Sustainable land management – Sea Lake, Hopetoun and Waitchie

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Take home messages

- *Yield Prophet®- the crop simulation model- is a great tool for assessing crop risk and predicting potential yields.*
- *For renovating overgrazed perennial pasture paddocks, the sowing of cereals is a low risk strategy.*
- *Pasture establishment is extremely difficult in the Mallee in years with limited spring rainfall.*
- *Cereal biomass production may be greater by an order of 10 times than either perennial or leguminous pastures in the first year of establishment.*
- *Best pasture options for a June sowing in terms of biomass in the first year of establishment are either forage brassica or Italian Ryegrass.*

Background

In order to measure and report the potential impact of best management practices for dryland agriculture in the Mallee, six demonstration sites were established in 2005, and a seventh (Sea Lake) was established in 2006. The sites at Sea Lake, Hopetoun, Waitchie, Carwarp, Cowangie, Chinkapook and Walpeup represent a range of land and farming systems. Each site tackles one or more of the various aspects of sustainable agriculture such as salinity management, soil erosion, soil health and nutrient management.

BCG is responsible for monitoring and assists with the implementation of best management practices for the Sea Lake, Hopetoun and Waitchie sites. In 2007, all three sites underwent extensive soil sampling and analysis prior to sowing. Throughout the year measurements of the following factors were taken; comparative productivity, water use efficiency, ground water, water use and balance, soil nutrition, soil biota, crop biomass and yields.

Sea Lake Demonstration Site

The site is 118ha in size and situated 1 km south east of the Sea Lake township. The paddock, which has been no-tilled for a number of years was sown to a cereal for the third year in a row. The paddock was chosen due to its variability in EC values and therefore the paddock provided the opportunity to demonstrate differences in crop growth as a result of such variability.

The paddock was sown on the 21 May to Sloop Vic Barley at 48kg/ha. 24.5kg of N was applied at sowing with 50kg/ha of Urea applied on 3 July. The paddock like most in the district experienced a good break in late April and early May, with good follow up rain after sowing in late May. However, rainfall deciles declined dramatically after May, with virtually no rainfall during August, September

and October (Figure 1). Plant establishment counts were done on 13 June at Zadok's growth stage 12. The average plant establishment was 154 plants/m²; the optimum for barley being approximately 130 plants/m².

The trials conducted in the paddock investigated the potential application of variable rate technology. Based on an EM survey, a number of zones within the paddock were identified with varying levels of salinity. Nitrogen strips were applied across the paddock to look at nitrogen responses and strips of trace elements including copper, zinc and copper/zinc were applied at Zadok's growth stage 30. The yield results from the nitrogen and trace element strips were not available at the time of publication.

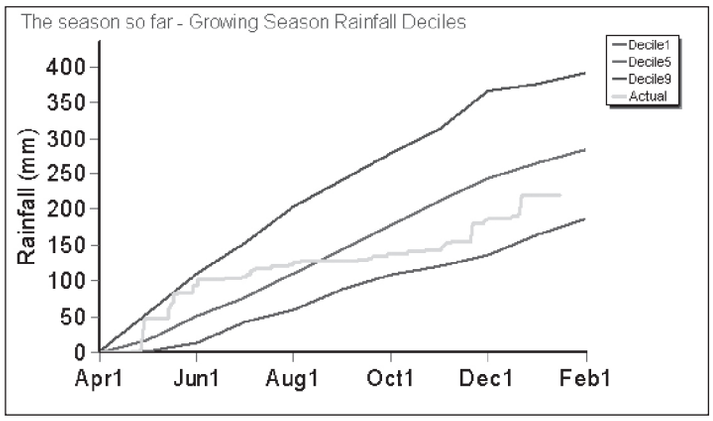

Figure 1: Growing season rainfall and rainfall declines for Sea Lake in 2007.

The crop simulation tool Yield Prophet was used at two locations in the paddock, representing relatively low (Figure a) and relatively high (Figure b) soil EC values. In early August, Yield Prophet indicated an economic response to nitrogen was unlikely except with the most favourable (decile 9) finish to the season. At that time, Yield Prophet indicated a 50% probability of achieving yields of approximately 2.5 t/ha at both the low and high EC points in the paddock (Figure 2a & b).

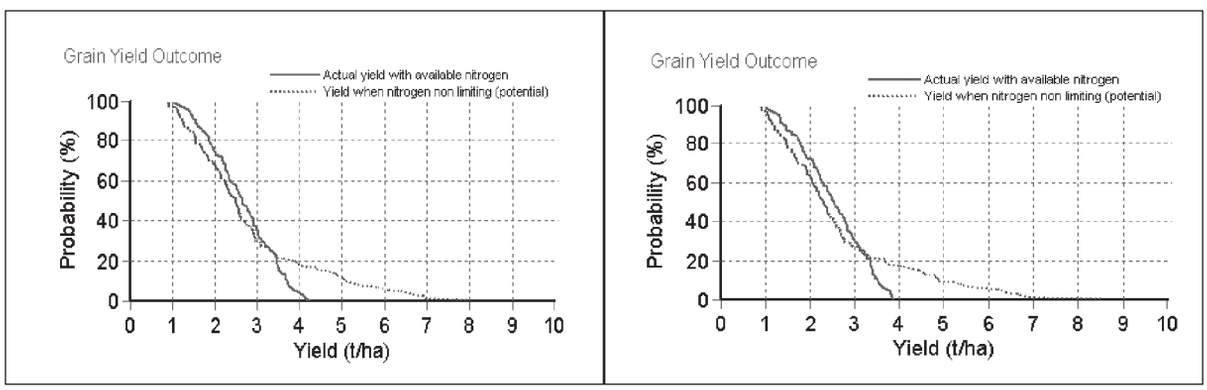

Figure 2a & b Yield Prophet grain yield outcome probabilities made in early August 2007 in the Sea Lake Landcare Delivery Site (LDS) paddock a) for site 1, a paddock location with relatively low EC and b) site 9, a paddock location with relatively high EC.

Following from the exceptionally dry winter and spring, Yield Prophet predicted yields for the paddock at crop maturity was approximately 1.0t/ha for both the low and high EC points within the paddock (Figure 3a & b). The actual average harvest yield for the paddock was 1.3t/ha.

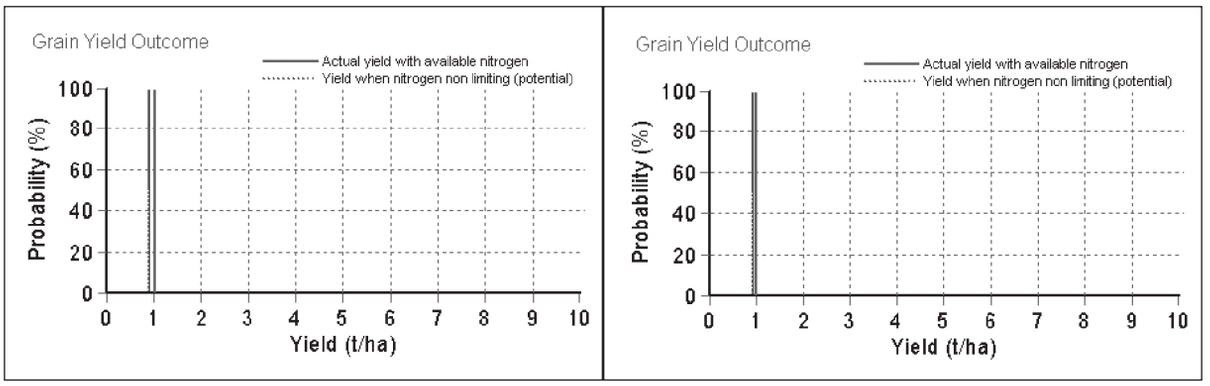

Figure 3a & b: Yield Prophet grain yield outcome probabilities made at crop maturity in the Sea Lake LDS paddock a) for site 1, a paddock location with relatively low EC and b) site 9, a paddock location with relatively high EC.

Hopetoun Demonstration Site

The site, located 10 km west of Hopetoun, is a paired paddock comparison. Both paddocks consist of sandy hills and rises moving into sandy clay loams and light clays with large amounts of limestone on the surface and through the profile on the lower slopes and depressions. The depressions in these paddocks have areas of saline discharge and bare ground. Best management practice for the saline areas was the key focus of this demonstration site.

In 2007, the northern paddock was sown with wheat on the rises and barley on the flats. The crops were sown in moist conditions with 30mm rain recorded the week prior to sowing. The flats of the paddock were sown to Sloop Vic barley on 4 May @ 60kg/ha. The rises were sown to Yitpi wheat on 6 May @ 70kg/ha. Granulock 25-13 was applied to both areas at 80kg/ha.

The southern paddock, an established lucerne stand, was heavily grazed over the summer period (2006/07) and was at high risk of soil erosion by April 2007. It was decided to sow the paddock to Sloop Vic Barley at 60kg/ha in moist conditions on 3 May to reduce the erosion risk. Granulock 25-13 applied at 80kg/ha at sowing.

In addition two trials were established in the southern paddock, one on a non-saline sandy loam (EC<0.6dS) and the other on a low lying, saline area of the paddock (EC=1.5dS). The trials looked at establishment, growth and persistence of different species and their suitability to the district, soil type and saline areas. The trials were sown 13 June with sowing delayed due to the very wet conditions in the paddock during May. Dry matter production was recorded for both trials on 15 October (Table 1) and grain yields harvested for the cereal varieties at crop maturity (Table 2) Soil water and erosion risk monitoring were also undertaken throughout the year across the paddock.

By 1 October the season had fallen below a decile 5 and finished at crop maturity at decile 2. (Figure 4.)

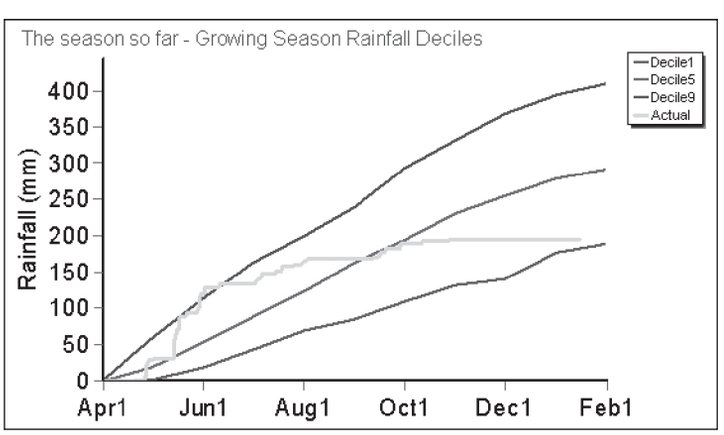

Figure 4: Growing season rainfall and rainfall deciles for Hopetoun in 2007.

Table 1: Dry matter production (kg/ha) recorded 15 October for species evaluated on saline and non-saline portions of the landscape.

Species	Variety	Dry matter production (kg/ha)		Relative production: saline versus non saline (%)
		High EC	Low EC	
Barley	Hindmarsh	583	3552	16%
Barley	SloopVic	618	3434	18%
Wheat	Derrimut	429	3315	13%
Wheat	Krichauff	653	2892	23%
Oats	Winteroo	293	2438	12%
Triticale	Rufus	508	3253	16%
Forage Brassica	SF Greenland	738	1408	52%
Italian rye	Winterstar	0	522	0%
Strand medic	Herald	0	<200	
Strand medic	Angel	0	<200	
Strand medic	Jaguar	0	<200	
Vetch	Capello	0	241	
Lucerne	SARDI 7	0	<200	
Medicago sativa × falcata	KI Creepa	0	<200	
Trifolium ochroleucum	Ochytas	0	<200	
Spanish Cocksfoot	Sendance	0	<200	
Spanish Cocksfoot	Uplands	0	<200	
Lsd (5%)		**647**	**1178**	

The cereals (wheat, barley, oats, triticale) produced substantially more dry matter, in both the saline and non-saline areas of the paddock, than the pasture species, with the forage brassica and Italian ryegrass being the best of the pasture species. Comparison of dry matter production on the saline and non-saline areas of the paddock provided an indication of the relative tolerance to salinity of the species assessed. In general, there was a similar level of tolerance amongst the cereals, although the wheat variety Krichauff, chosen specifically for inclusion in this trial due to a reputation for salinity tolerance, performed relatively better than the other cereals, with oats performing the worst. The forage brassica, SF Greenland, performed remarkably well in the trial with high salinity, indicating the potential for this species to be used to improve ground cover in salinity affected areas. In contrast, the Italian ryegrass was very poor in the saline area, failing to establish.

Grain yield comparisons for the cereal varieties (Table 2) provided similar information to the dry matter production data. Barley, wheat and triticale were of similar performance, whilst oats was the worst in terms of grain yield. Average yields for the barley (variety SloopVic) across the range of soil types in this paddock was 0.7t/ha.

Table 2: Grain yield (kg/ha) of cereal varieties evaluated on saline and non-saline portions of the landscape.

Pasture/Cereal	Variety	High EC	Low EC
		(kg/ha)	
Barley	Hindmarsh	102	1369
Barley	SloopVic	70	1237
Wheat	Derrimut	133	1433
Wheat	Krichauff	90	1314
Oats	Winteroo	0	971
Triticale	Rufus	68	1395
Lsd (5%)		**39.2**	**209**

The crop simulation tool Yield Prophet was used at two locations in the northern (wheat) paddock, representing relatively low (EC<0.6dS) and relatively high (EC>1.5dS) soil EC values. In late July, Yield Prophet indicated a relatively high probability of an economic response to nitrogen was at site 1, but virtually no possibility of a response to nitrogen at site 5 (Figure 5a & b). At that time, Yield Prophet indicated a 50% probability of achieving yields of approximately 3.2 t/ha (without further nitrogen) at site 1 and a 50% probability of achieving 3.9 t/ha at site 5. Following the very dry winter and spring, Yield Prophet predictions at crop maturity for both these sites were approximately 2.0t/ha (Figure 6a & b). The actual average yield for the wheat crop in this paddock was 2.2t/ha for wheat.

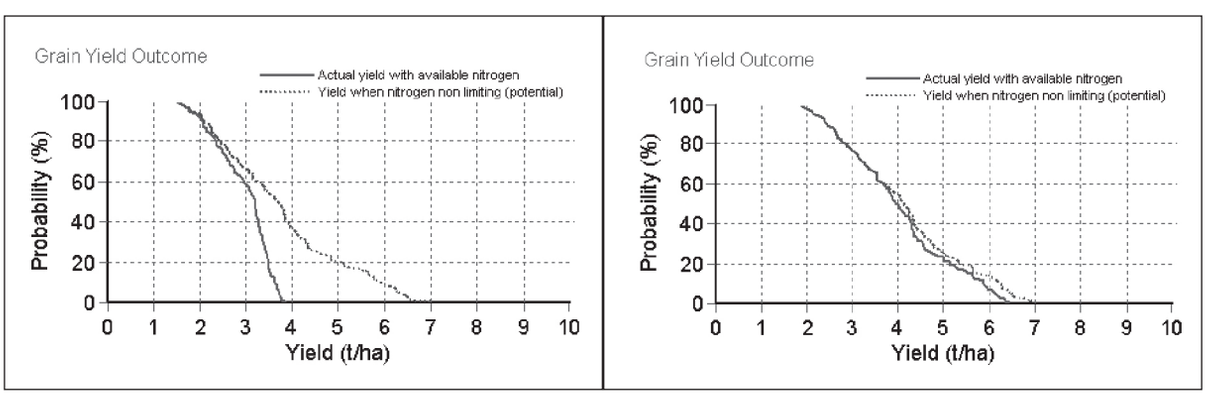

Figure 5a & b: Yield Prophet grain yield outcome probabilities made late July in the Hopetoun LDS paddock a) for site 1, a paddock location with relatively low EC and b) site 5, a paddock location with relatively high EC.

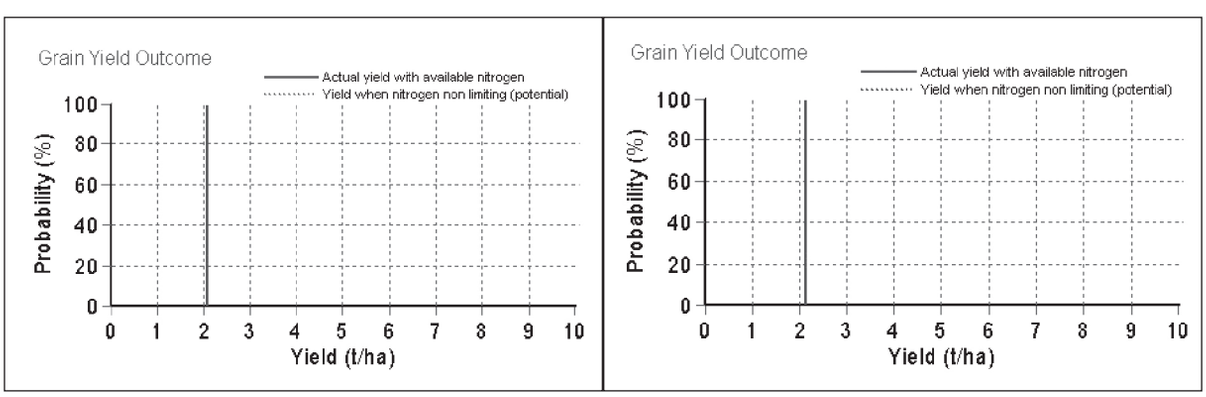

Figure 6a &b: Yield Prophet grain yield outcome probabilities at crop maturity in the Hopetoun LDS paddock a) for site 1, a paddock location with relatively low EC and b) site 5, a paddock location with relatively high EC.

Waitchie Demonstration Site

The site, north-west of Waitchie, is a paired paddock site where in the past the Landcare Group has compared Lucerne pasture with an adjacent cropped paddock. Both of the paddocks include gypsum hills caused by deposits of calcium sulphate and salt from the Timboram and surrounding lake systems, in both paddocks the flats are light clay.

The northern (lucerne pasture) paddock was heavily grazed during the summer/autumn period and represented a high soil erosion risk. Hence the primary objective was to establish a crop/pasture early with the aim of maximizing biomass production. The landowner sowed Barque barley on 23 April at 50kg/ha with 20kg/ha of DAP. An experimental trial was sown in this paddock on 14 June to evaluate alternative species options for the renovation of an existing Lucerne stand.

The southern (cropped) paddock was also sown to barley, being direct drilled to the malting variety SloopVic on 8 May. In this paddock two pasture trials were also sown on 14 June to assess the suitability of the species as pasture options for the region, including the relative performance of these species on both saline and non-saline soil types by sowing the trials in both high and low EC areas of the paddocks. Soil water and erosion risk monitoring continued throughout the year.

The paddocks experienced a good break in late April with good follow up rain after sowing and consistent rainfall throughout May. However, rainfall in winter and early spring months was very low resulting in severe drought (see Figure 7) with very low crop and pasture yields.

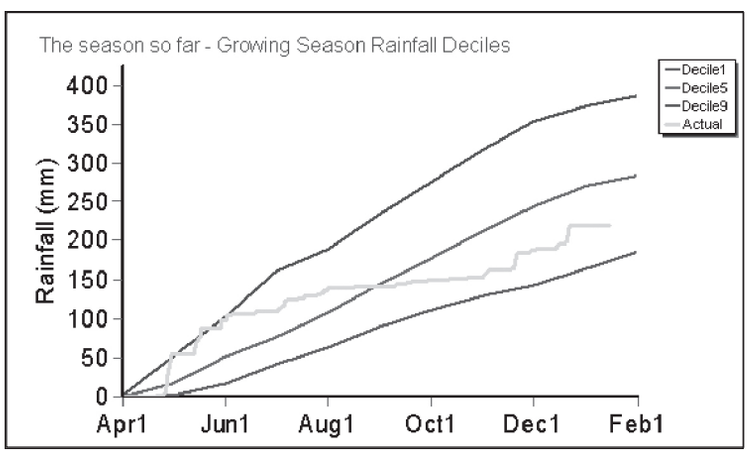

Figure 7: Growing season rainfall and rainfall deciles for the Waitchie LDS in 2007.

Dry matter production was recorded in the trial plots during October prior to plant senescence. In the (southern) cropping paddock, on the more saline (high EC) portion of the landscape, no annual pasture species established and no dry matter production was recorded. On less saline (low EC) portion of the landscape, forage brassica and Italian Rye were the best performing species, although both yielded less than 1000kg/ha dry matter; no other species recorded over 500kg/ha (Table 3). With such low yields, these pastures would not have provided any effective grazing value.

In the trial in the northern (Lucerne) paddock, the cereals were by far the most effective option for the production of biomass, with dry matter production of the cereals ranging from 1740 to 2442kg/ha (Table 4). In comparison, the best of the pasture species were Italian Rye (1531 kg/ha) and forage brassica (671 kg/ha) with the majority of the species yielding less than 500 kg/ha.

Table 3: Dry matter production (kg/ha) for pasture evaluation trials conducted on low and high EC regions. Note that no species established on the high EC region of the paddock.

Pasture species	Variety	Dry matter production (kg/ha)	
		Low EC	High EC
Arrowleaf	Cefalu	242	-
Balansa	Border	0	-
Balansa	Taipan	0	-
Barrel medic	Caliph	273	-
Barrel medic	Mogul	409	-
Forage Brassica	SF Greenland	923	-
Italian Rye	Winterstar	520	-
Persian clover	Flash	33	-
Persian clover	Nitro	0	-
Strand medic (pod holding)	Jaguar	323	-
Strand medic	Herald	265	-
Strawberry clover	Palestine	0	-
Tall Fescue	Flecha	0	-
Lsd (5%)		**237**	

Table 4: Dry matter production (kg/ha) for species evaluated for potential to renovate the heavily grazed Lucerne paddock at the Waitchie LDS.

Species	Variety	DM (kg/ha)
Medicago sativa x falcata	KI Creepa	3
Trifolium ochroleucum	Ochytas	0
Lucerne	SARDI 7	0
Spanish Cocksfoot	Sendance	30
Spanish Cocksfoot	Uplands	0
Strand medic	Herald	147
Strand medic	Angel	132
Strand medic	Jaguar	206
Vetch	Capello	579
Forage Brassica	SF Greenland	671
Wheat	Wedgetail	1740
Wheat	Derrimut	2125
Wheat	Correll	2171
Oats	Winteroo	2334
Barley	Hindmarsh	2389
Barley	SloopVic	2442
Italian rye	Winterstar	1531
Lsd (5%)		557

The crop simulation tool Yield Prophet was used at two locations in the southern (cropping) paddock, in locations with relatively low and relatively high soil EC values. In late July, Yield Prophet indicated a relatively high probability of an economic response to nitrogen at site 2 but a low probability

of a response to nitrogen at site 8 (Figure 8a&b). At that time, Yield Prophet indicated a 50% probability of achieving yields of approximately 3.6 t/ha (without further nitrogen) at site 2 and a 50% probability of achieving 2.8 t/ha at site 8.

Following the very dry winter and spring, Yield Prophet predictions at crop maturity for both these sites were approximately 2t/ha at site 2 and a yield of approximately 1.1t/ha at site 8 (Figure 9a&b). The actual yields for the barley crop in this paddock were approximately 0.53 t/ha at point 2 and 0.19 t/ha at point 8. The large discrepancy between actual and Yield Prophet predicted yields for these points may be due to a difference between the rainfall used (patched met station data) by Yield Prophet and the actual rainfall received at the site.

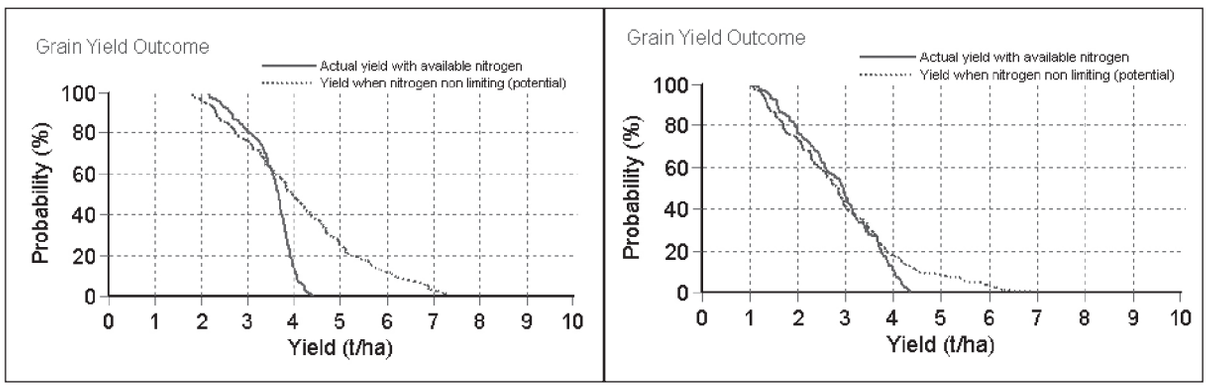

Figure 8a&b: Yield Prophet grain yield outcome probabilities in late July in the Waitchie LDS paddock a) for site 2, a paddock location with relatively low EC and b) site 8, a paddock location with relatively high EC.

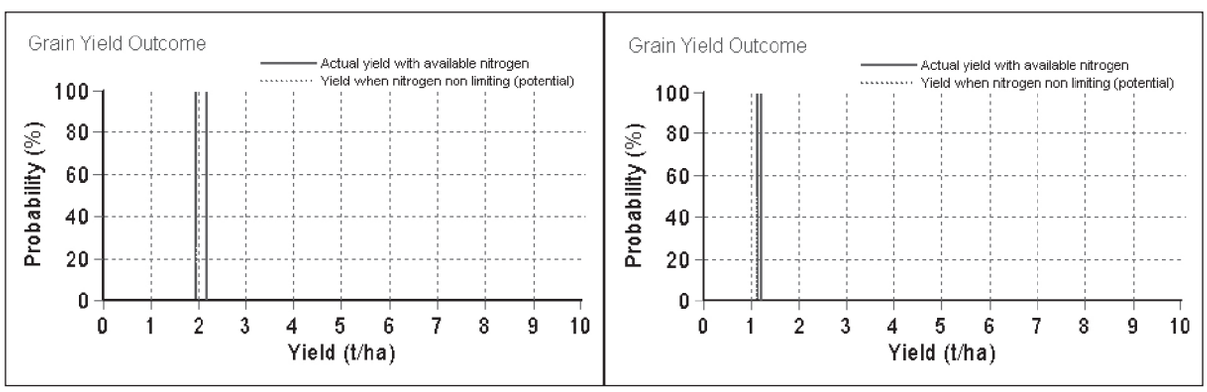

Figure 9 a&b: Yield Prophet grain yield outcome probabilities at crop maturity in the Waitchie LDS paddock a) for site 2, a paddock location with relatively low EC and b) site 8, a paddock location with relatively high EC.

Commercial practice

Managing high EC areas within paddocks to optimise production is a challenging task. This is particularly the case in low decile years, when pasture establishment is extremely difficult.

In high EC areas, cereal production is still the best bet option for the quick establishment of ground cover to reduce erosion risk.

The demonstration sites have identified forage brassica as a potential pasture species to explore further in 2008 at the Hopetoun and Waitchie sites.

The use of EM38 surveys to identify zones within paddocks to which variable rate technology can then be used to apply inputs will continue to be a focus at the Sea Lake and Waitchie demonstration sites.