

On-Farm Occultation Research Trial Report

July 2020



CAFF
COMMUNITY ALLIANCE
with **FAMILY FARMERS**

Introduction

Community Alliance with Family Farmers (CAFF) is a non-profit organization that provides farmers throughout California with on-the-ground programs and services as well as policy advocacy. CAFF's Climate Smart Farming Program works with growers throughout the state to conduct on-farm research trials on climate smart farming practices and systems. In recent years, conversations with small-scale farmers, including no-till farmers, have informed us that the practice of occultation has been an effective tool for reducing weed pressure. Because there is little on-farm research that's been done on occultation, CAFF collaborated with a group of farmers to better understand the practice. CAFF received a grant from the Western Sustainable Agriculture Research and Education (Western SARE) to conduct on-farm occultation research on five small-scale farms during the 2019 growing season.

What is occultation?

Also referred to as “weeding with tarps,” occultation is a practice used for weed control, particularly in small-scale organic vegetable production. Occultation is practiced in growing areas/fields that are between the harvest of one crop and the planting of another. The growing area is irrigated to encourage weed germination and then covered with a 5–7 millimeter tarp and left for 2 to 8 weeks, depending on the time of year, weather and location. Under the tarp, the weeds germinate in warm, moist conditions and then die due to the lack of light. After the tarp is removed the field is directly seeded or transplanted. Following tarp removal, tillage should not be practiced to avoid stimulating weed seed germination. This process reduces the weeds that would otherwise occur in the following crop. When the tarp is pulled off, the farmer has a moist seed bed that can be planted into with minimal soil disturbance, making it a favorite practice among small-scale farms that practice reduced tillage.



Beds under tarp (left side) & newly uncovered beds that were seeded for the trial (center)

Our Research Questions

CAFF partnered with five Northern California farms to gather data on four questions:

1. What effect does occultation have on the amount of labor needed to manage weeds in a bed?
2. What effect does occultation have on the weed pressure and weed types (broadleaf vs. grass) in a bed?
3. What effect does occultation have on vegetable quality (weight, marketability, etc)?
4. What effect does occultation have on carrot/beet yield (based on root weight)?

Our Partner Farms

Mountain Bounty Farm

Location: near Nevada City, CA
 Acres in cultivation: 18
 Employees: 14
 Markets: 800 member Community Supported Agriculture (CSA) Program, 1 farmers market, local BriarPatch Food Co-op, local restaurants
 Crops: mixed produce
 2020 will be the 5th season we've done occultation
 Crop in experiment: carrots



Hillview Farm

Location: near Auburn, CA
 Acres in cultivation: 1.5
 Employees: 5
 Markets: 2 farmers markets, local restaurants, food hub, CSA, local co-ops
 Crops: mixed produce
 2020 will be the 4th season we've done occultation
 Crop in experiment: carrots



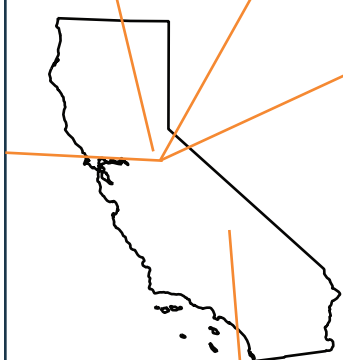
Super Tuber Farm

Location: Grass Valley, CA
 Acres in cultivation: 12
 Employees: 3-4
 Markets: Co-ops, grocery stores, food hub, local restaurants and other farms CSA programs.
 Crops: carrots, beets, potatoes, cabbage
 Crop in experiment: carrots



First Rain Farm

Location: near Nevada City, CA
 Acres in cultivation: 3.5
 Employees: 4
 Markets: 1 farmers market, local restaurants, farm stand
 Crops: mixed vegetables and berries, goat dairy, vegetable seed
 2020 will be the 3rd season we've done occultation
 Crop in experiment: beets



Kern Family Farm

Location: North Fork, CA
 Acres in cultivation: 7
 Employees: 3-16
 Markets: Their retail store, the Gnarly Carrot, misc. local restaurants and farmers markets
 Crops: mixed produce
 2020 will be the 3rd season we've done occultation
 Crop in experiment: carrots



Project Details

Experiment Set-Up & Methods:

At each partner farm, beds of the same length were tarped to apply the occultation treatment and compared to a non-tarped control. Prior to starting occultation, farmers prepared beds according to their standard practices including irrigation to pre-germinate weeds in the occultation beds. After irrigation, the treatment beds were covered with a 5–7 mm black tarp (silage tarps had white side facing down), and left undisturbed for 4 weeks. During occultation, the control beds were left uncovered and weeds were managed according to each farm’s standard practice (tillage, power harrow, etc.). After 4 weeks of occultation, farmers removed tarps and direct seeded beds with carrots or beets. At the time of planting, CAFF set up two 10” x 10” weed data collection quadrats in each replicate plot that were undisturbed by weeding or cultivation.



Occultation and control beds



Quadrat for data collection

Data collection:

Throughout the stages of crop growth, farmers kept track of labor hours spent weeding the control and occultation beds. CAFF conducted weed counts in each quadrat at 30%, 60% and 90% of crop maturity. Just before the crop was fully harvested, CAFF also collected data on yield and quality including weight, root length and overall crop quality.

Mountain Bounty Farm at 30% Data Collection



Occultated Bed



Control Bed

Project Results

The four main areas of research were occultation’s effect on: 1) cultivation labor, 2) weed pressure and type, 3) product quality, and 4) yield (based on root weight)

Labor Results

Takeaway: For the majority of farms there was a significant reduction in labor hours in the occultated beds compared to the control.

Note: Management practices and bed length varied from farm to farm, but were held constant within each farm.

*statistically significant result

Table 1: Labor Required by System (Hours)

	Kern Family Farm	Super Tuber Farm*	Mountain Bounty Farm*	First Rain Farm	Hillview Farm
Control	16.6	6	3.2	1.6	6.7
Occultation	11.6	3	1.2	1.0	6.4
% Reduction in farm labor with occultation	- 35%	- 66%	- 91%	- 46%	- 5%

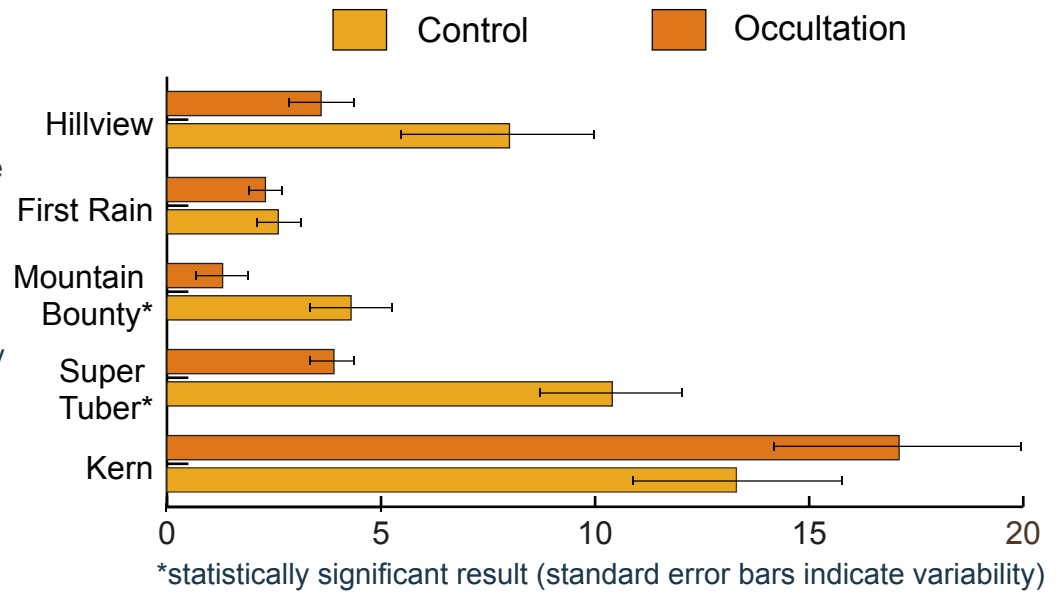
Project Results

Weed Pressure & Type

Takeaway: In 4 out of 5 farms, occultated plots had fewer weeds than the control.

Note: Higher number of weeds surveyed at Kern Family Farm may be due to weeding error and multiple natural disturbances (deer and rodent damage). Data collected at First Rain Farm may have been influenced by compost spread in the control zone that was not covered by the tarp, leading to the compost drying out. Once the crop was planted and irrigated, the compost biologically activated which likely contributed to less weeds and crop in the control bed.

Figure 1: Mean Number of Weeds Observed by Farm



	Occultation	Control
Grass	50.3%	48.3%
Broadleaf	49.7%	51.7%

Takeaway:

Across all farms, there was not a significant difference between the type of weeds (broadleaf vs. grass) that occultation suppressed compared to the control.



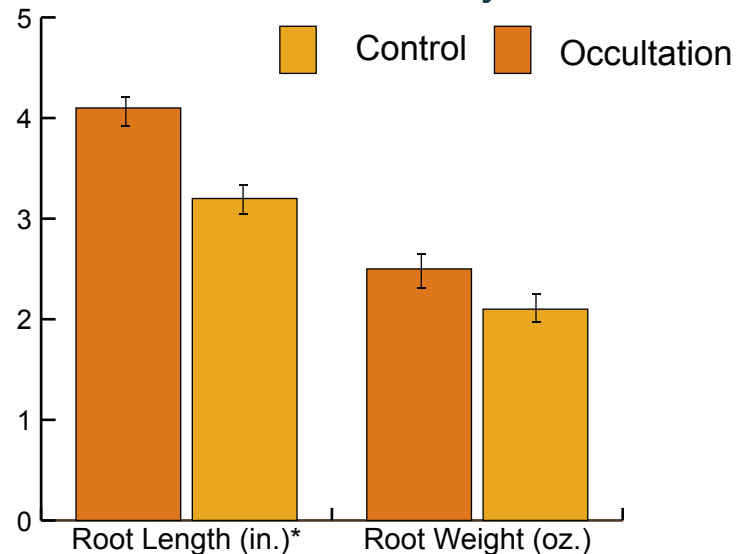
Broadleaf weeds

Product Quality Data

Crop quality data was collected by CAFF based on a visual rubric ranking system from 1-10 (forking, top quality, root smoothness, uniformity). **Takeaway:** Overall quality of the crop was better in occultated beds in 3 of 5 farms. In addition, 3 of 5 farms showed an increase in root weight and length in occultated beds. Uniformity of size and root shape was also higher in the occultated bed in 3 of 5 farms.

	Control	Occultated
Kern	5.1	5.5
Super Tuber	6.9	7.3
Mountain Bounty	5.5	4.5
Hillview	4.2	3.8
First Rain	4.5	6.3

Figure 2: Kern Family Farm Mean Harvest Quality



Product Quality Data Continued - Mean Harvest Quality

Figure 3: Super Tuber Farm

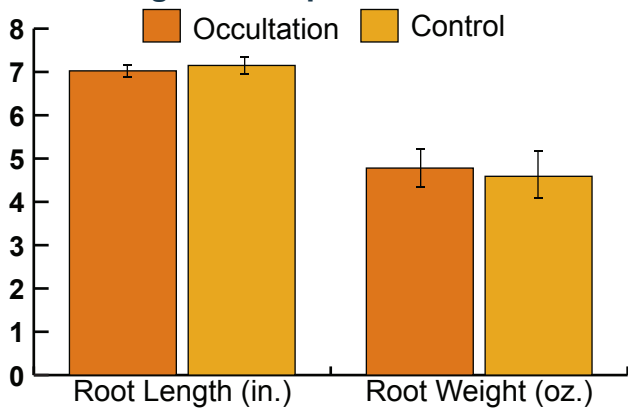


Figure 4: Mountain Bounty Farm

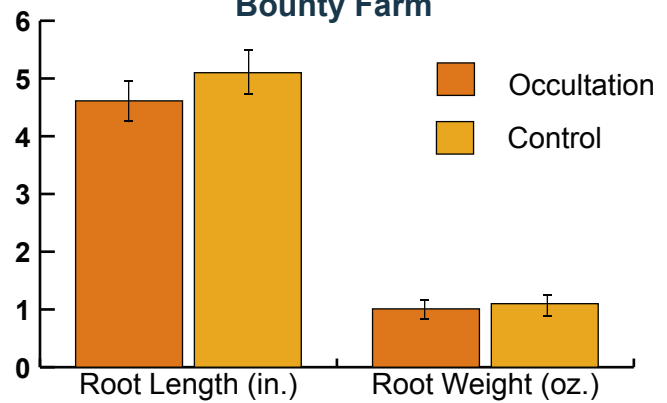


Figure 5: First Rain Farm

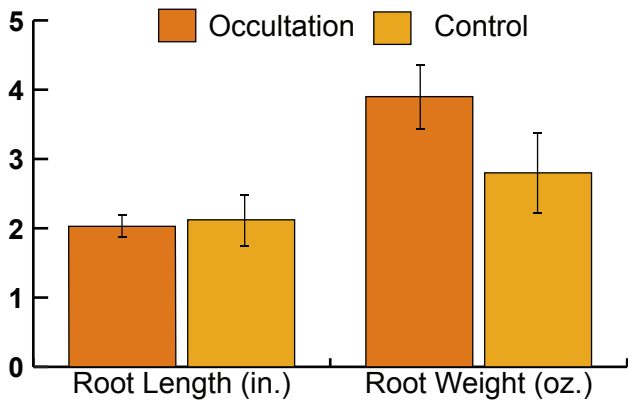
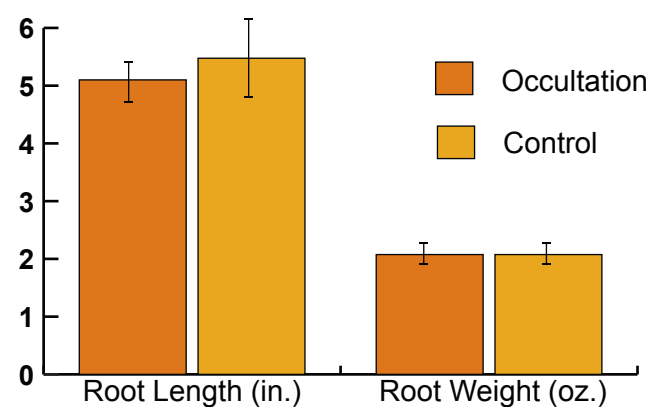


Figure 6: Hillview Farms



Results Summary: The majority of farms in the trial experienced less weed pressure, fewer labor hours and an increase in overall crop quality as a result of occultation. The most notable differences occurred at Mountain Bounty Farms and Super Tuber Farms where occultation resulted in 90% and 66% reductions in labor, respectively. Overall occultation reduced weed pressure, and was particularly effective in reducing weed pressure during between germination and 30% of crop maturity. As the crop developed and canopy was established, the differences between the number of weeds in control and occultation beds diminished. Weed type data (broadleaf and grass) did not show significant differences as a result of occultation. Crop quality indicators including root length and weight were higher at 3 of 5 farms as a result of occultation.

An important variable that was not evaluated in this trial was the effect of the amount of time the tarp was left on the field. Farmers expressed that they will often occultate beds longer than four weeks depending on the weather and time of year.

Farmer Benefits, Tradeoffs, and Recommendations

Benefits

Weed suppression: In the short term, occultation kills pre-germinated weeds that would have otherwise shown up in the following crop. When practiced over several seasons, occultation reduces the weed seed bank, which can significantly reduce weed pressure in the long term.

Crop residue decomposition: In addition to dealing with weeds, occultation is also used to prepare a bed/field for the next crop. After harvesting a crop, farmers can tarp the field and the process of occultation will decompose crop residue from the previous crop, effectively preparing the ground for the next planting. Farmers have noted that decomposition is accelerated under the tarp, resulting in excellent soil tilth and a prepped seedbed.

Reduced tillage: One way to think about occultation in its management of weeds and crop residue is that it replaces tillage operations. This aspect has made occultation an important tool for farmers who are practicing no-till or trying to reduce tillage operations.

Farmer Benefits, Tradeoffs, and Recommendations

Benefits Continued

Short fallow rotations: Several farmers remarked how they will also use occultation to “place hold” a field or area until it’s ready to plant. This allows farmers to effectively have short fallow periods while protecting the soil and suppressing weeds until the field is ready to plant. In some cases, farmers have used occultation for multiple months to fallow a field while simultaneously trying to eradicate difficult perennial weeds such as Bermuda and Johnson grass.

Labor savings: A tangible result of many of the benefits above is that less labor is required both in terms of hand weeding, because there is less overall weed pressure, and in reduced tractor cultivations. This reduction in labor as a result of occultation translates to a significant economic benefit.

Trade-offs

“It’s too much plastic”: The fact that occultation relies on the use of a large amount of plastic is a major drawback to the practice. While there is some work being done to develop biodegradable occultation materials, plastic tarps or landscape fabric remain the primary materials used for this practice. One farmer remarked that occultation tarps can differ in quality and that some will degrade faster than others, resulting in bits of plastic in the field. It should be noted that good quality tarps used for occultation can last several years without shredding plastic.

Time, space and planning required: While occultation to control weeds can replace cultivation passes, it takes a lot more time and requires planning ahead. Some farmers have noted this can be a drawback when the weather doesn’t cooperate with planned planting dates and tarps need to come off sooner or later than planned. It’s also important to note that when a field is being occultated for several weeks or months, it takes up space where a crop could be growing. In this way, it’s helpful to think of occultation as an aspect of crop rotation.

Tarp storage: Farmers also pointed out that tarps need to be stored properly if they are going to last long. It takes labor to move around tarps and space to store them where rodents won’t get into them when they are not in use.

Farmer-to-farmer Recommendations

“Experiment with your bed prep process. The farther ahead you can prepare the better as it will allow you to irrigate and germinate as many weeds as possible before putting the tarps on. The longer the tarps are on the better the results. In the middle of the summer, when it is hottest, less time will be required to obtain good results. (3–4 weeks?)” - Mountain Bounty Farm

“To be successful you need to have your moisture and temperature right to kill as much weeds as possible. Knowing your weed seed types can help you plan for successful elimination to get them to germinate at the right times under the tarps.” - Hillview Farms

“Weigh the tarps down well! Irrigate before tarping if the soil doesn’t have much moisture. Expect longer tarping times with cooler weather. Don’t let rodents nest in your tarps!” - First Rain Farm

“It’s no big deal to hand weed a few beds at a time, but when you are planting 20+ beds on a single day you really need to have your weed management strategies down.” - Super Tuber Farm

“For crab/bermuda grass and other such rhizomatous perennial weeds a long term dry occultation seemed to kill the grass passively when no other natural methods seemed to work. Also don’t hit it with a weedeater or it will shred!” - Kern Family Farm



Completing harvest data collection

Acknowledgments

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Learn more about occultation at caff.org/climatesmartfarming/ and listen to our podcast episodes on occultation on the Farmers Beet.



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