SA Drought Hub Technical Report

De-risking the seeding program in the Upper North (DN3_25_05)

PROJECT LEAD: Upper North Farming Systems

PREPARED BY: Rachel Trengove & Stefan Schmitt

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PROJECT SUMMARY

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The “De-Risking the Seeding Program in the Upper North” project was undertaken to help growers make informed decisions around dry and early sowing strategies under increasingly variable seasonal conditions. Consecutive dry seasons across the Upper North of South Australia have increased uncertainty around crop establishment, herbicide safety, seeding system performance, and sowing timing decisions.

To address these challenges, Upper North Farming Systems (UNFS) established a series of replicated trials near Port Pirie/Wandearah and a farmer-scale demonstration site near Booleroo during the 2025 growing season. The project investigated the interaction between seeding opener design and herbicide safety, time of sowing in dry saline soils, and the performance of alternative seeding systems under dry sowing conditions. The Booleroo demonstration site focused on practical comparisons of pre-emergent herbicide programs and seeding systems under commercial farming conditions.

The project improved grower understanding of crop establishment risks and management strategies under dry sowing conditions. Key findings increased grower confidence around herbicide crop safety, highlighted the importance of seed and herbicide separation, and reinforced the value of local validation sites. The results will benefit grain growers, advisors, and industry by supporting more informed seeding decisions and improving resilience to increasingly variable seasonal conditions.

EXECUTIVE SUMMARY

The “De-Risking the Seeding Program in the Upper North” project was undertaken to support growers in making more informed dry and early sowing decisions under increasingly variable seasonal conditions. Consecutive dry seasons across the Upper North of South Australia have increased the risks associated with crop establishment, particularly around herbicide safety, seed placement, soil constraints, and machinery performance. Growers identified a strong need for locally relevant research and demonstration activities that reflected the soil types, farming systems, and seasonal pressures experienced within the region.

The project was delivered by Upper North Farming Systems (UNFS) in collaboration with independent agronomist Stefan Schmitt through a combination of replicated trials near Port Pirie/Wandearah and a farmer-scale demonstration site near Booleroo. The work formed part of the broader South Australian “De-Risking the Seeding Program” initiative being delivered across multiple farming systems groups.

The western “super site” near Port Pirie focused on three key research areas:

- interactions between seeding opener type and pre-emergent herbicide safety;
- the effect of extended dry sowing periods in moderately saline soils on crop establishment and vigour; and
- the performance of alternative seeding systems designed to reduce establishment risks associated with surface crusting.

The eastern Booleroo site was designed as a practical demonstration site to allow growers to visually assess herbicide strategies and compare seeding system performance under local commercial farming conditions.

Key project findings included:

- Root Boot seeding openers maintained stronger crop establishment and improved crop safety compared with Atom Jet openers under higher-risk herbicide conditions;
- barley seed tolerated remaining dry in moderately saline soil for more than six weeks with minimal impact on establishment following the seasonal break;
- shallow surface incorporation using a Kelly Disc Chain did not improve establishment in 2025 conditions where surface crusting did not occur;
- no visible crop phytotoxicity was observed across any herbicide treatment combinations at the Booleroo demonstration site; and
- hybrid disc seeding systems showed slightly improved crop emergence and early establishment compared with tyne seeders under dry sowing conditions.

The project provided important practical benefits for growers and advisors by increasing confidence around herbicide crop safety and improving understanding of how seeding systems interact with herbicide placement and soil conditions. The absence of visible herbicide damage during a second consecutive dry sowing season was particularly valuable for growers concerned about crop safety risks under low-moisture conditions.

The project also reinforced the value of local validation sites and farmer-led extension activities. Strong grower engagement occurred through crop walks, field visits, and pre-seeding meetings, allowing growers to discuss results in the context of their own farming systems and seasonal conditions.

Some findings can be immediately adopted by growers, particularly around herbicide safety considerations, seed placement, and seeding system setup under dry sowing conditions. However, machinery-related adoption, including consideration of hybrid disc seeders or alternative opener systems, is expected to occur more gradually over time due to the significant capital investment required for machinery replacement.

The project highlighted the importance of combining replicated trial work with practical demonstration sites to support both robust data collection and grower engagement. Future opportunities include additional multi-season validation work across a wider range of soil types and seasonal conditions, particularly around seeding system performance and herbicide interactions under dry sowing scenarios.

The work completed through this project will benefit grain growers, advisors, farming systems groups, and industry stakeholders seeking to improve crop establishment reliability and drought resilience under increasingly variable seasonal conditions.

For further information or support regarding adoption of project findings, growers can contact:

Rachel Trengove, Upper North Farming Systems

Stefan Schmitt, Agricultural Consulting and Research

PROJECT BACKGROUND AND OBJECTIVES

The objective of this project was to help growers make informed decisions on strategies that can be employed under early and dry sowing conditions, with the aim of maximising seed germination, and improving both financial and environmental resilience. The project is linked to a broader set of “De-Risking the Seeding Program” initiatives being undertaken across southern Australian agricultural regions through AIREP, NSS, MPF, HART and MSF.

Dry and early sowing of cereal crops is now a widely adopted practice across southern Australian cropping systems, driven by increasingly variable and delayed seasonal rainfall. While substantial research has been undertaken in this area, there remains a strong need to translate findings into locally relevant, practical management strategies that reflect grower experience, soil type variability, and climatic risk profiles. This project aimed to extend previous UNFS work delivered under the AgEx-led “De-Risking the Seeding Program”, which was constrained in 2024 due to extremely dry seasonal conditions. Despite these limitations, grower feedback confirmed strong interest in repeating and expanding the work under more structured trial conditions.

In 2025, four demonstrations and trial sites were established across the Upper North region. The eastern component of the project included a farmer-scale demonstration in the Booleroo region assessing a range of pre-emergent herbicide strategies across multiple wheat varieties and seeder configurations. This site was designed primarily as an extension and observational platform, allowing growers to visually assess establishment differences, herbicide response, and early crop

development under local conditions. While no replicated data set was collected, the site provided a valuable opportunity for farmer engagement, discussion, and seasonal reflection. However, the lack of structured replication limited the ability to generate quantified treatment comparisons for broader extension purposes.

In contrast, the western component of the project was strengthened through replicated trials established near Port Pirie on heavy red clay loam soils, a soil type widely representative of the region but known for its inherent establishment risks. These soils are prone to surface crusting and transient salinity, both of which can significantly constrain crop emergence and early vigour, particularly under dry or early sowing conditions. These constraints create considerable uncertainty for growers, particularly in relation to seed placement, herbicide safety margins, and the interaction between seeding equipment and soil physical conditions.

This western site provided a structured environment to generate robust, quantitative data under conditions that closely reflect real-world production constraints in the Upper North. It enabled growers and advisors to evaluate crop establishment responses under saline and structurally challenging soils, while also supporting field-based discussion and extension activities throughout the season.

The project aimed to accelerate adoption of improved dry sowing strategies by delivering both replicated trial data and farmer-led demonstration sites. This combined approach was intended to ensure findings were both scientifically robust and practically relevant, supporting growers to refine seeding decisions under increasingly variable seasonal conditions. The project was completed successfully, with all planned objectives achieved and results contributing directly to regional knowledge on dry and early sowing risk management.

METHODOLOGY

Western Site – Port Pirie (Byron and Leighton Johns property)

A replicated dry seeding “super site” was established on a heavy red clay loam soil ($EC_{1:5}$ 1.6 in the top 10 cm; classified as moderately saline). The site was selected due to its relevance to regional farming systems and the known constraints associated with crop establishment, including surface crusting risk and transient salinity. These conditions provided a useful environment to test establishment strategies under realistic dry and early sowing pressures.

All trials at this site were established using a small-plot seeder under consistent operating conditions (approximately 8 km/hr sowing speed, 10-inch tyne spacing, uniform sowing depth, and a seeding rate of 75 kg/ha Commodus barley). This ensured comparability across treatments and reduced variability associated with machinery performance.

Trial 1: Seeding Opener × Herbicide Interaction Trial

This trial compared two seeding opener types, Root Boot and Atom Jet, for their ability to establish barley on this soil type and their performance under both a standard and a “hot” pre-emergent herbicide mix.

Root Boot opener: create some under-seed tilth placing seed on a ledge in paired rows approximately 50 mm apart. This configuration can help separate seed from herbicide-treated soil.

Atom Jet opener: place seed at the base of the furrow in a "skid-seed" configuration. They are often praised for their simplicity and consistent seed placement, but do not create under-seed tilth or spread seed as wide as Root Boot openers.

Two herbicide treatments were applied across both opener types:

- Nil / untreated control
- Overwatch (label rate)
- Sakura (applied at wheat label rate, off-label in barley for crop safety testing under higher-risk conditions)

Plots were sown at the same speed, depth and at a sowing rate of 75kg/ha of Commodus Barley using a small plot seeder.

Measurements and monitoring

- Plant establishment (plants/m²)
- Grain yield (t/ha)
- Statistical analysis using Fisher's LSD (P = 0.05)

Trial 2: Barley Time of Sowing (TOS) in Dry Saline Soil

Barley was sown weekly from the 9th of April until just prior to the seasonal break in June to assess whether crop establishment and early vigour were affected when seed remained dry in moderately saline soil for an extended period.

The aim was to determine whether prolonged exposure of dry seed in saline soil influenced:

- Crop establishment
- Early vigour
- Canopy development under field conditions

Seed remained in a dry seedbed throughout the treatment period, with no germination until the seasonal break rainfall event.

Measurements and monitoring

- Plant establishment counts (plants/m²)
- NDVI at GS30 as an indicator of early crop vigour
- Visual crop assessments
- Comparison of sowing dates to identify trends in establishment and vigour

Trial 3: Kelly Disc Chain Seeding System Comparison

This trial compared two establishment systems to assess whether shallow surface sowing could reduce establishment constraints associated with surface crusting:

- Surface-spread barley incorporated using a Kelly Disc Chain
- Barley sown using a knife-point press wheel seeding system

The aim was to assess whether surface spreading and shallow incorporation using a Kelly Chain could improve establishment on a soil prone to surface crusting.

Measurements and monitoring

- NDVI at GS30 to assess crop vigour and canopy development
- Visual assessments of emergence and crop uniformity
- Comparative analysis of herbicide vs non-herbicide treatments within each system

Qualitative and observational data – Western trial sites:

- In-field agronomic observations during crop establishment and early growth stages
- Seasonal interpretation of emergence patterns and crop performance
- Grower and advisor field visits and discussions at key crop stages
- Field site visits by UNFS members and trial site manager Stefan Schmitt during the growing season
- On-farm discussions to contextualise results under local farming systems
- Seasonal interpretation shared through group engagement and extension activities

Eastern Demonstration Site – Booleroo Region

A farmer-scale demonstration site was established in the Booleroo region to provide a practical, field-based assessment of pre-emergent herbicide strategies and seeding system performance under local conditions. The site was designed to reflect common grower practice rather than a replicated experimental design, with treatments applied at paddock scale to support real-world interpretation and discussion.

The demonstration evaluated a range of pre-emergent herbicide programs, (Treflan, Avadex, Sakura, Luximax, and Overwatch), applied in different combinations to reflect typical regional use patterns and emerging weed management strategies. These treatments were assessed across multiple wheat varieties, (Shotgun, Tomahawk, Calibre), to provide additional context on varietal response under early season conditions. All treatments were dry sown.

The site also incorporated different seeding system configurations to allow visual comparison of crop establishment and early vigour across establishment methods. The primary focus was on generating practical, observational learning opportunities for growers rather than generating statistically replicated data.

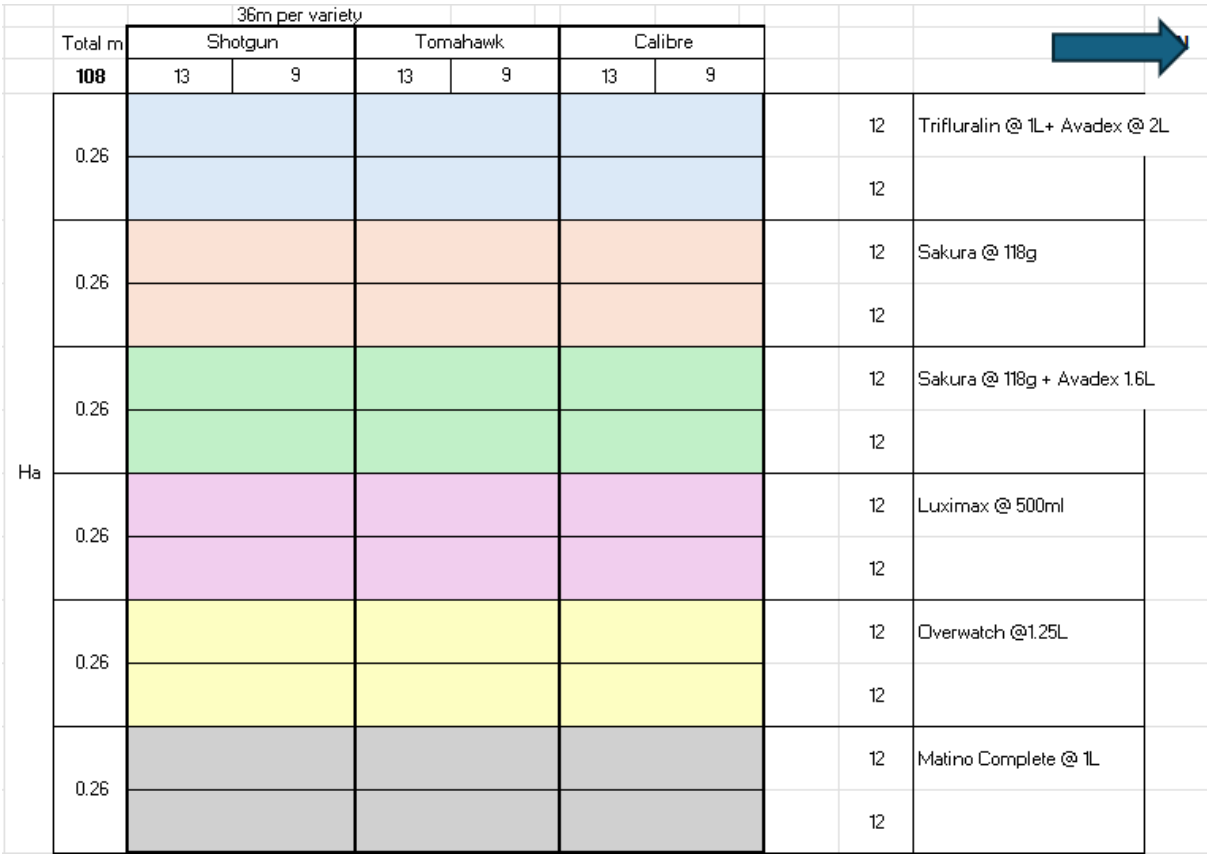


Figure 1. Booleroo demonstration site treatment plan

Measurements and monitoring

As a demonstration site, data collection was intentionally limited and focused on qualitative and observational metrics rather than replicated measurement.

Monitoring activities included:

- Visual assessments of crop emergence, vigour, and uniformity across treatments
- Observations of herbicide response, including any signs of crop phytotoxicity
- Plant establishment notes recorded during key growth stages
- Seasonal paddock walks and structured grower field visits
- Facilitated group discussions during crop walks and extension events to capture farmer feedback and interpretation of treatments under local conditions

No formal yield measurements or statistical analysis were undertaken at this site due to its demonstration-scale design.



Figure 2. Sowing the Booleroo demonstration site – air drill/tyne seeder



Figure 3 Sowing the Booleroo demonstration site - hybrid disc seeder

LOCATION

Site # and name	Latitude (decimal degrees)	Longitude (decimal degrees)	LGA
Trial Site # 1, 2 & 3 / Johns	-33.2769882 S	138.0457620 E	Port Pirie Regional Council
Demonstration Site # 4	-32.87281 S	138.34560 E	District Council of Mount Remarkable

RESULTS

Western Demonstration Site (Wandearah Region)

No formal adoption rates were measured at this stage of the project; however, strong engagement was recorded through multiple site visits and active discussion from growers and advisors, indicating high potential for future practice influence.

Trial 1 – Seeding Opener × Herbicide Interaction

Where no herbicide or Overwatch was applied, there was no difference in crop establishment or yield between the opener types. However, under the higher-risk herbicide treatment (Sakura), the Root Boot opener-maintained crop safety with no yield penalty observed. While plots sown with the Atom Jet opener exhibited a small reduction in yield. The Root Boot opener also maintained plant numbers when pre-emergent herbicides were applied whilst Atom Jet did not.

No yield difference was observed between opener types where no herbicide was applied prior to sowing. This indicates there was no advantage to the under-seed tilth or increased seed bed utilisation that Root Boot openers offer, in this season.

Note: Tyne spacing in the trial was 10 inches, and sowing speed was 8 km/hr, which is within the recommended operating range for this spacing.

Table 1. Yield Results

Seeder	Herbicide	Yield (t/ha)	Group
Root Boot	Nil	4.47	a
Atom Jet	Nil	4.42	a
Root Boot	Sakura	4.29	ab
Atom Jet	Sakura	4.03	b
Root Boot	Overwatch	4.42	a
Atom Jet	Overwatch	4.22	ab

Means sharing a common letter do not differ significantly at **P = 0.05 (Fisher's LSD).**

Table 2. Plant Establishment

Seeder	Herbicide	Mean Plant Count m2	Group
Root Boot	Nil	83.8	a
Atom Jet	Nil	74.6	ab
Root Boot	Sakura	83.3	a
Atom Jet	Sakura	68.3	b
Root Boot	Overwatch	87.8	a
Atom Jet	Overwatch	69.5	b

Means sharing a common letter do not differ significantly at **P = 0.05 (Fisher's LSD).**



Figure 4. Atom Jet Opener and Root Boot Paired Row Opener

Discussion

Root Boot openers demonstrated improved crop safety compared to Atom Jet openers when a herbicide with a narrow safety margin was used in this trial. This is likely due to the Root Boot's ability to 'tuck' seed onto a ledge beneath the soil surface, reducing the risk of contact with herbicide-treated soil if soil is thrown into the furrow by adjacent trailing points.

Root Boot openers maintained plant numbers in the presence of pre-emergent herbicides, whereas Atom Jet openers did not. As a result, higher plant establishment was observed with the Root Boot in this season.

These differences may be influenced by a range of factors and may not be consistent across seasons. It is also important to note that these results are based on a single site and season, and outcomes may vary under different soil types and management practices.

Trial 2 – Barley Time of Sowing

Barley seed tolerated sitting in dry moderately saline soil for more than six weeks with no impact on crop establishment.

Seed remained in dry soil from the earliest sowing date on the 9th of April until the seasonal break in June. No relationship was observed between the duration seed remained in the soil and crop establishment.

However, a very slight relationship was observed between sowing date and crop vigour at GS30, as measured by NDVI, with the later sowing dates producing a marginally higher canopy density compared to the earliest sowing date. The difference was small, not visually apparent in the field, and unlikely to improve yield. It indicated that there was potentially a minor vigour penalty from seed sitting in the soil ungerminated for such a long duration.

Establishment improved where barley was sown into a slightly moist seedbed following a small rainfall event (5 mm) shortly before the seasonal break. The small amount of moisture present improved seed–soil contact and consistency of seed depth.

Note: The seedbed remained dry during the dry sowing period. Results may differ where seed is sown into partially moist saline soil and begins to imbibe moisture prior to the seasonal break.

Table 3. Effect of sowing date on barley establishment and early vigour

Sowing date	Mean plant count (plants m^{-2})	Plant count group	Mean NDVI (GS30 – crop vigour)	NDVI group
9 April	52	A	0.407	A
15 April	66	A	0.428	AB
22 April	57	A	0.420	AB
2 May	60	A	0.442	BC
8 May	61	A	0.441	BC
19 May	62	A	0.457	C

Means followed by the same letter within a column are not significantly different (Fisher's LSD, $P \leq 0.05$).
NDVI measurements were taken at GS30.



Figure 5. Sowing the barley time of sowing trial

Discussion

Barley seed tolerated sitting in dry moderately saline soil for more than six weeks with no impact on crop establishment.

No relationship was observed between the duration seed remained in the soil and crop establishment. A small statistical increase in NDVI occurred with later sowing dates, although the differences were minor and not visually apparent in the field.

Establishment improved where barley was sown into a slightly moist seedbed following a small rainfall event (5 mm) shortly before the seasonal break, likely due to improved seed–soil contact and more consistent seed depth due to sowing into a more friable soil.

Trial 3 – Kelly Disc Chain vs Knife-Point Seeding System

In the absence of herbicides there was no clear advantage to either system regarding crop establishment. It was thought that shallow surface sowing with the Kelly Chain may improve establishment by reducing the chance of surface crusting above the seed. Anecdotally, surface crusting only occurs on the very low organic matter areas of paddocks with this soil type, after heavy rain at germination. The break to the season saw steady rainfall and crusting was not observed in this year.

When herbicides were applied, however, the plot seeder performed better. This was due to improved separation of seed from herbicide-treated soil compared with the spread-and-incorporate approach. These observations were based on NDVI assessments taken at GS30.

Table 4. Effect of seeding system establishment and NDV (GS30)

Seeding system	Herbicide applied	Relative NDVI (GS30) Kelly Chain verse Trial Seeder	Observations
Kelly Disc Chain (surface spread + incorporation)	No	Similar	No clear difference in establishment
Knife-point press wheel seeder	No	Similar	No establishment advantage observed
Kelly Disc Chain (surface spread + incorporation)	Yes	Lower	Herbicide-treated soil mixed with seed
Knife-point press wheel seeder	Yes	Higher	Better separation of seed from herbicide-treated soil



Figure 6. Kelly Engineering's - Kelly Chain sowing barley at Wandearah in 2025. Note barley is broadcast prior to the chain pass using an onboard hopper and air distribution system

Discussion

In the absence of herbicides there was little difference between seeding systems.

The expected advantage of surface sowing on a crust-prone soil was not observed in this trial. However, when pre-emergent herbicides were applied, the knife-point press wheel system provided improved crop safety by allowing greater separation of seed from herbicide-treated soil.

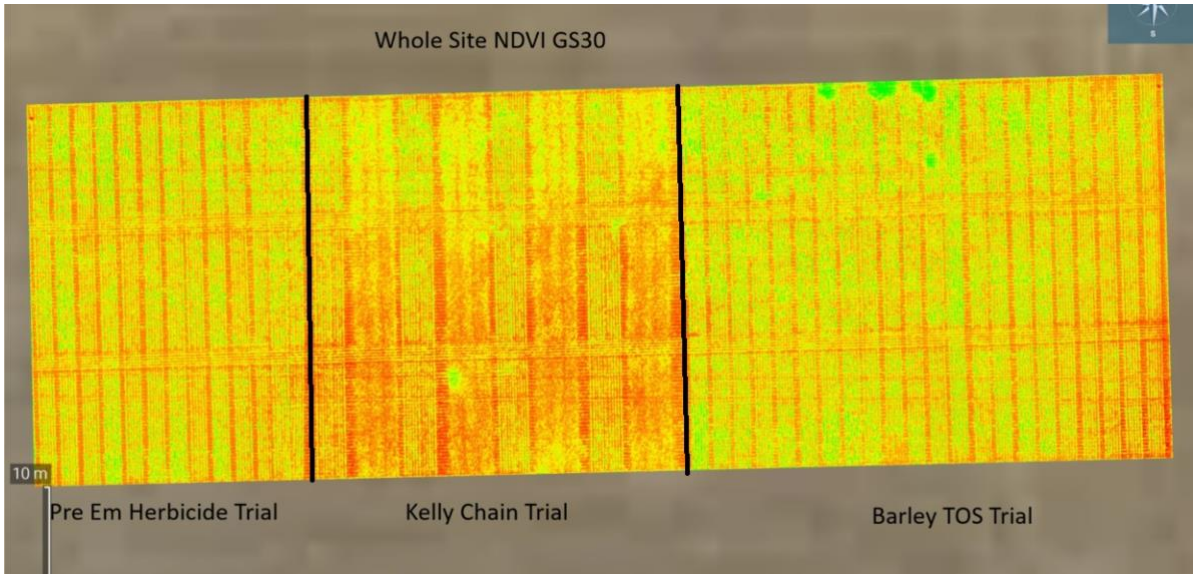


Figure 7. Wandearah trial site (3 trials) – NDVI at Growth Score (GS) 30

Eastern Demonstration Site (Booleroo Region)

The Booleroo farmer-scale demonstration site was established to provide practical, field-based insights into pre-emergent herbicide programs and seeding system performance under local farming conditions. As a non-replicated demonstration, results were based on observational assessment and grower interpretation rather than statistical analysis.

Across all herbicide treatments (Treflan, Avadex, Sakura, Luximax, and Overwatch) - no visible crop phytotoxicity was observed. Wheat crops (Sceptre, Calibre and Rockstar) emerged and established without any discernible negative herbicide effects across treatments, indicating strong crop safety under the 2025 seasonal conditions.

This outcome was particularly important in the context of two consecutive dry seeding seasons, where herbicide safety and crop damage risk were a key concern for growers. The absence of visible phytotoxicity helped reinforce grower confidence in the safety margins of commonly used pre-emergent herbicide programs and improved understanding of treatment boundaries under dry establishment conditions. While no formal adoption rates were measured, feedback from growers indicated increased confidence in maintaining or trialling established herbicide programs under similar seasonal risk profiles.

Crop establishment and early vigour were generally uniform across herbicide treatments, with minimal observable differences between programs under field conditions.

Subtle differences were observed between seeding systems. The hybrid disc seeder showed slightly improved crop emergence and early establishment compared with the tyne seeder, particularly under dry, late sowing conditions (shown in Figure 8). This was observed as more uniform emergence and marginally stronger early vigour in hybrid disc sown strips during early crop establishment assessments.

These observations generated strong interest among growers, however seeder system adoption is expected to be a long-term outcome rather than an immediate change in practice. Machinery investment decisions are significant and typically occur over extended timeframes. As such, the demonstration is expected to contribute to gradual “slow-burn” adoption, supporting future decision-making when growers are considering seeder replacement or upgrade cycles.

While no quantitative yield or replicated data were collected, the site successfully achieved its objective of providing a practical demonstration for herbicide programs and seeding systems. The site supported strong grower engagement and facilitated on-farm discussion around establishment strategies, herbicide safety, and seeding system performance under local seasonal conditions.

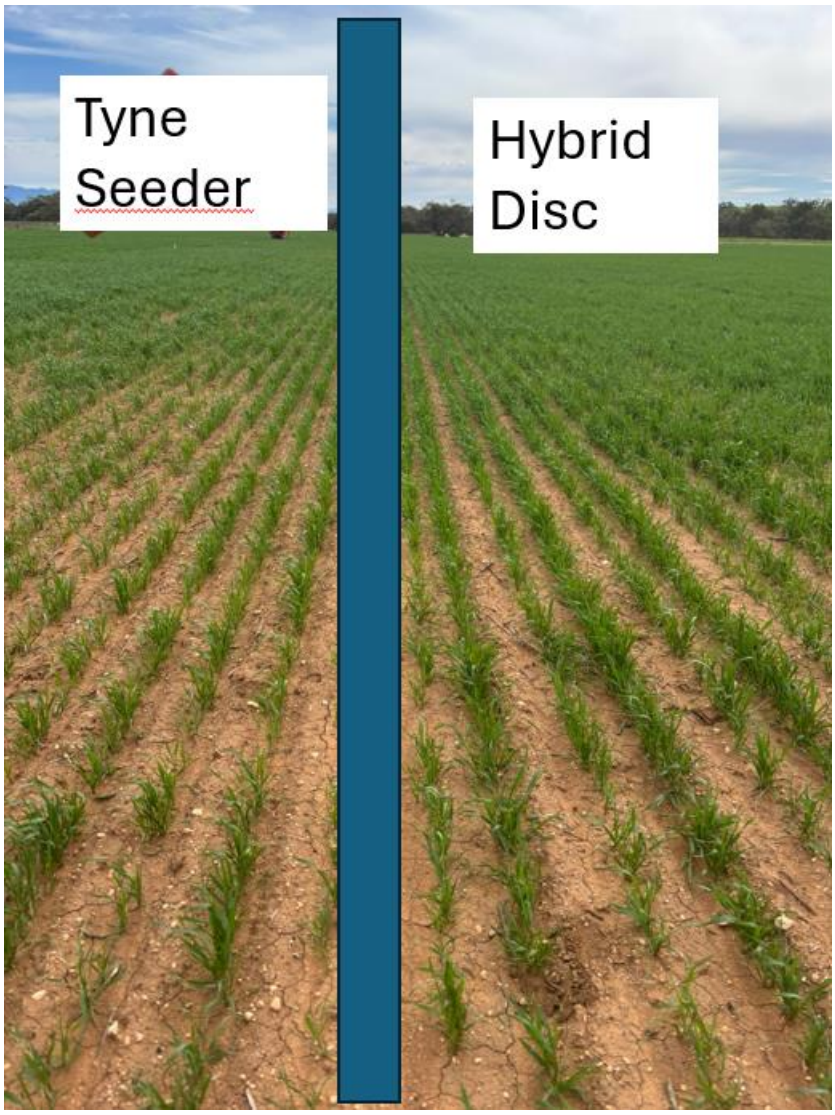


Figure 8. Observing crop establishment – tyne vs hybrid disc seeder

CONCLUSION

Key findings

The “De-Risking the Seeding Program in the Upper North” project successfully delivered locally relevant trial and demonstration outcomes that improved grower understanding of dry and early sowing strategies under Upper North farming conditions. The project combined replicated trial work at the western Port Pirie/Wandearah “super site” with a farmer-scale demonstration at Booleroo, allowing both scientifically robust data collection and practical grower-led extension activities.

Results from the replicated western trials demonstrated that seeding system design and herbicide interactions can influence crop establishment and crop safety under dry sowing conditions on heavy red clay loam soils prone to transient salinity and surface crusting. The Seeding Opener × Herbicide Interaction trial showed that Root Boot openers maintained stronger plant establishment and improved crop safety under higher-risk herbicide conditions compared with Atom Jet openers, particularly where Sakura was applied. These findings are important because herbicide crop safety has become increasingly critical during consecutive dry sowing seasons where rainfall activation patterns are less predictable.

The Barley Time of Sowing trial demonstrated that barley seed could remain dry in moderately saline soil for more than six weeks without significant reductions in crop establishment following the seasonal break. This finding provides important reassurance to growers considering earlier sowing opportunities under uncertain opening rainfall conditions. While slight reductions in early vigour were observed in the earliest sowing timings, these differences were small and unlikely to affect final productivity under the conditions experienced in 2025.

The Kelly Disc Chain trial highlighted that alternative shallow incorporation systems may not necessarily improve establishment on crust-prone soils in seasons where crusting conditions do not occur.

The Booleroo demonstration site successfully achieved its primary extension objective by providing growers with a practical, local site to visually assess herbicide programs and seeding system performance under dry sowing conditions. No visible crop phytotoxicity was observed across any herbicide treatment combinations, which increased grower confidence in the crop safety of commonly used pre-emergent herbicide programs during a second consecutive dry sowing season. Slightly improved emergence and establishment observed with the hybrid disc seeder also generated strong grower interest and discussion around machinery system performance under low-moisture conditions.

Across all sites, the project reinforced the value of local validation trials and demonstrations. Growers consistently reported that observing treatments under local conditions improved confidence in interpreting broader research outcomes and applying findings within their own farming systems.

Benefits to industry

This project delivered several direct and indirect benefits to the grains industry in the Upper North region.

Firstly, the project improved regional understanding of how seeding equipment, herbicide strategy, and sowing timing interact under dry establishment conditions. These findings help reduce uncertainty around early sowing decisions and support growers to make more informed risk management decisions in increasingly variable seasonal conditions.

Secondly, the project strengthened grower confidence around the use of pre-emergent herbicides during dry sowing. Herbicide toxicity and crop safety were highly topical issues throughout 2025 due to consecutive dry seasons. The lack of visible phytotoxicity at the Booleroo demonstration site helped provide practical reassurance to growers regarding the safety margins of commonly used herbicide combinations under local conditions.

Thirdly, the project delivered practical insights into machinery and seeding system performance. While machinery adoption decisions are long-term and capital-intensive, the work initiated important regional discussion around the role of opener design, seed placement, and hybrid disc seeding systems in improving crop establishment reliability under dry conditions.

The project also provided strong extension and engagement outcomes. Existing UNFS events, including crop walks and post-harvest/pre-seeding meetings, were used effectively to communicate findings and encourage grower participation. The combination of replicated trial data and practical demonstration sites created multiple opportunities for farmer engagement, peer discussion, and seasonal interpretation of results.

Importantly, the project demonstrated the value of farmer-led and co-designed research and extension activities. Local growers, advisors, and the trial manager were actively involved in shaping trial questions and implementation, ensuring that activities remained highly relevant to local farming systems and grower priorities.

Future adoption opportunities

The project has identified several opportunities for ongoing adoption, extension, and future investigation.

There is strong opportunity for continued extension around herbicide safety and seeding system interactions under dry sowing conditions. Consecutive dry seasons have increased grower interest in understanding how opener design, seed placement, and herbicide incorporation influence establishment success and crop safety. Further replication across additional seasons and soil types would strengthen confidence in the findings and support broader regional adoption.

The Time of Sowing trial highlighted opportunities for growers to consider earlier sowing opportunities with greater confidence under suitable conditions. However, further investigation would be valuable to better understand responses under partially moist saline soils where seed imbibition may occur prior to germinating rainfall.

The hybrid disc versus tyne seeder observations at Booleroo generated strong interest among growers; however, adoption of alternative seeding systems is expected to occur gradually over time due to the significant capital investment required for machinery replacement. Additional long-term demonstrations and replicated comparisons across multiple seasons would help support future machinery investment decisions and improve confidence in the circumstances where hybrid disc systems may provide advantages.

The project also highlighted the importance of replicated local trial sites for extension purposes. While the Booleroo demonstration site generated valuable discussion and engagement, the lack of replicated measurements limited the ability to produce quantified treatment comparisons for broader reporting and extension. Future projects would benefit from incorporating additional replicated trial components where funding allows.

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