

Long-term comparison of seeding systems

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Key findings

- Soil properties including organic carbon (SOC%), water infiltration (mm/h) and bulk density (g/cm³) were similar for all cropping systems at Hart in 2021.
- Strategic and no-till treatments had the highest levels of available soil nitrogen (N) leading into the 2021 growing season, with 129.9 and 95.5 kg/ha, respectively.
- Over the past 21 years (2000 – 2020), no seeding system has provided consistently higher grain yield (t/ha) each season.

Why do the trial?

The Hart cropping systems trial is unique. Running since 2000, it provides SA grain growers with information on the long-term effects of cropping systems (a combination of seeders, tillage and stubble management) and nitrogen fertiliser regimes. There continues to be industry interest in disc seeders due to their ability to retain heavy stubble, minimise soil disturbance, increased seeding speed and seed depth uniformity. To date the trial has shown that no one seeding system or nutrition regime is consistently higher in grain yield, quality or gross margin.

The trial aims to compare the performance of three seeding systems and two nitrogen (N) strategies. This is a rotation trial (Figure 1) to assess the long-term effects of seeding systems and higher fertiliser input systems on soil fertility, crop growth, grain yield and quality.

How was it done?

Plot size	35.0 m x 13.0 m	Fertiliser	MAP (10:22) @ 50 kg/ha
Seeding date	May 28 – No-till June 2 – Strategic June 22 - Disc	Medium Nutrition	No extra fertiliser applied
		High Nutrition	No extra fertiliser applied
Variety	PBA Butler field pea @ 100 kg/ha	Harvest Date	November 10 – No-till November 10 – Strategic December 1 - Disc
Location	Hart, SA		

The trial was a randomised complete block design with three replicates, three seeder treatments, and two nitrogen (N) treatments. This trial was also managed with the application of pesticides to ensure a weed, insect and disease-free canopy.

The disc, strategic, and no-till treatments were sown by local growers using their own equipment, Tom Robinson, Michael Jaeschke, and Matt Dare respectively.

Original seeding treatments

- Disc – Sown into standing stripper front stubble with John Deere 1890 single discs at 152 mm (6”) row spacing, closer wheels and press wheels.
- Strategic – worked up pre-seeding, sown with 100 mm (4”) wide points at 200 mm (8”) row spacing with finger harrows.
- No-till sown into standing stubble in one pass with a Flexicoil 5000 drill, 16 mm knife points with 254 mm (9”) row spacing and press wheels.

In 2021, Scepter wheat stubble was managed uniformly across the trial area with the disc, strategic and no-till seeder systems sowing directly into standing stubble.

Nutrition treatments

In years with cereals or canola, a varying nutrition treatment is applied, where a high treatment receives two in-season applications of nitrogen on top of the basal rate of sown fertiliser, and a medium treatment where only one application of in-season nitrogen is applied on top of the starting fertiliser. As this year’s trial consisted of field peas, no additional nitrogen was applied.

2021 assessments

Prior to seeding, soil available N was assessed on April 30, at depths of 0–20, 20–40, 40–60, and 60–80 cm. Plant establishment was also evaluated by counting the number of plants across 4 x 1 m sections of row in each plot. Water infiltration rate (mm/h) was conducted using a double ring infiltrometer, along with soil bulk density (g/cm³) for every treatment. Soil Organic Carbon (SOC%) was also measured from 0 – 10 cm in every plot. Grain yield and quality was not analysed in 2021.

Table 1. Crop history of the long-term cropping systems trial at Hart 2000 – 2021.

2000	2001	2002	2003	2004	2005	2006	2007
Sloop barley	ATR-Hyden canola TT	Janz wheat	Yitpi wheat	Sloop barley	Kaspa peas	Kalka durum	Janz wheat
2008	2009	2010	2011	2012	2013	2014	2015
Janz wheat	Flagship barley	Clearfield canola	Correll wheat	Gunyah peas	Cobra wheat	Commander barley	44Y89 (CL) canola
2016	2017	2018	2019	2020	2021		
Scepter wheat	Scepter wheat	Wharton field pea	Sheriff CL wheat	Scepter wheat	PBA Butler field pea		

Results and discussion

Plant establishment

This season, plant establishment was similar between the cropping systems, ranging from 31 to 40 plants/m². Target plant density was 55 plants/m², meaning final plant establishment was anywhere between 54% and 73% of the targeted establishment. In 2021, seeding systems had no effect on plant establishment, however, in previous years, some seeders had shown improved establishment. For example; in 2020, the disc treatment had a higher establishment of wheat seedlings when compared to the no-till and strategic treatments, although final yield was not affected (Noack *et al* 2021).

Nutrition level also had no effect on crop establishment in 2021. This has been a common observation across the duration of the trial (2000 – 2021).

Soil properties

Reducing the amount of soil disturbance from tillage is expected to help maintain higher carbon levels (Sanderman *et al* 2009). This means that the disc treatment was predicted to have higher soil organic carbon (SOC%) levels compared to the strategic treatment. This was not observed at Hart, with all cropping systems (disc, no-till and strategic) showing to have similar SOC% levels across three sampling years; 2007, 2014 and 2021 (Table 2).

Soil organic carbon was observed to be the highest in 2007 and 2014. This result is likely due to the crop type grown in the years prior to sampling, on both occasions, a legume. This is in contrast to 2021, where two cereal crops were grown in the two years prior to sampling (Table 1).

Table 2. Soil organic carbon levels (%) at Hart in 2007, 2014, 2021.

Seeding system	Nutrition	SOC %		
		2007	2014	2021
No-till	Medium	1.65	1.57	1.64
	High	1.78	1.89	1.67
Disc	Medium	1.70	1.97	1.61
	High	1.75	2.18	1.62
Strategic	Medium	1.69	1.98	1.59
	High	1.75	1.99	1.63
Average		1.72	1.93	1.62
LSD (P≤0.05)		NS	NS	NS

Soil available N was measured in autumn (prior to seeding) following a Scepter wheat crop in 2020, with values ranging from 54.2 kg N/ha to 132.7 kg N/ha (Table 3 and Figure 1).

Selection of seeder type influenced nitrogen levels in 2021, with the strategic and no-till treatment having the highest levels of available nitrogen, with 129.9 kg/ha and 95.5 kg/ha, respectively.

Table 3. Soil available N (kg N/ha) at Hart in 2021.

Seeding System	Nutrition	Soil available nitrogen (kg N/ha)		
		2019	2020	2021
Strategic	Medium	132	44	127
	High	146	116	133
No-till	Medium	95	58	72
	High	151	67	119
Disc	Medium	103	41	54
	High	118	89	100
LSD (P≤0.05)	Nutrition	35	NS	NS
	Seeder	NS	NS	42
	Seeder x Nutrition	NS	NS	NS

Water infiltration was assessed to measure the rate of water movement into a soil profile that is already wet, to achieve an accurate rate. Water infiltration rates for each seeding system were similar in 2021 with values ranging between 100 – 110 mm/h.

Soil bulk density is a measure of soil compaction; the mass of dry soil within a fixed volume (Brown and Wherrett 2021). Bulk density was similar across all treatments within the trial at Hart in 2021 (Table 4). Results show that continuous use of one particular cropping system including disc, no-till and strategic has not shown to improve or negatively affect measured soil characteristics.

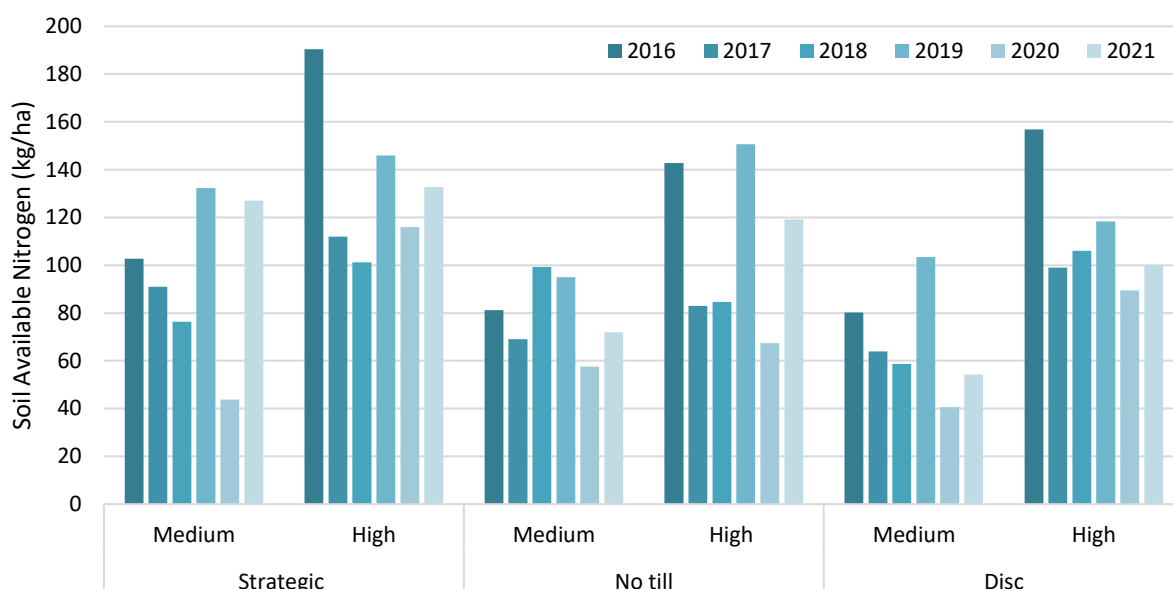


Figure 1. Five years of soil available N (kg N/ha) pre-seeding at Hart in 2016 – 2021.

Table 4. Soil bulk density (g/cm³) at Hart in 2021.

Seeding System	Nutrition	Soil bulk density (g/cm ³)
No-till	Medium	1.21
	High	1.27
Disc	Medium	1.23
	High	1.18
Strategic	Medium	1.20
	High	1.19
LSD (P≤0.05)		NS

Grain yield

Over the past 21 years of this project (2000 – 2020), no seeding system has provided consistently higher grain yield (t/ha) each season. In 43% of years, small yield differences were observed between the disc, no-till and strategic cropping systems and in most cases, these higher yields were observed for disc and no-till treatments. Similarly, over a number of seasons, seeding systems used have had minimal impact on grain protein (%), screenings (%) and test weight (kg/hL).

Table 5. Grain yield (t/ha) for seeder and nutrition treatments at Hart from 2015 – 2020. Yield data for field peas in 2021 was removed from analysis.

Seeder type	Fertiliser strategy	2015	2016	2017	2018	2019	2020
		Canola	Wheat	Wheat	Field pea	Wheat	Wheat
		Grain yield (t/ha)					
Strategic	Medium	0.6	4.8	3.5	0.8	1.3	2.6
	High	0.6	5.9	3.3	0.7	1.2	2.7
No Till	Medium	0.6	4.2	3.5	0.9	0.9	2.3
	High	0.5	5.8	3.5	1.0	1.1	2.4
Disc	Medium	0.5	5.0	4.1	0.7	1.3	3
	High	0.5	5.9	4.1	0.7	1.3	3
LSD nutrition (P≤0.05)		ns		NS	NS	NS	NS
LSD seeder (P≤0.05)		ns		0.20	0.18	0.15	0.24
LSD seeder x nutrition (P≤0.05)		ns	0.3	NS	NS	NS	NS

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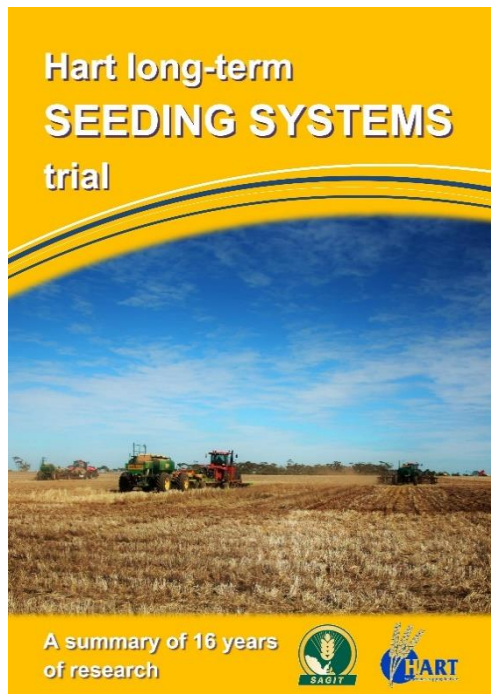
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Hart Field-Site Group (2016) Hart long-term seeding systems trial: A summary of 16 years of research, p 7-9.



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Read the full 16 years summary of results on the Hart website:

https://www.hartfieldsite.org.au/media/Seeding_systems_a_long_term_trial_at_Hart_2016_web.pdf