# How Tillage Influences the Amount of Residue (Example AGRON 183 Report)

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## Introduction

Residue is dead plant material that lies on the soil surface in an agricultural field. Most residue is from the crop grown the previous year. Residue is important for many reasons. It helps to hold the soil in place, reducing wind and water erosion. It supplies nutrients to the soil that are used by future crops. It reduces the amount of water that evaporates from the soil so that more soil water is available to crops. It influences the amount of sunlight absorbed by the soil, which affects the temperature of the soil.

The amount of residue present in a field depends on three things. First, both the current and previous crops. Second, the type of management, and primarily tillage, that has been used in the field. Tillage is when the soil surface is disturbed using some type of implement, like a plow. Third, the length of time that has passed since the residue was deposited.

## Problem Statement / Question

What type of tillage decreases the amount of residue the most?

## Hypothesis

I hypothesize that conventional tillage decreases the amount of residue more than a no–tillage system and a chisel plow system.

## Materials and Methods

Residue counts are one way to quantify the amount of residue in a field. My team made residue counts in three different soybean fields that had experienced different types of tillage. A corn crop had been grown in each soybean field the previous year. In one soybean field no tillage had been performed. In another soybean field, a chisel plow had been used. In the third soybean field, conventional tillage, defined as using a disc ripper the previous fall and two cultivation passes in the spring, had been used.

Figure 1: The method used to collect residue counts. At left, a person making residue counts. At right, a close–up view of the tape measure and residue.

We obtained residue counts by laying out a metric tape measure in the field. A picture of our method is shown in Figure 1. We laid the tape measure diagonally with respect to row direction, at about a 45° angle, for a length of 30 m. We examined the soil surface underneath the tape measure every 5 cm. If a piece of residue lay directly under the tape measure at that point, then we counted it. We reported the total number of counts in 30 m.

The method can be illustrated using Figure 1. From the perspective of the person that took the picture (and not following the shadow on the soil surface) at 55 cm there is residue beneath the tape measure, so that point would be counted. At 60 cm there is residue, another count. At 65 cm it is ambiguous: one person may count it, another person may not. At 70 cm and 75 cm there is no residue, so these points are not counted. The total counts for this section in Figure 1 is either 2 or 3. The maximum number of counts possible in 30 m (a piece of residue under the tape measure every 5 cm) is $30 \text{ m} \div 5 \text{ cm} + 1 = 601$.

# Data Collected

We made residue counts on June 21, 2016, in a conventional tillage field at the Curtiss Farm near Ames, IA, and on June 28, 2016, in a no–tillage field and in a chisel plow field at the Agronomy Farm between Ames and Boone, IA. Data for each field are shown in Table 1. We recorded three counts at one location in each field, each count made by a different person.

Table 1: Residue counts in three soybean fields, each with a different type of tillage. Within each field, three counts were made at the same location, each count by a different person.

| no–tillage | chisel plow | conventional |
|---|---|---|
| 586 | 129 | 188 |
| 563 | 142 | 197 |
| 594 | 163 | 195 |

Table 2: Analysis of data from Table 1.

| | no–tillage | chisel plow | conventional |
|---|---|---|---|
| mean | 581 | 145 | 193 |
| std dev | 16 | 17 | 5 |

# Analysis

I calculated the mean number of counts and the standard deviation for each field using the data in Table 1. The results are shown in Table 2.

I found that the residue counts for a soybean field with a chisel plow at one location has a mean value of 145 and can be expected to vary between $145 - 2 \times 17 = 111$ and $145 + 2 \times 17 = 179$ due to human error (assuming counts made by different people at the exact same location can be described by a Gaussian distribution, and that the expected variability in counts due to human error can be characterized by plus–or–minus two standard deviations away from the mean number of counts). A field with no tillage has a mean value of 581 and can be expected to vary between $581 - 2 \times 16 = 549$ and 601 (the maximum possible number of counts) due to human error. A field managed with conventional tillage has a mean value of 193 and can be expected to vary between $193 - 2 \times 5 = 183$ and $193 + 2 \times 5 = 203$ due to human error.

In summary, I found that: when no tillage was performed, the residue count can be expected to vary between 549 and 601; when conventional tillage was performed, the residue count can be expected to vary between 183 and 203; and when a chisel plow was used the residue count can be expected to vary between 111 and 179.

# Conclusion

I expected that conventional tillage decreases the amount of residue more than a no–tillage system and a chisel plow system. However, according to the number of residue counts observed in three different soybean fields, each with a different management system, I found that a chisel plow system decreases the amount of residue more than a no–tillage system and a conventional tillage system.