

Strip Till for Tobacco Production: a Five Year Trial at the Connecticut Agricultural Experiment Station Valley Lab



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Overview

Tobacco production in Connecticut relies heavily on conventional tillage to manage soil. Cover crop residue and fertilizer must be incorporated, weeds cultivated, and the soil aerated. In other production systems, reducing tillage can substantially increase soil health, water holding capacity, and resilience to extreme weather. Strip tillage is a reduced tillage practice that limits soil disturbance to the area where plants are grown. By using specialized equipment, farmers can till sections of their field for transplants while leaving the space between plant rows untouched. While this practice does have the potential to improve soil conditions, specialized equipment can be a barrier to entry, especially since strip till implements tend to require higher horsepower tractors. There are currently no tobacco farms in Connecticut using reduced tillage strategies, though several are interested and are developing trials.

This report summarizes research conducted at the Connecticut Agricultural Experimental Station comparing **conventional tillage** and **strip tillage** practices over the course of five years (2019-2023), with a focus on **yield**, soil **compaction**, and water **infiltration**. The goal is to help farmers make informed decisions about these tillage methods based on the data and findings presented.

Implementing strip tillage tended to result in faster water infiltration in the row and decreased compaction both in and between rows. At the same time, yield tended to be lower in the strip tilled areas. Some of the yield decrease can be attributed to the learning curve that comes with implementing new practices and may be alleviated with time.

Methods

Experimental plots were established at the CAES Valley Laboratory in Windsor, CT. Four rows were managed using conventional tillage, and 4 rows using strip tillage. These 40” wide beds were 1 meter apart and permanent for the duration of the study. Conventional tillage utilized a moldboard plow to 10 inches and either disced or rototilled to make a bed. Cultivation was done using a Farmall with tines and sweeps; side-dress fertilizer was incorporated at the same time as cultivation using this equipment.

Strip tillage was done with a single shank subsoiler with a depth of 14 inches, followed by spider wheel cultivators to create a 6- to 8-inch-wide smooth bed. Fertilizer was dropped into this strip at the same time as cultivation.

Tobacco transplants were spaced at 2 feet, as per regional norm. Varieties were B1 or C9 broadleaf varieties. Yield was measured by selecting and weighing five whole plants prior to curing. Plants were randomly selected from control and treatment rows, avoiding plants with obvious disease issues. Following harvest, cover crop mixture of winter rye (20 lbs/ac), crimson clover (20 lbs/ac) and radish (8 lbs/ac) was drilled.

Field operations for all 5 study years are described in Table 1 including: plow/till date; fertilizer applications; herbicide applications; tobacco set date; side dress dates; cultivation dates; topping dates; and harvest dates. Fields were irrigated as needed.

Compaction was measured with a digital penetrometer down to 15 cm. Compaction measurements were taken yearly in 2021, 2022, and 2023, with similar field conditions when possible.

Infiltration rate was measured differently over the study period. In all years, a 2-inch diameter PVC column was used and filled with 100 mL of water in 2021 and 200 mL in 2022 and 2023. Infiltration measurements were not taken in 2019 or 2020. When discussed in this brief, differences between years are not examined because of the change in methods.

All statistical analyses were performed using R Statistical Software (v4.4.2; R Core Team 2024). Figures were generated using the ggstatsplot (v0.12.1, Patil 2021), dplyr (v1.1.4, Wickham et al. 2023), ggplot2 (v3.5.2, Wickham 2025), and tidyverse (2.0.0, Wickham et al. 2023) packages. Welch’s t-tests were used to determine statistical significance among the data.

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TABLE 1. FIELD OPERATIONS 2019 TO 2023

	2019	2020	2021	2022	2023
Plow/Strip Till	June 13	April 20	June 2	April 11	April 12 / 21
Fertilize (and bed prep conventional)	June 13, broadcast 80 lbs/A 10-8-10	June 1, broadcast 52 lbs/A 10-8-10	June 8, 60 lbs/A 10-8-10	June 6, conventional 40 lbs/A 10-8-10, Strip till 100 lbs/A	June 6, 45 lbs/A 10-8-10
Herbicide in May	RoundUp Weathermax 2 pts/ac only on Strip Till	RoundUp Weathermax 2 pts/ac only on Strip Till	RoundUp Weathermax 2 pts/ac only on Strip Till	RoundUp Weathermax 2 pts/ac only on Strip Till	June 6, RoundUp for cover crop burndown, Glufosinate 22 oz/A
Set tobacco	June 17	June 4	June 21	June 20	June 12
Side dress 1 & Cultivation	June 24, 75 lbs/A 10-8-10	June 12, 70 lbs/A 10-8-10	June 28, 70 lbs/A 10-8-10	June 23, 70 lbs/A 10-8-10	June 15, 105 lbs/A 10-8-10
Side dress 2 & Cultivation	July 1, 75 lbs/A 10-8-10	June 19, 60 lbs/A 10-8-10	July 6, 80 lbs/A 10-8-10	June 30, 70 lbs/A 10-8-10	June 22, 55 lbs/A 10-8-10
Side dress 3 & Cultivation	July 8, 75 lbs/A 10-8-10	June 26, 50 lbs/A 10-8-10	July 13, 60 lbs/A 10-8-10	July 5, 60 lbs/A 10-8-10	June 30, 50 lbs/A 10-8-10
Irrigation	None	None	June 21, 23, 25, 29 180 gallons each time	July 7, 11, 12, 21 110 gallons each time	None
Herbicide	July 9, Prowl 3.3 EC at 2.4 pints/A	June 26, Prowl 3.3 EC at 2.4 pints/A	June 21 (strip till) and July 15 (conv.), Prowl 3.3 EC at 2.4 pints/A	June 22 (strip till) and July 5 (conv), Prowl 3.3 EC at 2.4 pints/A	June 30, Prowl 3.3 EC at 2.4 pints/A
Pesticide	None	July 2, Coragen @ 6 oz/A	None	None	None
Topping, Sucker Control	August 5, Prime Plus 1:50	July 17, Prime Plus 1:50	July 29, Prime Plus 1:50	August 2, Prime Plus 1:50	July 18, Prime Plus 1:50
Harvest	August 23	August 12	August 20	August 24	August 22

Results

Annual Yield Comparison (Figure 1):

- In 2019, conventional tillage resulted in a higher yield (8.75 kg) compared to strip tillage (7.35 kg) with a statistically significant difference ($p = 0.02$).

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- **2020** saw a similar trend, where conventional tillage outperformed strip tillage (5.84 kg vs. 4.55 kg), again with statistical significance ($p = 0.02$).
- By **2021**, yields were closer, with conventional tillage yielding 6.17 kg and strip tillage 5.67 kg. The difference was still statistically significant ($p = 0.04$).
- In **2022**, yields between the two methods were nearly identical, with strip tillage yielding 6.42 kg and conventional tillage 6.36 kg, and the difference was not statistically significant ($p = 0.89$).
- In **2023**, the gap in yields widened again, with conventional tillage yielding 9.23 kg and strip tillage yielding 7.13 kg. The difference was statistically significant ($p = .04$).

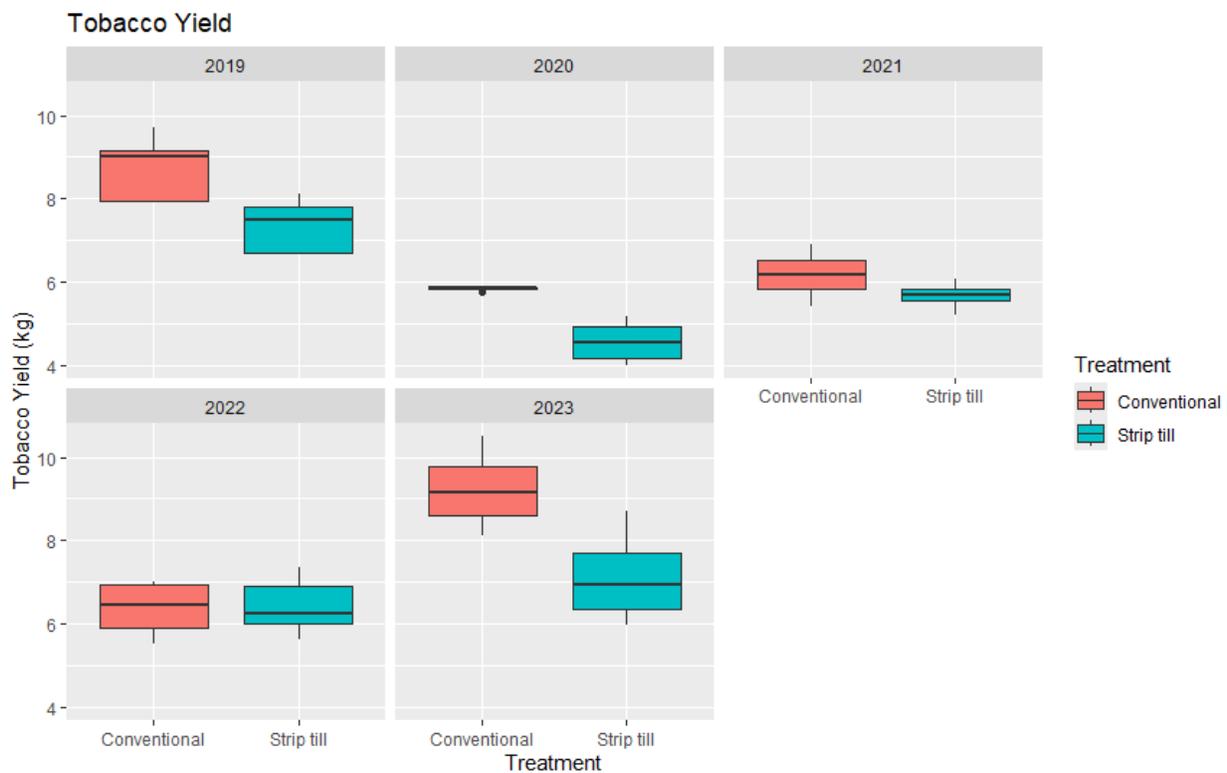


FIGURE 1: TOBACCO YIELD (KG) OVER FIVE YEARS OF STRIP TILL TREATMENT COMPARED WITH CONTROL PLOTS

Many of the differences in yield reflect the ability to control weeds and fertility. In 2019 through 2021, weed management was challenging, and there was a learning curve in adopting strip-till. Over the course of the multi-year trial, herbicide applications became earlier in the strip till plots (approximately the third week of June) to compensate for the fact that weeds germinate earlier because they are not cultivated.

In addition, fertility management also evolved. While tobacco farmers typically put down half of fertility down pre-plant, over the course of this trial we learned to put a larger percentage down pre-plant.

There was a noted increase in ring spot virus, which is transmitted by dagger nematode. Dagger nematode populations are reduced by tillage, with an effectiveness similar to fumigation treatment. The observed effect could have been exaggerated because of edge effects and the small size of each trail plot. Usually, ring spot virus is seen on the edge of fields and the impacts could be different in a larger field. Virus damage did not affect plant weight but reduces plant quality with some leaves being only binder quality.

Practical Takeaway:

Strip tillage plots showed slightly lower yields overall. There were many factors which may have contributed to this: weed competition, a mismatch in nutrient availability, difficulty incorporating fertilizer at planting and sidedress, and edge effects from the small trial size.

Soil Compaction

In-Row Compaction (Figure 2):

- **2021, 2022, and 2023** showed a significant reduction in in-row compaction for strip tillage compared to conventional tillage. When testing for statistical significance, p values were less than .001 in all years.
- Conventional tillage had much higher compaction in all years, while strip tillage reduced compaction significantly.

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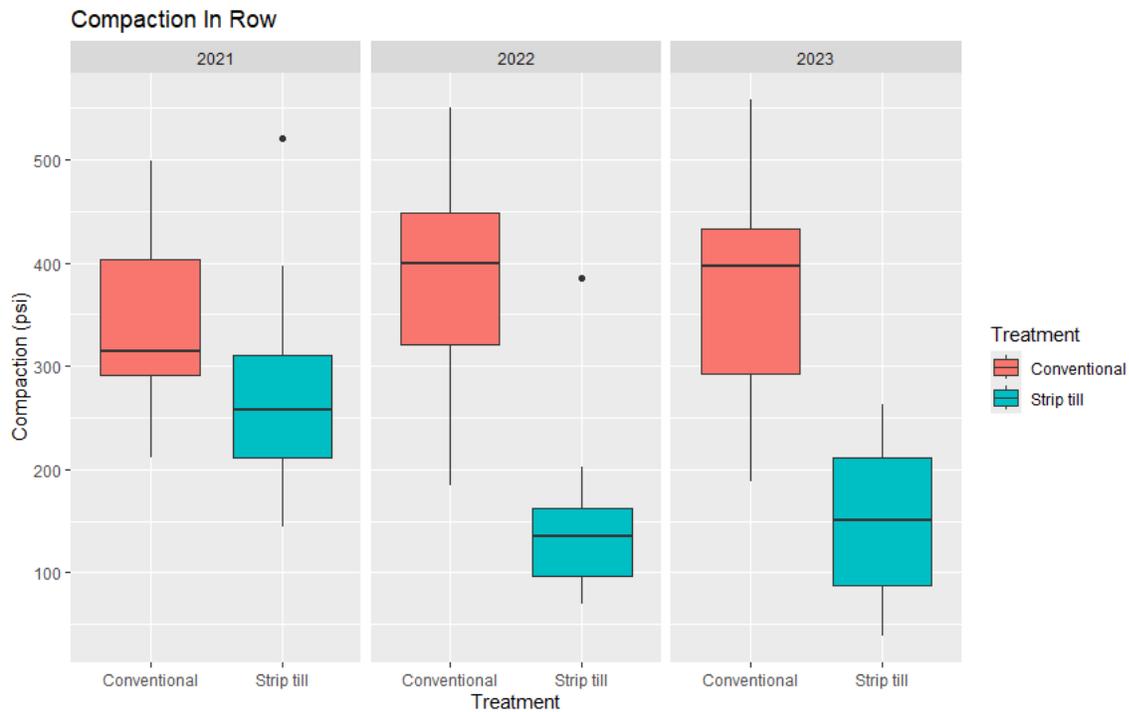


FIGURE 2: SOIL COMPACTION (PSI) IN TOBACCO ROWS

Between-Row Compaction (Figure 3):

- No significant differences were observed between conventional and strip tillage for between-row compaction in either **2021** or **2022** ($p = 0.47$ and $p = 0.41$, respectively). However, between row compaction was statistically significant in 2023 ($p = .04$).

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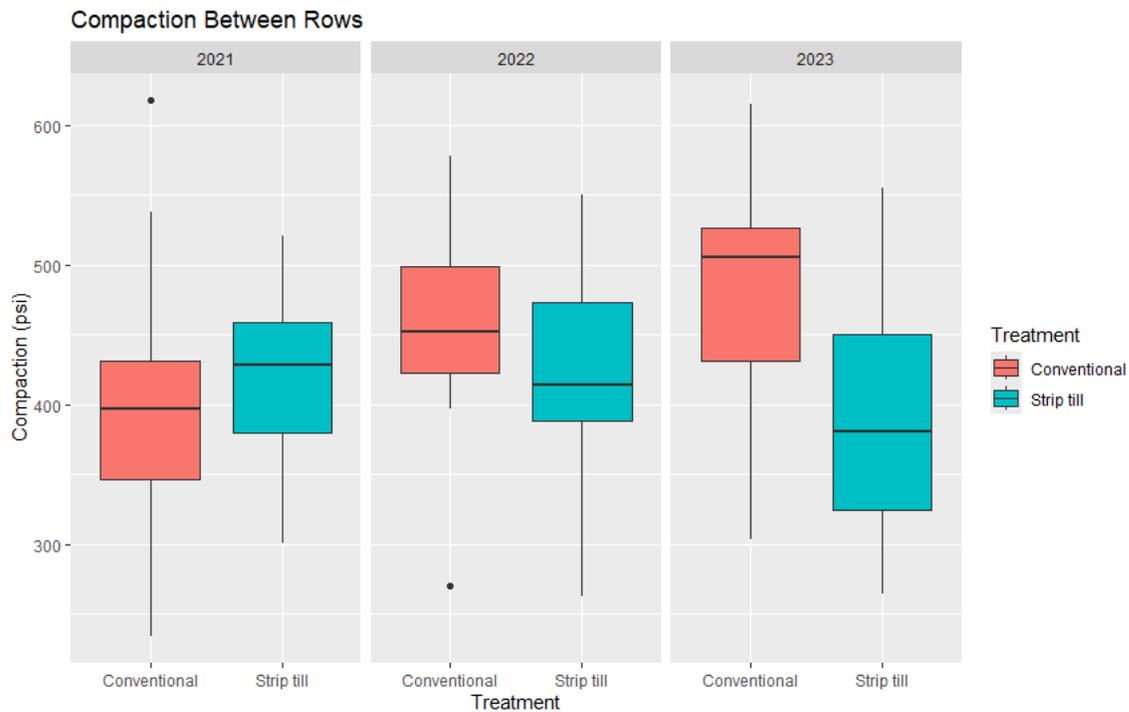


FIGURE 3: SOIL COMPACTION (PSI) BETWEEN TOBACCO ROWS

Practical Takeaway:

Strip tillage significantly reduced in-row soil compaction, which can improve root growth, water infiltration, and overall soil health. While between-row compaction did not differ between the two methods, except in 2023, the benefit in terms of in-row compaction suggests that strip tillage may be a better choice for improving soil structure, especially in areas with compacted soil.

Water Infiltration

Infiltration rate was measured in 2021, 2022 and 2023, and each year the method used a different volume of water, so the data can't be compared precisely. However, data can be looked at within each year. Four measurements were made in each of the years that infiltration data was collected. Though some differences appear pronounced in the figures, there is not enough data to show a strong statistical significance.

2021 (Figure 4):

- **In-row infiltration** rate in 2021 showed a large difference between the two methods, with strip tillage taking significantly less time (36.5 seconds) compared to conventional tillage (168.5 seconds) ($p = 0.001$).
- **Between row infiltration** rate in 2021 showed a substantial difference in infiltration rates between the two tillage practices, with conventional tillage having a slower infiltration rate (557 seconds) compared to strip tillage (116.75 seconds) ($p = 0.003$).

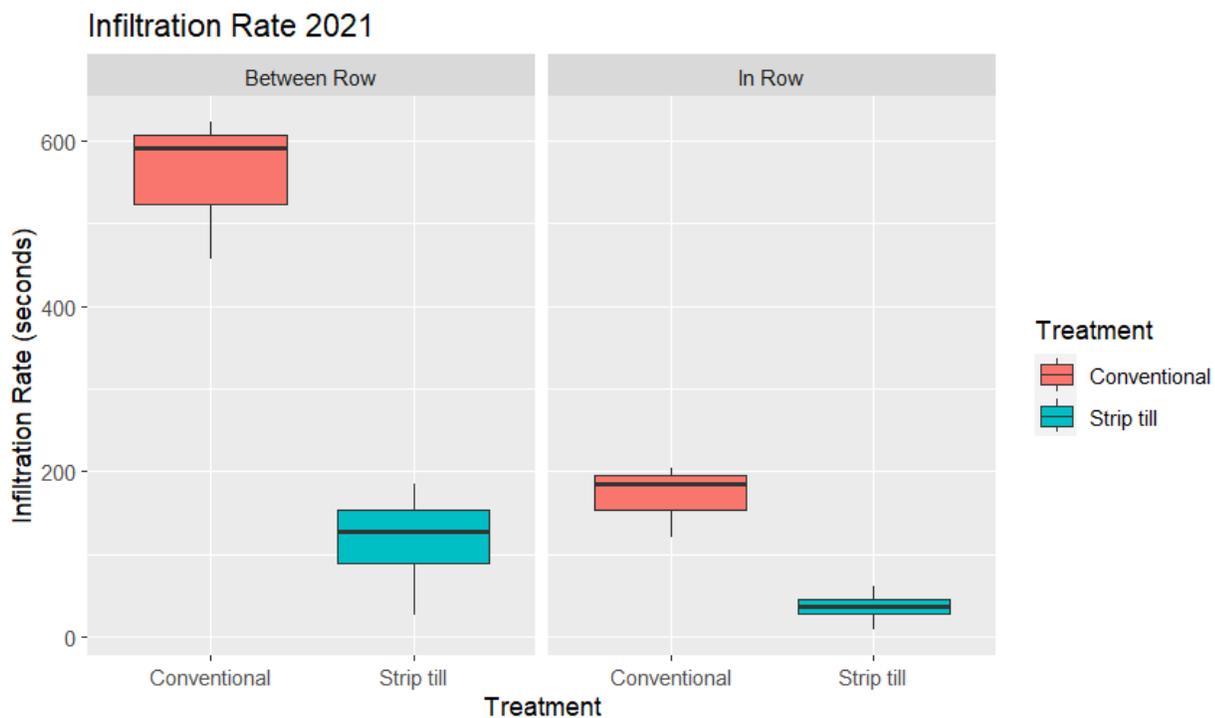


FIGURE 4: INFILTRATION RATE (SECONDS) IN 2021

2022 (Figure 5):

- **For in-row infiltration** rate in 2022, while strip tillage still showed faster infiltration (179.5 seconds vs. 498.17 seconds), the difference was less pronounced ($p = 0.05$), but still noteworthy.
- **Between row infiltration rates** in 2022 were nearly identical between the two methods, with conventional tillage at 535.17 seconds and strip tillage at 554.6 seconds ($p = 0.92$).

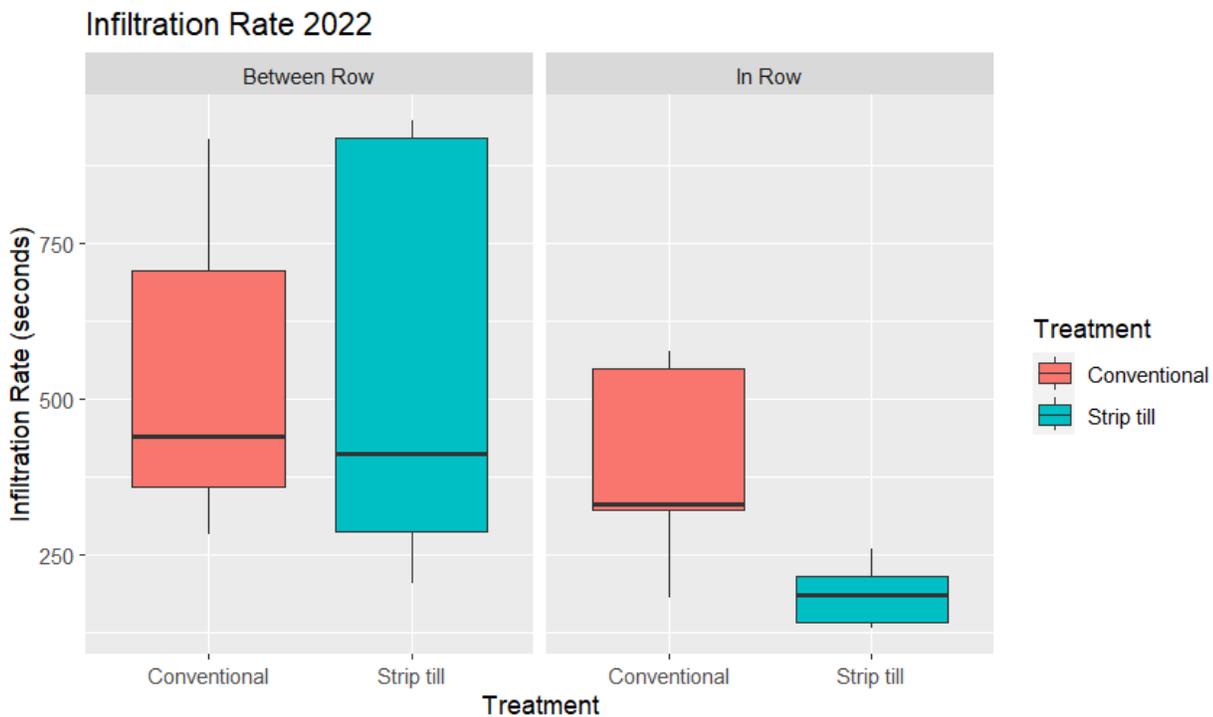


FIGURE 5: INFILTRATION RATE (SECONDS) IN 2022

2023 (Figure 6):

- **For in-row infiltration** rate in 2023, strip-till rates were significantly lower ($p=.03$). Infiltration rates in the row averaged 424.25 seconds in conventionally tilled fields and 126.25 in strip-tilled fields.
- **Between row infiltration rates** in 2023 tended to be lower in the strip till treatment but were not statistically significant ($p = .1$). Infiltration rates averaged 812.25 seconds in the conventionally tilled fields and 455.75 seconds in the strip-tilled fields.

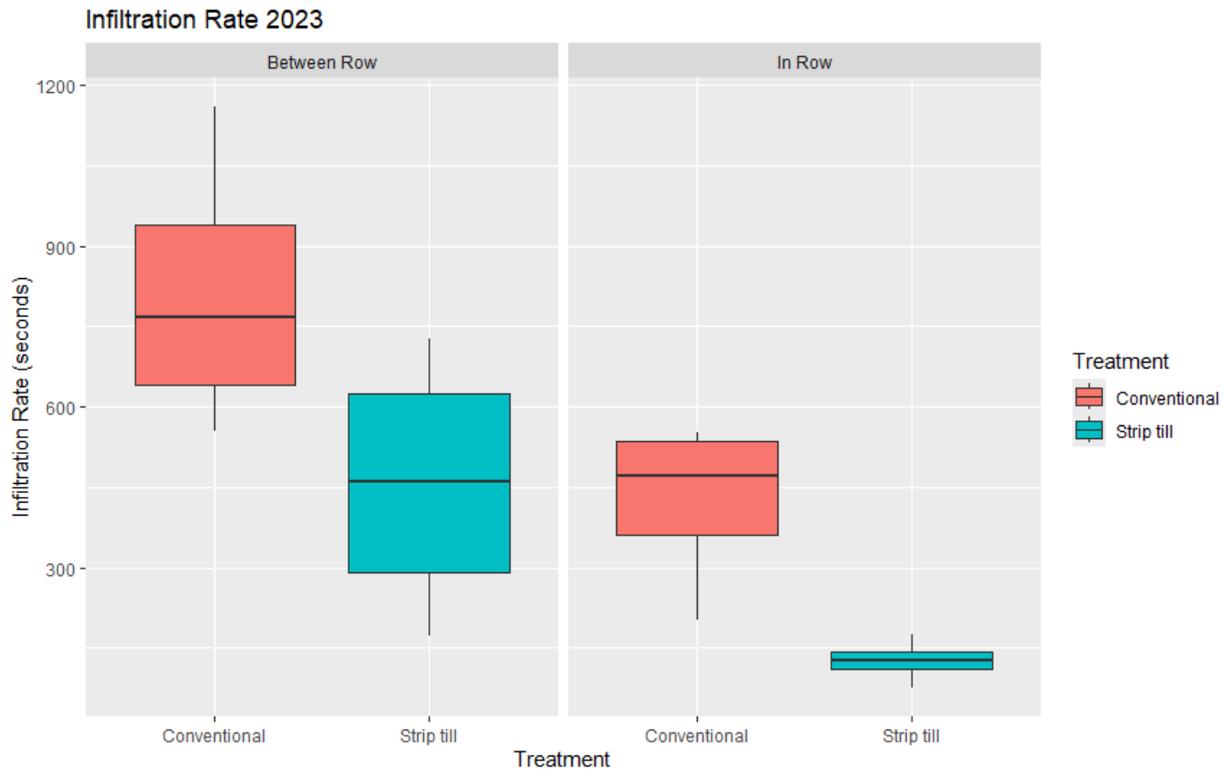


FIGURE 6: INFILTRATION RATE (SECONDS) IN 2023

Practical Takeaway:

Strip tillage significantly improved water infiltration, especially in the in-row areas, which is crucial for reducing runoff, improving water retention, and reducing soil erosion. Standing water promotes black shank disease pressure, so any increase in water infiltration has major benefits to plant health and overall soil health. Additionally, with a short growing season tobacco farmers are often forced to do tractor work on wet soils, which increases compaction. An added benefit of increased water infiltration may be better soil moisture levels for field operations.

Cornell Soil Health Assessment

The Cornell Soil Health Assessment (CASH) was used to evaluate changes in soil health in the conventional plots compared to the strip till plots. The CASH package includes a suite of chemical, physical, and biological analyses that assess the overall health of the soil. Results from each of the soil health analyses are reported as values, which are assigned a rating from 1 to 100 based on the optimal

range of values for each indicator (accounting for the influence of soil texture). The test also provides an overall score for the sample which combines the ratings for each of the soil analyses. This CASH test is widely used for research across the United States, with scores that are calibrated for the Northeast. It highlights the primary indicators that influence soil function and crop production for each sampled field.

The overall average CASH score for both conventional and strip till plots was 46 out of 100, which is a simple average of the ratings for all 10 indicators. There were slight differences in some indicators, but the only statistically significant difference was higher magnesium (Mg) in the strip till plots compared to the conventional plots.

Conclusion: Practical Recommendations for Farmers

Over the five years of this trial, there were significant changes in certain indicators of soil health in the strip tillage plots, specifically in-row soil compaction and in-row water infiltration. Given variable weather from year to year, tobacco growers who adopt and develop effective strip till practices will likely benefit from reduced compaction and improved water infiltration in wet growing seasons. **Yield differences** between the two methods were significantly different in four out of five years, with strip tillage plots having lower yield. **It is possible that yields could be comparable with experienced weed management and appropriate equipment.** Slightly lower yielding strip tillage may still potentially be financially viable, given the amount of time and diesel saved by omitting primary tillage. That calculation would have to be made after doing on-farm trials.

For farmers looking to reduce soil compaction, **strip tillage** offers significant benefits, particularly in reducing **in-row compaction**, which can improve root development and water absorption. Over time, strip tillage could lead to similar or even improved yields, particularly in areas where conventional tillage has caused compaction problems.

The **infiltration data** highlights strip tillage as the superior method for enhancing water absorption and reducing runoff. This could be especially useful in regions prone to heavy rainfall or drought, as it supports better moisture retention and reduces the risk of soil erosion.

There is a steep **learning curve** when using a new method of production, like strip till, which requires adaptive management of herbicides, fertilizer, and equipment for local field conditions. If growers are

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interested in experimenting with strip till approaches, they should have access to equipment that can effectively spread fertilizer in strips, incorporate it to the right depth, and effectively cultivate and spray for weed control in the strip zone. Farmers trialing strip till methods will need to consider applying preemergent herbicide earlier than their conventional fields, without primary tillage to kill early weeds.

More fertilizer may need to be applied upfront, because it can't be incorporated into the soil as it is done conventionally. In the first few years, nitrogen deficiency was observed in plants in the strip till treatment. This was attributed to substantial amounts of nitrogen lost to the atmosphere because no irrigation or rain and a lack of appropriate side dress equipment. Applying 150 lbs N/acre at planting, and reducing side dress N might ameliorate this problem. In addition, growers could use good zone tillage equipment that just requires one pass to fertilizer and create the zone, plus additional equipment that can apply either dry or liquid fertilizer as a side dress and incorporate it at cultivation.

In conclusion, farmers interested in improving **soil health, water infiltration, and reducing compaction** should consider trialing strip tillage, anticipating potential yield trade-offs in the first few years. The data suggests that with careful management, strip tillage could provide a sustainable, long-term solution for better soil and water management on tobacco farms.

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