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How Much Accuracy of Seed Placement Do You Need?

(i.e., how much precision is economically advantageous?)

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As an agronomist and the founder of a company that strives to improve seeding hardware and methods, I have long held the view that we need *greater* precision of seed placement. By 'precision of seed placement,' I am referring to *accuracy* and *consistency* of: A) depth of placement, B) firming of seed into surrounding soil, C) fill material over the seed, and D) low-density of fill material over the seed. It also refers to the handling of mulch, and at a minimum involves preventing 'hairpinning' (the tucking or folding of straw into the furrow, where the seed is nestled in straw instead of soil), and having the mulch spread uniformly across the field before seeding commences.

The question of 'adequate' precision of seed placement most frequently arises for producers who already own narrow-row drills for seeding cool-season cereals (wheat, barley, oats), as well as pulses (peas, lentils, faba beans), or canola. The grain drill (box drill or air drill) may be the only seeding tool on the farm, and is generally low-precision, although some moderately high precision models are gaining popularity.

Contrast these seeders with 'planters' which have singulators to count seeds individually. While planters had trailing treader wheels for depth-gauging in the 1950s and '60s (see photo), essentially all have now adopted gauge wheels alongside the opener blades for greater accuracy, and for separation of depth-gauging function from furrow closing & seed firming. Planters have traditionally been used for corn, sunflowers, and cotton, as well as soybeans and milo (grain sorghum).

The planter versus drill distinction is being whittled away. Planters are now commonly built with row spacing as narrow as 15-inch, and with central-fill capability. Grain drills are becoming increasingly sophisticated, with many now having depth-gauging wheels alongside the opener blades, as well as having the seed-firming and furrow-closing functions separated (which most OEM planters have yet to achieve: You or the dealer have to install Keetons or 'seed-lock' wheels to obtain in-furrow seed firming). Opener parallel-linkages are becoming more common on drills. A few 'hybrid' drills even have seed singulation capabilities.

In general, however, most grain drills are less precise than planters, although for many crops and agronomic practices, it may not matter much. But for some crops, plant spacing and uniform timing of emergence has significant yield effects—these include sunflowers, corn, and cotton. The

In the 1960s, planter openers gauged their depth from trailing treader wheels. Essentially all manufacturers have now gone to depth-gauging wheels alongside the opener blades, for greater precision.

Modern planter opener.

temptation for many who already own drills, and sometimes very large drills, is to use the drill to also plant their sunflowers, corn, and/or cotton. The additional costs associated with owning a planter (or hiring one) are a real-world concern. Also, it has frequently been noted that drills can generally be operated at faster speeds during seeding (although planter 'slowness' is perhaps something that pertains only to finger-pickup singulators), that even the 'fancy' drills usually have lower per-acre maintenance costs than planters (especially if half the drill openers are locked up), and that drills have larger seed tanks and central fill. Sometimes it is argued that the narrow rows of drills partly (or completely) offset the reduced precision of metering and/or seed placement.

A number of no-till early adopters (and rookie corn producers) in the Dakotas went down this path in the early 1990s, and installing IH 400 Cyclo drums on JD 750 drills became something of a craft. Part of the reason for this was early recognition that the 750 drill was unique in that it did a reasonably good job of seed placement in no-till, it almost never plugged with straw, and it didn't break (although closing wheel bearings were another story). At that time, Keetons for planters hadn't come on the market yet, nor had the 'seed-lock' wheels. Row-cleaners were new, and many people were still confused by the myriad of coulters they were supposed to be using. (Between lack of key attachments and lack of knowledge, many a no-tiller in the early '90s fought plugging with straw and/or mud, as well as mediocre stands with planters.) Several other attachments for planters were all the rage, many of which actually made problems worse. But the Deere 750 drill sorta worked, or at least it worked well enough most of the time that these producers saw value in using it for planting corn. *Of the dozen or so Dakota no-tillers who initially ran Cyclo drums on 750s, every single one of them eventually went to a row-crop planter* after recognizing the yield drag they were incurring.

Deere 90-series drill opener. Many no-till drills now have features to make them more precise, i.e., like a planter, such as using depth-gauge wheels alongside the opener blade. This drill model has some attributes that surpass OEM planters, such as an in-furrow firming wheel completely separate from the closing wheel. However, this model still cannot equal a well-tuned planter for placement.

A decade later in Kansas (and southern Nebraska), JD 50/60/90-series no-till air drills, as well as Flexi-coil 8100 drills with FSO openers, had become popular with some of the larger wheat growers, who were also attempting to add corn to their crop rotations. For these growers, the general idea was to use paired-rows (two 7.5-inch rows on 30-inch centers) so that the dispersion of seed across the pair of rows would partly compensate for the lack of singulation. Data from several trials comparing paired-row drilled corn versus 30-inch planter-planted corn indicate yield losses of 8 – 10% for the paired-row with a drill, although a couple trials showed no yield differences. Some studies by K-State indicated that drilled corn (sometimes using all the rows) may eventually attain yields equivalent to planter-planted corn in irrigated conditions *but only when much higher populations were used for the drilled corn*—thus negating any cost savings from using the drill. Other complications included slower harvesting for paired-row (the stalks have to bend) and increased harvest losses in some conditions. Again, many of the producers who were trying diligently to make the drill work for corn eventually gave up and either bought a planter or hired their corn (and sunflower) planting.

A test in north-central Kansas comparing drilled paired-row corn versus 30-inch singulation with a planter. This planter had row cleaners, Keetons, and spoked closing wheels. The drill was a Flexi-coil FSO that had been modified to include Keetons and spoked closing wheels.

What is causing the yield drag? Part of it is plant spacing, to which corn, sunflowers, and cotton are quite sensitive. However, some studies, such as Paul Jasa's at UNL, have shown that—at least for corn—the plant spacing effect isn't nearly as important as uniform *timing* of emergence (for a complete review of uniformity studies, see Exapta's DVD, or the info on our website). (And, for the record, it's not just getting all the plants to emerge at the same time, it's also keeping them growing at

the same rate, for which things like pop-up fertilizers with micronutrients become important, as well as providing a good rooting environment for the seedling, etc.) It is also well-established that plant spacing becomes less important with narrower rows, so it becomes rather unlikely that seed spacing effects (lack of singulation) is what was causing the yield drag with the drilled corn studies. Instead, it is lack of precision of *placement*, which results in uneven timing of emergence, as well as some seedlings placing their growing point too close to the soil surface (corn must be placed at least 1.75 inches deep to develop properly, and frost tolerance of some hypogeal crops—where the seedling's growing point remains belowground for a significant part of its early life—also depends on a certain minimum depth, such as for wheat, barley, field peas, lentil, and faba beans.)

Planters built in the last 35 years in North America have some advantages over drills for precision of seed placement. Up until the JD 50/60/90-series drills, the depth-gauging function of grain drills was accomplished with press wheels, which also did the seed firming (furrow closing was from whatever soil sloughed back into the furrow after the opener blades were done, and whatever the press wheels could squeeze back together). In the aforementioned studies, many of the planters used in the no-till trials were equipped with row cleaners and Keetons, and sometimes with spoked closing wheels. Also, quite importantly, planters all have parallel linkages for consistent depth (the JD 50/60/90-series drills struggle to achieve this because of very limited effective range of opener travel for the radial link and down-pressure spring configuration) as well as having double-disc openers for holding the furrow open while seeds are placed (again, the JD 50/60/90-series openers have only a single disc, and the seed boot is relatively ineffective at keeping dust and duff out of the furrow while seeds are being placed).

Do these design differences translate to more erratic seed placement? —yes, according to data gathered by K-State ag engineers during one of the studies comparing a JD 60-series drill to a planter. Depth was shallower, and more variable with the drill.

Taken together, all the evidence appears to indicate that corn and sunflowers should definitely be planted with a high-precision opener, which is to say a planter (the rules may change someday as drills get more precise). (Comparisons on sunflowers also show large yield losses with drills.) Data on cotton are a bit more contradictory, but again, the trend is towards yield advantages to more uniform emergence from more precise placement (as well as singulation).

What about seed costs? That is certainly another factor driving many Corn Belt producers to use split-row (15-inch) planters for soybeans instead of grain drills, although these farmers usually plant corn on 30-inch rows by locking up the 'splitter' row units. Some areas (the Dakotas, for instance) have gone more heavily into 20- and 22-inch planters for corn, for good reason (see my Row Spacing Review, Nov. '08 newsletter), and sometimes these planters are also used for soybeans, apparently with little or no yield drag versus narrower rows, at least in dryland conditions in the Dakotas. Again, the 20-inch planters allow lower seeding rates than 50/60/90-series drills due to more precise placement (higher emergence percentages).

Corn drilled in paired-rows with a Deere 1890 air seeder in north-central Kansas (dryland). After a couple years of large-scale experimentation, this producer now uses a planter for corn.

AVEC drill at Dakota Lakes Research Farm. It is built in Argentina and has a very functional opener design as well as a unique rapid-response down-pressure system that keeps equal pressure on all openers at all times. At least one manufacturer in Europe is working to integrate these features into a robust opener on an air seeder frame. Hopefully they'll get it right, and eventually introduce it to North America.

What about 30-inch planters for soybeans (or milo)? Yes, there will be cost savings from reduced seed usage, but be careful that you aren't letting the tail wag the dog, i.e., if you are giving up a couple percent of yield with wider rows (or suffering greater weed infestation), then perhaps the savings on seed are an illusion. While optimal row spacings tend to be wider in the more southerly regions (of the Northern Hemisphere), there is certainly a point where yield reductions become significant.

What emergence rates are typical? For planters with row cleaners, Keetons, and reasonably decent maintenance and adjustment, emergence rates in no-till generally run 75 – 90% depending on the crop, stubble type, planting date, and seed lot. Spoked closing wheels often improve emergence further, as do Mojo wires for many conditions. JD 50/60/90-series drills that are similarly maintained generally have emergence rates of 50 – 85% for the same crop, seed lot, and planting conditions. Again, some upgrades such as narrow flexible firming wheels (e.g., the SDX firming wheel) and spoked closing wheels can improve overall percentages of emergence as well as consistency (eliminating the frequency of the lower percentages). The main reasons for the reduced emergence with the JD 50/60/90-series drill are: A) no method to keep dust and duff out of the furrow since it's a single-disc opener and the boot cannot operate effectively below the soil line, B) a very small range of opener travel and effective down-pressure, C) difficulties in using a row cleaner, and D) difficulties in operating this opener at shallow depths due to the largish diameter of the blade, limitations of effective down-pressure, and difficulties using a row cleaner. However, there are innovations coming to market that help alleviate some of these problems. Also, improved no-till drill opener and down-pressure designs (such as the AVEC) may yet allow drills to seed with precision that is equal to or better than what is obtained currently only with well-tuned planters.

Summary: Accuracy of seed placement is important for both yield and reducing seed costs. Attaining more precise placement of seed is what Exapta is all about. The changes needn't be inordinately costly or complicated. We're as much concerned about seeding efficiency (acres per hour for that seeder width) as we are about exactitude of placement, since both contribute to your bottom line. We've been hard at work evaluating what is already on the market (both OEM and aftermarket), and figuring out what we should be bringing to market. Over the past 15 years, I've spent innumerable hours digging behind planters and drills in long-term no-till, and testing various adjustments and tweaks, as well as having the benefit of information derived from other keen observers. We hope you'll avail yourself of this accumulated expertise, which we have compiled on our website and especially in our educational DVD, *No-Till Seeding Explained.*

No-Till Seeding Explained™ DVD
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