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ALGERIE: semis direct, nouveautés.

En Australie, un nouveau type de dents pour semer plus vite.

James Barr, UniSA PhD candidate, with the bentleg opener.

Bent-leg openers, such as this South African prototype RT Blade, could potentially deliver quantum leaps forward in no-till seeding.

Sillons réguliers derrière le semoir.

Irrégularité des sillons. La trop grande vitesse entraîne la projection de terre dans les sillons latéraux .

La technique du semis direct évolue. Un nouveau type de dents permet de semer plus vite.

Djamel BELAID.

مهندس زراعي

BENT-LEG

De bonnes raisons

d'utiliser des dents « bent-leg ».

Sillon, récolte de pluie

En semis direct avec dents, le sillon permet de récolter et concentrer l'eau de pluie vers la semence et l'engrais localisé.

Sillon et vitesse

Une trop grande vitesse de semis provoque des projection de terre dans les sillons adjacents.

Sillon et désherbage

En cas de désherbage de pre-émergence, le recouvrement de la trifluraline est assuré par la terre remuée les dents. Il s'agit cependant d'éviter toute projection de terre et d'herbicide dans les sillons adjacents sous peine de phyto-toxicité.

Les dents Bent-leg

De par leur forme les dents de type « bent-leg » permettent des vitesses de 16 km/h sans risque de projection de terre.

Humidité du sol

Moins de perturbation du sol permet de moins diluer l'humidité contenu dans le sol.

Mauvaises herbes

Moins de perturbation du sol permet de moins oxygéner les semences de mauvaises herbes et donc de provoquer moins de germination.

Travail en sol sec

Les dents bent-leg sont plus adaptées au travail en sol sec.

Puissance de traction

Les dents bent-leg demandent moins de force de traction et sont particulièrement adaptées au parc matériel des petites exploitations.

Régularité de semis

Les dents bent leg assurent une meilleure régularité de semis.

« BENT-LEG »

Quels intérêts?

Réduire le volume de sol remué par la dent.

Date: 30.06.2014
Secrets of soil movement unearthed
Rebecca Jennings

University of South Australia researchers are investigating ways to improve seeding success and efficiency in no-till farming systems
Photo of bent-leg opener

Bent-leg openers, such as this South African prototype RT Blade, could potentially deliver quantum leaps forward in no-till seeding.

Here, the Agricultural Machinery Research Group's workshops house seeding, tillage and harvesting machinery, cutting-edge agricultural technologies and even a self-propelled autosteer lightweight vehicle, which could be used for automated soil sampling.

A walk around the precinct also reveals its 250-metre-long tillage test track, where a continuous sandy loam 'soil bin' between the rails allows tillage tools to be tested under repeatable conditions.

It signals the group's long-term work to advance no-till seeding technologies for improved seed placement accuracy and maximised crop establishment, vigour and yield.

In recent years, researchers have taken a closer look at the fundamentals of soil/tool interactions to shed light on the soil force system acting on disc seeder blades and how soil movement is induced by no-till furrow openers.

Soil throw

Although some lateral soil throw is often desirable for adequate pre-emergence herbicide incorporation, too much stimulates weed seed germination, dilutes furrow moisture and buries surface residue, leading to increased risk of soil erosion.

Over the past four years, as part of his PhD studies, Dr Aliakbar Solhjou from the Fars Research Center for Agriculture and Natural Resources in Iran has helped fill some research gaps, thanks to co-funding by the GRDC and UniSA.

Dr Solhjou homed in on narrow-point openers, which are used to open soil and place seed and fertiliser into the furrow. These openers can create excessive soil throw, even when used at typical sowing speeds, and result in crop damage.

Photo of man standing by tractor

Associate Professor John Fielke at the tillage test track at the University of South Australia's Mawson Lakes campus.

As well as exploring how the geometry of a narrow-point opener can influence soil movement, he tested an innovative concept based on a bent-leg opener and studied how the conformation of a bent-leg opener may affect soil movement.

Using UniSA's indoor seed-placement test rig, Dr Solhjou attached tillage tools to a frame that moves over bins of soil at desired depth and speed. He was able to trace how far and in which direction each soil layer moved by inserting a grid pattern of small PVC cubes acting as tracers.

When the furrow opener moved through the bin, these tracers were thrown with the soil and later located using a 3-D digitising frame to quantify soil movement, layer by layer.

The project highlighted how much a furrow opener's geometry affects soil movement. The shape, angle, width and face of openers contribute to the distances and directions that soil from each layer moves.

For example, vertical narrow openers with a two-sided face (chamfer) can increase furrow width, reduce forward and lateral soil movement and reduce the depth of soil layers being thrown out of the furrow, compared with a blunt-face vertical opener.

When it comes to the effect of rake angle, a furrow opener with a low rake angle (for example, 35 degrees) is much more effective at clearing dry topsoil away from the seed zone and bringing moist deep soil into the seed zone – important when sowing into a drying soil profile.

Conversely, a larger rake angle better maintains furrow backfill and may minimise soil moisture loss out of the

furrow. Under experimental conditions, a rake angle in the range of 50 to 55 degrees achieved the widest band of cleared surface soil, which may contribute to higher crop safety if pre-emergence herbicides are incorporated by sowing.

Under the experimental soil bin conditions (eight-kilometre-per-hour speed and 120-millimetre depth) at no-till row spacings upto 250mm, all opener rake angles moved significant topsoil onto the adjacent furrows, with potential crop-safety implications when using pre-emergence herbicide.

Global focus

The research also focused on the benefits of bent-leg openers, which have never been studied in the context of no-till seeding. Combining specific bent leg features with a leading face chamfer allowed soil throw to be cancelled or controlled to appropriate levels, while loosening large size furrows suitable for seed and fertiliser placement.

Associate Professor John Fielke, associate head of teaching and learning at UniSA's School of Engineering, says the sowing system technology research has identified opportunities for more effective seeder implement design and usage.

"The findings have implications for optimising no-till seeding practices, for example, when seeding into marginal moisture, as well as improving crop safety and in-furrow weed control when pre-emergence herbicides are incorporated by sowing."

It does not just shed light on seeding solutions for Australian growers. UniSA agricultural research engineer Dr Jack Desbiolles is involved in no-till projects in North Africa and the Middle East.

"Although zero-till disc-seeding technology has been adopted to a small extent on bigger farms in north Africa, tyned seeders are a simpler and lower-cost option for the majority of growers with smaller farms, who are not adopting no-till practices due to affordability issues," Dr Desbiolles says. "We are focusing on direct-seeding strategies associated with low tractor power and simplified low-soil-disturbance tyne seeding systems, for which the option of low-soil-throw openers are just as important."

He says understanding how furrow openers work in the soil also contributes to the development of improved management solutions for root diseases such as Rhizoctonia solani; for example, moving the top soil layer (where the highest concentration of disease inoculum lies) out of the seed zone to reduce the disease pressure on developing seedlings.

Looking ahead, Associate Professor Fielke says the sowing-system technology research paves the way for other PhD students, who will extend the bent-leg research into field context by assessing expected benefits of reduced weed germination and technology development for seed and fertiliser banding.

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ZOOM

Although some lateral soil throw is often desirable for adequate pre-emergence herbicide incorporation, too much stimulates weed seed germination, dilutes furrow moisture and buries surface residue, leading to increased risk of soil erosion.

CONSEILS

Nous conseillons à tous ceux qui sont intéressés par le semis direct (agriculteurs, conseillers, constructeurs, étudiants, ...) de suivre le dossier « bent-leg ». Il s'agit d'une voie d'innovation majeure pour l'avenir. Ndlr.

« BENT-LEG »

Quelle vitesse d'avancement?

Jusqu'à 16 km/heure sans nuire à la qualité du semis.

Bentleg opener brings speed and control to no-till
Rebecca Jennings
GRDC E-Newsletters Date: 02.11.2015

A University of South Australia (UniSA) engineering project is a step closer to delivering a new furrow opener design that reduces soil disturbance and increases operating speeds in no-till seeding.
UniSA PhD candidate James Barr is drawing on his Bachelor of Mechanical Engineering and farming background at Mallala, SA, to take the development of a 'bentleg' furrow opener out of the laboratory and into the paddock.

His work, within the Agricultural Machinery Research and Design Centre (AMRDC), is being funded by the GRDC, the South Australian Grain Industry Trust (SAGIT) and UniSA.

A work experience stint with the AMRDC drew Mr Barr to the centre, and he says this project hit the mark: "The bentleg project interested me because it has field and modelling components so I can learn a broad range of skills and it has potential to provide outcomes to growers."

Mr Barr's approach builds on a design initiated by South African grower Danie Rossouw in 2004. Mr Rossouw downscaled the bentleg concept of a Paraplow subsoiler tyne to fit a no-till seeder – the resulting RT Blade was designed to till below the seed with maximum furrow backfill and minimum surface disturbance.

The RT Blade was evaluated at UniSA in 2007-08, before agricultural engineer Ali Akbar Solhjou used his PhD project (2009–12) to research how a bentleg opener affected soil movement, mixing and soil throw.

Design
The innovative bentleg opener features a 45-degree rake angle leading foot, which offsets the shank away from the centre of the furrow, where the upheaval of soil is the greatest.
Reducing the interaction between the soil and shank overcomes the issue of the shank causing lateral soil throw.

A bevel edge further enhances the low soil throw benefits, while the bentleg style retains the majority of loosened earth in the furrow. It can loosen a large furrow without mixing soil layers.

Research was initially limited to laboratory trials, which involved testing the implement in soil bins at eight kilometres per hour and measuring the movement of PVC tracers in the soil.

James took the next step last year and trialled bentleg openers in a dry compacted silty-loam soil at Roseworthy, SA.

He compared two straight openers (rake angles of 53 and 90 degrees) and two bevelled-edge bentleg openers (45 and 95-millimetres shank offset) at 120 mm operating depth and 8, 12 and 16 km/hour seeding speeds. The extent of sideways movement of soil (lateral throw), furrow backfill, draught, vertical and side forces were measured.

Results
Soil throw
Both bentleg openers significantly reduced soil throw compared with straight openers at 8km/h.
At higher speeds, the 95mm offset bentleg opener maintained low soil throw, with a very small amount of loose soil reaching beyond the furrow width.

At higher speeds, the 45mm offset bentleg opener gradually developed similar levels of soil throw as the straight shank 53-degree rake angle opener, showing bentleg design features need to be optimised for high-speed sowing.

ZOOM
The bentleg opener shows promise as a way to reduce soil disturbance caused by tyne seeders, which may contribute also to reducing furrow moisture loss, weed seed germination, and seeding depth variability across rows.

CONSEILS
Nous conseillons aux conseillers et agriculteurs leaders de se tenir au courant de cette technique qui est particulièrement prometteuse. Ndlr.

« BENT-LEG »

Quel intérêt en pre-émergence?

Une diminution de la phyto-toxicité.

Furrow backfill
The straight openers significantly emptied the furrows with faster speed, especially the 53-degree rake angle.
The 95mm offset bentleg opener maintained maximum furrow backfill regardless of speed.
The 45mm offset bentleg, due to its increasing soil throw with speed, achieved a significantly lower backfill at 16km/h.

Draft force
The vertical knife opener required up to 50 per cent more pull than the 53-degree rake angle opener.
The bentleg openers featuring a 45-degree rake angle leading foot minimised the pulling requirement (25 to 30 per cent below the 53-degree rake angle opener).
The draft requirement significantly increased with speed for all openers (under dry conditions), most significantly with low draft openers (3 to 5 per cent increase per km/h above 8km/h).
Mr Barr says the 95mm offset bentleg design maintained its baseline (8km/h) lateral soil throw at twice the sowing speed (16km/h) and produced 100 per cent furrow backfill, offering an unprecedented ability for high-speed, low soil throw, no-till tyne seeders.

Crop safety
Although a limited amount of lateral soil throw at seeding is sometimes needed to mechanically incorporate soil-applied herbicides, excessive soil throw can cause crop damage, limit furrow backfill and soil cover over the seeds, and create unwanted ridging over adjacent seed rows, which increases seeding depth variability.

ZOOM
Dr Jack Desbiolles, from the AMRDC, measured losses to wheat plants from trifluralin damage (at 1.3 to 2 litres per hectare) in clay–loam soil. In these trials, 20 per cent plant losses were common in seed rows subject to uncontrolled soil throw and up to 45 per cent in the worst case when combined with shallow seeding depth.

The bentleg opener shows promise as a way to reduce soil disturbance caused by tyne seeders, which may contribute also to reducing furrow moisture loss, weed seed germination, and seeding depth variability across rows.

The bentleg opener contribute to reducing furrow moisture loss, weed seed germination, and seeding depth variability across rows.

In a ‘best of both worlds’ scenario, the bentleg opener could allow growers to capitalise on some benefits offered by disc seeders – such as the ability to operate at high speed while minimising key aspects of soil disturbance (including the possibility of reduced weed seed germination) – but with a tyned system that can more effectively navigate hard or sticky soils.

Computer modelling
Image of 3D modelling

James Barr is working on a 3D model to virtually assess how different operating speeds and bentleg opener designs affect soil movement.

Mr Barr’s research has highlighted that different designs perform differently as seeding speed increases.

“We need to investigate this interaction between opener design and speed to maintain low soil disturbance, to see why some designs perform better at high speed,” he says.

Other challenges include adapting the design to suit shallower soils (where stone disturbance needs to be avoided) with operating depths in the range of 70 to 100 mm rather than 120 to 150 mm currently, optimising performance in crop residue and in wet soil, adapting the concept to fit specific farming systems (such as non-wetting sands) and integrating the opener into accurate single and double-shoot seeding systems.

The discrete element method (DEM) of modelling is well suited to bulk materials and is used in industries such as mining, so the technique was adopted to model the bulk properties of soil, including parameters such as friction and cohesion.

The UniSA team can now create 3D models of soil movement (throw and mixing) and aims to validate how the bentleg opener could operate in different seeding scenarios such as soil type, depth and speed.

“Once we validate an accurate model we are confident

with, it will speed up the design process and allow us to assess how different designs work at different speeds and depths, or with the addition of seeding boots," Mr Barr explains.

Mr Barr will next test how the bentleg opener influences crop performance, with a trial planned in 2016 to assess crop establishment, vigour and yield relative to common seeding systems.

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