4 THE SOIL

4.1 PARENT MATERIAL AND GEOLOGY

Bester (1965 p. 6) gives the following account:

"The litho-sequence at Zebediela and surroundings are:

(1) Small local patches of unconsolidated, Recent deposits of limestone and conglomerates mostly south of Zebediela.

(11) Basalts of the Stormberg Series, Transvaal System.

(111) Thick deposits of dolomites of the Dolomite Series, also Transvaal System. The dolomites are in places interbedded with basalts.

(IV) Quartsites of the Black Reef Series, Transvaal System, which build the highest peaks of the Strydpoort Mountains. Also further east and to the west, quartsites of the Wolkberg Series, Witwatersrand System occur.

(V) Andesitic lavas and acid lavas of the Dominium Reef System on the norhtern slopes of the Strydpoort Mountains.

(VI) Granite gneiss and Argaic granite. These two formations form the northern slopes of the Strydpoort Mountains and contribute nothing or very little to the parent material of Zebediela soils.

To the west and east of Zebediela in the vicinities of the Maribaskop and Molsgat areas respectively, there also occur outcrops of shales, quartsite-conglomerates and tillites of the Pretoria Series, of the Transvaal System.

Still further to the west and also to the east in the vicinities of Potgietersrus-Drummondlea and Dwaalkop areas respectively, gabbro, and norite intrusions of the Bushveld Igneous Complex give rise to intensely red- and/or black coloured soils."

4.2 SOIL TYPES

According to Bester (1965, p. 7):

"Zebediela falls in an area which, according to the morphological classification of C.R. van der Merwe (1940), is on a transition of two Soil - Groups. It borders on the north-eastern regions of the Sub - tropic Black Clay soils of the Springbok Flats and merges towards the north and east into the Brown - to Reddish Brown Ferruginous Lateritic soils.

Zebediela's surface soils have been grouped by A.J. van der Merwe (1931) into 20 soil types. The soils are predominantly reddish - brown to red sandy loams and are normally very deep with very little profile differentiation.

The red colour apparently has originated from basalts with some influence of the calcium from the dolomites. In such soils the colloidal soils of aluminium hydroxide and iron hydroxide originating from basalt, are flocculated by calcium carbonate from dolomite, bestowing a red colour upon the soil.

Norite intrusions, especially to the south-west of Zebediela can be responsible for the dark (almost black) colour of some soil patches in this area of the Estates. Norite in conjunction with titanacious magnetite, sandstone and granite may also contribute to the red colour of these soils."

4.3 SOIL TEXTURE AND SOIL PROFILE AT SAMPLING SITE

In the region of the sampling sites at Section 3 B, the soils were a predominantly grey sandy loam. Plot A had a loose grey sandy loam throughout the 16cm profile. Stones were abundant.

At the sampling sites both plots B and C had a greyish sandy loam, which tended to become solid and clay-like from a depth of 8 cm. Occasional stones were found. On the other hand, the sampling sites of both plots D and E had a loose reddish-brown sandy loam soil which was devoid of stones.

4.4 SOIL ANALYSIS

For the purpose of the present investigation soil samples were taken stratigraphically to a depth of 16 cm. The samples were divided into four parts or subsamples of 4 cm. each. These subsamples each had a volume of 67 cc. Three samples were taken at each plot, preserved in four ounce bottles, and sent to Fisons (Pty.) Ltd., at Sasolburg for analysis.

For comparison, the absolute and mean values of the different nutritional elements are given in tables 1 - 5.

4.41 Phosphorus (fig. 2; table 1)

The phosphorus content of plots A, B and C was extremely low (5-10 p.p.m.), while that of plots D and E was considerably higher (up to 76 p.p.m.). The top layer of 12 cm had the highest count for phosphorus on the latter two plots.

4.42 Potassium (fig. 3; tabel 2)

No noteworthy differences in potassium content on the different plots has been observed. The control plot had the highest concentration (196.6 p.p.m.), which was registered in the upper 8 cm. of soil, with a gradual decline towards the 16 cm level. On plots B and C however, the concentration proportions were just the other way round, with the lowest concentration near the surface and the highest concentration towards the 4th subsample. Similar trends were observed for all the other recorded elements on plots B and C. This phenomenon could most likely be ascribed to the fact that the last mentioned plots have a loose sandy loam soil for the first 8 cm a and a hard clay-like stratum from the 12-16 cm subsamples down. Fertilizer and other chemicals deposited on the surface would leach through the sandy part of the soil but not penetrate the compact lower strata.

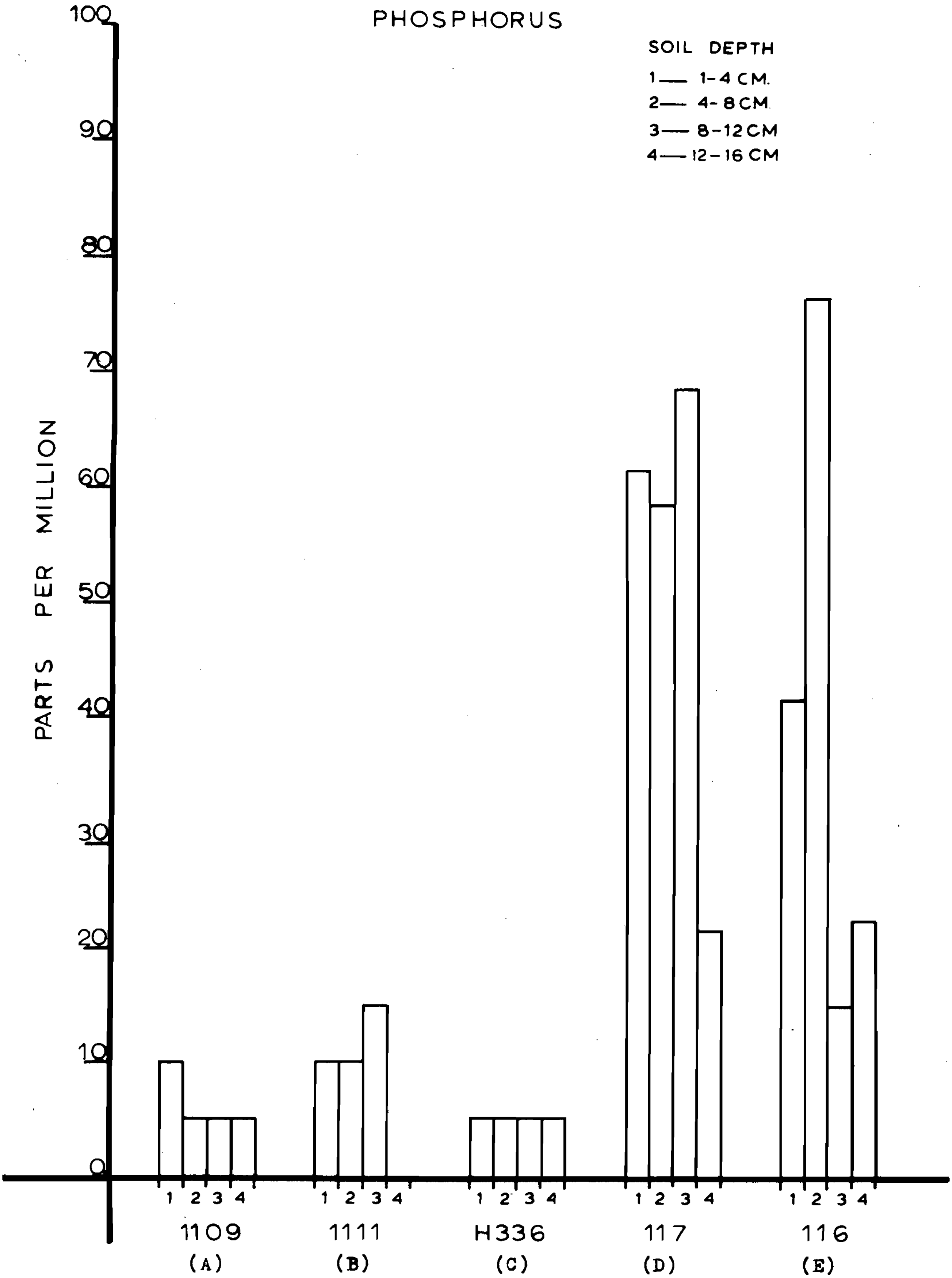

Fig. 2. Stratigraphical phosphorus values of plots A - E.

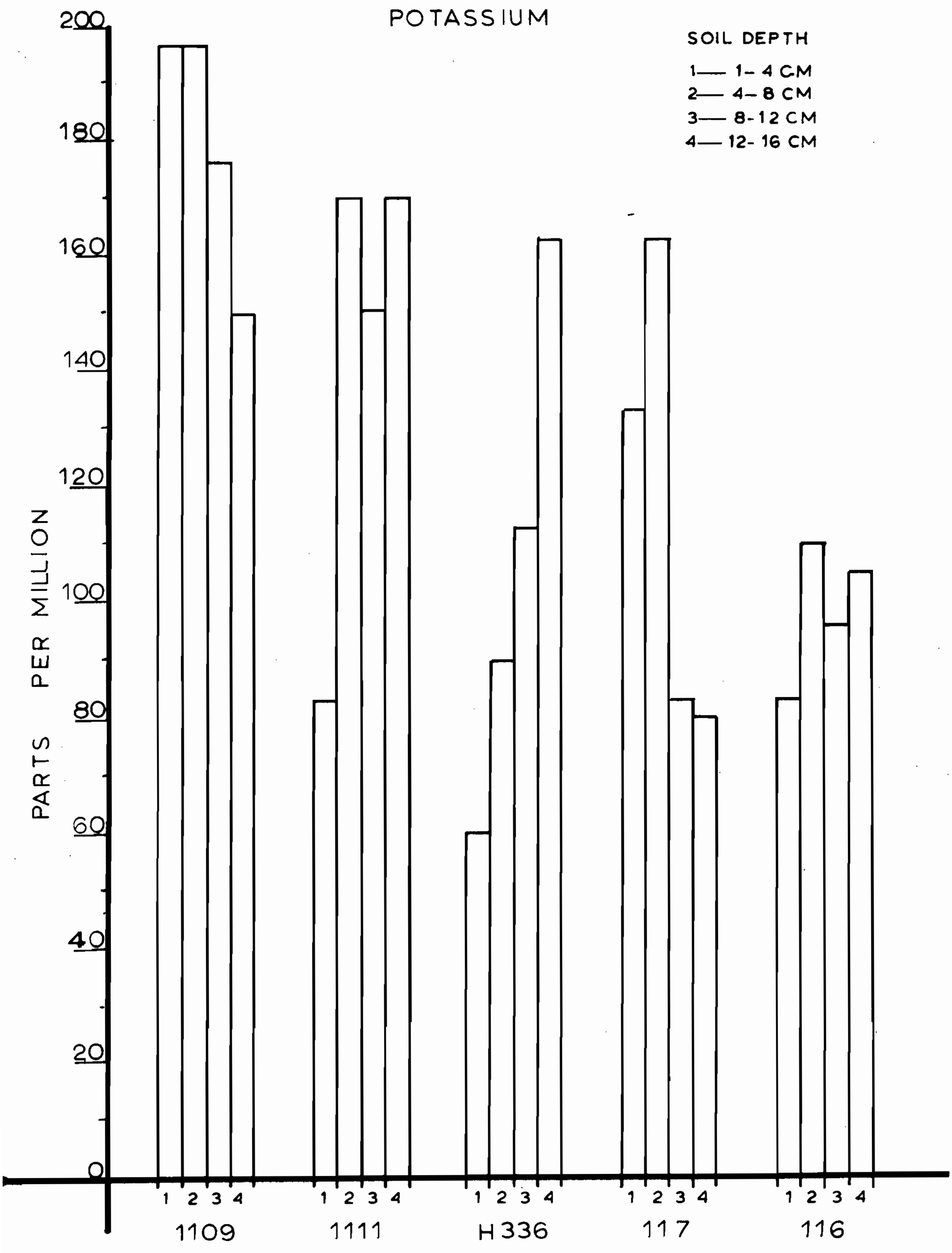

Fig. 3. Stratigraphical potassium values of plots A - E.

On plot D the first 8 cm had a higher concentration than the 12-16 cm region, while the potassium distribution in plot E was more or less even in concentration throughout.

4.43 Calcium (fig. 3; table 3)

The calcium values in the plots of Section 3 B were more or less on the same level, but whereas the calcium content diminished towards subsample 4 (16 cm) in the control plot, plots B and C revealed a gradual aggregation of calcium in the lower layers; a tendency that has been mentioned in the description of potassium on these particular plots.

Plot D had the highest overall concentration with a mean value of 2400 p.p.m. in the first 4 cm., 1286.6 p.p.m. in the second layer and 943.3 p.p.m. and 620. p.p.m. respectively for the third and fourth layers. On the adjacent plot E on the other hand, a relatively low calcium concentration was recorded with very little variation in the stratification.

4.44 Magnesium (fig. 4; table 4)

The magnesium content for the soils of all five plots varied between 110 p.p.m. and 263 p.p.m. The soil of Section 2 had a relatively higher magnesium content than the soils of Section 3 B, with the highest recording in the first 8 cm of plot D.

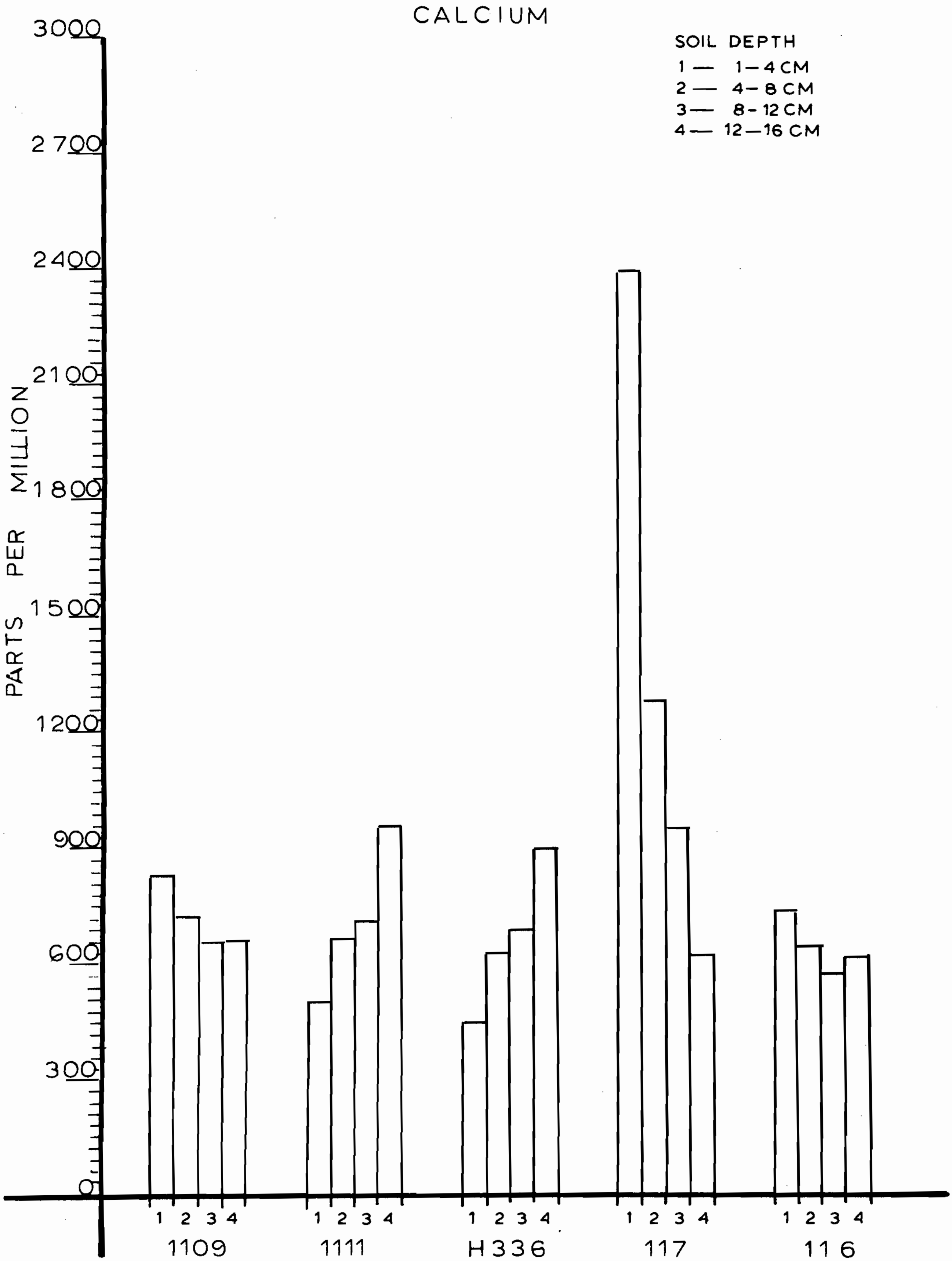

Fig. 4. Stratigraphical calcium values of plots A – E.

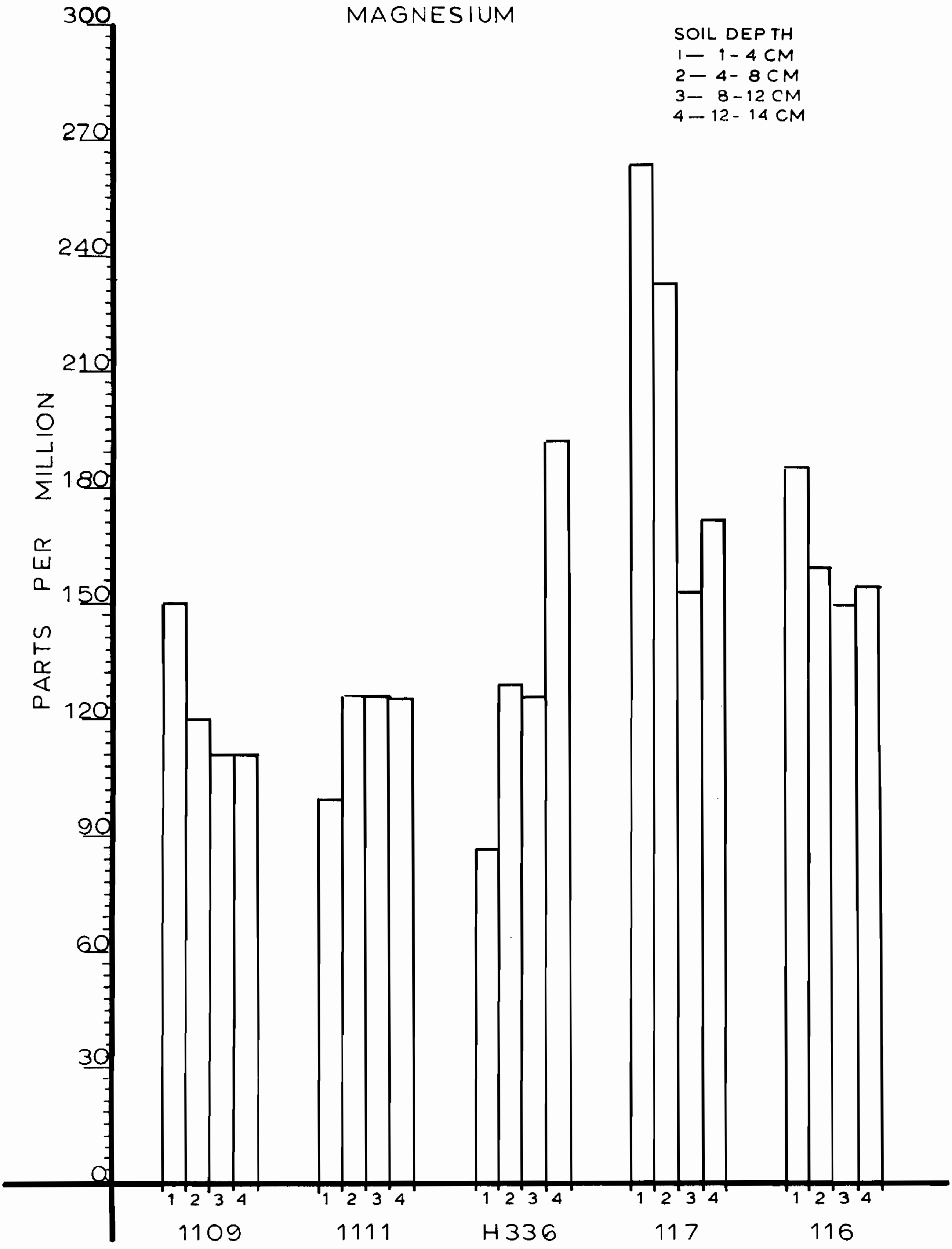

Fig. 5. Stratigraphical magnesium values of plots A - E.

4.45 Sodium (fig. 5; table 5)

The sodium content of the soils of all five plots was in the range 126.6 to 180 p.p.m. The stratificational variation was small, with a tendency to higher concentrations in the deeper layers.

TABLE 1 Stratigraphical phosphorus values of plots A-E

		Sample 1	Sample 2	Sample 3	Average
		p.p.m.	p.p.m.	p.p.m.	p.p.m.
Plot 1109 (A)	1-4 cm	10	10	10	10 000
	4-8 cm	5	5	5	5 000
	8-12 cm	5	5	5	5 000
	12-16 cm	5	10	5	6 666
Plot 1111 (B)	1-4 cm	5	10	10	8 333
	4-8 cm	10	10	10	10 000
	8-12 cm	15	15	15	15 000
	12-16 cm	5	5		5 000
Plot H 336(C)	1-4 cm	5	5	5	5 000
	4-8 cm	5	5	5	5 000
	8-12 cm	5	5	5	5 000
	12-16 cm	5	5	5	5 000
Plot 117 (D)	1-4 cm	40	70	75	61 666
	4-8 cm	45	60	70	58 333
	8-12 cm	75	60	15	68 333
	12-16 cm	15	40	10	21 666
Plot 116 (E)	1-4 cm	40	40	45	41 666
	4-8 cm	80	80	70	76 666
	8-12 cm	10	15	20	15 000
	12-16 cm	25	20		22 500

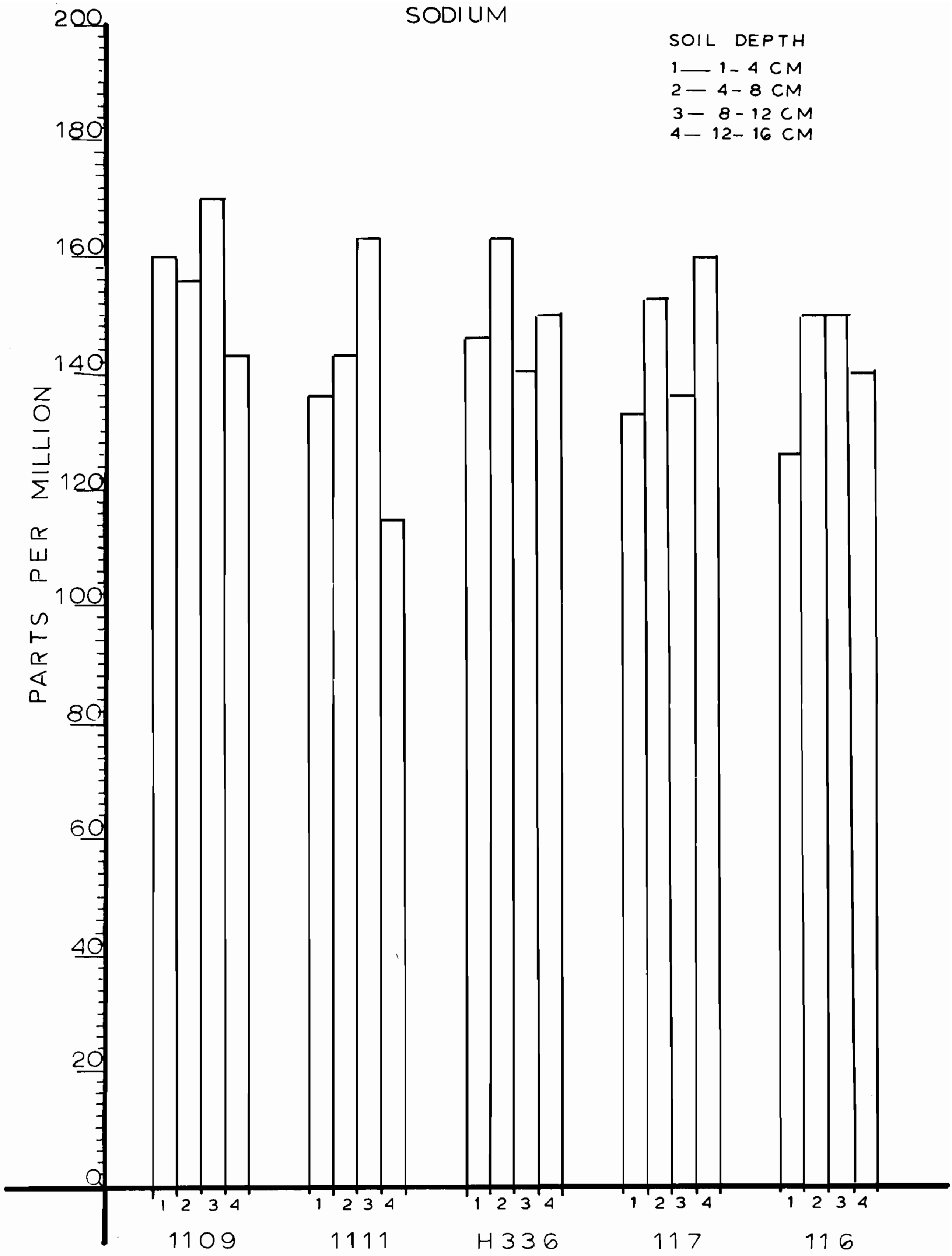

Fig. 6. Stratigraphical sodium values of plots A - E.

TABLE 2 Stratigraphical potassium values of plots A - E

		Sample 1	Sample 2	Sample 3	Average
		p.p.m.	p.p.m.	p.p.m.	p.p.m.
Plot 1109 (A)	1-4 cm	210	190	190	196 666
	4-8 cm	190	190	210	196 666
	8-12 cm	190	170	170	176 666
	12-16 cm	170	130	150	150 000
Plot 1111 (B)	1-4 cm	90	90	70	83 333
	4-8 cm	150	170	190	170 000
	8-12 cm	190	120	150	153 333
	12-16 cm	160	180		170 000
Plot H 336(C)	1-4 cm	50	50	80	60 000
	4-8 cm	90	110	70	90 000
	8-12 cm	110	110	120	113 333
	12-16 cm	150	170	170	163 333
Plot 117 (D)	1-4 cm	130	130	140	133 333
	4-8 cm	210	140	140	163 333
	8-12 cm	90	80	80	83 333
	12-16 cm	80	80	80	80 000
Plot 116 (E)	1-4 cm	100	70	80	83 333
	4-8 cm	110	100	120	110 000
	8-12 cm	100	90	100	96 666
	12-16 cm	100	110		105 000

TABLE 3 Stratigraphical calcium values of plots A - E

		Sample 1	Sample 2	Sample 3	Average
		p.p.m.	p.p.m.	p.p.m.	p.p.m.
Plot 1109 (A)	1-4 cm	960	750	800	836 666
	4-8 cm	800	700	690	730 000
	8-12 cm	700	690	590	660 000
	12-16 cm	690	660	640	663 000
Plot 1111 (B)	1-4 cm	530	530	460	506 666
	4-8 cm	590	670	740	666 666
	8-12 cm	740	690	690	706 666
	12-16 cm	800	1120		960 000
Plot H 336(B)	1-4 cm	420	420	510	450 000
	4-8 cm	620	770	500	630 000
	8-12 cm	690	690	700	693 333
	12-16 cm	800	960	960	906 000
Plot 117 (D)	1-4 cm	2400	2720	2080	2400 000
	4-8 cm	660	1440	1760	1286 666
	8-12 cm	1120	1120	590	943 333
	12-16 cm	590	660	610	620 000
Plot 116 (E)	1-4 cm	740	690	800	743.333
	4-8 cm	660	660	620	646 666
	8-12 cm	590	560	580	576 666
	12-16 cm	620	610		615 000

TABLE 4 Stratigraphical magnesium values of plots A - E

		Sample 1	Sample 2	Sample 3	Average
		p.p.m.	p.p.m.	p.p.m.	p.p.m.
Plot 1109 (A)	1-4 cm	170	130	150	150 000
	4-8 cm	120	120	120	120 000
	8-12 cm	110	120	100	110 000
	12-16 cm	110	110	110	110 000
Plot 1111 (B)	1-4 cm	100	110	90	100 000
	4-8 cm	110	130	140	126 666
	8-12 cm	130	120	130	126 666
	12-16 cm	120	130		125 000
Plot H 336(C)	1-4 cm	80	90	90	86 666
	4-8 cm	130	170	90	130 000
	8-12 cm	120	130	130	126 666
	12-16 cm	180	210	190	193 333
Plot 117 (D)	1-4 cm	230	320	240	263 333
	4-8 cm	240	230	230	233 333
	8-12 cm	140	160	160	153 333
	12-16 cm	160	170	190	173 333
Plot 116 (E)	1-4 cm	180	170	210	186 666
	4-8 cm	160	170	150	160 000
	8-12 cm	170	140	140	150 000
	12-16 cm	160	150		155 500

TABLE 5 Stratigraphical sodium values of plots A - E

		Sample 1	Sample 2	Sample 3	Average
		p.p.m.	p.p.m.	p.p.m.	p.p.m.
Plot 1109 (A)	1-4 cm	150	150	180	160 000
	4-8 cm	160	140	170	156 666
	8-12 cm	160	170	180	170 000
	12-16 cm	150	140	140	143 333
Plot 1111 (B)	1-4 cm	130	150	130	136 666
	4-8 cm	150	140	140	143 333
	8-12 cm	160	160	170	163 333
	12-16 cm	90	140		115 000
Plot H 336(C)	1-4 cm	140	160	140	146 666
	4-8 cm	160	190	140	163 333
	8-12 cm	140	140	140	140 000
	12-16 cm	140	160	150	150 000
Plot 117 (D)	1-4 cm	20	160	160	133 333
	4-8 cm	170	130	160	153 333
	8-12 cm	140	140	130	136 666
	12-16 cm	160	170	150	160 000
Plot 116 (E)	1-4 cm	140	90	150	126 666
	4-8 cm	140	160	150	150 000
	8-12 cm	130	120	140	130 000
	12-16 cm	160	150		150 555

4.46 Organic material

The extimations of the percentages of organic material present in the soils were done by the Walkley-Black method. The organic material percentages for the five plots were as follows:

Plot A : 8.7502%

Plot B : 7.6380%

Plot C : 10.4118%

Plot D : 3.3768%

Plot E : 2.2122%

The sandy loam soils from the three plots on Section 3 B had a considerably higher organic material content than the more sandy loams from plots D and E in Section 2. It is further interesting to note that plot C had the highest concentration of organic material. Repeated experiments confirmed the higher organic material content at the C sampling site.

4.47 Soil resistance

Soil resistance recorded for the different plots was as follows:

Plot A :	10,000	ohm	-	100	mmhos / cm
Plot B :	1,600	ohm	-	625	mmhos / cm
Plot C :	800	ohm	-	1250	mmhos / cm
Plot D :	3,600	ohm	-	278	mmhos / cm
Plot E :	2,700	ohm	-	375	mmhos / cm

For better interpretation the ohm- figures have been converted to mmhos / cm. Repeated tests on soil from the C sampling site revealed the high concentration of electrolites in comparison with the relatively low figure for the control plot.

4.48 Soil pH

The soil pH values recorded at the sampling sites of the different plots were as follows:

Plot A : 6.00

Plot B : 7.15

Plot C : 7.50

Plot D : 7.85

Plot E : 8.30

The citrus plots had a more alkaline soil.

4.5 RAINFALL

Zebediela receives an average rainfall of 26 inches a year.

TABLE 6 Average monthly rainfall and temperature for Zebediela Estates

Month	Average monthly rainfall in millimetres for the period 1911 - 1963	Average monthly relative humidity as % at 2 p.m. for the period 1956-1960	Average monthly temperatures in °F (°C in brackets) for the period 1956 - 1960 Maximum	Minimum
January	131.8	51.9	85.1 (29.5)	64.5 (18.1)
February	103.1	49.0	85.9 (29.9)	65.7 (18.7)
March	79.0	50.8	84.3 (29.1)	63.1 (17.3)
April	36.3	44.3	81.5 (27.5)	58.1 (14.5)
May	13.2	40.1	76.3 (24.6)	51.3 (10.7)
June	6.4	39.1	70.9 (21.6)	44.6 (7.0)
July	7.1	37.7	71.3 (21.8)	45.8 (7.6)
August	4.8	32.3	76.9 (24.9)	48.7 (9.3)
September	15.0	39.6	80.2 (26.8)	53.8 (12.1)
October	47.8	40.4	85.8 (29.9)	61.0 (16.1)
November	101.3	48.4	86.2 (30.1)	64.0 (17.8)
December	104.9	54.9	85.0 (29.4)	64.5 (18.1)
Average/year	650.7	44.0	80.8 (27.1)	57.0 (13.9)

After Bester (1965)

During the sampling period, however, the rainfall recorded wa considerably below the average; Section 3 B received 20.24 inches (table 7) and Section 2 only 15.46 inches (table 8). As is shown in the average monthly rainfall table (table 6) most of the rain fell in the four months November to February, and this period can be regarded as the summer rainfall season. During these months Section 3 B received 86.31% and Section 2, 78.78% of this total annual fall.

TABLE 7 Rainfall recorded during the sampling period at Section 3 B (plots A, B and C)

Monthly rainfall in inches. (July 1965 - June 1966)

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Febr.	March.	Apr.	May	June
1								4.50				
2				.12	.21			.18				
3												
4					.26							.14
5						.15		.07				
6			.11			.10						.13
7								.40				.17
8				.09		.05						
9												
10												
11							.02					
12					1.01					.79		
13					1.48							
14												
15							1.96					
16							.59	.24				
17						.07		.07				
18				.10								
19								.21				
20												
21						.18						
22						.37	.21	.07				
23								.09				
24			.81									
25			.29									
26					.32		1.03					
27							1.35					
28					.42	.57	.06					
29					.09	.57						
30					.20			.03	.02			
31												
	-	-	1.21	.31	4.36	2.06	5.22	5.83	.02	.79	-	.44

Year total: 20.24 inches

TABLE 8 Rainfall recorded during the sampling period at Section 2 (plots D and E)

Monthly rainfall in inches (July 1965 - June 1966)

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Febr.	March	Apr.	May	June
1				.14				2.17				
2					.55			.11				
3												
4					.28							
5												
6			.06			.09		.03				.14
7						.02		.59	.11			.36
8				.07		.01						.27
9												
10												
11							.03					
12					1.15					.91		
13					1.12							
14												
15							.74					
16								.12				
17						.08		.09				
18				.08								
19				.18				.07				
20												
21						.31						
22						.32	.80	.17				
23								.01				
24			.60									
25			.33									
26					.32		.41					
27					.67		.10					
28						.55	.13					
29					.08	.69						
30					.37				.03			
31												
	-	-	.99	.47	4.54	2.07	2.21	3.36	.14	.91	-	.77

Year total : 15.46 inches

4.6 SOIL MOISTURE

Moisture, together with temperature are usually considered to be the most important factors of the climate. The interaction of these two factors depends on the relative, as well as the absolute, values of each. Temperature, therefore, exerts a more severe limiting effect on organisms when moisture conditions are extreme, that is, either very high or very low, than when such conditions are moderate. Likewise, moisture plays a more critical role in the extremes of temperature.

The absolute soil moisture content in the different soil depths on the sampling plots is shown in table 9. Soil moisture contents are calculated as a percentage of water to dry soil weight. The percentages given in the table only reflect the moisture content of the soil at the time when the samples were taken.

TABLE 9 Soil moisture percentages recorded during samplings at the different plots

PLOT NO. 1109 (A)

Subsample layer	1-4 cm	4-8 cm	8-12 cm	12-16 cm	mean
July 1965					
Sample no. 1	2.988	1.334	1.042	1.207	
Sample no. 2	1.952	2.862	1.157	.745	
Sample no. 3	2.857	3.077	1.209	.874	

September 1965

Sample no. 1	8.411	6.732	4.670	4.810	
Sample no. 2	5.368	4.652	3.989	3.941	
Sample no. 3	5.440	3.989	3.540	3.400	
Mean	6.406	5.124	4.066	4.050	4.912

January 1966

Sample no. 1	1.347	3.777	6.827	5.828	
Sample no. 2	2.505	2.367	5.507	9.732	
Sample no. 3	1.410	5.899	5.893	1.262	
Sample no. 4	2.206	5.699	2.061	5.927	
Mean	1.867	4.435	5.072	5.687	4.265

April 1966

Sample no. 1	12.700	11.435	12.034	11.622	
Sample no. 2	22.700	13.107	12.980	12.038	
Sample no. 3	15.983	15.833	12.667	13.228	
Sample no. 4	13.333	10.405	11.706	12.819	
Mean	16.179	12.696	12.346	12.426	13.411

PLOT NO. 117 (D)

July 1965

Sample no. 1	2.927	2.791	3.227	2.632	
Sample no. 2	4.966	4.629	4.618	4.341	
Sample no. 3	3.219	3.881	3.815	2.150	
Mean	3.704	3.767	3.886	3.041	3.599

September 1965

Sample no. 1	4.545	3.820	5.842	4.123	
Sample no. 2	3.298	4.956	4.224	2.577	
Sample no. 3	4.595	4.534	4.904	4.335	
Mean	4.146	4.436	4.990	3.678	4.315

January 1966

Sample no. 1	1.661	1.319	2.520	2.347	
Sample no. 2	.874	1.868	2.050	1.881	
Sample no. 3	2.856	.933	1.800	1.904	
Sample no. 4	1.118	.755	2.153	2.131	
Mean	1.627	1.218	2.130	2.065	1.760

April 1966

Sample no. 1	10.911	4.986	3.990	3.194	
Sample no. 2	12.117	4.655	3.800	3.597	
Sample no. 3	9.244	5.668	3.439	3.058	
Sample no. 4	6.416	5.309	3.659	2.919	
Mean	9.672	5.154	3.722	3.192	5.435

PLOT NO. 116 (E)

July 1965

Sample no. 1	3.290	4.712	4.109	2.377	
Sample no. 2	2.773	6.511	2.845	2.805	
Sample no. 3	3.016	6.121	4.042	2.114	
Mean	3.026	5.781	3.665	2.432	3.726

<u>September 1965</u>

Sample no. 1	4.677	3.702	4.447	3.321	
Sample no. 2	5.252	4.256	4.002	4.402	
Sample no. 3	3.854	3.938	4.749	4.678	
Mean	4.594	3.965	4.399	4.133	4.272

<u>January 1966</u>

Sample no. 1	1.538	3.457	2.632	2.382	
Sample no. 2	.893	2.600	2.666	2.538	
Sample no. 3	.958	2.544	2.578	2.417	
Sample no. 4	.945	1.294	2.379	2.519	
Mean	1.083	2.473	2.463	2.464	2.120

<u>April 1966</u>

Sample no. 1	5.560	5.822	5.984	6.240	
Sample no. 2	4.121	5.299	5.910	5.650	
Sample no. 3	10.200	7.812	6.716	7.603	
Sample no. 4	9.066	5.461	5.536	3.670	
Mean	7.236	6.098	6.036	5.790	6.290

The air temperature and Relative Humidity figures were obtained from recordings at the Insectory, Zebediela Estates. Minimum temperature recordings, in Fahrenheit, were made at 8.0 am. and maximum temperature recordings at 2.09 pm. each day. Relative Humidity readings were done at the same time (fig. 7, table 10).

FIG. 7

WEEKLY MEAN AIR TEMPERATURE AND RELATIVE HUMIDITY

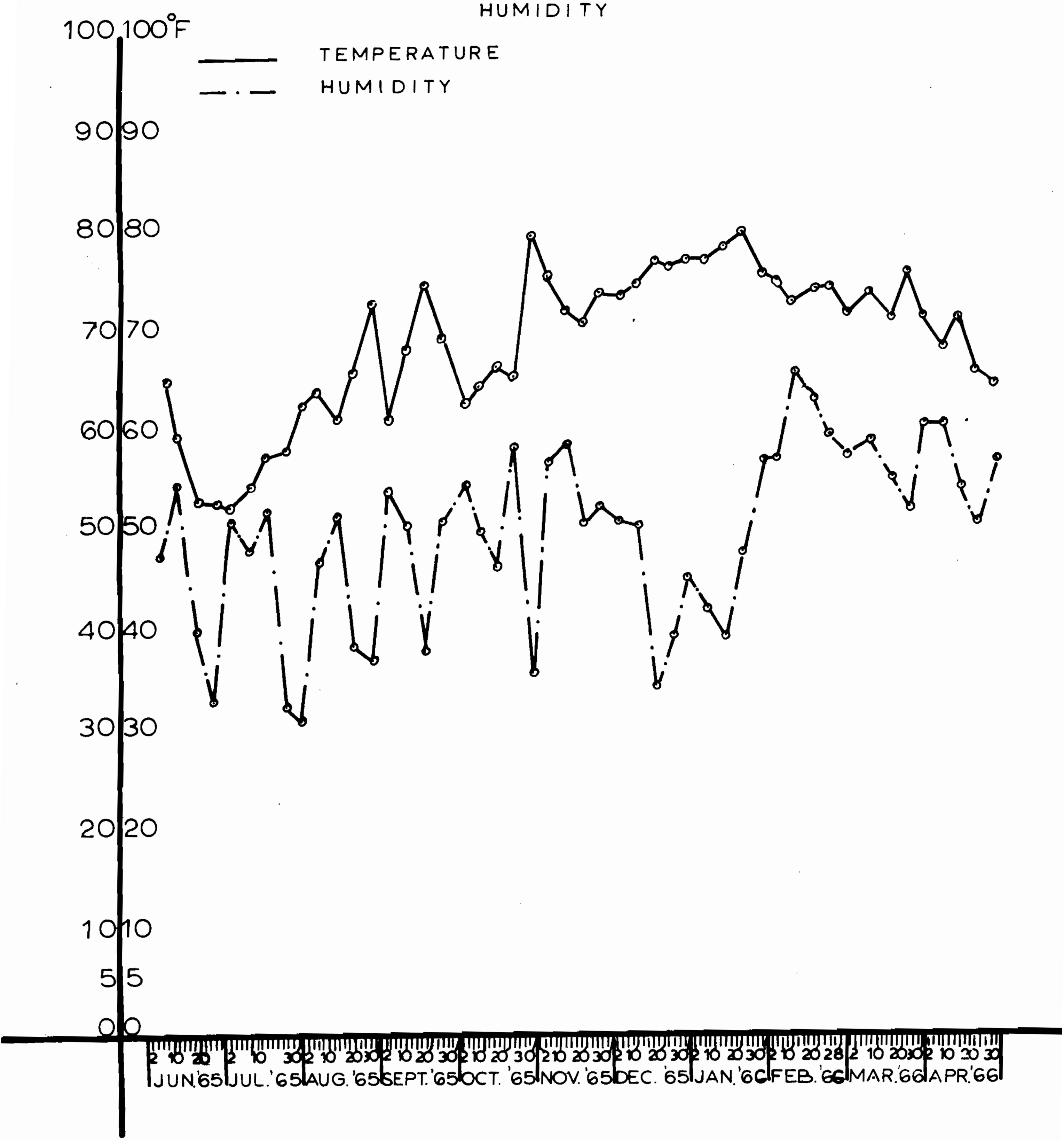

TABLE 10 Air temperature and relative humidity recordings for the sampling period

	Air Temperature (°F)			Relative Humidity (%)	
Date	Max.	Min.	Mean	8.0	2.09 recordings
June 1965					
5/6/65	65.0	66.0	65.5	66.0	30.0
12/6/65	70.0	50.0	60.0	69.0	46.0
19/6/65	65.0	42.0	53.5	58.0	23.0
26/6/65	66.0	41.0	53.5	45.0	22.0
Monthly mean	58.1			44.8	
July 1965					
3/7/65	66.0	40.0	53.0	72.0	31.0
10/7/65	67.0	43.0	55.0	66.0	31.0
17/7/65	72.0	44.0	58.0	70.0	35.0
24/7/65	73.0	44.0	58.5	38.0	28.0
31/7/65	76.0	50.0	63.0	35.0	25.0
Monthly mean	57.5			43.1	
August 1965					
7/8/65	76.5	52.5	64.5	59.8	35.0
14/8/65	74.0	49.0	61.5	67.3	36.7
21/8/65	78.9	53.6	66.2	52.6	25.3
28/8/65	84.4	58.7	71.7	47.0	28.3
Monthly mean	65.9			44.0	

(Table 10 continued)

	Air Temperature (^{o}F)			Relative Humidity (%)	
Date	Max.	Min.	Mean	8.0	2.09 recordings
September 1965					
4/9/65	73.3	49.3	61.5	70.0	38.9
11/9/65	80.9	55.4	68.1	65.0	37.4
18/9/65	86.4	59.7	72.9	50.0	27.3
25/9/65	82.1	57.3	69.7	64.7	38.4
Monthly mean	68.0			48.9	
October 1965					
2/10/65	74.2	52.4	63.3	71.0	49.5
9/10/65	77.4	52.4	64.9	61.1	39.9
16/10/65	79.4	53.3	66.9	59.4	34.4
23/10/65	76.8	55.2	66.0	69.5	53.1
30/10/65	94.0	66.4	80.2	44.1	28.6
Monthly mean	68.2			51.0	
November 1965					
6/11/65	83.5	65.9	76.1	61.6	53.3
13/11/65	82.1	62.2	72.8	66.8	51.7
20/11/65	80.4	62.8	71.6	60.8	42.1
27/11/65	83.3	65.7	74.5	64.8	41.7
Monthly mean	73.7			55.3	

(Table 10 continued)

	Air Temperature (^{o}F)			Relative Humidity (%)	
Date	Max.	Min.	Mean	8.0	2.09 recordings
December 1965					
4/12/65	84.8	64.1	74.4	60.4	43.1
11/12/65	86.6	63.8	75.4	61.4	40.8
18/12/65	90.2	67.7	78.8	38.8	21.3
15/12/65	91.0	65.5	78.3	52.4	28.0
Montly mean	76.7			43.2	
January 1966					
1/1/66	89.1	66.8	77.8	55.7	36.1
8/1/66	89.6	66.1	77.9	54.1	31.1
15/1/66	92.0	66.4	79.2	53.3	16.9
22/1/66	90.4	70.4	80.6	62.3	35.0
29/1/66	87.0	66.1	76.6	67.3	48.3
Montly mean	78.4			47.0	
February 1966					
5/2/66	85.7	65.9	75.8	70.0	45.9
12/2/66	81.0	66.3	73.6	75.3	57.9
19/2/66	84.0	67.4	75.0	76.1	52.0
26/2/66	83.6	67.0	75.3	74.3	46.3
Montly mean	74.9			62.2	

(Table 10 continued)

	Air Temperature (^{o}F)			Relative Humidity (%)	
Date	Max.	Min.	Mean	8.0	2.09 recordings
March 1966					
5/3/66	82.7	62.3	72.5	70.9	46.0
12/3/66	85.1	64.4	74.8	72.6	47.0
19/3/66	84.4	60.1	72.3	71.3	40.9
26/3/66	88.3	65.1	76.7	68.3	38.0
Monthly mean	74.0			56.8	
April 1966					
2/4/66	82.4	62.1	72.3	73.9	49.4
9/4/66	79.1	59.3	69.2	76.7	46.1
16/4/66	82.1	62.3	72.2	66.4	43.3
23/4/66	77.4	55.7	66.6	63.4	39.6
30/4/66	75.6	56.0	65.8	70.9	45.1
Monthly mean	69.2			57.4	
May 1966					
7/5/66	75.3	55.7	65.6	65.1	39.0
14/5/66	77.9	56.0	66.9	65.9	38.9
21/5/66	78.3	52.7	65.5	59.0	36.6
28/5/66	71.6	45.9	58.8	58.7	35.9
Monthly mean	64.2			49.8	

4.7 TEMPERATURE

During samplings, soil temperature was recorded for the first 4 cm soil-layer by means of a thermometer (table 11).

TABLE 11 Soil temperatures recorded during sampling

July 1965		September 1965	
A	- 6°C at 8 a.m.	A	- 45°C at 1 p.m.
B	- 12°C at 10 a.m.	B	- 40°C at 3 p.m.
C	- 18°C at 12	C	- 43°C at 2 p.m.
D	- 22°C at 2 p.m.	D	- 34°C at 4 p.m.
E	- 20°C at 4 p.m.	E	- 30°C at 5 p.m.

January 1966		April 1966	
A	- 30°C at 9 a.m.	A	- 10°C at 8.30 a.m.
D	- 40°C at 10.30 a.m.	B	- 19°C at 10 a.m.
B	- 41°C at 11.30 a.m.	C	- 22°C at 11.30 a.m.
E	- 43°C at 12.30 p.m.	D	- 24°C at 2 p.m.
C	- 45°C at 1.30 p.m.	E	- 20°C at 4 p.m.

The maximum soil temperature was higher than the maximum air temperature during spring and summer, but in April (Autumn) and July (winter) the maximum soil temperature was either the same or even below the maximum air temperature. This corresponds with the soil- and air thermograph recordings made by the author during 1962 - 1963 at Potchefstroom.

4.8 CULTIVATION PRACTICES

4.81 Irrigation

For irrigation purposes and for control of run-off rain water, the Estates practise a "four basin per tree-system". This consists of a system of square earth banks which cover the citrus orchard area. Water for irrigation runs in cement canals on the fringe of the plots and serve the trees by means of earth furrows, placed between the rows.

The control plot, with its natural vegetation, was not irrigated. The other four plots received irrigation.

The plots were irrigated on the following dates during the sampling period:

Plots B and C	Plots D and E
13/5/65	13/5/65
2/9/65	14/1/66
2/4/66	1/4/66

4.82 Pest control

4.821 Chemical applications on the experimental plots

Plot A, the control plot with natural vegetation, and plot C, the biological control plot, received no pest control chemicals. Plot E, on the other hand, is a normal routine plot used for comparison with the adjoining plot D, and as such received about 10 gallons of parathion per tree (with a concentration of 3 lbs. of powder per 100 gallons of water) on the 3rd of September 1965. Plots B and C both received a mean of 8.8 gallons of paration per tree of the same concentration on 24/8/65.

Lime sulphur sprays were applied against citrus bud mite on plots B, C and E, at a concentration of 1 lb. of powder per 100 gallons of water. Plot E received a mean of 8 gallons per tree on 15/6/65. During the 1966 season, the last mentioned three plots received a mixutre of lime sulphur (of the same concentration), and zinc oxide at a concentration of half a pound of powder per 100 gallongs of water. On 7/6/66 the trees of plot E were sprayed with a dosage calculated at 11.7 gallons per tree, while plots B and C both received a mean of 6 gallons per tree, by means of spraying on 24/6/66.

4.83 Nutritional practices

According to Schoeman (1960), Zebediela's soils were fertile to such an extent that only nitrogen had to be applied during the first 20 years of citrus growing. Citrus trees have a healthy appetite for nitrogen, as van Blerk (1962) aptly states:

"They are in fact, gluttons for nitrogen and thousands of tons of this fertilizer are fed to the trees each year on Zebediela. Minor elements such as zinc, magnesium, calcium, iron, copper and boron are also essential for nutrition. Continual chemical analyses are conducted to determine whether any of these trace elements are lacking and for the purpose of supplying the trees with these elements, a spray system is in operation which enables the elements to be administered at the rate of 20,000 gallons a day.

The trees varying food needs from time to time are also determined by analysing the leaves. So far this method seems to have been used little as a guide in the fertilizing of commercial citrus orchards, but its use at Zebediela over more than a decade has proved very reliable and has been instrumental in achieving a degree of fertilizing efficiency not possible before."

4.831 Nutritional applications on the experimental plots

4.8311 Nitrogen treatments

Plot A, the control plot, received no nutritional chemicals. Plots B and C both received ammonium nitrate (NH_4NO_3) at 2 lbs. per tree on the 27/7/65. At Section 2, both plots D and E received 4 lbs. per tree on 6/7/65 and a further 1 lb. per tree on 6/7/66.

4.8312 Potassium treatments

Plot B was the only experimental plot to receive muriate of potash (KCl) during the sampling period, each tree receiving 4 ounces.

The lowest air temperature recorded was 40°F (4°C) on the 3rd of July 1965, and as minimum air temperature is as a rule always lower than soil minimum temperature, it can be assumed that the soil never reached freezing point during the sampling period.

The soil surface temperature was exceptionally high at noon during spring and summer, but then it must be mentioned that temperature recordings were made on bare surface areas. Grass- or debris coverings, which were present on all the experimental plots, tend to moderate extreme heat.

Cameron (1925) noted a high surface temperature of 120°F (± 48°C) in the surface soil, while temperatures at 3 and 6 inches depth were 90°F (± 32°C) and 70°F (± 20°C) respectively. These temperatures were recorded in Illinois, U.S.A. George Salt (1952, 1955) mentioned the extremely high soil temperatures which he registered in East African pastures.

4.8313 Boron treatment

The only experimental plot to receive boron application was plot B, which received 4 ounces of borax ($Na_rB_4O_7$) per tree on 4/5/65.

4.84 Weed control

Since weeds in the orchards compete with the citrus trees for water and nutrients, workers with shovels kept the orchards clean throughout the year.