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A Dozen Do's for Successful No-till Corn Following Soybeans

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This bulletin summarizes the experiences of Extension personnel, conservationists, crop advisors, researchers, and farmers with no-till. The lessons learned focus on twelve principles that need to be observed to make no-till corn following soybeans successful.

No-till corn following soybeans presents both challenges and opportunities for cost savings and soil conservation for farmers in Indiana. On better drained soils, no-till has been very successful, but on somewhat poorly and poorly drained soils it can be more difficult to maintain high yields. Over the years, many farmers have successfully managed the transition from full width tillage to no-till on soils with drainage problems. Research and demonstration plots have contributed to greater understanding of how to best manage this transition.

If you are not currently using no-till, the recommendations in this bulletin may help you avoid potential problems when you make the transition from full width tillage. If you are already using no-till, this information may address your concerns or improve your management. If you have tried no-till for corn, but were not pleased with the results, the principles we discuss may help you give it further consideration.

1. Equip Your Combine to Chop and Evenly Spread Residue

Even distribution of residue is important for smooth planter operation while direct seeding the following spring. If the residue is in windrows, it will likely impact seed depth because the gauge wheels of the planter passing over the top of a mound of residue will tend to pull the openers up to a shallower soil depth. Uneven residue distribution can also influence planter slot closing and seed-to-soil contact. In other places that have no residue cover the openers may penetrate too deeply into the soil. All of these difficulties can cause irregular emergence and/or reduced population. Uniform emergence and spacing are important for maximum corn yield.

Uneven residue distribution leads to uneven soil drying at the surface in the spring. This can lead to delays in planting and poor tilth in the areas of the field planted under wet conditions.

An even distribution of residue begins at harvest. Cut the crop as high as possible to leave stalks in place. These stalks will catch the residue distributed from the combine. This also helps reduce the amount of residue moved by the wind or water. It is essential that the combine chop the stalks that have been taken up and spreads them as uniformly as possible across the width of the combine swath.

Wind and water can move large amounts of residue. These natural processes tend to concentrate rather than evenly distribute residue. The concentrations of residue that result can cause significant problems for the planter.

Starting with residue evenly spread over the field at the beginning makes it more likely to stay in place until the next planting season. Even with residue spreaders, there are some landscapes where it will be difficult to maintain a uniform distribution because of movement by wind and water.

In areas with unevenly spread residue, some type of residue cleaner may be needed. Properly set, a residue cleaner can remove a narrow band of residue and help the planter work more efficiently. It will also help avoid problems associated with poor residue distribution in some parts of the field. Some farmers use residue cleaners to maintain more consistent planting depth. Rows warm faster where residue has been removed, but the relative benefit may be dependent on soils.

2. Select A Corn Variety with Good Vigor, Cold Tolerance, and Disease Resistance

Early growth is critical for no-till corn. Somewhat poorly and poorly drained soils are usually less favorable for rapid early growth with no-till because they warm more slowly in the spring. It is important to select a variety that has the best chance to perform well under cooler and wetter conditions. Well drained soils are generally drier and warmer in the spring and variety choices for these soils may not be as critical.

Seed Selection for No-Till Conditions

First, demand the best high quality seed. No-till systems frequently result in more stressful germination conditions that are cooler and wetter than full width tillage. Starting with top quality seed gives the crop an advantage from the beginning. Seed quality is most commonly documented by warm germination test scores listed on the seed tag. Ask your seed dealer for cold germination test scores also. Most seed companies routinely reject seed lots that test less than 85 percent cold germination. For no-till, consider rejecting seed lots whose cold "germ" ratings are less than 90 percent.

Next, consider the variety's potential for emergence and early-season growth. Many seed companies rate their hybrids for emergence and/or early vigor. Pay close attention to published differences among hybrids when making selections for no-till and place higher priority on those hybrids with superior emergence and early plant vigor ratings.

Another attribute to consider is root and stalk health characteristics. Rooting depth in no-till systems is often shallower than in full width systems because of differences in soil temperature, soil moisture, and nutrient availability. Hybrids with superior rooting characteristics may perform better under these conditions. The greater amounts of surface residue in no-till contribute to a greater risk of leaf and stalk diseases that can translate into stalk rots later in the season. Hybrids with superior stalk strength and health characteristics will lessen the risk of lodged corn at harvest.

Finally, consider the hybrid's ability to withstand insect and disease pressures. With higher residue levels, unwanted pests can develop. By using more resistant varieties, as well as employing crop rotations to reduce corn after corn problems, many pest problems can be reduced or eliminated. The ability of the hybrid to withstand specific herbicide programs should also be considered, since changes in herbicides are often needed as traditional problem weeds are eliminated or succeeded by other species.

3. Do Not Plant Into Live Vegetation - Burn Down Weeds Well Before Planting

Living vegetation creates too much competition for small corn plants in terms of available soil moisture and light for early growth. Such competition has an immediate and negative effect on early growth and stand establishment. This is nearly impossible to overcome later in the season. If weeds are present prior to planting try to apply your burn down herbicide(s) in time to ensure that they are dead when the field is planted.

4. Maintain and Adjust the Planter

Uniform seed depth and seed-to-soil contact are essential for success with no-till corn. The key is a properly adjusted and maintained planter. Worn parts should be replaced as needed and lubrication completed on schedule, according to the specifications of the manufacturer. Some planters are not designed for no-till. No-till corn planters are generally sturdier and more rugged in construction due to the inevitable increased weight required when planting without a prepared seedbed. The extra weight will make it easier for the planter units to penetrate the soil for seed placement.

Planter Adjustments

One of the simplest and least expensive forms of maintenance is to level the planter and adjust unit height. Planter units that are not level can negatively influence seed placement and depth, furrow closing efficiency, and can limit the effectiveness of planter attachments in front of the units.

Farmers should check daily to see if their planter is level front-to-back and side-to-side, especially with planters over eight rows in width. Daily operation, changes in field conditions or in the planter itself, such as leaking cylinders, can greatly impact how level a planter remains.

Planter down pressure springs should be set so that depth gauge wheels are in firm contact with the soil. Too little down pressure can reduce seeding accuracy, place seeds too shallow, and fail to penetrate increased residue cover. Excessive down pressure can lift the tool bar and drive wheels off the ground and cause slippage in the seed metering mechanism, which may reduce stands.

Coulters

Numerous types of coulter designs and sizes are available. These include smooth, fluted, and rippled coulters. Coulter selection depends on field conditions and personal preference, with the three quarter inch or one inch fluted coulter the most commonly used.

In general, wider coulters increase tillage and require additional weight for penetration (about 400 to 600 pounds per coulter). Smooth and rippled coulters usually require less weight, perform less tillage, slice through residue more easily, and allow for higher planting speeds than fluted coulters.

Worn Parts

Among the most common parts to wear out on a planter, especially in no-till are the parallel linkage bushings. Worn bushings allow the parallel linkage to twist and allow row units to wander from side to side, causing row spacing problems. Total loss of the bushings can damage the linkage and, in extreme cases, allow row units to slide into the fertilizer band furrows. In cases where large areas are planted with the same machine, some manufacturers recommend replacing bushings annually.

Worn double-disk openers can affect seed placement and the ability of the planter to cut through residue. Damaged or bent press wheel shafts affect seed placement. Loose chains or drive units affect population. Improperly aligned press wheels reduce seed-to-soil contact needed for good emergence.

Planter Attachments

Check the adjustment of row attachments, especially row cleaners. Row cleaners and other attachments that operate too deep will move excessive amounts of soil. This can cause the attachment to push against the row unit and disrupt seed placement. Running too deep can also cause the attachments to vibrate excessively and wear out prematurely. It can also leave a permanent depression in the row, which is difficult to manage.

Seed firmers or narrow press wheels may be used to improve seed-to-soil contact. Press wheels and seed firmers are added just behind the seed furrow openers, and they press the seeds into the bottom of the furrow.

Furrow covering devices, such as small disk blades, angled wheels, small press wheels, or any combination of these devices, can in some cases help get good seed coverage by covering and firming the soil surface above the seed furrow. Such devices are also mounted behind the seed openers to improve seed coverage.

Strip or Zone Tillage

In fields where there are concerns about low soil temperatures and/or wet soil conditions, the use of multiple coulters, row cleaners, tines, or combinations of these devices for additional soil disturbance and aeration may be beneficial for no-till corn. Soil disturbance is limited to a narrow band six to eighteen inches wide in the fall or spring, and may include applications of N, P, or K into the soil. The depth and width of tillage depends on operations and goals of the pass (i.e. fertilizer incorporation, aeration), and may vary from field to field depending on soil type, moisture, residue levels and other factors.

In general, strip or zone tillage shows the greatest benefit in northern Indiana, where additional heat units are needed for early seedling emergence. It also provides an opportunity to plant earlier. In southern Indiana the benefits are not as great, with little to no effect due to warmer conditions earlier in the growing season.

5. Use Starter Fertilizer

As referred to here, starter fertilizer is applied at planting in a band two inches to the side and two inches below the seed. Nitrogen has been the one nutrient in starter fertilizer that always has a response in no-till

corn studies. Recommended rates vary from 20 lbs./acre to 50 lbs./acre of actual N. The remainder of the nitrogen is applied either pre-plant or sidedress. With nutrient stratification, potassium is the next most likely nutrient to be needed. Check levels of available potassium to see if a response may be likely.

6. Minimize the Risk of Nitrogen Loss

Nitrogen (N) management is a concern in any system. This is especially true for no-till. Efficient use of N is the ultimate goal. Factors such as weather, rainfall, soil types, placement, and N source all influence how effectively N is used. These factors can become even more challenging with no-till, unless properly managed.

When properly applied, most sources of N perform equally well for maximum efficiency, but losses can occur by volatilization of ammonia-N, leaching of nitrate-N, or loss of N with surface runoff and erosion.

Urea based N fertilizers (urea and urea ammonium nitrate UAN) are most susceptible to volatilization losses as the urea portion is transformed to ammonia-N on its eventual way to the nitrate-N form. If such fertilizers are applied over the crop residue (broadcast or as "weed and feed") and are not incorporated, significant volatilization can occur before rainfall occurs and moves the N into the soil. Minimize this risk of volatilization with urea based fertilizers by injecting them into the soil with a knife or coulter application tool rather than applying them over the no-till surface residues. A less effective intermediate method of reducing the risk of surface volatilization is to apply UAN solutions in a concentrated band or dribble.

The nitrate-N form of N is most susceptible to leaching or denitrification losses. Commonly used N fertilizers that contain nitrate-N include UAN and ammonium nitrate. Such nitrate containing fertilizer should be applied as close to planting as possible or as a sidedress application, rather than applied very early prior to planting to minimize the length of time in which the nitrate-N form of N is exposed to leaching or denitrification.

Anhydrous ammonia has the least initial risk for leaching or denitrification losses of N because of the lengthy process of converting the ammonia to the susceptible nitrate form. This can take several weeks. This source of N is susceptible to volatilization losses if the tool used for injection does not adequately close the knife slot during application.

Timing can contribute greatly to the efficient use of nitrogen. Due to the variability of over-winter conditions, including temperature fluctuations, precipitation, winter cover and vegetation, fall application of nitrogen is not recommended, even when a stabilizing additive is used.

Preplant vs. Sidedress Applications

Sidedress applications on irrigated sandy soils have consistently shown greater yields than preplant applications due to reduced loss of N through leaching. For medium to fine textured soils a small advantage may exist for the use of sidedress N applications over preplant applications early in the season when rainfall is excessive and the potential for denitrification is great.

The major potential disadvantage of relying on sidedress applications for the major portion of your N fertilizer program is that rain and wet conditions may prevent or delay sidedress applications. The risk is that corn may become too tall for ground-driven sidedress application equipment.

7. Rely on Soil Conditions to Determine Planting Date

Perhaps the most difficult management aspect of no-till is learning to plant by field conditions rather than by the calendar. No-till requires far fewer trips, but planting must be performed when the soil is suitable, if good results are to be expected.

If the soil moisture content is near field capacity and the soil molds easily in your hand, it is probably too wet for planting. The planter operation itself can also be a good indicator. If the seed slot is not closing properly or the sidewalls of the slot are smearing, the soil is too wet for planting. If the season is late and

wet soils are a problem, then a seed firmer may be a very good attachment to the planter to get the seed-to-soil contact needed.

A good drainage system can increase the number of suitable days for field operations. Some think that more narrow spacing of tile may be needed for no-till and the days gained as a result may be of greater significance than for full width tillage.

8. Planter Efficiency and Stand Improvement

Planting speeds should not be faster than five miles per hour for uniform stands. Excessive speed can cause the planter to bounce up and down, which can influence the uniformity of seeding drop as well as uniformity of seeding depth. Excessive speed can also leave the planter slot open with seed exposed. Proper speed also insures that attachments function properly to move residue, apply or place pesticides, firm seeds in planter slots, and replace soil and residue over seeds.

Seed depth should be set for about one and a half inches, with the goal of placing the seeds into uniform soil moisture. In conditions where drier soils exist, planting depths may be as much as two or three inches to reach moisture needed to insure proper emergence. Seeding depth is critical for no-till. Uneven planting depth across a field can result in uneven germination and uneven stands due to changes in soil temperature and moisture.

Differences in fields due to soil types, moisture conditions, previous tillage and residue levels, can affect the depth and operation of the planter in different ways. Seed depth should be checked at the beginning of each new field and throughout the day, particularly when changes are suspected in field conditions. It is also important to check the seed-to-soil contact in the planting process and that the closing wheels are working to close the slot properly.

Final corn plant populations should normally fall within the range of 26,000 to 30,000 plants per acre to achieve maximum grain yield. In full width tillage systems, seeding rates are normally calculated on the basis of an assumed 90 percent stand establishment. This is based on a 95 percent germination multiplied by 95 percent seedling survival rate. Seeding rates to achieve the final populations suggested above should be between 29,000 to 33,000 seeds per acre. This is the final population, divided by 0.9. If your experience says that either the germination or the seedling survival is likely to be below 95 percent then an adjustment is needed to insure adequate final population.

9. Scouting for Insects, Rodents, Weeds, and Disease

Fields should be scouted as soon as plants begin to emerge. It is critical to keep accurate, legible notes and maps. Include such factors as weather, growth stage, insects, weeds, unhealthy or missing plants, abnormal field patterns or colors, or any other item that may be worth noting. If available, a GPS enabled (Global Positioning System) crop scouting system can be very helpful in locating areas of concern.

Field borders, ditch banks, fencerows or other uncharacteristic field areas are poor places to take random samples or make observations. Odd areas may give misleading information about the crop as a whole.

Insect Control

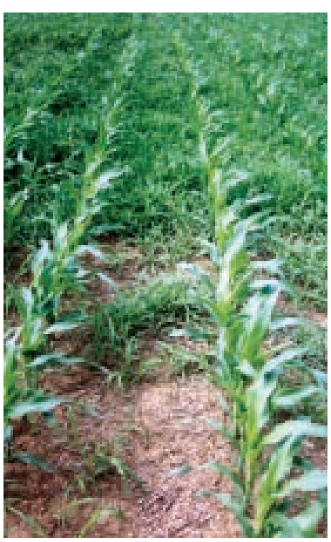
Insect management is similar for no-till, mulch-till or full width tillage. Scouting and previous insect concerns should be the major factors affecting the type and amount of insecticide applied. With a corn-soybean rotation, differences between the crops can lead to a

reduced number of pests. We would expect insects in larger numbers with continuous corn. One area of concern for insect management is the effect of residue on insect numbers. Residue may provide over-wintering sites for some pests, although these numbers do not always approach economically damaging levels. Residue may also be of concern when applying insecticides. Residue may contain or cover insects and prevent sprays from directly reaching targeted insects.

Rodent Control

Rodents are a concern in some no-till cornfields. Meadow voles (*Microtus. pennsylvanicus*) and prairie voles *(Microtus. orhrogaster)* are especially troublesome. Scout fields in late March to determine if voles are present in numbers serious enough to affect profits. Five active colonies per acre are considered the critical population that can lead to an economic level of damage. Control is achieved through one of three approaches.

First, altering field vegetation discourages voles. It does not kill them directly, but eliminates needed cover and food. Second, using alternative baits, like altering habitat, does not actually kill the targeted rodents. Instead, it provides an alternative food source until corn plants are above six to twelve inches tall. At this height vole feeding no longer significantly affects corn plants. Alternative baits, such as four bushels of cracked corn, two bushels of soybeans, or two bushels of wheat or rye per acre, can be spread to attract the voles. A third approach is the use of zinc phosphide placed in-furrow with the seed. Zinc phosphide is a rodenticide that poisons voles and other rodents. They ingest the poison when they attempt to eat the planted seeds. A control program should include mowing or burning field borders or buffer areas in late fall to reduce food sources and remove needed cover.



Weed Control

No-till systems require a well-managed weed control program. This includes scouting and proper timing and application of control measures. Weeds in no-till shift from the summer annuals found in full width and mulch-till systems to more winter and early summer annuals, biennials, and perennials. Effective herbicide control programs include the use of early preplant, burndown, preemergence, and postemergence herbicides.

Regardless of the method of application, no-till herbicides should be applied when annual weeds are less than two inches tall for best control. If herbicides

are applied during planting, booms should be placed in front of the planter, as soil and residue displaced during planting may shield some in-row weeds and limit their control. Herbicide applications in the fall are not the first option due to variability in weed control and concerns for increased soil erosion, but may be necessary to kill tough perennial weeds.

Early Preplant, Plus Preemergence or Postemergence

Early preplant (EPP) applications involve applying herbicides far in advance of actual seed placement. A goal of mid-April or roughly 30 days prior to planting is realistic. EPP is best used where early weed growth needs to be controlled. EPP also gives the additional advantage of removing succulent growth needed by several insect and rodent species, thereby reducing or eliminating the need for additional pesticides.

Some EPP herbicides can provide both burndown and residual control in corn. EPP herbicides are unlikely to provide season-long weed control, especially if application is made fairly early or if significant amounts of soil are moved during planting. Additional herbicide treatments may be required, such as splitting applications with combinations such as EPP with additional herbicides soon after planting, or EPP followed by a postemergence herbicide program.

A properly managed EPP program has several advantages for weed control, including control of weeds in March or April when cool weather and early rains enhance herbicide performance. This could eliminate more expensive burndown herbicide treatments. The major disadvantage for EPP is that preemergence or postemergence treatments may be needed, especially for later-planted corn, for season long weed control.

Burndown, Plus Preemergence or Postemergence

If EPP treatments are not used, an alternative application of herbicides is a "burndown" application, in which herbicides such as Roundup™ or Gramoxone™ Extra are used to control vegetation present at planting. For earlier plantings, a burndown application may not be needed, as few weeds are present. For EPP and burndown applications, postemergence herbicides should be used if additional weed control is needed. The type of postemergence herbicide needed later in the season will depend on the types of weeds present in the no-till corn being scouted.

Disease

Scouting for disease is important. There are few options for the current crop, but it does indicate potential future problems and suggests the disease resistance that must be considered in seed selection. Severe leaf blights may increase the risk of stalk rots later in the season. If stalk rots do develop, then the affected fields should be harvested as early as possible.

10. Soil Testing: Lime, Phosphorus, and Potassium Management

Soil Testing

Soil testing is the key to any sound fertility program. Usually only phosphorus (P), potassium (K) and pH are tested in Indiana soils. Additional nutrients may require evaluation if visible symptoms or decreased yields are noted. For P and K, most Cornbelt recommendations are based on soil tests calibrated to a depth of six to eight inches. Research from Indiana and the Midwest shows no reason for altering the total amounts of nutrients needed for no-till. As explained

below, it may require testing at two different depths and adding these together because of a concentration of nutrients at the surface.

Stratification of P and K in the top few inches of the soil's surface should not be a concern except under drought conditions. Under normal conditions, the largest percentage of root growth in no-till corn is found in the top three inches of the soil early in the season. This is also where the highest concentrations of P and K are located. In drought conditions, the corn roots near the surface die and other roots expand deeper into the soil where there is moisture. The roots that are deeper in the soil are outside the zone with the highest amounts of P and K.

Alternative sampling methods for P and K are needed to address the stratification of fertilizer. Take a sample for the upper four inches and a sample for the lower four inches of the old plow layer. Averaging the two samples and comparing the result with the recommended amount for the full eight inches is used to make recommendations. If the lower four inches shows very low levels of P and/or K, the use of deeper fertility placement techniques and/or minimal tillage to mix fertilizers into that zone may be needed.

For pH the major alternative in testing is examining pH levels in the upper two inches of the soil. The use of certain nitrogen fertilizers, such as urea or UAN on the surface quickly lowers the soil pH levels in the upper two inches. Testing of the upper two inches will point out low pH levels. These must be corrected to maintain plant growth and also to insure that herbicide effectiveness is not diminished.

Liming

Application of lime in no-till fields reflects the fact that lime is relatively immobile in the soil. Unless somehow incorporated or deep-placed, the effects of lime will mainly be in the top four inches of the soil. There is no opportunity to incorporate lime in no-till. It is recommended that lime should be applied at one-half the rate, twice as often, than would be applied on a field with full width tillage of the same pH. The pH levels should be adjusted to desired levels prior to the adoption of a no-till system if at all possible.

Phosphorus and Potassium Management

If possible, the soil fertility levels should be properly adjusted before conversion to no-till. By incorporating adequate to high fertility levels for both P and K to the full depth of eight inches, a reserve of these nutrients is established. In drier years, corn roots will make use of these nutrients lower in the topsoil. If a no-till system is already in effect, the use of alternative placement methods, such as deep banding or deep strip tillage, may help to provide P and K at deeper levels.

11. Control Traffic to Prevent Unnecessary Soil Compaction

Soil physical properties can be improved by the adoption of no-till. Research has shown that without traffic, soils can develop more pore space and more importantly increased permeability. These benefits, however, do not occur where tire tracks are present. One pass under adverse conditions can compact the soil and undo improvements in physical properties.

The best way to avoid this is to not create the track in the first place. It is critical to analyze the traffic patterns that have developed in crop production. Within practical limitations, it is important to attempt to control spring trips because they are normally done under conditions that lead to the greatest potential for compaction. Trips with heavy loads must also be considered, particularly grain carts in the fall. There may be reasons of efficiency that require a particular pass, but frequently there is also a hidden future cost that must be paid later.

No-till fields have excellent bearing capacity with very few visible tracks. This can easily lull one into thinking that no damage has occurred. Unfortunately, this is not always the case. No one answer fits every operation. Many factors must be considered. If traffic can be reasonably controlled then this is the best course of action for the long term.

12. Seek Advice from Successful No-Tillers

No-till practices are constantly evolving. It is important to visit with farmers, dealers, conservationists, Extension personnel, and others involved in no-till. More than likely, others have faced the problems that you are experiencing. Ask questions and get the thoughts and opinions from people whose judgment you respect. Have them tell you about techniques that have worked for them or for others. Keep in mind that no-till requires a higher level of management than full width tillage, but that it also offers more rewards for success. Every year presents a new set of experiences and results to compare. The results your neighbors and others have discovered in your community could be very helpful in resolving problems. One size does not fit all in no-till, but experience has shown that there is a way to make it work on a wide variety of Indiana soil conditions.

Photos courtesy of USDA Natural Resources Conservation Service.

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