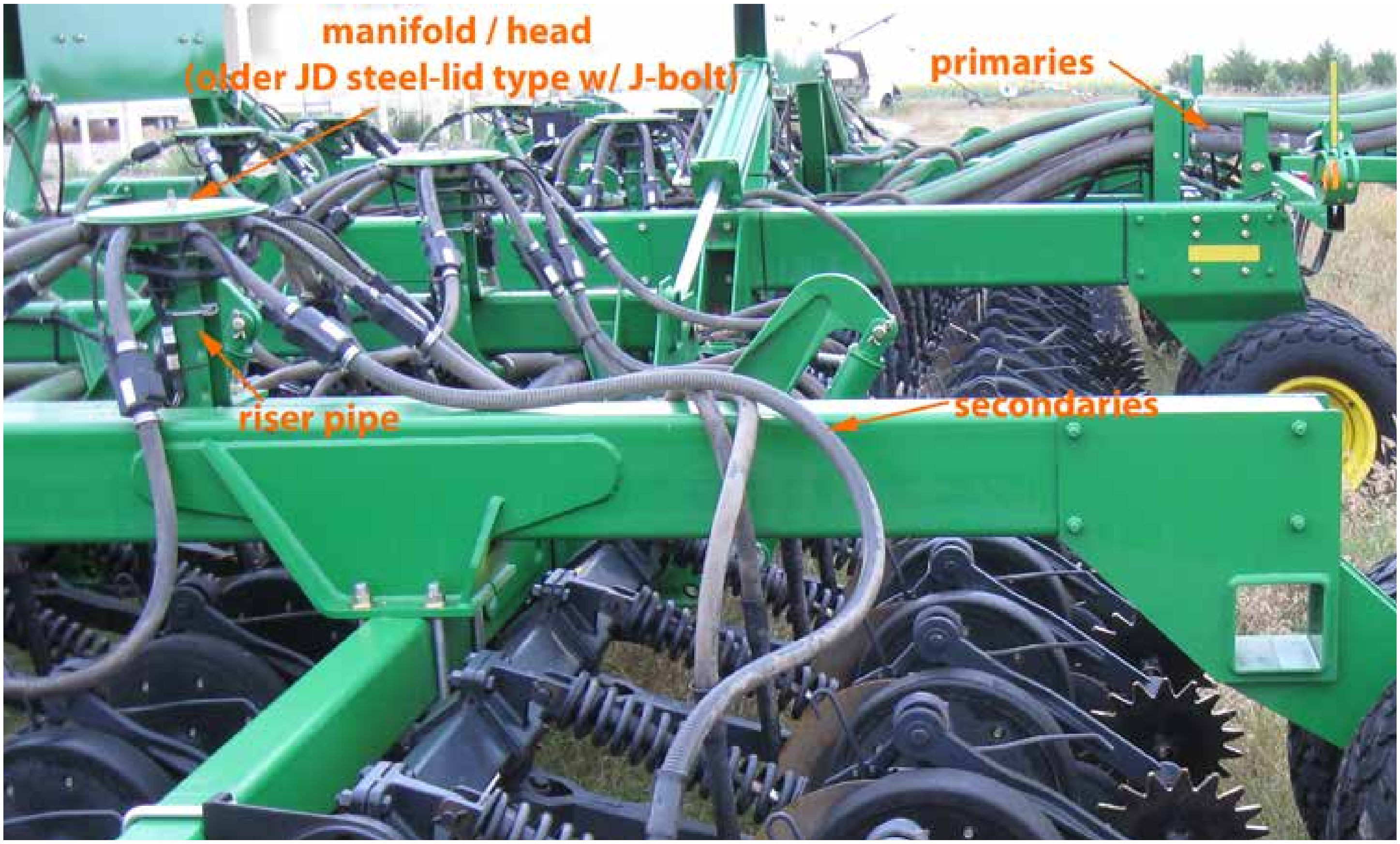
Air Drills & Other Air-distribution Systems

by Matt Hagny (with Jock Baker)



A Deere 1895. Note that the secondaries have a lot of sags that should be corrected for better product distribution and flow. The riser pipes should be raised, which is a simple matter of loosening some hose clamps and repositioning. Ideally, the antiquated flat-top steel-lid distribution heads would be updated for less seed damage and more uniform product flow.

Exapta has always focused on the soil-engaging components of planter & grain drill openers in no-till seedbeds. That has been the weakest link. Now that we're getting a handle on some of those shortcomings, we can free up a little grey matter in our noggins to deal with *uniformity of delivery* of seed & fertilizer in air streams—i.e., *the +/- variation from one row to the next of product* when the distribution or dividing of the product flow is by splitting air streams. This is much trickier than you might guess. And the trouble is, you cannot see a 20% difference in row-to-row variability of seed delivery—you have to measure, or count.

Australians are masters of this, perhaps because they use air drills for the majority of their crops. Or maybe because they've mostly used shank openers up until recently, so they had more time and energy to focus on product distribution between rows? Or perhaps because Aussie farmers set up so many of their own seeding rigs that they've come to question how best to divide the product in the air stream coming from the cart? In any event, Australian farmers are very aware of the problems from poor methods of dividing air streams, whereas farmers in the USA typically have never even thought about it (and I've neglected it too). Farmers in western Canada seem slightly more aware of the potential issues than their USA counterparts-perhaps because western Canadian farms use air drills for nearly all their crops, or perhaps because of education by some of the aftermarket companies in western Canada who make air diffusers that can 'tune' each row, etc. Or perhaps because western Canadians have simply used air seeders & air drills for many decades and are just more accustomed to dealing with their shortcomings.

In any case, it should be fairly obvious that we don't want significant variations in product rates from row-to-row. Not only is it a poor use of seed & fertilizer, but can be hazardous to stand establishment if your fertilizer rates down the seed row are also varying and you're too close to the 'danger zone' on the rate — perhaps because the soil is drier than usual, or whatever (this is much more of a concern on disk openers with narrow, well-defined furrows, as compared to shanks with a wide ribbon of seed and fertilizer). According to Jock Baker, air systems engineer and manager of Smallaire in Australia, it's very common for stock OEM air drills set up by the dealer to have +/- 20% variability row-to-row. But with some attention to detail, it is fairly easy and affordable to get this down to +/- 2% or less. (And, btw, the correct way to measure this is with buckets or pans under each opener to collect the product for weighing; don't use socks or cloth bags—these will impede the air flow enough to skew the results.)

What to do about row-to-row variability?

Okay, so you've made up your mind to work on this—good for you! You might first want to see where you're at, by doing the bucket test. Simply do a 'priming' or short burst of seed or fertilizer into the air stream with the rig setting still. Weigh the product in the buckets carefully to find out how much variation is being created by the riser pipe, manifold (a.k.a. distribution head), and secondary lines.

A Smallaire riser pipe with enlarged elbow to reduce ricochet of product as it travels up to the head. This results in more uniform feeding of product into the secondaries. The crimps create turbulence to help disrupt any remaining ricochet. The 'square' crimps have proven to outperform dimples.

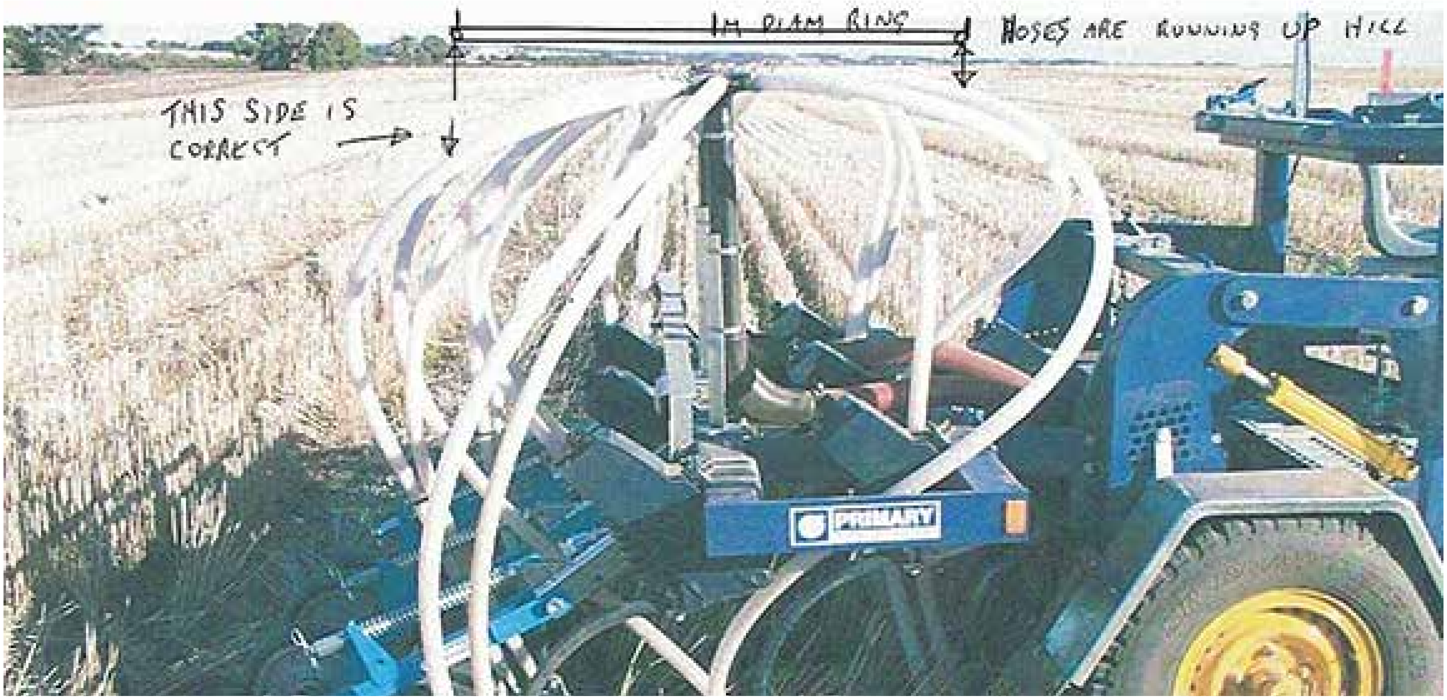
Learn more

If poorly designed, the riser pipe will create variability by overloading one side of the distribution head. This occurs if the riser pipe has an ordinary mandrel bend, instead of an enlarged elbow—as the product comes around the bend, it tends to travel to the outside of the curve, and then ricochets repeatedly back & forth inside the pipe until reaching the head. Enlarged elbows create a pressure drop, which helps disrupt the airflow and prevent ricochet. Even more important are the dimples or crimps in the riser pipe which induce turbulence to smooth out (disperse) the ricochet. Riser pipes without dimples are a big no-no (and JD air drills didn't have them until recently!).

Inside the manifold, ideally there is a cone in the center to help with dispersing the product to the various outlets by taking up the empty space to stop product from bouncing around in the head (and this is especially important on sidehills). The interior of the manifold shouldn't have any flat spots for seeds to bang into and for air to 'dam up.' All internal surfaces should be contoured (again, the Deere air drills with flat-top steel-lid heads are notorious for having lots of flat spots inside, and this manifold design is still in use by some other OEMs; another fault of this design is the J-bolt inside, which by itself can cause up to 2% seed cracking, not to mention countless plugging problems from fertilizer accumulation around it).

Restrictions in the secondary lines create further distribution problems, since the air isn't escaping as readily from some lines as compared to others—the resulting backpressure further messes up the distribution in the manifold (the product follows the air via the path of least resistance). Restrictions in secondaries can be from hose clamps partly crushing the plastic secondary line when it mates into the steel seed tube or boot, for instance. Variability is also created by differences in the length of the secondary lines and also primary lines, since there's turbulence being created all along the length by the hose wall. Longer lines have more backpressure. The worst case is if the system has a lot of backpressure—usually a result of secondary hoses being too small. For instance, Case/New Holland and John Deere use 1" secondaries, whereas most Australian air drill manufacturers use 1.25" (that might not sound like much difference, but it's nearly double the air volume that can be pushed thru that slightly larger diameter hose). Not only does backpressure create irregularities of product distribution, but the tractor hydraulics have to work a lot harder to push against this backpressure (it's the same as having an inefficient exhaust system on a race car—it's a significant drain on power).

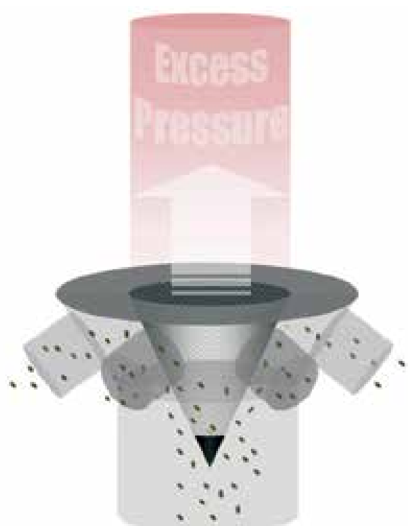
Australian-built air drill. Note how high the risers are and the steepness and straightness of the secondaries all of which is very desirable for uniform flow to each row. Note also the diffusers in each secondary, just above the opener. The drill's owner Robert 'Ruwy' Ruwold also runs SeedVUs in each head.



The secondaries coming out of the front side of this head are going uphill, which creates considerably more resistance than the ones going downhill only. Farm a lot of slopes? Then you need to risers positioned higher and even more vertical drop on the secondaries to ensure that none go uphill.

Another big source of variability in secondaries can be the trajectory—there should not be the slightest amount of droop, nor anywhere that a given secondary is going the slightest bit uphill. Many air drills are improperly set up by the manufacturer or dealer and have secondaries that have droops, or may even go slightly uphill immediately when coming out of the manifold. In many cases, this can be sorted out simply by unclamping the risers and repositioning them a bit higher, and/or doing some trimming of secondary hoses so they're exactly the right length—long enough not to pull out of the manifold, but short enough to run reasonably straight. Sometimes a little wire or other support is needed, or hoses are simply routed the 'wrong' way around a frame or whatever.

Another way of eliminating the backpressure problem is to install SeedVU diffusers, which go directly into the manifold. These are adjustable (there's a baffle inside, adjusted with a knob on the outside) so that much of the backpressure at that point can be eliminated, while still keeping some air going down the secondaries to help move product—which is especially useful if the secondaries are relatively horizontal.



(Exapta is the exclusive seller of SeedVUs & Smallaire ag products in North America; for anywhere else, please contact JPD Agriculture & Smallaire directly.)

Pulsing or clumping of seed along the length of row

This can be an even worse yield robber than row-to-row variability. The main cause of this is trying to move too much product thru lines that are too small. Solving the problem is a matter of up-sizing the lines, and/or removing restrictions. (A temporary fix is to drive slower.) The primaries need to have at least double the air speed of the secondaries. If that is not the case, then product will start piling up in the primaries, which restricts the line and creates its own increase in air speed, which picks up the product — creating a surge or pulse of extra product being delivered to all the rows fed by that primary (the pulses may not arrive at each row simultaneously, since some secondaries are longer and thus more delayed). A sure sign of inadequate air speed in the primaries is if there's product that continues to dribble out after you raise the toolbar at the end of the pass. This is easily fixed by installing SeedVUs which will relieve backpressure and free up the air speed in the primary lines to keep them clear.

Sometimes, the operator will try to compensate by increasing the fan speed. Many air drills are run with fan speeds that are much too high, which is actually decreasing the pressure of the air flow. This is due to the fan spinning so fast that the air can't get away from the fan due to high backpressure—this is called "running in stall," and the only decent way to fix this is to redesign the system with the correct (larger) hose sizes, or install bleed-off units such as the SeedVU or Smallaire relief units.

Although Jock Baker of Smallaire doesn't agree, he does acknowledge that Flexi-coil and several other air drill manufacturers have promoted the following method to figure out the necessary fan speed: Remove a secondary hose and aim it straight up in the air. Drive at normal speed and delivering the desired amount of product. If the product is blowing 6 ft up in the air, then fan speed is excessive. If the product is blowing less than 12" up into the air, then too little. About 18 - 24" is optimum.

Flat or linear distribution heads.

By the time the air stream gets to the boot, it should be ~1,300 FPM (6.5 m/s) or less, and ideally only about 400 (2 m/s) with the assistance of diffusers in the secondaries just above the boot. Any more than that, and there's a higher chance of seed bounce—depending on seed tube & boot design & maintenance (also, the seed bounce flaps are important—see Exapta's Ninja flaps for JD 50 & 90-series no-till drills). This is where diffusers at the manifold (e.g., SeedVUs) and/or in the secondaries are a considerable advantage. Some air drills are simply designed wrong or use a linear head (see photo above) and need a higher air speed throughout the entire system to prevent blockages from occurring, which most certainly causes more seed bounce.

Spending a little time checking your air drill over now will give you the best returns by getting the correct rate of seed and fertilizer down each row. There is some real know-how involved when it comes to dividing the product in air streams. Take advantage of this expertise, and make your drill run ***better*** *than new!*