Bringing Pasture into Production

Demonstrating low-till techniques

Turning pasture into productive land using mulching, tarping, solarization, and biosolarization techniques

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Funding for this project was provided by the governments of Canada and British Columbia through the Canadian Agricultural Partnership, a federal-provincial-territorial initiative.

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Purpose & Introduction

Bringing pasture into production: a demonstration site to compare low and no-till techniques in transitioning pasture into cultivatable land. The purpose was to have 10 trial plots with 10 treatments and demonstrating the effectiveness of mulch, solarization, and biosolarization strategies, observe the results, and share the results with the local farming community.

Trial plots were 10' x 10' (or 1,000 sq ft). When considering the application of these treatments for small scale regenerative farmers, transitioning an area of 2,500 sq ft (50' x 100') seemed more realistic. Therefore, material costs and labor time expectations are based off of a 2,500 sq ft area.

Cost of Materials

Item	Supplier	Cost/sq ft or yard	Total Cost
Black Silage Tarp	Integrity Sales & Distributors	$0.10 sq ft	$250.00
Clear Plastic Tarp	Dubois Agrinovation	$0.19 sq ft	$463.00
Compost	Peninsula Landscape Supplies	$68/yard	$2,040.00
Wood Chips	Local arborist	$0.00	$0.00
Organic Material: Grass Clippings	Farm	$0.00	$0.00
Cardboard	Local Irrigation Store	$0.00	$0.00

Labor Considerations

Justification for the labor hours associated with each treatment is based on an approximate average, knowing farmers work at different speeds. We made assumptions of supply distribution (compost, wood chips, organic materials, and cardboard) to be distributed by wheelbarrow (average capacity of 4 cubic feet - 27 cubic feet/yard – 7 wheelbarrow loads/yard of material). Based on these assumptions, the following hour rates are associated with the following action, which are communicated in the materials as labor hours:

Compost & Organic Material
30 yards at 7 wheelbarrow loads/ yard = ~ 210 wheelbarrow loads
Approximately 2.5 minutes/load = ***8.5 hours***

Wood Chips
46 yards at 7 wheelbarrow loads/yard = ~322 wheelbarrow loads
Approximately 2.5 minutes/load = ***13 hours***

Cardboard
Approximately 15 seconds to cover a square yard
2,500 sq ft = 833 sq yards x 0.25 minute/ 60 seconds/minute
Approximately = ***3.5 hours***

Tarp
Approximately = ***0.5 hour*** to lay out tarp and weight down

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Treatment Plots

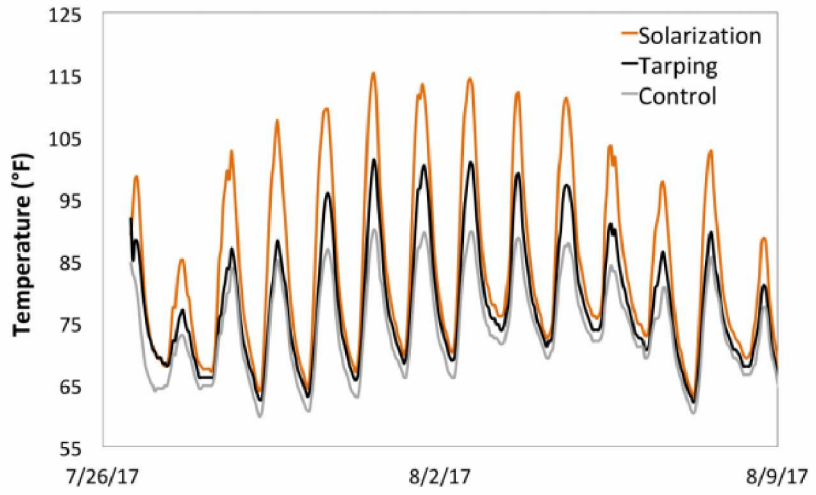
Treatment plots were set-up at two intervals:

1. **June 9th:** Mulching and black tarping based treatments (plots 1-7)
2. **August 22nd:** Solarization and biosolarization treatments (plots 8-10, utilizing tillage)

The treatments on plots 1-7 are slower acting than plots 8-10 solarization and biosolarization treatments; for this reason they were set with two intervals.

Tarping and solarization techniques utilize heat build-up from the sun to kill weed seeds and seedlings with varying degrees of effectiveness (see *Figure 1*).

Figure 1: Comparing temperatures of Solarization and Tarping (*1.*)



Tarping and solarization techniques for terminating pasture have improved outcomes with increased soil moisture. Soil moisture leads to increased biological activity resulting in increased seed germination and subsequent termination.

1. Solarization and Tarping for Weed Management on Organic Vegetable Farms in the Northeast USA.

Soil moisture was high on June 9th and did not require additional irrigation. On August 22nd the pasture soil moisture was low and needed additional irrigation prior to covering with clear plastic tarps. The clear plastic sheets edges were buried to create a greenhouse effect (locking heat in).

Set-up of Treatment Area - June 9th

1. Measured out general area for plots (ten 10'x 10' plots with 4-5' space between plots).
2. Mowed area, measured and marked out the ten plots using wooden stakes.
3. Weed whacked inside borders of the ten plots to get the pasture about 1" in height.
4. Established treatments on plots 1-7.
5. Weed whacked spaces around plots once between June 9th and August 22nd.
6. Weeds species observed in area: Field Bind Weed, Dandelion, Chicory, and Wild Carrot.

Set-up of Treatment Area - August 22nd

1. Prepared plots with irrigation to soften pasture.
2. Tilled the ground using a rototiller on a walk-behind BCS tractor.
3. Established treatments on plots 8-10, watered for 2 hours, plots 9 & 10 were covered with clear plastic tarp and tarps edges buried on plots 9 & 10.

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Observations & Results

On September 12th we observed the following for treatment plots 1-10, and left a corner of each treatment site uncovered until October 8th to see what sort of weed growth may take place.

For treatment plots 1-7 (non-tillage treatments) we used a **penetrometer** to compare soil compaction compared to non-treatment areas. **Penetrometers** are tools to measure the depth and extent of subsurface soil compaction. Pressure is applied to the penetrometer to insert the probe of the tool into the ground.

Soil compaction can limit plant root growth, nutrient, and water absorption. Most plant roots can grow well up to a soil pressure of 200 pounds per square inch (or PSI). Any higher than 200 PSI makes it extremely difficult for healthy plants to grow .

To understand the results of the penetrometer readings for plots 1-7, a baseline was needed. The baseline test was done in the pasture area surrounding the treatment plots.

Baseline

First inch of soil (dry, large sod root mass) exceeded 300 PSI

This baseline is helpful to understanding the context of where these treatment plots are located, namely extremely compacted soils.

Each of the treatments plots 1-7 was tested 3 times in 3 different areas of the plot with the penetrometer and the results were divided into two categories.

Category	Description
A	Top soil layer (2-3”) had a dry crust; penetrometer reached a depth of 10-12” before exceeding 200 PSI and hitting a compaction layer.
B	Low pasture termination and some soil crusting leading to minimal penetration of upper soil layer.

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No-Till Treatments

#1 Black Tarp

Observations: Minor hole damage from rodent population living under tarp (tunneling observed in soil layer); high moisture level in soil. Penetrometer results were Category A.

Pasture termination/regrowth: 80% terminated, with 20% regrowth, with pasture decomposition starting.

Weeds: Field Bind Weed pervasive in growth, not terminated and still germinating.

What's left behind: 30% bare soil, no significant changes to soil organic matter (SOM).

Costs:

Tarp – $250.00

Labor – 0.5 hour

#2 Compost

4-inch layer of compost applied to pasture

Observations: High fungal activity/mycorrhizae growth in compost, and high moisture level in soil. Penetrometer results: Category A.

Pasture termination/regrowth: 80% terminated and decomposed.

Weeds: High weed growth on top layer of compost (most likely from wind drift or birds). Grasses and dandelion have also grown through from pasture layer.

What's left behind: Minimal weeding required and could plant directly into compost (realistically, could have planted into compost in June when treatment was applied to the field).

Costs:

Compost - $2,040.00;

Labor – 8.5 hours

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#3 Cardboard + Compost + Tarp

4-inch layer of compost applied to pasture

Observations: High fungal activity/growth and some observable rodent holes in tap. Compost and cardboard quite dry but high moisture underneath cardboard layer. Penetrometer results were Category A.

Pasture termination/regrowth: 80% terminated but still potential for regrowth (some green shoots observed).

Weeds: No weed growth.

What's left behind: Would need more time for cardboard to fully break down, not ready for production yet.

Costs:

Cardboard – Free

Compost - $2,040.00

Tarp – $250.00

Labor – 3.5 hours laying cardboard, 8.5 hours distributing compost, and 0.5 hour laying tarp = 13 hours

#4 Woodchips + Tarp

6-inch layer of applied to pasture

Observations: High fungal activity/mycorrhizae growth in woodchips, high moisture level in soil. Penetrometer results were Category B.

Pasture termination/regrowth: 20% termination with minimal breakdown. Lots of observable green shoots meaning potential for regrowth.

Weeds: Pervasive Field Bind Weed growth.

What's left behind: Woodchips would need longer time frame for significant sod termination and breakdown. Would need to remove woodchips from area before prepping for production.

Costs:

Woodchips – Free;

Tarp - $250.00;

Labor – 13 hours distributing woodchip and 0.5 hour laying tarp = 14 hours

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#5 Woodchips

6-inch layer of applied to pasture

Observations: High fungal activity/mycorrhizae growth in woodchips, and high soil moisture level. Penetrometer results were Category B.

Pasture termination/regrowth: Low breakdown of pasture.

Weed growth: 30% regrowth of weeds through the wood layer, less compared to the straight compost treatment. Expecting more to grow between September 12th and October 8th.

What's left behind: Remove wood chips, and would need to till before being able to use for production.

Costs:

Woodchips – Free

Labor – 13 hours distributing woodchip

#6 Cardboard + Organic Material + Tarp

4-inch layer of grass clippings applied to sod

Observations: Minimal rodent tunneling underneath tarp. Cardboard had low breakdown. High worm activity in the soil structure, observable frass. Organic material layer broken down by 80%. High soil moisture level and penetrometer results were Category A.

Pasture termination/regrowth: 80% terminated and decomposed.

Weed growth: Field Bind Weed growing.

What's left behind: Organic material and cardboard would both need more time to breakdown before area could be used for production.

Costs:

Cardboard – Free

Organic material – Free

Tarp - $250.00; Labor – 3.5 hours

Laying cardboard – 8.5 hours

Distributing organic material – 8.5 hours and 0.5 hours laying tarp

= 21 hours

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Tillage Treatments

#7 Cardboard + Tarp

Observations: Minimal rodent activity and medium fungal activity. High soil moisture level and penetrometer results were Category A.

Pasture termination/regrowth: 50% broken down.

Weeds: Field Bind Weed growing.

What's left behind: Cardboard hardly broken down, would need to remove before planting or tilling.

Costs:

Cardboard – Free

Tarp - $250.00;

Labor – 3.5 hours laying cardboard and 0.5 hour laying tarp

= 4 hours

#8 Tilling

Observations: Uncovered pasture low moisture.

Pasture termination/regrowth: 30% breakdown of grass.

Weeds: No new growth observed.

What's left behind: Significant organic materials (sod, dead weeds) remaining, would need to wait for further breakdown, or remove from area prior to planting.

Cost:

Gasoline

Labor – 2 hours tillage time

Labor – 2 hours watering

= 4 hours

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#9 Solarization

Tillage + Clear Plastic Tarp

Observations: High soil moisture level, and no rodent holes in clear plastic.

Pasture termination/regrowth: Solarization was not fully successful, perhaps because we did not till the area enough before watering and tarping with clear plastic. The solarization process should not need a lot of time if done properly. Interesting to see a fair amount of sod regrowth even though plastic is fully sealed. 90% of sod terminated (no new growth) but not broken down.

Weeds: No observable weed growth.

What's left behind: Significant organic matter from pasture still remaining, would need more time to break down before being ready for production.

Cost:

Clear Tarp - $462.50

Labor – 2 hours tillage time, 2 hours watering, and 1 hour tarping

= 5 hours

#10 Biosolarization

Tillage + Organic Materials (grass clippings) + Clear Plastic Tarp

Observations: High soil moisture level.

Pasture termination/regrowth: 80% breakdown of organic material. Goal is to kill all weed seeds.

Weeds: Field Bind Weed regrowth happening.

What's left behind: 80% decomposition of organic materials, so would need more time to breakdown, or further tillage to incorporate it into the soil before ready for production.

Cost:

Clear Tarp - $462.50

Labor – 2 hours tillage time, 2 hours watering, 8.5 hours distributing organic material, and 1 hour tarping

= 13.5 hours

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Results

Non-tillage Treatments

The overall effectiveness of each plot's treatment strategy can be observed in Figures 2 and 3, comparing each treatments effects on *(pasture and weed termination, respectively)*.

Figure 2: Pasture Termination Results

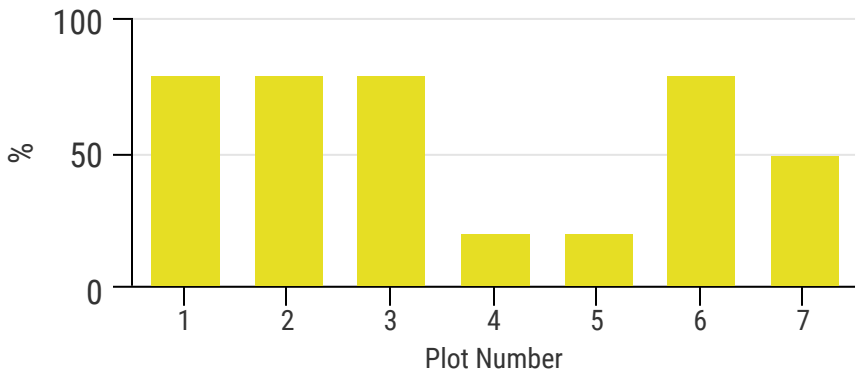
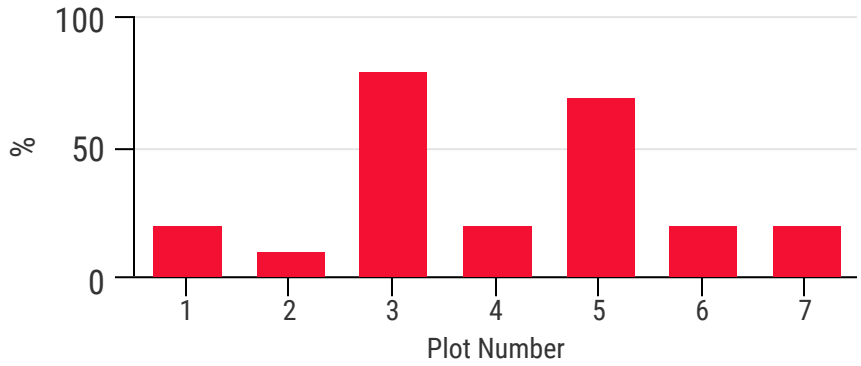


Figure 3: Weed Termination Results



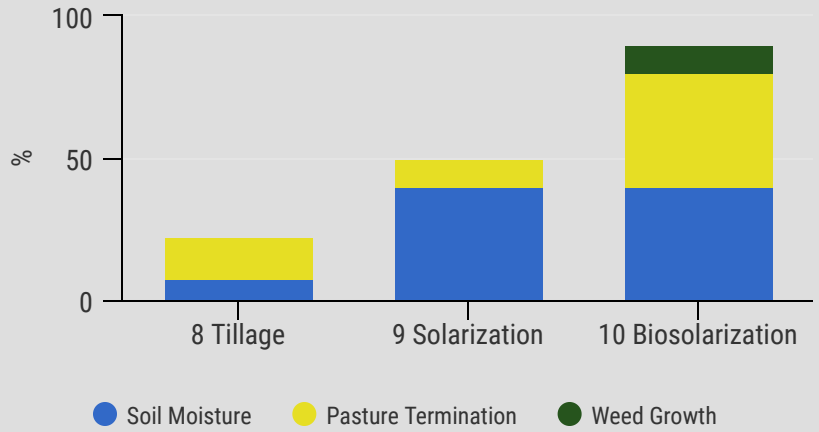
Figures Legend

1: Black Tarp
2: Compost
3: Cardboard + Compost + Tarp
4: Woodchips + Tarp
5: Woodchips
6: Cardboard + Organic Material + Tarp
7: Cardboard + Tarp

Tillage Treatments

The overall effectiveness of each plot's treatment strategy can be observed in Figure 4, comparing each treatment's effects on soil moisture, pasture termination, and weed growth.

Figure 3: Observational Results



As expected, the tillage treatments were more effective in **weed termination** than the non-tillage treatments, having disturbed root structures of the weeds.

Although treatment 8 was the most effective in **weed termination**, it had the lowest results of all 10 treatment plots for **pasture termination** and **soil moisture** levels.

Conclusions

Based on the results of the 10 treatment plots and our observations, we are making the following recommendations for treatment strategies for the following criteria:

Highest ranked without tillage: Treatments 1-7

Most Effective Sod Termination	Readiness For Production	Most Cost Effective	Least Labor Intensive
#6 Cardboard + Organic Material + Tarp	#2 Compost	#5 Woodchips	#1 Black Tarp

Highest ranked of solarization and biosolarization (utilizing tillage): Treatments 8-10

Most Effective Sod Termination	Readiness For Production	Most Cost Effective	Least Labor Intensive
#10 Biosolarization	#9 Solarization	#8 Tillage	#8 Tillage

Every farmer makes land management and production decisions based on many factors:

- Soil management system (tillage, low-tillage, no-tillage)
- Total land
- Production and financial goals
- Tenure on land
- Availability of materials
- Labor time and energy

These factors influenced the decision of treatment strategies and the ranking of treatments based on the results and our observations as growers.

Further Questions:
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For ISFS extension resources, go to:
https:/www.kpu.ca/organic-ag-extension

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