Organic Soil Pillars

Could augering a field *once* improve compacted soil for years to come? This experiment observes what happens when narrow holes are augered in clay soil.

⚠ This paper has *not* been peer-reviewed. This is an informal, casual application of the scientific method. I'm choosing to do this in a way that is motivating, enjoyable, trustworthy, and helpful for me.

I welcome comments, questions, and feedback!

Author

Josh Terrell - josh@somagardens.org

Started	Completed
August 14, 2023	November 3, 2023

📸 Full photo album for this paper: https://photos.app.goo.gl/yGwH8J2NhDjc1pwF7

This paper's evolution has been inspired by conversations with friends, and an online discussion about how to improve pure clay at notillgrowers.com:

https://notillgrowers.community.chat/post/drilling-pillars-of-organic-matter-into-the-soil-12682952

Table of Contents

Synopsis

I augered deep, narrow holes in ten of fifteen 25-gallon pots. I placed a scoop of compost on all fifteen pots, but in three different ways. After about two months, I could not detect a measurable difference between the foliage or soil in the pots.

When conducting this experiment, I found videos, research, and discussions indicating that daikon radish can be an effective companion for creating deep, organic pillars in soil, without using a drill. In the spirit of "do nothing" (natural) farming, I have concluded this experiment to try the simpler, less labor-intensive, more natural approach of using daikon radish to create the organic soil pillars for me.

Motivation

Compaction severely limits plant life. Roots must breathe; soil must drain. Healthy soil has *lots* of mostly aerobic life around plants' roots. However much of the soil we often start growing in is far from ideal. It drains poorly, is not frothy nor organic, and hardly breathes.

If whatever plants or weeds which thrive in poor soil are allowed to mature and reproduce, year after year soil will gradually improve (see also: "forest succession"). If we add mulch and/or water, soil can improve more quickly. However it still may take many years to enrich soil and improve soil-structure deeper down.

Background

Tilling is a technique commonly used to immediately improve soil's structure. Tilling pulverizes and blends soil, making it fluffier (aerated) and easier to germinate and transplant into. If used year after year, repeated tillage erodes soil, leaving it depleted and lifeless. However initial tillage is still used by no-till, regenerative growers to immediately improve soil structure. Presumably, the ecosystem that re-establishes in the tilled soil is able to penetrate and take hold deeply much more quickly in the aerated and organic blend left behind the tiller.

Broadforking is a method of improving soil-structure without pulverizing the soil. Broadforking relieves compaction and aerates soil. Some broadfork advocates state that after a few years, broadforking is no longer as helpful because the soil structure has improved. This is in contrast to conventional farming where fields are usually tilled indefinitely.

Augering is a method of deep-soil improvement where holes of soil are drilled out with an auger (drill bit). Augering opens columns for air and water to exchange in deeper parts of the soil, and it allows organic matter from the soil surface to enter deeply into the soil.

Plot

This experiment occurs in fifteen 25-gallon pots. The pots were filled with mostly clay as well as some handfuls of compost and peat moss over a year ago. They have been growing cover crops since then.

The pots are in a shaded area

Experimental Groups

Control Group (no marker)

No hole augered. One mound of compost added.

Group 1 (white marker)

One 1.2-inch (3cm) hole augered down to the bottom of the pot. One mound of compost added a few inches away from the hole.

Group 2 (blue marker)

One 1.2-inch (3cm) hole augered down to the bottom of the pot. One mound of compost added on top of the hole. Stick used to poke some compost into the hole.

Hypotheses

Unfortunately, I did not record my hypotheses in this paper before I started. However I will recall them now, near the end:

I hypothesized that augering holes into nearly pure clay soil would allow water and air to penetrate further into the soil, which would in turn encourage roots and microbial life to move deeper as well, improving plant and soil health.

Methods & Observations

Day 0: Start Experiment

August 14, 2023

Step 1: Gather Materials

Materials

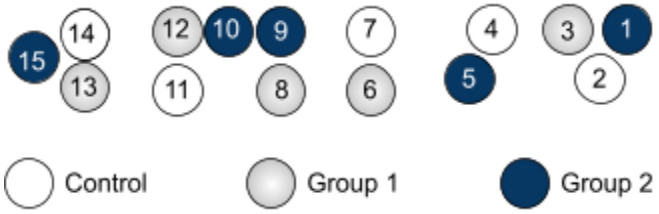
- Auger & Drill
- Markers (to identify pots)
- Wheelbarrow full of compost & gloves
- I didn't use the bucket

Step 2: Randomly Assign Pots

How I randomly assigned 5 pots to each of the three groups:

1. Used rolladie.net to create a 3-sided die
2. Chose three pots and mentally labeled them "1", "2", and "3"
3. "Rolled" the 3-sided die. Whichever number came up (1, 2, or 3) was a "Control" pot (no marker/label).
4. "Rolled" the 3-sided die again until a different number came up. That pot was a "Group 1" pot, and I labeled it with a white marker.
5. Labeled the remaining pot with a blue marker, it is a "Group 2" pot.
6. Selected the next three unassigned pots and repeated the instructions until all 15 pots were randomly assigned and labeled.

Group Assignments:



Step 3: Auger Holes

For all pots assigned to "Group 1" or "Group 2", I augered a 1.2-inch (3cm) hole down to the bottom of the pot. I drilled all holes in about the same location in each pot (a few inches from the east side of the pot).

The soil did not drill out as well as I expected. I think it was too wet. Not much came out of the hole, only what was attached to the bit (not much).

Step 4: Add Compost

I added one mounded scoop of compost to every pot (including control pots which had no holes drilled). In "Group 1" pots, I just mounded the compost a few inches (several cm) away from the hole. In "Group 2" pots, I poured some of the compost out, poked it into the hole using a stick, and then poured the rest of the

compost in a mound directly on top of the hole.

I could not get the compost in deeply with the stick. I suspect wider holes or a finer compost would be necessary.

Day 1: Observe Depth

August 15, 2023

I was concerned the wet clay holes would recompact very quickly.

The next day, I dropped a stick back into some of the open “Group 1” holes. It went down deeper than I expected. The stick went about half-way down (1 foot or 0.3 meters). Gravity was the only downward force.

Day 13: Measure Depth of Holes

August 27, 2023

I had a thin straight stick, about a half an inch (1cm) thick. I dropped it into each “Group 1” hole, and gently rocked it side to side to see if it would fall any deeper on its own. Gravity was the only downward force. At that depth which it would go down no further, I pulled it out and measured it.

The deepest hole was about 15 inches (38 cm) deep. The shallowest hole was only about 6 inches (15 cm) deep. The other three holes were about 8, 9, and 9.5 inches (20, 23, 24 cm) deep.

I suspect the clay started refilling with the rain and pressure. All the holes were initially 20 inches (74 cm) or more deep.

Average depth:

Deepest:

Shallowest:

The brick in the picture is 8 inches long and the grout is about 1/2 inches thick. The part of the stick to the left of the fingertips was the depth of a hole.

Day 30: Take Cores

September 13, 2023

I took soil cores from a few pots, and from other areas in my yard for comparison.

Examples
(see album for all photos)

Core 10: taken from a 25-gal pot

The soil in the pots was mostly clay with 0-2 inches (2-5 cm) of organic matter on top. There were pockets of organic matter.

I suspect the pockets of organic matter in the pots is due to the initial “tilling” I did when filling the pots. I alternated handfuls of peat and compost with shovel-fulls of clay.

Core 5: taken from typical suburban grass

The soil taken from the lawn areas was very clay-y. There was no noticeable organic material except for the grass and roots itself.

Core 4: taken from center of one year old leaf pile

The soil under the leaves had 2-4 inches of organic matter on top, but there was hard, dry clay underneath the dark organic stuff (see album).

The soil taken from the cover cropped & chop-and-drop mulched area (in mostly shade) was very moist clay, unlike what was found in the other areas. Photo in album.

Learning 👨‍🔬
I think it's best to stop pushing the corer before pushing as hard as you can. The area inside the corer compacts, and it's difficult to get the clay out.

Day 56: Take Photos & Cores

October 9, 2023

I took photos of the foliage and cores from all 15 pots.

I noticed no measurable difference in the health of the foliage in the pots.

Furthermore, when I analyzed the cores taken from various pots, I saw no pattern that was clear enough to warrant mentioning. For example: some "Group 2" pots were very richly organic and soft, and others were pure clay, and got hard a couple of inches down. Some "Control" pots were extremely hard, and some were softer.

Results

I detected no measured difference in the plants or soil between the three groups.

When I analyzed the soil organic matter, moisture content, and compaction of the cores taken, I could not discern a pattern that indicated that augering was better or worse in any way than not augering.

I discovered a problem: I built these pots inconsistently. I did not blend the soil. I put shovels full of clay, and handfuls of compost and peat moss in them, somewhat arbitrarily. I added transplants into a couple of them. I believe the differences I saw in cores may have been due to my inconsistent pot creation over a year ago 😞

The augered holes did not refill immediately.

I thought that the augered holes would rapidly refill due to the pressure of wet clay. The deeper parts of the holes did refill, however many of the holes were still 9 or more inches deep a month after drilling them. The hole that was the shallowest was the hole which was exposed–with no mulch or foliage protecting it from the elements.

Thoughts

Inspired by hügelkultur, I'm considering whether jamming straight sticks deep into the holes would help. Perhaps as they decompose, they would leave cavities for air to exchange more deeply. Plus, it may help boost the fungi population without tying up nitrogen in the entire soil.

As I started this experiment, I got some great validation on the notillgrowers.com forum about using daikon radish to improve soil. My next experiment compares these same pots in a different experiment: with or without daikon radish.

In the next experiment, I believe I'll be able to detect patterns more strongly due to altering each pot to have a swale in the center and raised edges

(for consistent moisture) and having a simplified experiment (daikon radish vs no daikon radish).

I welcome your thoughts, feedback, and questions!
E-mail: josh@somagardens.org