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# G86-782 Distribution of Crop Residue A Requirement for Conservation Tillage

John A. Smith
*University of Nebraska - Lincoln*, jsmith5@unl.edu

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# Distribution of Crop Residue A Requirement for Conservation Tillage

**This NebGuide describes problems associated with inadequate distribution of crop residue behind the combine, and identifies techniques to obtain proper distribution.**

*John A. Smith, Extension Machinery Systems Engineer*



Uniform distribution of crop residue during harvest is essential to the successful use of conservation tillage systems. Crop residue on the soil surface reduces soil erosion and conserves soil moisture. However, the residue must be properly managed to achieve these benefits. Uniform distribution behind the combine is an important part of this management. Large capacity combines equipped with 24- to 30-foot grain platforms and 8- to 12-row corn headers complicate residue distribution. When crop material is collected from a 30-foot width and deposited from the rear of the combine in a 6-foot band or windrow, residue related problems can be expected. This is a common problem with wheat, but has also been experienced with corn and other heavy residue crops.

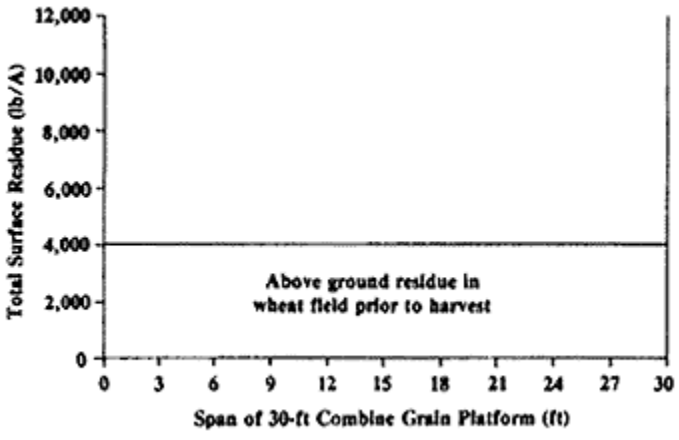


**Figure 1. Residue distribution prior to wheat harvest on a field with 4,000 lb/A residue.**

## How Serious Can Combine Residue Distribution Be?

As an example, wheat produces approximately 100 lbs of above-ground residue per bushel of grain

yield. A 40 bu/A yield would thus produce about 4,000 lb/A of straw and chaff. Depending on the height of cut and other factors, roughly 50 percent of the total residue produced by the crop will pass through the combine. Of the total residue passing through the combine, 40 to 70 percent is composed of fine particles, normally called chaff, that drops from the combine chaffer and sieve section. These fines normally do not reach the straw spreader or straw chopper.

*Figures 1* through *4* represent several possible residue distribution situations. Each assumes an initial 4,000 lb/A residue amount--50 percent left as uncut stubble, 50 percent of the total passing through the combine as chaff--and a 30-foot wide grain header. *Figure 2* shows that a concentration of 12,000 lb/A is left if the combine has no straw or chaff spreaders, and if the residue drops in a 6-foot windrow. This situation is nearly impossible to seed into without removing the windrow or using some form of tillage.

Many combines with a 30-foot grain header are equipped with straw spreading devices capable of spreading the straw over an 18-foot width, but do not have chaff spreaders. The result of this arrangement is shown in *Figure 3*. The 6-foot wide strip where the chaff falls will have a total residue accumulation of nearly 9,000 lb/A. This amount of residue is also very difficult to seed or plant through, and illustrates that distribution of both straw and chaff is necessary for acceptable results.

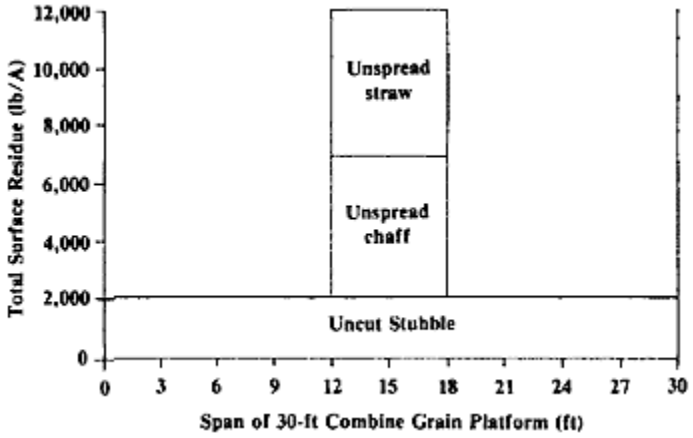


**Figure 2. Residue distribution after harvest using a combine with no straw or chaff spreading. Assume 50% of total residue passed through combine and 50% left as standing stubble.**

*Figure 4* represents the same field using a combine equipped with both straw and chaff spreaders capable of spreading to a width of 24 to 30 feet. The maximum residue amount is less than 5,000 lb/A and is acceptable for most planters or seeders equipped for no-till.

Corn and other crops generally produce smaller amounts of residue than wheat, but the effect of concentrating this material as it passes through a combine without spreaders is similar.

## Problems Related to Inadequate Residue Distribution

- ***Weed Seed Concentration*** **--** Weed seeds and grain lost through the combine are concentrated when the residue is concentrated. A concentration of weeds or volunteer wheat is more difficult to control than uniformly distributed plants.

- ***Interception of Herbicides*** **--** Poorly

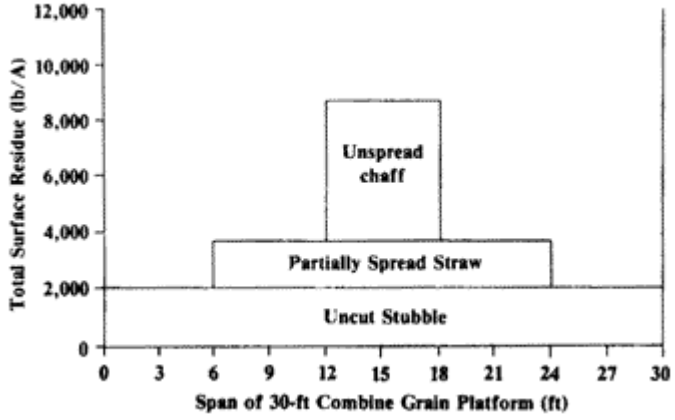


**Figure 3. Residue distribution after harvest using a combine that spread straw uniformly over 18-ft width, but no chaff spreading. Assume 50% of residue passing through combine was chaff.**

distributed residue can be a physical barrier that may prevent uniform and effective application of herbicides to the soil or weeds.

- ***Pest Infestation*** -- Piles or windrows of residue may provide habitat for insects and rodents and encourage disease.

- ***Insulates Soil Surface From the Sun*** -- Heavy concentrations of residue shield the warming effects of the sun from the soil surface. This may depress soil temperature and seedling emergence. The soil moisture content may remain higher under heavy residue, which could be undesirable in certain planting situations.

- ***Poor Tillage Performance*** -- If tillage operations are included in the cropping system, concentrations of residue may plug the tillage implement or impair its performance.

- ***Necessitates or Increases Tillage*** -- If weed control or planting cannot be accomplished because of poorly distributed residue, tillage or increased tillage may be necessary.

- ***Increased Demands on Planting Equipment*** -- Good residue distribution may allow use of existing planters or seeders. Poor residue distribution may dictate use of special, more expensive equipment to obtain an adequate crop stand. Windrows and piles of residue may plug planting equipment or cause bunching of the residue. This can be both annoying and detrimental to the crop stand.

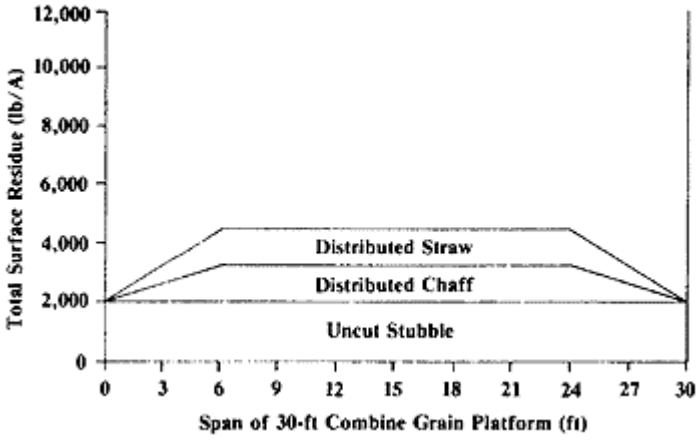


**Figure 4. Near ideal distribution of straw and chaff by a combine equipped with spreader for chaff and straw capable of spreading over a 24- to 30-ft span. Residue left in windrows interferes with herbicide application, tillage, and planting operations.**

- ***Poor Seed-Soil Contact*** -- If the planter or drill mechanism cannot cut through or separate heavy accumulations of residue, it may punch the residue into the soil with the seed. Often termed "hairpinning," this can cause poor seed to soil contact and poor germination. Planting equipment with disks or colters are most vulnerable to this problem.

- ***Excess Residue Directly Over the Seed Furrow*** -- When there is too much crop residue directly over an emerging plant, various degrees of plant injury may result. This phenomenon, often termed phytotoxicity or allelopathy, is not yet completely understood. However, poor stand and poor yields often result.

## How Much Residue Is Tolerable?

Acceptable quantities of residue, or the allowable extent of residue concentration, depend on many factors and specific values cannot be provided. Factors to be considered include the crop harvested, the crop planted, climate, planting equipment, age of the residue, and the amount of residue remaining directly over the emerging plant.

A common example in the Nebraska Panhandle is no-till winter wheat in a wheat-fallow rotation with an annual precipitation of 15 inches. Uniformly distributed residue in excess of 8,000 lb/A located directly over the emerging wheat plant would be expected to cause some planting problems, plant injury, and yield reduction.

**A good general rule is to avoid residue amounts in excess of 5,000 lb/A *directly over the emerging plant.*** If the field has higher levels of residue prior to planting, either in the form of windrows or uniformly distributed, the planting equipment should move some of the residue into the inter-row area to avoid direct contact with the emerging seedlings. After the seeder has passed, the residue directly over the seed furrow and one or two inches on either side should not exceed 5,000 lb/A. Higher amounts of residue in this critical seedling area may result in reduced yields.

## How To Improve Straw and Chaff Distribution

Prior to 1985, combines were not designed to spread the chaff or fines that drop from the shoe section of the combine. Straw spreaders on certain combine models with grain platforms of 24 feet or less provide adequate distribution of the long residue that falls from the straw walkers, but produce unacceptable spreading on other models. Wind in excess of IS mph further hampers good spreading.

As conservation tillage systems become more common and there is increased demand for good residue distribution, combines may come equipped with improved straw spreaders plus chaff spreading features. In the meantime, there are alternatives that must be used.

### Management Practices to Improve Residue Distribution

- *Bale Straw* -- This will not pick up the chaff, but will remove the long residue if windrowed by the combine. Economics may limit baling to those with a use for baled straw or stalks.

- *Straw and Chaff Collectors* -- These units are towed behind the combine and collect the straw and chaff as it drops from the rear of the combine. This substantially decreases the effective speed of harvest with a given combine, because of additional materials to be handled.

- *Select a Short Growing Variety* -- Small grain varieties termed dwarf or semi-dwarf are being released that, in many cases, produce less straw than the taller varieties. This in turn will often mean less residue on the field and less passing through the combine to be spread. Short varieties often have less lodging, which would allow higher cutting height and less material passing through the combine.

- *Leave a Tall Stubble* -- If small grains are cut as tall as possible without missing low growing heads, there will be less residue passing through the combine and less to spread.

- *Avoid Stopping the Combine* -- Whenever it is necessary to stop the forward motion of the combine, first attempt to allow the combine to clean out by pulling out of the uncut grain or backing up, if possible. This will prevent the piles of residue that occur when forward motion is stopped first.

### Equipment Considerations to Improve Residue Distribution

- *Improve Existing Spreaders* -- Repair or modification of existing straw spreaders and choppers will often improve spreading of the long residue. Since chaff does not pass through these devices,

this will do nothing for chaff distribution. If the spreader bats are worn and have rounded edges, replace them. Square edges on new rubber bats will normally increase spreading width. Try increasing the rotational speed of the spreader by changing drive sprockets or sheaves. Add more bats, longer bats, or increase the width of the bats. If alterations are made in the mechanism, provide safety shields that will prevent accidental contact with moving machine components. Longer and angled deflector blades may improve spreading of chopper attachments. Before attempting modifications, check with the combine dealer or manufacturer to determine if these changes could have an adverse affect on the life or performance of the combine.

- *Improvise for Chaff Spreading* -- Some combine operators have improvised existing equipment to obtain some degree of chaff spreading. This often includes some method of getting the chaff back to the straw spreader and improving the spreader to handle chaff. Increased or redirected air flow may move the chaff far enough to reach the straw spreader bats, but avoid sacrificing the cleaning performance of the combine. Deflector pans or chutes may be used to move the chaff back to the straw spreader. Lowering the straw spreader may help get the chaff into the spreader. Longer bats, more bats, or a solid disk in' the center of the bat assembly may improve chaff spreading by the straw spreader.

- *Purchase Add-On Equipment* -- Add-on equipment to spread straw and/or chaff can be purchased for most larger capacity combines. Chaff spreading concepts include horizontal spinning disks, axial fans, and other air conveyance systems. Most add-on straw spreaders utilize a spinning disk or blade mechanism. Longer and more angled deflector blades are available for choppers. Many of these add-on devices will have excellent spreading performance, but carefully consider other aspects before making modifications. If hydraulically driven, does your combine have adequate hydraulic pressure, flow rate, and cooling capacity? Does it appear to be vibration-prone to cause structural damage to your combine? Will the unit consume enough power to detract from the combine capacity? Do the mounting and mechanical drive features appear to be adequate to avoid early maintenance problems? Is it detachable so it can be installed on another combine? Is it convenient to operate the combine without running or removing the spreader? Does the spreader limit access to sieve or chaffer adjustments?

**Last Resort Options**

If the distribution of residue is clearly inadequate for subsequent field operations, some form of tillage may be necessary. Drags, rotary hoes, and light harrows have been used with varying degrees of success to spread residue with limited soil disturbance. These methods are often inadequate and may cause further residue bunching.

A tractor powered, high rotational speed, straw chopper could be used to chop the residue and provide some redistribution. The chopped residue would improve planting performance in most situations, but any beneficial effect of standing residue will be lost. The finely chopped residue may not be as effective for wind erosion control as standing, attached residue. Standing residue will trap more snow than chopped residue, which in turn will increase soil moisture and may reduce winter injury of fall seeded crops. This type of chopper requires high energy input and will increase production costs.

Intensive tillage with implements such as a chisel plow or disk will provide a remedy for poorly distributed residue that cannot be handled otherwise. These primary tillage operations must normally be followed with one or more secondary operations, such as with a rod weeder, to prepare the field for seeding. Although tillage may solve the problems caused by poor residue distribution, the operation will increase production costs and increase the opportunity for undesirable soil erosion and moisture loss.

**Custom Combine Crews**

Only a small percentage of the custom combining operations are presently equipped with good straw and chaff spreaders. Growers who use no-till or reduced tillage systems and employ custom harvesting should search for custom combine operators with appropriate spreading equipment. These crews must be contacted far ahead of combining time.

## Residue Distribution is a Must

Good distribution of straw and chaff is absolutely essential to the success of no-till planting a crop into wheat stubble. In certain situations it may be just as important when no-till planting into corn stalks. Uniform residue distribution will enhance weed control, and will allow use of less specialized seeding equipment to obtain good crop stands.

There are several methods and types of equipment available to obtain satisfactory distribution of the residue. The best option is with the combine during harvest. The extent of distribution must match the abilities of the weed control program, planter, or seeder that follow the harvest. If good residue distribution is not achieved, it may be necessary to abandon no-tillage and select a tillage system that will still maintain some surface residue while allowing good weed control, good planting, and subsequently good crop yields.

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