HART LONG-TERM SEEDING SYSTEMS TRIAL

A SUMMARY OF 22 YEARS OF RESEARCH

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Front & back cover photos by Sandy Kimber.

Disclaimer

Contents

Foreword

When we produced the first edition of this booklet in 2016, then Hart vice-chairman Justin Wundke wrote the foreword and much of what he said still rings true.

The decisions we make when upgrading our seeding system, whether new or second-hand, can have a significant impact on many aspects of our farming operations.

Financial investment is an important factor, as are issues like sowing speed, the machine's ability to handle various stubble loads and soil types, pest and weed management, servicing requirements and availability of parts.

The effect on crop yield is another issue high on the list of considerations and that's exactly what we've looked at in this research.

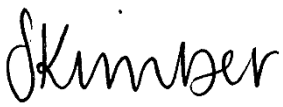
Since the Hart Field-Site Group first purchased land in the year 2000, we've been able to continuously assess grain yield differences at Hart between three seeding systems; conventional, strategic and disc, using commercial scale equipment.

That's twenty-one years of data collected across a range of crop types and seasonal conditions.

By now, many of you are familiar with our findings over the years, but you'll find the updated data presented in this second edition really interesting as you drill down into the detail.

We've also provided an update on the five farmers featured in our first edition; have they made a change to their seeding system or not? And why?

We hope the information provided here proves helpful when making your own decisions into the future.



Sandy Kimber
Executive Officer
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November, 2022

Background

Why do the trial?

A major shift in seeding systems

In 1995, after a series of favourable seasons and good economic returns, many growers in the area were in a position to upgrade their seeding equipment. There was a big focus on direct drill air seeders (one pass systems, either knife-point or disc), with only a handful of growers in the area already using them. Over the next four years, prior to the trial starting, there was a rapid adoption of direct drill seeding systems.

In general, the majority of growers wanted to adopt direct drill systems to reduce the risk of soil erosion and improve the timeliness of seeding. Erosion wasn't a big driver at Hart due to the soil type, however, it was an issue in areas with soils prone to erosion. The quickest uptake of direct drilling was further inland to the east, in areas with hard setting soils and cooler soil temperatures. In some years with a heavy rain after sowing, parts of the paddock would crust over, and the crop emerged poorly. Once they started direct drilling with knife-points and press wheels they never had that issue again. These growers were also keen to use a deeper point which fractured the soil below the seed in harder setting soils. This produced a better crop establishment.

Photos (L-R): Seeding systems trial sown to durum wheat in 2006; disc treatment by Greg Butler, SANTFA, no-till treatment by Matt Dare, strategic treatment by Michael Jaeschke.

It was this combination of soil issues and erosion control that was the real driving force for some growers. For others, the move to no-till or zero-till was simply for operational efficiency. That is, instead of a pre-working cultivation to incorporate urea, they went seeding. It was through direct drilling that they were able to bring their sowing date forward to a more optimal time. This system also improved crop safety with soil incorporated herbicides, such as trifluralin.

Disc seeding systems were uncommon then. In the early days, planning the trial included only knife-point (no-till) and strategic tillage (cultivation, burning and wide points) treatments. However, Hart board member (then chairman) and Bute grower, Phil Harris, was the main advocate for the disc treatment remarking "Nah, you've got to have a disc, it's the next big thing, I'll bring it across". For the first five years of the trial Phil drove his disc seeder from Bute to Hart, over 50 km away.

Resulting research questions

In the initial days of direct drilling, growers and agronomists observed poor crop vigour if one or more nutrients were limiting, in particular, zinc. This was explained by the fact that zinc is not readily mobile in soil and does not move far from where it is applied in the fertiliser granule. Less soil disturbance in no-till and zero-till systems meant nutrients like zinc were not mixed throughout the topsoil but left in concentrated bands where they were applied at the time of application.

The zinc issue was addressed through additional zinc fertiliser applications and is part of the reason why a two-tiered nutrition treatment was established in the trial. There was also evidence that in harder settings soils, where it is colder, early direct drilled crops were slower in early crop growth. These observations formed some of the key questions to be investigated in the seeding systems trial:

- Was there a nutritional penalty in direct drilled systems?
- Could this problem be fixed by adding additional nutrients?
- How long did it last for and did it make any difference in terms of yield?

Direct drilling also meant a significant shift in the way nitrogen was applied. In conventional systems it had been common practice to apply nitrogen fertiliser in a pre-sowing cultivation. The additional nitrogen treatments in the Hart trial were included to address the question that if crops were slower earlier, would the addition of extra nitrogen fix it? In short, no nutritional deficiencies were detected in direct drilled crops at Hart compared to conventional systems, as the soil already had adequate nutrition. Nor was the crop slower in those early years which may have been due to the location of the site. If the trial site was further inland where it was colder, there may have been an effect. The nutritional treatments became more of a monitoring tool for longer term effects over time.

Photo: All systems go – preparing to sow the trial in 2007.

How has the trial evolved to keep up with seeding systems?

Since the development of the trial, the no-till treatment did not significantly change. It remained a knife-point and press wheel system relevant to growers, but the discs did change frequently. Throughout the trial, various disc systems were used due to machine proximity to the trial site and changes in disc seeder setups. Many Hart members thought direct drill treatments (disc and knife-point) should be sown earlier as that was best practice, however, that would have immediately confounded results.

The most significant change to the trial design was harvesting the disc treatment high to simulate stripper front straw. This change was designed to replicate the evolution of stubble management for disc seeding systems and started in 2013.

Trial setup

The trial consisted of three seeding systems, including a combination of seeder type, cultivation and stubble management with two nutrition regimes replicated at the Hart field site.

Seeding systems

1. Strategic

This treatment was worked up pre-seeding until 2012, sown with 100 mm (4 inch) wide points on 200 mm (8 inch) row spacing with finger harrows. For the past 22 years this treatment was sown by grower Michael Jaeschke (Grower Case Study 5 - page 32).

2. No-till treatment

Sown into standing stubble in one pass with a Flexicoil 5000 drill, 16 mm knife-points with 254 mm (9 inch) row spacing and press wheels. This treatment was sown by a number of seeders and is the most common setup in regions near Hart (Grower Case Study 1 - page 20).

3. Disc treatment

Sown into standing stripper front stubble with John Deere 1980 single discs with row spacings of 152 mm (6 inch), closer wheels and press wheels. In latter seasons, this treatment was sown by Tom and Ashley Robinson (Grower Case Study 2 - page 23).

While there have been slight modifications to the trial, the core principles of these three seeding systems have remained. Each seeding system resulted in various levels of soil disturbance (Figure 1) and stubble retention.

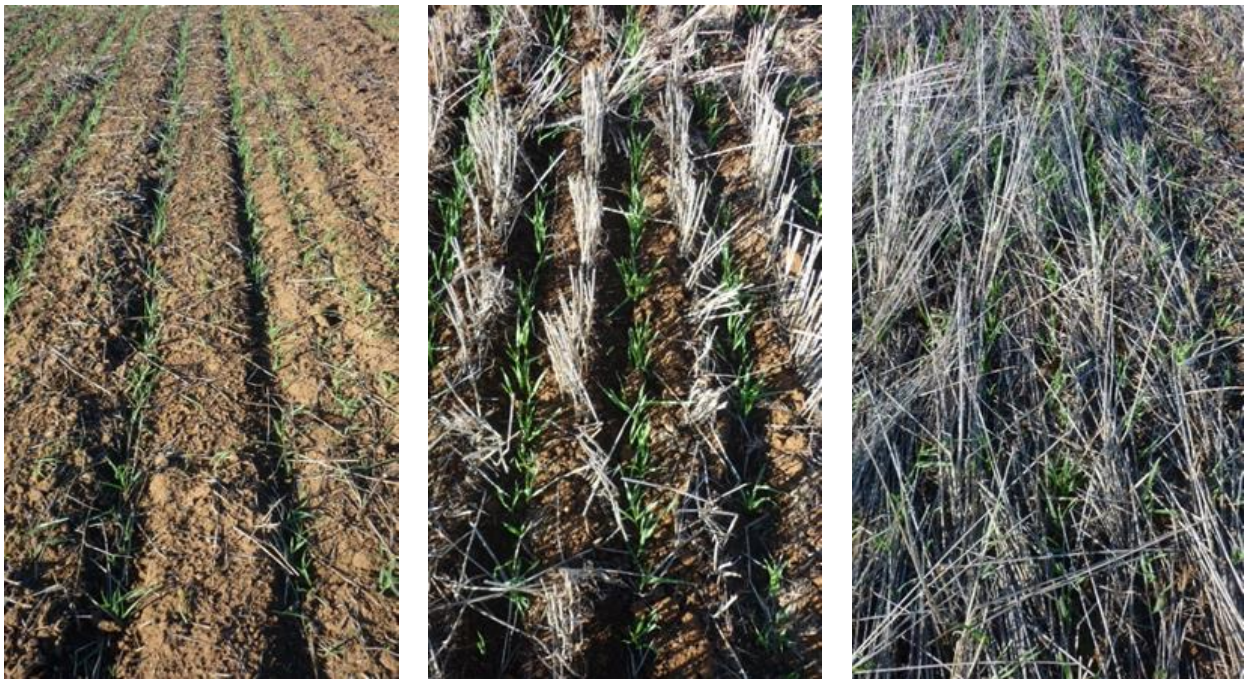

Figure 1. (Left to right) Commander barley sown in the strategic treatment, no-till treatment sown into 30 cm standing stubble and the disc seeder into stripper front stubble (70 cm tall), on June 18, 2014.

The two **nutrition treatments** trialed were based on varying applications of nitrogen and the addition of the micronutrient zinc.

1. **Medium nutrition** treatments represent standard practice nitrogen for the district based on Yield Prophet® and general rules of thumb.
2. **High nutrition** treatment represents standard district practice plus an additional nitrogen application in season (generally an additional 20-50 kg N/ha).

Crop rotation

2000	2001	2002	2003	2004	2005	2006	2007
Sloop barley	ATR-Hyden canola	Janz wheat	Yitpi wheat	Sloop barley	Kaspa field pea	Kalka durum	Janz wheat

2008	2009	2010	2011	2012	2013	2014	2015
Janz wheat	Flagship barley	Clearfield canola	Correll wheat	Gunyah field pea	Cobra wheat	Commander barley	44Y89 canola

2016	2017	2018	2019	2020	2021
Scepter wheat	Scepter wheat	Wharton field pea	Sheriff CL Plus wheat	Scepter wheat	Butler field pea

Photo: Crop rotations in Hart's long-term seeding systems trial in 2020 (left), sown to Scepter wheat and Butler field peas (right) in 2021.

Site information

Rainfall

Hart's long-term average annual rainfall is 400 mm, with a growing season average of 300 mm.

Over the 22 years of this trial, only nine seasons (40% of years) received above average growing season rainfall (Figure 2). The remaining thirteen seasons were below average, particularly in the mid-2000s when the district experienced successive dry seasons. This was also observed from 2017 – 2019 when Hart experienced two decile 1 (10th percentile) rainfall seasons consecutively.

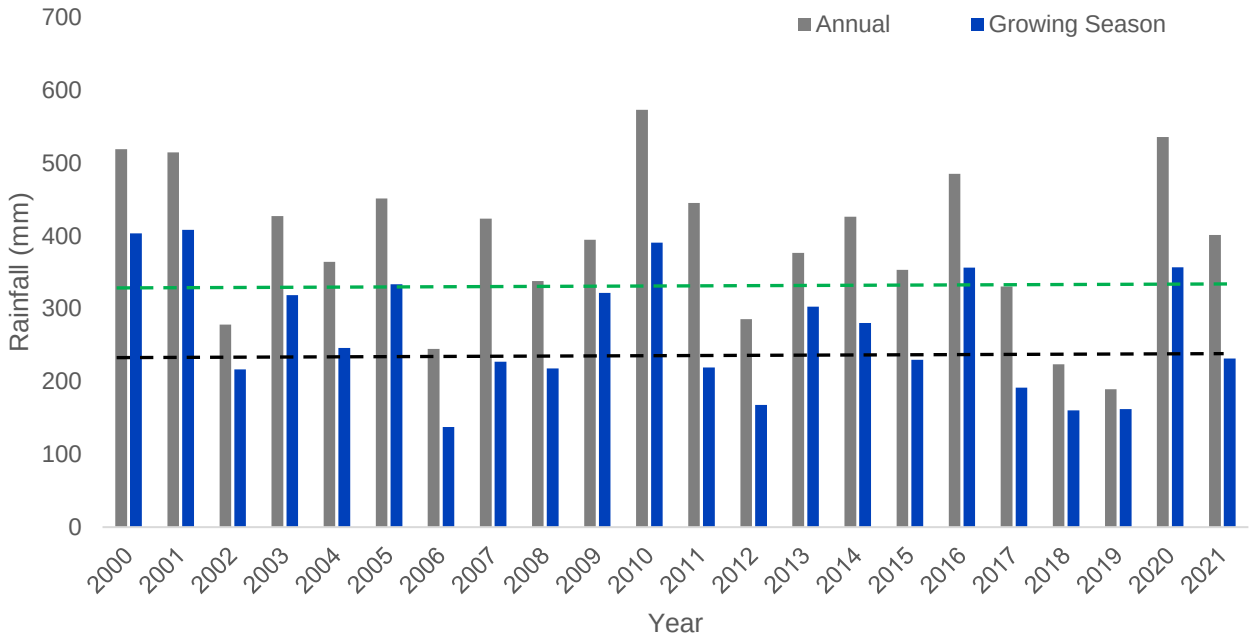

Figure 2. Hart annual and growing season (April – October) rainfall (mm) from 2000 – 2021. The long-term average growing season rainfall for Hart (300 mm) is represented by the dashed black line (bottom) with the average annual rainfall for Hart (400 mm) represented by the dashed green line (top).

Soil Type

Clay loam grading to calcareous and dispersive clay subsoil (Table 1).

Table 1. Long-term seeding systems trial soil profile description

Horizon	Depth (cm)	Description
A11p	0 - 8	Dark reddish brown, heavy clay loam with moderate structure
A12	8 - 22	Moderately calcareous, dark reddish brown and yellowish red, light clay with weak structure
B1	22 - 36	Highly calcareous, reddish brown, medium clay with moderate structure and 10–20% fine carbonate segregations
B2k	36 - 65	Highly calcareous, slightly dispersive, reddish brown, medium clay with 20–50% fine carbonate segregations
B3	65 - 96	Highly calcareous, slightly dispersive, reddish brown, medium clay

What do the results say?

Grain yield and quality

Across the 22 years of this trial, the overall performance of crop grain yield (t/ha) was not significantly improved by any seeding system; strategic, no-till or disc (Table 2 & 3).

- In years where yield differences were observed (nine out of 21 seasons), the no-till and disc system, either stand-alone or equally outperformed the strategic treatment.
- In the years where grain yield differences were observed, 60% received below average growing season rainfall (>300 mm).

Seeding systems (disc, no-till and strategic) continued to have minimal impact on grain protein (Table 2), screenings and test weight (Appendix 1) across the history of this trial. The additional nitrogen treatments resulted in higher protein in ten (67%) of the cereal phase years. In 80% of the years that wheat was sown, protein levels increased with additional nitrogen. Increases in barley protein was also observed in three out of four years (75%). Grain protein is influenced by a range of factors including rainfall, grain yield and starting available soil nitrogen.

In two out of three years that canola was sown, the higher nitrogen rates resulted in small but significant reductions in oil content (Table 2).

Table 2. Grain protein or oil content (%) for nutrient treatments (averaged across all three seeding systems) from 2000-2021.

	2000	2001*	2002	2003	2004	2005	2006	2007
Medium	10.6	39.7	11.7	10.9	12.9	*field*	14.7	13.1
High	12.1	38.0	12.0	12.8	16.4	*pea*	14.8	13.2
LSD (P≤0.05)		**0.7**	**ns**	**1.5**	**1.4**		**ns**	**ns**

	2008	2009	2010*	2011	2012	2013	2014	2015*
Medium	15.5	10.8	42.8	10.2	*field*	12.6	12.0	36.3
High	17.2	11.4	42.1	12.7	*pea*	13.9	14.3	35.7
LSD (P≤0.05)	**1.1**	**0.4**	**0.4**	**0.5**		**0.6**	**0.8**	**ns**

	2016	2017	2018	2019	2020	2021
Medium	7.5	6.7	*field*	12.8	11.7	*field*
High	9.8	10.8	*pea*	14.1	13.4	*pea*
LSD (P≤0.05	**0.7**	**0.5**		**1.2**	**0.4**	

*Indicates canola oil content (%)

Table 3. Grain yield (t/ha) for seeding systems and nutrient treatments from 2000-2020.
**Grain yield data from 2021 was not analysed.*

Year	Crop	Strategic		No-till		Disc		LSD (P≤0.05)		
		Medium	High	Medium	High	Medium	High	Seeder	Nutrition	Seeder × nutrition
2000	Barley	3.8	3.8	3.7	3.8	3.7	3.9			
2001	Canola	1.3	1.6	1.4	1.7	1.3	1.8	ns	0.1	ns
2002	Wheat	0.9	0.7	0.9	0.8	0.7	0.6	ns	ns	ns
2003	Wheat	2.8	2.6	3.0	3.0	3.1	3.2	0.3	ns	ns
2004	Barley	2.3	2.0	2.1	2.1	2.0	1.7	ns	ns	0.3
2005	Field pea	2.5	2.6	2.4	2.3	2.1	2.1	0.2	ns	ns
2006	Durum	0.1	0.1	0.2	0.2	0.1	0.1	ns	ns	ns
2007	Wheat	1.9	2.2	2.3	2.1	2.3	2.4	ns	ns	ns
2008	Wheat	1.1	0.8	1.3	1.2	1.5	1.4	0.2	ns	ns
2009	Barley	4.3		4.2		4.2		ns	ns	ns
2010	Canola	1.2	1.9	1.5	2.0	1.6	1.9	ns	ns	0.3
2011	Wheat	2.3	2.2	2.5	2.5	1.7	1.8	0.2	ns	ns
2012	Field pea	0.9	0.9	1.1	1.1	1.1	1.0	0.1	ns	ns
2013	Wheat	-	-	5.0	5.0	5.2	4.8	ns	ns	ns
2014	Barley	4.4	3.9	4.7	4.0	4.5	4.0	ns	0.2	ns
2015	Canola	0.6	0.6	0.6	0.5	0.5	0.5	ns	ns	ns
2016	Wheat	4.8	5.9	4.2	5.8	5.0	5.9	ns	ns	0.3
2017	Wheat	3.5	3.3	3.5	3.5	4.1	4.1	0.2	ns	ns
2018	Field pea	0.8	0.7	0.9	1.0	0.7	0.7	0.2	ns	ns
2019	Wheat	1.3	1.2	0.9	1.1	1.3	1.3	0.2	ns	ns
2020	Wheat	2.6	2.7	2.3	2.4	3.0	3.0	0.2	ns	ns

Available soil nitrogen

From 2001 – 2021, an increase in available soil nitrogen was observed for six out of 21 sampling years in the high nutrition treatment (Figure 3). In general, the difference between the high and medium nutrition treatment had ranged from 4 to 75 kg N/ha at the start of each season (pre-seeding). This is not surprising, as over 22 years an additional 528 kg N/ha has been applied to the higher nutrition treatment. The higher amount of nitrogen in this treatment meant there was additional soil nitrogen to break down carbon rich stubble, which resulted in faster mineralisation rates.

Across 71% of years, no difference in starting soil N was observed across the three seeding system treatments. This can be attributed to a number of factors that influence mineralisation (and therefore available soil nitrogen) such as summer rainfall, stubble type (cereal, canola or legume) and stubble placement.

Overall, seeding systems had had little impact on starting available soil nitrogen prior to each season, with disc and no-till treatments producing similar results over the life of this trial. Across 21 years of sampling, a small proportion of seasons (20%), higher available nitrogen pre-seeding was seen in the strategic treatment (Figure 3 & Table 4).

This is likely attributed to the placement of stubble in this treatment influencing decomposition and mineralisation rates, in combination with increased soil mixing. The surface placement (e.g., no-till and disc) of stubble results in slower decomposition rates compared to the strategic treatment, which was often cultivated pre-seeding or prickled chained, incorporating stubble into the topsoil.

Over the final 8 years of this project, the strategic treatment turned into a one pass system, no longer including pre-seeding cultivation, or post seeding chaining. However, greater soil surface and stubble disturbance was still present when compared to the disc and no-till seeder.

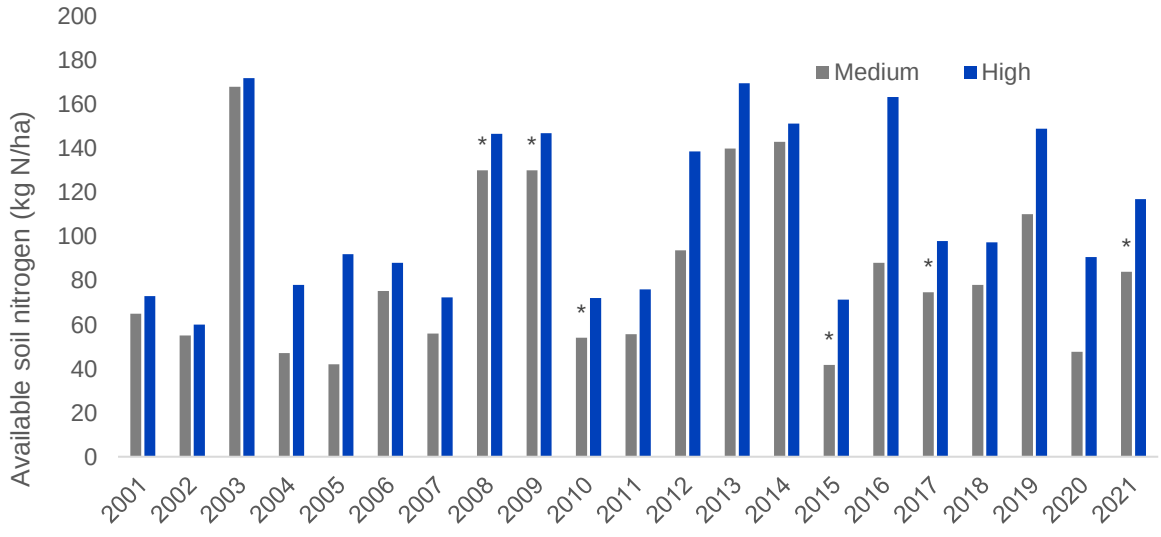

Figure 3. Summary of soil available nitrogen pre-seeding in nutrition treatments. Bars appended with an asterisk are significantly different (P≤0.05) for the treatments in that year.

Table 4. Summary of soil available nitrogen in seeding systems 2001-2021.

Year	Available Soil Nitrogen (kg N/ha)			LSD (P≤0.05)
	No-till	Disc	Strategic	
2001	66	72	68	ns
2002	55	67	51	ns
2003	162	182	166	ns
2004	57	60	70	ns
2005	85	60	60	ns
2006	73	85	88	ns
2007	59	62	72	ns
2008	106	129	181	50
2009	105	129	181	69
2010	39	57	93	11
2011	59	59	81	ns
2012	113	121	115	ns
2013	147	159	160	ns
2014	158	137	147	ns
2015	33	57	80	35
2016	112	119	147	ns
2017	76	82	102	15
2018	92	83	89	ns
2019	123	111	155	ns
2020	63	65	80	ns
2021	96	77	130	42

Soil organic carbon

Soil organic carbon (SOC%) is found in soils in the form of various organic compounds, commonly called soil organic matter. Data from previous long-term trials has shown a reduction in tillage, and therefore soil disturbance, resulting in increased SOC% levels (Sanderman et al. 2009). Soil organic carbon (SOC%) levels were measured in 2007, 2014 and 2021 (Table 5). In each of the seasons that SOC% was measured, no differences were observed between the disc, strategic and no-till seeder treatments, however; soil organic carbon levels were significantly higher (P<0.002) in 2014 (1.92%) when compared to 2007 and 2021 (1.72 and 1.63% respectively). Observed differences are likely a result of 2014 having greater soil available N, increasing organically bound carbon. In comparison, data collected from the native vegetation area at the Hart field site in 2014 contained 5.20% SOC (data not shown).

Table 5. Soil organic carbon (%) levels in seeding systems and nutrition levels. measured at Hart in 2007, 2014 and 2021.

Seeding system	Nutrition	SOC %		
		2007	2014	2021
Strategic	Medium	1.69	1.98	1.59
Strategic	High	1.75	1.99	1.63
No-till	Medium	1.65	1.57	1.64
No-till	High	1.78	1.89	1.67
Disc	Medium	1.70	1.97	1.61
Disc	High	1.75	2.18	1.62
LSD (P≤0.05)		ns	ns	ns

Water infiltration

The adoption of tyne and disc seeding systems has been associated with minimum till, decreasing levels of soil disturbance when compared to strategic seeding systems. In 2021, water infiltration for each seeding system was assessed using a double ring infiltrometer (one year of data only). Measurements were recorded every 2 minutes until a constant infiltration rate was achieved. No differences were observed for water infiltration between seeder types (ranging from 100 – 110 mm/hr) despite differences in soil disturbance from the tillage systems (data not shown).

Soil bulk density

In 2022, soil bulk density was measured for each seeder treatment. Results showed that none of the seeding systems negatively affected soil bulk density (one year of data only). Bulk density for the disc, strategic and no-till treatments were 1.21, 1.20, and 1.24 g/cm^3, respectively (Table 6). Previous research has shown that no-till and disc seeding systems tend to have increased bulk densities due to less soil disturbance (Grant & Lafond 1993). Moving from a two, to one-pass system in 2013 is likely to have removed treatment effects that could otherwise be observed in a true strategic system.

Table 6. Soil bulk density for the top soil (0 -10 cm) of each seeding system at Hart in 2022.

Seeding system	Bulk density (g/cm^3)
Strategic	1.20
Disc	1.21
No-till	1.24
LSD (P≤0.05)	ns

Weeds and pests

Weed spectrum change without tillage

Differences between seeding systems, such as tillage and residue levels, affect the microenvironment around weed seeds; for example, light exposure, temperature and the vertical distribution of the seeds in the soil. This vertical distribution has been shown to affect the dormancy of and therefore ability of weed seeds to germinate. In local studies at Roseworthy and Minlaton, Chauhan *et al.* (2006) found that ryegrass seed in no-till systems, which tended to accumulate on the soil surface, was less inclined & slower to germinate due to adverse germination conditions (topsoil drying out quicker). Seed which failed to germinate was also more vulnerable to predation by insects such as ants.

In this study the authors looked at germination behaviour of ten different weed species common to the wheat belt of southern Australia under both minimum tillage & no-till. Weed species that prefer soil disturbance and burial with minimum tillage system (two cultivation passes pre-seeding) included annual ryegrass, three-horned bedstraw and wild radish. In contrast, the germination of Indian hedge mustard, sow thistle, silver grass, marshmallow and turnip weed was higher under the no-till system. The germination of wild oats and wild mustard was not influenced by either minimum or no-till seeding systems.

These differences were primarily due to the ability of the weeds to germinate on or near the soil surface. Small seeded species often require light for germination and are favoured under no-till, whereas large seeded species have lower dependence on light and have greater energy reserves from the seed for deeper germination under conventional or minimum tillage. However, a consequence of deeper burial is that these weed seedlings can take longer to emerge and are generally less vigorous, which can sometimes reduce their competitiveness with crops.

Weed observations

In 2009, significant differences in brome grass and annual ryegrass populations across the seeding treatments was observed. Brome grass populations were also high in no-till plots that were sown early across 2007 and 2008, causing a population spike of 71 plants/m^2. (Table 7). The population spike observed in the following seasons can be attributed to dry sowing or sowing prior to weed emergence in these years.

Table 7. Grass weed populations (plants/m2) in the seeding systems trial at Hart, 2009 averaged across the nutrition treatments.

Seeding system	Brome grass	Annual ryegrass	Wild oats
	Plants per square metre		
Disc	14	19	10
Strategic	26	137	0
No-till	29	79	16
No-till (early)	71	92	28
LSD (P≤0.1)	**33**	**84**	**ns**

The disc treatment had the lowest level of brome grass. However, this is not reflective of grower observations. Evidence suggests brome grass is becoming an increasing issue in no-till systems, particularly in disc seeding systems (see example Grower Case Study 4 - page 29). The prevalence of brome grass has increased through more intensive cropping systems with few effective in-crop herbicide options. The adoption of no-till has meant brome seeds are buried at seeding and emerge later in the crop's growth.

The highest rate of brome grass germination has been shown to occur if seeds are buried within 50 -100 mm of the soil surface. Therefore, in the no-till systems, where seeds are generally close to the soil surface, most surviving seeds will germinate in the year after seed production. Furthermore, brome grass germination is inhibited by light; that is, seed placement too close or on the soil surface will inhibit germination (Kleemann and Gill 2009). In zero-till (disc) systems, where this is little soil throw, seeds can be left undisturbed on the surface and will not germinate until covered (e.g., by crop residue) which is likely to be later in the season and harder to control leading to weed escapes.

The results for annual ryegrass were more reflective of grower paddocks. The highest levels of ryegrass were found in the strategic (137 plants/m^2) and no-till (86 plants/m^2) treatments. As observed by Chauan et al. (2006) ryegrass is a smaller seeded weed species and germination is favoured by light and tillage to create optimal germination conditions. In contrast the low disturbance disc treatment contained the lowest ryegrass population.

The average wild oat density in the seeding systems trial was 13 plants/m^2 and there was no significant difference among the treatments. This is in line with the study of Chauhan et al.

(2006) who found the germination of wild oats was not influenced by either minimum or no-till seeding systems.

Pest observations

In 2001, round snail damage was greatest in the disc and no-till treatments with an average of 20% and 34% of plants containing snails compared to 7% in the strategic treatment (Table 8). Generally, the retention of stubble and lower disturbance creates favourable habitats for pests like snails compared to slashing, burning and prickle chaining. Over summer the snails remain dormant on any objects they can find above the soil surface, such as stubble (Figure 4) to avoid the hot soil temperatures.

Table 8. Snails present on canola (%) in the seeding systems trial at Hart, November 30, 2001.

Seeding system	Nutrition		Average
	Medium	High	
Strategic	7	7	7
Disc	28	13	21
No-till	30	37	34
LSD (P≤0.05) seeder			20

In 2015, snail damage was observed in the trial when sown to canola. Similar to 2001, snail populations were highest in the standing stubble treatments causing plant damage and patchy crop establishment. Snail populations were also present at harvest and plots were cut high to prevent intake of snails, which would have required seed cleaning if delivered.

Figure 4. Round snails taking refuge from the hot summer soil temperatures on stripper front stubble (left) and in crop/stubble at harvest (right), taken at Hart.

The shift to no-till has also contributed to increased mouse activity in southern Australia. Mouse burrows have been observed in the current trial and are more evident in the high stubble and lower disturbance treatments. There has been considerable work in this area showing there are a number of factors in our modern cropping systems which contribute to increased mouse numbers and activity (Mutze 2014):

- Adoption of no till – less burrow disturbance and shelter from standing stubble.
- Reduction in livestock - less competition for seeds and lower burrow disturbance from stubble grazing.

- New crops - more high-quality food available.
- Shallower seeding depths - easier access to sown seeds.

Combined, these factors have resulted in more cover, undisturbed burrows and more food available for mice. Monitoring and a sound management plan in place are important for making these systems work.

Soil biology and seeding systems

The long-term seedings systems trial at Hart was utilised by SARDI researchers in 2012 and 2013 to better understand how different management practices influence free living nematode communities in farming systems. Unlike parasitic nematodes (causing damage to crops), free living nematodes have the potential to act as indicators of soil health.

Across a range of management factors investigated, Linsell *et al.* (2014) found nutrient additions (nitrogen, phosphorus, potassium and sulphur) were a key driver of nematode community differences, followed by environment (soil type and rainfall), rotation, organic matter and tillage.

The analysis of tillage showed two distinct free living nematode communities under no-till and tillage systems (Linsell *et al*. 2014). The conventionally cultivated soils had more plant parasitic nematode, *Pratylenchus*, and also bacterial feeding nematodes. The no-till community was characterised by fungal feeding nematodes and the large omnivorous nematode, *Eudorylaimus,* indicating a more structured community which may be expected with less disturbance.

The no-till soils also had higher organic C and generally higher yields. This may explain the fungal dominance as there would be more organic matter retained on the surface than conventionally tilled soils, which would be largely decomposed by fungi.

The main findings from these results were:

- Disc treatments were dominated by more fungi compared to bacteria. The no-till treatment also contained fungi but in addition, more bacterial opportunists.
- The fungal pathogen, crown rot (*Fusarium pseudograminearum)*, was the main driver of this seeding system effect.
- Crown rot inoculum was more abundant in the disc than no-till treatments. The levels of this pathogen were very high and fell into the high disease risk category as determined by Predicta®B ratings.
- A similar trend was observed for stem nematode (*Ditylenchus dipsici)*, which was also more abundant in disc seeded plots.
- The data suggests no-till treatments may encounter lower populations of both crown rot and stem nematode as there is greater disturbance of both soil and stubble during sowing.

Economics

2000 – 2008

A partial gross margin analysis was conducted from 2000 – 2008 to assess the impact of seeding systems and fertiliser rate. This analysis considered differences in grain yields, fuel use, labour use and depreciation on the capital items for an area of 1500 ha. Weed control, disease control and grain quality were all considered the same.

The analysis showed small differences among the treatments (Figure 5). During the period analysed, the no-till seeding system provided the highest cumulative margin and combined with the medium nutrition input level, the best financial outcome. The no-till treatment at medium nutrition was $200/ha above the disc and strategic treatment, which over eight years can be expressed as $22/ha per year. It was not surprising that the lower fertiliser input level proved to be the best financial outcome, as the average growing season rainfall during the trial period was a low decile 3. Generally, the best economic results in poorer seasons occur from low input strategies.

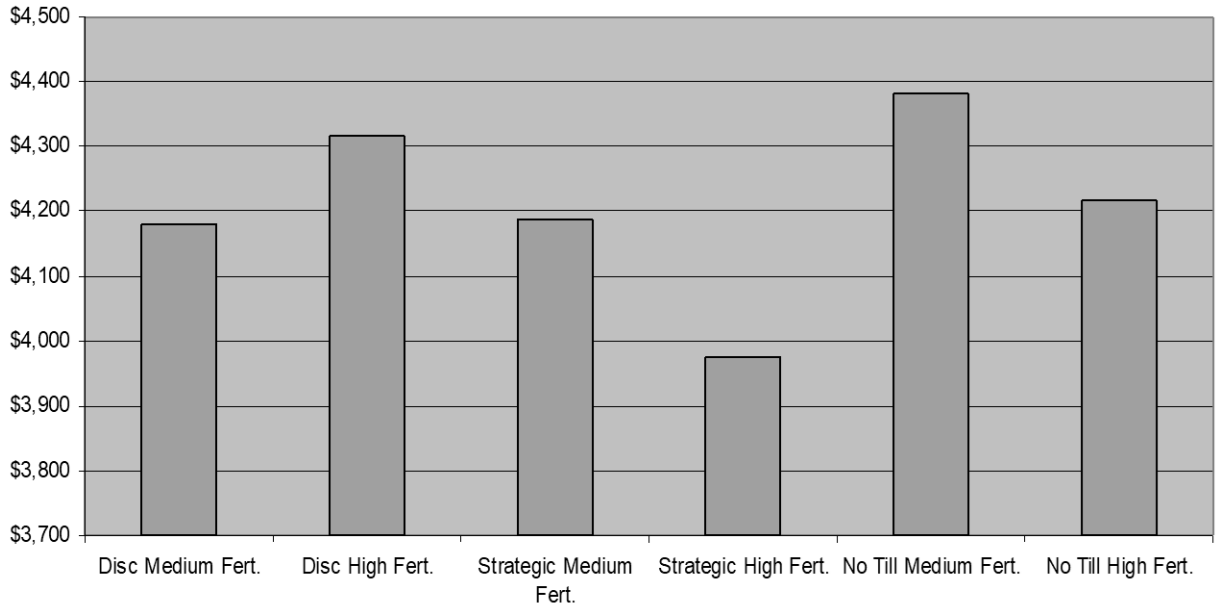

Figure 5. Cumulative partial gross margin ($/ha cumulative) results for seeding systems and nutrition rate from 2000 – 2008. *Krause, Applied Economic Solutions.*

Although the cumulative gross margins between the treatments are similar there are differences which were unable to be measured.

- The no-till and disc seeding systems offer growers greater labour efficiency compared to the strategic system. The gross margins do allow for labour, however, sourcing and maintaining it can be difficult, which may impact on a strategic approach.
- These systems also offer the potential for improved time of sowing, being able to sow into marginal soil moisture and using only one pass.
- As farms continue to get bigger, the ability to sow quicker becomes more important and is where disc seeders might have a big advantage.
- Strategic cultivation in the strategic treatment means that the reliance on herbicides for pre-sowing and summer weed control is much less.

2014 – 2020

A second partial gross margin analysis was conducted from 2014 – 2020 (Figure 6). The analysis considers grain yield, fertiliser costs, pesticide inputs, fuel, labour and insurance. Across the seven-year period, the analysis shows some differences between seeding systems, particularly when comparing the disc seeder to strategic and no-till treatments. This result is due to the disc treatments out-yielding either the strategic or no-till, or both, in 50% of years analysed.

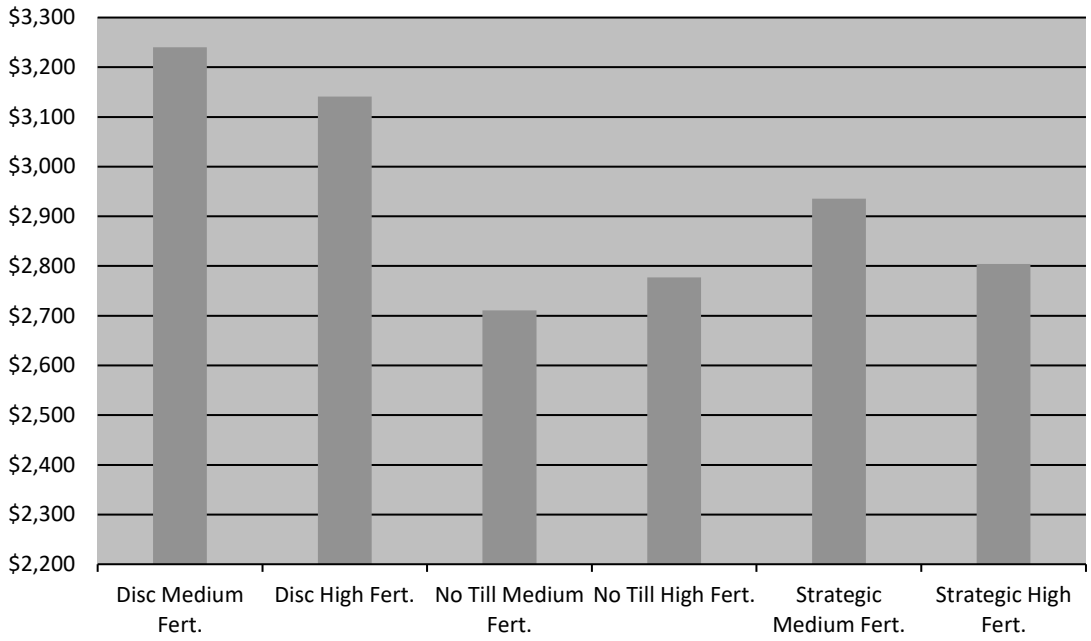

Figure 6. Cumulative partial gross margin ($/ha) results for seeding systems and nutrition rate from 2014 – 2020. Values used for this analysis were based on input and return costs from the Farm Gross Margin and Enterprise Planning Guides for each respective year. Depreciation, repairs and maintenance costs were not included in this analysis and will impact the cumulative gross margin income.

The gross margin analysis conducted for 2014 and 2015 displayed similar returns for each seeder (data not show). Across the years 2014 to 2020 the disc seeder treatment had the greatest average return and provided an increase of $37/ha/year. Further analysis, to include seeder depreciation, repairs and maintenance costs will impact the cumulative gross margin income reported.

Returns for the strategic and no-till treatments were similar to each other but lower than the disc treatment. These similarities are attributed to the strategic treatment moving to a one-pass system in recent years, reducing the input costs factored in the gross margin analysis conducted in 2008. The disc treatment also had significantly higher yields in 2017, 2019, and 2020 correlating to higher gross margin returns.

The return on nitrogen fertiliser inputs was similar across many years, with either small or no gains ($/ha) for high N treatments across disc, no-till and strategic seeder treatments. The medium input treatment performed well across most years, excluding 2016 which was a well above average growing season (decile 8) and provided a greater average return of $23/ha across the six-year period.

This analysis does not consider changes in receival grade due to protein or oil content. Wheat analysis was classed as APW and barley as feed receival standards.

Summary

The overall outcome from the seeding systems project has been a good story for growers.

Across the 22 years of this project, no specific seeder type (no-till, strategic or disc) or nutrition regime has given a consistently higher yield each season.

In the later years of this project, water infiltration and soil bulk density were not affected as a result of seeder type.

Soil organic carbon levels were similar across years, with observed differences in 2014 likely due to greater soil available N, potentially increasing organically bound carbon.

Overall, seeding systems had had little impact on starting available soil nitrogen prior to each season, producing similar results over the life of this trial. The return on nitrogen fertiliser inputs was similar across many years, with either small or no gains ($/ha). In the most recent gross margin analysis, the medium input treatment performed well across most years, excluding 2016, a well above average growing season (decile 8), providing greater average returns of $23/ha across a six-year period.

Outcomes from this project show that the decision-making behind the selection of a seeder can be influenced by factors affecting crop management practices, including; plant establishment, pests and weeds, sowing speed, stubble management, soil type and herbicide residue. This result is reflected across the southern region, where a large variation of seeding and crop management strategies now exist.

Photo: Aerial view of the large-scale long-term seeding systems trial at Hart in 2020.

Experience and comparison of seeding systems on farm

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A flexible seeding system

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GROWER CASE STUDY 5

Simplicity seeding

Michael Jaeschke, Hart

Grower Case Study 1

A flexible seeding system

Grower	Matt Dare
Location	Marola
Property size	840 ha
Rainfall	470 mm annual 350 mm growing season
Soil type	Red loam & brown cracking clay
Enterprise	100% seeding cereals, legumes, canola and oaten hay
Seeder	Flexicoil 5000 bar 16 mm knife points with 10 inch row spacing and press wheels

Marola grower Matt Dare has been utilising a no-till seeding system for 21 years. His shift to, and continued use of, a knife-point press wheel seeder has been attributed to the flexibility of the system and a combination of its ability to retain stubble, reduce erosion, minimise weed stimulation and offer more timely sowing operations.

Matt's seeding operations in 2016

When we spoke to Matt in 2016, he'd recently purchased his Flexicoil 5000 bar (2012) and described his unit as flexible and simple. The system was also running on 250 mm row spacings with inter-row sowing facilitated by 2 cm RTK auto-steer, with an average sowing speed of 8 km/h.

At the time, he'd not long upgraded from the old Flexicoil 820, gaining more weight on the press wheels. They also improved trash flow by having castor wheels on the front, with no wheels within the frame. He said, "We have a row of press wheels at the back, and they take the majority of the bar weight. There is a lot more pressure in the furrow and in our soils that is fine, but for hard setting soils that can be an issue."

Marola grower Matt Dare has been using a no-till seeding system for 21 years.

The main weeds on Matt's property were ryegrass, wild oats and bifora. He found the shift to no-till improved his weed control through decreased weed seed burial enabling an earlier time of sowing. It also increased crop competition and gave greater flexibility in chemical rates and application timing. He encountered other seeding problems like sticky soils that encouraged legume stubbles to wrap around press wheels and vine type summer weeds (such as wire weed, caltrop & melons) wrapping around tines. This has increased the importance of summer weed control.

Matt Dare's shift to, and continued use of, a knife-point press wheel seeder has been attributed to the flexibility of the system and a combination of being able to retain stubble, reduce erosion, minimise weed stimulation, along with more timely sowing operations.

The only modification Matt had made to his system as a whole, was more timely summer weed control. When it came to purchasing a new seed cart, Matt was specifically looking for something with a 2 m wheel spacing to follow his tram lines and reduce compaction.

In 2016, upgrading his seeding system was not on his immediate agenda, but Matt was keen to see how the disc technology came along. He said, "We actually do all of our stubble management with our header whereas other people running discs can't put too much trash through the header, which is where stripper front harvesters have come into play."

"For me disc seeding systems are a bit inflexible at the moment and machinery isn't my strength, I'd rather have something simple."

Matt Dare's Flexi-coil 5000 seeder bar in action, sowing the long-term seeding systems no-till treatment at the Hart field site in 2020.

Where is Matt now?

Matt has recently upgraded to a newer tyne seeder. He has kept the Flexi-coil 5000 bar design as it has continued to work very well. The main differences in his new set-up is a change from double to single shoot delivery for both seed and fertiliser, and moving to a larger working width. Matt's transition to a single shoot setup is based on improved seed depth and placement for lentils, wheat and canola. The improved depth also helps to establish crops when dry sowing and reduce pre-emergent herbicide damage.

Along with the purchase of a new seeder, Matt has included a small seeds box on his air cart. This allows a more accurate rate for sowing canola and allows inoculation of pulses using granular inoculant within the small seeds box, something new to Matt's system. He's also hoping to have better nodulation after sowing in dry conditions.

Matt's transition to a single shoot setup has improved depth and seed placement for lentils, wheat and canola. The improved depth also helps to establish crops when dry sowing and reduce pre-emergent herbicide damage.

Matt's weed types have changed very little with annual ryegrass, wild oats and bifora still significant, although his seeding system has allowed him to greatly reduce populations. He contributes this to new pre-emergent herbicides available in no-till systems, as well as the rotation and inclusion of oaten hay.

The flexibility of the tyned machine, due to the number of pre-emergent herbicide options available particularly when compared to traditional disc systems is still a big positive for Matt. The ability to gain greater pressure on press wheels when sowing in dry conditions has allowed better seed soil contact, giving crops a chance to emerge from smaller rainfall events.

Matt's Flexi-coil 5000 seeder bar and Simplicity seed box.

Grower Case Study 2

Full stubble retention and maximum soil cover

Grower	Tom Robinson
Location	Hoyleton
Property size	1620 ha
Rainfall	420 mm annual 380 mm growing season
Soil type	Red brown clay loam
Enterprise	100% seeding cereals, lentils and cover cropping (sunflowers & sorghum)
Seeder	John Deere 1890 single disc at 6 inch row spacing, closer wheels and press wheels

Along with his father Ashley, Tom Robinson has been using a one pass seeding system since 1992 with their previous seeder combining a prickle chain at the back. They have been using a disc seeding system since 2003; the decision to make the shift was primarily to retain as much stubble as they could and also maintain it at a consistent level.

The Robinson's purchased their 1890 John Deere single disc in 2003, consisting of 6-inch row spacing, RTK guidance and a sowing speed of 8-12 km/h. Their disc seeder allows them to retain high amounts of stubble and still be able to sow their crop without reduced establishment.

Photo: Tom Robinson from Hoyleton, is very happy with their single disc seeder due to continued versatility within his farming system.

Tom's seeding operations in 2016

In 2016, the Robinson's crop rotation consisted of wheat, sown two to three times consecutively, followed by canola or a bean crop depending on the paddock's need and weed burden. Their interest was also around companion seeding to improve ground cover and diversity. Tom said, "That's probably the main thing I think we are lacking in our system, diversity. At this stage I can't come up with a stable pulse rotation that is going to give us the groundcover that we want which is why we've looked into summer cropping."

Their main focus at the time was crop competition. "Crop competition is the most underutilised "herbicide" that we have. We aim for good competitive plants and try to get them all up on the same day." Tom said that although their choice in herbicides was limited, it has not impacted the level of weed control they can achieve. "All our weeds are on the soil surface; we don't have shoots coming through the soil which is why we are finding things like Sakura® and Boxer Gold® good for weed control as they are root uptake herbicides."

> "Crop competition is the most under-utilised 'herbicide' that we have. We aim for good competitive plants and try to get them all up on the same day." **Tom Robinson**

The majority of the problems the Robinson's faced with their disc seeding system was with modifications. "We have made a lot of modifications to the seeder in terms of upgrading different equipment, but all of it has been changed for a reason." Fertiliser toxicity was a problem, but Tom said it was a good thing as it has led them to think about reducing early fertiliser application rates.

Tom believed the seeding systems trial at Hart has been a way for growers to discuss where they can improve. "You want growers to question their system and that's what Dad and I are always doing, it's to see where we can improve and why we're doing the things that we are."

Photo: Tom Robinson sowing the long-term seeding systems trial at Hart in 2020.

Where is Tom now?

Tom has not significantly changed his seeder over the past six years, as it still provides good results. He has, however, made changes to cropping rotations, replacing canola with lentils. The main reason behind this was high input costs for canola production. These changes have allowed Tom to include more legumes within his system, helping to maintain greater diversity through his winter cropping program. Tom also says he can still achieve 100% groundcover after harvesting lentils due to the previous season's cereal stubble.

> Making changes to crop rotations on farm has allowed **Tom** to maintain diversity within his winter cropping program, while still gaining 100% groundcover after lentils due to the previous years' cereal stubble.

Tom has also taken on opportunities to cover crop over summer months. When good summer conditions are met, Tom will sow a multi-species cover crop to utilise soil moisture and due to a lack of disturbance, he is able to sow without losing substantial soil moisture.

Weed management has not drastically changed in the last six years, as the Robinsons are still able to utilise Boxer Gold, Sakura and imidazolinone herbicides with great results.

Another change on-farm has been the inclusion of livestock. Cattle are grazed on opportunistic summer cover crops, while also contributing to some weed control.

Tom is still very happy with his seeder, and says it remains versatile within his farming system. With regular machine maintenance the single disc also continues to have low running costs and there are no plans to upgrade his seeder in the near future for this reason.

Photo: Tom's John Deere 1890 single disc with closer wheels and press wheels at Hart.

Grower Case Study 3

Disc seeder providing continued benefits

Grower	Patrick Neal
Location	Ngapala
Property size	1360 ha arable cropping + grazing country
Rainfall	450 mm annual 325 mm growing season
Soil type	Red loam – brown clay loam
Enterprise	65% cropping and 1500 ewes Cereals, legumes, canola and oaten hay
Seeder	RootBoot Razor disc on 8.75 inch row spacings and press wheels

Patrick Neal has been no-till farming for 21 years on his property at Ngapala. His shift from operating a knife-point press wheel system to a disc machine was driven by his need to eliminate issues with rocks at seeding time and a desire to significantly reduce crop row spacings.

Patrick's seeding operations in 2016

In 2016, Patrick said, "We have plenty of rocks on our property and our old Conserva Pak tyned machine used to pull them up out of the ground, which created issues later on." Switching to his newly purchased John Deere 1890 single disc allowed him to reduce the row spacing of their system from 12 inch to a 7.5 inch spacing. He said, "We wanted to get our row spacing narrower for better weed competition and to grow a bit more of a canopy. To achieve this narrower row spacing we needed the disc to handle our stubble load." Although not the primary driver for his purchase, other disc seeder benefits such as stubble handling and improved soil cover were added incentives for Patrick.

Photo: Shifting to a disc seeder has allowed Patrick to better manage rocks while reducing row spacing.

Patrick's cropping program in 2016 consisted of canola, followed by two consecutive wheat crops then a pulse, which was predominately beans or lentils. It was often then followed by another wheat or barley crop. Vetch pastures also had a fit within his cropping rotation, in paddocks where harvesting pulses could be an issue. Livestock were only grazed on Patrick's cropping areas during summer.

Ryegrass and wild oats were problem weeds on Patrick's property with some brome grass also present, however, it was not yet a major issue for them. At the time he said, "We do not grow oaten hay, so our strategy consists mainly of chemical control, including pre and post emergent applications and crop topping, windrow burning and now narrow row spacing." Patrick was also getting good results from Sakura® and Boxer Gold® within their cereal crops and was still able to use trifluralin in their break crops.

Hair pinning had also been an issue which Patrick attributes to grazing sheep on their stubbles. "We try not to overgraze our stubbles. We can get through the stubble with no problems when they are standing up but by the time we have grazed them and particularly with narrow row spacing, the sheep tend to knock them." Arick's wheels were added to the seeder at the time of purchase to alleviate this issue and Patrick has been happy with the results. "We set them up pretty aggressively this year (2016) to try and move more stubble and we have also added extra weight to the machine to penetrate the stubble better."

"We wanted to get our row spacing narrower for better weed competition and to grow a bit more of a canopy. To achieve this narrower row spacing we needed the disc to handle our stubble load." **Patrick Neal**

Patrick said that his machine maintenance increased since his shift towards a disc system, but said this had been more preventative rather than because of issues during seeding. "In comparison to our previous tyned machine, we don't break as many parts on our disc seeder, so we're not fixing our seeding system as often during the season. We wear down discs a bit more on our country so we do have to change them halfway through the season which takes almost a full day, but we are prepared for when it needs to happen."

In 2016, Patrick said a new purchase wasn't likely, but said he would be hesitant to go back to a knife-point system due the issues he has with rocks at seeding. "At this stage the only thing I would consider moving to would be a machine that requires a little less maintenance and penetrates stubble better if one happened to come along. For now though we're happy with what we've got."

The ability to see the Hart seeding systems trial and make comparisons has been interesting for Patrick. "Being able to easily see the job that each machine does and then being able to compare how similar it is to your own system is one thing I've gotten out of it."

Where is Patrick now?

Patrick is a reasonably new adopter of disc seeders, having now operated his disc system for six years. In 2018, he upgraded to a locally built RootBoot Razor disc machine (from his John Deere 1890 single disc). Since that upgrade, Patrick has seen a reduction in the level of machine maintenance required. The RootBoot Razor deliverss significantly higher levels of disturbance when compared to traditional style disc seeders, because of the wider row spacings, at 8.75 inches.

Patrick is impressed by the benefits of his new disc seeder and says "The more aggressive discs throw a bit more dirt away from the row, which improves crop safety of pre-emergent herbicides".

Patrick has seen benefits of the higher disturbance with hair pinning now greatly reduced. A second benefit of increased disturbance is that he can safely use most pre-emergent herbicides that are used within no-till seeding systems. "The more aggressive discs throw a bit more dirt away from the row, which improves crop safety of pre-emergent herbicides". The higher soil disturbance is also increasing ryegrass germination for Patrick, which allows him to control the weeds earlier in the season with pre-emergent and early post emergent herbicides.

Patrick has seen improved germination with his small seeded crops, like canola. He contributes some of this to safer fertiliser use as the new seeder has greater separation of fertiliser and seed, also allowing him to safely increase rates.

Patrick has been impressed by his new seeder as it solves many of his previous issues, while also enjoying the benefits of a disc system.

Photo: The RootBoot Razor disc seeder on Patrick's property at Ngapala.

Grower Case Study 4

Full circle on seeding systems

Grower	Andrew Sargent
Location	Crystal Brook
Property size	2000 ha
Rainfall	400 mm annual 300 mm growing season
Soil type	Sandy loam
Enterprise	100% seeding cereals, legumes, canola and oaten hay
Seeder	Flexicoil ST820 bar, knife-point paired row boots with 300 mm row spacing and press wheels.

Andrew and his father Malcolm farm 2000 hectares at Crystal Brook and have been no-till farming since 1999. During this time, they have used both knife-point and disc seeding systems, with the aim of retaining a high amount of stubble and maximising crop germination.

Andrew's seeding operations in 2016

When we spoke to Andrew in 2016, the Sargent's seeding system had recently been upgraded to an 18-metre wide Flexicoil ST820 knife-point bar to address stubble handling issues. The machine had 300 mm row spacing, paired row boots and a sowing speed of 7.5 km/h. For the two years prior, they had a single disc system and during that time observed issues with reduced establishment, hair pinning and herbicide incorporation. "I think we got lucky with the years that we had our disc seeder as they were favourable years so it didn't matter that we had a lower plant count."

Andrew Sargent, pictured above, farms with his father Malcolm at Crystal Brook and has used both knife-point and disc seeding systems.

After selling their disc seeder, the Sargents trialed four different seeder bars with knife-points to figure out what could best get through their stubble. "We still wanted to retain a similar amount of stubble as we could with the disc. For us, we found this could be achieved with a knife-point system and it was easier in terms of herbicide selection for better weed control."

A crop rotation of two cereals in a row (wheat or barley) followed by a break crop of either canola or a pulse crop (including lentils, peas, beans and chickpeas) is common on the Sargent's farm.

Ryegrass and brome grass were the two main in-crop weed issues for the Sargents. Although they only had their disc seeder for two years, they noticed brome grass numbers increase rapidly during that time. "We had huge problems with brome grass. Our brome grass numbers blew out massively when we had our disc system because we weren't getting good herbicide incorporation, and we are still getting on top of this problem four years later," Andrew said.

A combination of pre and post emergent herbicides, crop topping and incorporating legume crops for the use of selective herbicides were all aspects of the Sargent's integrated weed control strategy.

> "What we got out of the process of trying a couple of different bars was that it didn't really matter what you had, it was more about timing. We just wanted a machine that would go through our stubble and was going to be reliable."
> **Andrew Sargent**

Other problems the Sargents faced with their seeding system included limited trash handling and seed placement, which Andrew attributes partly due to not being able to inter-row sow. "We haven't modified that much on our machine, but we are looking at implement steer. If we can get the inter-row sowing right, then the other stuff will come by itself."

Andrew said, "Implement steer is the only thing we'll look at changing in the near future. Ideally, we'd look at a parallelogram type seeder, but I think at this stage trash flow is an issue for those machines. If we can get the inter-row sowing going right then we might look at taking the punt on a parallelogram type seeder."

Similar to other growers, Andrew said that the interesting thing they've got out of the long-term seeding systems trial is that there was no significant difference between machine types. "I guess it depends on what else you have got your seeding system for, because at Hart there aren't any real limitations. What we got out of the process of trying a couple of different bars was that it didn't really matter what you had, it was more about timing. We just wanted a machine that would go through our stubble and was going to be reliable."

Where is Andrew now?

The Sargents are still operating the same seeder on their Crystal Brook farm. Andrew continues to get good crop establishment and trash flow with the Flexi-Coil ST820 knife point system. Most recently, he has found just how much influence seeder set up, like fan speed, has on ensuring even crop emergence and establishment. This was highlighted through the uneven distribution of small seeds like canola between crop rows.

As flagged in 2016, a major change to Andrew's system has been the inclusion of implement steer to better inter-row sow. Andrew has found inter-row sowing has improved his trash flow, and this would not be possible without the implement steer technology. It has not been without its issues, as technology compatibility problems can interrupt their operations.

> A major change to **Andrew's** system since 2016, has been the inclusion of implement steer to better interrow sow. Andrew has found this has improved trash flow, and this would not have been possible without implement steer technology.

Due to the knife point press wheel setup of his seeder, Andrew has found increased weed control through better incorporation of herbicides. This has helped them control weeds like annual ryegrass and brome grass, which remain two of his biggest weeds. Trifluralin and triallate are still utilised within Andrew's as they are providing good control within his system.

Photo: The Sargent's Flexicoil ST820, knife-point paired row bar in action on the Crystal Brook property.

Grower Case Study 5

Simplicity seeding

Grower	Michael Jaeschke
Location	Hart
Property size	670 ha
Rainfall	425 mm annual 320 mm growing season
Soil type	Red brown loam, sandy rises (sand over clay)
Enterprise	85% seeding plus sheep Cereals and legumes with 600 self-replacing Dohne Merino
Seeder	Flexicoil 820, 100 mm wide points, 8-inch row spacing with finger harrows

For Hart grower Michael Jaeschke, his seeding system is all about flexibility. Michael has had his Flexicoil 820 bar since 1999 and has never had any issues with it. "The Flexicoil was expensive at the time, but I knew it was going to last me a long time".

Michael's seeding operations in 2016

Having the option of ripping up or direct drilling was the main reasoning for Michael's choice of seeding system. When we spoke to Michael in 2016, his system consisted of knock-on points ranging from 2 – 4 inches on 7.2 inch row spacings. Michael had also slowed his sowing speed down to 8.5 km/h to reduce soil throw. "I have a pretty strong breakout so I can still direct drill the same as anyone else, my only problem is that if soil moisture is marginal, the soil comes up a bit cloddy. My soil is pretty friable so I don't dry sow but because I have a smaller property, I can be done seeding in two weeks."

Photo: Michael Jaeschke farms at Hart and says his seeding system is all about simplicity.

As Michael had livestock within his system, his crop rotation consisted of durum, bread wheat, followed by barley for livestock feed and then a legume crop. Durum was usually after peas and his pastures were sown to paddocks where there was a weed issue.

Ryegrass was the main problem weed and Michael's control strategy consisted of a knockdown and a full cut at seeding. Livestock were also used for weed control especially within his barley pastures. He said, "The sheep tend to chase the ryegrass before they start eating the barley, my theory with ryegrass is because I've got sheep, if you're going to disturb the soil, disturb it properly." Trifluralin would go on after seeding and Logran® gets mixed in much more evenly by getting sprayed and then prickle chained.

In 2016, Michael introduced Boxer Gold® into the trifluralin and Logran® mix, post seeding / pre-emergent. There seemed to be good results on ryegrass numbers, but had problems with crop emergence on limestone ground due to heavy rainfall after seeding. Michael also used a selective herbicide within his pea crops.

> "The Flexicoil was expensive at the time, but I knew it was going to last me a long time. It's a solid machine and I have had no problems at all, it's a simplicity seeder." **Michael Jaeschke**

The main modification that Michael had made to his seeding system was the ability to switch from a 7-inch sweep point, to 2 or 4 inch knock-on points with the use of clips. Michael says that this increases his flexibility by having knock on points for deep ripping if needed. Apart from this, not many changes were made to the seeder, however; Michael said the amount of direct drilling he does had increased a bit.

Michael also switched his pastures from medic to barley and increased the amount of peas in his seeding program. "I've actually got more sheep and I'm growing better crops than what I had with medic pastures. He said "I'm growing a lot more peas and with a year like the last our wheat was going APW - H1 and we didn't have any screenings problems."

Photo: The current set up on Michael's Flexicoil 820 bar.

Where is Michael now?

Michael's system remains very similar, utilising the same seeder and set-up since we spoke to him in 2016. He has, however, moved to one-pass system which he has said has allowed him to cover sowing area quicker.

Michael has also reduced the area he prickle chains, focusing mostly on his legumes with the purpose of levelling the paddock to make harvest easier. Sakura has been an inclusion to Michael's weed control as a pre-emergent herbicide. He has seen good results with good safety. Michael also continues to use Boxer Gold and is considering the potential of Overwatch® within his system into the future. Due to the limited pre-emergent options, Michael utilises trifluralin and Avadex® Xtra as post-seeding pre-emergent options which helps increase his weed control.

Michael has sown the strategic treatment in the Hart seeding systems trial for the past 22 years and says that for him, the trial resulted in learnings across nutrition, rather than seeding system. He said, "It's not so much the seeding system selected that makes the difference, it's the fertiliser."

Michael has no plans to change his seeder going forward. He has been very happy with the performance of his seeder in all conditions and doesn't see this changing in the future.

He says, "It's a simplicity seeder."

Photo: Michael seeding the strategic treatment in long-term seeding systems trial at Hart in 2005.

References

Chauhan B, Gill GS and Preston C (2006) Seedling recruitment pattern and depth of recruitment of 10 weed species in minimum tillage and no-till seeding systems. Weed Science 54 (4): 658-668.

Grant C and Lafond G (1993) the effects of tillage systems and crop sequences on soil bulk density and penetration resistance on a clay soil in southern Saskatchewan. Canadian Journal of Soil Science73 (3): 223-232.

Haskins B (2012) Using pre-emergent herbicides in conservation farming system NSW Department of Primary Industries pg 1-20.

Kleemann S and Gill G (2013) Seed Dormancy and Seedling Emergence in Ripgut Brome (Bromus diandrus) Populations in Southern Australia. Weed Science 61: 222-229.

Kleemann S, Desbiolles J, Gill G and Preston C (2013) Disc seeders and pre-emergence herbicides. GRDC Research Update Paper, Adelaide.

Kleemann S, Noack S, Gill G and Hooper P (2015) Influence of seeding systems and stubble management on pre-emergent herbicides. Hart Field Site Group Trial Results Book.

Linsell, K (2014) Free living nematodes of indicators of biological soil health. GRDC Research Update Paper, Adelaide.

Mutze, G (2014) Mice – they're back again! GRDC Grains Research Update Paper, Horsham.

Sanderman J, Farquharson R and Baldock J. (2009) Soil Carbon Sequestration Potential: A review for Australian agriculture. Report prepared for the Department of Climate Change and Energy Efficiency, Sustainable Agriculture Flagship, CSIRO.

Photo: 'Synchronised seeding' of the long-term seeding systems trial at Hart in 2015.

Appendix 1

Grain screenings (%) for seeding system and nutrient treatments from 2000-2021.

		Strategic		No-till		Disc		LSD (P≤0.05)		
Year	Crop	Medium	High	Medium	High	Medium	High	Seeder	Nutrition	Seeder × nutrition
2000	Barley	12.1	14.2	11.1	13.8	15.7	16.9			
2001	Canola									
2002	Wheat	1.6	1.4	1.6	1.4	1.8	1.7	ns	ns	ns
2003	Wheat	2.3	1.7	2.4	2.1	2.1	2.5	ns	ns	ns
2004	Barley	1.9	8.9	2.0	8.9	2.2	7.7			2.8
2005	Pea									
2006	Durum	1.8		3.7		2.5		ns		
2007	Wheat	0.5	0.6	1.9	2.3	3.4	5.7	ns	ns	ns
2008	Wheat	8.0		6.3		7.3		2.8		
2009	Barley	5.4		4.8		5.1		ns	ns	ns
2010	Canola									
2011	Wheat	1.1	1.7	1.0	1.5	1.8	2.0	0.5	0.41	ns
2012	Pea									
2013	Wheat	-	-	5.1	7.4	4.7	6.6	ns	ns	ns
2014	Barley	11.1	26.8	5.9	28.2	6.5	24.1	ns	ns	ns
2015	Canola									
2016	Wheat	1.1	1.3	1.2	1.6	1.2	1.0	0.14	ns	0.20
2017	Wheat	1.9	3.9	1.1	3.3	1.3	4.5	ns	0.76	ns
2018	Pea									
2019	Wheat	2.8	2.5	3.3	3.3	3.8	7.8	ns	ns	ns
2020	Wheat	1.0	0.7	0.9	0.7	1.5	1.0	0.12	0.09	ns
2021	Pea									

Grain test weight (kg/hL) for seeding system and nutrient treatments from 2004-2021.

		Strategic		No-till		Disc		LSD (P≤0.05)		
Year	Crop	Medium	High	Medium	High	Medium	High	Seeder	Nutrition	Seeder × nutrition
2004	Barley	58.2	52.4	56.7	52.0	56.5	52.2			2.5
2005	Pea									
2006	Durum	No data		No data		No data				
2007	Wheat	No data		No data		No data				
2008	Wheat	No data		No data		No data				
2009	Barley	64.5		64.9		65.2		ns	ns	ns
2010	Canola									
2011	Wheat	78.4	76.0	79.0	77.0	77.3	76.0	1.1	0.92	ns
2012	Pea									
2013	Wheat	-	-	73.1	70.3	73.4	73.6	ns	1.7	ns
2014	Barley	67.9	65.6	70.1	66.4	69.5	65.8	ns	1.4	ns
2015	Canola									
2016	Wheat	81.4	80.8	81.4	79.6	81.4	81.3	ns	ns	ns
2017	Wheat	75.4	73.8	76.6	74.6	74.6	72.7	1.0	0.82	ns
2019	Wheat	76.1	75.4	73.2	74.4	74.0	69.4	ns	ns	ns
2020	Wheat	82.0	81.3	82.0	81.4	81.5	80.9	0.42	0.34	ns
2021	Pea									

SYNCHRONISED SEEDING

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