No-Till On The Plains 2001 Speakers - Matt Hagny

Mastering No-till Seeding Equipment & Techniques

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Hagny works as an independent crop consultant, has focused on no-till cropping systems in Kansas and Oklahoma since 1994. All Matt's clients have implemented continuous low-disturbance no-till systems with rotations typically including corn, milo, soybeans, cotton, sunflower, alfalfa, spring & winter wheat, and covercrops. He guides decisions on rotations, fertility, equipment selection and adjustment, variety selection, and weed, insect and disease avoidance and control. Countless hours spent adjusting and modifying seeding equipment and checking results led to Matt's insight for a new furrow closing method for no-till, now marketed by Exapta Solutions.

Topic Description: No-till requires entirely different seeding equipment and methods than what were previously used in conventional-till or even minimum-till systems. No-till seeders must handle heavy stubble and soils that are more moist and structured (ie., the natural integrity of untilled soils), in a manner that consistently establishes uniform and vigorous stands. Both our current equipment and our habits of thought contain vestiges from our long history of planting into tilled seedbeds -- these outdated concepts must be recognized as such and discarded if we are to achieve the true potential of no-till.

I. Why is no-till seeding different?

A. Soils will have structure & will be more firm than those fluffed with tillage

B. Soils will often be more moist, yet be more trafficable

C. Crop residues remain on surface

1. Importance of uniform straw & chaff spreading when harvesting

D. Soils will be cooler in spring & warmer in fall compared to conv. till

E. Must seed thru areas trafficked during last harvest

1. Need for flotation tires on combines, grain carts, cotton harvesters, boll buggies

2. Keep grain cart loads small; reduce tire pressures

3. Reduce or control traffic

F. No-till is a continuous & permanent system of very low soil disturbance

1. Drastic improvement in moisture infiltration & retention

2. Temperature moderation

3. Eliminates emergence problems from crusting

4. Weed & pest cycling affected

5. Strip-till and other high-disturbance systems resort to tillage to solve problems best addressed with other methods (seeding equipment modifications, fertility management, rotations)

II. Principles of No-Till Seeding

A. Consistent depth, gauged beside furrow (not with a packer/closing wheel) -- Gauging depth from a packing/firming wheel is an idea leftover from the days when seedbeds were fluffed and dried with tillage prior to planting, and any extra packing of the loose soil around the seed aided in drawing moisture from deeper in the soil. No-till soils have integrity or structure that requires more downpressure on the opener. After the opener blade has reached its depth, any additional downpressure ends up on the depth-gauging mechanism, which will tend to cause compaction in damp conditions-- it is highly undesirable to have this compaction exactly where the seedling must emerge.

B. Seed firmed into bottom of furrow without packing the sidewall

C. Closing by crumbling, not squeezing -- disrupting sidewall important for root develop.

D. Move residue if very heavy, or if allelopathic, or if warmer seedbed needed

E. Pop-up (in seed furrow) fertilizer? Separate fert. placement? Benefit varies by crop, soil nutrient level, rotation, time available at seeding

F. Row spacing?

G. Seed metering (singulation vs. volumetric)

H. Low disturbance -- coulters, knives, etc. tend to plug with mud and/or residue and create problems such as crusting, poor root development, weed flushes, etc.

I. Down-pressure -- varies w/ conditions

J. Parallel-link desired

III. Drills vs. Planters (the distinction is starting to blur)

A. How much metering accuracy needed?

B. Parallel link & residue managers needed?

C. Are 30" rows too wide? 20"? 15"? Two (or more) toolbars needed for narrow spacings esp. if using residue managers (residue won’t flow if all on one toolbar)

D. Harvesting equipment considerations

IV. Planters: working with what we currently have

A. Heavy down-pressure springs (or add ballast to each row unit)

1. Purpose: provide sufficient down-force on row-unit to maintain seeding depth

2. At higher settings, make sure row-units aren't lifting the planter frame

a. May need to keep fert. tanks ½ full or add other ballast to planter frame

3. Adjustment: keep gauge wheels firmly on soil surface, but don't overkill

B. Fertilizer openers

1. Purposes: Allow more N, P, K, S to be placed w/o risk of seed injury & improve residue flow thru the seeder esp. if using residue managers

2. Single-disc w/ wiper or gauge wheel

Ausherman Vantage II, Deere, Kinze, Yetter Viper, Agco (in US?)

3. Smooth (or less than ½" ripple) w/ injection nozzle or knife

a. Some problem w/ soil lifting since no wiper wheel to hold soil in place

b. Cut off lower end of knife -- plugs w/ residue & does too much tillage

4. Mounting & adjustment

a. Spacing away from row 2-3" (closer if no pop-up in seed furrow)

b. Prefer gauge/wiper wheel away from seed furrow

c. Depth: 1" is sufficient (crown roots start above the seed)

C. Residue Managers

1. Purposes: move some (not all) of the residue away from the furrow to speed soil warming, reduce hair-pinning by seed openers, and reduce allelopathy

2. Straight vs. curved teeth (forward-swept preferred)

3. Teeth need to be slender and somewhat sharp on the tip

4. Solid vs. springy teeth (springy?? -- needs further testing)

5. Single vs. two-wheel (single can be adequate if properly designed)

6. Floating vs. solid-mount

7. Combo w/ fert. opener if space limited (some folding planters)

8. If residue wheel(s) gauge their depth by mounting solid to face of row-unit, then prefer mounting as close as possible to seed opener/gauge wheels

9. Mounting & adjustment

a. Lead wheel should reach across path of seed opener toward fert. opener

b. Move residue, not soil -- moving 50 - 70% of the residue is enough

10. Expect to see major innovation in residue managers over next few years

D. Seed furrow openers

1. Replace if worn 0.75 - 1.0" or more off original diameter

-- less hairpinning with sharp openers

2. Replace seed-tube guard if worn -- this wedge between the discs prevents them from flexing inward in firm soils (excessive flexing may wear off the sides of seed tube and cause early opener bearing failure) -- use J.S. Ag's seed-tube guard w/ wings to keep discs away from seed tube

3. Do not use aftermarket firming points that run deeper than the discs -- these will smear the bottom of the furrow, inhibiting the seed firmers from doing their job, as well as restricting root growth

4. Case-IH firming point/wedge should have the bottom edge cut away so it doesn't protrude below the openers after they have worn down some

E. Gauge wheels

1. Shim close to disc openers, but turn freely (R-K Products kit to fix worn arms)

2. Install walking gauge wheels on older planters to let them move independently

3. Adjustment

a. Seed as shallow as possible but still consistently in moisture (but see minimum depths for crops in Part VII)

1. Eliminates excessive compaction -- driving the wedge deeper

2. Promotes rapid & uniform emergence

3. Decreases fuel consumption & horsepower requirement

F. Seed firming devices

1. Purpose: provide seed-to-soil contact w/o compacting sidewalls

2. Wheels vs. sliding (Keeton)

a. Wheel-type plugs w/ mud if small diameter and/or too wide

b. Firming wheel should be large diameter w/ narrow edge to fit the "v"

c. In dry conditions where more firming is needed, a narrow wheel can typically exert more pressure than a Keeton

d. Shaeffert Rebounder is not a firmer (it controls seed bounce & doesn't run at the bottom of the furrow)

3. Keetons available w/ tube holder for fert. & other liquids (except Case-IH)

4. Adjustment

a. Wheels: a couple pounds of downforce is enough

b. Keetons (White, Kinze, Deere): set tensioning screw tight

b. Keetons (Case-IH): no tensioning screw; firmer itself is wimpy (Hint: buy Keetons intended for grain drills & make your own bracket)

5. Replace Keetons every 1 to 2 years -- material fatigues & not enough tension

G. Furrow closing wheels (White, Kinze, Deere, Great Plains planters)

1. Purpose: uniformly cover seed with loose soil to prevent drying & protect seedling & promote uniform emergence; to disrupt the sidewall for easy penetration by the nodal (crown) roots

2. OEM (Originally Equipped by Manufacturer) smooth (non-spoked) wheels & brackets usually detrimental -- these close by squeezing which typically causes sidewall compaction, crusting, and poor root development

3. Spoked wheels can be significantly better

a. May-Wes "Star," Martin "Spader," Acra-Plant, Yetter, others

b. Spoke shape & length & material (poly vs. steel) important

1. Too long & slender can penetrate too far & disrupt seed placement & do too much tillage when on OEM bracket (less of a problem on HCS, see below)

2. Too blunt can cause too much packing

3. Some designs have trouble shedding mud

c. OEM brackets not optimal for spoked wheel performance

1. 20 camber (tilting from vertical) and zero toe-out (departure from parallel to direction of travel) of closing wheel on OEM bracket is a vestige of planting into tilled seedbeds, where they firmed the soil around and below the seed (but not above); these angles have no relevance to the crumbling or shattering type of closing we are desiring in no-till with spoked wheels (spoked wheels at the original angles often do inadequate furrow closure or lift the entire sidewall and disrupt seed placement).

2. First attempt to improve spoked wheel performance was to create a 6 or 7 toe-out on the OEM bracket, which helped the spokes to crumble & pull soil toward furrow (discovered the importance of having the bracket pivot freely, as well as using a very light spring)

3. Realized the spokes were engaging the soil at a poor angle -- they would not only break thru the sidewall easier if running at high camber values, but would also be less likely to lift the sidewall as they exit the soil -- resulted in developing a spoked wheel running at very high-camber & close to furrow (patent pending, Matt Hagny of Salina, KS, marketed as Hagny HCS by Exapta Solutions)

4. Adjustment of closing wheels

a. Reduce spring tension!! Be gentle here -- less is almost always better;

start w/ zero tension & adjust upward; loose soil over the seed is desirable so long as seed is firmed into furrow "v" (it won't dry out too quickly if you have enough stubble on the surface)

b. If using OEM bracket, replace OEM coil spring w/ a much lighter one

c. In wet conditions, no spring tension required (bracket weight enough) H. Covering discs & treader wheel (Case-IH)

1. Often detrimental: closes furrow w/ aggressive tillage, ie., slabbing a large portion of sidewall into the furrow

a. Usually results in poor seed-to-soil contact

b. Sometimes results in severe crusting (although it's fragmented, the soil covering the seed is severely compacted from the opener prying the furrow open and covering discs scrunching it shut)

2. Discard covering discs & treader wheel; replace with seed firmer, spoked closing wheels and new mounting brackets

I. Drag chains & harrows

1. Purpose: same as closing wheels

2. Unnecessary if closing wheels functioning properly

J. Other stuff

1. Stalk catcher -- leans stalks in direction planter is traveling which prevents much trouble w/ stalks tearing off sensor wires, tubes, hoses & chains

2. Notched markers w/ depth band vs. GPS guidance

3. Population monitors -- worth the $, will eventually become standard equipment

4. Pop-up (seed furrow) fertilizer

a. Place behind firmer & ahead of closing wheels preferably

b. Uniform stream desired; watch rates carefully

V. Drills

A. Same goals & concepts as planter

B. Deere 750/1560 & 1850/1860

1. Single-disc opener w/ gauge wheel to the side

2. Firming & closing separated

3. Opener lacks parallel link -- spring tension varies widely during opener travel; boot and blade change angles during opener arc

4. Ballast often required -- make sure drill frame isn't lifting

a. Fert. tanks mounted on rear (not front) of 750/1560 drill

b. Other ballast -- 1850/1860 requires more than 750/1560

5. Downpressure measured by spring compression

a. Rockshaft position & gauge reading irrelevant (the amount of twist on the rockshaft determines the compression on the coil springs, until the compression force of all the springs exceeds the weight of the drill, which causes the frame to lift and the opener to "roll under")

b. If enough ballast & downpressure, drill will eventually penetrate

c. Setting gauge wheel deeper will not result in greater depth if insufficient downpressure or ballast -- it will, however, increase variability of depth

d. Adjust so gauge wheels firmly on soil surface

6. Opener disc: replace if more than 1" worn off diameter

7. Gauge wheel

a. Shim to disc, but should turn freely

b. Running deeper than 3d notch (750/1850) will cause more boot wear unless boot is adjusted upward by moving the bolt to the top hole

8. Boot

a. Corner tends to wear out, resulting in dust & residue falling into furrow ahead of seed -- available w/ tungsten carbide tiles to slow corner wear point (eventually wears out on side rubbing against disc)

d. Attaching hole oblongs out eventually -- Exapta Solutions' sleeve kit

e. Adjustment: center hole for most applications; top hole if discs worn out, bottom hole if doing lots of very shallow seeding (1" or less)

9. Firming wheel

a. Doesn’t run when wet (wider than furrow)

b. Wider than furrow -- firms by tearing out the sidewall; has trouble pushing seed into bottom of "v" when sidewalls are firm c. Replace w/ beveled poly wheel from May-Wes (consider using a lathe to bevel the edge even more) or Case’s SDX firming wheel

10. Closing wheel

a. See previous comments under "Planters"

b. Bushings in pivot point wear out, resulting in excessive lateral movement (wheel no longer tracks properly to side of furrow)

-- replace bushings or use R-K Products’ spring washer kit

c. Adjustment: reduce spring tension to lowest setting for most conditions

11. Other stuff

a. Stalk catchers

b. Markers vs. guesstimating vs. GPS light bar guidance

c. Population monitors important

d. Wide bar-lug tires w/ max. offset rims for caster wheels

e. Pop-up fertilizer

C. White 6800 series

1. Central fill hopper, air delivers seed to singulators on each row

2. Basically planter units on 2 or 3 toolbars on 20" or 10" spacing

D. Flexicoil FSO opener & 8100 toolbar

1. Functionally similar to 750 opener (single-disc, gauges depth to side) but w/ parallel link; FSO is very different from Flexicoil Barton opener (Barton gauges depth from the packer/closing wheel)

2. FSO firming/closing wheel nonfunctional -- remove & replace w/ a Keeton and a spoked closing wheel (brackets available from Exapta Solutions)

3. FSO seed tube & boot vent the air better than the 1850 & 1860, resulting in better seed placement

4. 3-pt mounting of toolbar -- superior in mud & weight transfer to toolbar, but problems w/ opener being forced side-to-side

5. Problems w/ serviceability and longevity of FSO currently

E. Case-New Holland SDX

1. Functionally identical to 1850 & 1860 but w/ a larger diameter disc

2. Poor seed tube design

3. Still no parallel-link or seed singulation

4. Even worse in mud than the 1850 & 1860 due to staggered caster wheels

5. Will require as much or more ballast than 1850 & 1860

F. Hiniker

1. Gauges depth beside furrow; lightweight units on single toolbar

2. Serious problems w/ residue flowing; problems w/ soil lifting by opener disc

VI. Current technology is very workable, but far from optimal

A. Is any product ever perfect, so that there is no room for improvement?

B. Always trade-offs in design:

1. Conflict between features (many of the components interact) -- as the number of interacting components increases, the probability increases that improvements in one component will adversely affect the performance of several others ("complexity catastrophe" in evolution)

2. Conflict between features & user-friendliness & durability & economics

C. Design will continue to improve; biggest improvements in early years

1. Why can't we achieve 95% emergence every time?

2. Why can't we seed at 20 m.p.h.?

3. Why can't we buy a seeder that will do 50,000 acres without repairs?

4. Why can't we seed during a rainstorm? During winter?

VII. No-till seeding strategies

A. Start seeding early enough to finish within optimum window w/ avg. weather

B. Plant into different residue types (see rotational planning)

C. Stagger seeding dates of beans -- risk vs. return

D. Match seeding rate to conditions: planting date, residue level, seeder performance, seed quality and genetics

E. Optimum depth

1. Broadleaf crops: as shallow as possible but consistently in moisture

(Note: make sure the seed is either consistently in moisture or else nowhere near moisture as when "dusting in"; it will take more moisture to germinate soybeans, cotton, and sunflowers than wheat or milo)

2. Grass crops:

a. Corn is optimum at 1.5" -- shallower will result in setting the growing point near the surface (more likely to be damaged by a late freeze or herbicides) and in poor root development and more lodging

b. Wheat preferably not shallower than 1 to 1.25" (winterkill and lodging are worsened by planting less than 1" deep), optimum depth depends on variety, climate, and rotation -- shorter coleoptile (usually semi-dwarf) varieties don’t need to be as deep; climates or crop sequences that reduce winter injury don’t need to be as deep

c. Milo preferably not shallower than 0.75 to 1" but again varies by hybrid

3. Planting any crop deeper than necessary reduces & delays emergence, weakens or even kills the seedling, and causes more compaction

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