Research seeks to improve performance of single disc seeders

KATHERINE MAITLAND

Moist, sticky soils remain a major concern for zero-till farmers.

Researchers at the University of South Australia are seeking to improve the performance of disc seeders in sticky soil conditions by better understanding the mechanics of disc machines.

One of those researchers is Ali Khosravani, a PhD candidate with the Agricultural Machinery Group at the university's Barbara Hardy Institute, who is investigating the soil/blade/wheel mechanics of single-disc seeders.

"The interactions between soil, a disc blade opener and its accompanying gauge wheel - such as on single disc seeders - are poorly understood," Ali said.

"A large proportion of disc seeders commonly use single flat disc blades combined with a side wheel to control the operating depth and reduce the soil throw."

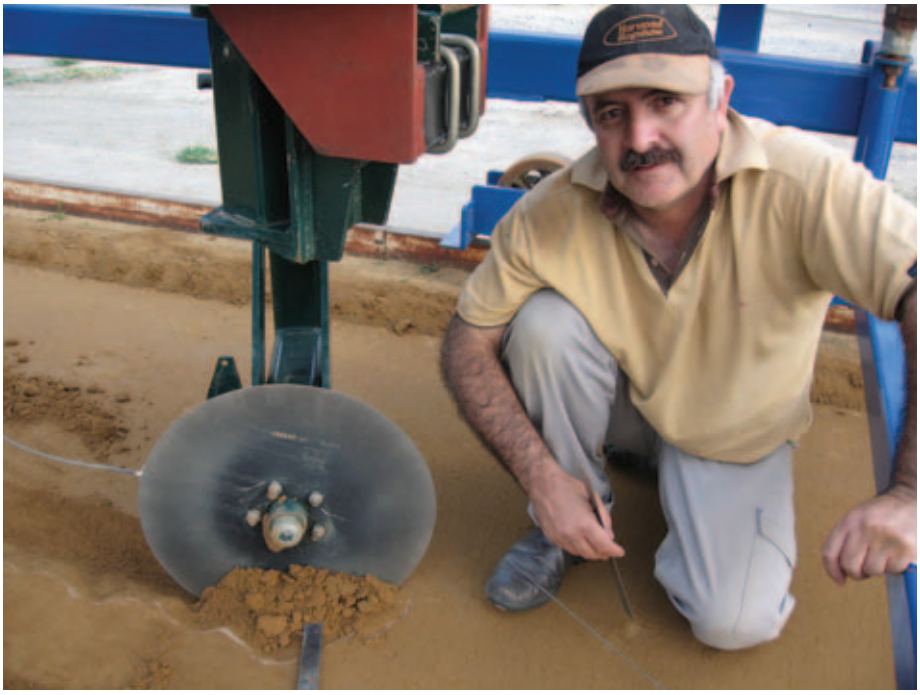
Project co-supervisor Dr Jack Desbiolles explains that field experience suggests single-disc machines are often better suited to sticky soils while double discs can induce greater furrow-wall compaction and increase smearing risks in moist conditions while triple discs generally increase the exposure of in-furrow seeding components to sticky soil.

He also points out that single disc mechanisms are subject to potentially large interaction forces between disc blade and side wheel that can negatively affect field performance.

The project, which is funded by the GRDC and is scheduled to be completed this year, is designed to improve understanding of how a flat disc blade with side wheel operates in soil, Ali Khosravani said.

"My research is aiming to develop an analytical force prediction model able to predict overall soil forces and provide a basis for improving performance of these machines, particularly in sticky conditions.

"Available soil force prediction models for disc blades have mostly considered plough and harrow disc implements that use concave disc openers. Flat-blade openers with side wheel arrangements like those as used on zero-till seeders have not been investigated."



ALI KHOSRAVANI, A PHD CANDIDATE AT THE UNIVERSITY OF SOUTH AUSTRALIA, STUDYING THE MECHANICS OF DISC BLADE INTERACTIONS WITH THE SOIL.

"Disc speed ratio appears a critical aspect of disc seeder performance in terms of forces and residue cutting," commented Jack Desbiolles.

"Understanding how to maximise disc blade speed ratio is expected to improve disc seeder component performance with particular consideration to sticky soil conditions."

"Disc speed ratio quantifies how much faster – or slower – the disc cutting edge is travelling than the forward ground speed of the machine," explains Ali Khosravani. "A higher disc speed ratio is beneficial for residue cutting and is an indicator of effective disc drive with little frictional drag in the soil.

"Tillage test track measurements show the cutting edge of a free-rolling blade can travel up to 8% faster than the forward speed of the machine, depending on blade characteristics and settings.

"However, in poor conditions with poor disc drive and high frictional drag blades can have very low disc speed ratios and can even stall in particularly bad instances."

Data for development of the flat-disc soil force prediction model are being obtained from controlled experiments conducted in the tillage test track at the University of South Australia.

Ali is also working to determine the critical disc angle and quantify the contact area of scrubbing under different sweep and tilt angles.

"At disc sweep angles below the critical angle, additional soil scrubbing occurs on the back of the disc blade, typically due to the effect of the bevel edge," he explains.

"In previous test-track experiments, disc bevel edge scrubbing tended to increase soil forces and improve the disc drive.

"We have now found that soil failure (producing the cutting effect of the disc) is generated by the front quadrant of the disc blade, particularly at low sweep angles. The proportion of the total disc interface that is actively involved in generating soil failure is in the range of 50 to 55% for sweep angles of six to 10 degrees.

"The rear quadrant of the soil/disc blade interface only pushes pre-loosened soil across to widen the furrow opening."

A series of field experiments were also conducted in moderately sticky soils to investigate the effects of position and loading of the side wheel on disc unit forces and soil build up.

"Results of the field tests showed that the presence of the gauge wheel, its position relative to the disc blade and its loading could significantly affect the soil build-up," Ali said.

"We also found that forward speed had a remarkable effect on reducing soil build up on the disc due to higher centrifugal forces and shorter soil/disc contact time.

"The interface contact area between a gauge wheel and a disc blade increases with a more forward position of the gauge wheel, which typically makes the situation worse in a sticky clay soil.

"Soil build up on a disc blade coated with ultra high molecular weight (UMMW) polyethylene was slightly less than the build up on a similar blade without the coating but this benefit does not seem sufficient to warrant the cost of implementing such an upgrade and we have no data on the practical wear life of UMMW polyethylene in this application.

"Higher loads on the side wheel increased draught force requirements, suggesting load settings on disc seeder units should be adjusted to match field conditions, with minimum load likely to optimise performance."

The jump force of a disc unit is a key indicator of capacity for single disc seeding systems and this characteristic, akin to the better-known break-out characteristics of tine machines, has proved to be a useful guide to the approximate point of action of the soil force reactions onto the disc blade, Ali said.

"Overall, this project will help us understand the key drivers of single-disc seeder performance and hopefully assist with improving field performance in adverse field conditions such as sticky soils and high residue loads."

For more information: Ali Khosravani – goshtasb@mymail.unisa.edu.au or Jack Desbiolles – jack.desbiolles@unisa.edu.au

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3) Creating offsets that are Kyoto-compliant may provide better medium and long-term value than non-Kyoto ACCU offsets that will be traded in a voluntary market free of any legislative or regulatory requirement to participate.

4) The terms of emission reduction agreements are much less demanding than those for carbon sequestration because avoided emissions offsets dare not subject to the 100 year permanence requirement of carbon storage.

Based on these criteria the best value is going to come from Kyoto-compliant offsets that have a good synergy with the farming system, high CO_2-e and no permanence requirement.

On the other hand, low CO_2-e, non-Kyoto offsets that are not complimentary to the farming system and have a 100-year permanence period are likely to generate the least value.

The key question is not whether to dismiss or jump into carbon farming but 'where are the good deals and how do I avoid the bad?'.