Core site - 2005

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Key Messages

In 2005 the Farming Systems Comparison Trial, the Core Site, came through its 8th season and has a further two years to complete the second, and final, rotation,

- A dry start to the growing season resulted in another late sow.
- The decision to refrain from sowing canola due to the late sowing date was repeated in 2005.
- For the first time since the initiation of the project we see a difference in the grain yields between farming systems.
- Projection of fleece weights suggests that fleece production may have approached performance of previous years.
- The perennial pasture was the highest profit making system based on crude estimates of gross margins.

Background

The Farming Systems Comparison Trial, otherwise known as the Core Site, has been operating at the Condobolin Agricultural Research and Advisory Station (ARAS) since 1998. The initiation of crop and pasture phases began in 1998 and the livestock component was introduced, two years later, in the year 2000. The purpose of the trial is to examine the running, profitability and sustainability of four farming systems used in Australia.

The Core Site is a large scale experiment and covers 160 hectares of land at the ARAS. Efforts have been made throughout the course of the program to balance the needs of research and the needs of farmers to ensure that the results are scientifically rigorous as well as applicable to the grower community. As much as possible, the system has attempted to manage these systems as many growers would anywhere in low rainfall regions of New South Wales.

As stated in the earlier section, "Statistics - How they help find a trend", repetition is key to identifying whether differences between treatments, or farming systems, is a coincidence or really a result of a different method of farming. The Core Site uses four replicates, or repetitions, of each farming system with every rotational phase within the system present in every year (Table 1). The four farming systems, each replicate approximately ten hectares, vary in cropping intensity and their use of plant species.

The traditional farming system is a mixed farming system that uses conventional tillage with livestock. This protocol is similar to the system used by many growers in the district and relies on tillage and livestock for weed control, although the use of chemicals is not unusual. The rotation is five years in length and consists of long fallow wheat (LFW), followed by short fallow wheat undersown with a pasture based on a combination of lucerne, clover and medics (SFWu/s). The remaining three years in the rotation are dedicated to a grazed pasture.

The second system, reduced tillage with livestock, is another mixed farming system that grows wheat crops on long fallow. The first year in the system's rotation consists of long fallow wheat (LFW) followed by a year of inactivity. During the second year, the stubble is maintained and weeds are controlled by grazing and a single herbicide application in August. The third rotation is a long fallow wheat undersown (LFWu/s) with a similar combination as the traditional system (SFWu/s) with a lucerne, clover and medic-based pasture. The final two years in the rotation are a grazed pasture.

The third system is a zero till, no livestock system with continuous cropping that is dependent on herbicide applications for weed control. This system, which includes no perennial species, is representative of intensified cropping in the Central West. The rotations include canola in the first year followed by short fallow wheat (SFWaC - the aC designates "after canola") in the second year. A pulse crop is utilised in the third year followed by a short fallow wheat crop (SFWaP - "after pulse") in the fourth year. The final year of this rotation is a green manure crop.

The final system is a perennial pasture: Each replicate of this pasture system is approximately 10 ha and is divided into 12 equal-sized segments radiating from a central watering point in each plot. This system, at present, has sheep rotationally grazed with weekly intervals in each segment. In good years when feed is present year round, the sheep will graze the pasture continually. In recent years drought has been severely affecting the system and grazing has only taken place, at various stocking rates, for part of the year.

2005 Methods

As was the case in 2004 when drought affected the site, there was no significant rainfall on the Core Site until June (Table 2) which, as in previous years, resulted in the late sowing of most crops. The mean monthly rainfall for 2005 was largely below average when compared to the previous eight years rainfall at the Core Site. The annual average rainfall was also below average for the same period.

The dates and varieties sown since 1998 are shown in Table 3. In the continuous cropping system (no tillage, no livestock), the decision not to sow canola was maintained from 2004 and wheat was again sown during this phase. The optimal sowing time for canola was already past by the time adequate moisture was available and the protocol adopted in 2004 was again used in 2005. As planned in 2004, a phase following the canola-substitute crop of wheat was not followed by a sowing of wheat-on-wheat, but barley was sown in these four replicates.

The previous year saw continuing phases of pasture in the traditional system resown under a cover crop of field peas due to establishment difficulties as a result of continuing dry conditions. The status quo returned in 2005 with pasture sown under the wheat and no peas in the system.

As in previous years where feed was not available to livestock as a result outcome of drought and locusts, sheep were present for a very small portion of the year in 2005. Weights for the sheep were taken going onto the site, and again when leaving. The sheep were shorn early and weights recorded in April 2005, again due to continuing drought conditions. Estimates of end of year wool production are forecast from historical data, a procedure that is explained in detail later in this chapter.

Cropping information

The average wheat yields obtained at the Core Site in 2005 (1.63 t/ha, table 4) were lower than the district average (2.0 t/ha district average). Barley (2.5 t/ha) and field pea (1.7 t/ha) yields were marginally above average for the district (2.3 t/ha and 1.6 t/ha district average, respectively). All wheat grown in the continuous cropping system produced a significantly higher yield when compared to reduced till and traditional farming systems (5% lsd = 0.234). There were no significant differences within each cropping system. Total soil water content (Figure 1) has, since late 2003 when soil moisture began to be measured, been consistently higher in the continuous cropping plots; this higher soil water content may have lead to the comparatively greater yield in the wheat varieties. The overall low yields from the entire site in 2002-2004 have probably resulted from the low rainfall during the growing season. This also lowered the uptake of nutrients from the soil and, coupled with the slightly higher rainfall during the growing season in 2005, likely was a contributing factor to the higher yield for this system along with the earlier sowing time of two weeks.

The 2004 "wheat-instead-of-canola" plot in the continuous cropping system showed a higher level of water content due to pulse crop in 2003 not growing (effectively making the plot fallow). This higher water content was reduced in 2005 with barley following the wheat crop and the average water content falling at approximately the same rate with the other crops. The yields of barley from this isolated plot, while not able to be compared within the Core Site, were marginally above the district average.

Unlike previous years, 2005 showed no significant difference between wheat varieties in terms of yield and there was also no statistical difference in the grain quality (Table 5) or moisture content. When the systems were compared using the results of screenings (the amount of material that falls through a 2 mm sieve; small, cracked or broken grain; grain shrivelled by frost, heat or moisture/carbohydrate stress; and other foreign material such as weed seeds, small plant material, soil and insects), however, a statistically significant difference was found (5% lsd = 3.987). The traditional system (Drysdale SFWu/s, sown into stubble) had the highest screenings with an average of 26.1%. Test weights for wheat were significantly different (5% lsd = 2.565) with Chara wheat returning a higher test weight (75.3 kg/hl) than Drysdale wheat (69.5 kg/hl).

For the first time since the beginning of the project, we see a significant difference (5% lsd = 0.257) between the yields taken from different farming systems, regardless of the crop sown. In 2005, the continuous cropping farming system created an average of 1.56 t/ha for wheat harvested in this time compared to 1.24 and 1.27 t/ha for reduced tillage and traditional systems respectively. This difference is still evident when the wheat substituted for canola is removed from the analysis. This suggests that the higher yield is a result of the farming system practices and not a result of the altered protocol. This result should be viewed with caution; a single year isolated from the project will not represent the overall results. It should not, however, be overlooked that this effect may be a result of the long-term influences of the systems. These results will prove to be extremely valuable in the final years of the project and great interest will surround whether these trends.are sustained through to the completion of the project.

Livestock Information

Pastures were established prior to the introduction of sheep to the trial in March 2000 making the livestock information two years behind cropping information. The initial gross margin analysis did not take into account the parts of the system that had livestock, and the drought further impeded valuable analysis in recent years as livestock has spent a great deal of time off the trial on agistment due to lack of feed.

Sheep were present on the trial in 2005 when feed was present. This amounted to approximately 30% of the time on the traditional plots and 50% of the time on the perennial pasture and reduced tillage plots in 2005. Once again, the absence of sheep on the trials limits our ability to correlate livestock information reliably with the effect of the farming systems, although agistment expenses have been included in the gross margin analysis..

The sheep were weighed and shorn prematurely in April 2005. In order to estimate the fleece weights of sheep at year's end 2005, a regression was performed on existing sheep weight and fleece weight data from 2002 in order to determine a relationship between the weight of the sheep and the amount of fleece produced (Figure 2). A simple example of how regression might be useful is by thinking about the relationship between a person's height and their weight. As a person grows taller, they subsequently grow heavier and so it might be possible to determine a relationship between those two values and be able to predict a person's weight by knowing their height. By plotting the values for height against weight we might be able to see that as height increases, the average weight increases with it in a linear fashion. Fleece weight can be determined in a similar fashion.

It was determined that using the formula, $y = 0.0648x + 1.7895$ (where x = the sheep live weight and y = the projected fleece weight), an estimation of the fleece produced by each sheep could be calculated within acceptable limits. These results show that average fleece production may have been greater than 2004, and may have began approaching the performance of previous seasons (table 6).

The live weights for the end of 2005 (Table 7) show that the average percentage increase of body weight in reduced tillage (calculated from presented data as 21.23%) was significantly higher than the increase shown in the perennial pastures plots (15.45%). Traditional farming practices (18.44%) showed no difference to either of the other two systems. This follows the trend recorded in 2003 with the perennial pasture plots being the lowest weights of all systems. Stocking rates on the perennial pasture system were approximately two sheep per hectare compared to one sheep per hectare on the other systems.

Gross Margin Information

Economist D. Patton, NSW DPI, calculated the gross margins for the Core Site for the years 1998 to 2001 (Table 8) for the cropping section of the trial only. The information has not been examined again by an economist since the drought has been affecting the trial, and it is planned that this will be repeated at the completion of the rotational phase.

While table 8 presents information on only the cropping portions of the trial compiled by an economist for previous years, table 9 presents approximations of costs and gross margins with livestock included up to 2005 by the Core Site manager. The figures presented must be viewed with caution as they are very crude approximations and considerable differences may be evident when the figures are recalculated formally by an economist.

Grain prices are based on actual sale values from 2005. In addition to actual income, the following assumptions were made in order to calculate the figures presented in table 9;

- All operations are calculated on a rate equivalent to contract less 20% plus fuel;
- Chemical applications are calculated on the actual purchase price;
- Certified seed was sown for all applications;
- Wool returns for 2005 were calculated using current prices and based on average wool cuts from previous seasons;
- Agistment was acquired locally at current rates;
- And no labour inputs have been applied to the livestock figures.

It is clear from the approximate gross margins for each system that the high costs of cropping have continued to take a toll on gross margins in another successive dry year. Perennial pastures returned the greatest gross margin in 2005 with the reduced tillage system running at a loss. Traditional farming methods returned a minimal profit at 17 cents per hectare. This is due, in part, to input costs being able to be maintained at a low level whereas continued difficulties in cropping systems once again edged input costs higher and a late sowing date affecting the yields. Input costs for the traditional system, for example, were again high in 2005 as a result of ever increasing input costs and financial burden of weed control. While the flexibility in this system allows for the opportunistic hay-making of 2004, this was not undertaken in 2005.

Discussion

Monthly rainfall during the growing season, April to September, was below average for three of those six months. Of particular relevance to this study is the fact that April and May were both well below average with both months barely registering rainfall at all. As in previous years these dry months forced the delay of sowing and, compounding this delay, late rains in June delayed the sowing further due to too much moisture on the ground, As explained in previous years' reports, it is important not to discount the poor result of 2005 as dry years are an unavoidable and integral part of the farming life in the district.

The reason these results are still relevant - and further, are of particular interest - is due largely to the way in which the Core Site has been set up from its inception. We must revisit the idea of replicates in order to fully appreciate why dry, lean years are still valuable to the project as a whole.

In 1998 each farming system was set up with four replicates of each. This means that the continuous cropping system had four, equally sized repeats of the same system in different paddocks, traditional farming had four, equally sized repeats of the same system and so on. Where this becomes important, is the notion that each system did not begin on the same phase, with the exception of the pasture system since it, in essence, has only one phase -pasture. In 1998 the traditional farming system began with one paddock sown to LFW, one paddock to SFWu/s and two paddocks to pasture - phases 1,2, 3 and 4 all in the first year. The following year the LFW paddock moved to SFWu/s, the SFWu/s paddock progressed to pasture and so on.

This kind of replication ensures that, in the event of a single dry year occurring in a five year rotation, we can theorise how each system will behave with a dry year at different stages of the rotation. This allows a much more rigorous appraisal of how each farming system will react to natural environmental or management events because it will affect different phases. Similar to "not putting all your eggs in one basket", by having a staggered replication in the design, we can suggest how any farmer in the district might be affected by these events no matter where in the rotation they are in that particular system.

What is starting to appear at the Core Site is a situation where two of the four rotations have been managed differently and the remaining two have been managed as planned. This creates a balanced view on how dry years in the district will affect each system and will add value to the overall results after two complete rotations have been completed. To experience 10 years of near perfect growing season rainfall is not only highly unlikely on the Core Site, but not nearly as valuable as being able to effectively quantify the impact of these dry years for growers in an area of Australia that are equally unlikely to experience year after year of good rainfall. There may be added advantages to these conditions in that the Core Site may lead to sophisticated recommendations of best management practices for seasons where poor rainfall is experienced.

The data being collected by Brett Honeysett (DPI) is also proving to be an invaluable addition to the project and for further science in other areas. Figure 1 shows how spikes in rainfall, predictably, precede spikes in soil moisture. Site specific hydrology will become more and more interesting as the project's second, and final, rotation draws to its conclusion within two years and the information on the characteristics of soil moisture under certain crops and management systems will provide very useful insights. When more thorough examination of the soil characteristics that may affect moisture content are undertaken are and included in the analysis, such as soil texture and organic matter, a far more valuable discussion will be possible.

One of the most important things in science is the need to follow scientific design through to its endpoint. When long term projects are designed, they are often designed with a defined time in which to complete the tasks. For the Core Site, this time is 10 years, two full rotations in each system. The going has been tough and at times the results, when viewed by themselves, not heartening but it must be remembered that all these results will be most rigorous and the most informative when carried to the project's conclusion. The project was designed with the replicates, the systems and the rotations in place to make the 10 year results as powerful as they can be and the fortitude and will to pursue this endpoint will be rewarded with good science, good information and good conclusions.

Conclusion

The pastures system returned the highest positive gross margin in 2005. This is largely due to the fact that inputs were able to be kept to a minimum.

The real work and the real information is going to be produced by this program in less than two years. This is the take home message of 2005 - two full rotations are left at the Core Site and the ensuing analysis of 10 years of data will provide a complete and highly valuable set of findings.

Table 1: Rotational phases for each of the four farming systems included in the Core Site program.

Farming System	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Traditional	Long fallow wheat (LFW)	Short fallow wheat undersown (SFWu/s)	Pasture	Pasture	Pasture
Reduced tillage with livestock	LFW	No crop	LFW undersown (LFWu/s)	Pasture	Pasture
Continuous cropping	Canola	Short fallow wheat (SFWaC)	Pulse	Short fallow wheat (SFWaP)	Green manure
Perennial pasture	Pasture	Pasture	Pasture	Pasture	Pasture

Table 2: Monthly rainfall recorded at Condobolin Agricultural Research and Advisory Station, 1997 - 2005. Average annual rainfall, AAR, (1881 - 2004) = 442 mm. Bold monthly rainfall figures in 2005 indicate a below average total when compared to the previous eight years. Growing season months italicised.

Year	**J**	**F**	**M**	*A*	*M*	*J*	*J*	*A*	S	O	N	D	**MR**
1997	21.6	**6**	4.1	0.9	44.6	16.3	15.7	27.4	122	24	27.8	6.6	317
1998	35.8	4.5	4.4	53.7	56.3	48	75.3	82	79	47.9	50.9	14.2	552
1999	37.2	16.3	73.3	34.5	7	26.9	53.2	41.9	16.8	122	16.9	128	574
2000	8.8	30.6	76.1	45	95	17.8	14.9	58.7	12.5	64	63.2	16.7	503.3
2001	2.2	39.9	38.2	16.3	27.4	51	28.6	19.6	42	25.4	46.6	2.8	340
2002	0.8	172	19.4	11	22.1	4.4	8	6.6	45.1	0	2.8	14.2	306.4
2003	26.2	63	25.7	11.2	7.4	19.7	60.7	70.7	9.8	19.3	16.8	18.3	348.8
2004	90	32.1	8.3	2.3	17.8	46.9	13.9	32.2	26.9	52.7	30.8	45.8	399.7
2005	**8.8**	**16.1**	**3.8**	**2.6**	0	76.9	45.9	**39**	99.7	**31.5**	57.5	**17**	**398.8**

Table 3: Varieties and the dates sown for crop plots in years 1998 - 2005.

System	Phase	1998	1999	2000	2001	2002	2003	2004	2005
Traditional	LFW	Janz (31/5)	Janz (9/6)	Janz (22/5)	Sunbri (9/5)	Sunbri (26/4)	H45 (7/7)	Drysdale (17/6)	Chara (5/7)
	SFWu/s	Janz (31/5)	Janz (10/6)	Janz (29/5)	Janz (30/5)	H45 (5/6)	H45 (7/7)	H45 (22/6)	Drysdale (12/7)
Reduced tillage with livestock	LFW	Janz (31/5)	Janz (1/6)	Janz (25/5)	Janz (30/5)	H45 (30/5)	H45 (4/7)	Drysdale (17/6)	Chara (5/7)
	LFWu/s	Janz (29/5)	Janz (2/6)	Janz (30/5)	Sunbri (9/5)	Sunbri (27/4)	H45 (7/7)	H45 (22/6)	Drysdale (12/7)
Continuous cropping	SFWaC	Janz (31/5)	Janz (12/6)	Janz (20/4)	Sunbri (7/5)	Sunbri (24/4)	Sunbri (1/5)	Drysdale (17/6)	Tilga barley (5/7)
	SFWaP	Janz (31/5)	Janz (12/6)	Janz (19/5)	Sunbri (7/5)	H45 (1/6)	H45 (20/5)	H45 (22/6)	Drysdale (21/7)
	Canola	Monty (22/5)	Mystic (8/6)	Oscar (18/4)	46C03 (5/5)	ATR Beacon (7/4)	ATR Beaco n (30/4)	H45 wheat (22/6)	Chara wheat (12/7)
	Pulse	Bohatyr peas (5/6)	Bohatyr peas (14/6)	Bohatyr peas (31/5)	Snowpea kpeas (31/5)	Wonga lupis (18/4)	Wong a lupins (30/4)	Parafield peas (24/6)	Parafield peas (19/7)
	Green Manure	Bohatyr peas (5/6)	Bohatyr peas (15/6)	Bohatyr peas (31/5)	Popany vetch (23/3)	[redacted]	HDLs (29/4)	Morgan peas (25/6)	Parafield peas

Table 4: Grain yield (t/ha) and growing season rainfall (GSR [April - September]) for 1998 to 2005.

	1998	1999	2000	2001	2002	2003	2004	2005
Traditional								
LFW	3.37	2.3	2.4	2.06	0.44	0.7	0.55	1.26
SFWu/s	2.67	1.12	2.5	1.67	0.73	0.86	0.65	1.27
Reduced								
LFW	3.35	1.98	2.2	1.69	0.142	0.84	0.47	1.19
LFWu/s	2.71	1.9	2.4	3.03	0.43	1.02	0.53	1.29
Continuous								
SFWaC	3.17[1]	1.18	2.9	1.89	0.6	0.26	0.85	2.50"
SFWaP	3.17[1]	1.38	2.6	1.92	0.73	0.93	0.76	1.63
Canola	1.04	0.36	1.5	1.21	0.08	0.36	1.163	1.493
Peas	1.71	0.77	0	0.71	0.13	0.18	0.91	1.67
GSR mm	394	180	244	185	97	180	140	264

[1] The wheat in 1998 was not separated between the two plots in the no till, no livestock system;[2] Low yield a result of herbicide damage; [3] Wheat sown as a subsitute to canola as sowing rains did now occur in time; [4] Barley after substituted canola phase to avoid wheat-wheat sowing

Table 5: Percentage grain protein for wheat crops, 1998 to 2005

	1998	1999	2000	2001	2002	2003	2004	2005
Traditional								
LFW	11.7	13.8	10.9	16.2	15.2	15.1	16.9	15.8
SFWu/s	11.8	15.2	10.6	13.7	13.2	14.2	16.3	16.9
Reduced								
LFW	11.8	14.6	10.6	14.8	14.5	14.8	17.2	16.3
LFWu/s	11.8	15.2	10.6	14.3	14.9	13.4	16.5	**16.7**
Continuous								
SFWaC	11.8	15.1	10.5	13.8	15.2	16.0	16.7	17.8
SFWaP	11.8	14.2	11.2	12.4	13.5	16.4	17.9	16.7

Table 6: Average fleece weight, 2003 - 2006.

	Average fleece weight			
	2003	2004	2005[1]	2006[2]
Traditional	5.67	6.53	4.63	5.19
Reduced	5.35	6.13	4.73	4.90
Perennial Pasture	4.80	6.37	4.26	5.46

[1] Nine months wool growth;[2] Projected fleece weights calculated from sheep live weights.

Ta e 7: Average live weights of sheep from Dec 2003 to Dec 2005.

	Weight onto trial	Weight off-shears	Weight onto plots	Weight off trial	Weight on trial	Weight off trial
	Dec-03	**Sep-03**	**Aug-04**	**Mar-05**	**Sep-05**	**Dec-05**
Traditional	44.7	57.2	60.58	63.9	49.26	57.99
Reduced	45.3	55.8	62.04	66.6	51.17	61.77
Perennial Pasture	44.5	49.8	60.72	63.8	47.59	54.54

Table 8: Average and cumulative gross margins ($/ha) for each cropping system. Calculated by D. Patton, NSW DPI economist.

	Average annual gross margin					
	1998	1999	2000	2001	Average 4-yr	Cumulative
Traditional	+104.52	+51.85	+64.26	+78.63	+74.82	+299.25
Reduced Tillage	+113.13	+31.67	+36.75	+107.81	+72.34	+289.35
Continuous Cropping	+247.53	-40.35	+108.92	+57.99	+93.52	+374.08

Table 9: Approximations of variable costs and gross margins for each of the four systems,

	Total Variable Cost ($/ha)				Gross Margin ($/ha)			
	2002	2003	2004	2005	2002	2003	2004	2005
Traditional	27.01	47.6	97.8	88.22	17.45	48.27	139.551	0.17
Reduced Tillage	47.83	47.33	49.54	93.87	-26.17	50.51	-23.26	-10.79
Continuous cropping	75.92	170.29	140.97	167.7	-12.53	-97	29.812	13.23
Pasture				26.07				35.96

[1] The high returns seen due to opportunistic hay-making operation. [2] The gains experienced for continuous cropping due to high price for field peas in that year.

Figure 1: Average soil moisture (left axis) to 3 m in 2003 - 2005 for cropping systems used at Core Site (data from Brett Honeysett, NSW DPI) and monthly rainfall (mm) for the same period (right axis).

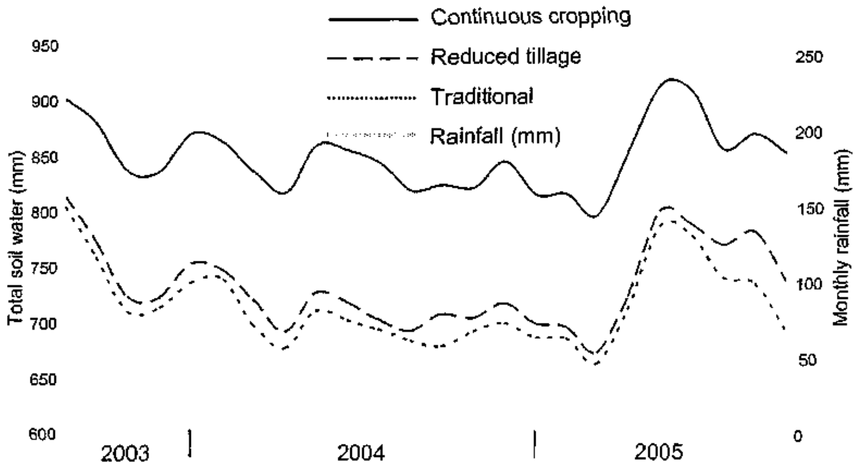

Figure 2: Live weights of sheep plotted along the bottom axis compared to increasing fleece weight on side axis. Line fitted through values represents most likely fleece weight when given a live weight based on applied data.