

Direct-sowing in living mulch vs dead mulch

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Synopsis

Can seeds sown directly into living mulch germinate? This experiment is my first documented trial of germinating seeds in living mulch vs plant-free beds. Although the seeds sown in no-till living mulch beds germinated, they germinated at a lower rate than the seeds sown in tilled living mulch and dead mulch beds. In the near future, I'd like to compare germinating seeds in healthier soil.

Photos from this experiment:
<https://photos.app.goo.gl/UNffNfgzuRVNEJi49>

1. Context

I have been experimenting with germinating annual vegetable seeds in living mulches of clover, weeds, and grasses for a few months now (see appendix A.2). I have had some success, however I have had very poor documentation of my methods and results. Now that I have witnessed that various vegetable seeds can germinate in living mulch and grow into fruiting plants, I'd like to be more methodical about my approach and my documentation of results. My hope to become adept at germinating and growing annual vegetables in living mulch.

2. Casual Format of Paper

I intend to write my research papers in a less formal format than what I have read and contributed to in the past. I'd like this to be an enjoyable process for me, to keep me motivated. And I doubt anyone will read these papers except me, at least initially.

3. Plot

The plot of this experiment is called the top "step". It's about 25ft by 50ft. The photo album for this experiment contains a picture of the step taken on day 1 (link in Appendix A.1).

The step has a groundcover of dutch white clover, weeds, and grass. Some dirt is showing through the clover as the heat and dryness of the summer takes over. There are about 10 zucchini and corn plants growing in a line in the center. There are also several 1 to 2 inch mounds of dead mulch composed of grass and radish. The dead mulch mounds range from about 1 to 5 feet in diameter. The step is in zone 7—in Nebo, North Carolina, USA.

4. Variables

4.1 Independent Variables

In this experiment, I compare sowing in...

- Dead straw mulch mounds vs living mulch
- Raised dirt mounds vs flat ground
- Stripped vs tilled living mulch

4.1 Dependent Variables

Germination

- How many seedlings are currently visible & alive?
- measured on day 5 (July 21st) and day 10 (July 26th)

Health

- Height from dirt to top of plant

- Width
- Number of living leaves having majority of surface area still vital
- Approximate percentage of leaf surface area that has been eaten (10, 50, 90)
- Approximate percentage of leaf surface area that is discolored or spotted (10, 50, 90)
- Light/yellow (1), average (2), or dark/green (3) coloration of leaves
- Percentage of plants that are still alive
- Measured on day 15 (July 31st) and day 29 (Aug 14th)

- Cucumber (White Wonder and Marketmore 76)
- Melon (Green and orange honeydew cucumber)
- Squash (Acorn, Butternut, Spaghetti)
- Bean (Contender & Cherokee Wax)
- Mixed field corn

5. Hypotheses

I think the raised mounds under dead mulch will do best. I think the raised mounds where living mulch was will do nearly as well. I think the flat ground experiments will do the worst.

6. Method

For photos, see appendix A.1.

6.1. Install Deer Fence

July 16, 2022 9:00 am

Lots of the germinated veggies died from what I presume was deer (droppings).

Use a sledge to drive 4 wooden posts in each corner of the step. Snugly run a fishing line about waist height and knee height around the perimeter to repel deer. (It's worked so far in the tunnel! They were munching on the tomatoes too).

6.2. Prep Seeds

July 17, 2022 7:00 am

Using a 6-divot muffin tin, place each of the following seeds in their own muffin divot:

- Okra (mostly clemson spineless, some red burgundy)

6.3. Day 1 - Sow Seeds

July 17, 2022 8:00 am

6.3.1. Sowing Instructions

For all the following, sow such that the top of the seed is at the following depth:

- okra—about ½ of distance between index finger's fingertip and first knuckle
- all others—the full distance between index finger's fingertip and first knuckle

For seeds with a tip, place pointy side up.¹

For all seeds, cover flush with soil, don't pack as watering will pack it.

6.3.2. Watering instructions

1. Water each hole for 3 seconds with shower sprayer at about waist height (will spray around the hole too).
2. Wait 60 seconds.
3. Water each hole again at the same height, but for 5 seconds.

6.3.3. Large (5-foot) dead mulch mound

1. Pull out weeds
2. Create 6 holes in mulch. Use hands to push aside mulch and uncover bare ground about the size of my hand with fingers extended.
3. For all holes, use a pickaxe to lightly till the bare ground 2 inches deep.
4. In an alternating/random pattern, select 3 holes to be the "mound" holes and 3 to be the "flat" holes.

¹ After reading, I actually think I should have oriented the pointy sides down. However the important thing is that I oriented them all consistently.

5. For the 3 “mound” holes, scoop the dirt into a raised mound about the size of my fist, creating a small moat/ring around the mound.
6. Also, stick a blank label-stick with blue tape next to each of the mound holes.
7. For all holes, use two fingers to push one of each seed type from the muffin tin into the ground at the correct depth, and cover with soil.
8. Water each hole.
9. Sprinkle dead mulch back over each hole such that there is a very thin layer (50-65% of light should permeate).

6.3.4. Smaller dead mulch mounds

There are 6 smaller dead mulch mounds. Do the following for all mounds:

Follow instructions above, but only place one hole in the center of each mound. Ensure I am watering for the same length of time, with the same delay as in 6.3.3.

6.3.5. Tilled Living mulch

1. Create 6 beds to sow in: Use a pickaxe to lightly till the living mulch & ground 2 inches deep, the width of my hand with fingers spread. Brush aside the mulch to the perimeter.
2. In an alternating/random pattern, select 3 holes to be “mound” holes and 3 to be “flat” holes.
3. For the 3 mound holes, scoop the dirt into a raised mound about the size of my fist, creating a small moat/ring around the mound.
4. Stick a blank label-stick with blue tape next to each of the mound holes.
5. For all holes, use two fingers to push one of each seed type from the muffin tin into the ground at the correct depth, and cover with soil.
6. Water each hole.

7. Sprinkle dead² mulch back over each hole such that there is a very thin layer (50-75% of light should permeate).

6.3.5. Stripped Living mulch (no-till)

1. Create 10 beds to sow in: Use my hands to pull living mulch upwards, and use sickle to cut at base, creating mostly bare soil without tilling. Brush aside the chopped mulch to the perimeter.
2. Stick a blank label-stick in the ground next to each hole.
3. For all holes, use a screwdriver to create 5 holes, one for each seed. So each seed and cover with dirt.
4. Water each hole.
5. For consistency, sprinkle dead mulch back over each hole such that there is a very thin layer (50-75% of light should permeate).

6.4 Water

6.4.1 Day 1

See section 6.3.2 for how I watered on day 1.

6.4.2 Day 6

July 22 2022 9:00 am

1. Water each bed from section 6.3 for 3 seconds.
2. Repeat in the same order, but this time water each bed for 5 seconds.

7. Observations

See also: photos in appendix A.1.

7.1. Day 1 - Softness & Moisture of soil

I noticed that for several holes, the living mulch soil felt softer when picking when compared to the soil

² Use dead mulch so that there are no other differences between the experimental groups.

under the dead-mulch mounds. easier to till (felt softer when picking)

After a week or longer of not watering, I noticed that the living mulch soil generally felt dryer than the soil under dead-mulch.

7.2. Day 6 - Germination

July 22, 2022 8:30 am

From a general feel, it seems stripped living mulch is doing the worst so far, others may be about the same. Recordings in section 7.4.

7.3. Day 12 - Germination

July 28, 2022 8:30 am

Rabbits! Rabbits have chopped off the heads of almost all of the seeds. Unfortunately this is the end of the experiment.

7.4. Germination Table

Variant	% germinated - Day 6	Count germinated/sown - Day 6
Dead mulch (mound)	77	4/5 + 5/5 + 3/5 + 3/5 + 5/5 + 3/5
Dead mulch (flat)	57	3/5 (2 decapitated) + 3/5 + 3/5 + 4/5 + 2/5 + 2/5
Living mulch (mound)	60	2/5 + 5/5 + 2/5
Living mulch (flat)	53	4/5 + 2/5 + 2/5
Living mulch (striped)	44	2/5 + 2/5 + 3/5 + 1/5 + 1/5 + 4/5 + 4/5 + 2/5 + 1/5

8. Results

8.1. Germination

Though there weren't enough beds to draw a firm conclusion, this experiment had better germination in mounded vs flat beds. I also saw better germination in tilled dead/living mulch than stripped living mulch beds.

Thoughts

Unfortunately the rabbit damage inhibited this experiment from going any further. In my next experiment I'd like to add an exclusion barrier.

Sowing the seeds upside down (pointy tip up) may have affected the germination rate between stripped and tilled beds. It may be easier for a root to grow out the top of a seed and then grow downwards if it's in tilled soil.

Since I intend on sowing multiple seeds per hole in production plots, 77% germination rate is quite acceptable to me for direct sowing. However, I'd ideally like to sow directly into living mulch, so I'd like to improve my current rate of 44%.

I think soil composition & health may have more to do with germination, growth, and harvest than the variables I compared in this experiment. I just started spreading more organic matter to improve soil health. I look forward to trying experiments with different soil health in the future.

A. Appendix

A.1. Experiment Photos

<https://photos.app.goo.gl/UNffNfgzuRVNEJi49>

A.2. Summary of previous experiments

Although I haven't been as meticulous with my previous experiments as I am in this experiment, I have developed some hypotheses based on what I've observed.

A.2.1. No-dig in unfinished compost inhibits growth (nitrogen burn?)

Inspired by "no-dig", in Fall 2021, I laid a few rows of compost about 3-4 inches deep in the tunnel (middle step). In late fall & early winter, all the seeds I attempted to germinate yellowed, developed spots, and eventually died.

I noticed the surface of the beds were hard and crusty, but underneath the compost was soggy. I ended up mixing peat moss into all of the rows, which I imagine helped.

I kept sowing month after month. Lettuce and radish began taking off in late winter (Feb?). Zucchini & Corn have done very well late spring to early summer this year (2022).

A.2.2. Green manure retains moisture

Around late spring/early summer, the tunnel's beds were drying out extremely quickly. Inspired by what I had been reading, I walked around the property gathering grass, thin bamboo shoots (with leaves), and radish stalks (with leaves) and sprinkled them onto the two center rows. I watered the beds reasonably consistently, but noticed quickly that the beds with green manure on top were retaining moisture much better than the rows without.

A.2.3. Raised mound -> healthier veggies

In one of my latest experiments, I made two bare-ground beds in the living mulch about 12 inches in diameter. In one of the beds, I mounded the dirt, and in the other bed, I created a divot/pot hole. To my surprise, the seeds planted in the mound did much better than the seeds planted in

the divot. This observation inspired one of the two primary independent variables in this experiment.

A.2.4. Deer kill veggies

Though there was some germination in my last experiments on the top step, the heads of almost all my beans and melons have been chewed off by what I presume to be deer (judging by droppings and conversations with the owner of the plot). I put up a barrier made of fishing line and so far no deer have broken the line.

A.2.5. Thick green manure kills

In my past experiment in the top step, I was surprised to see that only a few inches³ of green manure piled onto living mulch was enough to kill it. Very few weeds have grown up through the thick green manure.

A.2.6. Germination in living mulch is possible!

What I have seen in multiple of my latest experiments is that it is possible to germinate in living mulch. My success rate is quite low, but I have harvested zucchini and corn from seeds planted in living mulch without tilling. I've also recently germinated squash, melon, okra, and beans in clover living mulch, weeds/sticks (where trees were just chopped), grass, and ground ivy.

³ In the beginning it was perhaps 3-4 inches.. After sitting outside and decaying for about a month, the mounds are now about 1 inch tall.