1985

Soil acidity in the eastern wheatbelt.

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SUMMARY OF EXPERIMENTAL RESULTS, 1985

SOIL ACIDITY IN THE EASTERN WHEATBELT

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85M48/4231EX

Effect of profile acidity on nutrient and water use by wheat.

AIM:

To determine whether soil acidity reduces wheat growth by reducing the plants ability to extract water or mobile nutrients from the soil.

BACKGROUND:

The extreme acidity of many eastern wheatbelt yellow sandplain soils, particularly the acidity of subsoil, has been shown to cause reduced wheat growth. There appear to be few management options available for farmers to alleviate this problem.

From this experiment we aim to understand something of the mechanism by which subsoil acidity affects wheat growth and so perhaps develop alternative methods of dealing with acidity.

RATIONALE:

The two most likely ways in which acidity affects wheat growth operates through effects on root growth. Subsoil acidity has been shown to reduce root growth. Low density of roots in the subsoil could result in poor extraction of water or nutrients from the subsoil and so to top growth being affected by a water or nutrient deficiency.

Liming a profile could improve root growth and alleviate these deficiencies.

To test these hypothesese this experiment was established. There were eight treatments, made up a complete three level factorial of limed/unlimed x extra nutrients/no extra nutrients x irrigated/not irrigated (2x2x2x4 replicates).

If lime improves wheat growth by overcoming a nutrient deficiency then there should be no - or at least a smaller - effect of lime where extra nutrients are supplied. If lime improves wheat growth by overcoming a water deficiency then there should be no - or a smaller - effect of lime where extra water is supplied frequently.

OVERVIEW:

A site was selected on Merredin Research Station to represent a deep yellow sandplain soil with an acid surface and a very acid subsoil. The site was not an extremely poor yellow sandplain but has produced acceptable crops in the past.

The soil was removed in layers to 1.7m from a 2.6m x 6.0m area, each layer stockpiles separately. Thirty two pairs of drums (each 200 L. capacity, 57 cm ID x 88 cm high with tops and bottoms cut out) were placed in the hole. The drum pairs were spot-welded together to form a 176 cm long open tube.

The soil was placed in the drums in layers after liming and mixing, or after mixing only. Wheat was planted in the drums and in sixteen adjacent plots (2m x 1.7m). The extra nutrient drums and plots received N, K and S every two weeks until physiological

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maturity. The irrigated drums and plots received approximately 25 mm when cumulative pan evaporation since the last watering exceeded cumulative rainfall by approximately 25 mm (except towards the end of the season when less was supplied).

Plant growth data collected from the experiment included dry matter production at thinning of the drums, lengths of leaf and stem/leaf sheath, harvest yield components and dry matter.

RESULTS:

By 121 days after sowing a lime response had appeared in the drums which had received no extra water or nutrients (Tables 4 and 5). From leaf and stem sizes it was estimated that there was 19% more dry matter in the limed than unlimed drums (Table 5). Applying extra nutrients, rather than reducing the response to lime, increased it to 29%. Similarly extra water increased the response to 33%, and both extra nutrients and extra water also increased the response to 29%.

A dry finish to the season resulted in poor final yields. The lime responses only carried through to grain yield in the irrigated drums.

CONCLUSIONS:

1). There appeared to be some mechanism, other than poor root growth limiting water and nutrient availability, by which soil acidity reduced wheat growth in this experiment.

2). The design of this experiment does not allow us to rule out the water and nutrient mechanisms as being important.

TABLE 1: CHARACTERISTICS AND TREATMENTS OF SOIL LAYERS.

SOIL LAYER (cm)	BULK DENSITY(1) (g/cm^3) (1)	BUFFER CAPACITY(2) (Mole (±)/ cg/pH unit) pH (H_2O)	pH($CaCl_2$)	pHi H_2O	pHi $CaCl_2$	Kg SOIL RETURNED TO LAYER	g $CaCO_3$ ADDED (3)
0-5	}1.42	1.27	0.84	6.0	5.1	19	0
5-10	}	1.10	0.80	5.9	5.0	16	1.0
10-16	-	0.74	0.66	5.1	4.4	25	8.7
16-23	1.62	0.84	0.83	4.4	3.9	32	23.7
23-35	1.61	1.32	1.43	4.2	3.8	48	67.0
35-50	1.60	1.32	1.43	4.1	3.7	60	89.3
50-69	1.62	1.45	1.53	4.1	3.7	84	134
69-88	1.61	1.61	2.09	4.0	3.7	76	167
88-110	1.65	1.48	2.09	4.0	3.6	93	219
110-139	1.61	1.48	2.25	3.9	3.6	120	152
139-174	1.68	0.83	0.77	4.1	3.8	157	145

(1) 40 cm diam. x 99 mm deep cores taken from side of excavated pit.
(2) A two point titration (0.3 ml 0.45 M $CaCOH_2$ in 15 g soil + 75 mls H_2O). Units are equivalent to one hundred times meq/100g/pH unit.
(3) Total lime added = 1.006 kg/drum, equivalent to 40 t/ha. Mixed for 5 minutes with soil in cement mixer.

TABLE 2: CALENDAR OF EVENTS

DATE		DAYS AFTER SOWING	EVENT
April	23	-35	Buffer Capacity (BC) of nearby pit measured.
	24	-34	Bulk Density (BD) measured in nearby pit.
	22-25		Soil removed in layers and stockpiled separately. BD measured.
	27	-31	BC of actual layers checked.
	29 *	-29	Began replacing layers.
May	9	-9	Finished replacing layers into drums.
	28-29	0-1	Sowed trial.
June	6	9	1st emergence some drums. Sprayseed 10 g/L.
	8	11	Emergence drums only. Sprayseed 10 g/L. into plots and around drums.
	9	12	Sprayseed damage on plants in drums.
	10	13	Plots emerged - all damaged by Sprayseed. Damage in drums (mostly block 4) Emergence of plants on N side of drums slower than south side (shading by drum lip?).
	14	17	Drums: 1-1.5 leaves, sprayseed damage infrequent. Plots: patchy, 1 leaf widespread sprayseed damage.
	17	20	Nutrients applied for first time (N 10 kg/ha, K 10, S 4.1). Reapplied fortnightly to Sept. 23. Irrigated (20 mm).
	24	27	Irrigated by hand (3 mm) Photographs taken. Stage Zadok 12.0 - 12.2 Measured leaf length.
	28	31	Watered (25 mm)
July	5	38	Plots: Hoegrass (1 L./ha in 625 L. water/ha). Brominil (1 L./ha in 625 L. water/ha).
	8	41	Measured leaf length.
	10	43	Watered (19 mm)
	11	44	Rates drums: white patch symptom widespread on 2nd or 3rd youngest leaves (photographs).
	24	57	Drums rates. Plants thinned final time.
	29	62	Leaf length measured (62 d).
Aug.	12	76	Leaf length measured (76 d).
	23	87	Irrigated (25 mm).
Sept	3	98	Irrigated (25 mm) Drippers cleared.
	9	104	Irrigated (16 mm)
	17	112	Irrigated (24 mm)
	20	115	Irrigated (26 mm) First anthers emerging on all irrigation treatments. Drums unirrigated dead, cooking. Plots unirrigated OK - droughted.
	26	121	Leaf length measured, plant parts study.
Oct.	18	143	Irrigated (34 mm)
	25	150	Irrigated (42 mm).

DETAILS OF SEEDING: 28 - 29th May, 1985.

Plots: Cultivated with hoe, raked, smoothed. Pressed furrows 21 cm apart 2 - 3 cm deep into soil. Placed into rows Super Cu Zn Mo (2-4 mm sieve fraction, 171 kg/ha) and seed (120/m^2 Gamenya). Raked soil over rows, watered 2.5 mm by watering can. Topdressed Agran (73 kg/ha) between rows after half water applied.

Area = 0.25 m^2.

Drums: Cultivated with how, raked, smoothed. Pressed two circular furrows (22 cm and 44 cm diam. approx. 2 cm deep) into each drum. Placed into rows super Cu Zn Mo (2-4 mm sieve fraction, 200 kg/ha) and seed (228 Gamenya seeds/m^2). Raked, watered 2.5 mm by watering can. Topdressed Agran (75 kg/ha) after half water applied.

DETAILS OF EXTRA TREATMENTS:

IRRIGATION SYSTEM: Plots - Eighteen 4 L./ha drippers each irrigating a 36 x 48 cm area.

Drums - Three 2 L/ha drippers equally spaced around a 41 cm diameter circle in the 57 cm diameter drums.

Unirrigated Plots and Drums - Had the same irrigation system set up on them but the system set up on them but the system was not connected to the water supply.

Water Supply - Mains.

NUTRIENT APPLICATION: NH_4NO_3 applied as solid, K_2SO_4 applied in two solutions (20 mls/drum, 100 ml/plot).

TABLE 3: RAINFALL, EVAPORATION AND IRRIGATION.

DAY	JUNE			JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER		
	R	E	I	R	E	I	R	E	I	R	E	I	R	E	I	R	E	I
1				1.7	7.8		t	1.5			NM			4.3			16.5	12
2				2.0	2.0			2.1			9.8			4.8			NM	
3				t	1.3		2.5	3.5			5.6	25		6.4			NM	
4				7.0	2.3		t	3.4			5.0			6.1		5.0	31	
5					3.5		2.0	2.0			4.1			5.6			9.0	
6					1.8		2.5	2.5			5.0			4.4			14.0	
7					3.6			1.0			4.6			7.8	25		EVAP.	
8					4.0			1.7			6.4			NM			RECORDS	
9					3.8		3.0	3.0		t	1.7	16		18.0			ENDED	
10					3.5	19		2.7			3.9		1.5	5.4				
11					5.5		0.5	2.5		0.5	4.0			7.0	25			
12					2.6		1.3	2.6	25		3.5		5.9	NM				
13					3.6			3.0			4.6		0.2	8.3				
14				17.5	15.9			2.3			7.3			3.2				
15				0.5	1.9			2.7		1.0	1.0			NM				
16					2.0			4.3			3.6			NM				
17			20		3.1			5.8			3.7	24		16.7				
18	EVAP.			7.0	1.7		5.5	7.9			5.2			8.7	34			
19	RECORDS			8.5	1.9		4.0	1.8			6.7			NM				
20	STARTED				NM		1	1.0			9.2	25		NM		8.5		
21		4.4		1.0	4.2		t	2.5		6.5	6.5			23.7		28.5		
22		4.6		1.2	1.2			2.3		3.5	5.3			6.1				
23	0.5	1.8			2.5		0.5	3.4	25	1.0	1.7			NM				
24		2.4	3		2.3		1.0	4.2			3.6			16.7				
25	1.5	2.3		1.0	2.4		1.5	3.3			3.6			NM	42			
26	1.0	1.8		15	1.6		2.5	3.6			3.6	26		NM				
27		3.3		0.5	2.9		9.5	3.6			6.2			NM				
28		6.4	25	0.5	2.1			3.4			10.1		1.0	21.2				
29		7.6			1.6			2.2		18.0	4.0			7.3	14			
30	2.3	3.3			1.7			3.3		t	3.9			12.4				
31	/	/	/	2.0	3.7		1	2.8		/	/	/		NM				

NM = Not measured (The following day's figure includes this day's).
R = Rainfall (mm)
E = Evaporation (mm) - measured using class A pan with bird net.
I = Irrigation applied to "irrigation" drums and plots only. (mm - calculated from monitoring a dripper each irrigation, and measuring output of drum drippers at a number of times).
t = Trace of rainfall.

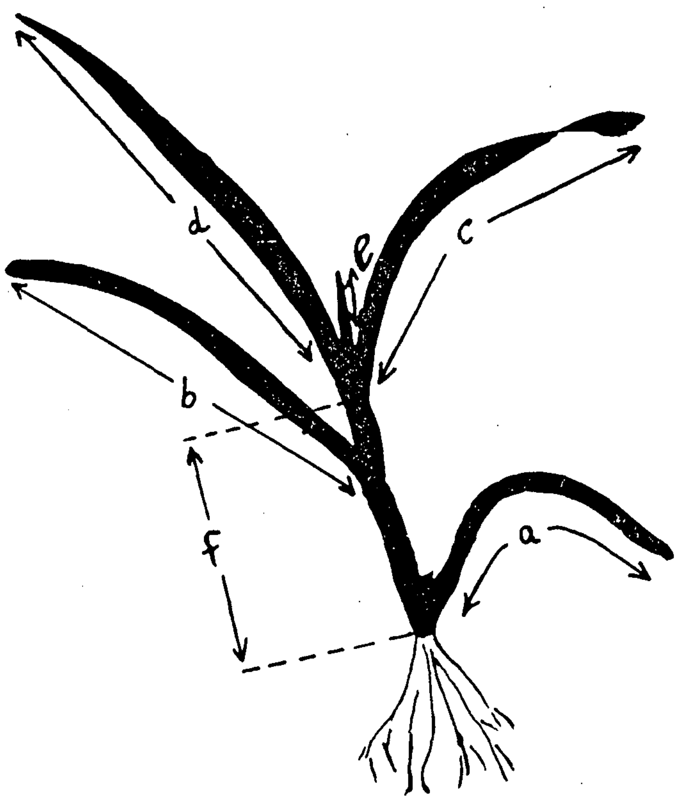
TABLE 4 LENGTH OF LEAVES AND STEM

TREATMENT			LENGTH OF LEAF AND STEM (m/plant)(1)					LIME RESPONSE
IRRIG	NUT'S	LIME	27d	41d	62d	76d	121d	121d
-	-	-	1.5	3.4	10.6	13.9	15.9	}
-	-	+	1.7	3.9	10.5	15.1	17.4	} 0
-	+	-	1.4	3.4	10.7	15.5	19.2	}
-	+	+	1.6	4.0	13.0	19.8	22.5	} 17
+	-	-	1.8	5.9	12.1	15.2	22.5	}
+	-	+	1.8	6.3	13.6	18.9	27.5	} 22
+	+	-	1.7	5.7	12.4	16.0	24.3	}
+	+	+	1.8	6.1	15.8	22.5	33.2	} 37

RESULTS OF ANALYSIS OF VARIANCE

	27d	41d	62d	76d	121d
IRRIGATION	N.S.	0.001	0.025	N.S.	0.001
NUTRIENTS	N.S.	N.S.	N.S.	0.025	0.01
LIME	0.10	N.S.	N.S.	N.S.	0.005
INTERACTIONS	N.S.	N.S.	N.S.	N.S.	N.S.
SED main effect means	0.1	0.4	0.9	1.4	1.4

(1) length calculated as follows (example):



length = a + b + c + d + e + f

Same three plants in each drum measured at each time, 4 reps.

TABLE 5: DRY MATTER PRODUCTION AND SOME YIELD COMPONENTS

TREATMENT (1)			DRY MATTER PRODUCTION				YIELD COMPONENTS				
I	N	L	57d[2] (g/m^2)	121d[3] (g/m^2)	Harv. (g/m^2)	Grain (g/m^2)	HI (g/g)	Head/ plant	Grain /head	g/ head	g/100 grains
DRUMS											
-	-	-	20	96	200	69	0.34	1.1	18	0.57	3.1
-	-	+	18	114	190	59	0.30	1.3	15	0.41	2.8
-	+	-	20	151	206	61	0.29	1.0	18	0.55	3.1
-	+	+	21	182	213	50	0.23	1.1	14	0.41	2.9
+	-	-	26	102	736	329	0.44	2.2	33	1.35	4.1
+	-	+	31	136	970	421	0.43	2.5	36	1.52	4.2
+	+	-	26	192	958	411	0.42	2.6	36	1.42	4.0
+	+	+	34	248	1186	495	0.41	3.0	36	1.49	4.1
CONTROL PLOTS											
-	-	-	ND[4]	ND	167	71	0.43	ND	22	0.75	3.4
-	+	-	"	"	216	93	0.43	"	25	0.91	3.6
+	-	-	"	"	245	102	0.42	"	27	0.91	3.4
+	+	-	"	"	587	234	0.40	"	31	1.18	3.8

ANALYSIS OF VARIANCE RESULTS - DRUMS ONLY

	Harv.	Grain	HI	Head/ plant	Grain /head	g/ head	g/100 grains
LIME (<p)	0.001	0.005	0.005	-	-	-	NS
IRRIGATION (<p)	0.001	0.001	0.001	-	-	-	0.001
NUTRIENTS (<p)	0.001	0.01	0.001	-	-	-	NS
SED main effect means (n=16)	20	12	0.009	-	-	-	0.05
L X I (<p)	0.001	0.001	(0.10)	-	-	-	0.05
L X N (<p)	NS	NS	NS	-	-	-	NS
I X N (<p)	0.001	0.005	0.005	-	-	-	NS
SED A X B interactions (n=8)	68	17	0.013	-	-	-	0.08

(1) I = Irrigation; N = Nutrients; L = Lime.

(2) Thinning harvest, replicates 1 and 3 only. Weight per plant converted to g/m^2 based on plant density after thinning (116 plants / m^2 in reps 1, 2, 3 and 96 / m^2 in rep 4).

(3) Calculated from leaf and stem lengths and widths using regressions shown in Table 6.

(4) ND = Not determined.

Estimating plant size from leaf and stem dimensions:

On September 26, 1985, one hundred leaves were picked from 18 plants, and twenty stems from ten of those plants. The following data were collected for each leaf:

- Plant number (1 to 18)
- Tiller number (1 to 5)
- Leaf number (1 to 8)
- New growth (16 were not fully emerged)
- Length of green tissue (30 - 235mm)
- Length of dead tissue (0 - 95 mm)
- Width at widest point (3.5 - 17 mm)
- Area of green tissue (75 - 2390 mm^2)
- Area of dead tissue (0 - 239 mm^2)
- Weight of green tissue (7 - 128 mg)
- Weight of dead tissue (0 - 17 mg)

Leaf area was measured using a Delta-T video-based system.

The following data was collected for each stem/leaf-sheath-bundle.

- Plant number (1 to 10)
- Tiller number (1 to 5)
- Length (14 to 290 mm)
- Diameter (1.5 to 4.5 mm)
- Weight (4 to 640 mg).

TABLE 6 PREDICTORS OF THE WEIGHT OF VARIOUS PARTS (mg).

DEPENDENT VARIABLE	INDEPENDENT VARIABLE	r^2	a	b
1. LEAF WEIGHT				
1.1 Fully emerged				
1.1.1 Green Section Only (n = 83)	Length	0.598	-28.06	0.553
	Width	0.798	-31.67	8.859
	Area	0.943	-6.128	0.058
	Length x width	0.912	-5.028	0.041
1.1.2 Dead Sections only (n = 83)	Length	0.553	-2.638	0.152
	Green width	0.184	-1.312	0.629
	Length x width	0.784	-2.833	0.017
1.1.3 Green & Dead (n = 83)	Length	0.640	-45.71	0.610
	Width	0.805	-32.44	9.174
	Area	0.942	-6.128	0.058
	Length x Width	0.935	-8.406	0.039
1.2 New Growth (n = 17)	Length	0.623	-12.355	0.381
2. STEM WEIGHT (n = 20)	Length	0.941	-100.50	2.356
	Width	0.527	-322.52	163.5
	Width ^2	0.579	-112.31	28.96
	Length x width	0.951	-45.98	0.547
	Length x width ^2	0.919	-7.471	0.125

TABLE 7 OTHER INTERRELATIONSHIPS.

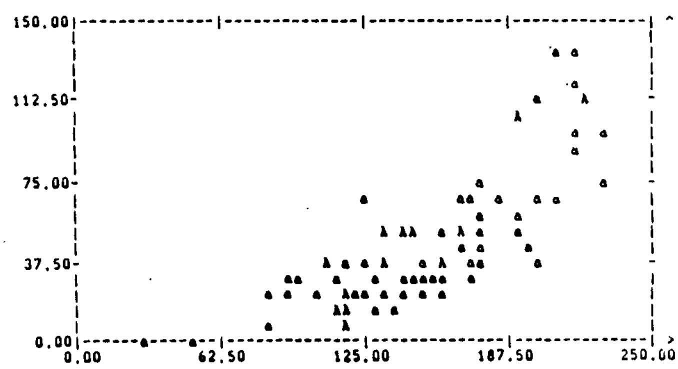
DEPENDENT VARIABLE	INDEPENDENT VARIABLE	r^2	a	b
1. FULLY EMERGED LEAVES				
1.1 Green section (n = 83)				
Area	Length	0.647	-388	9.564
Area	Width	0.860	-446	152.8
Area	Weight	0.943	147.7	16.13
Area	Length x Width	0.949	26.62	0.695
1.2 Green & Dead (n = 83)				
Length	Width	0.486	70.25	9.354
Area	Length	0.646	-633.1	10.096
Area	Width	0.872	-459.6	157.3
Area	Length x Width	0.941	-14.31	0.655
2. STEM (n = 20)				
Length	Width	0.606	2.033	0.008

LEAF:

Y variable(s): TOTAL WEIGHT (MG)

X variable(s): TOTAL LENGTH (MM)

Total of 83 cases processed.

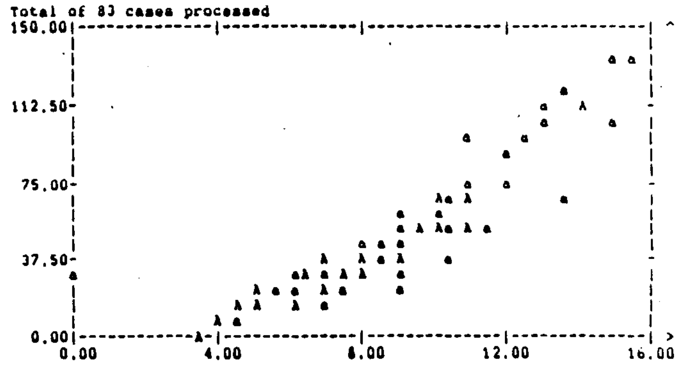


LEAF:

Y variable(s): TOTAL WEIGHT (MG)

X variable(s): WIDTH (MM)

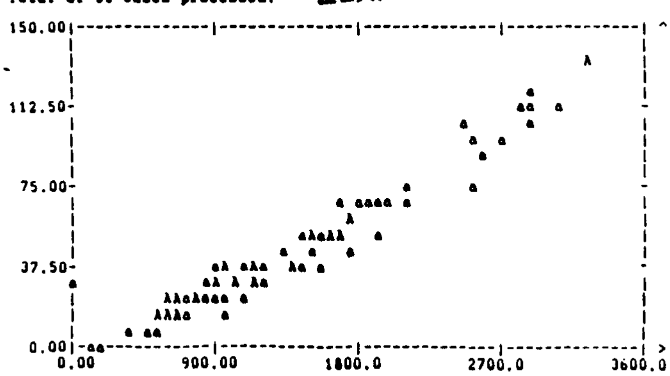
Total of 83 cases processed



Y variable(s): TOTAL WEIGHT (MG)

X variable(s): TOTAL LENGTH (MM) * WIDTH (MM)

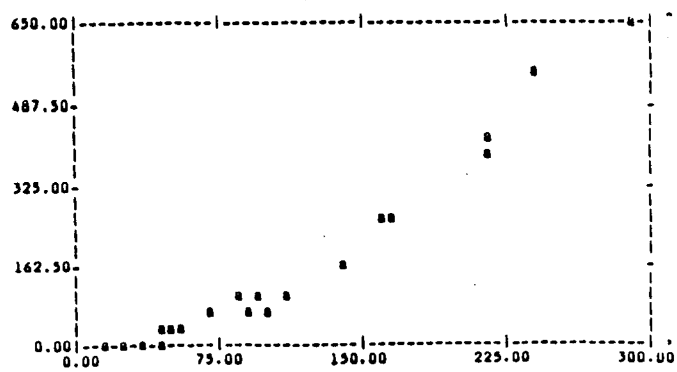
Total of 83 cases processed. LEAF



Y variable(s): WEIGHT ●

X variable(s): LENGTH ●

Total of 20 cases processed. STEM



82ME10 / 4231EX

Effect of liming a wodjil soil profile on lupin production.

1985 DETAILS

27th June Simazine 1 L./ha (0.4 ml in 250 ml water over 4 sq. m).
Sprayseed 3.1 L./ha (1.25 ml in 250 ml water over 4 sq. m)
Topdressed Super (200 kg/ha), sowed Yandee in Drums (made 28 holes 2-3 cm deep, placed inoculated seed in hole, covered, firmed - density: 112/sq m) and in Plots (made furrows 2 - 3 cm deep, 18 cm spacing, placed seed at approx 8 cm spacing in furrows, raked over - density : 70/sq m). Drum area = 0.25 sq. m.

1st October: Counted and cut lupins from all drums and plots, dried and weighed.

TREATMENT	PLANTS / m^2	DM t/ha
Drums - Lime	63	0.36 (100%)
Drums + Lime	73	0.77 (214%)
Plots - Lime	44	0.49 (136%)
AOV (Drums) p<:	N.S.	0.061

82M5/4231EX

Effect of liming a wodgil soil profile on lupin production.

25th June Sowed using same procedure as in 82ME10.

HARVEST:

TREATMENT	PLANTS / sq. m.	DM kg/ha	GY kg/ha	HI
Drums - Lime	38	550	200	0.34
+ Lime	38	700	280	0.39
Plots - Lime	50	1150	450	0.39
AOV (drums) p<	N.S.	0.05	0.08	N.S.

81M54/4231EX

Lime banding in acid subsoils for wheat.

1985 DETAILS:

5th June: Cultivated (combine and harrows). Agran topdressed across all plots (75 kg/ha) then extra N plots (200 kg/ha). "Run over" control plots run over with combine.

6th June: Seeded Gamenya (50 kg/ha) with super (200 kg/ha).

DEPTH OF RIPPING (cm)	DEPTH OF LIME APPLICATION (cm)	RATE OF QUICK - LIME AT EACH DEPTH (t/ha)	Kg N/Ha	GRAIN YIELD (t/ha)
-	-	0	26	0.92
-	0	0.4	26	0.91
40,20	-	0	26	0.91
40,20	0	0.2	26	0.96
40,20	0	0.4	26	0.92
40,20	20	0.2	26	0.94
40,20	40	0.2	26	0.94
40,20	40,20	0.2	26	0.98
40,20,40,20	-	0	26	0.91
40,20,40,20	40,20	0.2	26	0.92
Plots run over once extra at seeding :				
-	-	0	26	0.96
-	-	0	77	0.96

(AOV : Treatment : N.S.)

80M30/3831EX:

Effect on wheat of lime applied to the surface soil of an eastern wheatbelt acid sandplain.

1985 PROCEDURE:

29th May: All plots scarified ('7.5 cm').

5th June: Plots harrowed.
All plots sown to : Wheat (50 kg Gamenay/ha)
with : DAP (98 kg/ha).

HISTORY:		A	B	C	D
1980 :	Species :	Wheat	Wheat	Clover	Clover
	Mo (g/ha):	0	500	0	500
1981 :	Species :	Wheat	Wheat	Clover	Clover
1982 :	Species :	All volunteer pasture.			
1983 :	Species :	Wheat	Wheat	Triticale	Triticale
	Mo (g/ha):	500	0	500	0
1984 :	Species :	Wheat	Wheat	Wheat	Wheat
1985 :	Species :	All sown to Wheat.			

VEGETATIVE YIELD (SEPT 1985) t/ha.

	t lime/ha 1980					
HISTORY	0	0.5	1.0	2.0	4.0	mean
A	1.58abc	1.61abc	1.58abc	1.53abc	1.66ab	1.59
B	1.78a	1.46c	1.61abc	1.63abc	1.44c	1.58
C	1.55bc	1.77a	1.55bc	1.68ab	1.70ab	1.65
D	1.55bc	1.50bc	1.46c	1.66ab	1.64abc	1.56
mean	1.62	1.58	1.55	1.62	1.61	1.60

(AOV: History N.S., Lime N.S., Interaction 0.05, Rep 0.01)
(L.S.D. (0.05, n = 3, 38 df) = 0.215)

GRAIN YIELD 1985 (t/ha)

	t lime/ha 1980					
HISTORY	0	0.5	1.0	2.0	4.0	mean
A	1.16	1.14	1.17	1.19	1.19	1.16a
B	1.13	1.16	1.22	1.16	1.17	1.16a
C	1.08	1.16	1.08	1.11	1.20	1.12b
D	1.10	1.16	1.08	1.08	1.16	1.11b
mean	1.11c	1.15ab	1.13bc	1.13bc	1.17a	1.14

AOV: History $p<0.005$, Lime $p<0.01$, Interaction $p<0.10$.
L.S.D. : 0.05, History : 0.032, Lime : 0.036.

80M31/3831EX:

Residual value of lime.

1985 PROCEDURE:

29th May : Simazine 2 L/ha across all plots.
Direct drilled with harrows to Yandee (100 kg/ha) with plain super (221 kg/ha).

Harvest : Split seeds in high lime rate plots.

t lime / Ha 1980	Vegetative Yield September (t/ha)	Grain Yield (t/ha)
0	1.69	0.76 c
0.5	1.57	0.60 ab
1.0	1.71	0.54 a
2.0	1.46	0.53 a
4.0	1.79	0.70 bc

(AOV : Grain yield : Lime $p<0.025$, L.S.D. : 0.137).

85ME92/4231EX:

Survey of extremely poor eastern wheatbelt yellow sandplain soils.

AIM:

1). To determine whether there is a consistent relationship between some soil profile parameter and the degree to which productivity is restricted by the acidity of the site.

2). to characterise the variability in chemical properties of acid, eastern wheatbelt sandplain soils.

BACKGROUND:

A proportion of eastern wheatbelt yellow sandplain soils (probably about 20%) appear to be so severely affected by acidity that they are of no value for agriculture. The site of experiment 82ME10 (and 80ME3 adjacent) is an example.

From accumulated casual observations it appeared that these soils may be separated from 'better' yellow sandplain soils on the basis of subsoil pH. The extremely poor soils appeared to often have deeper subsoil (> 40 cm) pH values (water or $CaCl_2$) less than 4.0, even as low as 3.5.

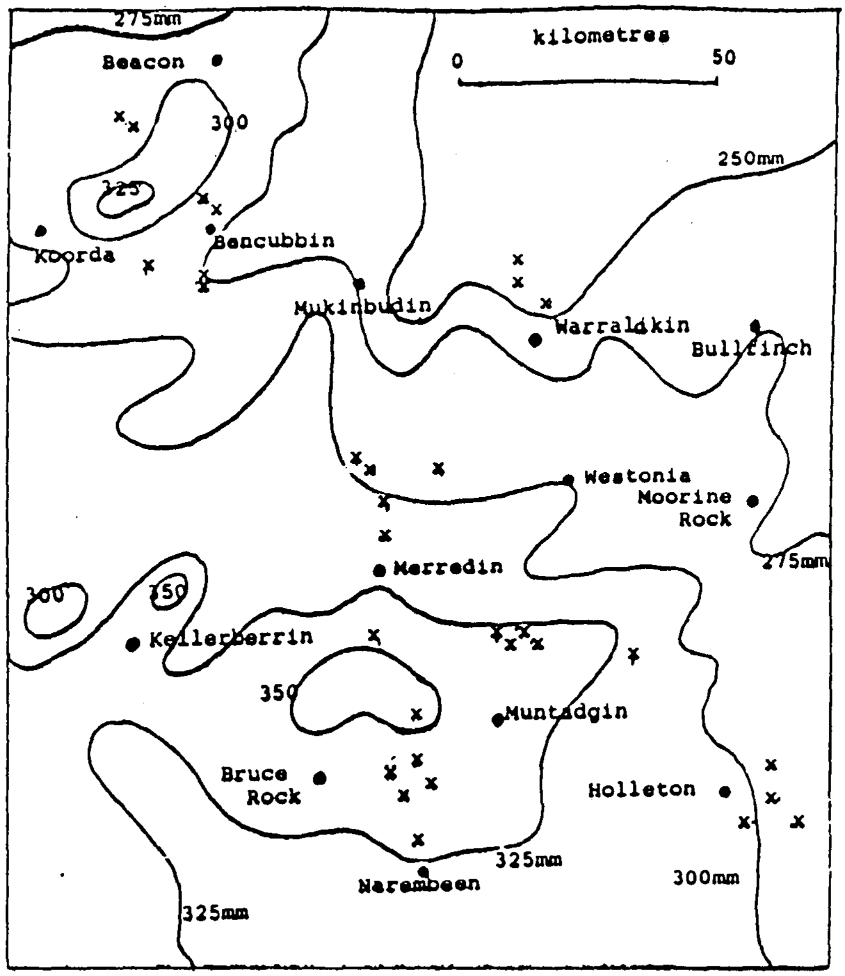
This survey was targetted particularly at these soils - i.e. not to pick out marginal differences between soils affected moderately by pH, but to pick out the extremes.

PROCEDURE:

In September and October, 1985, 31 sites were surveyed in the eastern wheatbelt (Fig 1). At each site the farmer was asked to select two patches of wheat crop on deep yellow sandplain - one on an area which has consistently produced very poor crops and, the other, on a significantly more productive area within the same paddock. In each of these areas measurements of the crop were made (depth to seed, plant density, dry matter), and soil was collected (samples surface (0 - 10 cm and of each 10 to 30 cm thick layer down to 2 m) for later analysis.

The history of the paddocks for 1980 to 1985 and rainfall records for 1985 were obtained where the farmer had them.

FIGURE 1: Map showing sites surveyed and rainfall isoheits.



RESULTS:

As yet only preliminary analyses have been conducted, however a number of significant results from the survey have been obtained.

In summary these are :

a). Differences between 'good' and 'poor' areas within sites were consistent with the hypothesis that acidity is limiting wheat production. In almost every case, lower wheat production was associated with lower surface soil pH (fig 2) and lower subsoil pH (fig 3).

b). Topsoil pH cannot be used as an indicator of subsoil pH. The data (fig 4) confirm that there is little relationship between topsoil and subsoil pH.

c). A useful equation has been derived which summarises the relationship between pH's measured using two techniques (fig 5).

In the past soil pH has usually been measured in a soil:water mixture. However, as a dilute salt mixutre is a better medium for measuring pH, many laboratories are coverting to using calcium chloride. The general equation for the top 10 cm of the soils sampled is :

$$pH\ (CaCl_2) = 1.471 + 0.602 \times pH\ (water).$$

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Figure 2. Higher wheat vegetative production at either 'good' or 'poor' acid sandplain sites were associated with higher topsoil (0-10cm) pH values (measured in 1:5 0.01M $CaCl_2$) in 23 out of 28 sites.

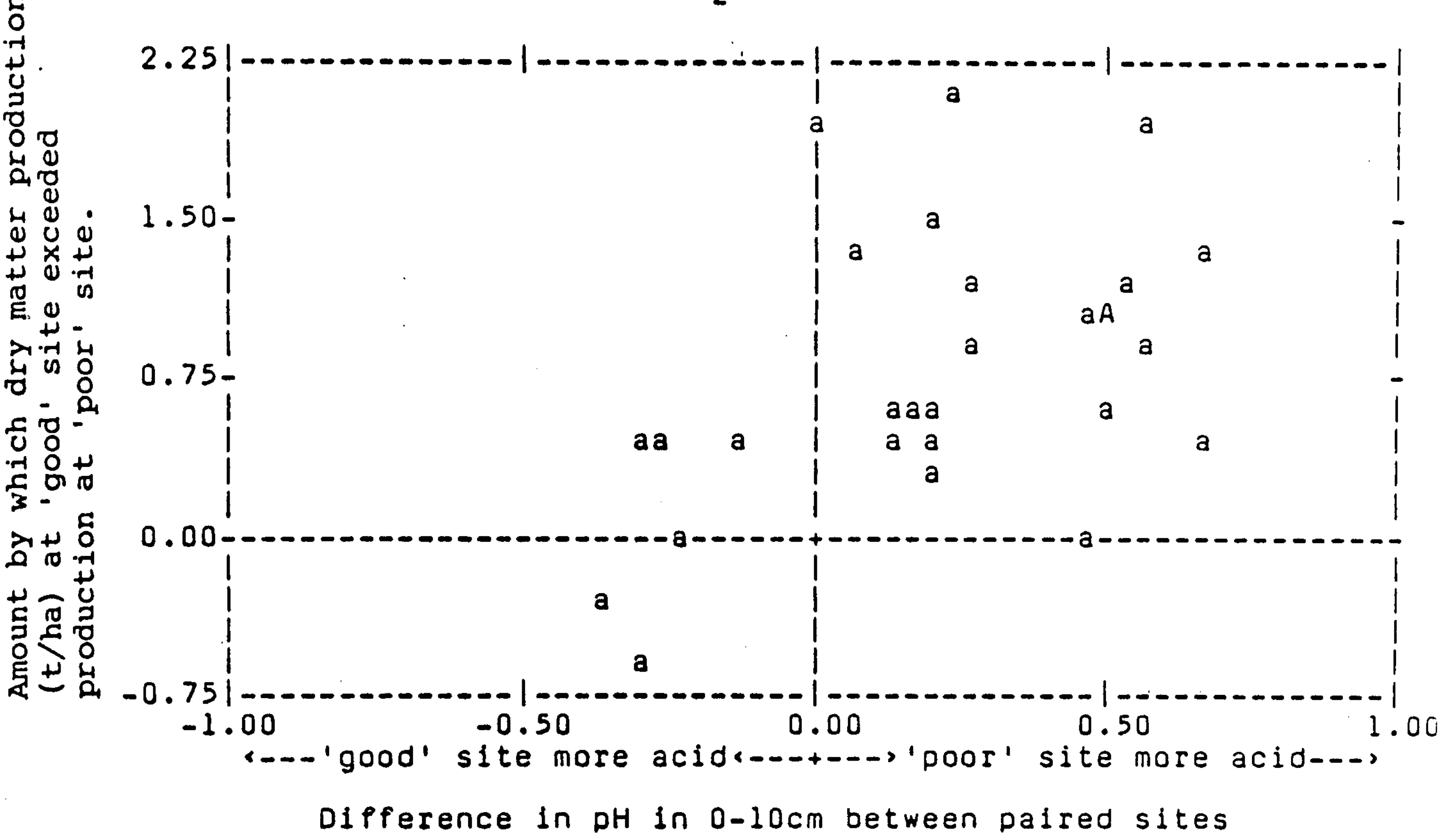
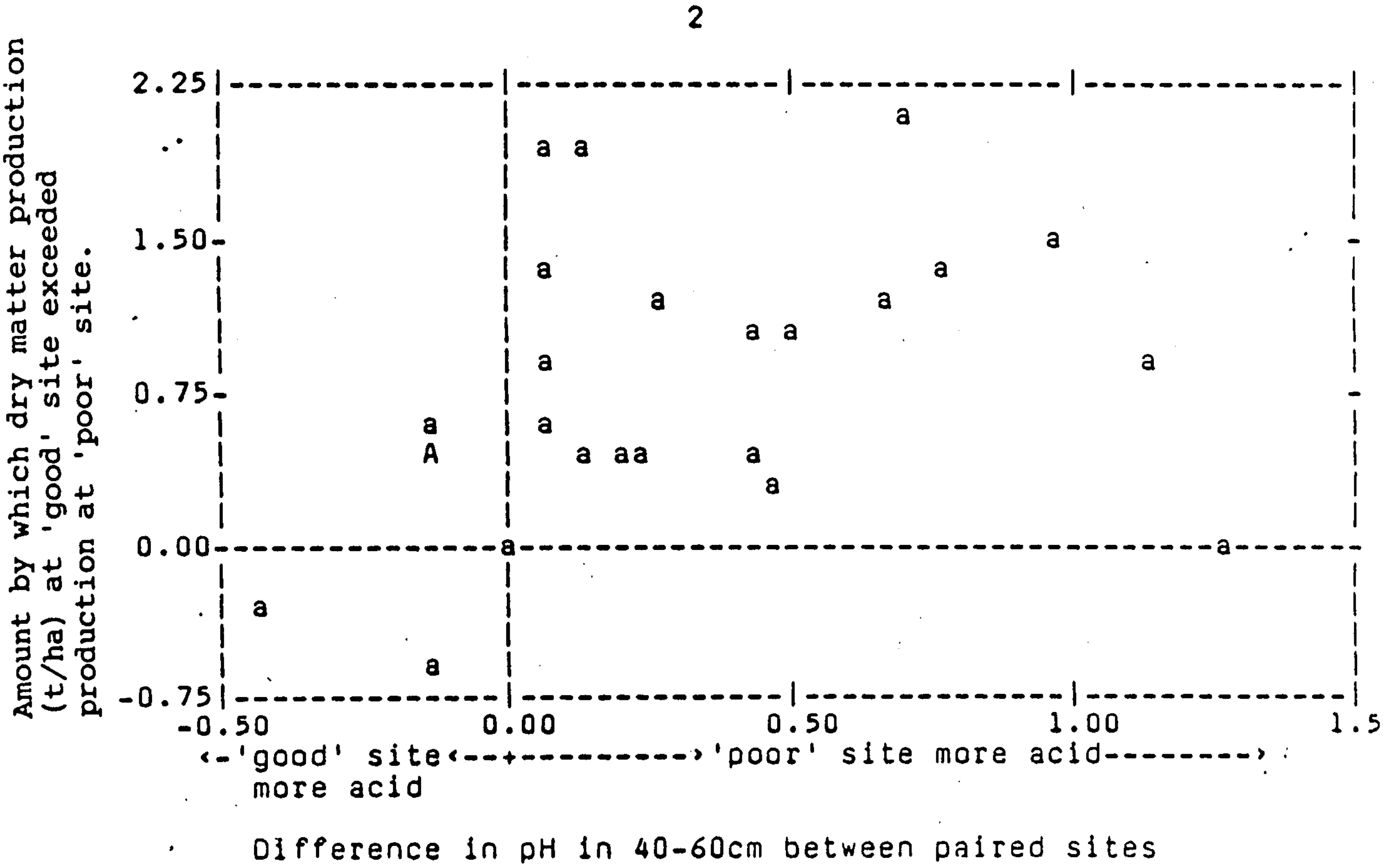
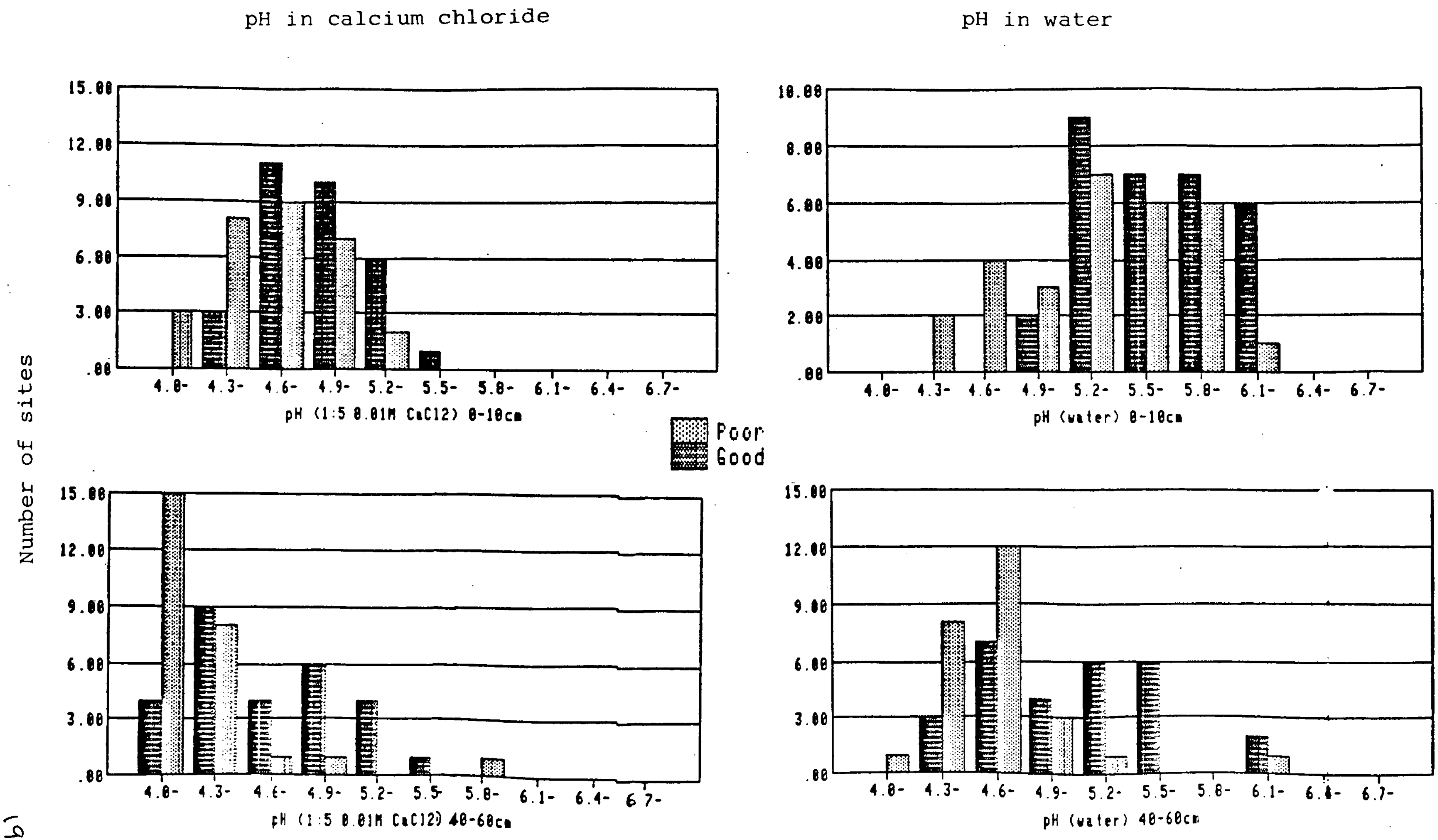


Figure 3. Higher wheat vegetative production at either 'good' or 'poor' acid sandplain sites were associated with higher topsoil (40-60cm) pH values (measured in 1:5 0.01M $CaCl_2$) in 19 out of 23 sites.





85ME92 Frequency distribution of topsoil and subsoil pH.

85ME92 Frequency distribution of plant parameters.