A Sustainable Dryland Community Achieved Through Proactive Research on Effective Management of the Soil Resource (Liebe Group Soil Health Project)

Aim: To establish if the current wheat yield could reach potential yield by extra N fertilisation and to identify potential constraints of 8 Satellite Sites throughout the Liebe area.

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Company: Liebe Group

Farmer: Peter & Colin Bryant
Location: Latham

Background: Eight Satellite Sites were established in 2003 for the Liebe Soil Health Project. The focus for these sites is to spread the trials and information from the Soil Health Project so that it is applicable to the Coorow, Dalwallinu and Perenjori Shires. These sites were chosen mostly as the poorer yielding paddocks, or areas of paddocks, of the Satellite Site farmers. Soil type, farmer management and rainfall of these sites are quite variable. The objective of these trials was to a) firstly determine if nitrogen is limiting yield and b) identify potential constraints to yield within the soil resource. If nitrogen is limiting yield that must first be addressed. Trials and demonstrations will be developed in consultation with researchers and Satellite farmers to ameliorate primary soil constraints to yield.

Trial Details:

Plot size and replication	10 x 10 m * 3 replicates. Randomised block design.
Soil type	Deep acidic sand
Sowing date	27th May 2003
Conditions at sowing	Moist below, dry surface
Machinery	Flexi-Coil
Seeding rate	70 kg/ha Arrino
Fertiliser Treatment 1: Basal fertiliser Treatment 2: Basal plus additional N fertiliser	 60 kg/ha MAPSZC (all plots –farmer applied); 50 kg/ha Urea (all plots – farmer applied) As above, plus additional N = topdressed as Urea @55 kg/ha (DS applied on 24th July)
Herbicides and Insecticides	1.4 L/ha Glyphosate, 0.25 L/ha Ester
Paddock History	2002 = Lupins, 2001 = Wheat

Results:

Peter Bryant's Satellite Site had five separate trials as detailed in this book. One of the trials, APSIM Wheat Yield simulation (pg 103) used the same measurement locations to predict yield using N and rainfall measurements, and the information adds value to this trial.

Potential yield of 3.05 t/ha was not reached (Table 1) with Peter's fertilisation (1.32 t/ha). This site had 262.7 mm of growing season rainfall.

Table 1: Actual yield vs. potential yield and water use efficiency based on growing season rainfall (French-Schultz equation).

Rainfall (mm, 28th March - 30th October)	Basal Yield (t/ha)	Potential Yield (t/ha)	Water Use Efficiency (kg/ha/mm)
262.7	1.32	3.05	8.64

Yield was not significantly affected by the topdressing of extra N in the plus N treatment, nor was harvest index (Table 2). The protein, unusually decreasing with extra N, could not be tested for significance (due to lack of replicates).

Table 2: Grain yield, protein and harvest index for the plus N and basal treatments. The plus N treatment was the topdressing of 55 kg/ha urea 24th July.

Treatment	Grain Yield (t/ha)	Protein (%)	Harvest Index (%)
basal	1.32	15.10	45.14
plus N	0.93	13.80	45.06
LSD (5%)	n.s	*	n.s

* indicates that not enough grain was collected during sampling to produce 3 replicates for the statistical analysis for grain protein.

%N (N present in leaves and stem) at anthesis was highly significant (P=0.04), indicating that some of the extra N topdressed in the plus N treatment was translocated into the plant. However, this was not reflected in the N in the biomass at anthesis nor the %N uptake.

Table 3: Biomass and Nitrogen content of the leaf and stem at anthesis, total N in topsoil (soil N measured at seeding + applied N in top 10 cm), the N translocated into the plant at anthesis and the %N taken into the plant.

Treatment	Biomass at anthesis (t/ha)	%N at anthesis	Total N in topsoil (kg/ha)	N in biomass at anthesis (kg/ha)	%N uptake
basal	1.69	1.36	46.19	23.53	50.95
plus N	1.84	2.03	71.26	37.20	52.20
LSD (5%)	n.s	0.32		n.s	n.s

Moisture does not appear to have been taken up efficiently below 30 cm depth of the profile (Figure 1). Roots were only found down to the 20-30 cm zone, which supports this statement. Rain before the harvest measurements may have overshadowed this effect.

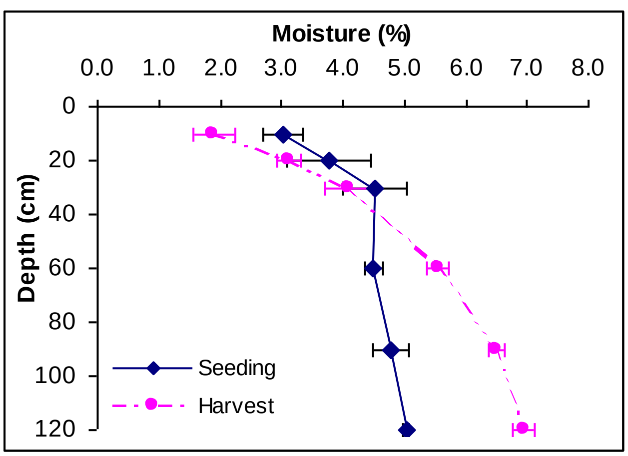

Figure 1: Gravimetric moisture content (%) of soil measured to depth

Acidity is likely to be a yield limiting constraint due to pH of 4.30 at the surface decreasing to 3.84 at 30 cm, then stabilising until decreasing again to 3.75 at 120 cm. Aluminium toxicity and nutrient deficiency would be expected at these pH's. The severe subsoil acidity is the likely constraint to root penetration below 30cm and therefore using the available moisture.

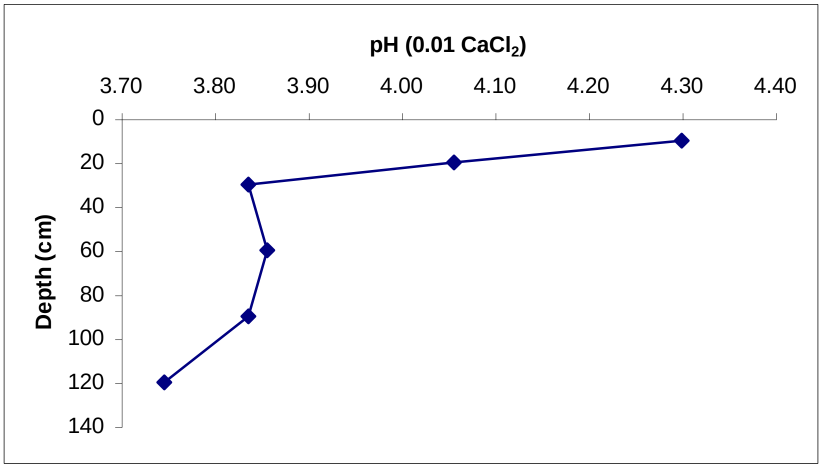

Figure 2: pH, measured in calcium chloride, down to depth

The penetrometer measurement, after wetting the soil profile to field capacity, was taken nearby in February 2003 (Figure 3). This shows a potential barrier to roots accessing water below this depth.

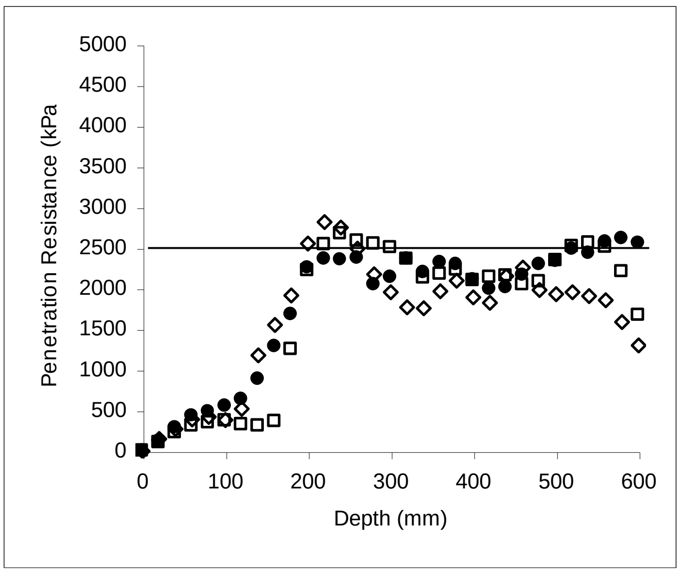

Figure 3: Penetrometer measurement for compaction at Peter Bryant's. The line indicates where root penetration may be constricted

Summary:

- Actual yield (basal treatment) was well below potential yield according to the French-Schultz equation.
- Yield did not significantly increase with extra N. N is not limiting plant yield.
- %N in the plant at anthesis significantly increased. The N was taken into the plant but did not significantly increase yield.
- Acidity is most likely a yield limiting factor throughout the soil profile, and there may be a compacted layer at approximately 25 cm depth.

Trials were undertaken in 2003 to ameliorate subsoil acidity (see pg 73) and these will continue to be monitored as effects may be more prominent in the coming years.