

RESEARCH REPORT

No-till tomatoes 3-ways

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Farmer-Researcher

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IN A NUTSHELL

To further explore no-till techniques, Matt compared no-till tomatoes three ways: compost + landscape fabric, compost + cover crop + landscape fabric, and compost + cardboard + landscape fabric.

- He detected no difference in cumulative or monthly tomato yield among the three methods.

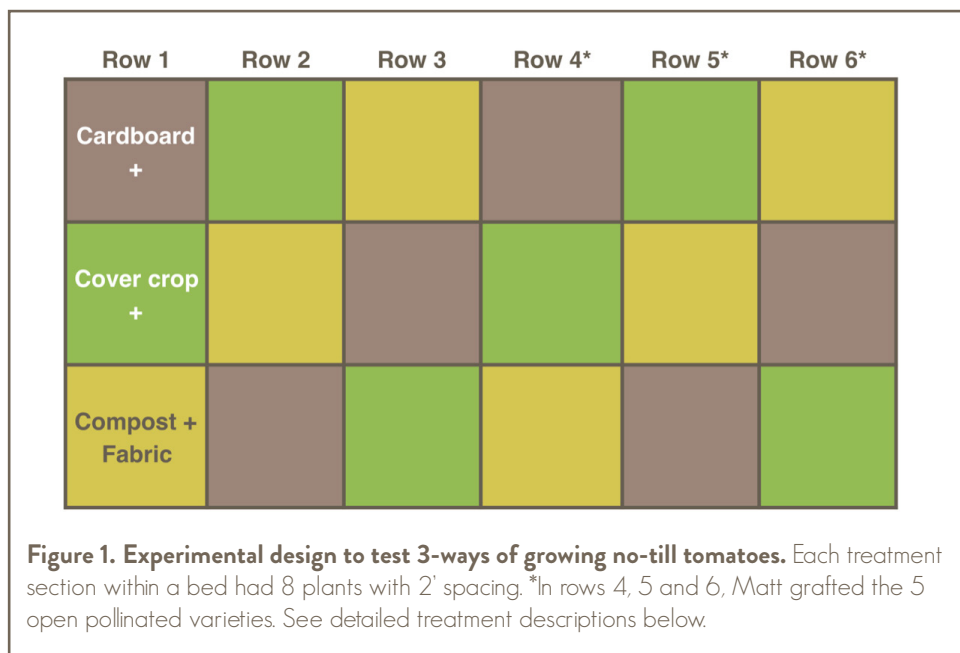
- He also detected no difference in water infiltration, an indicator of soil health, among the three methods.
- This data indicates that adding cardboard or cover crops to compost and landscape fabric does not improve yield for no-till tomatoes; and cardboard and cover crops may be a useful means of further building soil without negative effects on yield.

MOTIVATION

Minimizing soil disturbance, including tillage, is a key principle of soil health and regenerative agriculture. Implementing no-till techniques, however, is still a challenge, especially for organic growers who do not use chemical methods for weed control.

To reduce soil disturbance, Matt grows full season vegetables using landscape fabric for weed control without tillage. Specifically, his practice has been to put a layer of compost on beds early in the season (i.e. March/April), cover with landscape fabric, and then transplant vegetables into the fabric at the appropriate time.

While this method has worked well for Matt, he was curious to know if it provides sufficient nutrients for the full season. Two methods that may improve nutrient availability could be the addition of cardboard mulch (reference 1) and the use of cover crops (reference 2).



DESIGN

To test these three ways of growing no-till tomatoes, Matt used a randomized complete block design with 6 replicates. He divided six

beds into three sections and assigned each section to a treatment for a total of 18 plots, as shown in **Figure 1** and **Photo 1**.



Photo 1. Matt's trial in the spring, with landscape fabric over the Compost + Fabric and Cardboard + but not the Cover crop +, which was covered after crimping.



Photo 2. (top to bottom) (a) The crimper Matt made using 4' of 1 1/2" slotted angle attached to 2"x2" wood to stand on with 2"x2" used for handles; and (b) Matt crimping the cover crop.



Photo 3. (top to bottom) (a) The spring-planted cover crop of oats and barley before crimping; and (b) the cover crop after crimping on June 6, 2020.

3-WAYS

Compost + Fabric (●): Matt raked an even layer of compost on the soil and covered with landscape fabric.

Cardboard +(●): Matt placed a layer of cardboard (with no tape, staples or coloured ink; minimum of 3" overlap between sheets), then placed an even layer of compost the same thickness as the other treatments on top of the cardboard and covered with landscape fabric.

Cover crop +(●): Matt raked an even layer of compost the same thickness as the other treatments and direct-seeded a cover crop of peas, oats and barley using 3 ganged Earthway seeders with 5" spacing. Just prior to transplanting, Matt crimped the cover crop using 4' of 1 1/2" slotted angle attached to 2"x2" wood to stand on with 2"x2" used for handles (**Photo 2**), and then covered the crimped mulch with landscape fabric. Plots before and after crimping as shown in **Photo 3**.

For the cover crop plots, Matt planted peas and oats with an Earthway on April 1, 2020, and he seeded all tomatoes on April 6. Due to delivery delays, he also hand sowed barley on April 29. The barley didn't establish, so the cover crop ended up being mostly peas and oats. He crimped the cover crop plots on June 6 and transplanted the next day.

In all 18 plots, he placed one plant of the 8 varieties of tomatoes in the following order: Purple Bumblebee, Chocolate Cherry, Pink Bumblebee, Sunrise Bumblebee, Principe Borghese, Sakura, Esternia and Super Sweet 100. In rows 4, 5 and 6, Matt grafted the 5 open pollinated varieties (i.e., Purple Bumblebee, Chocolate Cherry, Pink Bumblebee, Sunrise Bumblebee, Principe Borghese) to Estamino rootstock on April 29 and May 2. Throughout the season, Matt routinely suckered the tomatoes and trellised using a Florida weave.

Matt placed HOBOPendant® MX Water Temperature Data Loggers w/Bluetooth 5 cm below the soil surface in row 3 prior to being covered in landscape fabric (March 27 for Compost + Fabric and cardboard and June 7 for Cover crop +); to monitor ambient temperature, he placed a fourth temperature logger in the foliage of a nearby tree (June 25).

FINDINGS

Yield

Matt harvested 11 times during July 17 - September 14, 2020 and measured harvestable yield from each plot separately (**Photo 4**). To evaluate the effect of the three methods on total yield, early yield (July), mid-season yield (August) and late-season yield (September), we used a statistical model called analysis of variance (ANOVA) with a 95% confidence level to calculate the least significant difference (LSD) needed to call the treatments "statistically different". We also tested the effect of row (i.e. soil conditions and previous management) and grafting (since 5 of 8 tomatoes in rows 4-6 were grafted).

Using this approach, we found that tomato yield was not affected differently by the three no-till methods, as shown in **Figure 2**. The LSD he needed to see was 2.8 lbs, but all three treatments



Photo 4. Mixed varieties of tomatoes from one harvest.

were within 0.9 lbs of each other. With 95% confidence, we also concluded that monthly yield was also not statistically or practically different among treatments; and yield was not affected by row or grafting. He did not have enough data to draw conclusions about the grafted vs ungrafted tomatoes in this trial. See More on Statistics at the end of the report.

In general, Matt's yields were lower than average. This may be because of the specialty varieties that he selected, an early frost that cut is season short and the fact that he does not use fertility through drip lines.

Water Infiltration

As a measurement of soil health, Matt also measured water infiltration using the in-field method (reference 3). Matt detected no effect of the three treatments on water infiltration, as shown in Figure 3.

Soil temperature

Using HOBO Pendant® MX Water Temperature Data Loggers w/ Bluetooth, Matt recorded soil temperature under one plot of each of the 3 treatments. Temperature recording was unreplicated, thus any differences cannot be definitively attributed to treatment effects, but some trends emerged (Figure 4).

For example, the soil was slightly cooler under Cardboard + than Compost + Fabric for the first 2-3 weeks; and then it was warmer, possibly due to biological activity. Compared to the Compost + Fabric treatment, Cover Crop + resulted in a larger daily range in soil temperature. Higher soil temperature with cover crop residue may be due to increased biological activity in the soil (Figure 4).

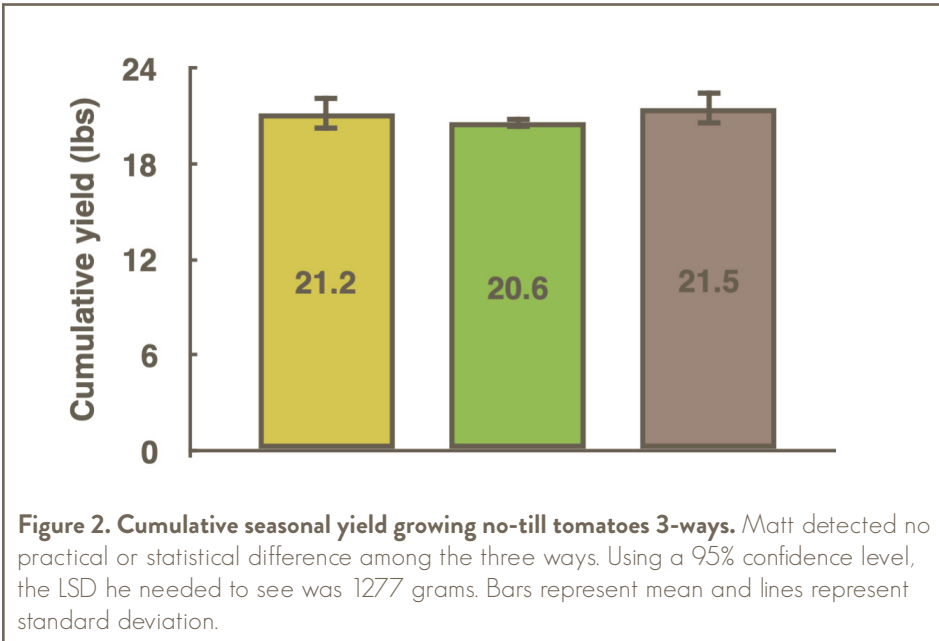


Figure 2. Cumulative seasonal yield growing no-till tomatoes 3-ways. Matt detected no practical or statistical difference among the three ways. Using a 95% confidence level, the LSD he needed to see was 1277 grams. Bars represent mean and lines represent standard deviation.

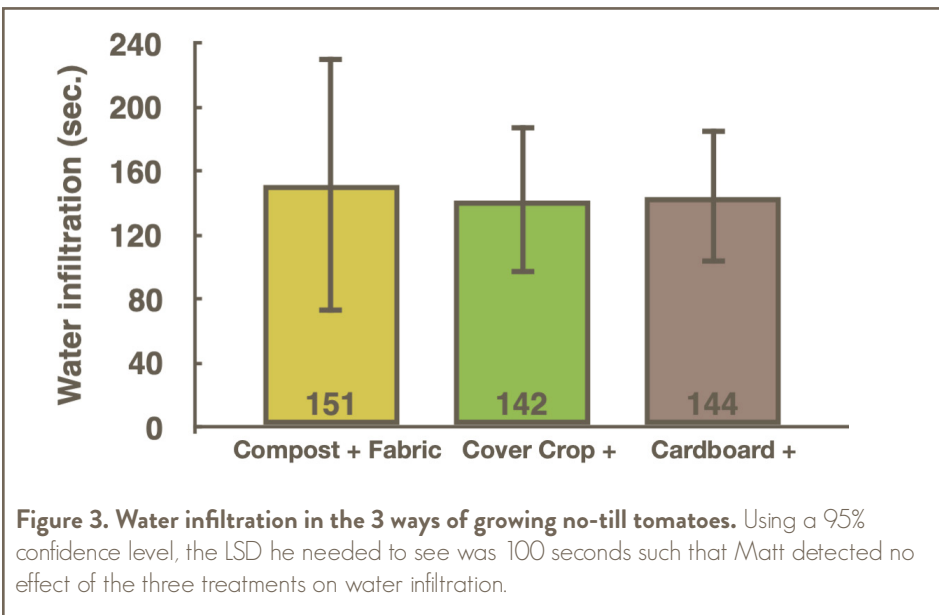


Figure 3. Water infiltration in the 3 ways of growing no-till tomatoes. Using a 95% confidence level, the LSD he needed to see was 100 seconds such that Matt detected no effect of the three treatments on water infiltration.

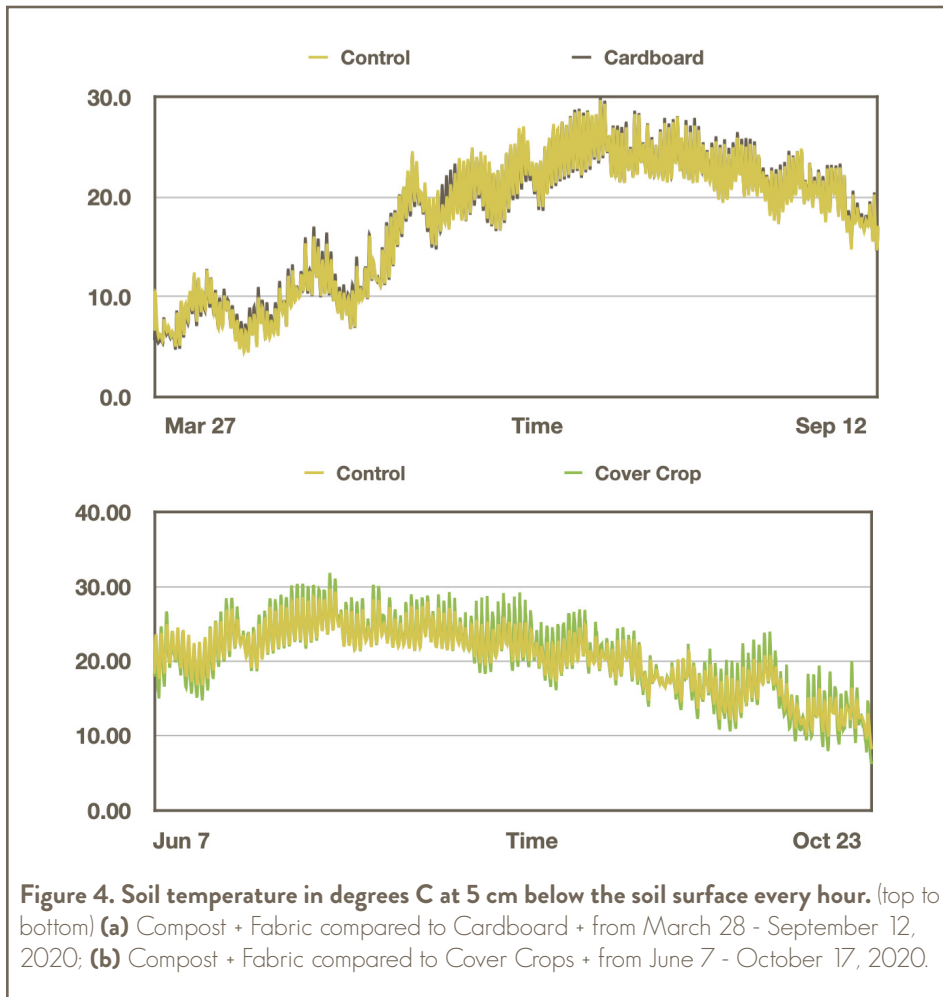


Figure 4. Soil temperature in degrees C at 5 cm below the soil surface every hour. (top to bottom) (a) Compost + Fabric compared to Cardboard + from March 28 - September 12, 2020; (b) Compost + Fabric compared to Cover Crops + from June 7 - October 17, 2020.

Transplanting into crimped cover crops was more difficult and is an extra step at a busier time of year (i.e. late May-early June).

TAKE HOME MESSAGE

The three no-till methods for tomato production did not affect tomato yield differently.

This data indicates that Matt's business-as-usual method for no-till tomato production that includes using compost and landscape fabric provides his tomatoes with sufficient fertility for full season growth.

NEXT STEPS

While Matt was disappointed that no treatment appeared to provide clear yield benefits, he did gain value from the experiment.

While there may not be a yield benefit to adding cover crops or cardboard to his no-till system, these additions may be useful means of weed suppression and building soil.

Weed Control & Management Effort

Weeds can still be an issue when using landscape fabric, especially when re-using fabric with older holes. For the trial, Matt burnt fresh holes into landscape fabric and thus no weeds came through the holes for the trial plots. In other parts of the garden, cardboard prevented

weeds from coming through when used under landscape fabric with old holes.

Most of the cardboard under compost was consumed quickly, and was gone by the time Matt transplanted into it. In another area where he put cardboard on top of compost, the cardboard is still intact as of November.

The potential for heavy metals in cardboard, however, give Matt pause to its use until this concern better understood. For Matt to continue using a cover crop mulch, he will need a better crimping method.

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MORE ON STATISTICS

Using a 95% confidence level means:

- When we measure a yield or infiltration difference between any two treatments that is greater than the calculated least significant difference (LSD), we expect this difference would occur 95 times out of 100 and, therefore, consider it a reliable difference.
- When we measure a yield or infiltration difference between any two treatments that is less than the calculated LSD, we consider these treatments unreliably different and not statistically different.

REFERENCES

1. Ricky Baruc of Seeds of Solidarity discusses his use of cardboard mulch in Growing for Market pp 9-19 Feb 2018 issue.
2. Andrew Mefferd's The Organic No-Till Farming Revolution pp 81-104.
3. Soil Health Benchmark Study Protocol, EFAO: <https://efao.ca/wp-content/uploads/EFAO-Soil-Health-Benchmark-Protocol-2Oct2019.pdf>.