Chop It, Distribute It And Do It Evenly.

2008 National No-Till Conference.

Handout to Accompany Presentation.

By

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Residue Distribution Behind The Combine

Successful no-tillage begins with even distribution of straw AND chaff during the harvest of the previous crop. Short chop length is also important to achieve accelerated residue decomposition and faster nutrient cycling, but shorter lengths of straw consume more power and are more of a challenge to distribute across the header width. Mixing the straw and chaff together (such as used with Case 2388/8010/John Deere STS/Claas Lexion) and spreading it as one mass of material helps convey the ligher material and chaff. Light crops harvested on windy days present the biggest problems for all brands of combines, so any chopper/spreader combination positioned closer to the ground is generally a better option because the wind does not affect the material as much. Any chopper/spreader system which incorporates an air distribution principle is better still. Its many times easier to blow residue, rather than trying to throw it, especially during dry harvest conditions.

Most US built combines have adequate residue distribution systems, but some work better than others during specific crop and crop moisture conditions. In many examples, modifications or upgrades are required to achieve the standard of residue uniformity required for successful no-till.

One example of a combine with less than ideal residue distribution is the John Deere 9600 illustrated in Image 1 (above right). This combine was operating in high yielding (90-100bu/ac) wheat which was treated with a fungicide. Fungicides can increase the stay-green of the straw, making it more of a challenge to chop and distribute evenly.

Image 2 (above right) illustrates the rasp bars within the 9600, which was illustrated in Image 1. Closer examination revealed that the flighting within the center of the header auger was bringing too much material to the center of the feeder house. This resulted in an overloading of the center of the cylinder and too much straw was then directed towards the center of the straw chopper. This was confirmed by comparing the wear on the centre chopper blades to the ones on the outer ends. Many headers have bolt on flighting in the centre section of the auger, so if material is found to concentrate in the middle of the feeder-house, try removing some of the flighting.

Image 3 and 4 (above right) illustrate a single and double spinner chaff spreader (both manufactured by Vittetoe) installed on John Deere 9600's. While both chaff spreader designs are better than none, the double spreader does distribute chaff much more evenly than the single spinning spreader.

Image 5 (above right) illustrates a John Deere 9650 STS operating in 30-40 bu/ac wheat in Kansas. The 10-20mph side wind really took its toll on residue distribution, especially on this combine which was working round and round the field. When wind speeds are high, if possible try to cut the crop up and down on the downwind side of the crop, rather than into the wind, because it will usually produce the best spread residue pattern.


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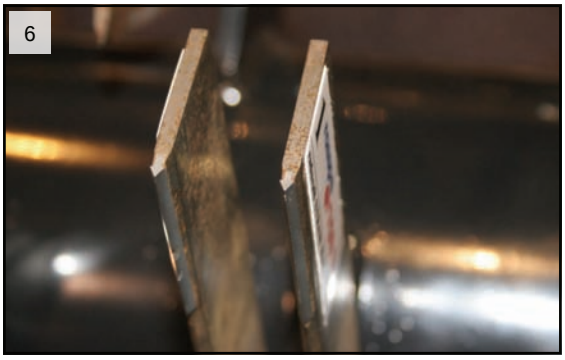
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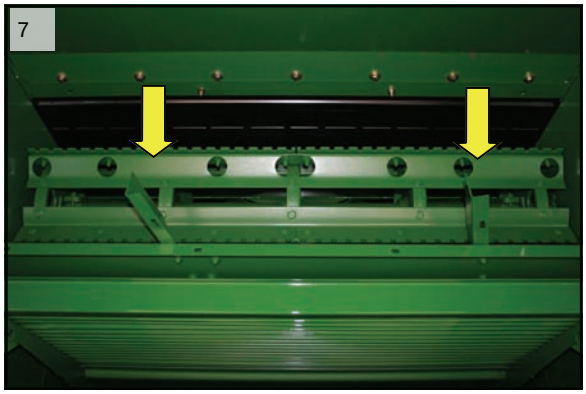
Knife blades must remain sharp to ensure even residue sizing and minimize power losses. Various brands of after-market knives are also available, such as the ones illustrated in Image 6 (above).

John Deere STS Discharge Beater Vane Adjustment

Feeding material into any straw chopper evenly is essential to achieve uniform output. One commonly forgotten adjustment on the John Deere STS combine which can significantly improve residue distribution, is the adjustment of the vanes behind the discharge beater as illustrated in Image 7 (right). Adjustable vanes are standard on the 70 series, but holes or slots can be made within earlier season models. In very dry crops the John Deere STS rotor discharges more of the material to the left, so position the vanes to move more material to the right. In higher moisture conditions, the rotor discharges more material to the right, so position left vane straight back and move the right vane to the left so it deflects material to the left.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John Deere PowerCast Tailboard

John Deere introduced its PowerCast tailboard in 2006 (Image 8, right). Although this was a very welcome improvement over the previous chopper offerings, it's performance is still limited in light, dry crops. The PowerCast system does produce much greater spread widths compared to the standard chopper and tailboard combination, but in many conditions too much dense material is sent to the outer ends of the spread pattern. Removal or cutting of the rear shroud (illustrated within the inset Image 8) will help distribute more material behind the combine. Adjustment of the plastic vanes (forwards or backwards) on the paddles also improves the performance of this tailboard. 70 series combines also have deeper paddles, which should also help improve distribution uniformity.


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New John Deere 70 Series Fine Cut Chopper

The new John Deere fine cut chopper illustrated in Image 9 (right) utilizes 44 wing blades instead of the former 68 paddle blades. The chopper also features four scoop paddles at each end of the rotor to create an air-stream which improves material flow through the chopper. Also on the 70 series is a new and wider tailboard which helps distribute residue better across 30' or narrower combine head widths.


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Case Combine Choppers

Image 10 (right) illustrates the standard straw chopping and spreading system on a Case AFX8010 combine. This is a good system because it includes an internal straw chopper, which chops and throws the sized material to a pair of rotating spreaders. The distance between the chopper and the spreaders appears to distribute the residue flow more evenly into the two spreaders, to help with distribution. The speed of the spreaders can be adjusted with a hydraulic block on the left side of the combine (when viewed from the rear). The AFX8010 two part system works well in most conditions, but this current version has no ability to adjust the spreaders from the cab or the direction that material is thrown to allow for different crop moisture levels and side winds. Both additions would be very welcome for no-tillers.


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Case Choppers (continued)

Image 11 (right) illustrates the good residue chopping and spreading performance of a Case 2388 combine. It also incorporates a two part system of chopping and spreading, similar in design to the Case AFX8010, but the speed of the spreaders cannot be adjusted hydraulically, because they are belt driven rather than hydraulically driven. The speed of the spreaders can however be changed by switching a pulley on the spreader drive system. The standard spreading system includes a 10" pulley, but an 8" pulley is preferred for header widths larger than 30' or when harvesting lighter materials. Your Case IH dealer will be able to order the 8" pulley to help with increased spreading performance.

New Holland Choppers

Most New Holland CR series combines struggle with even residue distribution. Their choppers perform quite well, but most of them concentrate residue into three distinct bands behind combines including the CR960 combine illustrated in Image 12 (right). Adjustments to the tailboard helps in some situations, but it always seem a struggle to achieve a satisfactory pattern especially with 30' or wider header widths which are becoming very common.

Caterpillar Lexion Choppers

The 500 series Lexion combines incorporate a standard Redekop MAV chopper, the highest performing chopper currently available on the US and Canadian market. The Lexion 480 illustrated in Image 13 (right) was fitted with a Redekop MAV chopper and the chopping and spreading performance is excellent across the 36' header as illustrated in Image 13.

This chopper is achieving all of the required parameters which include:

- Uniform spreading of straw across the header width.
- Uniform spreading of chaff.
- Fine chopping of straw.

Challenger Spreaders

The Challenger 670 pictured in image 14 (right) was really struggling to distribute residue wider than 15-20' with the factory spreader. Fitted with a 36' draper head, the combine in this situation produced concentrated bands of residue directly behind the combine which would make no-till systems a real challenge, if not impossible. The rotary separation system, added to the dry harvest conditions did destroy the residue quite well, but the distribution pattern was very poor in this situation and was well in need of improvement.

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Redekop Straw Choppers

One sound solution for most combine residue sizing and distribution problems can be achieved by Canadian manufacturer, Redekop. Many Canadian farmers have been direct seeding for 20 years and Redekop responded during the early direct seeding days with a series of products which addressed most residue management problems. Redekop builds advanced choppers for most brands of combine and their new MAV is the flagship of the range. The MAV offers the benefits of a tight knife spacing for excellent chopping with an air-assisted residue distribution system which utilizes a fan at each end of the rotor. Redekop MAV choppers are fitted to the combines (with 36' platforms) in Image 15 and they can be seen chopping and evenly distributing material across the header width. Also available on the complete chopper options is an electrically adjustable tailboard as illustrated in Image 16. This option electrically adjusts the tailboard using motors. Each side can raise or lower independently, to increase or decrease the spread width of the combine. This is especially effective in side winds or within different crop conditions. An in-cab monitor (inset Image within 16) can be programmed to position the tailboard at the angle which achieves the best spread pattern after each pass is made through the field.


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Stripper Headers

Image 17 illustrates a Shelbourne Reynolds stripper header harvesting wheat. A stripper head is an excellent option to increase combine capacity, improve residue management and reduce fuel costs. As long as the crop is seeded evenly, the stripped straw remains firmly attached to the soil, making future passes with seeding equipment much easier. These headers are especially beneficial when harvesting higher moisture wheat, especially when fungicides are utilized, because very little of the straw enters the combine. Many producers also find they can start earlier and finish later in the day with a stripper header, compared to a conventional platform which quickly loses performance in damp straw. The stripper header uses a rearward spinning rotor to convey grain, chaff and a small amount of leaf material into the combine. In dryer regions, producers have also found that the standing straw catches more snow over the winter months, which helps accumulate soil moisture and helps increase crop yields.


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Image 18 illustrates double-crop soybeans no-tilled into a field of wheat harvested with a stripper header. Stripper headers work very well in high-yielding wheat and areas of the field which lodge, because the head does not take the majority of the material into the combine, most of the straw remains firmly attached to the ground and is much easier to plant through. Waiting a day or two for the residue to dry usually helps planting because the damp or green straw is a challenge to cut through. Row cleaners and the removal of a no-till coulter usually helps most planters penetrate the soil, close the slot and achieve better emergence.


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Chopping Corn Heads

As producers plant more corn following corn within a not-till system and select hybrids with traits such as Bt and improved stay-green characteristics, managing the previous corn residue has become a big challenge. This task is likely to be even worse in the future when producers take advantage of fungicides to increase their yields further.

The biggest challenges occur within northern climates where the season is shorter and the opportunities for residue deterioration are reduced. Rainfall is also linked to residue deterioration, so drier northern climates have the biggest challenges by far, especially within no-till rotations.

Image 19 illustrates a producer in Central Nebraska no-tilling corn back into corn stalks. Note his use of row cleaners, plus liquid fertilizer tanks which supply a band of N, P, K, S and Zn placed alongside the row. Such systems warm the soil and provide early nutrition to get the crop off to a good start within the cooler soils of a no-till system. While its possible to no-till into such quantities of residue, it would be almost impossible without planter attachments, like row cleaners. As the residue levels increase, then choppers and shredders on the corn head aid the process further.

Image 20 illustrates the stalk roller design common to most corn heads. A pair of counter-rotating non-touching rollers which pull the stalk and leaf material down to the ground. The power demand is low, but the stalk shredding action is minimal, as illustrated in Image 21.

Outside of standard corn heads, within the US market, there are three classes of corn residue management options. These are listed as follows:

1. Chopping knife roller systems
2. Shredding Systems
3. Rotary Flail shredders

Close examination of Image 22 will illustrate the performance of two of the three previously listed principles. The row to the right was harvested with a knife shredding system and the one to the left was chopped with a rotary flail chopper. Which is the best depends on a number of factors. The Shredding system is more expensive to purchase, operate and maintain, but does chop the residue into smaller pieces so they break down faster. The rotary flail system is cheaper to purchase and maintain, but power demands can be higher than a shredding system (with new blades). Be aware that the blades on both systems can lose their sharp cutting edges quickly and the power requirements can increase dramatically.

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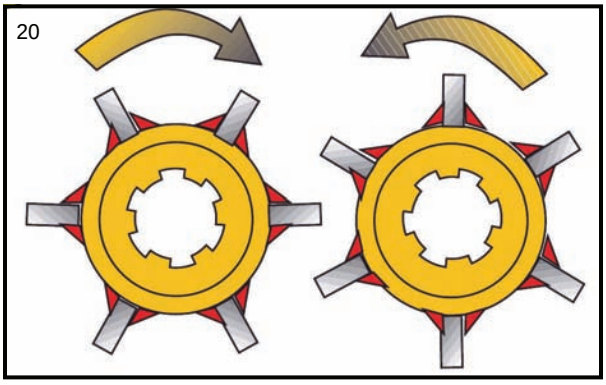

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Rotary flail chopped. Notice the clean cut corn stalk.

Shredded concept, notice the sized residue pieces and shattered stalk.

Chopping Knife Rollers

There are many different types of chopping knife roller options on the market including the Italian Cressoni and the German Gerringhoff Northstar.

The Cressoni system (Image 23) has 5 edge to edge orientated cutting blades. Such knife configurations provide very good chopping action, especially if the head is ran close to the ground. The hardened knife blades are easier to replace than some of the systems mentioned later.

The second chopping knife roller configuration is the Gerringhoff Nortstar (Image 24). This design utilizes a four blade system with edge to edge orientation for good chopping action. The blades are hardened for long life.

Shredding Systems

Within the shredding systems category, there are at least two different product offerings. These include the German Gerringhoff Rota Disc and the Italian Cressoni Roto Cross Cut systems.

The Gerringhoff Rota Disc system (Image 25) is well established on the US market and offers excellent stalk chopping characteristics, especially if the head is run closer to ground level. The chop length of residue pieces are from 3-6" in length, so if you are no-tilling or conventional tilling, managing this residue should be easy.

The Cressoni Roto Cross Cut system (Image 26) offers a pair of chopping stalk rollers. This design is unique because the rollers offer both touching knives which run the length of the roller, but also intermeshing knives that are positioned at 90 degrees to the roller. This system offers excellent chopping action.

Rotary Flail Shredders

Many manufacturers also offer a rotary flail system in addition to the above listed chopping and shredding options. Rotary flail choppers offer the benefits of additional residue management in addition to short stubble heights, without the operator having to run the head on the ground. Rotary flails also spread the material randomly, instead of concentrating the shredded material down the center of the corn row.

Many different flail shredder options are available, and some these include corn head designs with faster revolving two blade systems and slower speed three blade systems.

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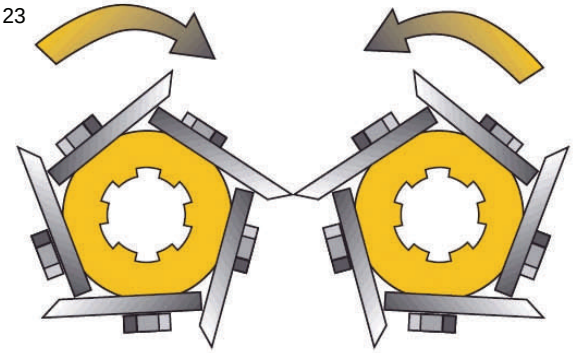

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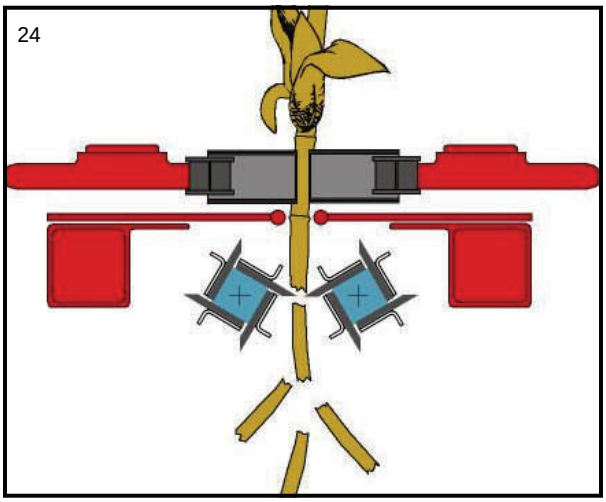

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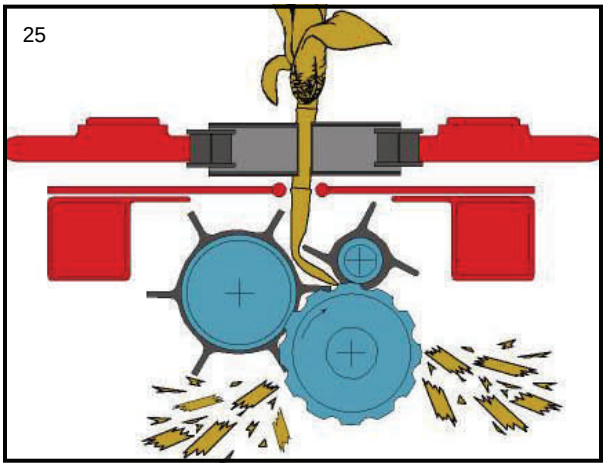

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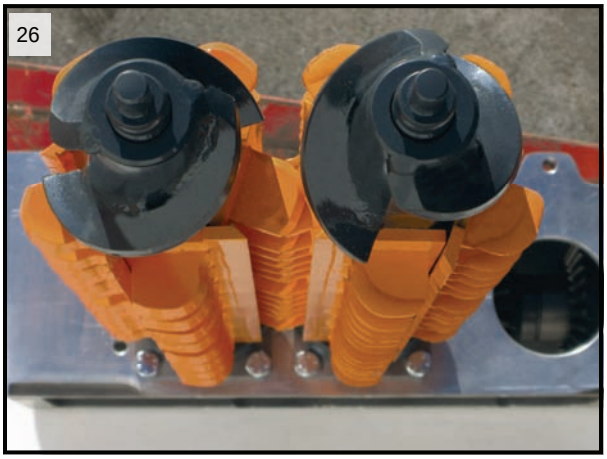

Rotary flail shredders are another sound way of managing residue, but the mechanical destruction of the stalk is usually less than some of the options discussed previously. Image 27 illustrates the principle of a flail shredder, either two or three rotating blades are mounted under the knife rollers. Ideally they are positioned towards the rear of the knife rollers so the point of cutting the stalk is after the point at which the ear is separated from the stalk. Any excessive vibration of the stalk caused by chopping prior to the removal of the ear can result in grain losses or ear losses. The knives on the rotary flail designs are usually 2 sided and are easy to change. The total cost of replacing all of the blades is also much easier than some of the other concepts, but again this comes at the cost of not reducing the size of the residue as much as the other chopping principles. Some may also argue that stalk decomposition is less when the stalk is cleanly chopped as Image 26 illustrates, so crimping the stalk or shredding the stalks will increase decomposition rate, in addition to opening up the stalk still attached to the ground, as illustrated earlier in Image 21.

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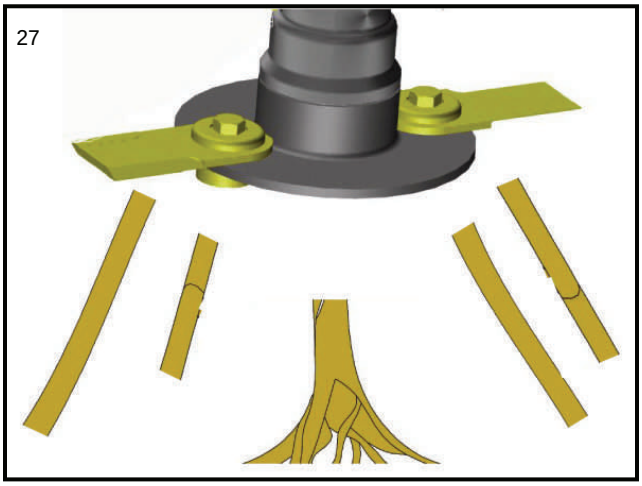

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Image 28 illustrates the positioning of a flail chopper design. The lower the head, then the shorter the stalk attached to the ground will be.

Image 29 illustrates the Drago chopping corn head. These heads have longer knife rollers (22 1/2" long, compared to most corn head knife rollers 15-18" long) and the angle of the knife rollers are less, around 23^{o} compared to 25-30^{o} with most other brands. Lower angles helps reduce losses and improve the processing of down corn. The Drago rotary flail shredder can easily be removed with 4 bolts and the flails are positioned at the rear of the rollers so the ear is removed before the stalk is chopped, this results in lower losses.

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Image 30 illustrates the John Deere 600C series corn head with StalkMaster flail shredder design. The flail design mounts on the corn head frame directly beside the row unit gearcase. The blades turn at 2200 rpm (with 520 backshaft speed) and increase incrementally with backshaft speed to adjust for maximum stalk processing. Each individual gear case is protected from rocks and other obstructions by an internal radial pin slip clutch. The blades on the chopping gearcase are heat treated and wear-coated to increase life in tough stalk-cutting conditions. They are also reversible to double the time between replacement.

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