those who weren't able to make it to the field day. In this article, a range of equipment is described, some that are more widely used for row-crop farming operations, and others that are more specialized for biomass and residue management. All photos are courtesy of Brian Park.

Lopez Coulter Sled

This implement is used in the spring under light cover crop conditions (low biomass, not very stringy). The double set of coulter blades cuts material and lightly mixes soil with residue. There is a "lawn mower" style roller on the back, also known as a crumbler. It helps mix cover crop residue in with the soil and levels the bed off for the next cash crop. This implement does not work well under very wet conditions because the coulter blades are at an angle and get plugged up more easily if there is dew in the reside or the soil is wet. Normally driven at 4-6 MPH.

Unverferth Ripper Stripper

This tool covers three 60-inch beds at a time and works the center of the bed (can't be used on drip irrigated fields). It has a single coulter in the front of the chisel point and two coulters on each side, which have adjustable angles so residue can be controlled. On the back end of the implement is a crumbler/squirrel cage that crumbles any large clods that get through the disks. This tool works in most soil conditions, wet or dry, and works well at higher speeds (6-7 MPH). It is an implement that can be used in the fall and spring depending on environmental conditions and the following crop. It is typically used to prep beds prior to cash crop planting on lighter

ground to help loosen up soil prior to planting and to ensure adequate oxygen for the next crop (usually in advance of tomato). This tool can also be useful with managing high amounts of residue in the fall or spring. Shorter shanks are substituted in higher moisture conditions to reduce excessive soil disturbance after winter rains. In the fall, when the soil is drying, a longer shank can be used to rip deeper soil. The Unverferth Ripper Stripper can be used to prep beds for planting a cover crop after a cash crop, or to incorporate cover crop residue. It does not disturb all the soil in the field, but rather the soil in the planting row, so disturbance is minimized.

Yetter Strip Till

This is a vertical tillage tool that can be used to incorporate cover crop residue in the spring during wet years. It is very efficient, and with one pass of this tool after chopping the cover crop, a bed is ready for planting a row crop. While residue will stay in the non-planted part of the beds and in the furrows, this implement provides an efficient way to terminate a cover crop and plant the following crop quickly following a wet winter/spring, when time is of the essence. Then, at a later date, the remaining residue can be managed once conditions dry down. As pictured, it is set up for crops that would be planted in two rows on a 60" bed (corn, beans, etc.) but the vertical tillage gangs are adjustable on the tool bar and can be set at different spacings.

Davis Machine Furrow Mower

This implement is helpful for managing cover crop residue in the furrow that most choppers can't reach. It is a front mount mower that chops biomass and residue in the furrow and does not disturb soil in the beds. This implement cleans up residue in the furrows to prevent plugging of subsequent equipment used for other farming operations. If the soil is wet and beds can't be worked without damaging soil structure, this will clean up furrows without affecting soil in the beds. This implement works well with green succulent covers but not so much with dry covers because the fibrous dry material wraps around the tool and it gets plugged up. Great tool to use when trying to minimize soil disturbance and reduce "plugging" of following passes. It is used in the spring to incorporate cover crops. Depending on how thick the residue is, this implement works most effectively at 3-4 MPH.

Rears Pak Flail Mower

This mower works well to cut cover crop biomass into small (2-3”) pieces in the spring at termination and is the first piece of equipment to be used at termination. This mower speeds up cover crop residue breakdown because the smaller residue size has more surface area that microbes can access for decomposition. When the mower is set to a taller height, the implement can also be used to control weeds during the winter in a cover crop stand by raising the mower above the cover crop canopy. The mower can cut off the inflorescence on weeds before they set viable seeds, reducing future weed pressure. This tool can also be used to effectively chop cash crop biomass following harvest in the fall, before cover crop planting. It is most efficient when the beds are level to ensure all residue can be mowed evenly, reducing the risk that large chucks will remain in the field. Keep knives sharp to keep this mower working most efficiently. Speed depends on the amount of biomass in the field. If heavy, 2-3 MPH, and if light biomass, 4-5 MPH.

Full Bed Lilliston with Bed Knife

This implement has been set up as a Lilliston tool with a bed knife in the front and works three beds at a time. It is a light piece of equipment and won’t work well with very heavy cover crop biomass. However, in the right conditions, it handles cover crop residue well during incorporation in the spring and leaves beds level. Light cover crop stands (non-fibrous materials) can be efficiently terminated at higher speeds (6-7 MPH).

GP Turbo Chisel

The GP Turbo Chisel is an implement with coulter blades in the front, followed by chiselers, and finally a crumbler in the back. It will heavily disturb soil and degrade soil structure, so shouldn't be used unless necessary but is useful for heavy ground, following rice, and when there are issues with compaction. It works well as a tillage tool in both the fall (to prep for planting cover crops) or late spring (to terminate cover crops). It can handle plant matter, loosen up the ground, and mix soil with cover crop residue in one pass. If planting on beds, re-listing is needed after running this equipment. A higher horse-power tractor (300+ HP) is needed to run this implement. It works efficiency at higher speeds (5-7 MPH).

JD 16' foot Disk

This disk has been around for a long time and doesn't have hydraulics. It is more narrow than some other comparable implements (16' wide) but is very dependable and efficient. It doesn't require high horsepower (120 HP) so you can use it with a tractor with narrower tire spacing and not drive on the beds. It has a light frame and terminates cover crops with minimal soil compaction and soil disturbance (it won't flip the soil but will lightly mix residue with soil). This implement works well when incorporating any (heavy or light) cover crop residue in the spring. Can go up to 5.5 MPH.

Horsch Joker Disk

The Horsch Joker Disk is a disc with fixed blades in the front and a roll flex packer in the back. The roll flex packer stabilizes the discs and determines disc height. The higher the packer, the deeper the discs will run in the soil. The lower the setting, the more shallow the cultivation. This tool will efficiently break up cover crop biomass. A furrowing disc can be added to the back of this implement to clean up furrows while terminating the cover crop. It is on a three-point hitch system so it can be easily turned at the edge of the field without driving over beds and transferred from field to field quickly. The joker runs best between 7-10 mph. Thus, this equipment makes for efficient and fast cover crop termination in the spring.

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