

Crop Residue Management Raises Soil Fertility Questions

By Harold F. Reetz, Jr.

Residue management is an important consideration as farmers move toward reduced tillage to control erosion and meet other conservation plan objectives on highly erodible land (HEL). Determining the actual percent residue cover can be a challenge. The photos with this article illustrate different amounts of corn and soybean residue. Some soil fertility considerations are discussed.

IN RECENT YEARS, the soil-saving value of crop residue has gained importance. Recent changes in management systems result in more residue remaining on the surface of fields.

Color photographs featured here show actual field situations. The photos were provided by the Soil Conservation Service (SCS) state office in Illinois, to illustrate varying percentages of corn and soybean residue cover after planting. The photos should be useful for estimating residue cover by comparison.

Actual measurement is a more reliable method of determining whether a field's residue cover is in compliance with HEL conservation plan requirements. The "line-and-point method," using a 50 ft. tape marked in 6-inch increments (or a rope with knots tied at 6-inch intervals)

is an easy, accurate way to estimate residue cover (**Figure 1**).

Increasing residue left on the soil surface through reduced tillage raises several questions relative to soil fertility management. Research is ongoing to help provide answers and establish management guidelines. Following are some of those questions and some points for consideration.

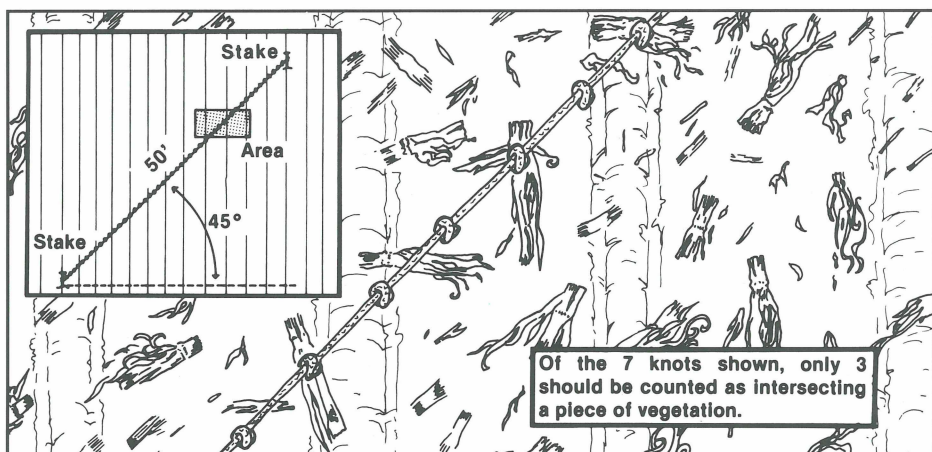
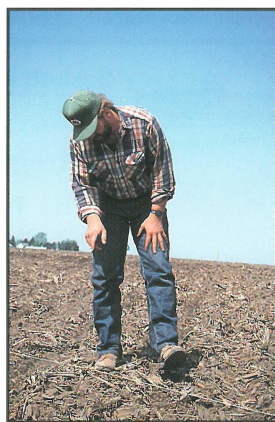


Figure 1. Overview (insert) and closeup of the line-and-point method of determining percentage of surface residue covering.

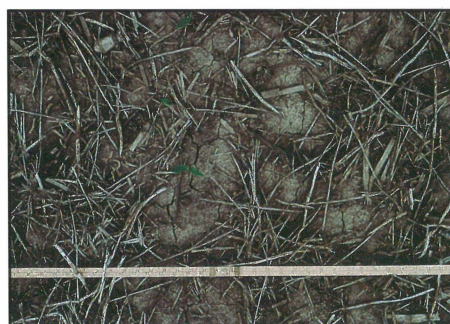
Dr. Reetz is Midwest Director of the Potash & Phosphate Institute, Monticello, IL.

Crop Residue Management

Corn



High Residue (80 percent)



Medium Residue (35 percent)



Low Residue (10 to 15 percent)

Soybeans



High Residue (60 to 65 percent)



Medium Residue (40 percent)



Low Residue (10 to 15 percent)

How does leaving more residue on the surface affect soil test levels and nutrients available to crops?

- Residue on the surface ties up nutrients for a short time until that residue can decompose, possibly increasing the amount of fertilizer needed for the current crop. This residue can also be a slow release nutrient source in some situations.
- As the residue decomposes, there is a tendency for phosphorus (P) and potassium (K) to accumulate at or near the surface. Fertilizer P and K are also likely to accumulate at the surface. Under residue mulch with no-till, there is more root mass in the top 3 inches to utilize these nutrients. In dry years or low rainfall areas, nutrients may be “positionally

unavailable" to the growing crop.

- There may also be a tendency to deplete nutrient levels . . . especially P and K . . . lower in the root zone where the decrease is not detectable by the standard 6 to 8-inch soil sampling depth. Shallower sampling in compacted soils may give inaccurate, high soil test readings.
- Often, pH will be lower near the surface due to acid produced by nitrification and by the decomposing crop residue. However, when lime is applied, the surface pH may remain unusually high. At either extreme, herbicide and nutrient availability may be adversely affected. Applying half the amount of lime twice as often will help to alleviate this problem.
- Occasional tillage to incorporate lime and mix nutrients into the root zone may be an acceptable part of a conservation plan for a given field. Consultation with local SCS offices will help determine the options available. Explore deep placement and timing alternatives to have least impact on residue cover.

How does soil fertility level influence the amount of residue produced by a crop?

- As yields increase, residue production

may increase. Each extra bushel of corn is accompanied by about 56 lb of added stover production. It is easier to get 35 percent residue cover with a 200 bu/A corn crop than with a 100 bu/A corn crop.

- Higher fertility produces higher yield potentials. Set a realistic yield, then build and maintain soil tests to support that yield.
- Higher yielding crops produce more extensive root systems, which more efficiently utilize water and nutrient resources and also help hold soil in place.

How does increased residue affect fertilizer requirements?

- Residue on the surface insulates the soil, making it slower to warm up in the spring. A concentrated nutrient supply, such as starter fertilizer close to the seedlings, may help to get optimum stands established and early crop growth, even when soil test values are high. Conditions later in the season will determine whether these early advantages are translated into yield increases.
- Having more nutrients tied up in crop residue may increase the short-term fertilizer requirement, especially in the first 3 to 5 years.

Table 1. Guide to estimated percentage of soil covered by crop residue after field operations.

Predict the effect your till/plant system will have on crop residues by multiplying the percentages for each operation you use. These are broad ranges. Speed, depth and soil moisture can affect the amount of residue left.

Tillage operation	Corn/Small grain	Soybeans
After harvest	90-95	60-80
Over-winter decomposition	80-95	70-80
Moldboard plow	0-10	0-5
Paraplow	80-90	75-85
Combination secondary tillage tool	50-75	30-60
Chisel (twisted points)	50-70	30-40
Chisel (straight points)	60-80	40-60
Disk (off-set, primary >9" spacing)	40-70	25-40
Disk (tandem, finishing 7"-9" spacing)	30-60	20-40
Anhydrous applicator	75-85	45-70
Field cultivator (as secondary operation)	60-90	35-75
Row planter	85-95	75-95
No-till drill	55-75	40-60

Here's an example of how to estimate how much residue cover will be left after each tillage operation.

$$\begin{aligned}
 &95\% \left\{ \begin{array}{l} \text{after corn} \\ \text{harvest} \end{array} \right\} \times 60\% \left\{ \begin{array}{l} \text{fall chisel} \\ \text{twisted points} \end{array} \right\} \times 90\% \left\{ \begin{array}{l} \text{after} \\ \text{winter} \end{array} \right\} \times 45\% \left\{ \begin{array}{l} \text{spring disk} \\ \text{tandem} \end{array} \right\} \times 90\% \left\{ \begin{array}{l} \text{planting} \end{array} \right\} \\
 &= 21\% \left\{ \begin{array}{l} \text{residue cover} \\ \text{after planting} \end{array} \right\}
 \end{aligned}$$

How does the residue requirement affect fertilizer placement options?

- Any injection or incorporation method will reduce the amount of residue left on the surface. So placement systems such as surface banding or broadcast will cause least disturbance of residue. **Table 1** shows how to estimate residue cover loss from various field operations.
- The option of building soil test levels before going to reduced tillage is even more important as a means of supplying adequate nutrients throughout the root zone.

Residue management for conservation compliance is good business. It preserves the basic soil resources of the farm while helping protect water resources from contamination. Coupling sound agronomic management with responsible environmental protection can result in long-term optimization of profits. Farmers working in cooperation with their fertilizer dealer, their SCS representative, their Extension adviser and other consultants can develop a management plan that meets all of these goals. ■

How to Measure Crop Residue on Fields

- **Use a 50-ft. rope** equally divided into 100 parts. A 50-ft. tape measure using each 6-inch and 12-inch mark also works well.
- **Stretch the line** diagonally across the rows. Count the number of marks, tabs or knots that have residue under them. It is important to use the same point under each mark for accuracy. If a piece of residue is smaller than one-eighth of an inch, don't count it.
- **Walk the entire length** of the rope or tape. The number of marks with residue under them equals the percentage of cover. If your rope or tape has only 50 marks, then multiply your count by two.
- **Repeat the above steps three** times in different areas of the field. Add the scores together and divide by three to find the average percentage of cover for the field.

12 Ways to Leave More Crop Residue

1. **Use high residue producing crops.** Plant crops such as corn in your rotation.
2. **Spread residue evenly.** Spreaders on harvesting equipment will help.
3. **Skip fall tillage,** especially after soybeans. Fall-tilled soybean ground is very vulnerable to erosion in late winter and early spring.
4. **Make fewer tillage passes.**
5. **Use cover crops.** Rye and wheat are good options when you grow low-residue crops such as soybeans.
6. **Set chisels and disks to work shallower.** Residue will be buried to about one-half the tillage depth.
7. **Don't use a moldboard plow.**
8. **Drive slower on tillage operations.** Tilling at higher speeds throws more soil and covers more residue.
9. **Use straight points and sweeps on chisel plows.** Twisted points may bury about 20 percent more residue.
10. **No-till drill soybeans.** No-till drilling keeps more crop residue on the soil surface and produces a canopy faster than row planting.
11. **Go no-till on sloping land or ridge-till on flatter land.** Both disturb only the crop residue in the rows.
12. **Don't till when soil is wet.** Tilling wet soil will cover more residue than tilling when the soil is dry.