HART
SA's premier cropping field site

Rocky River Ag Services
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CNH CAPITAL

Trials Results 2009

www.harfieldsite.org.au

Contents

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SARDI Crop Care Evaluation and Agronomy Unit and Field Crop Evaluation Unit, Waite.
Site Manager: John Nairn, assisted by Rob Wheeler, Larn McMurray, Peter Maynard, Rohan Steele, Stuart Sheriff and Shafiya Hussein.

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The Board welcome you as a visitor to Hart and value your feedback and questions.

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Diary Dates and Membership

Diary Dates

GETTING THE CROP IN
March 11th 2010
8am – 1pm
The Valleys Lifestyle Centre

AGM
March 11th 2010
2:30pm
The Valleys Lifestyle Centre

WINTER WALK
July 27th 2010

HART FIELD DAY
21st September 2010

SPRING TWILIGHT WALK
21st October 2010

Membership

You can now choose what level of admission / membership best suits you and your business.

Membership terms now Field Day to Field Day.
No-fuss - renew as you register at the Field Day each year.

BRONZE $30

General Admission

- Entry to this year's Field Day
- Field Day Book
- Hart email updates - quarterly

SILVER $60

- Entry to this year's Field Day
- Field Day Book
- Hart email updates - quarterly
- Trials Results Book
- Hart Beat newsletter (Yield predictions throughout the growing season)

GOLD $90 / CORPORATE $200

- Entry to this year's Field Day (for up to **3 partners** in your business)
- Field Day Book per partner
- Hart email updates - quarterly
- Trials Results Book
- Hart Beat newsletter (Yield predictions throughout the growing season)
- Exclusive access to Gold Members Only lane (food and drink) at the Field Day
- Priority booking and 30% discount for all Hart seminars and workshops.
- "Hart" Hat

All Financial Members are eligible nominate for a position on the Hart Board and to attend and vote at our AGM.

What if you can't attend the Field Day?

We'll contact you after each year's Field Day *(provided we have your up to date contact details)* and offer you the opportunity to renew. On receipt of your payment, we'll send you a copy of the Field Day book and a copy of the Trials Results book on its release. According to which level of membership you choose, you'll also be eligible for all other benefits as listed.

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Interpretation of statistical data from the trials

The least significant difference (LSD P<0.05), seen at the bottom of data tables gives an indication of the treatment difference that could occur by chance. NS indicates that there is no difference between the treatments. The size of the LSD can be used to compare treatment results and values must differ by more than this value for the difference to be statistically significant.

So, it is more likely (95%) that the differences are due to the treatments, and not chance (5%).

Of course, we may be prepared to accept a lower probability (80%) or chance that 2 treatments are different, and so in some cases a non-significant result may still be useful.

Disclaimer

While all due care has been taken in compiling the information within this manual the Hart Field-Site Group Inc or researchers involved take no liability resulting from the interpretation or use of these results.

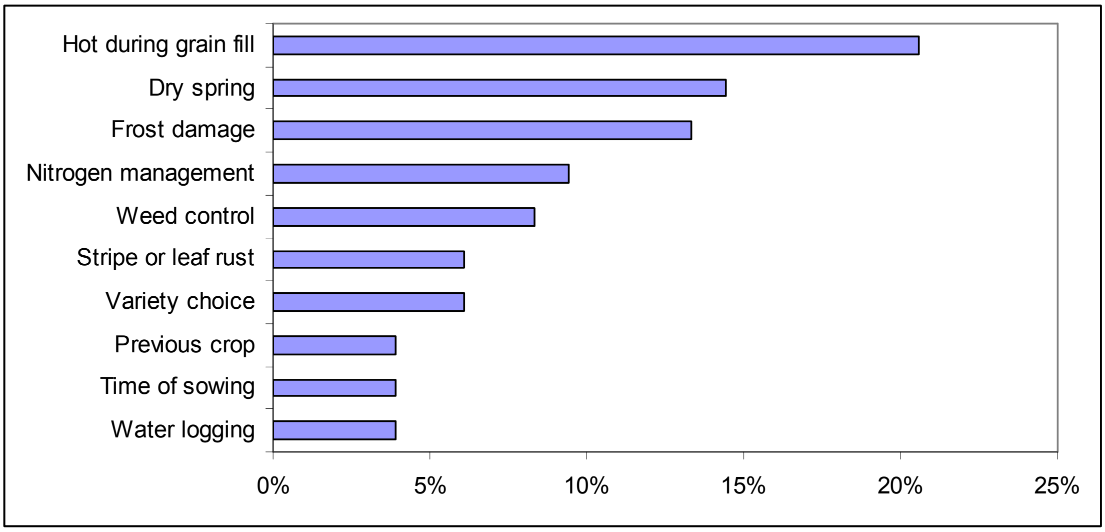
We do not endorse or recommend the products of any manufacturers referred to. Other products may perform as well or those better than specifically referred to.

Any research with unregistered pesticides or of un-registered products and rates in the manual does not constitute a recommendation for that particular use by the researchers or the Hart Field-Site Group Inc.

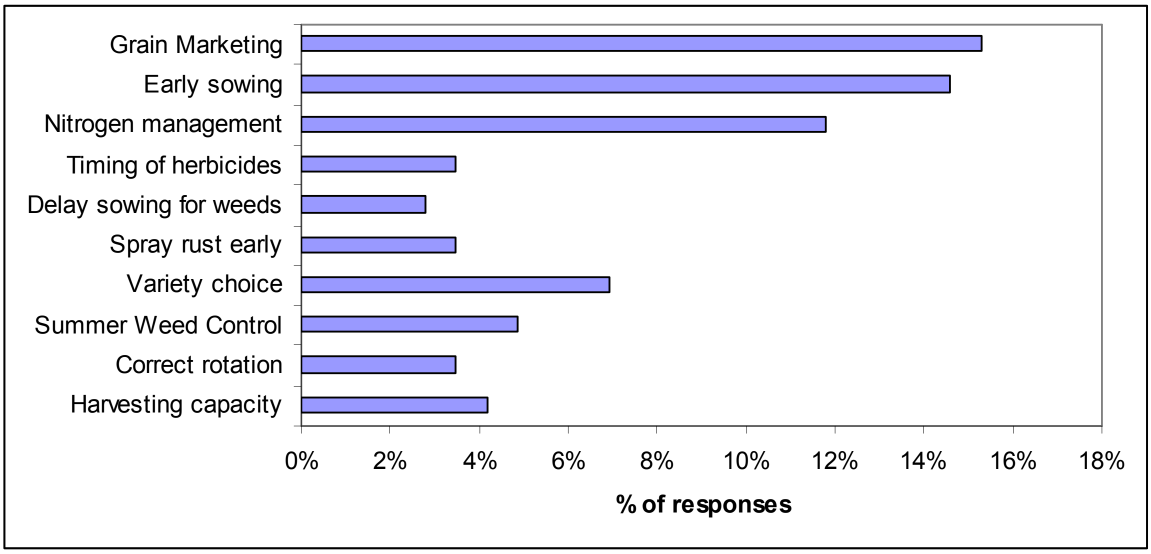
Hart 2009 grower survey

This is a summary of the responses collated from the 2009 grower survey. We hope this information helps to add value to your business.

1. What were the main limiting factors to achieving maximum grain yields in wheat and barley in 2009? n = 180



2. What were three key lessons you have learnt in 2009 in your farming operation to get the best economic return? N = 144

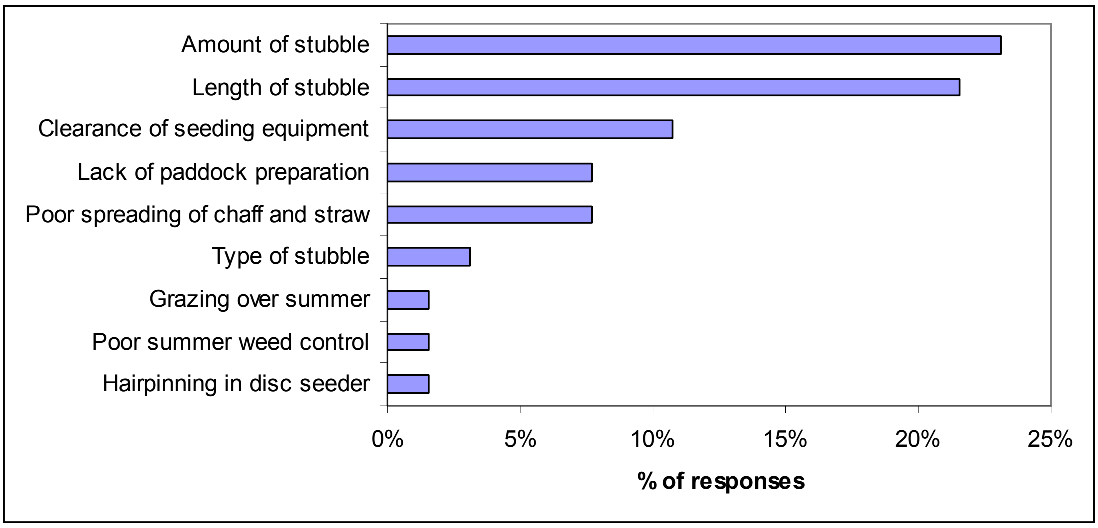


Other responses;

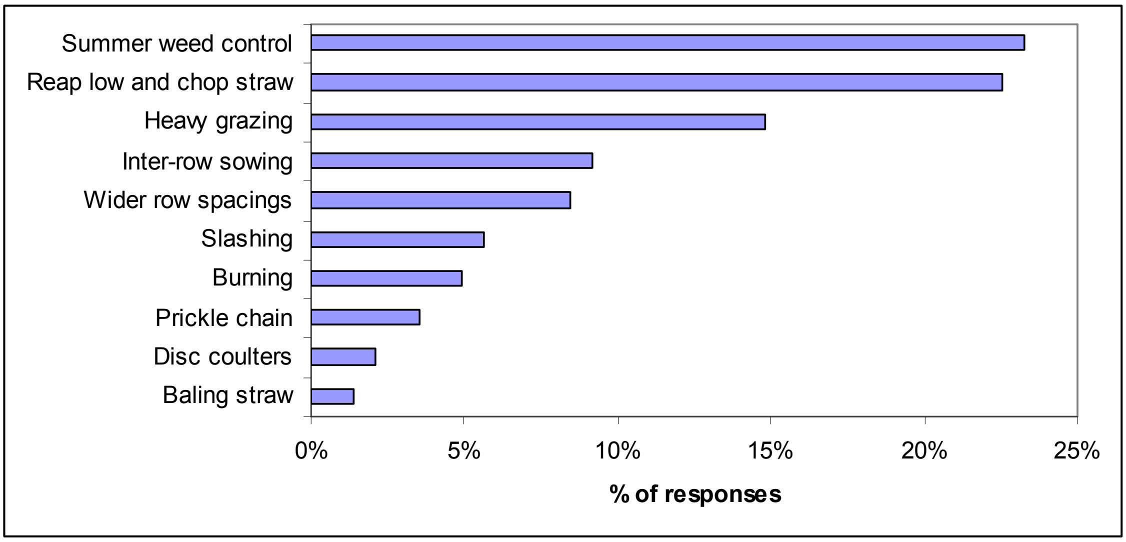
- Need for good weed control
- Snail bait legumes
- Maximum stubble cover
- Wheat on wheat a success
- Legumes are back in vogue
- Root diseases from paddock history
- Leaf disease carryover
- Legumes still failing

3. At seeding did you have any trouble sowing through the residue from 2008? If so, what contributed to this problem? N = 52

40% of growers had trouble at seeding (n= 65)



4. If you didn't have any trouble what helped to avoid this problem?



5. If you intentionally inter-row sowed in 2009 what were the advantages and disadvantages of this practice? N = 23

Advantages:
56% of the responses were that improved stubble clearance was the advantage of inter-row sowing. Other advantages included creating a micro environment and improved crop emergence.

Disadvantages:
According to 13% of the responses the main disadvantage was the accuracy of the auto-steer. Other disadvantages included 9 inch spacing being too narrow to inter-row sow and that hilly country was unsuitable.

Comparison of wheat varieties

Key findings

- Mace, Wyalkatchem, Pugsley, Derrimut and Gladius were the highest yielding wheat varieties at Hart in 2009, averaging 3.06 t/ha.
- All varieties met the test weight, protein and screening requirements for the maximum achievable grade.

Why do the trial?

To compare the performance of new wheat varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn Urea @ 50 kg/ha 10th August
Seeding date	8th May 2009		

The trial was a randomised complete block design with 3 replicates and 21 varieties.

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Results

Grain yields ranged between 2.34 t/ha (Bullet) and 3.19 t/ha (Mace). The APW varieties Mace, Wyalkatchem, and Pugsley and hard varieties Derrimut and Gladius were the highest yielding wheat varieties at Hart in 2009, averaging 3.06 t/ha (Table 1).

Wheat grain protein levels ranged from 11.6% (Guardian and Bullet) to 13.4% (Pugsley) with an average of 12.4%.

The test weight for all varieties was greater than the required 74 kg/hL for APW and Hard classifications.

Lincoln produced the highest screenings at 2.1% followed by Guardian at 1.6%. The average screenings (%) across all varieties at Hart in 2009 was 0.9%.

Table 1: Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) of wheat varieties at Hart in 2009.

Quality	Variety	Grain yield (t/ha)	% of Yitpi	Protein (%)	% of Yitpi	Test weight (kg/hL)	% of Yitpi	Screenings (%)	% of Yitpi
APW	Espada (RAC1263)	2.86	106	13.0	102	75.7	97	0.9	80
	Frame	2.43	90	13.1	103	80.3	103	0.8	72
	Guardian	2.75	102	11.6	91	79.0	101	1.6	148
	Pugsley	2.98	110	13.4	104	79.2	102	0.6	58
	Wyalkatchem	3.14	116	12.2	95	79.5	102	0.4	33
	Mace (RAC1372)	3.19	118	11.7	91	79.3	102	0.6	55
Soft	Barham	2.92	108	12.0	94	77.0	99	0.6	58
Hard	Axe	2.58	95	13.0	102	77.5	100	0.6	52
	Bullet	2.34	86	11.6	91	77.9	100	1.2	107
	Catalina	2.47	91	12.5	98	79.2	102	0.9	85
	Clearfield JNZ	2.52	93	12.0	93	79.0	102	0.7	66
	Correll	2.71	100	12.6	98	75.6	97	1.1	97
	Derrimut	3.01	111	12.1	95	79.2	102	0.8	74
	Gladius (RAC1262)	2.98	110	12.6	98	77.6	100	0.8	76
	Peake	2.87	106	11.9	93	79.6	102	0.9	82
	Yitpi	**2.70**	**100**	**12.8**	**100**	**77.8**	**100**	**1.1**	**99**
	Young	2.54	94	12.2	95	78.2	101	0.7	61
	Bolac (VQ2621)	2.94	109	13.1	102	78.3	101	1.3	122
	Lincoln (LPB03-0545)	2.60	96	11.9	93	80.1	103	2.1	190
Yet to be classified	RAC1412	2.82	104	13.4	105	79.4	102	0.5	47
	RAC1684	2.83	105	12.0	94	78.6	101	0.8	74
	Site mean	2.77	103	12.4	97	78.5	101	0.9	83
	LSD (0.05)	0.21	8	0.3	2	1.2	2	0.2	18

Comparison of barley varieties

Key findings

- Capstan, Fleet, Lockyer, Commander and Oxford were the highest yielding barley varieties at Hart in 2009, averaging 4.94 t/ha.

Why do the trial?

To compare the performance of new barley varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn Urea @ 50 kg/ha 10th August
Seeding date	12th May 2009		

The trial was a randomised complete block design with 3 replicates and 21 varieties.

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight, screenings with a 2.2 mm screen and retention with a 2.5 mm screen.

Results

The feed varieties Capstan (5.20 t/ha), Fleet (4.97 t/ha) and Lockyer (5.02 t/ha) and malting varieties Commander (4.76 t/ha) and Oxford (4.72 t/ha) were the highest yielding barley varieties at Hart in 2009 (Table 1).

The average grain yield across all feed varieties was 4.52 t/ha compared to 4.33 t/ha for the malting varieties, a difference of 4.5%. In the year of 2005 with average yields of 3.6 t/ha the difference was 8.5% and in lower yielding seasons (2007 and 2008) with average yields of 1.3 t/ha the difference was 21%, the feed varieties were higher yielding in all seasons.

The feed variety Roe had the greatest grain protein (13.1%) and malting variety Oxford, which was one of the highest yielding varieties, had the lowest grain protein (11.0%).

Varieties Fleet and Keel had the lowest test weights, both measuring 66.8 kg/hL, however, this was still above the minimum test weight for the maximum allowable grade.

All varieties except Finniss (a hull-less variety) had screenings less than 2% and retention greater than 93%.

Table 1: Grain yield (t/ha), protein (%), test weight (kg/hL), screenings (%) and retention (%) for barley varieties at Hart in 2009.

Quality	Variety	**Grain yield (t/ha)**	% of Sloop SA	**Protein (%)**	% of Sloop SA	**Test weight (kg/hL)**	% of Sloop SA	**Screenings (%)**	% of Sloop SA	**Retention (%)**	% of Sloop SA
Feed	Capstan	5.20	127	11.2	91	69.8	100	1.7	169	93.6	96
	Fleet	4.97	121	12.1	98	66.8	96	0.6	63	97.3	100
	Hannan (WA2321)	4.69	114	11.5	93	71.9	103	0.4	45	98.5	102
	Hindmarsh	4.52	110	12.2	99	69.7	100	0.8	81	97.2	100
	Keel	4.18	102	11.6	94	66.8	96	1.3	129	97.0	100
	Lockyer (WA2288)	5.02	122	12.2	99	70.9	102	0.5	53	98.5	101
	Maritime	4.00	98	12.9	105	68.1	98	0.8	84	97.1	100
	Roe (WA2310)	3.90	95	13.1	106	69.6	100	0.6	58	97.8	101
	VBHT0805	4.28	104	12.0	98	68.5	98	1.1	112	96.4	99
	Yarra	4.41	108	11.4	93	69.8	100	0.4	35	99.0	102
Malting	Baudin	4.26	104	12.0	97	69.5	100	0.5	50	97.8	101
	Buloke	4.26	104	11.7	95	69.9	100	0.9	91	96.4	99
	Commander (WI3416)	4.76	116	11.1	90	69.1	99	1.1	106	97.1	100
	Flagship	3.91	95	12.4	100	69.7	100	1.1	110	96.7	100
	Gairdner	4.47	109	11.7	95	70.6	101	1.1	110	96.1	99
	Oxford	4.72	115	11.0	89	69.8	100	3.8	377	94.7	98
	Schooner	4.23	103	12.1	98	70.0	100	1.1	113	95.0	98
	SloopSA	**4.10**	**100**	**12.3**	**100**	**69.8**	**100**	**1.0**	**99**	**97.0**	**100**
	Shepherd	4.33	106	12.3	100	69.3	99	0.7	72	98.3	101
Hull-less	Finniss (WI3930)	4.29	105	12.9	105	78.2	112	13.3	1331	53.0	55
Yet to be classified	WI4262	4.58	112	12.2	99	69.5	100	0.9	94	97.8	101
	Site mean	4.43	108	12.0	97	69.9	100	1.6	161	94.9	98
	LSD (0.05)	0.46	11	0.9	7	1.2	2	0.7	70	3.0	3

Comparison of durum varieties

Key findings

- Hyperno (WID22209) was the highest yielding currently released variety, 3.0 t/ha and of the breeding lines WID803 yielded 3.44 t/ha.

Why do the trial?

To compare the performance of new durum varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn Urea @ 50 kg/ha 10th August
Seeding date	8th May 2009		

The trial was a randomised complete block design with 3 replicates and 9 varieties.

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Results

WID801, WID802 and WID803 were the highest yielding durum varieties at Hart in 2009, averaging 3.29 t/ha. Of the named varieties Hyperno and Kalka were the highest yielding, averaging 2.93 t/ha (Table 1).

Protein ranged from 12.2% (WID802) a high yielding variety, to 14.5% (Jandaroi) a low yielding variety

Test weights ranged from 77.0 kg/hL (WID801) to 79.2 kg/hL (Caparoi) and screenings for all varieties were less than 2.0%. The variety producing the lowest screenings was Kalka (0.9%).

Table 1: Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) for durum varieties at Hart in 2009.

Variety	**Grain yield (t/ha)**	% of Tamaroi	**Protein (%)**	% of Tamaroi	**Test weight (kg/hL)**	% of Tamaroi	**Screenings (%)**	% of Tamaroi
Caparoi (TD60F)	2.64	104	13.5	97	79.2	101	1.2	78
Hyperno (WID22209)	3.00	118	13.3	96	78.0	100	1.2	82
Jandaroi	2.03	80	14.5	104	78.5	100	1.0	66
Kalka	2.85	112	12.6	90	78.0	100	0.9	58
Saintly (WID22279)	2.21	87	13.1	94	77.5	99	1.9	126
Tamaroi	2.54	100	13.9	100	78.4	100	1.5	100
WID801	3.16	125	12.5	90	77.0	98	1.2	82
WID802	3.26	129	12.2	88	76.4	97	1.1	72
WID803	3.44	136	12.6	90	78.1	100	1.9	128
Site mean	2.79	110	13.1	94	77.9	99	1.3	88
LSD (0.05)	0.34	13	0.4	3	1.3	2	0.3	20

Comparison of triticale varieties

Key findings

- Jaywick and Kosciuszko were the highest yielding triticale varieties at Hart in 2009, averaging 3.53 t/ha.

Why do the trial?

To compare the performance of new triticale varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn Urea @ 50 kg/ha 10th August
Seeding date	8th May 2009		

The trial was a randomised complete block design with 3 replicates and 6 varieties.

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Results

Jaywick (3.63 t/ha) and Kosciuszko (3.43 t/ha) were the highest yielding triticale varieties at Hart in 2009 (Table 1).

The high yielding variety Jaywick produced the lowest protein (9.8%) and the lowest yielding variety Speedee produced the highest protein (11.7%).

For all triticale test weights were greater than 70.0 kg/hL and screenings were less than 2.0%.

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Table 1: Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) for triticale varieties at Hart in 2009.

Variety	**Grain yield (t/ha)**	% of Tahara	**Protein (%)**	% of Tahara	**Test weight (kg/hL)**	% of Tahara	**Screenings (%)**	% of Tahara
Hawkeye	3.24	101	10.0	94	74.8	104	1.0	65
Jaywick	3.63	114	9.8	93	74.6	104	1.3	83
Kosiuszko	3.43	107	10.9	103	73.9	103	1.5	96
Rufus	2.98	93	10.5	99	71.8	100	1.2	79
Speedee	2.64	82	11.7	110	70.8	99	1.4	95
Tahara	**3.20**	**100**	**10.6**	**100**	**71.7**	**100**	**1.5**	**100**
Site mean	3.18	100	10.6	100	72.9	102	1.3	86
LSD (0.05)	0.21	7	0.6	6	0.5	1	0.3	20

Comparison of oat varieties and hay yields

Key findings

- The highest yielding commercial oaten hay varieties at Hart in 2009 were Wintaroo, Tungoo and Mulgara, averaging 6.7 t/ha.
- The highest yielding variety was the breeders line, SV9200-3 (8.7 t/ha).

Why do the trial?

To measure the hay yield of 6 oat varieties and lines against the current industry standards.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn Urea @ 50 kg/ha 10^{th} August
Seeding date	15^{th} May 2009		

The trial was a randomised complete block design with 3 replicates and 6 varieties.

Seeding rates were adjusted for grain size to achieve a plant density of 220 plants per square metre.

All plots were assessed for hay yield by cutting 1 square metre of dry matter per plot at 10cm above the soil surface, at the milk dough stage. The cutting dates are shown in table 1.

Edge rows were excluded from the sample area.

Results

The average hay yield for oats sown at Hart on the 15^{th} of May in 2009 was 6.7 t/ha.

The breeders line SV97200-3, which is a long season variety took advantage of the spring rainfall and was the last to be cut (Table 1). It produced the highest hay yield of 8.7 t/ha. The next highest yielding variety was Wintaroo at 7.1 t/ha, which was 22% behind SV97200-3. Tungoo and Mulgara were not significantly different to Wintaroo. The lowest yielding oat lines at Hart in 2009 were Kangaroo and Brusher, averaging 5.6 t/ha.

Table 1: Cutting date and hay yield (t/ha) for oaten hay varieties at Hart in 2009.

Variety	Date of cutting	Hay yield (t/ha)	% of Wintaroo
SV97200-3	19-Oct	8.7	122
Wintaroo	30-Sep	7.1	100
Tungoo	30-Sep	6.7	94
Mulgara	23-Sep	6.3	89
Kangaroo	23-Sep	5.7	81
Brusher	23-Sep	5.5	77
Site mean		6.7	94
LSD (5%)		0.8	12

Carlyn Mellor, Stuart Sherriff, Chris Lawson
and Sam Trengove at the Hart Eve Dinner 2009

Time of sowing and seeding rate in wheat

This trial was funded by GRDC

Key findings

- The highest yielding treatment in the wheat time of sowing trial at Hart in 2009 was Gladius sown on the 30th of April.
- Later maturing varieties were best sown in early May.
- Axe is a good option for sowing in late May.

Why do the trial?

To measure the effect of time of sowing (TOS) and plant density on wheat varieties with different development habits and maturities.

How was it done?

Plot size 1.4m x 10m

Seeding date TOS 1 30th April 2009
TOS 2 14th May 2009
TOS 3 29th May 2009

Fertiliser DAP @ 60 kg/ha + 2% Zn
Urea @ 50 kg/ha 10th August

The trial was a randomised block design with 3 replicates 4 wheat varieties, 3 plant densities and 3 times of sowing.

The wheat varieties used were Axe (early maturing), Gladius (early-mid maturing), Correll (mid maturing) and Frame (mid-late maturing).

The plant densities achieved are shown in table 1.

Table 1: Wheat plant density (plants per square metre) for Axe, Correll, Frame and Gladius at Hart in 2009.

Plant density	Wheat plant density (plants/m²)
Low	127
Medium	171
High	215
LSD (0.05)	8

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight, grain weight and screenings with a 2.0 mm screen.

Results

The grain yields of wheat were similar when sown prior to May 14th (TOS 2) for all varieties and plant densities (Table 2). Delaying sowing until the 29th May reduced average grain yields by 0.31 t/ha, and extended the dates of flowering (Figure 1).

Table 2: Grain yield (t/ha) and time of sowing at Hart in 2009, averaged for variety.

Time of sowing	Grain yield (t/ha)
Apr-30	2.81
May-14	2.73
May-29	2.46
LSD (0.05)	0.20

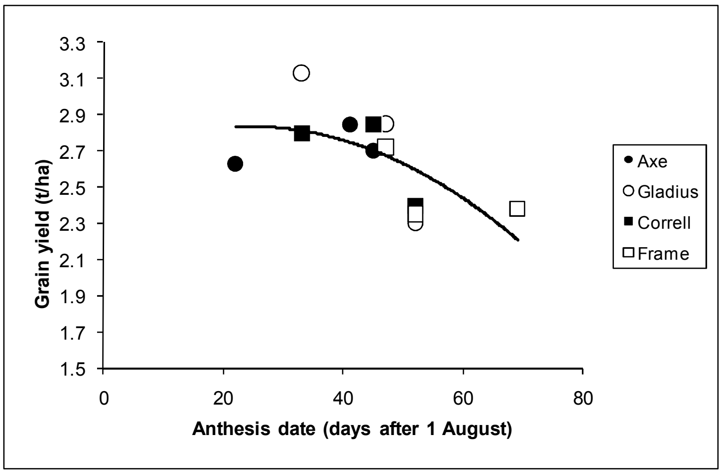

Figure 1. Grain yield (t/ha) and flowering date for Axe, Gladius, Correll and Frame at Hart in 2009.

At the first time of sowing (TOS 1) Gladius produced the highest grain yield of 3.13 t/ha, across all plant densities (Figure 2). There was no significant difference between the other varieties averaging 2.71 t/ha.

Sowing on May 14th (TOS 2) produced similar yields compared to April 30th, with Axe, Gladius and Correll averaging 2.85 t/ha. However, the mid-late maturing variety (Frame) was significantly lower yielding, 2.35 t/ha (Figure 2).

The earliest maturing variety Axe produced a similar yield in TOS 3 (2.71 t/ha) compared to TOS 2 (2.82 t/ha). Delaying sowing until May 29th (TOS 3) significantly reduced grain yields for Gladius (2.33 t/ha) and Correll (2.43 t/ha), while the grain yield for Frame did not change compared to TOS 2 (Figure 2).

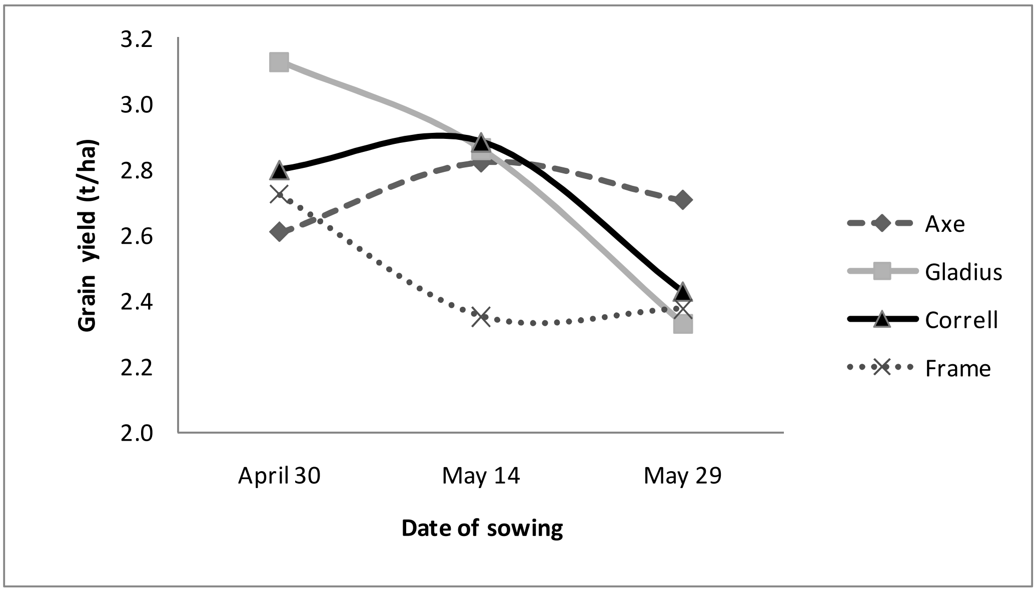

Figure 2: The effect of time of sowing on grain yield (t/ha) for wheat at Hart in 2009, averaged for plant density.

Plant density did not significantly influence grain yields for any time of sowing or any of the wheat varieties (Table 3).

Wheat head density at harvest ranged from 335 heads/m^2 to 352 heads/m^2 for all TOS, variety and seeding rates.

Table 3: The response of grain yield (t/ha) to time of sowing and plant density, for all wheat varieties at Hart in 2009.

Time of sowing		Plant density (plants/m^2)		
		127	171	215
TOS 1	Apr-30	2.90	2.80	2.75
TOS 2	May-14	2.69	2.75	2.75
TOS 3	May-29	2.42	2.48	2.48
LSD (0.05)				
Plant density * TOS			0.20	

Protein ranged from 12.4% (Correll, TOS 2) to 13.7% (Frame, TOS 2) (Table 4). Plant density had no significant impact on grain protein. Protein increased significantly for all varieties with delay in sowing.

Table 4: The response of grain protein (%) to time of sowing and wheat variety for all plant densities at Hart in 2009.

Time of sowing		Axe	Correll	Frame	Gladius
TOS 1	Apr-30	13.3	12.8	12.8	13.0
TOS 2	May-14	13.3	12.4	13.7	13.1
TOS 3	May-29	13.5	12.7	13.4	13.3
LSD (0.05)					
Variety * TOS			0.2		

The lowest screenings were produced in TOS 1 and TOS 2 averaging 1.0% for all varieties. At TOS 3 screenings increased to 1.5% and 1.7% at the medium and high seeding rates respectively and then increased further to 2.1% at the lowest sowing rate.

Axe produced the lowest screenings at all times of sowing averaging 0.8%. Generally the screenings increased in the other varieties as sowing was delayed. Frame sown at TOS 3 had the highest screenings at 2.1%.

All treatments produced grain with a test weight greater than 74.0 kg/hL, the limit for maximum allowable grade. Frame produced the highest test weight in the trial in TOS 1 (81.4 kg/hL) and also produced the highest test weights in TOS 2 and TOS 3. Axe sown on the 30th April produced the lowest test weight in the trial (74.7 kg/hL), but also produced the second highest in TOS 2 and TOS 3.

Chris White representing Clare TAFE
inside the 2009 Hart Field Day marquee

Barley agronomy, seeding rate and annual ryegrass

Martin Lovegrove & Rob Wheeler, SARDI Waite

Key findings

- Annual ryegrass did not affect crop establishment, but did reduce grain yield.
- Increasing the seed rate from 80 seeds/m^2 to 150 seeds/m^2 had no significant impact on grain yield, however, increasing the seeding rate to 220seeds/m^2 significantly reduced grain yield, by 13%.
- At 220 seeds/m^2 25% of the annual ryegrass survived, compared to 45% at 80 seeds/m^2.

Why do the trial?

The investigate barley varietal performances under various seeding rates and the influence of annual ryegrass.

How was it done?

The trial contained 4 barley varieties; Maritime, Fleet, Hindmarsh and Flagship. All varieties differ in growth rates and habit. The varieties were compared over three seeding rates 80, 150 or 220 seeds/m^2. These treatments were compared against two weed densities, annual ryegrass planted at 25 kg/ha and an un-treated control. The trial was sown with chisel points and press wheels.

Plot size	1.5m x 10m	**Fertiliser**	DAP @ 70 kg/ha + 2% Zn
Sowing date	13th May 2009		

Barley and annual ryegrass (ARG) plant counts were carried out four weeks after sowing to determine crop and ARG establishment. ARG populations were re-scored on October 14th to assess ARG survival. The trial was harvested on the 9th of November. Grain quality was assessed for retention with a 2.5 mm screen, protein (% dry basis), screenings with a 2.2 mm screen and test weight (kg/hL).

Results

Increasing the seed rate of barley from 80 seeds/m^2 to 150 seeds/m^2 had no significant impact on grain yield (averaging 3.35 t/ha), however, grain yield was significantly reduced (2.87 t/ha) when the seeding rate was increased to 220seeds/m^2 (Table 1).

The establishment of ARG across the three seeding rates showed no significant difference, indicating that the seeding rate of barley had no impact on ARG establishment.
The second assessment of the ARG on the 14th October showed that there was no difference between the 80 and 150 seeds/m^2, however, ARG survival was significantly lower in the 220 seeds/m^2 treatments.

Table 1. Grain yield, ARG establishment and survival averaged across variety and ARG for barley seeding rate at Hart in 2009.

Seeding rate (seeds/m^2)	Grain yield (t/ha)	ARG establishment (plants/m^2)	ARG survival (plants/m^2)
80	3.40	76	34
150	3.31	57	20
220	2.87	53	13
LSD (0.05)	0.16	ns	15

Hindmarsh recorded the highest grain yield of 3.77 t/ha (Table 2). ARG establishment was significantly different across barley varieties. ARG establishment in Hindmarsh (81 plants/m^2) was significantly higher than that in Flagship and Fleet (53 and 51 plants/m^2) while Maritime was similar to all other varieties. There was no difference in ARG survival across varieties.

Table 2. Grain yield, ARG establishment and survival averaged across sowing rate and the presence of ARG for barley variety at Hart in 2009.

Variety	Grain yield (t/ha)	ARG establishment (plants/m^2)	ARG survival (plants/m^2)
Flagship	3.02	53	18
Fleet	3.20	51	18
Hindmarsh	3.77	81	34
Maritime	2.80	63	19
LSD (0.05)	0.19	23	ns

The presence of ARG had no significant impact on grain yield, averaging 3.20 t/ha (Table 3). The ARG data shown in Table 3 shows that there was a very low background ARG population of just 4 plants/m^2. By the 14th October the ARG population in the plus ARG treatments had been reduced by 63%.

Table 3. Grain yield, ARG establishment and survival averaged across variety and sowing rate for the presence of ARG at Hart in 2009.

ARG	Grain yield (t/ha)	ARG establishment (plants/m^2)	ARG survival (plants/m^2)
Minus ARG	3.22	4	0
Plus ARG	3.17	121	45
LSD (0.05)	ns	16	12

Table 4 shows the mean grain quality characteristics for seeding rate. Seed rate had no impact on grain protein (averaging 14.2%). The 220 seeds/m^2 treatments had significantly higher screenings and lower retention levels compared to the lower seed rates. Although increasing the seed rate above 80 seeds/m^2, significantly reduced grain quality, all seed rates met the requirements for the receival grade of Feed 1.

Table 4. Protein, screenings, retention, test weight and receival grade averaged across variety and the presence of ARG for barley seeding rate at Hart in 2009.

Seeding rate (seeds/m^2)	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
80	14.2	1.9	87.3	69.0	Feed 1
150	13.9	3.6	79.5	68.6	Feed 1
220	14.5	6.0	69.8	67.5	Feed 1
LSD (0.05)	ns	0.9	2.7	1.1	

There was no significant difference between varieties for grain protein (Table 5). Flagship showed significantly higher screenings (6.0%) compared to all varieties (averaging 3.1%). The retention levels and test weights of Fleet (83.2%) and Maritime (83.9%) were significantly higher compared to Flagship (72.8%) and Hindmarsh (75.6%), however all varieties were high.

Table 5. Protein, screenings, retention, test weight and receival grade for barley variety at Hart in 2009.

Variety	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
Flagship	14.2	6.0	72.8	68.7	Feed 1
Fleet	14.0	2.9	83.2	67.3	Feed 1
Hindmarsh	14.0	3.9	75.6	69.6	Feed 1
Maritime	14.6	2.5	83.9	68.0	Feed 1
LSD (0.05)	ns	1.1	3.1	1.3	

The addition of ARG had no impact on grain protein, screenings, retention, test weight and overall receival grade (Table 6).

Table 6. Protein, screenings, retention, test weight and receival grade for the presence of annual ryegrass (ARG) at Hart in 2009.

ARG	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
Minus ARG	14.4	3.9	79.3	68.4	Feed 1
Plus ARG	14.1	3.7	78.4	68.4	Feed 1
LSD (0.05)	ns	ns	ns	ns	

Discussion

Early rainfall allowed good crop and annual ryegrass establishment at Hart. Rains throughout winter led to good biomass production with crops setting a high grain yield potential. These beneficial conditions resulted in good grain yields and grain quality.

Increasing the seed rate from 80 seeds/m^2 to 150 seeds/m^2 had no significant grain yield impact, however, increasing the seeding rate to 220 seeds/m^2 significantly reduced grain yield by 13%. This is likely the due to excessive biomass in the high density treatments using more soil water than the other treatments.

Comparing the establishment of ARG across the three seeding rates showed no significant difference. However, when comparing the ARG survival there was no difference between the 80 and 150 seeds/m^2 but the 220 seeds/m^2 had significantly lower ARG survival, 63% lower than 80 seeds/m^2. Despite the grain yield penalty of the higher seeding rate these results suggest that increasing seeding rate will result in better ARG competition and a lower seed set.

The establishment of ARG in Hindmarsh was significantly higher compared to other varieties in the trial, indicating this variety has lesser ability to compete with ARG early in the season. However, there was no significant difference between varieties for ARG survival, indicating that all varieties have the same ability to compete with ARG later in the season.

Seed rate had no impact on receival quality of the barley. However, the seed rate of 80 seeds/m^2 did have significantly lower screenings, higher retention levels and test weights compared to the higher seed rates. This can be explained by the smaller canopy produced by having a lower crop density using less moisture early in the season, leaving more for later growth and grain fill.

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Barley agronomy, row spacing

Martin Lovegrove & Rob Wheeler, SARDI Waite

Key findings

- Crop establishment was not affected by row spacing, regardless of barley variety or row width.
- Barley grain yield and quality were unresponsive to row spacing at Hart in 2009.

Why do the trial?

This trial was conducted to investigate barley varietal performance across two row spacings, 225mm (9 inch) and 350mm (14 inch). Characteristics measured included differences in early vigour, grain yield and grain quality.

How was it done?

A replicated trial was conducted at the Hart field site to assess four barley varieties; Maritime, Fleet, Hindmarsh and Flagship, which differ in their growth rate and habit. They were compared across two row spacings, 225mm (9 inch) and 350mm (14 inch).

Seeding rates were adjusted according to grain weight and germination percentages to produce target plant populations of 145 plants/m^2. The trial was sown using chisel points and press wheels.

Plot size	1.5m x 10m	**Fertiliser rate**	DAP @ 70 kg/ha + 2% Zn
Sowing date	12th May 2009		

Plant counts were carried out four weeks after sowing to determine crop establishment. Trials were harvested on the 9th of November. Grain quality was assessed for retention with a 2.5 mm screen, protein (% dry basis), screenings with a 2.2 mm screen and test weight (kg/hL).

Results

The average barley grain yield was 2.43 t/ha and row spacing had no significant impact on this. Similarly, no difference was recorded in barley plant densities (Table 1).

Table 1. Grain yield and plant density averaged across variety for row spacing at Hart in 2009.

Row Spacing	Grain yield (t/ha)	Plant density (plants/m²)
225mm (9")	2.47	127
350mm (14")	2.39	142
LSD (0.05)	ns	ns

Maritime was the highest yielding variety, 2.78 t/ha (Table 2), with no significant difference between the other varieties. There was no significant difference in crop establishment across varieties.

Table 2. Grain yield averaged across row spacing for variety at Hart in 2009.

Variety	Grain yield (t/ha)	Plant density (plants/m²)
Flagship	2.62	129
Fleet	2.05	141
Hindmarsh	2.28	145
Maritime	2.78	124
LSD (0.05)	ns	ns

No differences in grain quality characteristics were measured across the two row spacing treatments. Grain protein levels were all high, above the malt receival standard of 12%. No significant difference was identified for screenings, retention and test weight between the two row spacings, with an overall receival grade of Feed 1 (Table 3).

Table 3. Protein, screenings, retention, test weight and receival grade averaged across variety for row spacing at Hart in 2009.

Row spacing	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
225mm (9")	13.0	1.5	87.3	70.1	Feed 1
350mm (14")	13.8	1.5	87.1	70.5	Feed 1
LSD (0.05)	ns	ns	ns	ns	

There was no grain quality characteristic measured that produced significantly different results in relation to variety. All varieties produced high grain protein, averaging 13.4%. Fleet had the lowest screenings (0.9%) and Hindmarsh produced the highest (2.2%), however these results were not significant. All varieties produced good retention and test weights. All varieties achieved the same receival classification, Feed 1(Table 4).

Table 4. Protein, screenings, retention, test weight and receival grade averaged across row spacing for variety at Hart in 2009.

Variety	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
Flagship	13.1	1.4	87.1	70.3	Feed 1
Fleet	13.6	0.9	90.7	70.2	Feed 1
Hindmarsh	14.1	2.2	84.1	69.5	Feed 1
Maritime	12.8	1.4	86.9	71.2	Feed 1
LSD (0.05)	ns	ns	ns	ns	

Discussion

Early rainfall enabled good crop establishment at Hart. Rains throughout winter allowed outstanding biomass production with crops setting high grain yield potential. These beneficial conditions were followed with a dry spell in August, but late rains enabled good grain yields.

Plant counts confirmed that both row spacings produced the same barley plant establishment. A corresponding lack of difference in grain yield between the two spacings suggests that the growth habit of the trialled varieties enabled adaptation to these treatments. Considering no barley variety by row spacing interaction was recorded in either grain yield or quality; it is suggested all barley varieties respond alike to changes in row spacing.

The results from this trial indicate that all varieties tested respond alike to row spacing for grain yield and grain quality. These data support two years of previous results established at Hart in drought affected seasonal conditions, suggesting there is no grain yield, or quality penalty in increasing row spacing from 225mm (9 inch) to 350mm (14 inch).

Acknowledgements
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Funding Body
GRDC, Southern Zone Barley Agronomy

Barley agronomy, grazing and annual ryegrass

Martin Lovegrove & Rob Wheeler, SARDI Waite.

Key findings

- Simulated grazing significantly reduced grain yield.
- Non-grazed controls were more competitive with annual ryegrass (ARG) reducing the ARG population by 58% compared to the grazed treatments.

Why do the trial?

To compare the grain yield and quality of barley varieties with grazing and annual ryegrass (ARG).

How was it done?

A replicated trial was conducted at the Hart field site assessing 4 barley varieties, Flagship, Hindmarsh, Maritime and Urambie which differ in growth rate and habit. ARG was sown at a rate of 25kg/ha. Grazing treatments were simulated using a mower, at the beginning of stem elongation (GS30).

Seeding rates were adjusted according to grain weight and germination to produce target plant populations of 145 plants/m^2. The trial was sown using chisel points and press wheels.

Plot size	1.5m x 10m	**Fertiliser rate**	DAP @ 70kg +2% Zn
Sowing date	30th April 2009		

Barley and ARG plant counts were carried out four weeks after sowing to measure establishment. ARG populations were re-scored on October 14th to assess ARG survival. Dry matter production was recorded at stem elongation when the plots were mowed to simulate grazing. Trials were harvested on the 9th of November. Grain quality was assessed for retention with a 2.5 mm screen, protein (% dry basis), screenings with a 2.2 mm screen and test weight (kg/hL).

Results

Hindmarsh was the highest yielding variety (2.92 t/ha), however analysis of grain yields indicated no significant differences between the barley varieties (Table 1). Comparison of dry matter production showed no significant differences between tested varieties. Similarly, no differences in ARG establishment or survival populations were recorded between varieties.

Table 1. Grain yield, dry matter production, ARG establishment and survival averaged across grazing treatment for variety at Hart in 2009.

Variety	Grain yield (t/ha)	Dry matter (kg/ha)	ARG establishment (plants/m²)	ARG survival (plants/m²)
Flagship	2.58	986	29	23
Hindmarsh	2.91	1129	35	29
Maritime	2.79	915	39	16
Urambie	2.75	860	34	16
LSD (0.05)	ns	ns	ns	ns

The presence of ARG did not influence grain yield or dry matter production (Table 2).

Table 2 also shows that there was a background population of ARG (15 plants/m^2) and the plots that were sown with ARG had a population of 53 plants/m^2. By the 14th October populations were reduced to 8 and 34 ARG plants/m^2 in the minus and plus ARG treatments respectively.

Table 2. Grain yield, dry matter production, ARG establishment and survival averaged across variety for grazing treatment at Hart in 2009.

ARG	Grain yield (t/ha)	Dry matter (kg/ha)	ARG establishment (plants/m²)	ARG survival (plants/m²)
Minus ARG	2.67	946	15	8
Plus ARG	2.84	999	53	34
LSD (0.05)	ns	ns	32	16

Grain yield was not significantly affected by grazing at Hart in 2009 for any variety.

No significant differences were observed in early establishment of ARG between the grazed and non-grazed treatments (Table 3). However, non-grazed treatments consistently produced significantly lower ARG numbers (12 plants/m^2) compared to the grazed treatments (30 plants/m^2), for ARG survival.

Table 3. Grain yield, ARG establishment and survival averaged across variety and ryegrass treatment for grazing treatment at Hart in 2009.

Grazing treatment	Grain yield (t/ha)	ARG establishment (plants/m²)	ARG survival (plants/m²)
Graze	2.69	35	30
Un-graze	2.82	33	12
LSD (0.05)	ns	ns	17

All barley varieties produced high grain protein levels, which were all statistically similar averaging 13.3% (Table 4).

Differences in screenings and retention were also not significant averaging 8.6% and 57.1% respectively.

Flagship produced the lowest test weight (65.3kg/hL) compared to the other 3 varieties with an average of 68.5%.

Table 4. Protein, screenings, retention, test weight and receival grade averaged across grazing and ryegrass treatments for variety at Hart in 2009.

Variety	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
Flagship	13.9	12.4	47.6	65.3	Feed 1
Fleet	12.9	5.3	64.4	68.9	Feed 1
Hindmarsh	12.9	7.3	62.2	68.7	Feed 1
Maritime	13.4	9.4	54.1	67.8	Feed 1
LSD (0.05)	ns	ns	ns	2.1	

The presence of ARG had no impact on grain quality characteristics grain protein, screenings, retention, test weight or grain quality receival grade (Table 5).

Table 5. Protein, screenings, retention, test weight and receival grade averaged across variety and grazing treatments for ARG treatment at Hart in 2009.

ARG presence	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
Minus ARG	13.4	10.5	52.9	66.9	Feed 1
Plus ARG	13.2	6.7	61.3	68.5	Feed 1
LSD (0.05)	ns	ns	ns	ns	

As observed with the presence of ryegrass, simulated grazing treatment had no impact on grain protein, screenings, retention, test weight or grain receival grade.

Table 6. Protein, screenings, retention, test weight and receival grade averaged across variety and ARG treatments for grazing treatment at Hart in 2009.

Grazing treatment	Protein (%)	Screenings (%)	Retention (%)	Test weight (kg/hL)	Receival grade
Graze	13.6	9.0	55.7	67.5	Feed 1
Un-graze	12.9	8.2	58.4	67.9	Feed 1
LSD (0.05)	ns	ns	ns	ns	

Discussion

The trial was sown on the 30th April to maximise potential for early dry matter production to best suit simulated grazing. Good early rainfall enabled excellent crop establishment at Hart. Rains throughout winter allowed outstanding biomass production with crops setting high grain yield potential.

ARG establishment was not influenced by grazing, as this treatment was applied after the ARG emergence which was shortly after seeding. However, when ARG survival populations were measured, 14th October, the un-grazed treatment had significantly lower ARG numbers than the grazed treatment. The competition from the un-grazed barley exceeded that of grazed treatments and the surviving ARG population of the un-grazed treatment was 58% lower than the surviving population of the grazing treatment. This most likely occurs because whilst grazed plants are recovering from defoliation they are unable to maintain a high level of competition. As a result it is possible that grazing under high ARG pressure can lead to higher surviving populations and potential ARG problems in future years.

Grazing treatments significantly reduced grain yield across all varieties. However, a recorded reduction of just 130 kg/ha meant the benefit of feed value increased the overall return of this treatment. Overall value of the grazing treatment was able to result due to favourable seasonal conditions after the de-foliation event, allowing the grazed treatments to recover well.

No varietal interaction was identified for grain yield, dry matter production or ARG establishment and survival, meaning that all varieties responded alike to both, grazing and ARG treatments.

It is important to remember that grazing was simulated in this research and factors such as preferential grazing, timing of grazing, stocking rate, row spacing and trampling could also impact on results.

Acknowledgements

Thanks go to GRDC for funding this research, SARDI Clare staff for trial management, SARDI Waite staff for quality evaluation and the Hart field site group for the provision of land.

HART FIELD DAY

2009


Hart's Kenton Angel with Mick Faulkner, Agrilink


Hart Chairman, Grant Roberts


Guest Speaker, Mr Malcolm May, Balco Australia


Larn McMurray, SARDI speaking at a Pulse trial

Wheat row spacing

This trial was funded by the GRDC and conducted in collaboration with Nick Poole (Foundation of Arable Research, NZ)

Key findings

- Nitrogen applied during stem elongation significantly improved grain yield and protein.
- The higher density crop produced greater yields for both row spacings.
- There was little difference in grain yield between the row spacings.

Why do the trial?

To improve the nitrogen and water use efficiency of wheat by manipulating canopy size using different row spacing, nitrogen application timing and plant density.

How was it done?

Plot size	350mm (14") spacing 2.1m x 10m 225mm (9") spacing 1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn Urea @ 65 kg/ha
Seeding date	13th May 2009	**Variety**	Gladius wheat @ 70 kg/ha
Available soil moisture 27th March (0-60cm)	0mm	**Soil nitrogen 27th March (0-60cm)**	117 kg N/ha

The trial was a randomised complete block design with 3 replicates, 2 row spacings, 2 crop densities and 2 nitrogen timings.

65 kg/ha urea was either broadcast by hand and incorporated by sowing on 13th May or broadcast by hand prior to a rain front at 2nd node (GS32) on 7th August. 1mm was received on the 7th August and 6.5mm on the 11th August.

Target plant densities were 100 and 200 plants per square metre.

Plot edge rows were removed prior to harvest.

All plots were assessed for grain yield, protein, test weight, grain weight and screenings with a 2.0 mm screen.

Results

There was no response in plant, tiller or head number from nitrogen timing or row spacing, but there was to sowing rate (Table 1). At the end of tillering the high density plots had 1.8 stems per plant and in the low density plots there was an average of 2.9 stems per plant. Although the lower crop density had fewer plants, it was able to compensate by producing more tillers per plant and grains per head. By the 19th October both the high and low density plots had lost an average of 29% of the stems to produce 216 heads per square metre in the high density plots and 186 heads per square metre in the low density plots (Table 1).

Although the high density plots produced 30 heads per square metre more, the number of grains per square metre in the high density plots was not significantly higher.

Table 1: Plant, tiller, head, aborted tillers and grain number per square metre, averaged across nitrogen timing and row spacing for high and low sowing rates at Hart in 2009.

Sowing rate	Plants	Tillers	Heads	Aborted tillers	Grains
			per square metre		
High	171	309	216	92	4712
Low	89	255	186	69	4575
LSD (0.05)	10	30	21	10	ns

By delaying the application of urea (65 kg/ha) until 2nd node (7th August, GS32) both grain yield and protein were significantly improved (Table 2). Grain yield was increased by 0.14 t/ha (7%) and protein by 0.4% (3%).

Table 2: Grain yield (t/ha) and protein (%) for nitrogen timing, averaged across row spacing and plant density at Hart in 2009.

Nitrogen timing	Grain yield (t/ha)	Protein (%)
IBS	2.04	13.2
GS32	2.18	13.6
LSD (0.05)	0.11	0.2

Grain yield was also significantly affected by plant density and row spacing (Table 3). The highest yielding treatment of the trial, by 0.17 t/ha, came from the high sowing rate, at narrow row spacing, yielding 2.25 t/ha. At the low crop density narrow and wide rows both produced similar yield results, averaging 2.05 t/ha. These results are similar to previous years and show that there is no disadvantage to low density on wider rows, however, at high densities there is a trend for narrow row spacing to produce higher yields. Screenings were higher for the narrow row spacing at either the low or high sowing rates, averaging 1.8% compared to 1.4% for the wide row spacing.

Table 3: Grain yield (t/ha) and screenings (%) averaged across nitrogen timing for row spacing and crop density at Hart in 2009.

Row spacing	Plant density	Grain yield (t/ha)	Screenings (%)
Narrow	High	2.25	1.9
Wide		2.08	1.2
Narrow	Low	2.02	1.7
Wide		2.08	1.6
LSD (0.05)			
Spacing		ns	ns
Density		0.11	ns
Spacing*Density		0.21	0.2

Wayne Hawthorne surveys the scene.
Hart Field Day 2009

Wheat canopy management

This trial was funded by GRDC, in collaboration with Nick Poole (Foundation of Arable Research, NZ) and the Mid-North High Rainfall Site.

Key findings

- Grain yields increased with the addition of nitrogen, producing a maximum of 4.64 t/ha, with 75 kg N/ha.
- Nitrogen application timing produced no significant differences to grain yield.
- Crop sensors used at early stem elongation, were able to accurately measure crop nitrogen uptake and tiller number.

Why do the trial?

- To improve the nitrogen and water use efficiency of wheat by manipulating canopy size and structure using post sowing applications of nitrogen.
- To maintain yield and quality, while reducing the risks associated with excess early crop growth.
- To compare and investigate the value of different optical crop sensors.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	Triple super (0:20:0) @ 90 kg/ha
		Variety	Mace wheat @ 70 kg/ha
Seeding date	7th May 2009		
Available soil moisture 1st April (0-90cm)	23mm	**Soil nitrogen 21st May (0-90cm)**	146 kg N/ha

This trial was conducted at the Mid-North High Rainfall site, at Tarlee, under the supervision of Jeff Braun and Mick Faulkner, Agrilinks Agricultural Consultants. The trial was a randomised complete block design with 3 replicates, 5 nitrogen rates and 3 nitrogen timings.

The sowing nitrogen treatments were applied by spreading sulphate of ammonia onto the sown plots, prior to rain. The 1st node (23rd July, GS31) and flag leaf emerged (14th August, GS37) were applied using urea broadcast by hand prior to rain.

3 optical crop sensors were used to scan plots at 2 tillers (GS22,14, 23rd June), 1st node (GS31, 31st July), 2nd node (GS32, 6th August) and flag leaf emerged (GS37, 14th August). The sensors used were the Greenseeker, Crop circle, and the Yara N-sensor active light sensor (ALS). Digital photos were also captured at each scanning.

All plots were assessed for grain yield, protein, test weight, screenings less than 2.0 mm and grain weight.

Results

At Tarlee grain yields ranged from 2.95 t/ha (0 kg N/ha, at sowing) to 4.64 t/ha (100 kg N/ha, at sowing). Grain yields increased significantly with the addition of nitrogen up to 75 kg N/ha, averaged across all nitrogen timings (Figure 1) (Table 1). There was no difference in grain yield between nitrogen applied at sowing and that applied at GS31.

Grain protein significantly increased with nitrogen rate and post emergent applications, particularly for rates above 25 kg N/ha. Grain weight decreased with increasing nitrogen, especially the 75 kg N/ha treatment (Table 1 & 2). Harvest index was significantly higher with the addition of any nitrogen, compared to the control (0 kg N/ha).

Table 1: The response in grain yield (t/ha), protein (%), screenings (%), grain weight (mg) and harvest index to the addition of nitrogen, averaged across all nitrogen application timings at Tarlee in 2009.

Nitrogen rate (kg/ha)	Grain yield (t/ha)	Protein (%)	Screenings (%)	Grain weight (mg)	Harvest index
0	3.07	9.5	0.8	43.8	28
25	3.45	9.7	0.9	42.0	31
50	4.07	9.8	0.9	42.3	32
75	4.45	10.2	1.0	40.7	33
100	4.59	10.5	1.1	41.2	34
LSD (0.05)	0.20	0.3	ns	1.3	4

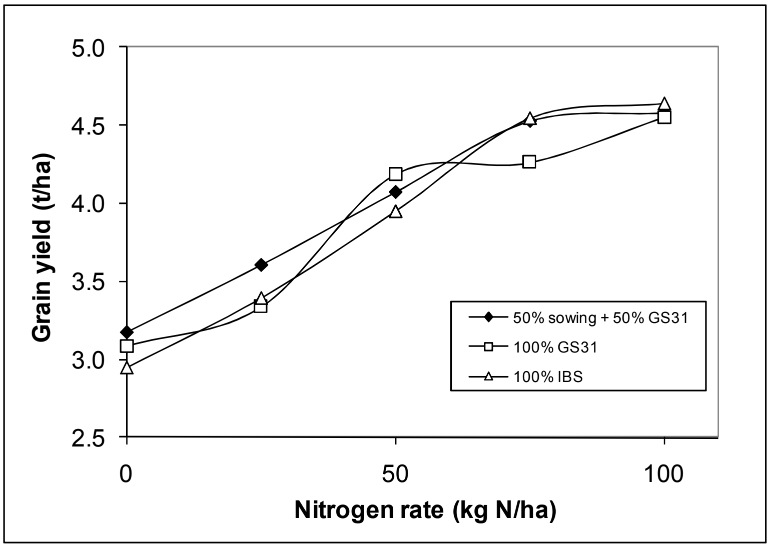


Figure 1. Grain yield (t/ha) for nitrogen rate and application timing at Tarlee in 2009 (LSD 0.05 – 0.35 t/ha).

Table 2: The response in grain yield (t/ha), protein (%), screenings (%), grain weight (mg) and harvest index to the addition of nitrogen, for 75 kg N/ha only at Tarlee in 2009.

Nitrogen rate (kg/ha)	Grain yield (t/ha)	Protein (%)	Screenings (%)	Grain weight (mg)	Harvest index
GS31 + GS37	4.15	10.3	1.1	41.5	33
GS37	4.04	10.8	1.2	42.8	30
LSD (0.05)	ns	0.1	ns	ns	ns

During the growing season the crop sensors produced good relationships with crop biomass, crop nitrogen uptake and tiller number (Figures 1,2 & 3). Importantly, these interactions are very good between late tillering and early stem elongation, when crop potential and further nitrogen requirements are being considered. This matches results achieved in previous years of this project. Using digital images to determine the percentage of green area was also effective for measuring tiller number (Figure 2), compared with Greenseeker NDVI (Figure 1).

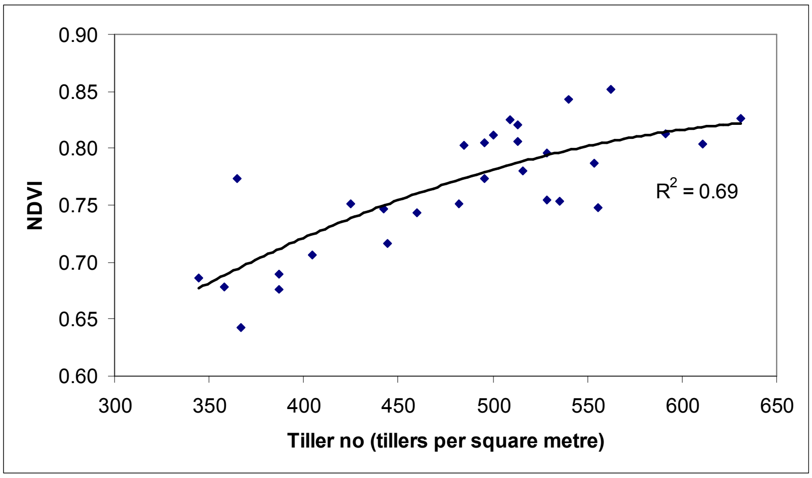


Figure 1: Tiller number and Greenseeker NDVI for all nitrogen rates and application timings at 1st node (GS31) for Mace wheat at Tarlee in 2009.

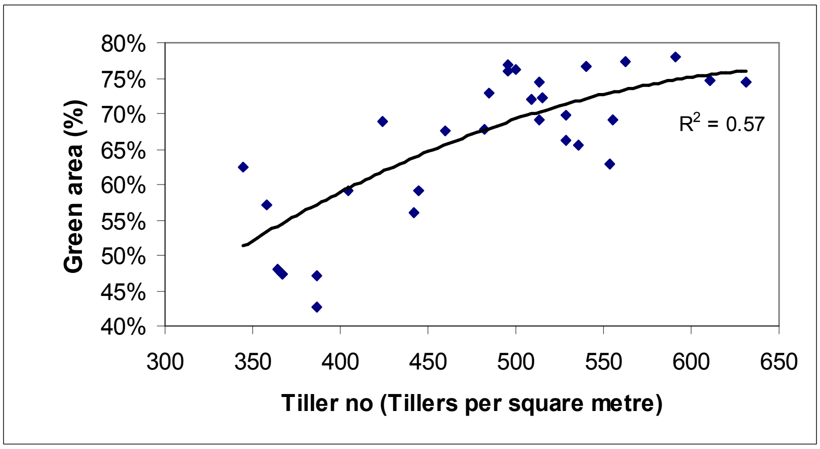


Figure 2: Tiller number and green area % for all nitrogen rates and application timings at 2nd node (GS32) for Mace wheat at Tarlee in 2009.

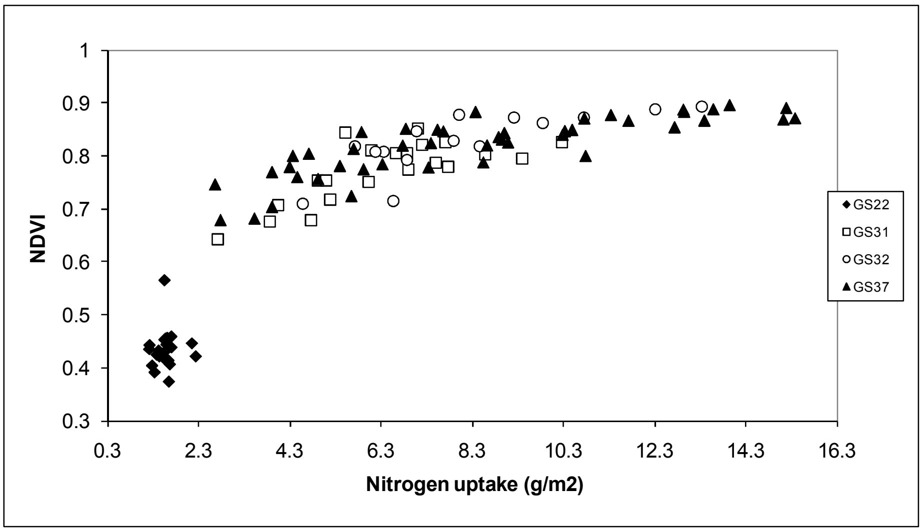


Figure 3: Nitrogen uptake (g/m2) and Greenseeker NDVI across all nitrogen rates and timings for Mace wheat at Tarlee in 2009.

Peter Hooper
Hart Field-Site Group Trials Manager

Durum management

Funded by SAGIT and conducted in collaboration with SARDI.

Key findings

- Hyperno (3.44 t/ha) and WID802 (3.50 t/ha) were the highest yielding durum varieties in this trial at Hart.
- Nitrogen application timing did not influence grain yield at Hart in 2009.
- Durum grain yield was reduced by 17% in the presence of ryegrass.
- Grazing in the absence of ryegrass increased durum grain yield.

Why do the trial?

To investigate the effect of different nitrogen and grazing strategies on crop competition with annual ryegrass.

To evaluate the performance of new durum varieties at different crop densities.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn Urea applied as per treatment
Seeding date	13th May 2008		
Available soil moisture 27th March (0-60cm)	0mm	**Soil nitrogen 27th March (0-60cm)**	117 kg/ha

There were three trials within the experiment, all randomised complete block designs with 3 replicates.

1. Grazing, nitrogen timing and ryegrass

   2 grazing treatments, grazed or ungrazed

   Plots were defoliated to simulate grazing on the 8th July at GS 15/23 (for a description of growth stages see Table 1) with a walk behind slasher from 35cm to 15cm high.

   3 nitrogen treatments, 100% IBS, 100% GS30 or 50% IBS + 50% GS30

   Urea @ 100 kg/ha was incorporated by sowing or broadcast by hand post emergent according to treatment.

   2 ryegrass treatments, no ryegrass or ryegrass spread prior to seeding

   25 kg/ha ryegrass seed was spread and incorporated lightly with the seeder prior to sowing.

2. New varieties and there response to seeding rate

   5 varieties

      Saintly, Hyperno, Kalka, Caparoi or WID802

   3 seeding rates

      Low, medium and high plants per square metre

3. Durum response to nitrogen timing

   6 nitrogen timings

      No nitrogen, 50% IBS + 50% GS30, 100% GS30, 100% GS37, 50% GS30 + 50% GS32 or 50% GS37 + 50% GS49

Table 1: Zadocks growth stage and the corresponding physiological description of the main stem.

Zadocks growth stage value	Physiological discription of main stem
GS15	5 fully emerged leaves
GS23	3 tillers
GS30	start of stem elongation
GS32	second node
GS37	flag leaf emergence
GS49	first awns visible

Results

1. Grazing, nitrogen timing and ryegrass

Grain yield was reduced by 17% in the presence of ryegrass (2.32 t/ha) compared to having no ryegrass in the plot (2.79 t/ha) (Table 2).

A split application of nitrogen in the absence of ryegrass produced significantly lower yields (2.52 t/ha) than 100% GS31 (3.05 t/ha). However, in the presence of ryegrass there was no difference between any of the nitrogen timings (averaging 2.33 t/ha).

Table 2: Grain yield (t/ha) for ryegrass and nitrogen timing treatments averaged across grazing treatments at Hart in 2009.

Nitrogen timing	Ryegrass treatment	Grain yield (t/ha)
100%IBS	No ryegrass	2.79
100%GS31		3.05
50%IBS + 50%GS31		2.52
100%IBS	Ryegrass	2.16
100%GS31		2.34
50%IBS + 50%GS31		2.48
LSD (0.055)		
Ryegrass		0.23
Nitrogen timing		ns
Ryegrass*Nitrogen timing		0.40

There was no difference in grain yield between grazing or no grazing, however, grazing in the absence of ryegrass increased grain yield by 0.38 t/ha to 2.98 t/ha (Table 2). Grazing in the presence of ryegrass reduced grain yield slightly although this was not significant.

Grain weight was higher in the absence of ryegrass (49 mg per grain) compared to the ryegrass treatments (Table 3). Grazing also reduced the grain weight in the presence of ryegrass.

The grazing treatments consistently reduced grain protein compared to the un-grazed treatments. Grain protein was not significantly affected by ryegrass treatment or nitrogen timing (Table 3).

Table 3: Grain yield (t/ha) and grain weight (mg) averaged across nitrogen timing for ryegrass and grazing treatments at Hart in 2009.

Grazing	Ryegrass treatment	Grain yield (t/ha)	Grain weight (mg)	Protein (%)
No grazing	No ryegrass	2.60	49	12.2
Grazed		2.98	49	11.4
No grazing	Ryegrass	2.42	48	11.8
Grazed		2.23	45	11.4
LSD (0.05)				
Ryegrass		0.23	1	ns
Grazing		ns	2	0.5
Ryegrass*Grazing		0.33	ns	ns

Screenings were below 1% for all treatments and no significant difference was measured for test weight.

2. New varieties and their response to seeding rate

Hyperno (3.44 t/ha) and WID802 (3.50 t/ha) were the highest yielding durum varieties in the durum agronomy trial at Hart in 2009. Caparoi, Kalka and Saintly all had similar grain yields averaging (2.94 t/ha). Seeding rate produced no significant differences in grain yield or any quality trait measured.

Protein averaged 12.8% and was statistically similar for all varieties and sowing rates.

Caparoi produced the highest test weight (81 kg/hL), one of the lowest screenings (0.7%) and the highest grain weight (53.1 mg) in the trial for 2009. Hyperno, Kalka and Saintly had a test weight between 79.6 kg/hL and 80.4 kg/hL and screenings below 1.5%. The breeders line WID802 had the lowest test weight (79.0 kg/hL) and the lowest grain weight (46.8mg) in the trial.

Table 4: Grain yield (t/ha), protein (%), test weight (kg/hL), screenings (%) and grain weight (mg) averaged across seeding rate for durum variety at Hart in 2009.

Variety	**Grain yield (t/ha)**	**Protein (%)**	**Test weight (kg/hL)**	**Screenings (%)**	**Grain weight (mg)**
Caparoi	3.01	13.0	81.0	0.7	53.1
Hyperno	3.44	12.7	79.6	0.6	50.4
Kalka	2.89	12.9	80.4	0.8	49.2
Saintly	2.93	13.0	80.1	1.2	49.0
WID802	3.50	12.4	79.0	1.1	46.8
LSD (0.05)	0.25	ns	0.4	0.2	1.2

Although there were differences in plant density due to seeding rate at emergence (Table 5), by the end of tillering seeding rate had become insignificant, as the plants had compensated.

However, not all varieties responded the same way. Table 6 shows that Caparoi, Hyperno and Kalka had an average tiller density of 454 tillers/m^2, 20% more than Saintly and the breeders line WID802 (averaging 378 tillers/m^2). However, by harvest time there were no significant differences between head number for any variety or seed rate, thus, the extra tillers produced by Caparoi, Hyperno and Kalka were aborted and did not lead to a greater number of heads.

This highlights the flexibility of durum to adjust the number of tillers produced and aborted per plant to form final head number. This result might be due to the level of soil nitrogen.

Table 5: Plant density averaged across the 5 varieties for seeding rate at Hart in 2009.

Seed rate	Plant density (plants/m²)
Low	147
Medium	185
High	222
LSD (0.05)	13

Table 6: Plant, tiller and head density (per square metre) and tillers and heads per plant averaged across seeding rates for durum varieties at Hart in 2009.

Variety	Plant (plants/m²)	Tillers (tillers/m²)	Heads (heads/m²)	Tillers per plant	Heads per plant
Caparoi	169	449	268	2.7	0.6
Hyperno	184	444	246	2.4	0.6
Kalka	197	469	251	2.4	0.5
Saintly	194	380	264	2.0	0.7
WID802	179	376	234	2.1	0.6
LSD (0.05)	17	57	ns		

3. Durum response to nitrogen timing

Durum grain yield in the nitrogen timing trial at Hart in 2009 averaged 2.85 t/ha and was not influenced by nitrogen timing. Screenings (averaging 0.5%) and test weight (averaging 0.5%) were not influenced by nitrogen timing. However, protein was significantly higher (13.9%) when all of the nitrogen was applied at flag leaf emergence (GS37) compared to all other treatments which were similar with an average of 13.1%. Although this treatment produced the lowest test weight of 79.5 kg/hL.

Table 7: Grain yield (t/ha), protein (%), test weight (kg/hL), screenings (%) and grain weight (mg) for nitrogen timing at Hart in 2009.

Nitrogen timing	Grain yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)	Grain weight (mg)
Nil	2.84	13.2	80.0	0.5	48.4
50% IBS + 50% GS30	2.83	13.0	79.7	0.6	47.6
100% GS30	2.84	13.2	79.7	0.5	47.3
50% GS30 + 50% GS32	2.91	12.8	80.0	0.5	47.5
100%GS37	2.82	13.9	79.5	0.7	46.5
50% GS37 + 50% GS47	2.88	13.2	80.0	0.5	48.9
LSD (0.05)	ns	0.4	0.4	ns	ns

Phosphorus rate trial

Key findings

- The addition of any form of phosphorus did not increase grain yield.

Why do the trial?

To investigate the impact of traditional phosphorus fertilisers and phosphorus alternatives on the grain yield and quality of wheat.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	Urea @ 35 kg/ha at sowing Urea @ 50 kg/ha 10th August Phosphorus applied as per treatment
Seeding date	25th May 2009	**Variety**	Peake wheat @ 70 kg/ha

Trial 1 Phosphorus rate: randomised complete block design with 3 replicates and 4 treatments.

Treatments were re-sown over the same treatments from 2007 and 2008.

Trial 2 Biosolids and chicken litter: randomised complete block design with 3 replicates and 8 treatments.

A single application of biosolids and chicken litter were broadcast by hand prior to sowing in 2008. The Biosolids + 65 kg/ha Single super and Chicken litter + 65 kg/ha Single super treatments had a repeated application of 65 kg/ha Single super in 2009.

Treatments were sown over the same treatments from 2008.

Trial 3 Biochar, phosphorus solubiliser and foliar phosphorus: randomised complete block design with 3 replicates and 12 treatments.

Biochar is a carbon-rich product created when organic matter is burned in a low-oxygen environment. The foliar phosphorus treatments contained 20% phosphorus and were applied at the 5 leaf stage. The phosphorus solubiliser was a seed inoculant applied at seeding.

Treatments were sown into standing wheat stubble from the commercial crop from 2008.

Single superphosphate was used as the standard phosphorus treatment.

The initial soil phosphorus (March 2007) was 40 mg/kg (0 – 10 cm)
The phosphorus buffering index (PBI) (March 2007) was 102.

Plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Leaf tissue samples were taken from selected treatments on 4th August 2009 at 1st node (GS31) on selected treatments.

Plant biomass cuts were taken from treatments 1 to 4 on 4th August 2009 at 1st node (GS31) to measure dry matter production.

Samples of the biosolids and chicken litter from 2008 were analysed for nutrient concentration (Table 1).

Table 1: Fertiliser nutrient concentrations

Nutrient	Single superphosphate	DAP	Biosolids	Chicken litter
		kg/t		
Nitrogen	0	180	15	43
Phosphorus	90	200	1	8
Potassium	0	0	8	2
Sulphur	110	15	8	6
Zinc	0	0	1	1

Results

Leaf tissue nutrient analysis taken on the 4th August 2009 (wheat growth stage 1st node, GS31) showed that there was no difference in phosphorus concentration in treatments, nil, 110 kg/ha single super, 165 kg/ha single super, biosolids and chicken litter, the average phosphorus concentration was 0.33%. Analysis of crop biomass on the same day showed no significant difference between treatments averaging 1.02 t crop biomass/ha.

No phosphorus treatment in any of the 3 trials produced significantly different grain yield results at Hart in 2009 (Tables 2, 3 & 4). Treatments in trials 1 and 2 did not show any significant yield response in the years 2007 and 2008.

Protein was generally higher in trial 2 when any form of phosphorus was applied but was not significant in trials 1 and 3. This is likely a result of different rotation history.

Screenings were less than 1.5% for all 3 trials in 2009.

There was a trend in all 3 trials in 2009 that when high rates of phosphorus fertiliser where applied the test weight was 0.3 kg/hL higher compared to other treatments.

Table 2: Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) for trial 1 at Hart in 2009.

Treatment	Grain yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)
Nil	3.09	10.6	78.4	1.1
5 kg/ha P	3.01	10.4	78.8	0.8
10 kg/ha P	3.27	10.5	78.7	0.8
15 kg/ha P	2.99	10.5	79.1	0.7
LSD (0.05)	ns	ns	0.3	0.3

Table 3: Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) for trial 2 at Hart in 2009.

Treatment	Grain yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)
Nil	2.96	10.8	78.8	0.9
5 t/ha Biosolids	3.10	11.3	79.1	1.0
5 t/ha Biosolids + 12 kg/ha P	2.90	10.9	79.1	0.9
3 t/ha Chicken litter	2.85	11.2	78.1	0.9
3 t/ha Chicken litter + 12 kg/ha P	3.06	11.2	79.0	1.0
10 kg/ha	2.84	11.1	79.2	1.0
LSD (0.05)	ns	0.4	0.3	ns

Table 4: Grain yield (t/ha), protein (%), test weight (kg/hL) and screenings (%) for trial 3 at Hart in 2009.

Treatment	Grain yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)
Nil	3.08	11.5	79.0	0.9
5 kg/ha P	3.27	11.6	78.9	1.0
10 kg/ha P	3.03	11.4	79.1	1.0
500 kg/ha Biochar	2.83	11.3	78.8	1.0
100 kg/ha Biochar + 5 kg/ha P	2.72	11.4	78.9	1.1
100 kg/ha Biochar + 10 kg/ha P	2.89	11.3	79.1	0.9
100 kg/ha Biochar + Liquid P 5 kg/ha	2.56	11.2	79.0	1.1
P solubiliser	2.80	11.4	78.6	1.3
P solubiliser + 5 kg/ha P	2.83	11.4	79.0	0.9
P solubiliser + 10 kg/ha P	3.06	11.1	78.6	1.0
2.0 L/ha Foliar P 1	2.86	11.4	79.0	1.0
2.5 L/ha Foliar P 2	2.95	10.9	78.6	1.2
LSD (0.05)	ns	ns	0.4	ns

Pulse row spacing and standing stubble

Key findings

- Height to lowest pod was greater in wider rows for beans compared to peas or chickpeas.
- Beans were higher yielding on narrower row spacing.
- Standing stubble did not increase grain yield in any pulse crop trialled.
- Standing stubble improved bean yields only at the wide row spacing.

Why do the trial?

To investigate the effect of row spacing and standing stubble on the grain yield and harvestability of pulse crops.

How was it done?

Plot size	Wide 450mm (18”) spacing 2.7m x 10m Narrow 225mm (9”) spacing 1.4m x 10m	**Fertiliser**	MAP @ 60 kg/ha + 2% Zn
		Crop	Kaspa peas Farah beans Genesis 090 chickpeas
Seeding date	13th May 2009	**Stubble**	Standing or Slashed

The trial was a randomised split, split plot design with 3 replicates of 3 crops (beans, peas and chickpeas), 2 row spacings, (22.5cm (9”) and 45cm (18”)) and 2 stubble treatments (standing and slashed). The light stubble was from an ungrazed wheat crop in 2008 and the treatments were inter-row sown.

All plots were assessed for height to lowest pod (cm from the ground) prior to harvest and grain yield.

Plot edge rows were removed prior to harvest in the beans and chickpeas. The peas were lodged and tangled and so the whole plots were harvested.

Results

Sowing beans on wider rows significantly increased height to the lowest pod from 32cm to 36cm. There was no difference in the peas and chickpeas. The height to the lowest pod in all crops was not affected by stubble treatment.

Table 1: Height to the lowest pod (cm from the ground) averaged across stubble treatment in Farah beans, Kaspa peas and Genesis 090 chickpeas at Hart 2009.

Row spacing (cm)		Height to lowest pod (cm)		
		Beans	Peas	Chick peas
Narrow	22.5	32	20	30
Wide	45.0	36	19	29
LSD (0.05)		2	ns	ns

Beans were the highest yielding crop, averaging 2.90 t/ha, followed by peas with an average of 2.72 t/ha. Chickpeas were the lowest yielding, averaging 1.30 t/ha.

Beans produced 0.93 t/ha higher grain yields when sown on narrow row spacing (3.37 t/ha) compared to sowing on wide row spacing (2.44 t/ha Table 2). Stubble treatment had an impact only when the beans were sown on wide row spacing. Grain yield was significantly reduced from 2.64 t/ha to 2.23 t/ha when the stubble was slashed compared to leaving the stubble standing. The stubble treatment however did not significantly influence the grain yield of beans in the narrow spacing (3.37 t/ha average). This result illustrates the importance of standing stubble cover in bean crops sown at wider row spacing. Note that there was only a light stubble present, and this may have helped to contribute to the reduction in bean yields with wide row spacing in this trial. Loss of soil moisture through evaporation where there is insufficient ground cover is an important issue to consider in wide row beans.

The chickpea grain yield was not significantly affected by row spacing or stubble treatment, and ranged from 1.27 t/ha to 1.35 t/ha.

As with the beans, pea grain yields were significantly higher when they were sown on narrow row spacing (2.98 t/ha) compared to sowing on wide row spacing (2.46 t/ha). The pea grain yield was not significantly affected by stubble treatment.

Table 2: Grain yield (t/ha) for Farah beans, Genesis 090 chick peas and Kaspa peas for pulse row spacing trial at Hart in 2009.

Crop	Narrow spacing (22.5cm)		Wide spacing (45.0cm)	
	Removed	Standing	Removed	Standing
Beans	3.31 ab	3.42 a	2.23 f	2.64 cde
Chickpeas	1.30 g	1.35 g	1.27 g	1.27 g
Peas	2.90 bcd	3.06 abc	2.51 def	2.41 ef
LSD (0.05)	Letters indicate significantly different values			

Field pea - time of sowing and disease

Larn McMurray, Jenny Davidson, Mick Lines, Mark Bennie & John Nairn, SARDI

Key findings

- The field peas sown at Hart on the season break in 2009, were heavily infected with blackspot and grain yields were reduced by 30% (0.8 t/ha) compared with later sowing times.
- Sowing peas two to four weeks earlier (late May) than the conventional time (early – mid June) optimises production of Kaspa and the earlier, longer flowering line OZP0602.
- OZP0602 was generally higher yielding than Kaspa particularly in later sowing treatments.
- Yield loss from blackspot can be minimised if peas are sown after 60% of airborne spores have been released.
- The combination of P-Pickel T with two sprays of mancozeb was economic in some cases in the time of sowing trial at Hart in 2009, resulting in an average 7-14% yield gain in Kaspa and OZP0602.

Why do the trials?

To identify best sowing time and fungicides strategies in new pea varieties to maximise yields and to improve recommendations from the 'Blackspot Manager' disease risk prediction model in different regions by incorporating data from replicated trials.

How was it done?

Plot size	1.5m x 10m	**Fertiliser**	MAP @ 70 kg/ha with seed
Sowing date	TOS 1: 30th April 2009		
	TOS 2: 18th May 2009	**Row Spacing**	22.5 cm
	TOS 3: 4th June 2009		
Varieties	Alma (45 plants/m^2), Kaspa, OZP0602 & OZP0601 (55 plants/m^2)		
Trial design	Split plot with 3 replicates, blocked by sowing date. Variety by fungicide treatments randomised within blocks		

Fungicide	Seed *	Foliar
Nil	Apron	None
PPT + Mancozeb	Apron + PPT	Mancozeb @ 2 kg/ha – 9 node. June 24 (TOS1); July 23 (TOS2) & Aug 4 (TOS3)
Mancozeb @ 4-6 node & early flower	Apron	Mancozeb @ 2 kg/ha – 9 node & early flowering. June 11 & Aug 4 (TOS1); July 9 & Aug 26 (TOS2), July 23 & Sept 8 (TOS3)
Mancozeb @ 9 node & early flower	Apron	Mancozeb @ 2 kg/ha – 9 node & early flowering. June 24 & Aug 4 (TOS1); July 23 & Aug 26 (TOS2), Aug 4 & Sept 8 (TOS3)
PPT + Mancozeb @ 9 node & early flower	Apron + PPT	Mancozeb @ 2 kg/ha – 9 node & early flowering. June 24 & Aug 4 (TOS1); July 23 & Aug 26 (TOS2), Aug 4 & Sept 8 (TOS3)
Fortnightly	Apron + PPT	Chlorothalonil @ 2L/ha – May 29, June 4, 11 & 24, July 9 & 23, Aug 4 & 19, September 1, 18 & 30

* Apron® at 75ml/100kg seed for downy mildew control and PPT® at 200ml/100kg seed for blackspot control.

A similar trial was also conducted at Turretfield (high rainfall) and forms part of this SAGIT funded research. Results from this trial are also reported on in this article.

Results

Foliar disease and grain yield

High levels of early foliar disease (blackspot) infection occurred (Table 1) and significant and frequent rainfall events in spring favoured disease progression (Table 2). The field peas were severely affected by blackspot, especially at the earliest sowing time.

At Hart in 2009, the yield of all varieties in the earliest sowing period were 25-30% below the second two sowing periods due to severe blackspot (Table 1), clearly demonstrating the disease risk associated with early sowing (on the season break) of field peas. However, over the three years these trials have been run, the two earlier sowings have generally been equal or higher yielding than sowing in early June. Despite significant disease infection levels at Turretfield, the later sowing dates yielded similarly to the earlier sowing date as they were more adversely affected by the November heat wave than at Hart.

Table 1. Effect of sowing date and cultivar on blackspot disease severity and grain yield at two sites in SA 2009.

Sowing date	Foliar blackspot % plot severity					Grain yield (t/ha)				
	Alma	Kaspa	OZP 0601	OZP 0602	Mean	Alma	Kaspa	OZP 0601	OZP 0602	Mean
May-01	6.8	5.8	5.0	3.2	5.2	1.41	2.24	2.06	2.08	1.95
May-21	2.3	1.1	0.8	0.6	1.2	2.12	2.93	2.88	3.09	2.75
Jun-08	0.7	0.1	0.2	0.1	0.3	1.53	2.76	2.97	3.10	2.59
Average	3.3	2.4	2.0	1.3		1.69	2.64	2.64	2.75	
	lsd (P<0.05) = 1.7 (1.8 same sow date)					lsd (P<0.05) = 0.30 (0.15 same sow date)				
May-09	13.0	11.1	11.1	10.5	11.4	2.09	2.92	2.87	3.17	2.76
May-30	5.1	4.7	4.4	3.9	4.5	1.71	2.95	3.15	3.09	2.72
Jun-20	2.8	2.2	2.1	2.2	2.3	1.53	2.66	3.04	2.94	2.54
Average	7.0	6.0	5.8	5.5		1.78	2.84	3.02	3.06	
	lsd (P<0.05) = 1.3 (0.9 same sow date)					lsd (P<0.05) = 0.16 (0.11 same sow date)				

Table 2: Effect of sowing date and fungicide treatment on disease severity of field peas at Hart and Turretfield, SA, 2009.

Treatment	Foliar blackspot % plot severity					
	Turretfield (rated 24/9/2009)			Hart (rated 15/9/2009)		
	May-09	May-30	Jun-20	May-01	May-21	Jun-08
Nil	16.7	10.0	6.0	16.5	7.8	3.9
Mancozeb @ 4 node + early flowering	15.2	10.1	5.5	15.6	7.5	3.6
Mancozeb @ 9 node + early flowering	15.6	10.0	4.8	15.3	6.4	3.8
PPT + Mancozeb @ 9 node	15.7	9.0	4.0	15.8	7.7	3.5
PPT + Mancozeb @ 9 node + early flowering	15.8	9.0	4.7	14.5	6.0	3.0
Fortnightly chlorothalonil	9.0	3.3	1.1	4.4	1.7	0.6
LSD (P<0.05)	1.4 (1.4 same sow date)			1.1 (1.1 same sow date)		

Yield gains of 0 – 27% over the untreated plots were achieved, dependent upon sowing date and variety (Table 3). The line OZP0602 was higher yielding than Kaspa, particularly at the later sowing times of mid-May and early-June (Table 1). The benefit of OZP0602 over Kaspa was lost in the earliest sowing treatment at Hart under severe blackspot. Alma was lowest yielding particularly under high disease pressure. It had higher levels of foliar disease and therefore a greater yield gain from the fungicide treatments.

Yield gains in Kaspa and OZP0602 ranged from 7 - 14% and these varieties performed similarly in relation to disease infection level and response to foliar fungicide treatments in 2009. Fungicide applications found that the combination of P-Pickel T® seed treatment with two sprays of mancozeb (at 9 nodes and again at early flowering) were economic in some instances at Hart in 2009 (12% control). The fortnightly fungicide application produced significantly higher levels of disease control (71%) however, this treatment would generally be cost prohibitive.

Without the seed dressing, yield gains from two sprays of mancozeb, were generally less and more variable ranging from 0-14%. However timing of sprays relative to rainfall events and varietal flowering commencement appeared critical to yield response, such that fungicide sprays should be applied prior to significant rainfall events and earlier in OZP0602 than Kaspa, due to its earlier flowering date.

The above yields gains from the fungicides treatment strategies were still a lot less than those achieved by the fortnightly spraying treatment (19-65%) (Table 3). This treatment is uneconomical but does indicate that there are still yield gains to be made by controlling blackspot either through improved fungicides or increased genetic resistance.

Model validation

The disease spore predictions made by Blackspot Manager (a WA Department of Agriculture model that predicts the timing of release of airborne spores of blackspot from pea stubble) were analysed against final disease severity for each time of sowing in the 2007 and 2008 fungicide trials (including data from a third trial at Minnipa). Early results indicate that blackspot stem lesions will exceed 5 nodes, and hence affect yield, if more than 40% of spores are still present after sowing (Figure 1). Extremely dry seasons, such as occurred at Minnipa in these two years, will not result in disease irrespective of spore loads.

Table 3: Effect of sowing date and fungicide treatment on grain yield of field peas at Hart and Turretfield, SA, 2009.

Hart		Grain yield (t/ha) in each fungicide treatment						
Time of sowing	**Variety**	**Nil**	**Mancozeb @ 6 node + EarlyFlower**	**Mancozeb @ 9 node + EarlyFlower**	**PPT plus mancozeb @ 9 node**	**PPT plus mancozeb @ 9 node + EarlyFlower**	**Fortnightly Chloro-thalonil**	**Mean**
30-Apr	Alma	1.18	1.44	1.28	1.30	1.35	1.94	1.41
	Kaspa	2.05	2.14	2.03	2.04	2.20	2.96	2.24
	OZP0601	1.73	2.01	1.98	1.77	2.03	2.86	2.06
	OZP0602	1.89	2.07	1.94	1.79	2.03	2.76	2.08
	Mean	1.71	1.91	1.81	1.73	1.90	2.63	1.95
18-May	Alma	1.82	1.98	1.95	1.95	2.31	2.72	2.12
	Kaspa	2.75	3.01	2.78	2.56	3.11	3.37	2.93
	OZP0601	2.82	2.70	2.52	2.83	2.84	3.57	2.88
	OZP0602	2.82	2.98	3.10	2.96	3.11	3.54	3.09
	Mean	2.55	2.67	2.59	2.57	2.84	3.30	2.75
4-Jun	Alma	1.44	1.61	1.58	1.35	1.51	1.72	1.53
	Kaspa	2.70	2.68	2.44	2.58	2.71	3.45	2.76
	OZP0601	2.84	2.72	3.11	2.72	2.86	3.54	2.97
	OZP0602	2.76	2.88	2.67	3.41	3.13	3.73	3.10
	Mean	2.43	2.47	2.45	2.51	2.55	3.11	2.59
LSD variety x TOS x fungicide = 0.43								

Turretfield		Grain yield (t/ha) in each fungicide treatment						
Time of sowing	**Variety**	**Nil**	**Mancozeb @ 4 node + EarlyFlower**	**Mancozeb @ 9 node + EarlyFlower**	**PPT plus mancozeb @ 9 node**	**PPT plus mancozeb @ 9 node + EarlyFlower**	**Fortnightly Chloro-thalonil**	**Mean**
11-May	Alma	1.87	2.11	2.01	2.15	2.00	2.39	2.09
	Kaspa	2.79	2.63	2.75	2.88	2.89	3.56	2.92
	OZP0601	2.71	2.94	2.72	2.60	2.72	3.54	2.87
	OZP0602	3.03	3.07	3.12	3.11	3.11	3.56	3.17
	Mean	2.60	2.69	2.65	2.68	2.68	3.26	2.76
1-Jun	Alma	1.64	1.83	1.65	1.66	1.77	1.69	1.71
	Kaspa	2.84	2.93	2.87	2.77	2.82	3.46	2.95
	OZP0601	3.02	3.15	3.00	3.03	3.26	3.42	3.14
	OZP0602	2.97	2.89	3.11	3.02	3.13	3.42	3.09
	Mean	2.62	2.70	2.66	2.62	2.74	3.00	2.72
19-Jun	Alma	1.42	1.53	1.56	1.45	1.59	1.65	1.53
	Kaspa	2.55	2.66	2.69	2.64	2.72	2.73	2.66
	OZP0601	2.91	2.95	3.06	3.00	3.01	3.31	3.04
	OZP0602	2.76	2.89	2.87	2.99	3.01	3.11	2.94
	Mean	2.41	2.51	2.55	2.52	2.58	2.70	2.54
LSD variety x TOS = 0.16								
LSD variety x fungicide = 0.15								
LSD TOS x fungicide = 0.17								
LSD variety x TOS x fungicide = ns								

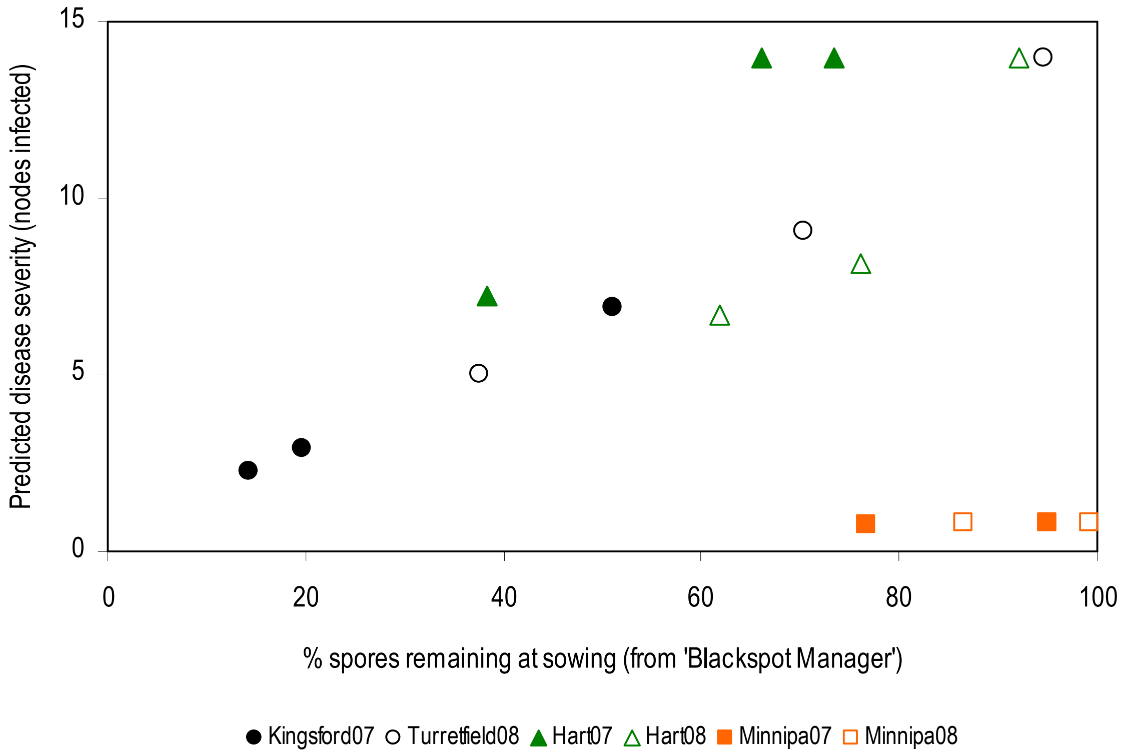


Figure1: Relationship between percent spores remaining at sowing and disease severity

Summary

These pea management trials have been conducted during shorter drier seasons and yield has been optimised by planting Kaspa and the early and longer flowering cultivar OZP0602 at an earlier date (late May) than the conventional time of early June. Combined with strategic fungicides the losses due to blackspot were minimised at this mid sowing date. Sowing at the break of the season (early May) exposed the crops to maximum blackspot risk with yield losses of 30% in 2009. Economic fungicides with greater efficacy than mancozeb are required before peas can be sown at the earliest period.

Early sowing of field pea is often essential for economic yields in dry years in low rainfall environments, however frost, weed and blackspot risks must be known and best practice management strategies implemented where possible.

Acknowledgements

SA Grains Industry Trust (SAGIT) for kindly funding this research and GRDC for providing funding of additional measurements.

SAGIT

GRDC
Grains Research & Development Corporation

Blackspot manager – release of blackspot spores from pea stubbles

Jenny Davidson (SARDI, Adelaide), Peter Hooper and Stuart Sherriff (Allan Mayfield Consulting, Clare)

Key findings

- Early sowing plus large numbers of airborne spores caused severe blackspot infection in pea crops in 2009.
- Winter and spring rain increased severity of blackspot in the pea crops.
- Airborne blackspot spore numbers are expected to be high in 2010 since pea stubbles have severe disease loads.

Results

'Blackspot Manager', developed by Dr. Moin Salam of DAFWA, predicts the timing of airborne spore release from blackspot affected pea stubble for a given time of sowing. This model is used in Western Australia and South Australia to determine the disease risk associated with different sowing dates for field peas.

Research is being conducted at Hart field day site to validate the predictions made by 'Blackspot Manager'. Immediately after harvest in 2007 and 2008, three batches of blackspot infested pea stubble were collected from commercial pea crops in the Hart region, each with a different disease severity. Pieces of diseased stubble were placed into nylon mesh bags and put on the soil surface at the Hart field day site. Every fortnight, one bag of stubble per batch was collected and the stubble was wetted to release blackspot spores which were captured on slides in a wind tunnel. The spore numbers were counted microscopically (Figure 1) so they could be correlated with the predictions from 'Blackspot Manager'.

Many pea crops were sown in early or mid-May in 2009 in response to the dry springs of the previous three seasons. These crops were at 3-4 nodes when the numbers of blackspot spores in the air reached their maximum, causing severe infection in young crops. Furthermore, actual spore counts far exceeded those observed in previous season (Table 1), further exacerbating disease levels. Spore numbers in 2009 were so large that distancing crops away from pea stubbles was not as effective in reducing disease levels, unlike previous seasons when distance was an important control measure. Ongoing rain during winter and spring continued to increase blackspot levels, and finally in some crops the combination of hail and blackspot during podding caused severe lesions on pods and seeds.

High blackspot infection on pea stubbles leading into 2010 season suggests that the risk of blackspot in the coming season will be high, unless summer rains lead to an early release of spores. Weekly updates of the predictions of spore release will be available to the industry on the website 'http://www.agric.wa.gov.au/cropdiseases' beginning in late March and continuing until mid June.

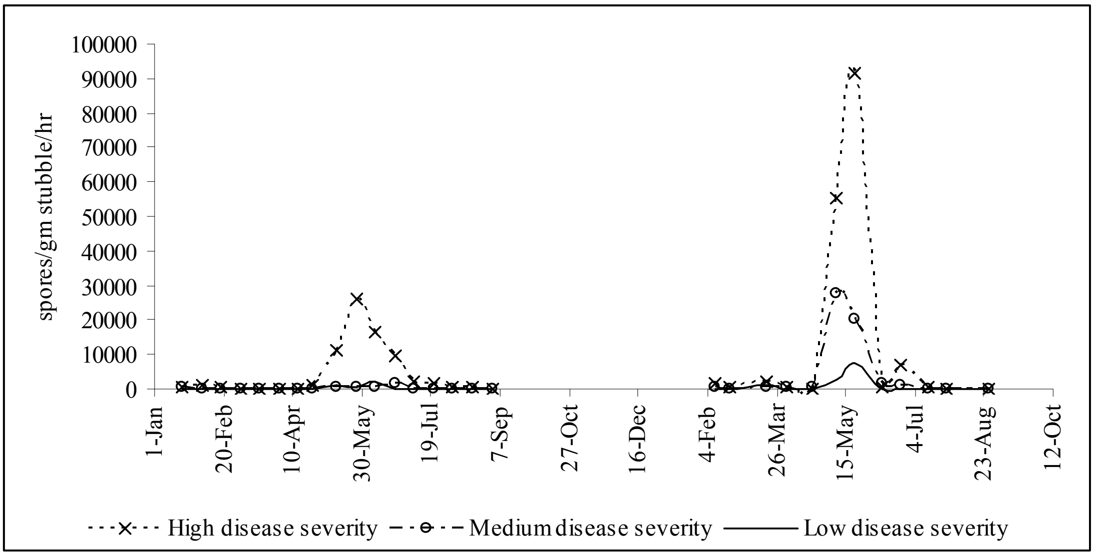


Figure 1. Numbers of blackspot spores released from pea stubbles with different levels of infection incubated at Hart field day site during 2008 and 2009 seasons.

Table 1. Total number of blackspot spores released from pea stubbles with different levels of infection incubated at Hart Field Day site during 2008 and 2009 seasons.
Spore numbers at the peak release time are in italics. Units = spores per gm of stubble per hour.

Stubble severity	2008		2009	
16 nodes infected *	71,436	*(26,205)*	159,059	*(91,695)*
8 nodes infected	4,304	*(1,642)*	53,320	*(27,653)*
4 nodes infected	4,205	*(2,384)*	11,830	*(7,555)*

* Many pea stubbles from 2009 crops have 16 nodes or more infected with blackspot.

HART SPRING TWILIGHT WALK 2009

Rabobank''s Justin Sherrard, guest speaker, addressed more than 50 farmers. October 15th

Rabo boys Matt and Matt cooking up a storm back at the shed, while the rest of us enjoyed a couple of drinks and a yarn.

Crown rot - varietal screening

Margaret Evans and Hugh Wallwork - SARDI Plant Research Centre, Innovative Food and plants. GRDC funded project – DAS00099

Key findings

- Durum breeders' lines screened in 2008 and 2009 do not show consistently improved resistance or tolerance to crown rot.
- Hyperno performed somewhat better than Kalka or Tamaroi.
- Data from at least two seasons is needed to make sound decisions about the response of entries to crown rot.

Why do the trials?

To evaluate a range of durum breeding lines for resistance and tolerance to crown rot.

How were they done?

Plot size	1.5 m x 5 m	**Fertiliser rate**	DAP @ 100kg/ha
Seeding date 2008	May 28th	**Plants sampled 2008**	October 23rd
Seeding date 2009	May 25th	**Plants sampled 2009**	October 29th

The trials had over 40 entries in 4 replicates. Represented were SARDI durum families (Td and W prefixes) and University of Adelaide durum lines (Q and R prefixes) provided by Hugh Wallwork, Tony Rathjen and Michael Quinn.

Checks included 2-49 which has moderate resistance; Kukri, Sentinel and Sunco which are moderately susceptible; Frame, Krichauff and Janz which are susceptible and Tamaroi and Kalka which are very susceptible.

Seed was inoculated with a crown rot spore suspension prior to seeding.

Plant samples were collected from 4 x 0.5 row from each plot in 2008 and 4 x 0.35 m row from each plot in 2009. Crown rot severity on main stems was scored visually using a 0 (no disease, no yield loss) to 5 (complete yield loss) scale. Whiteheads and total emerged heads were counted to calculate % whiteheads.

Results

Bread wheat and durum check varieties performed as expected at the sites in both years. Disease pressure was much higher in 2008 than 2009, which is reflected in higher disease scores and more whiteheads in 2008 (Table 1).

Bread wheat entries generally had lower disease scores and whitehead expression in both years than did the durum entries. Hyperno performed better than Kalka and Tamaroi in both disease score and whiteheads.

Table 1. Disease expression in bread wheats (above the double line) and durum, expressed as % white heads and disease score (0 = no disease, 5 = total crop loss) in 2008 and 2009.

Entry	% Whiteheads 2008	% Whiteheads 2009	Disease score 2008	Disease score 2009
Feb-49	1	0	0.4	0.1
Sunco	5	1	1.4	0.7
Gladius		1		1.2
Frame	15	2	1.9	0.5
Kukri	5	2	1.4	0.7
Sentinel	8	3	0.9	0.6
Janz	8	3	1.8	0.7
Krichauff	17		1.6	
R53380	39	3	2.6	1
Td19/1/1	38	5	2.2	0.8
Hyperno	35	5	2.2	0.9
RWID902		5		0.9
QD8/95-036		5		1.5
R53280	37	6	2.2	1.1
R71140	39	6	2.5	1.2
W1051/7/7		7		1.5
QD8/95-099		9		1.1
QBO417	18	9	2.3	1.9
Td10/6	35	10	2.1	1.3
Td10/8	26	10	1.9	1.5
Saintly		11		0.9
Kalka	**45**	**13**	**2.6**	**1.3**
QD8/95-119		14		1.5
R53188	20	14	1.7	1.9
Tamaroi	**45**	**16**	**2.4**	**1.9**
W979-33/6/6	21	19	1.4	1.2

Discussion

Improving field resistance and/or tolerance to crown rot in durum is proving difficult and this is reflected in the screening results from 2008 and 2009. Lines which appeared promising in 2008 generally did not perform well in 2009 and some which performed well in 2009 did not perform well in 2008. This highlights the need for acquiring data from at least two seasons before drawing conclusions about crown rot resistance and/or tolerance.

Some of this variability in performance, particularly in terms of whiteheads, may be accounted for by the lack of agronomic adaptation exhibited by many of the durum lines. Despite these difficulties, in 2010 we will continue to assess new durum breeders' material and the more promising lines from 2008 and 2009.

Control of ryegrass with pre-emergent herbicides

This trial was funded by GRDC and conducted in collaboration with the Birchip Cropping Group and the University of Adelaide.

Key findings

- Boxer Gold IBS + PSPE or Trifluralin IBS + Avadex Xtra IBS + Dual Gold PSPE gave the best pre-emergent annual ryegrass control in 2009.
- Boxer Gold or Dual Gold applied PSPE significantly improved ryegrass control in the crop row.

Why do the trial?

Hart has conducted many years of research on pre-emergent herbicides and the control of annual ryegrass. A summary of the results generated (Table 1) shows that good control of group D (trifluralin) resistant ryegrass can be achieved. It has also shows that older herbicides can be just as effective as some of the newer, more expensive herbicides.

Table 1: Ryegrass % control for pre-emergent herbicide treatments at Hart in the years from and including 2003 to 2008.

	2003	2004	2005	2006	2007	2008	Average
Rate of Trifluralin 480 L/ha	**1.0**	**1.2**	**1.2**	**1.5**	**1.4**	**1.4**	**1.3**
Number in the nil (plants per sq m)	564	145	282	95	31	65	197
Herbicide treatment			**% ryegrass controlled**				
Nil	0	0	0	0	0	0	0
Trifluralin 480 IBS	86	60	80	49	70	17	60
Avadex Xtra 1.6L/ha IBS			45	52	57		51
Dual Gold 0.5L/ha IBS			55	42	47		48
Trifluralin480 + Glean 10g/ha IBS	93	76	83				84
Trifluralin480 + Avadex Xtra 1.0L/ha IBS	83	71	85		70		77
Trifluralin480 + Avadex Xtra 1.6L/ha IBS			81	54	69	74	70
Trifluralin480 + Dual Gold 0.5L/ha IBS		76	85	52	64	52	66
Trifluralin480 + Avadex Xtra 1L/ha + Dual Gold 0.35L/ha IBS	93	75	90	59	76		79
Trifluralin480 IBS + Dual Gold 0.35L/ha PSPE	90	86	87				88
Trifluralin480 IBS + Dual Gold 0.5L/ha PSPE	96	90	91	52	83	67	80
Trifluralin480 IBS + Dual Gold 0.25L/ha IBS + Dual Gold 0.35 L/ha PSPE		79	94	44	77		74
Boxer Gold @ 2.5L/ha				72	81	76	76
Sakura (BAY-191 118g/ha)				88	80	79	82
LSD (0.05)	17	21	15	17	16	27	

However, regardless of herbicide efficacy a common paddock observation is the lack of annual ryegrass control within the crop row. Techniques to improve the control of ryegrass within the crop row include modifying seeding equipment to leave a layer of treated soil in the row or to apply pre-emergent herbicides after sowing and before emergence (PSPE), in a separate spray application.

In past trials PSPE treatments specifically using S-metolachlor (Dual Gold) have produced good ryegrass control, depending on soil moisture. Hence, this trial aims to compare the effect of different pre-emergent herbicides applied pre sowing and post sowing on wheat establishment and ryegrass control and to specifically improve the control of ryegrass in the crop row.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 70 kg/ha + 2% Zn
Seeding date	22nd May 2009	**Variety**	Catalina wheat @ 70 kg/ha

The trial was a randomised complete block design with 3 replicates and 16 herbicide treatments (Table 2). Active ingredients of the herbicides used in the trial are listed in table 3.

To ensure even ryegrass establishment across the trial ryegrass seed was broadcast at 25 kg/ha ahead of seeding and tickled in with a shallow pass with the seeder prior to herbicide application. The ryegrass used was harvested from paddocks in 2007 and is approximately 30% resistant to trifluralin.

The seeding equipment used was a 6 row plot seeder on 225mm (9”) spacing with narrow points and press wheels.

Pre-sowing herbicides were applied within 1 hour of sowing and incorporated by sowing (IBS), the post sow pre-emergent (PSPE) herbicides were applied 3 days after sowing following 12mm of rain the previous night. Follow up rain was negligible until 12 days later, when 25mm was received.

Crop emergence was measured by counting plants along 2 metres of row in each plot.

Ryegrass was counted within the seed row, on the shoulder of the furrow and on the rise between 2 furrows. 0.1 of a square metre was counted in each of the 3 areas in every plot.

Table 2: Pre-emergent herbicides, rates and timings

	Treatment
1	Nil
2	Trifluralin 480 1.4L/ha IBS
3	Avadex Xtra 3.0L/ha IBS
4	Trifluralin 480 1.4L/ha IBS + Avadex Xtra 1.6L/ha IBS
5	Trifluralin480 1.4L/ha IBS + Dual Gold 0.5L/ha IBS
6	Trifluralin 480 1.4L/ha IBS + Avadex Xtra 1.6L/ha IBS + Dual Gold 0.35L/ha PSPE
7	Trifluralin 480 1.4L/ha IBS + Dual Gold 0.35L/ha PSPE
8	Boxer Gold 2.5L/ha IBS
9	Boxer Gold 1.5L/ha IBS + Boxer Gold 1.0 L/ha PSPE
10	Boxer Gold 1.5L/ha IBS + Dual Gold 0.35L/ha PSPE
11	Trifluralin 480 1.4L/ha IBS + Boxer Gold 1.5L/ha IBS
12	NUL1493 0.75L/ha IBS
13	NUL 1493 0.5L/ha IBS + NUL 1493 0.35L/ha PSPE
14	Sakura 118g/ha IBS
15	Sakura 118g/ha IBS + Dual Gold 0.35L/ha PSPE
16	Sakura 118g/ha IBS + Avadex Xtra 1.6L/ha IBS

Table 3: Pre-emergent herbicides and active ingredients

Herbicide	Active ingredients
Trifluralin 480	trifluralin 480g/L
Dual Gold	S-metolachlor 960g/L
Avadex Xtra	tri-allate 500g/L
Boxer Gold	S-metolachlor 120g/L + prosulfocarb 800g/L
NUL-1493	experimental
Sakura (BAY-191 850WG)	pyroxasulfone

Results

No herbicide treatment significantly affected wheat plant establishment compared to the untreated. However, in previous trials, the herbicides NUL1493 0.75L/ha IBS and Avadex Xtra 3.0L/ha IBS have caused significant crop damage. The average crop density achieved in 2009 was 117 plants per square metre.

All treatments produced significant control of ryegrass between the crop rows and ranged between 60% (Trifluralin 480 1.4L/ha IBS) and 89% control (Sakura 850WG 118g/ha IBS + Avadex Xtra 1.6L/ha IBS) (Table 4). Treatments giving better than 85% control ryegrass between the crop rows were:

- Trifluralin 480 1.4L/ha IBS + Dual Gold 0.5L/ha IBS
- Trifluralin 480 1.4L/ha IBS + Boxer Gold 1.5L/ha IBS
- NUL1493 0.75L/ha IBS
- Sakura 850WG 118g/ha IBS + Avadex Xtra 1.6L/ha IBS.

All treatments containing Dual Gold produced lower ryegrass control in the inter-row (76%) highlighting the solubility and movement of this herbicide.

Trifluralin 480 1.4L/ha IBS produced 31% control on the shoulder of the press wheel furrow, however, this difference was not significant, with all treatments averaging 59% control. The greatest control in this area of the plot came from NUL1493 0.50L/ha IBS + NUL 1493 0.35L/ha PSPE or Trifluralin 480 1.4L/ha IBS + Avadex Xtra 1.6L/ha IBS + Dual Gold 0.35L/ha, averaging 75% control (Table 4).

Ryegrass control in the crop row was generally poorer compared to the other areas measured, averaging only 56% compared to 79% control on the inter-row. This matches paddock observations. However, all PSPE treatments (averaging 70% control) were significantly better compared to IBS alone (averaging 51% control) at controlling ryegrass in the crop row. Of the IBS treatments Avadex Xtra 3.0L/ha IBS, NUL1493 0.75L/ha IBS and Sakura 850WG 118g/ha IBS + Avadex Xtra 1.6L/ha IBS produced the best in-row control averaging 63%.

Trifluralin 480 1.4L/ha IBS produced the worst control of the treatments in all areas of the crop row (41% overall control compared to the untreated) (Table 4). This result was expected as the ryegrass sown was 30% resistant to trifluralin. The treatments listed below all achieved at least a 75% reduction in the ryegrass plant population across the whole row.

- Trifluralin 480 1.4L/ha IBS + Avadex Xtra 1.6L/ha IBS + Dual Gold 0.35L/ha PSPE
- Boxer Gold 1.5 IBS + Boxer Gold 1.0 PSPE
- NUL1493 0.75L/ha IBS
- NUL1493 0.5L/ha IBS + NUL1493 0.35 PSPE
- Sakura 118g/ha IBS + Avadex Xtra 1.6L/ha IBS

A further 3 treatments produced at least 70% control across the whole row (Table 4).

Overall, for the control of Group D resistant ryegrass there are a number of effective pre-emergent herbicide options available. For the greatest control of in-row ryegrass PSPE applications are the most effective. However, these present a higher risk to crop safety, depending on soil type and rainfall after application.

Table 4: Pre-emergent herbicide treatments, ryegrass plant number and % control at Hart in 2009. Plants per square metre values are expressed as the number of ryegrass plants in a square metre between the crop rows, on the crop row shoulder or in the crop row.

	Treatment	Ryegrass between crop rows		Ryegrass on crop row shoulder		Ryegrass in crop row		Overall control	
		plants/m²	% control	plants/m²	% control	plants/m²	% control	plants/m²	% control
1	NIL	553	-	243	-	163	-	320	-
2	Tri 1.4L IBS	220	60	167	31	180	0	189	41
3	Ava 3L IBS	107	81	120	51	67	59	98	69
4	Tri 1.4L + Av 1.6L IBS	143	74	97	60	93	43	111	65
5	Tri 1.4L + DG 0.5L IBS	73	87	100	59	80	51	84	74
6	Tri 1.4L + Av 1.6L IBS + DG 0.35L PSPE	123	78	63	74	40	75	75	76
7	Tri 1.4L IBS + DG 0.35L PSPE	170	69	137	44	60	63	122	62
8	BG 2.5L IBS	120	78	93	62	107	35	107	67
9	BG 1.5L IBS + BG 1.0L PSPE	97	82	73	70	33	80	68	79
10	BG 1.5L IBS + DG 0.35L PSPE	107	81	90	63	73	55	90	72
11	Tri 1.4L + BG 1.5L IBS	83	85	120	51	90	45	98	69
12	NUL 1493 0.75L IBS	73	87	87	64	57	65	72	77
13	NUL 1493 0.5L IBS + NUL 1493 0.35 PSPE	87	84	60	75	43	73	63	80
14	Sak 118g IBS	147	73	103	57	87	47	112	65
15	Sak 118g IBS + DG 0.35L PSPE	133	76	103	57	40	75	92	71
16	Sak 118g IBS + Av 1.6L IBS	63	89	83	66	57	65	68	79
	LSD (0.05)	85	48	83	66	140	75		

Chickpea competition with annual ryegrass

Mick Lines & Larn McMurray, SARDI, Trial funded by GRDC

Key findings

- Although chickpea yields were higher than previous years at Hart, the rapid finish to the season favoured earlier flowering and maturing varieties such as Genesis™079 and Sonali.
- Ryegrass competition at 31 and 86 plants/m^2 reduced chickpea grain yield by 31% and 56%, respectively.
- Breeder's line "Chickpea 4" recorded the lowest yield loss from ryegrass competition at both sites (9% at the low ryegrass density at Hart), and also displayed 35% better tiller suppression than other varieties at Hart.
- Early vigour appeared an important trait in chickpea for improved competiveness with ryegrass, whilst short plant height was a disadvantage.

Why do the trials?

Chickpeas are widely recognised as poor competitors, with previous research showing high yield losses caused by competition with ryegrass. This trial was established with the aim of identifying chickpea plant types which are more competitive with ryegrass. Traits of particular interest included chickpea height, vigour, maturity and plant architecture (eg branching angle).

How was it done?

Plot size	1.4 x 10m	**Fertiliser**	MAP @ 76 kg/ha + 2% Zn
Seeding date	22nd May 2009	**Inoculant**	Group N granular

Trial design Randomised complete block design with 3 replicatess

Seeding rate (1)	35 plants/m^2 (kabuli) 50 plants/m^2 (desi)		
Varieties (10)	See Table 1		
Treatments (3)	Nil ryegrass	Nil ryegrass	
	Low ryegrass [a]	Sown with ryegrass @ 40 plants/m^2	
	High ryegrass [a]	Sown with ryegrass @ 100 plants/m^2	

[a] Ryegrass = cv. Wimmera annual ryegrass, no herbicide resistances

Table 1: Attributes of chickpea varieties included at Hart in 2009

	Variety	Early Growth Habit [a]	Early Vigour	Canopy Density [b]	Height	Maturity
Kabuli	Almaz	semi-erect	poor	medium	medium	late
	Genesis™ 079	semi-erect	moderate	medium	short	early
	Genesis™ 090	semi-erect	good	dense	medium	mid
Desi	Genesis™ 509	semi-erect	moderate	thin	medium	mid
	PBA Slasher⟅	semi-spread	moderate	medium-thin	medium	mid
	Sonali	semi-erect	good	medium	tall	early
	Chickpea 1 [c]	semi-erect	very good	dense	very tall	mid-late
	Chickpea 2 [c]	erect	good	very dense	tall	mid
	Chickpea 3 [c]	semi-erect	moderate	dense	medium	mid
	Chickpea 4 [c]	erect	very good	very thin	medium	mid

[a] Early growth habit refers to the initial branching angle, where spread denotes prostrate branching and erect denotes upright branching.

[b] Canopy density refers to the density of the mature canopy, and is important in preventing light penetration.

[c] Denotes Pulse Breeding Australia advanced chickpea line.

Results

Grain yield

Grain yields at Hart in 2009 were significantly higher than previous years, with weed free control plots averaging 1.34 t/ha, compared with just 0.54 t/ha in 2008, and 0.87 t/ha in 2007. The dry finish to the 2009 season favoured the earlier maturing varieties Genesis™079 and Sonali (Figure 1a), which recorded more than double the yield of late maturing varieties e.g. Almaz. Trends observed at Hart were supported by a similar trial at Turretfield (Figure 1b), however grain yields were much lower (nil treatments averaging 0.57 t/ha) due to high temperatures during early pod fill at this site.

All lines at both sites generally decreased in yield as ryegrass density increased, although Chickpea 4 at low ryegrass density yielded similarly to the nil, and Chickpeas 1 and 2 showed little difference in yield at low and high ryegrass densities. Genesis™079 and Sonali in the absence of ryegrass were the highest yielding varieties at Hart, followed by new release PBA Slasher⟅ and chickpea breeder's lines 3 and 4 (at Turretfield these lines all yielded similarly and higher than other lines). In competition with ryegrass the same varieties were generally still higher yielding although CICA0512 also performed similarly to this group.

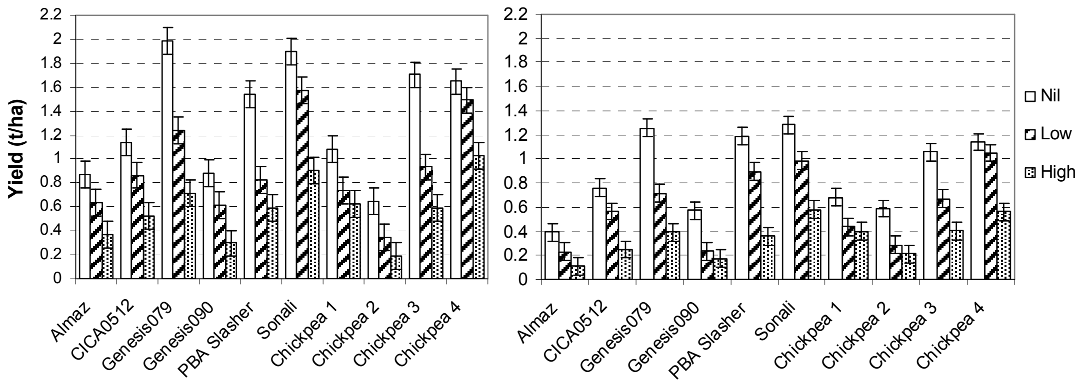


Figure 1a: Effect of ryegrass density on the yield of 10 chickpea lines, Hart 2009.
Figure 1b: Effect of ryegrass density on the yield of 10 chickpea lines, Turretfield 2009.

Percentage Yield Loss

Across all varieties competition from ryegrass reduced grain yields by an average of 31% at Hart and 33% at Turretfield in the low ryegrass treatment, and 56% and 61% respectively in the high density treatment.

Breeder's line Chickpea 4 showed the lowest percentage yield loss at both ryegrass densities at Hart (9% and 38% loss at low and high densities respectively – Figure 2a). A similar result was found at Turretfield, with Chickpea 4 showing 8% and 51% yield losses at low and high ryegrass densities (Figure 2b). At both sites Sonali showed relatively low yield loss at the low ryegrass density only, while Chickpea 1 displayed relatively lower yield loss at the high density. All these varieties have good to very good levels of early vigour (Table 1).

Chickpea 2 suffered higher yield losses than most other varieties across both sites, supporting similar results in 2008. Other varieties showing high yield loss under ryegrass competition included PBA Slasher$^{\Phi}$, Genesis^{TM}079, Genesis^{TM}090, Almaz, CICA0512, and Chickpea 2. All these varieties have poor to moderate levels of early vigour, with the exception of Chickpea 2 which showed good early vigour.

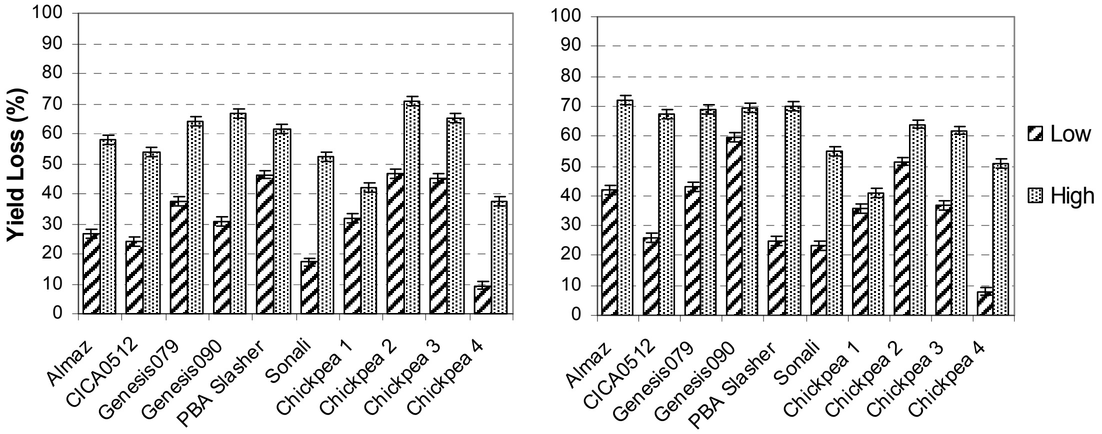


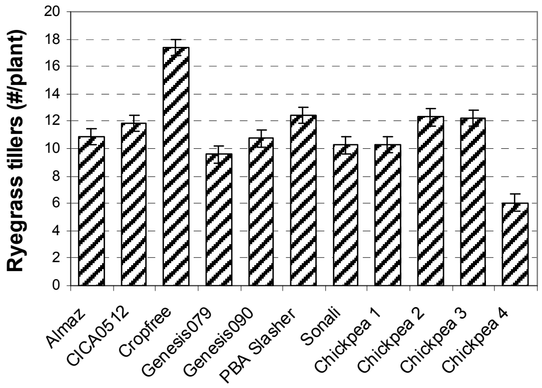
Figure 2a: Percentage yield loss of chickpeas under low and high ryegrass densities, Hart 2009
Figure 2b: Percentage yield loss of chickpeas under low and high ryegrass densities, Turretfield 2009

Ryegrass plant and tiller counts

The ability of chickpea lines to suppress tillering in ryegrass was deemed to be one of the most important measurements indicating competitiveness. Ryegrass tiller counts showed an almost four-fold increase in tillering in 2009 compared with that found in 2008.

Comparisons between low and high ryegrass treatments showed that ryegrass tillering was reduced by 39% at Hart and 25% at Turretfield as the sown ryegrass density was increased from 40 to 100 plants/m^2. Ryegrass tillering was also higher at Hart than Turretfield (16 tillers/plant compared with 12 tillers/plant at the low density).

At Hart all varieties performed similarly in their abilities to reduce ryegrass tillering, regardless of ryegrass density. As with yield, PBA Slasher$^{\text{Ⓓ}}$ and Chickpeas 2 and 3 were amongst the worst competitors at Hart (Figure 3a). Chickpea 4 was again found to be more competitive with ryegrass as it showed a 65% reduction in tillering compared to the crop-free treatment, and was more than 35% better than all other varieties (Figure 3a). In contrast, PBA Slasher$^{\text{Ⓓ}}$ featured as one of the best competitors based on ryegrass tiller suppression at Turretfield (Figure 3b), together with Chickpea 4. Although Genesis$^{\text{TM}}$079 and Sonali yielded well, Figure 3b shows relatively high ryegrass tillering in these varieties, once again suggesting that while they yield well they do not necessarily compete well with ryegrass. By contrast, Chickpea 4 consistently competed well with ryegrass, and yielded relatively well compared to other varieties.



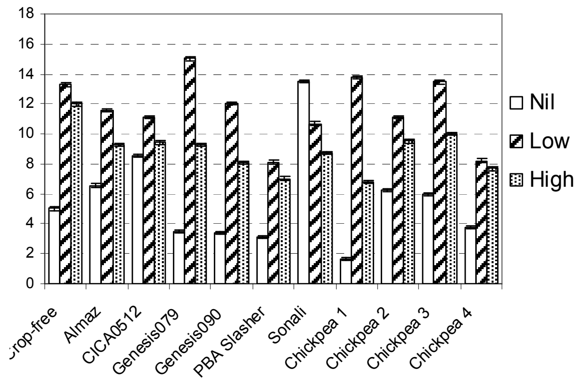


Figure 3a: Ryegrass tillering under competition with 10 chickpeas lines, Hart 2009.
Figure 3b: Effect of ryegrass density on its tillering under competition with 10 chickpeas lines, Turretfield 2009.

Summary

The higher yielding chickpeas without ryegrass competition were also higher yielding with competition. This is likely because the moisture stressed environment created by competition with ryegrass is similar to the moisture stress caused by a hot and dry season finish, as seen in 2008 and 2009, and these conditions are likely to favour early flowering and maturing lines such as Genesis^{TM}079 and Sonali.

Genesis^{TM}079 yielded well in 2009, but also displayed high relative yield loss and poor rye grass tiller suppression. The early maturity of Genesis^{TM}079 allows it to yield relatively well in moisture stressed situations (ie short season or under competition), however its short plant height and only moderate early vigour compromised its ability to compete with ryegrass.

Chickpea 4, which has very good early vigour, consistently performed well at both sites for yield loss and ryegrass tiller suppression, suggesting it has plant traits which enable it to compete well with ryegrass. Other varieties showing low yield loss also had good to very good early vigour, while those varieties suffering high yield losses generally had moderate to poor early vigour. Therefore agronomic strategies aimed at maximising early vigour are likely to be important in suppressing ryegrass in chickpea production.

Chickpea 2, which has traits that on paper should enable it to compete well, showed the highest yield loss, as well as poor ryegrass tiller suppression. PBA Slasher$^{\Phi}$ showed poor tiller suppression at Hart, but good suppression at Turretfield. These ambiguous findings and the lack of understanding of the impact of canopy density on ryegrass competition may be due to the unfavourable seasonal conditions for chickpea production which prevailed in SA last year. However, they do indicate the need for more work in a more favourable growing season, and potentially on a larger set of phenotypes (particularly those similar to Chickpea 4).

Acknowledgements
Thanks to GRDC for kindly funding this research. Thanks to Mark Bennie, Peter Maynard, John Nairn, Rowan Steele and Stuart Sherriff for assisting with trial management.

Controlling ryegrass along fence lines

Peter Boutsalis, Jenna Malone, and Christopher Preston
University of Adelaide

Key findings

- Glyphosate alone at high rates produced poor control of annual ryegrass along the fenceline.
- Spray.seed + Diuron, Round up Power Max + Diuron and Alliance all gave good control of the glyphosate resistant annual ryegrass.

Why do the trial?

To investigate the effectiveness of different herbicide mixes at controlling glyphosate resistant ryegrass along fencelines.

How was it done?

Plot size	1.75m x 7m	**Application dates**	18th August 31st August

Herbicides were applied in plots along a fenceline infested with annual ryegrass, 40% resistant to glyphosate.

Herbicides were applied using a hand boom with flat fan 110° 01 nozzles with 84 L/ha water.

Visual assessments and ryegrass head counts were made to evaluate the control of each herbicide or herbicide mix.

Results

Glyphosate is an important herbicide in no-till farming systems. A problem with the continual reliance on glyphosate for weed control is the evolution of glyphosate resistant weeds. To date glyphosate resistance has been confirmed in populations of three weed species in Australia: annual ryegrass, barnyard grass and liverseed grass. Resistance is suspected in other weed species. In principle any weed species can evolve resistance to glyphosate; however, in South Australia the biggest risk is annual ryegrass.

Glyphosate resistance can occur wherever glyphosate is intensively used, no other effective herbicides are used and no other weed control is practiced. Glyphosate is widely used for controlling vegetation growth along fence lines and crop margins. Where glyphosate is the only effective weed control used, resistance can occur. Of the 103 confirmed sites with glyphosate resistant annual ryegrass in Australia, a quarter are from fence lines and crop margins (Table 1). Many of these populations are from South Australia.

Table 1: Situations containing glyphosate resistant annual ryegrass in Australia

Situation		Number of sites	States
Broadacre cropping	Chemical fallow	28	NSW
	No-till winter grains	19	Vic, SA, WA
Horticulture	Tree crops	4	NSW
	Vine crops	15	SA, WA
Other	Driveway	1	NSW
	Fence line/Firebreak	25	NSW, SA, Vic, WA
	Irrigation channel	8	NSW
	Airstrip	1	SA
	Railway	1	WA
	Roadside	1	SA

From Preston, C. (2009) Australian Glyphosate Resistance Register. Australian Glyphosate Sustainability Working Group. Online. Available from www.glyphosateresistance.org.au

There is a concentration of glyphosate resistance on fence lines in the area around Clare in South Australia. Populations are also present on the Eyre Peninsula, Yorke Peninsula and around Horsham in Victoria.

Management of glyphosate resistant annual ryegrass on crop margins is necessary in order to stop resistance moving into the cropped area. A trial was conducted to look at the ability of glyphosate mixtures and alternative herbicides to control a glyphosate-resistant population of annual ryegrass on a fence line (Figure 1). This site had a high density of annual ryegrass and when tested proved to have high levels of resistance to glyphosate.

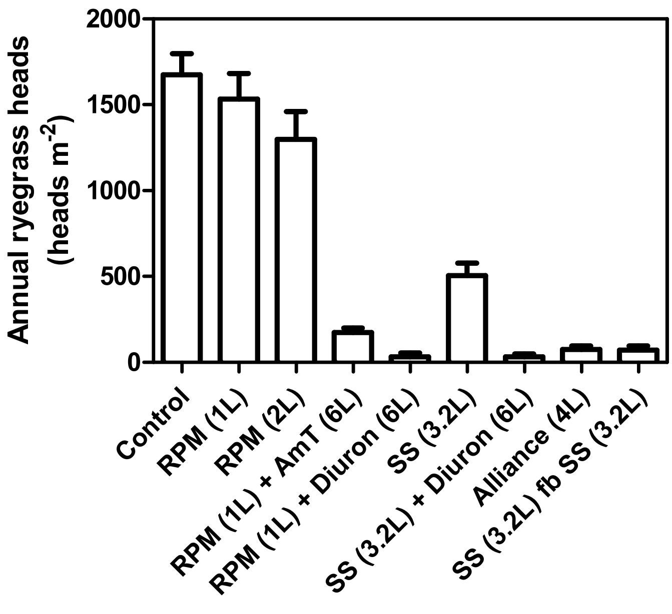


Figure 1: The efficacy of different mixes and rates of herbicides on glyphosate resistant ryegrass. RPM = Roundup PowerMax, SS = Spray.Seed, AmT = Amitrole T, fb = followed by after 14 days.

Glyphosate, even at high rates provided little control of the resistant ryegrass. Roundup PowerMax at 1 L/ha and 2 L/ha provided very little control of the ryegrass on the fence line. Some mixtures with glyphosate were more effective. Adding Amitrole at 6 L/ha to Roundup PowerMax did not provide sufficient control. Diuron at 6 L/ha was a more effective mixing partner.

Spray.Seed alone at 3.2 L/ha was insufficient to control the ryegrass. However, Diuron at 6 L/ha added to Spray.Seed was effective, as was Alliance and two applications of Spray.Seed 14 days apart. Additional treatments are being explored in other trials.

GRDC Project UA00104

Hart's Linden Price at the
2009 Hart Field Day

Crop topping feed barley for annual ryegrass in 2008

This trial was funded by the GRDC

Key Findings:

- All herbicide treatments reduced grain yield by 13% in TOS 1 and at least 8% in TOS 2.
- Glyphosate (540 g/L) at 3.0L/ha was the only treatment to significantly reduce germination, down to 7% at TOS 1 and 88% at TOS 2.
- For each application timing glyphosate (540 g/L), glufosinate (200g/L) and paraquat (250g/L) significantly reduced the germination percentage of ryegrass.

Why do the trial?

Crop topping is a highly successful and widely used practice for pulse crops, but little or no work has been done on wheat or barley. This strategy offers another tool for controlling annual ryegrass, while reducing the development of herbicide resistance particularly for early maturing varieties or seasons.

To investigate the effect of crop topping cereals for annual ryegrass control with non-selective herbicides.

How was it done?

Plot size	1.5m x 5m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn
Seeding date	6th June 2008	**Application date**	TOS 1 8th October TOS 2 15th October
Variety	Keel		

Please note that apart from diquat (250g/L), the herbicide treatments used in this trial are not registered for use in barley. This trial was conducted in 2008.

Crop topping barley:

The trial was a randomised complete block design with 3 replicates, 2 times of spraying (TOS) and 7 herbicide treatments.

All plots were assessed for grain yield, test weight, germination and screenings with a 2.2 mm screen.

Herbicide application timing was based on the barley growth stage:

Time of spraying 1 (TOS 1) 8th October
Barley 50% milk, awns turning, and heads still quite green
Whole head moisture (total/wet*100) 55%

Time of spraying 2 (TOS 2) 15th October
Barley firm dough, no milk but moist, leathery, springs back
Whole head moisture 43%

Herbicides were applied with a hand boom with 01-110º flat fan nozzles in 114L water/ha

Herbicide treatments:
- Nil
- glyphosate (540 g/L) 1.8L/ha
-glufosinate (200g/L) 3.0L/ha
- paraquat (250 g/L) 0.9L/ha
- glyphosate (540 g/L) 0.9L/ha
- glyphosate (540 g/L) 3.0L/ha
- diquat (250 g/L) 2.0L/ha + wetter 0.1%

Crop topping annual ryegrass:

This trial was conducted in a grower's paddock containing annual ryegrass and was a randomised complete block design with 3 replicates, 2 times of spraying (TOS) and 7 herbicide treatments. The herbicide treatments and application were as per the barley trial.

All plots were sampled at maturity and the ryegrass seed was assessed for germination in Autumn.

Herbicide application timing was based on the ryegrass growth stage:

Time of spraying 1 (TOS 1) 8th October
Ryegrass beginning to flower, 10% of heads flowering

Time of spraying 2 (TOS 2) 15th October
Ryegrass well into flowering, 20% of heads flowering

Results

Crop topping barley:

All herbicide treatments reduced grain yield by 13% in TOS 1 and at least 8% in TOS 2 (Table 1).

The difference in grain yield between TOS 1 and TOS 2 was not significant accept in the case of glyphosate (540 g/L) 1.8L/ha or 3.0L/ha, where there was a 15% increase in grain yield from delaying application until TOS 2 (Table 1).

Glufosinate (200g/L) 3.0L/ha produced the greatest yield losses in both application timings, 27% in TOS 1 and 20% in TOS 2, though these were not significantly different.

Delaying herbicide application until TOS 2 (October 15th) generally reduced screenings, although it was not significant.

All herbicide treatments significntly increased screenings compared to the nil independent of TOS.

Glyphosate (540 g/L) at 1.8 or 3.0L/ha produced the lowest grain weights and germination percentages for both herbicide application timings (Table 2). For all other treatments grain weight and germination were not affected. Glyphosate (540 g/L) at 3.0L/ha was the only treatment to significantly reduce germination, down to 7% at TOS 1 and 88% at TOS 2.

Table 1: Grain yield (t/ha) and screenings (%) for herbicide treatment and time of spraying (TOS). TOS 1 - 8th October, TOS 2 - 15th October.

Herbicide treatment	Rate	Grain yield (t/ha)		Screenings (%<2.2mm)	
	(L/ha)	TOS 1	TOS 2	TOS 1	TOS 2
Nil	0	3.24	3.04	39	55
glyphosate (540g/L)	0.9	2.62	2.80	76	70
glyphosate (540g/L)	1.8	2.42	2.79	91	70
glyphosate (540g/L)	3.0	2.40	2.66	92	69
glufosinate (200g/L)	3.0	2.37	2.65	92	63
diquat (250g/L)	2.0	2.48	2.57	75	60
paraquat (250g/L)	0.8	2.55	2.64	80	62
LSD (0.05)					
TOS		0.14		10	
Herbicide		0.26		18	
TOS*Herbicide		n.s.		n.s.	

Table 2: Grain weight (mg/grain) and germination (%) for herbicide treatment and time of spraying (TOS). TOS 1 - 8th October, TOS 2 - 15th October.

Herbicide	Rate	Grain weight (mg/grain)		Germination (%)	
	(L/ha)	TOS 1	TOS 2	TOS 1	TOS 2
Nil	0	35	32	97	99
glyphosate (540g/L)	0.9	30	31	94	96
glyphosate (540g/L)	1.8	28	31	12	92
glyphosate (540g/L)	3.0	29	28	7	88
glufosinate (200g/L)	3.0	27	31	97	96
diquat (250g/L)	2.0	30	31	96	98
paraquat (250g/L)	0.8	29	31	97	97
LSD (0.05)					
TOS		n.s.		2	
Herbicide		3		4	
TOS*Herbicide		n.s.		6	

Crop topping annual ryegrass:

At each application timing Power Max, Basta and paraquat significantly reduced the germination percentage of ryegrass. This matches previous results and highlights the success possible using this strategy (Table 3). The diquat treatments did not reduce the viability of the ryegrass seed.

Table 3: Germination (%) of annual ryegrass for herbicide treatment and time of spraying (TOS). TOS 1 - 8th October, TOS 2 - 15th October.

Herbicide treatment	Rate (L/ha)	Germination (%) TOS 1	Germination (%) TOS 2
Nil	0	52	54
Power Max	0.9	2	2
Power Max	1.8	0	0
Power Max	3.0	2	0
Basta	3.0	2	0
Diquat	2.0	78	66
Paraquat	0.8	14	14
LSD (0.05) Herbicide		6	17

Hart Board Members Jane Adams and Justin Wundke with a group of Clare High School Ag students at the Hart Field Day 2009

Legume and oilseed herbicide tolerance

Key findings

- Sakura (BAY-191) and Boxer Gold produced slight effects on all 3 types of canola.
- Raptor had no negative impact on beans at Hart in 2009.

Why do the trial?

To compare the tolerance of legumes and canola varieties to a range of herbicides and timings.

How was it done?

Plot size	2m x 3m	**Fertiliser**	MAP @ 60 kg/ha
Seeding date	30th May 2009		

14 strips of canola, pasture, vetch, chickpeas, faba beans, field peas and lentils were sown. 61 herbicide treatments were applied across these crops at one of 5 timings.

The timings were

Pre sowing (IBS)	21st May
Post seeding pre-emergent (PSPE)	26th May
Early post emergent (3 – 4 node)	29th June
Post emergent (6 node)	8th July
Late post emergent (10 node)	31st July

Treatments were visually assessed and scored for herbicide effects 4 weeks after application.

Crop damage ratings were:

1 = no effect
2 = slight effect
3 = moderate effect
4 = severe effect
5 = death

Results

Many of the herbicides are not registered for the crops that have been sprayed. It is important to check the herbicide label before following strategies used in this demonstration. Herbicide effects can vary depending on soil and weather conditions.

Sakura (BAY-191) and Boxergold applied pre-sowing had slight effects on all 3 canola varieties and the Frontier balansa. NUL-1493 had slight effects on the Clearfield canola, TT canola, Frontier balansa and Herald medic. Other pre-sowing pre-emergent herbicides had little or no effect on all of the crops. A reminder that registrations for these herbicides are limited or not recommended for many of these crop types.

Post sowing pre-emergent (PSPE) herbicide treatments Balance and Balance + Simazine produced an excellent result killing all but the chickpeas. All PSPE treatments caused severe effects on all of the pasture and canola types.

A new addition in 2009, Terbyne was safe in chickpeas, beans and peas and is registered for these crops. Note that lentils and vetch are not on the label. It is a triazine (group C) herbicide and provides good control of mustards, turnips, radish and thistles.

Raptor applied early post emergent had no effect on either of the bean varieties. There is currently a permit for the use of Raptor in beans but it should be noted that in past years moderate effects have been observed.

Conclude, Precept, Velocity and Banvel M did a good job of controlling all crops when applied at the post-emergent 5 node stage. Ecopar + MCPA Amine and Affinity Force + MCPA Amine produced the weakest effects across the range of crops at this timing, Ecopar was slightly softer on pastures.

All knockdown treatments achieved at least severe effects on all crops accept for the 2 vetch varieties. The 2 different herbicide groups of Alliance (Group F and Group L) and Basta (Group N) produced complete control. Morava was slightly more tolerant than the Capello at Hart in 2009. The most effective knockdown treatments for killing vetch were glyphosate + Cadence, Alliance or Basta.

Legume & Oilseed Herbicide Tolerance				Canola			Beans		Peas	Chick Peas	Vetch		Lentil	Pasture		
Sown: 21/5/09				44C79	ATR Cobbler	Garnet	Farah	Nura	Kaspa	Genesis 090	Capello	Morava	Nipper	Frontier Balansa	Scimitar	Angel
		Treatment	Rate kg/ha	5	5	5	140	140	100	80	45	45	45	15	15	15
Pre-sow 21/05	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Avadex Xtra	1600ml	1	1	1	1	1	1	1	1	1	1	1	1	1
	3	Dual Gold	500ml	1	2	1	1	1	1	1	1	1	1	1	1	1
	4	NUL 1493	1000ml	2	2	1	1	1	1	1	1	1	1	2	2	1
	5	Boxer Gold	2500ml	2	2	2	1	1	1	1	1	1	1	2	1	1
	6	Sakaura (BAY-191)	118g	2	2	2	1	1	1	1	1	1	1	3	1	1
PSPE 26/05	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Diuron	850g	4	5	4	1	1	1	1	1	1	1	5	2	3
	3	Simazine	850g	4	1	4	1	1	1	1	1	1	1	5	3	3
	4	Diuron + Simazine	410g/410g	3	3	4	1	1	1	1	1	1	1	4	3	3
	5	Metribuzin	280g	5	4	5	1	1	1	1	1	1	2	5	4	4
	6	Terbyne	1000g	5	3	5	1	1	1	1	1	1	2	5	5	5
	7	Spinnaker	70g	2	5	4	1	2	1	1	1	1	3	4	3	1
	8	Spinnaker + Simazine	40g/850g	4	4	4	1	2	1	1	1	1	2	4	4	3
	9	Balance	100g	5	5	5	5	5	5	1	5	5	5	5	5	5
	10	Balance + Simazine	100g/830g	5	5	5	5	5	5	1	5	5	5	5	5	5
3-4 node 29/06	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Simazine	850g	4	3	3	1	1	1	1	1	1	1	5	2	1
	3	Metribuzin	280g	5	4	5	5	3	2	5	2	2	2	5	5	5
	4	Broadstrike	25g	2	5	4	3	3	2	1	3	2	1	3	1	1
	5	Brodal Options	150ml	5	5	5	4	4	2	3	4	4	3	5	4	4
	6	Brodal Options + MCPA Amine	150ml/150ml	5	5	5	4	4	2	4	4	4	4	5	4	4
	7	Sniper 750WG	50g	5	5	5	4	4	3	3	4	4	3	4	4	4
	8	Spinnaker + wetter	70g/0.2%	3	5	5	3	3	1	3	3	3	3	3	3	2
	9	Raptor + wetter	45g/0.2%	2	5	4	1	1	1	2	3	2	2	4	3	2
5 node 08/07	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Logran+wetter	10g/0.1%	3	5	5	5	5	5	5	5	5	5	5	5	2
	3	Ally + wetter	7g/0.1%	3	5	5	5	5	5	5	5	2	5	5	5	4
	4	Eclipse SC + Uptake	50ml/0.5%	1	5	5	5	5	5	4	5	5	4	5	4	4
	5	Ecopar + MCPA Amine	400ml/500ml	5	5	5	3	3	5	3	3	2	3	2	1	1
	6	Conclude + Uptake	700ml/0.5%	5	5	5	5	5	5	5	5	5	5	5	5	4
	7	Precept + Hasten	750ml/1%	5	5	5	5	5	5	5	5	5	5	5	5	5
	8	Velocity + Hasten	670ml/1%	5	5	5	5	5	5	5	5	5	5	5	5	5
	9	Banvel M	1L	5	5	5	5	5	5	5	5	5	5	5	5	5
	10	Intervix + Hasten	600ml/1%	1	5	5	4	4	4	5	4	3	5	5	5	2
	11	Midas + Hasten	900ml/0.5%	4	5	5	4	4	4	5	5	3	5	5	5	2
	12	Hussar OD + wetter	100ml/0.25%	3	5	5	5	5	5	5	5	5	5	5	5	5
	13	Crusader + Uptake	500ml/0.5%	1	5	5	5	5	5	5	5	5	5	5	5	4
	14	Atlantis OD + Hasten	330ml/1%	2	5	5	5	5	5	5	5	5	5	5	5	5
	15	Affinity Force + MCPA Amine	100ml/500ml	5	5	5	4	4	3	5	3	2	3	2	2	2
	16	Atrazine + Hasten	833g/1%	5	1	5	3	1	4	5	4	3	4	5	5	4
	17	Lontrel	150ml	1	1	1	5	5	5	5	5	5	5	5	5	5
8 node 31/07	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	MCPA Sodium	700ml	4	4	4	5	5	1	2	3	3	2	2	2	2
	3	MCPA Amine	350ml	4	4	4	4	4	1	3	3	3	2	2	2	2
	4	Amicide 625	1.2L	5	5	5	5	5	5	5	5	4	4	4	3	3
	5	2,4-D Ester	70ml	4	4	4	4	4	2	2	3	3	3	5	5	5
5 node 08/07	1	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1
	2	Sprayseed	2L	5	5	5	4	4	5	5	4	4	4	5	5	5
	3	Glyphosate	1L	5	5	5	4	4	5	4	3	3	5	5	5	5
	4	Glyphosate + LVE 680	1L/500ml	5	5	5	5	5	5	5	5	4	5	5	5	5
	5	Glyphosate + Hammer	1L/50ml	5	5	5	4	4	5	5	3	3	5	5	5	5
	6	Glyphosate + Goal	1L/100ml	5	5	5	4	4	5	5	3	3	5	5	5	5
	7	Glyphosate + Cadence	1L/115g	5	5	5	5	5	5	5	5	5	5	5	5	5
	8	Alliance	2L	5	5	5	5	5	5	5	5	5	5	5	5	5
	9	Glyphosate // Sprayseed 3DAS	1.2L//1.2L	5	5	5	5	5	5	5	4	3	5	5	5	5
	10	Sprayseed // Sprayseed 3DAS	1.2L//1.2L	5	5	5	5	4	5	4	4	3	4	5	5	5
	11	Basta	2.5L	5	5	5	5	5	5	5	5	5	5	5	5	5
	12	NIL		1	1	1	1	1	1	1	1	1	1	1	1	1

Cropping systems

Funded by Caring for Our Country and conducted in collaboration with farmers Michael Jaeschke, Matt Dare and Jack Desbiolles from the University of South Australia.

Key findings

- There was no significant difference between sowing systems or level of nutrition on grain yield.
- Levels of brome grass were higher under the early sowing no-till plots and annual ryegrass was lower in the disc system.
- There is very little difference in long term gross margin between seeding system or level of nutrition.

Why do the trial?

To compare the performance of 3 seeding systems and 2 nutrition strategies. This is a rotation trial to assess the longer term effects of seeding systems and higher fertiliser input systems.

How was it done?

Plot size	35m x 13m		**Fertiliser**	DAP @ 50 kg/ha + 2% Zn
			High nutrition	Urea @ 60 kg/ha 10th August
Seeding date	Disc	27th May	**Medium nutrition**	Urea @ 120 kg/ha 10th August
	No-till	29th May		
	Strategic	29th May	**Variety**	Flagship barley @ 70 kg/ha

This trial is a randomised complete block design with 3 replicates, each containing 3 tillage treatments and 2 nutrition treatments. The strategic and no-till treatments were sown using local farmers seeding equipment, Michael Jaeschke and Matt Dare. The disc seeding treatments were sown by Jack Desbiolles from the University of South Australia.

Table 1: Previous crops in the long term cropping systems trial at Hart.

2000	2001	2002	2003	2004	2005	2006	2007	2008
Sloop Barley	Canola	Janz Wheat	Yitpi Wheat	SloopSA Barley	Kaspa Peas	Kalka Durum	JNZ Wheat	JNZ Wheat

Tillage treatments:

Disc – sown into standing stubble with a John Deere single opener disc seeder, 275mm (11”) row spacing.

Strategic – worked up pre-seeding, sown with 100mm (4”) wide points at 175mm (7”) row spacing with finger harrows.

No-till – sown into standing stubble in 1 pass with narrow points with 225mm (9”) row spacing and press wheels.

Nutrition treatments:
Medium – 60 kg/ha post emergent urea on 10th August
High – 120 kg/ha post emergent urea on 10th August

In the years 2007 and 2008 an early time of sowing treatment was introduced in the no-till treatment to demonstrate the benefits of dry sowing. In 2009 all no-till treatments were sown on the same day.

Soil nitrogen (0-60cm) was measured on 27th March in all plots.

Bromegrass, annual ryegrass and wildoat densities were counted using 3 counts with a 0.1 metre square quadrat in each plot.

Financial analysis:
A partial gross margin analysis of the trial results between 2000 and 2008 was conducted by Mike Krause of Applied Economic Solutions.

The analysis took into account differences in grain yields, fuel use, labour use and depreciation on the capital items for an area of 1500ha. Weed control, disease control and grain quality were considered the same between the treatments.

Results

The density of brome grass was significantly higher for the early sown no-till treatment (71 plants per square metre) compared to the other sowing systems, averaging 23 plants per square metre. This is due to dry sowing or sowing prior to weed emergence. The disc system had the lowest level of brome grass. However, this result is unexpected given that brome grass has been observed in the disc sowing treatments for many years. The disc also had a significantly lower level of annual ryegrass (19 plants per square metre) compared to the other sowing systems, averaging 103 plants per square metre. The average wild oat density in the cropping system trial was 13 plants per square metre, there was no significant difference between the sowing systems.

Table 2: Grass weed densities (plants per square metre) in the cropping systems trial at Hart in 2009 averaged across the nutrition treatments.

Sowing system	Bromegrass	Annual ryegrass	Wildoats
	Plants per metre square		
Disc	14	19	10
No-till	29	79	16
No-til early	71	92	28
Strategic	26	137	0
LSD (0.1)	33	84	ns

No treatment produced significant differences in grain yield between sowing system or level of nutrition (Table 3 & 4).

Table 3: Grain yield (t/ha), protein (%), retention (%), screenings (%), test weight (kg/hL) and soil N (kg N/ha 0-60cm) averaged across nutrition treatments for sowing system at Hart in 2009.

Sowing system	Grain yield (t/ha)	Protein (%)	Retention (%)	Screenings (%)	Tet weight (kg/hL)	Soil N (kg N/ha 0-60cm)
Disc	4.22	10.6	92.8	5.1	65.2	129
No-till	4.18	11.3	92.7	4.8	64.9	105
Strategic	4.32	11.5	91.7	5.4	64.5	181
LSD (0.05)	ns	0.5	ns	ns	ns	69

Table 4: Grain yield (t/ha), protein (%), retention (%), screenings (%), test weight (kg/hL) and soil N (kg N/ha 0-60cm) averaged across sowing system for nutrition treatments at Hart in 2009.

Nutrition	Grain yield (t/ha)	Protein (%)	Retention (%)	Screenings (%)	Tet weight (kg/hL)	Soil N (kg N/ha 0-60cm)
High	4.156	11.4	91.3	5.8	64.7	147
Med	4.322	10.8	93.5	4.4	65.0	130
LSD (0.05)	ns	0.4	1.9	ns	ns	ns

Higher protein was measured in the no-till and strategic treatments, compared to the disc in 2009. High nutrition also increased the protein to 11.4% compared to 10.8% in the medium treatment. In previous years tillage and nutrition have had little effect on protein (Tables 3 & 4).

Tillage and nutrition treatment did not have a significant impact on test weight and screenings in 2009. Test weights were all above 64kg/hL and screenings averaged 5.1% (Tables 3 & 4). High nutrition produced slightly lower retention (91.3%) compared with medium nutrition (93.5%) and was unaffected by sowing system.

Although soil nitrogen levels were not significantly different between the medium and high nutrition treatments, the high treatment has accumulated 17kg N/ha more than the medium treatment to a depth of 60cm. The strategic sowing system produced the highest soil nitrogen (181 kg N/ha 0-60cm) while the disc treatment is significantly lower (105 kg N/ha 0-60cm).

Financial analysis

The partial gross margin analysis of the results between 2000 and 2008 showed very little difference between the seeding systems or levels of nutrition (Figure 1).

The no-till tillage treatment at medium nutrition is $200/ha above the disc or strategic or $22/ha per year (Figure 1).

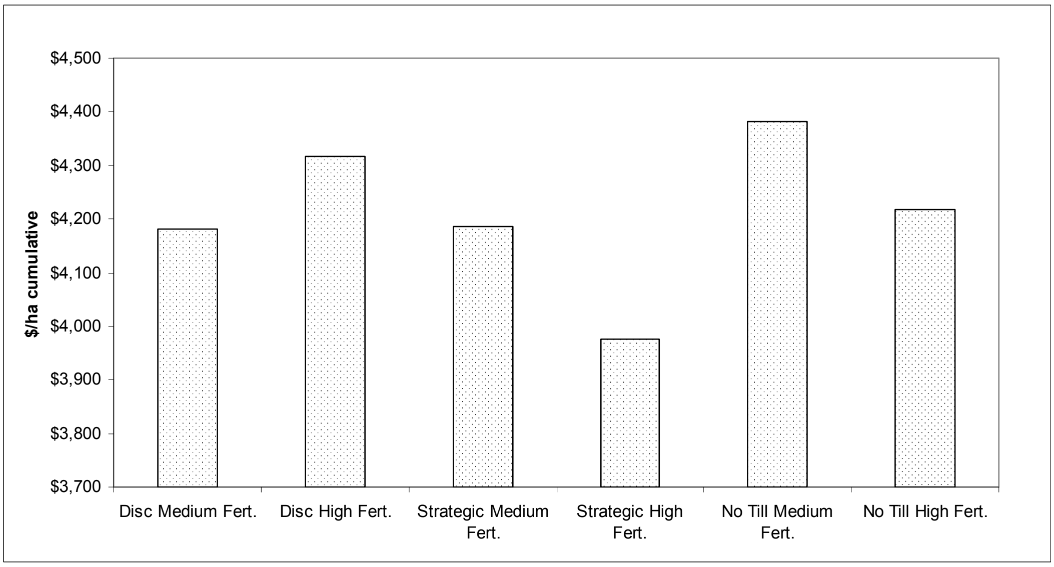


Figure 1: Cumulative partial gross margins for tillage and nutrition treatments at Hart between 2000 and 2008.

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 much greater labour efficiency compared to the strategic system. The gross margins do allow for labour, however, sourcing and maintaining it can be a difficult task.
- these systems also offer the potential for improved time of sowing, being able to sow into marginal soil moisture and using only one pass, in recent years this has proven to generate significant differences in grain yields.
- 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. The herbicide costs for this treatment are lower and would help to account for the differences shown in Figure 1.

Yield Prophet® performance in 2009

Key findings

- The actual wheat grain yield at Hart in 2009 was 2.46 t/ha, well under the final Yield Prophet® prediction of 3.7 t/ha.

Why do the trial?

Wheat growth models such as APSIM are highly valuable in their ability to predict wheat yield.

Yield Prophet® is an internet based service using the APSIM wheat prediction model. The model relies on accurate soil character information such as plant available water and soil nitrogen levels, as well as historical climate data and up to date local weather information to predict plant growth rates and final hay or grain yields.

How was it done?

Seeding date 18th May 2009 **Fertiliser** DAP @ 60 kg/ha + 2% Zn

Variety Gladius wheat @ 70 kg/ha

Soil samples were taken for soil nitrogen and moisture on the 2nd April 2009.

Table 1: Soil conditions at Hart (0-90cm), 2nd April 2009.

Available soil moisture	0mm
Initial soil N	94 kg/ha

Yield Prophet® simulations were run throughout the season to track the progress of wheat growth stages and changes in grain yield predictions.

20%, 50% and 80% levels of probability refer to the percentage of years where the corresponding yield estimate would have been met, according to the previous 100 years of rainfall data.

Results

The grain yield for Gladius wheat sown on the 18th May at Hart in 2009 was 2.46 t/ha. This final grain yield is well below the final Yield Prophet® prediction, however it fell between the 50% and 80% level of probability up until the 23rd of September 2009 (Figure 1).

On the date of the first simulation, 24th June 2009, the Yield Prophet® simulation predicted that Gladius wheat sown on the 18th May with 165 plants per square metre would yield 3.3 t/ha in 50% of years. The predicted yield increased slightly in July and then by the end of

August had dropped 0.7 t/ha to 2.6 t/ha at the 50% level of probability (Figure 1). Yield predictions continued to drop at a steady rate until significant rainfall events occurred in mid September. The final Yield Prophet® simulation on the 28th September for predicted yield at the 50% level was 3.7 t/ha.

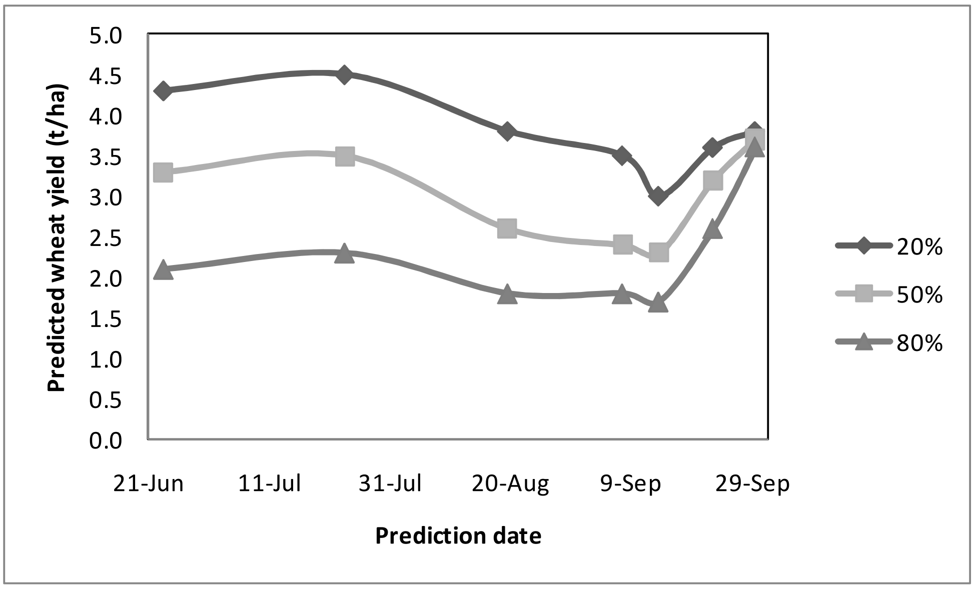


Figure 1: Yield Prophet® predictions from 24th June to the 28th September for Gladius wheat sown on the 18th May with 60 kg/ha DAP. 80%, 50% and 20% represent the chance of reaching the corresponding yield at the date of the simulation.

At sowing plant available water (PAW) measured 0mm (0-90cm). Figure 2 shows that by the 24th of June PAW had increased to 27mm and increased further to 47mm by the 24th July. However, as the season progressed PAW declined and significant water stress began to occur during August (Figure 3). Around the time of flowering, 12th to 16th September, the daily maximum temperature was above 25 ^{O}C, this also occurred in October. Rainfall from the 16th September relieved the stress and PAW increased to an estimated 52mm on the 28th September.

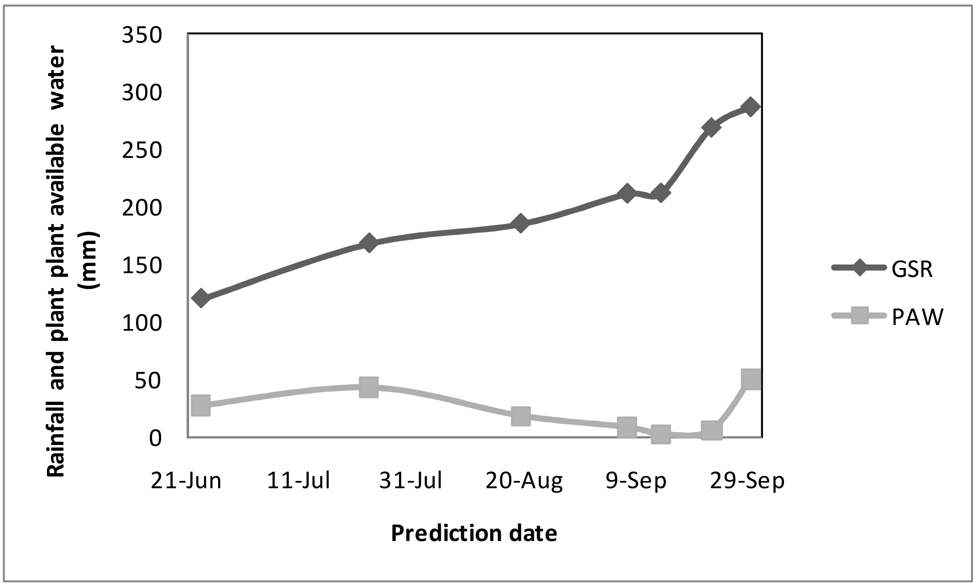


Figure 2: Predicted plant available water and cumulative growing season rainfall from 24th June to the 28th September at Hart in 2009.

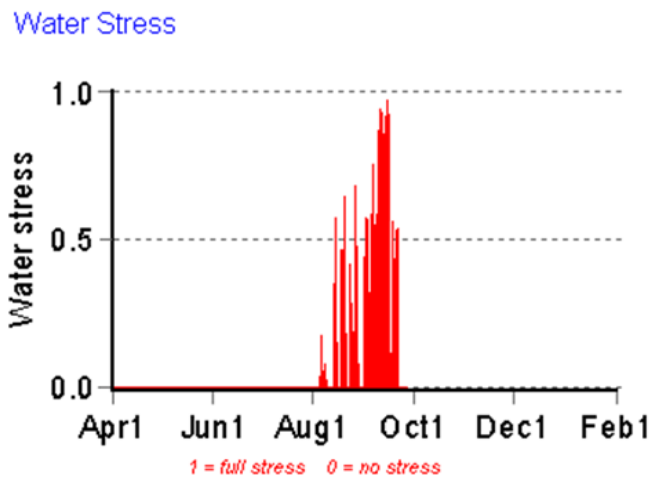


Figure 3: Predicted crop water stress for Gladius wheat sown on the 18th May at Hart in 2009.

Summer rain and stubble management

Funded by the GRDC Water Use Efficiency Initiative and conducted in collaboration with SARDI and the University of Adelaide.

Key findings

- Wheat yield increased from 2.6 t/ha in controls to 3.2 t/ha in plots receiving the equivalent of summer rainfall decile 5 (50mm) or decile 9 (100mm) in a single event in February.
- Stubble treatments (bare ground control, standing 2 t stubble/ha, flat 2 t stubble/ha, flat 5 t stubble/ha) did not affect the dynamics of soil water nor grain yield.

Why do the trial?

In south-eastern Australia, cereals depend on two sources of water: water stored in the soil during summer fallow, and in-season rainfall. However, the actual value of capturing out-of season water in the Mid-north region of SA is uncertain. In contrast to the dominance of small events in winter rainfall, summer rainfall is characterised by large storm events. The potential for deep-storage of water in soils is greater in large events.

This trial aimed to measure the interaction between stubble management and soil moisture on:

1. the retention of soil water accumulated outside the growing season.
2. the value of stored water to crop physiological traits and yield.

How was it done?

Plot size	5m x 6m	**Fertiliser**	DAP @ 65 kg/ha
Seeding date	8th May 2009	**Variety**	Gladius

The trial was a randomised complete block design with 3 replicates and 12 treatments resulting from the combination of four stubble treatments and three water regimes.

Rainfall treatments:

- Control (no added water)
- Decile 5 (50mm applied with trickle irrigation)
- Decile 9 (100mm applied with trickle irrigation)

Stubble treatments:

- Standing (2 t/ha)
- Flat (2 t/ha)
- Additional flat stubble (5 t/ha)
- Bare ground control

Soil moisture content was intensively monitored using capacitance probes from the establishment of the experiment to harvest, to determine the fate of the summer rainfall and the effects of stubble. Crop phenology and growth were monitored during the season, and grain yield and yield components determined at maturity.

Crop evapotranspiration (ET) was calculated as the difference between soil water at sowing and maturity plus the rainfall during this period. Water use efficiency (WUE) was calculated by dividing yield (kg/ha) by ET (mm).

Interception of photosynthetically active radiation (PAR) was recorded throughout the season using a ceptometer. Radiation use efficiency (RUE) was calculated by dividing shoot biomass by cumulative PAR. RUE is grams of biomass per MJ radiation intercepted and is a measure of the photosynthetic efficiency of the crop.

Results

Stubble effects

Stubble had a transient effect on top-soil temperature during fallow and crop establishment. The top soil in the plots with 5t stubble/ha had lower maximum temperature and higher minimum temperature than bare ground controls. This insulating effect favoured faster emergence, but differences in development were not evident after emergence. Stubble treatments did not affect the capture and dynamics of soil water and had no measurable effect on grain yield. The analysis in the following section therefore pools the data across stubble treatments.

Yield value of summer rainfall

At sowing, the decile 9 treatment had 46mm extra soil water in the soil profile compared to the control treatment (Fig 1a, Table 1). Approximately half the water applied through summer rainfall was retained and the remainder was lost to evaporation.

This high fallow efficiency can be attributed to the large size of the single rainfall event. It is likely that if the same amount of rain had fallen over a number of events more of the water would be lost through evaporation with a consequent lower fallow efficiency.

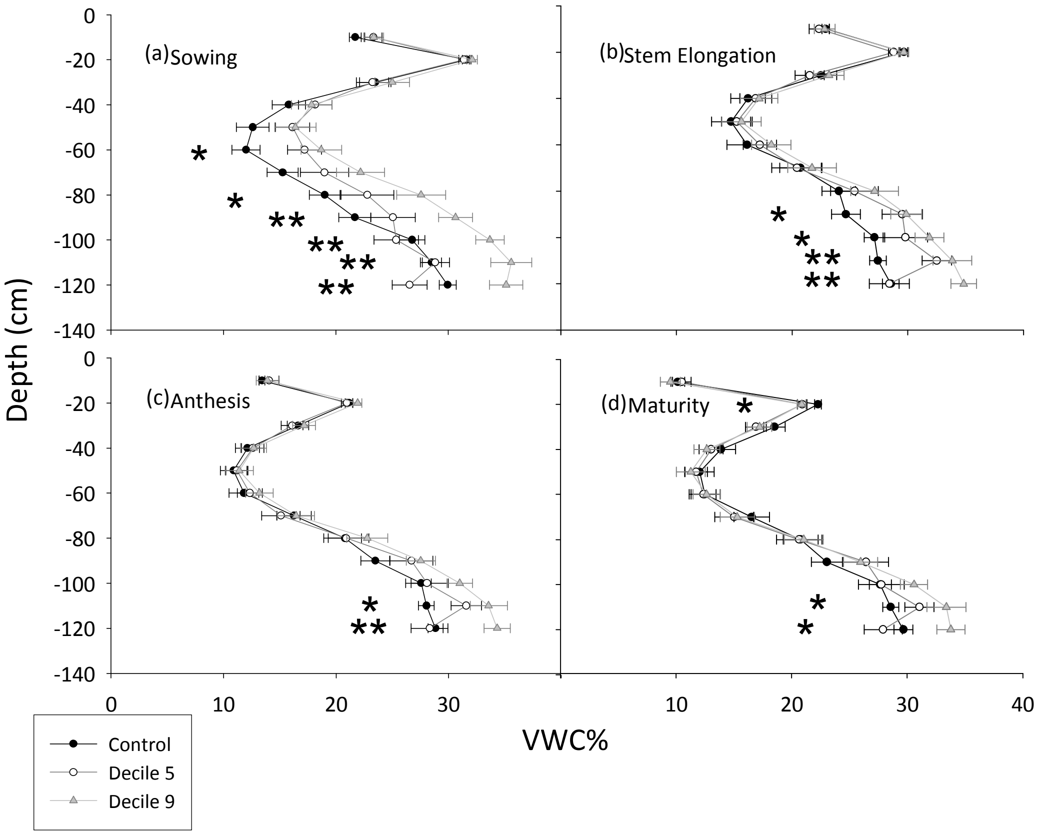


Figure 1. Soil Volumetric Water Content (VWC%) at depth split by summer rainfall treatments. Results from sowing (a), stem elongation (b), anthesis (c) and maturity (d). Stars indicate significant difference (* <0.05, ** <0.005).

Table 1. Additional available soil water at critical crop stages calculated as difference between irrigated and control treatments.

Depth	Sowing		Stem Elongation		Anthesis		Maturity	
(cm)	Decile 5	Decile 9	Decile 5	Decile 9	Decile 5	Decile 9	Decile 5	Decile 9
0-50	7.0	9.5	-1.3	2.4	0.7	2.8	-3.8	-5.3
50-100	14.7	38.1	9.7	16.2	3.2	11.0	1.7	5.0
0-100	21.7	47.5	8.4	18.6	3.9	13.9	-2.1	-0.3

The additional soil moisture in the profile from the summer rainfall treatments affected crop growth earlier than expected. Differences in shoot biomass (Figure 2) and crop water use (not shown) were evident in the first sampling date at stem elongation. The additional water, although deep in the profile, had significantly increased the biomass by over 0.5 t/ha, and by maturity the difference between the control and summer rainfall treatments exceeded 1.0 t/ha (Figure 3). Despite the difference in additional soil water shown between decile 5 and decile 9 treatments, there were no differences between the two for grain yield or any yield components.

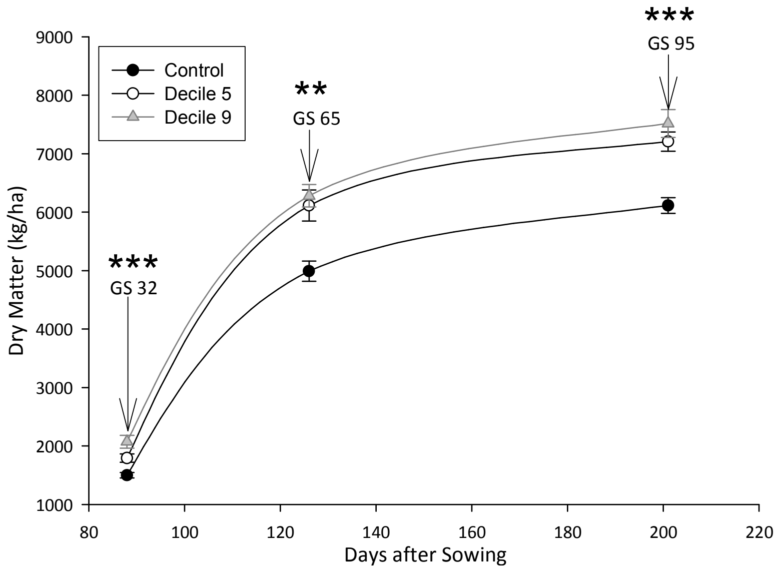


Figure 2. Shoot dry matter at crop stage GS 32 (Stem Elongation), GS 65 (Anthesis), and GS 95 (Maturity). Stars indicate level of significance (**<0.005, ***<0.0005).

The early difference in growth was maintained throughout the season, and was responsible for increasing the yield of the crop as harvest index was unaffected (Table 2). Water use, rather than water use efficiency, accounted for the difference in growth and yield with additional water.

Table 2. Grain and biomass yield and yield components and their corresponding radiation use efficiency (RUE) and water use efficiency (WUE). WUE and ET calculated using 100cm profile.

Measurement	Summer Rainfall Decile			Significance
	Control	Decile 5	Decile 9	
Grain Yield (t/ha)	2.6	3.2	3.2	<0.005
Dry Matter Yield (t/ha)	6.1	7.2	7.5	<0.0001
Harvest Index (%)	43.2	43.9	42.3	Not significant
RUE (g/MJ)	1.0	1.1	1.1	<0.05
WUE (Grain, kg/ha/mm)	9.2	10.0	9.5	Not significant
WUE (Biomass, kg/ha/mm)	21.2	22.8	22.4	Not significant
ET (mm)	288.6	313.0	335.7	<0.0001
No. Heads/m^2	220.0	254.0	263.0	<0.005
Grains/m^2	6185.0	7420.0	7432.0	<0.001
1000 Grain Wt (g)	42.5	42.8	42.8	Not significant

The increase in early growth due to the additional moisture was unexpected. Many reports suggest the greatest benefit of subsoil moisture is through the grain filling period.

Insufficient nitrogen may account for the lack of yield difference between the decile 5 and decile 9 treatments and for the residual water in the soil at maturity in the decile 9 treatments (Fig. 1).

Conclusion

- Summer rainfall corresponding to deciles 5 and 9 increased yield by 0.5t/ha in relation to controls.
- The extra 50mm of rainfall added in the decile 9 treatment did not increase grain yield from decile 5.
- Contrary to the expectation that stored soil water would contribute to yield late in the season, we found subsoil water effects on growth were evident early in the season.
- Subsoil moisture increased yield by increasing early growth and number of heads and therefore grains per m^2.
- It is likely that the lack of stubble effect on retaining moisture, and the high fallow efficiency was partially due to the large single event that was applied.
- Subsoil constraints or shortage of nitrogen could reduce the yield benefits of summer rainfall stored in the subsoil.

Further Work

This trial will be repeated in the coming season with some changes to adjust for the lessons learnt in the 2009 trial. The number of sites will be increased, the effect of rainfall event size will be investigated, and nitrogen treatments will also be included.

Hart's Matt Dare speaking at the 2009 Hart Field Day

Soil moisture retention granules

Key findings

- Soil moisture retention granules did not influence wheat grain yield at Hart in 2009.

Why do the trial?

To investigate the performance of soil moisture retention granules and seed coatings on wheat grain yield.

How was it done?

Plot size	1.4m x 10m	**Fertiliser**	DAP @ 60 kg/ha + 2% Zn
Seeding date	25th May 2009	**Variety**	Gladius @ 70 kg/ha

The trial was a randomised complete block design with 3 replicates and 5 treatments.

Aquaboost soil moisture retention granules (AG100) were applied with the seed at 2 kg/ha or 4 kg/ha. Aquaboost seed coat seed dressing (AG30) was applied to the seed prior to sowing at 10L/t.

Plots were assessed for grain yield.

Results

Grain yield in this trial ranged from 3.10 t/ha to 3.32 t/ha. The use of soil water retention granules and/or seed coats did not significantly increase the yield of Gladius wheat (Table 1).

Table 1: Grain yield results (t/ha) for soil moisture retention granules at Hart in 2009.

Treatment	Grain yield (t/ha)	% of untreated
Untreated	3.22	100
Seed coat	3.20	100
Granules 2 kg/ha	3.32	103
Granules 4 kg/ha	3.31	103
Seed coat + granules 2 kg/ha	3.10	96
LSD (0.05)	0.18	6

Improving water use efficiency

This trial is funded by the GRDC in collaboration with the University of Adelaide and CSIRO

Key findings

- WUE was generally low at the 4 sites in 2009, ranging from 9.1 kg wheat/mm/ha at Tarlee to 12.2 kg wheat/mm/ha at Spalding.

Why do the trial?

Impressive gains in improving crop and systems water use efficiency (WUE) have been captured by Australian farmers over the past 30 years and some farmers are achieving close to their environmentally attainable yields in most seasons.

This trial will investigate the reasons for these differences in WUE by continuing with trials established at 4 sites in 2008 on different soil types and rainfall zones in selected grower paddocks. The sites established are:

- Hart, 400mm annual rainfall, sandy clay loam
- Condowie, 350mm, sandy loam
- Spalding, 450mm, red brown earth
- Tarlee, 550mm, cracking red earth

How was it done?

Plot size	8m x 10m			
Seeding date	Hart 18th May	**Fertiliser**	Hart	DAP@60 kg/ha+2% Zn
	Condowie 30th April		Condowie	DAP@40 kg/ha+2% Zn
	Spalding 9th May		Spalding	DAP@85 kg/ha+2% Zn
	Tarlee 1st June		Tarlee	DAP@130 kg/ha+2% Zn

Each trial was a randomised complete block design with 3 replicates and 5 crops.

The 5 crops are Gladius wheat, Keel barley, Buckley wheat hay, Kaspa peas and Tornado canola, grown in rotation to ensure weed free plots are available for wheat in each successive season.

All trials were sown with 50mm chisel points and press wheels on 225mm (9”) spacing.

All cereal grain plots were assessed for grain yield, protein, wheat screenings with a 2.0 mm screen and barley screenings with a 2.2 mm screen.

Break crops (hay, peas and canola) were not assessed for grain or hay quality.

The hay was cut and removed from the plots by hand and assessed for hay yield.

Drained upper limit and crop lower limit (wheat) were measured at each site in 2008 to calculate plant available water capacity (PAWC).

WUE was calculated for the cereal crops at each site using the French & Schultz formula.

Wheat
Yield potential = (GSR-110mm)*20 kg/mm/ha

Barley
Yield potential = (GSR-90mm)*20 kg/mm/ha

Results

The wheat WUE was generally low compared to previous seasons for the 4 sites in 2009, ranging from 9.1 kg/ha/mm at Tarlee to 12.2 kg/mm/ha at Spalding (Table 1).

The lower rainfall sites Condowie and Hart received slightly above average GSR and the Spalding and Tarlee sites received about 125mm greater GSR than the average. However, there were some periods across all sites during the 2009 season where temperatures were well above average, especially leading up to flowering, and where soil moisture was limiting. Incidences of frost also occurred. Pre-flowering stresses combined with high temperatures during grain fill are likely to be the cause of lower WUE values compared to other seasons. WUE at the Tarlee site would have also been restricted by a later sowing date.

Table 1. Soil type, average total and average growing season rainfall (GSR), 2009 total and 2009 GSR and wheat and barley water use efficiency (WUE) for the four WUE sites in 2009.

Site	Soil type	Average total rainfall	Average GSR	2009 total rainfall	2009 GSR	Wheat	Barley
			(mm)			WUE (kg/ha/mm)	
Condowie	sandy loam	349	252	359	288	11.6	17.6
Hart	sandy, clay loam	400	305	394	322	11.0	11.0
Spalding	red brown earth	434	322	541	437	12.2	13.2
Tarlee	cracking red earth	469	350	531	477	9.1	10.0

Wheat grain yields ranged from 1.96 t/ha (Condowie) to 4.00 t/ha (Spalding) and barley grain yields ranged from 3.51 t/ha (Condowie) to 4.57 t/ha (Spalding) (Table 2).

Protein was lower in the wheat at the higher rainfall sites, Spalding (11.0%) and Tarlee (10.0%), and all values were above 10.0%.

Wheat screenings were all below 1.5%, with Hart having the lowest, 0.9%. Barley screenings were highest at Condowie (8.4%), Tarlee produced the second highest (3.3%) and the remaining 2 sites produced screenings below 1.3%.

Table 2. Grain yield (t/ha), protein (%) and screenings (%<2.0 mm for wheat and %<2.2mm for barley) at the four WUE sites in 2009.

Site	Crop	Grain yield (t/ha)	Protein (%)	Screenings (%)
Condowie	Wheat	1.96	13.7	1.4
	Barley	3.51	11.7	8.4
Hart	Wheat	2.46	11.4	0.9
	Barley	4.08	11.3	1.3
Spalding	Wheat	4.00	11.0	1.4
	Barley	4.57	10.7	1.2
Tarlee	Wheat	3.33	10.0	1.4
	Barley	3.57	11.2	3.3

Pea yields ranged from 0.77 t/ha at Condowie to 3.16 t/ha at Tarlee (Table 3).

Canola yield was highest at Spalding (2.13 t/ha). At Condowie, the lower rainfall site, the canola yield was 0.91 t/ha, highlighting the potential benefits of early sowing in marginal environments. The missing canola yield at Tarlee is the result of poor plant establishment.

Hay yields ranged from 4.03 t/ha at Condowie to 8.33 t/ha at Spalding.

Table 3. Grain and hay yields (t/ha) for the break crops, peas, canola and hay, at the four WUE sites in 2009.

Crop	Condowie	Hart	Spalding	Tarlee
	Grain or hay yield (t/ha)			
Peas	0.77	1.90	1.72	3.16
Canola	0.91	0.96	2.13	na
Hay	4.03	4.07	8.33	8.03

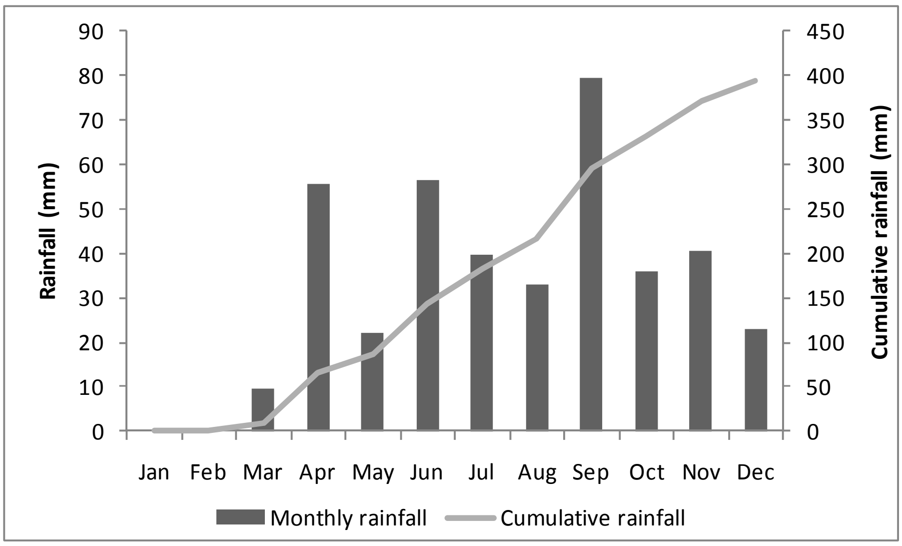
Acknowledgements: Brian Kirchner, Andrew and Rowan Cootes and Mark Hill.

Rainfall, Hart 2009

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1							4.6	0.8	0.8			
2			0.4		0.2		0.6	0.2		15		
3			1.2				1.4	0.2	1.2			
4			6.2				0.4		0.2			
5			0.6									
6						6				0.2		
7						0.6		0.8	1			
8						7		0.2	1.4			13.4
9						8			0.2			
10						4	0.2					0.8
11							7.6	6.6				0.2
12							0.2	0.2		0.2		
13			0.8			1	0.6		0.2	9.8		
14			0.2		2.8	0.8	0.4	0.2		7.4		
15					0.6	7	12.2			1.8		
16					1	0.2	4.2	1.8		0.6		
17					2	1.4	0.8	0.4	14	0.6		4.6
18						0.2			0.8			3.8
19								0.4				
20								0.2	0.2			
21						1.2					11	
22							0.8	3.6	21.8		26	
23								3.4	19.8		0.2	
24				19	1.8	4.4		0.4	0.2			
25				4.6	12.8			2.6	5.2	0.2		
26				15	0.6	13	1.2	2	8		1.2	
27				5.2		1.6	1.2		3.2			
28				11.8	0.2		0.6		1.2		0.2	
29					0.2		0.8	8			1.6	
30							0.4	0.6			0.2	
31							1.4	0.2				
Monthly total	0	0	9.4	55.6	22.2	56.4	39.6	32.8	79.4	35.8	40.4	22.8
Running total	0	0	9.4	65	87.2	143.6	183.2	216	295.4	331.2	371.6	394.4
Rain days	0	0	6	5	10	15	19	20	17	9	7	5

Average GSR (Apr-Oct) 305 mm
2009 GSR (Apr-Oct) 322 mm

Average rainfall 400 mm
2009 Total rainfall 394 mm



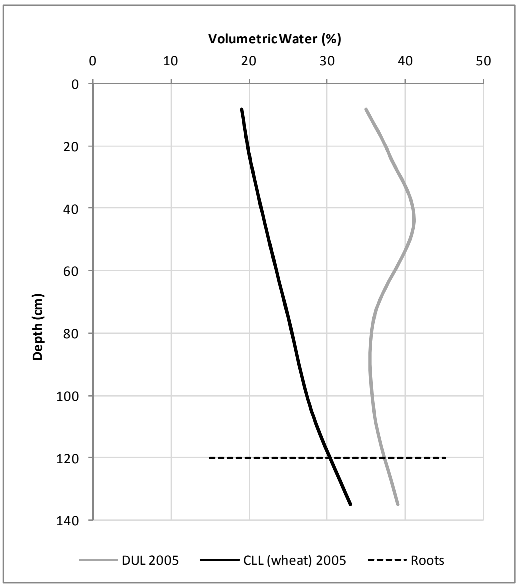
Soil test Hart trial site 2009

March 2009

	Depth (cm)	**0 - 10**
	Phosporus (ppm) (Cowel P)	33
	Potassium (ppm)	358
	pH (calcium chloride)	7.8
	pH (water)	8.5
	Phosphorus buffering index	118

Available soil moisture 27th March (0-60cm)	0mm	**Soil nitrogen 27th March (0-60cm)**	117 kg/ha

Hart soil water characteristics



The crop lower limit (CLL) for wheat and the drained upper limit (DUL) for the Hart field site measured in 2005.

Plant available water capacity for wheat at hart is 182mm to the depth of 150cm.

In 2005 roots were found to a depth of 120cm.