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.

Research Officer: David Scholz
Company: Liebe Group

Farmer: Grant Hudson
Location: Goodlands

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 designs.
Soil type	Loamy clay
Sowing date	22nd May 2003
Conditions at sowing	Moist at depth
Machinery	DBS bar
Seeding rate	45 kg/ha Arrino
Fertiliser Treatment 1: Basal fertliser	 70 kg/ha AgStar & 35 L/ha Flexi N (all plots –farmer applied); 38 L/ha Flexi N (all plots – farmer applied)
Treatment 2: Basal plus additional N fertiliser	As above, plus additional N = topdressed as Urea @ 55 kg/ha (DS applied on 24th July)
Herbicides and Insecticides	Roundup 1.0 L/ha
Paddock History	2002 = Wheat, 2001 = Wheat.

Results:
Grant Hudson's Satellite Site is characteristic of the red country that predominates much of the Goodlands area. This site almost reached 91% of the potential yield of 2.14 t/ha high, and had a water use efficiency of 18.13 kg/ha/mm, which was in part due to a drier growing season than most parts (Table 1). However, this rain when it fell was timely, and the stored soil water from an early storm would have had an impact.

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)	BasalYield (t/ha)	Potential Yield (t/ha)	Water Use Efficiency (kg/ha/mm)
217*	1.94	2.14	18.13

* Indicates that a percentage of stored soil water from a summer storm was added onto growing season rainfall.

Yield was not significantly affected by topdressing extra nitrogen in the plus N treatment (Table 2). The extra nitrogen did significantly increase the protein at harvest time. The harvest index is low for both treatments, indicating a possible haying-off effect. The plants did not efficiently turn biomass resources into grain.

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	1.94	11.80	37.48
plus N	1.87	13.33	36.68
LSD (5%)	n.s	1.34	n.s

The extra nitrogen treatment (plus N) significantly increased the %N contained in stem and leaf tissue at anthesis, and also the amount (kg/ha) present in the biomass at anthesis (Table 3). A significantly higher amount of N was taken into the plant with the plus N treatment. However this did not significantly increase biomass, but did significantly increase grain protein at harvest (Table 2). The N taken into the plant was converted into protein but not a yield increase.

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 top 0-10cm (kg/ha)	N in biomass at anthesis (kg/ha)	%N uptake
basal	4.52	1.02	95.57	46.01	48.14
plus N	4.97	1.60	120.64	79.48	65.89
LSD (5%)	n.s	0.47		23.48	n.s

Roots were discovered down to the 30-60 cm zone at harvest in the profile, and below this the moisture content of the soil tapers off toward what it was at seeding, indicating that roots have not extracted much, if any water from below 60cm (Figure 1). This unused water could have been accessed to increase the yield. A constraint must be a barrier to use of this excess moisture.

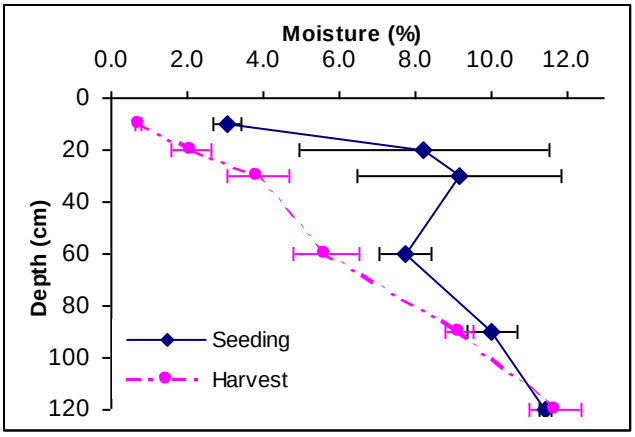

Figure 1: Gravimetric moisture content (%) of the soil, measured down to depth

The pH measurements show a consistent increasingly alkaline trend with increasing depth (Figure 2). Between 60 - 120cm the pH increases from 7.67 to 8.28, which may be hostile for root water and nutrient uptake. The pH is 5.62 at the surface.

It is difficult to say because of the clay nature of the soil, but the 60-90 cm depth is considered slightly saline (3-400 uS/cm), which may be a constraint to deep root penetration. The moisture content of the soil below 60 cm is quite high (9-11%), therefore if roots could access this moisture it would make a big difference to yield.

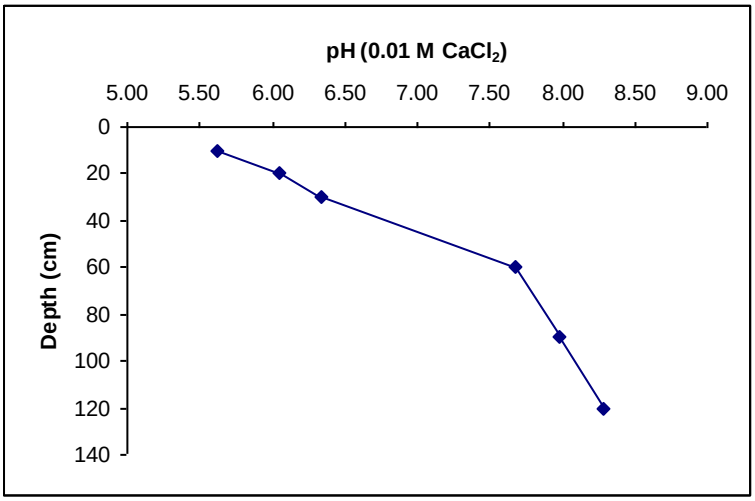

Figure 2: pH, in calcium chloride down to 120 cm

Summary:

- This site was close to achieving potential yield according to the French-Schultz equation.
- Yield was not significantly affected by increasing protein. N in the leaf and stem at anthesis and grain protein at harvest time were all significantly increased. Nitrogen was adequate, however possibly in excess given a dry growing season. The harvest index was low, indicating inefficient conversion of biomass resources into grain.
- There is unused water below 60 cm in the profile, with alkalinity and salinity possible constraints to roots accessing this water.
- Other measurements, such as compaction, may show up a severely compacted layer as was suggested with initial exploratory measurements. More measurements and trials will take place in 2004.

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