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Tillage

No-Till on Stony Soils

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RESEARCH

Location: Lock
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Rainfall
Av. Annual: 340 mm
Av. GSR: 260 mm
2009 Total: 356 mm
2009 GSR: 315 mm

Yield
Potential: 4.2 t/ha (W)
Actual: 2.1 t/ha (W)

Paddock History
2008: Wheat

Soil Type
Calcareous clay loam and shallow limestone ridge.

Plot size
80 m x 1.5 m x 4 reps

Yield Limiting Factors
Late sowing

Key messages

- **Wheat established by no-till yielded at least as well as full cut sowing on stony soils in 2009.**
- **Seed scattered on soil surface germinated at Lock in 2009!**
- **Hydraulic tines, K-Hart discs and Canadian designed points are excellent options for no-till on stony soils.**

Why do the trial?

No-till crop establishment in stony soil can be difficult, particularly when using knife point systems with spring tines. Maintaining the balance between optimal seed placement, whilst minimising damage to machinery over stony reefs is a challenge. This is the third in a series of trials investigating options for no-till sowing in stony soils. Previous results can be found in EPFS 2007, p 174 and EPFS 2008, p 51.

How was it done?

The trial was sown at Lock using a 6 row plot seeder set on 254 mm row spacing. Wyalkatchem wheat was sown at 60 kg/ha with 60 kg/ha of DAP banded with the seed.

The trial was sown into excellent moisture conditions on 27-28 May over a limestone ridge and a calcareous clay loam, so a comparison of seeding systems could be made over both soil types.

Emergence and seed placement were assessed three weeks after seeding. Yield was measured with a small plot harvester, with grain retained for quality analysis.

Similar treatments were used in 2009 as in the 2008 trial at Port Kenny. They included the K-Hart disc, Rock Hopper, Agpoint, Agmaster, 250 mm Sweeps, Conservapak and DBS systems. Three Canadian designed front delivery points, the standard Atom-Jet, Atom-Jet Mallee point and the Bourgault front delivery point were also tested.

The sowing system of Agmaster points and Agmor Boots was used as a standard control, with which several sowing variations were trialled, working shallow, working deep, using snake chains, using Agmaster wing points and sowing at 10 km/h.

All treatments were sown at 6 km/h however two contrasts were made with the disc and knife point system to see if sowing at 10 km/h would have any adverse effects to seed placement.

All treatments except the DBS, Conservapak and K-Hart disc systems were sown using Flexi-Coil 350 lb trip tines.

What happened?

The crop established well with excellent moisture at sowing. The conditions were moist enough after sowing that seed which was scattered on the surface when the tines were breaking out was able to germinate, establish a root system and a viable plant.

Most sowing systems maintained sowing depth greater than 20 mm in the stony soil. The Agpoint + Agmor system was shallower due to incorrect setup of the Agmor boot, which was rectified in the subsequent treatments. The Agmaster wing point + Agmor boot, Agmaster point + Agmor boot, Agmaster point + Agmaster Flexi-boot, and Atom-Jet Mallee point all had shallower seed placement in the stony soil. All other systems were able to maintain similar seed placement in both soil types.

There were no significant differences in crop emergence measured on the deeper soil. On the stony soil, however there were some differences observed. The Agpoint + Agmor boot system was one of the poorer emerging treatments, most likely due to shallow seed placement from incorrect boot setup. K-Hart discs at 10 km/h, Agmaster points + Agmor boots at 10 km/h, Rock Hopper + Agmor boots, Agmaster points + Agmor boots, Agmaster wing points + Agmor boots, Agmaster points + Agmor Boots + snake chains, Agmaster points + Agmor boots working shallow, sweeps + harrows, Atom-Jet and DBS had higher levels of crop emergence on the stony soil than the remaining treatments (Table1).

Increasing sowing speed from 6 to 10 km/h with the K-Hart disc and Agmaster and Agmor systems did not have any impact on seed placement or crop emergence, however the faster sowing speed resulted in a much more violent breaking out of tines over stone. This would have a significant impact on machinery maintenance. The disc system yielded the same with both sowing speeds, however the Agmaster + Agmor system suffered a yield penalty for faster sowing speed on the deep soil, but not on the stony soil.

In terms of grain yield achieved on the stony soil, the DBS system performed better than the Conservapak, Agmaster points + Agmor boots, Agmaster points + Agmor boots @ 10 km/h, Agmaster points + Agmaster Flexi Boot, Atom-Jet Mallee point and sweeps + harrows treatments (Table 1).

The DBS system and Agmaster point + Agmor boot working deep treatments yielded more than the Atom-Jet Mallee point system and the sweeps + Agmor boot systems.

Shallower working of the Agmaster + Agmor system (i.e. lifting machine out over stony reefs) resulted in seed placement on the stony soil reducing from 30 mm to 17.8 mm. There were no differences in crop emergence for the shallower seed placement or final grain yield.

There were no benefits or penalties for working the points deeper in either soil type.

The addition of snake chains did not increase seed depth or contribute to any difference in crop emergence. Using snake chains, however did result in a yield reduction on the deep soil, however there was no differences on the stony soil.

The K-Hart discs performed as well as the tine treatments for crop establishment on both soil types. The slower sowing speed resulted in a lower grain yield than the best tine systems on the deep soil, but the discs performed as well as the best tine systems on the stony soil. At the faster (more typical) travel speed, the discs grew as much grain as the best tine systems on the deep soil type.

What does this mean?

All of the no-till treatments yielded at least as well as the full cut treatment, which by default guarantees some soil on the top of seed in stony soil which can be an advantage.

The Atom-Jet concept of a front delivery point system has the most merit on stony soils. The shallower working depth is ideally situated for sowing in to stony soils, as less steel is in the ground. The standard Atom-Jet point and the similar Bourgault design yielded similarly to the highest yielding treatments in the trial on stony soil.

The K-Hart disc performed well in 2009, which is a viable option for growers to reduce their downtime at seeding, increase their overall work rate with faster travel speed, as well as reduce the amount of stone brought to the surface by tines.

Table 1 Seeding system impact on wheat performance on stony and deep soil at Lock, 2009

Opener	Technology	Other sowing treatments	Emergence Depth (mm)		Emergence (plants/m²)		Grain Yield (t/ha)	
			Soil	Stone	Soil	Stone	Soil	Stone
K-Hart		6 km/h	30	28	155	121	1.85	1.12
K-Hart		10 km/h	26	30	172	157	1.91	1.14
Rock Hopper	Agmor		19	23	143	147	1.89	1.13
Agpoint	Agmor		23	19	137	90	1.62	1.09
Agmaster	Agmor	Wing Point	44	29	150	142	1.96	1.11
Agmaster	Agmor		48	30	148	144	2.08	1.04
Agmaster	Agmor	10 km/h	42	34	157	149	1.52	1.01
Agmaster	Agmor	10mm Snake Chains	43	39	169	141	1.79	1.19
Agmaster	Agmor	Work Deep	39	28	176	115	1.73	1.23
Sweeps	Agmor	Star Harrows	53	54	140	138	1.68	0.98
Agmaster	Agmaster Flexi-Boot		48	32	118	122	1.60	1.01
Agmaster	Agmor	Work Shallow	31	17	152	141	1.89	1.16
Atom-Jet	Front delivery boot		46	35	165	126	2.05	1.17
Atom-Jet Mallee	Front delivery boot		43	29	165	109	1.60	0.99
Bourgault	Front delivery boot		54	43	172	114	1.92	1.10
Conservapak			54	49	129	105	1.62	1.05
DBS			29	34	156	123	2.10	1.28
LSD (P≤0.05)			*13*		*ns*	*39*	*0.22*	

Hydraulic tines are an obvious choice for growers looking to optimise their seeding success in stony soils. The DBS system utilises hydraulic tines, which was one of the higher yielding treatments sown. Growers have overcome serious delays at seeding time through downtime with the use of hydraulic tines. Whilst searching for a suitable site for the stony soils trials, the author saw some rocky country which is sown with knife points and hydraulic tines (with minimal breakdowns) which must have been a horrible nightmare with spring tines.

Breakout characteristics of tines can have a significant impact on how well they perform in stone. The tip of the knifepoint needs to be behind the pivot point of the tine. If this is not the case, when the point strikes an obstacle like a rock, it will dig deeper before it begins lifting out to jump over the barrier. This places greater force at the point of impact as well as a greater recoil speed upon re-entry. The breakout pressure works best if it increases to a maximum (to keep the tine in the ground while sowing), however reduces as the tine lifts out over an obstacle, such as a rock.

Regardless of seeding system chosen for stony soil, it is critical to optimise seed placement on deep soil as well as provide adequate backfill on shallow ground to maintain seed depth so that an acceptable result can be achieved on all soil types. The seeding system also needs to be robust enough to take the wear of sowing into stone. This can be a challenge and is where the advantage of a hydraulic tine or disc system is greatest.

Acknowledgements

Thanks to SANTFA sponsors, CASE IH, Flexi-Coil, Agmaster, K-Hart, Atom-Jet, Agpoint and Kelbro Machinery for trial equipment. Thanks to Matthew Cook for braving his spring tines in the stony conditions again! Thanks to Jack Desbiolles for help with trial design. Thanks to Brenton Spriggs, Wade Shepperd, Liam Cook and Willie Shoobridge for trial assistance. Special thanks to Rex Glover for the use of his land for the trial. Thanks also to all the growers who had input in to the treatments for this trial.