SEEDER TRACKING AND GUIDANCE FOR PRECISE ROW SOWING

By Jack Desbiolles, Agricultural Machinery R&D Centre, University of South Australia

A SEEDER THAT MAINTAINS PRECISE PASS-TO-PASS ACCURACY REGARDLESS OF TERRAIN OPENS THE DOOR FOR GUIDED SOWING RELATIVE TO EXISTING STUBBLE ROWS. ACCURATELY SOWING IN RELATION TO PREVIOUS STUBBLE ROWS CAN BE CRITICALLY IMPORTANT TO SUCCESSFULLY ESTABLISH CROPS IN LOW OR UNEVEN MOISTURE SITUATIONS.

In high residue loads, inter-row sowing into standing residue with tine seeders can decrease or eliminate residue clumping and interference over the seed rows. With disc seeders, inter-rowing sowing controls residue hairpinning, especially in combination with residue managers. It also ensures good soil-to-seed contact.

In both cases, inter-row sowing significantly improves the efficiency of crop establishment, enabling lower seed rates, and higher speeds at similar pre-emergence herbicide safety and efficacy. At the same time, the intact stubble can effectively shelter seedlings against wind damage and soil moisture loss. Inter-row sowing also reduces take-all and crown rot disease pressure, and makes it easier to harvest pulse crops.

Alternatively, in non-wetting soils and low fertility sands it is often advantageous to place the seed in proximity to the previous stubble row rather than in the middle of the inter-row because more moisture and nutrients are present in an existing furrow compared to the inter-row zone. This approach results in drastically improved germination, a longer sowing window, more even crop development, and increased grain yield.

While near-row (or edge-row) seeding and centre-row (or on-row) seeding can both be used to generate these benefits, edge row seeding is preferred to retain stubble integrity with tine seeders, and to minimise hairpinning with disk seeders. Overall, better results are achieved with a side banding configuration.

With accurate implement guidance, the contiguous row sowing within a dedicated permanent seed zone may over time create improved fertility strips. A research project funded by Grains Research Development Council (GRDC) will evaluate this technique over the next four years.

While there are a number of guidance technologies with various capabilities, implement tracking stability is the starting point. This article provides an overview of relevant considerations on the subject.

SEEDER TRACKING STABILITY

Accurate sub-inch RTK guidance of the tractor and stable implement tracking are both necessary to achieve guided row sowing. Accurate tractor guidance increasingly uses sophisticated ‘terrain compensation’ software to accurately steer the tractor hitch along the guidance path.

Different towed seeder bars have different tracking abilities, so accurate auto-steering of the tractor alone may not always be sufficient.

The stability of the seeder is influenced by the forces applied onto the bar in relation to the tractor pulling force. The forces applied on the seeder bar include:

- forces at the implement hitch, including tractor pull;
- the weight of the seeder bar;
- tyre reactions, including rolling resistance;
- opener draft, penetration and side forces;
- drag forces from a tow-behind air-cart.

An imbalance in horizontal (draft, side) forces creates drift as the implement’s centre of draft tries to line-up with the tractor centre of pull. This drift can be random in response to changing soil conditions or working depths. Or it can be systematic, when the implement is set incorrectly or its weight causes the implement to crab downhill when operating along a side slope.

Random drift is a significant issue when trying to accurately inter-row sow, while systematic drift may sometimes be managed by following the same seeding pathway, season after season.

Implement drift is measured by the extent of skew angle in relation to the travel direction. While at work, forces from the implement’s wheels and the furrow openers create ‘restoring’ forces that stabilise the bar and limit drift within a maximum skew angle.

Successful guided row sowing requires the bar to travel straight. With large multi-rank bars even a small skew angle, such as on a side slope, quickly becomes incompatible with guided row sowing because it creates variable seed furrow spacings.
A small skew angle with very compact bars (one or two ranks) is generally acceptable and guided row sowing can be achieved by following the same seeding pathway, season after season.

**DESIGN PRINCIPLES FOR GOOD TRACKING**

A balanced bar design is the first requirement for a good tracking stability. This includes symmetrical layouts of both openers and wheels, and a uniform distribution of the seeder bar weight, including over the wing sections.

Where the wheels are positioned relative to the tines can improve or worsen tracking. For example, working depths will be affected if they ride into the furrow or over soil throw ridges during skimming.

Wide tyres placed on a walking beam are typically least sensitive to the above. A longer A-frame gives an advantage by stabilising drift at smaller skew angles.

A common rule of thumb is that the draw-bar length should be half the implement width to give sufficient restoring power to rigid frame wheels.

Constant tillage depth across the bar is critical. It is best achieved by openers that follow ground contours. This is especially important on wider, less-stable bars and undulating land.

A poorly set-up bar or inadequate floatation in soft soils can create a constant force imbalance that causes systematic drift to the left or right. You can check the extent of systematic drift by sowing up and back on flat land and checking for alternate 'closed' and 'open' spaces between adjacent passes.

The use of a pointer and dial kit (a pointer fitted to the tractor over a dial fitted to the implement) can provide a reference to assess and/or video the extent of skimming movements while at work.

Rigid wheels, either singles or as a walking beam on the bar, act as rudders and provide restoring forces. Their 'restoring power' is improved by a greater loading weight, a larger wheel skid angle, and a greater distance behind the tractor’s towing point.

Larger skid angles can be obtained by positively steering frame wheels to keep the bar on its intended path. This can be done manually or automated with sensor or GPS input (see below).

To maximise the stability of a tine seeder bar, avoid steep narrow openers because they absorb some of the bar weight by generating an upward soil reaction, especially when dry seeding in hard soils.

Conversely, shallow rake angle points (less than 60 deg.) with optimum wear at the cutting edge can both add to the existing frame weight and decrease the seeder draught requirement.

Avoid castor wheels because they take on the weight of the frame but do not help restore tracking.

A fully mounted air seeder box placed near the rearmost supporting (rigid) wheels of the seeder bar and openers placed close to the towing tractor can improve tracking.

A tow-between air-cart adds another 'link' to the tow-chain, and places the implement further behind the tractor. On side slopes, this can increase the extent of implement drift downslope, especially when the air-cart is near-empty.

On the other hand, a tow-behind air-cart acts as a damping force on the flat. It tends to reduce the amount and suddenness of random implement drift by decreasing the impact of a force imbalance. However, when operating on a side slope, the tow-behind cart drag force increases the downslope-pull on the seeder which increases its skew angle. Twin axle air-carts with steerable wheels can minimise this impact relative to single axle carts.

**FIELD OPERATION**

Working at slower speeds can improve guided row sowing accuracy. In practice, inter-row sowing is easier to achieve than near-row sowing because of the larger margins of error, especially at row spacings of 300mm or more. Edge-row sowing is suitable to narrow row spacing (150-200mm) with accurate guidance and stable tracking.

A common source of implement drift is the tendency for the openers to return to last year’s row when inter-row sowing, especially in harder soils. Force imbalances push the openers away from the harder inter-row zone into the weaker furrow side. This problem is more significant with lighter weight seeders, and stability can be improved with a higher load on the seeder wheels and the use of steering hitches guiding the implement.

**IMPLEMENT GUIDANCE**

Guiding implements to targeted pathways gives the most accurate implement control. Implement guidance falls into two categories:

- **Passive guidance:** These systems combine GPS data from mounted receivers on both the tractor and implement to auto-steer the tractor such that the implement always remains on the intended guidance path. This is the cheapest option but requires the tractor to move on and off track to keep the implement on the targeted path.
- **Active guidance:** Guiding the implement.

It is best suited to gradual and systematic drift so it is combined with a stable seeder bar to minimise transient and sudden
JOHN DEERE OFFERS ONE UNIT TO CONTROL THEM ALL

This year John Deere is rolling out its new Rate Controller 2000, which integrates with many implements for high-resolution product control.

The new Rate Controller 2000 is compatible with many different equipment platforms, including non-John Deere pull-type sprayers, liquid and dry fertiliser systems, and some planters.

Rate Controller 2000 aids in field documentation, map-based prescription applications, and overlap control when used with John Deere Section Control.

Farmers and contractors who use the new rate controller can manage the application of up to five different products, liquid or dry, and will have increased section control capabilities when applying these products.

They also have the ability to simultaneously apply liquid fertilisers, along with other inputs such as herbicides, insecticides, or granular products, to reduce the number of field passes and improve productivity.

John Deere marketing manager John Misher says the new Rate Controller 2000 provides customers who want a single rate controller much greater flexibility and more scope across numerous equipment platforms. “Customers using other rate controllers can easily and conveniently migrate to a single John Deere Rate Controller 2000 at a lower cost rather than using multiple controllers.”

The John Deere Rate Controller 2000 is a drop-in replacement for current GreenStar Rate Controller-equipped implements that use a GreenStar 3 2630 display. It can be used on non-John Deere equipment such as three-point linkage sprayers and drawn sprayers when used with a GreenStar 3 2630 Display or tractors equipped with the 4600 CommandCenter.

For more information on the new John Deere Rate Controller 2000, visit deere.com.au or see your local John Deere dealer.

TAKE HOME MESSAGES

- Accurate tractor guidance is not always sufficient for guided sowing operations.
- The starting point for good seeder tracking is the design and setting of the seeder bar and its openers. This includes maintaining sufficient frame weight on rigid wheels while seeding.
- Passive and active implement guidance systems can deliver additional accuracy and cost-effective guided seeding in challenging conditions.

Contact Jack Desbiolles for further information on Jack.desbiolles@unisa.edu.au or phone 08 8302 3946.