

A REPORT TO THE HORTICULTURAL DEVELOPMENT COUNCIL
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EXAMINATION OF NITRATE LEVELS
IN RED BEET CROPS (1993)
FV161

ANNUAL REPORT

Project Number: FV161

Project Title: Examination of nitrate levels in red beet crops.

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Authentication

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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Contents

	Page
Objectives	5
Project Details	
Part I: Monitoring levels in commercial crops	5-14
Part II: Comparison of four nitrogen fertiliser rates	15-18
Part III: Additional studies	19-21
Overall Conclusions	22
Recommendations for Future Work	23
Appendix I: Monitoring nitrate levels in commercial crops	24-26
Appendix II: Comparison of four nitrogen fertiliser rates at HRI Stockbridge House	27-28

EXAMINATION OF NITRATE LEVELS IN RED BEET CROPS

Objectives

To organise the collection of samples of red beet from commercial growers and to grow red beet at a range of nitrogen rates at Stockbridge House for nitrate testing. At present there is a shortage of reliable data and the implications of the proposed EEC directive on nitrate levels on production of red beet are unknown.

Project Details

Part I: Monitoring levels in commercial crops

Samples of fresh red beet were collected by four commercial growers and sent to Lancrop Laboratories on 30 July, 12 August, 23 August, 6 September, 20 September and 4 October. The red beet was harvested at most sites at both 9 am and 4 pm and samples from three size grades (1"-1 $\frac{5}{8}$ ", 1 $\frac{3}{4}$ "-2 $\frac{1}{2}$ ", and 2 $\frac{1}{2}$ "-3") were sent for analysis.

After sampling all red beet was kept in cool conditions prior to dispatch to the laboratory. Each sample consisted of between 10 and 20 roots depending on size grade.

Results

The results of the 109 samples are summarised in the following histograms.

FIG 1. NITRATE LEVELS IN BEETROOT 1993

Averaged over 4 commercial sites (109 samples)

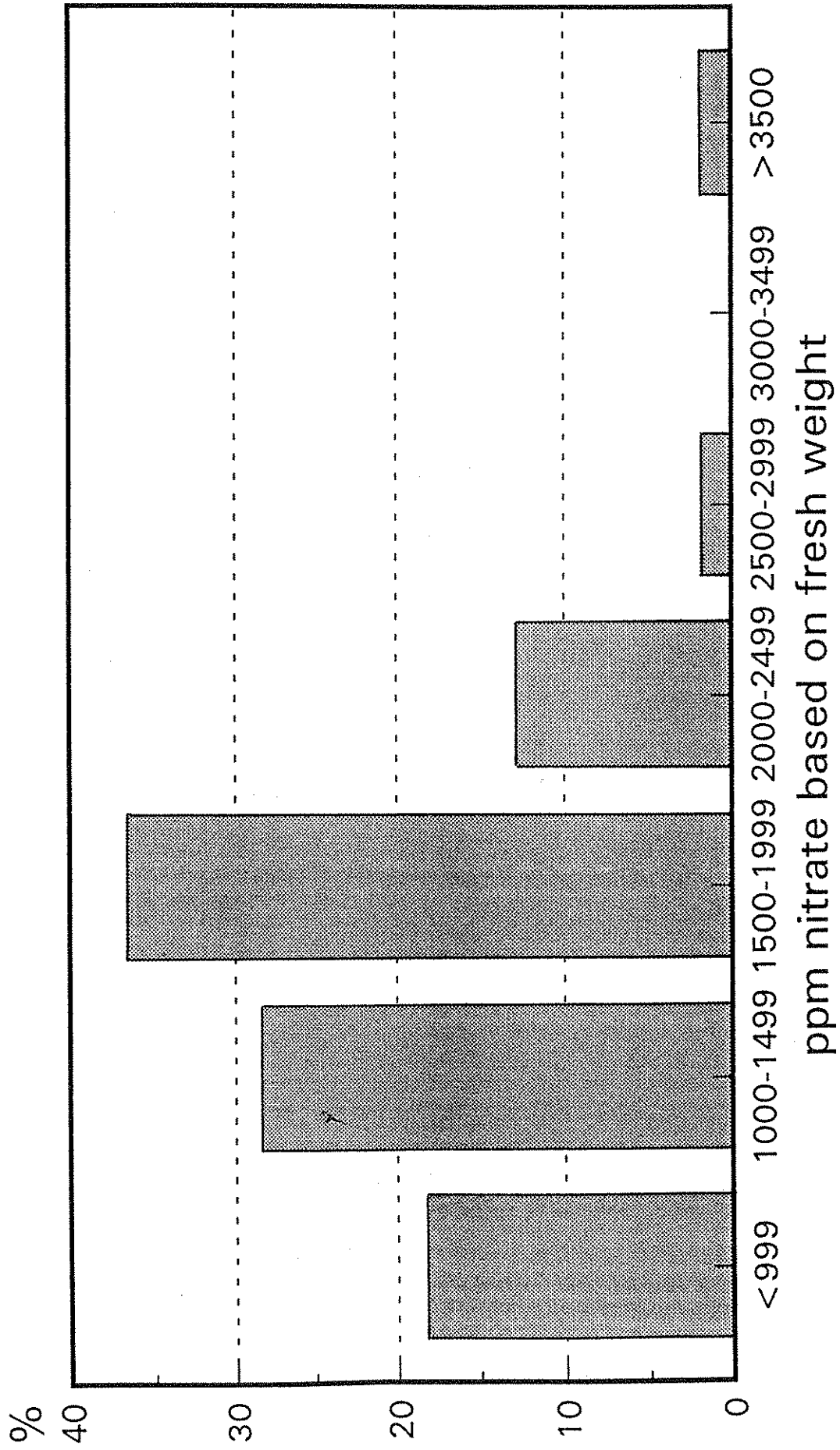


FIG 2. NITRATE LEVELS IN BEETROOT 1993

Averaged over 4 commercial sites (109 samples)

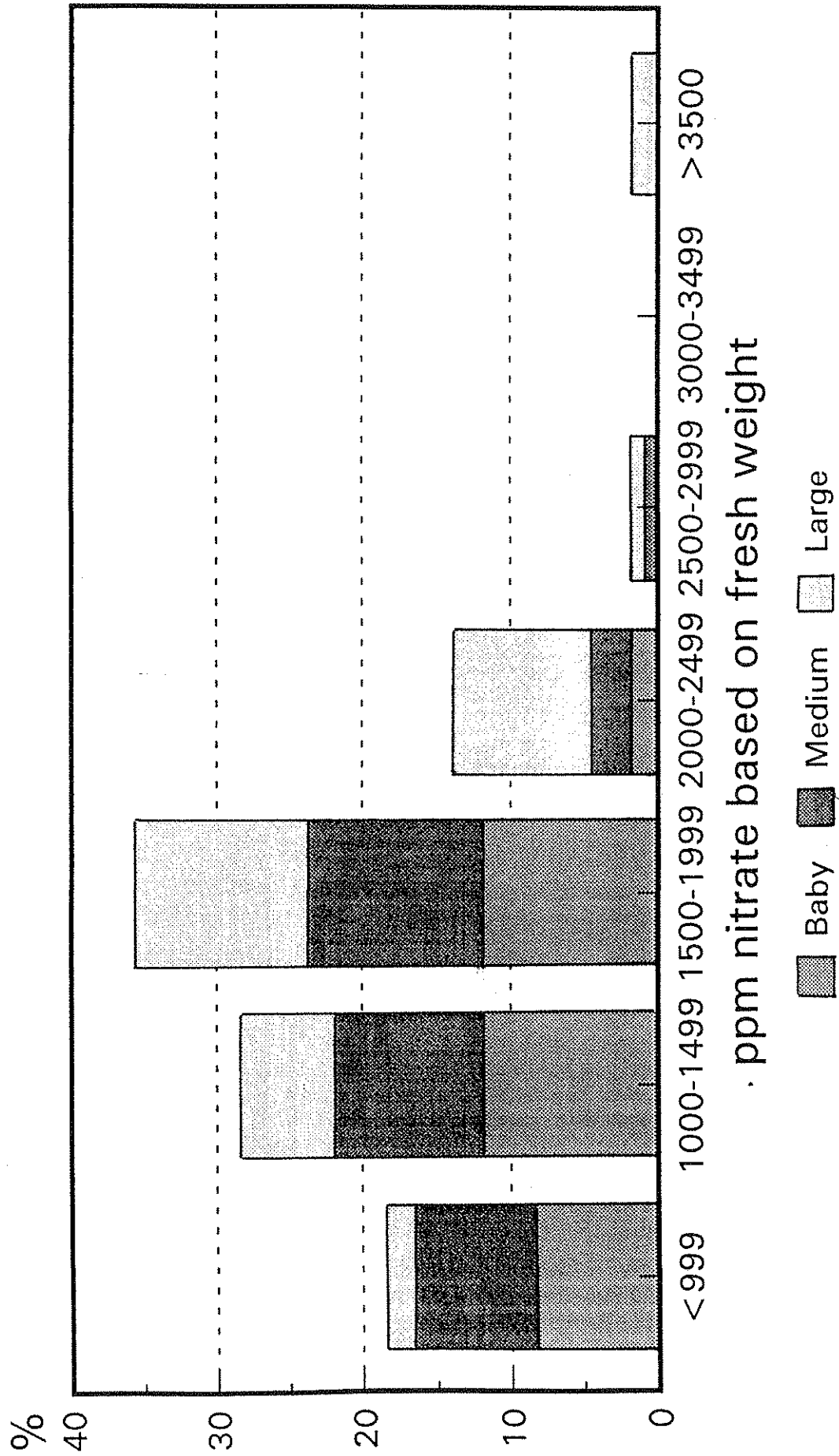


FIG 3. NITRATE LEVELS IN BEETROOT 1993

Averaged over 4 commercial sites (109 samples)

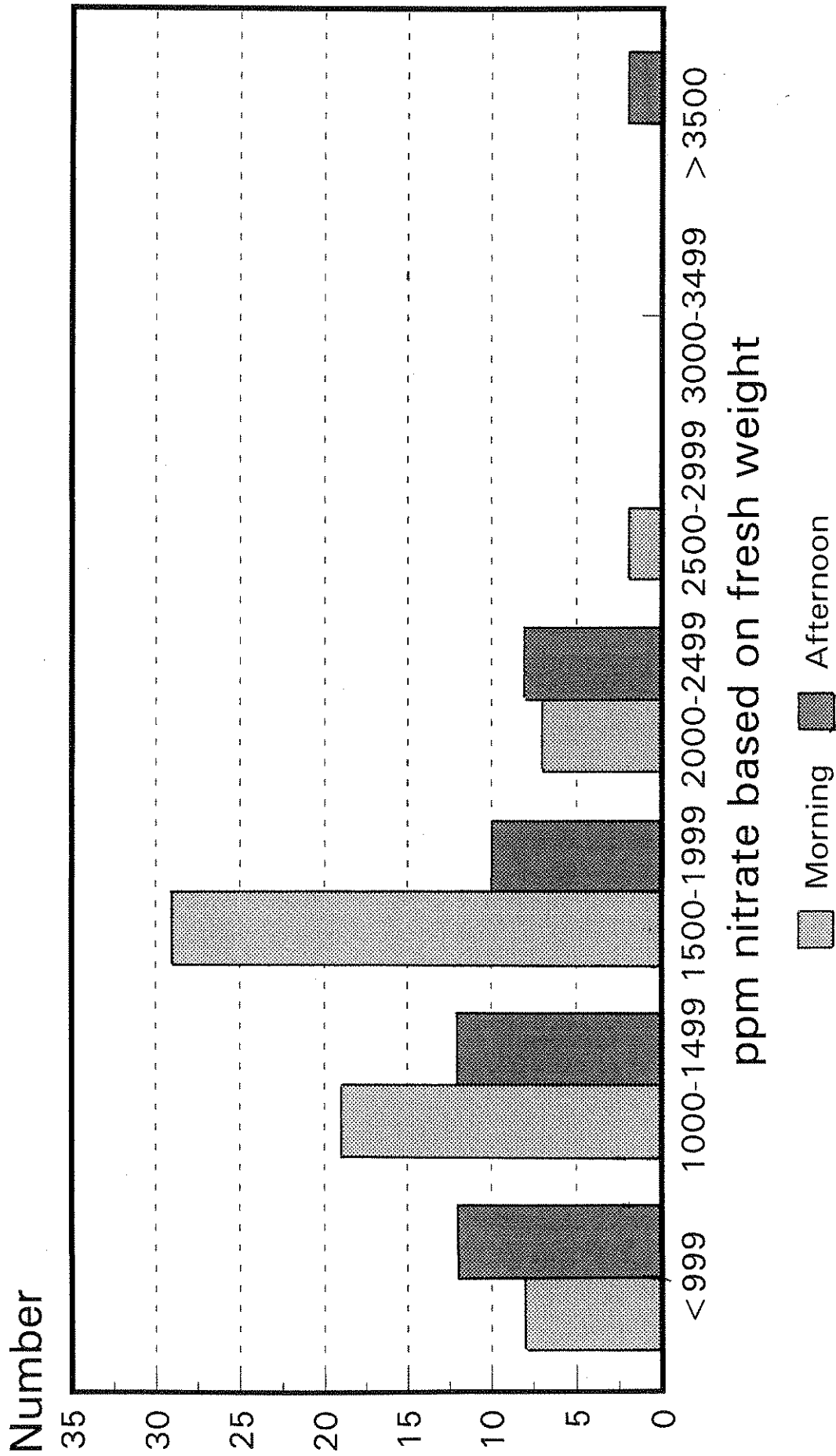


FIG 4. NITRATE LEVELS IN BEETROOT 1993

Averaged over 4 commercial sites (109 samples)

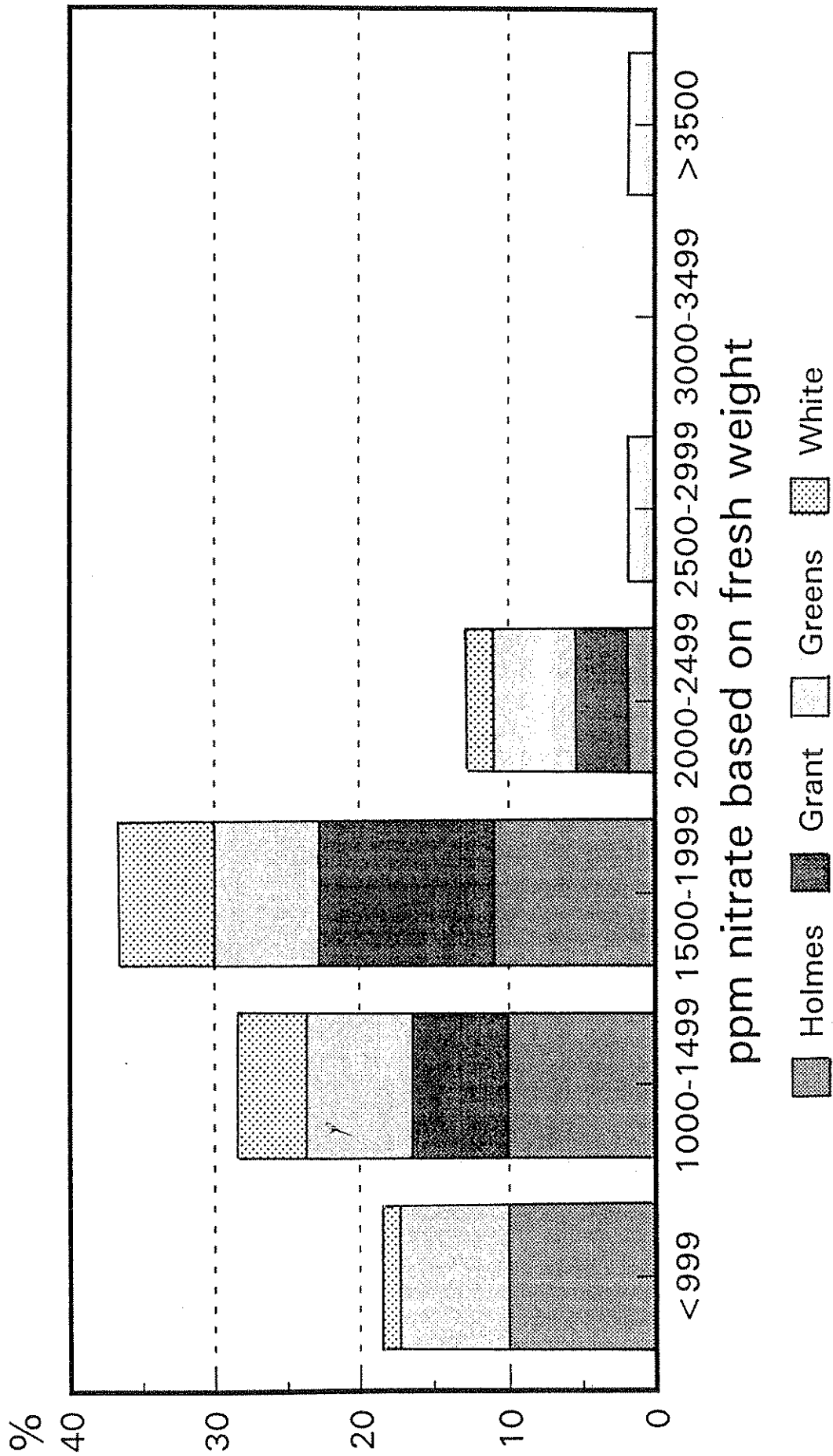


FIG 5. NITRATE LEVELS IN BEETROOT 1993

Samples from Michael Holmes (36 samples).

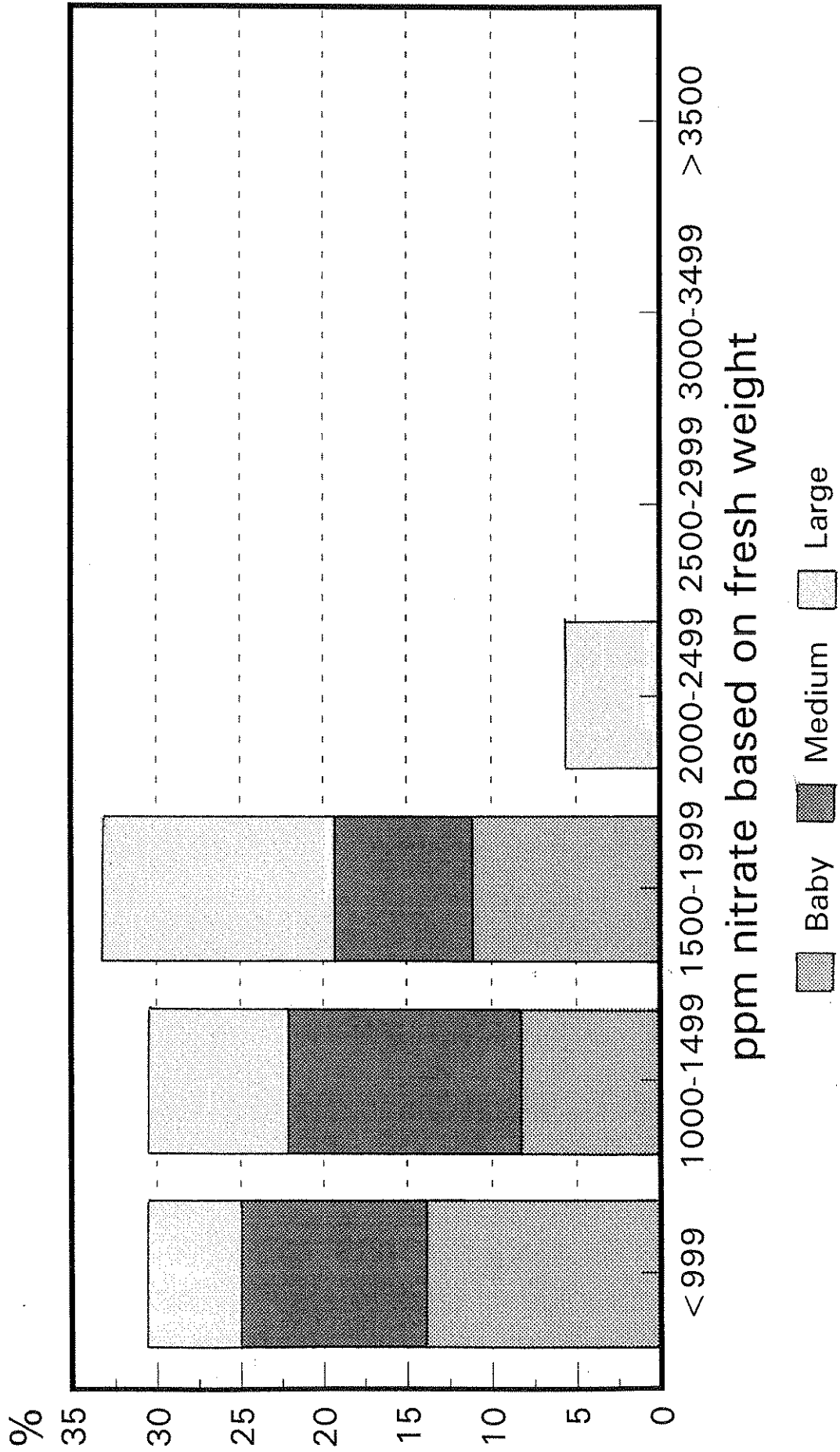


FIG 6. NITRATE LEVELS IN BEETROOT 1993

Samples from James Grant (24 samples).

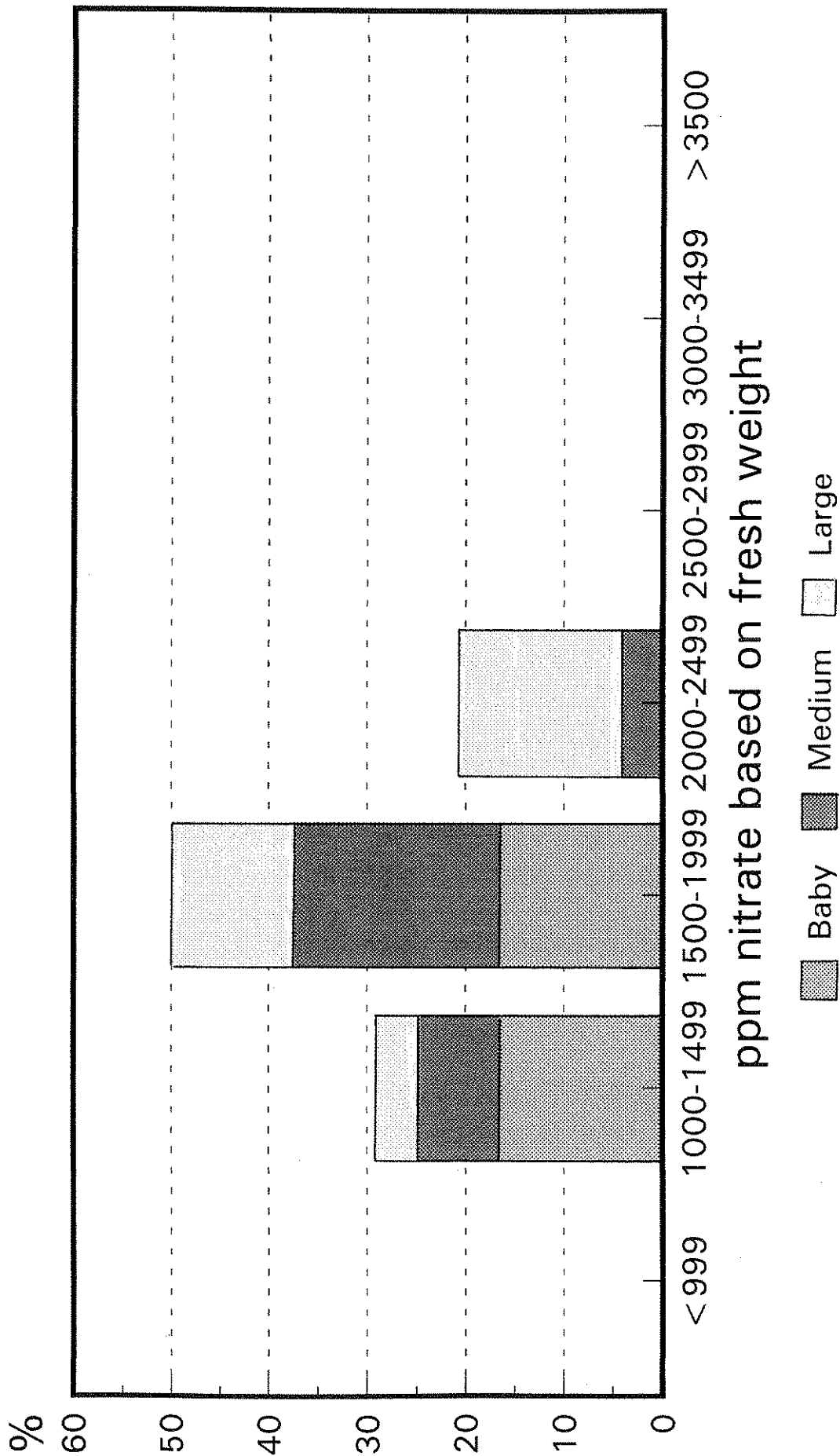


FIG 7. NITRATE LEVELS IN BEETROOT 1993

Samples from Greens of Soham (34 samples).

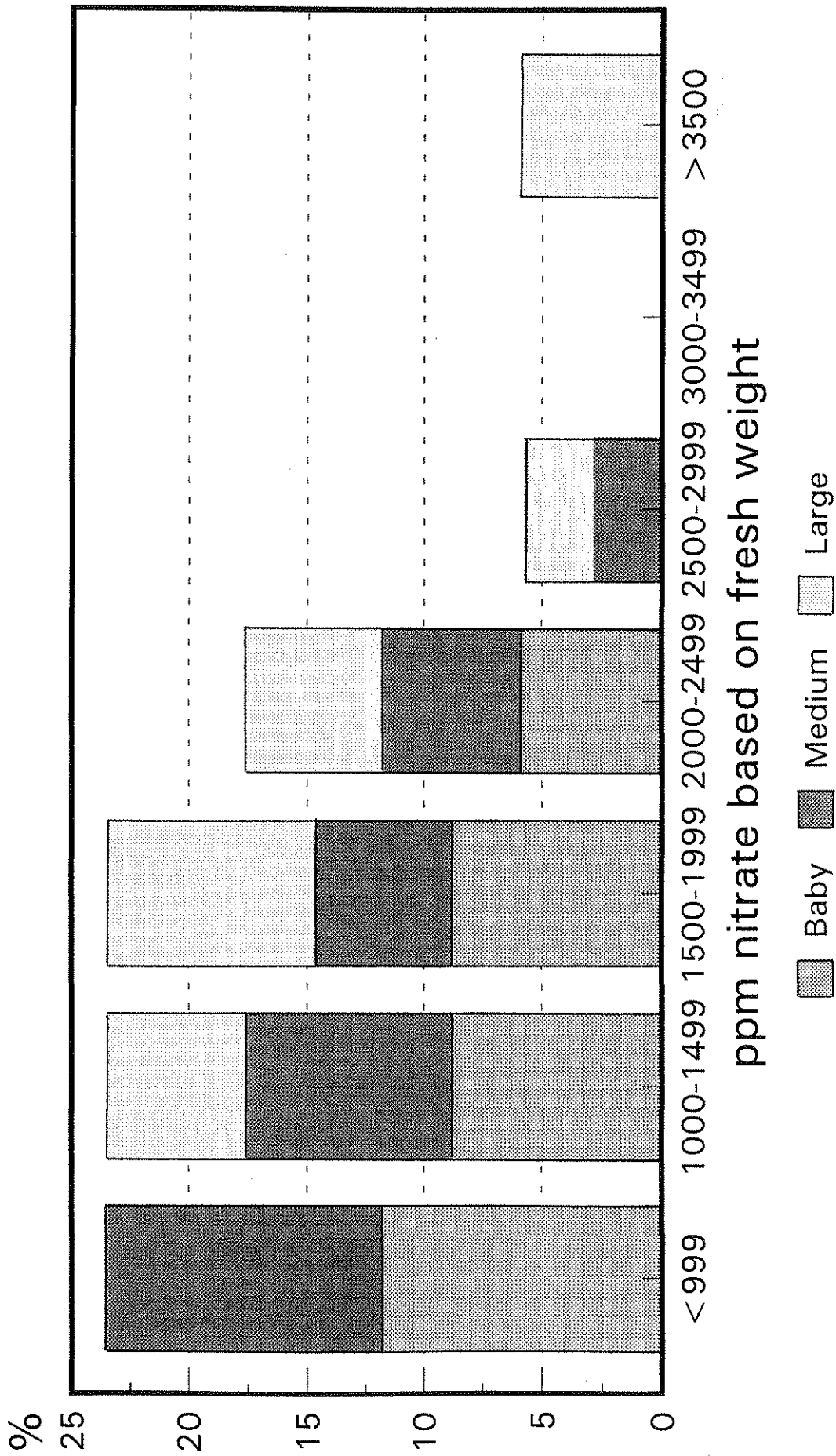
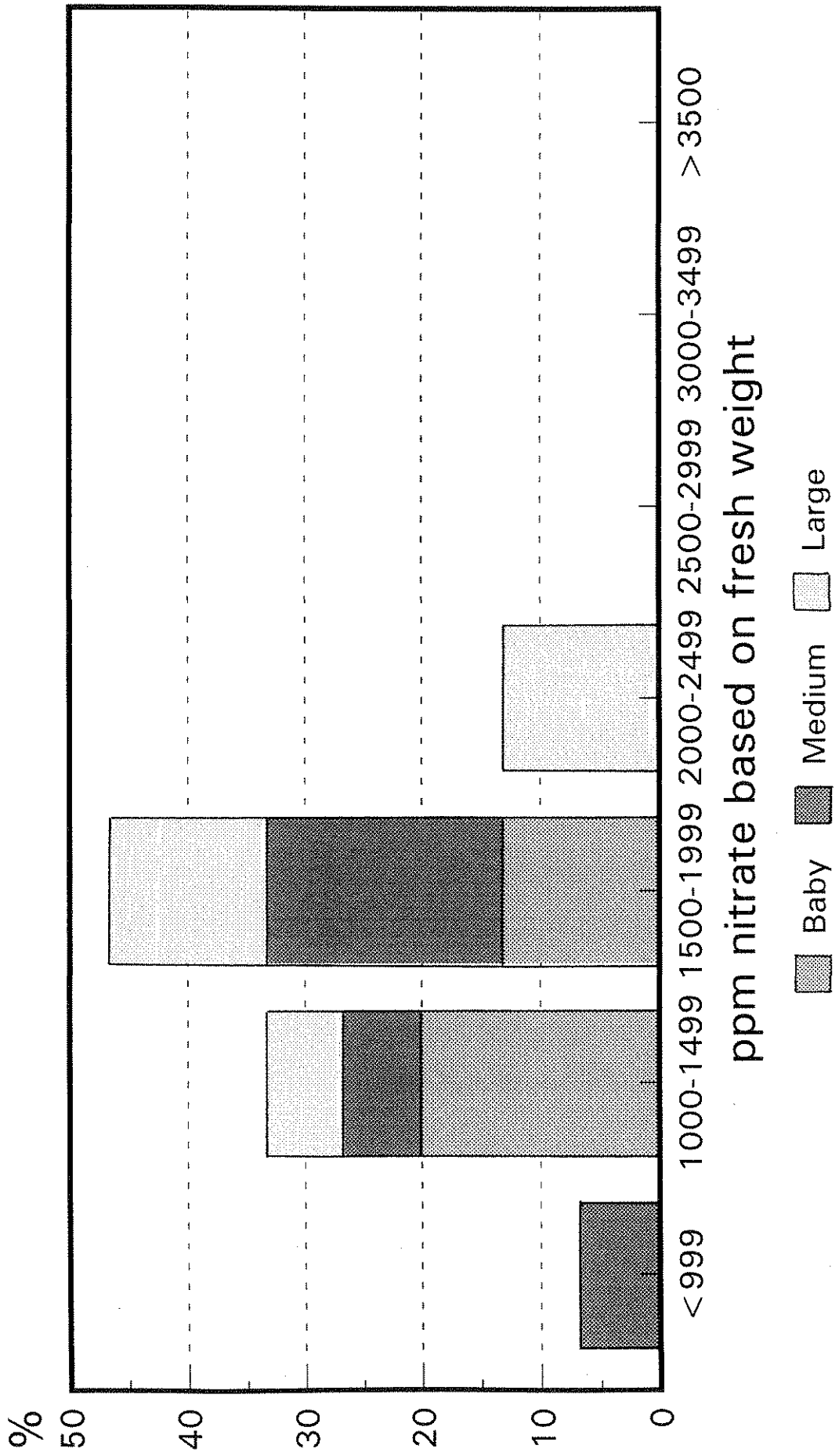


FIG 8. NITRATE LEVELS IN BEETROOT 1993

Samples from Stan White (15 samples).



Conclusions

1. The nitrate levels based on fresh weight were below the proposed maximum level of 3,000 ppm for all but two of the samples.
2. The nitrate levels appeared to be similar in the baby and medium size grades with a tendency for the highest levels to be in the larger sized beet.
3. There appeared to be no consistent effect of the time of sampling on nitrate levels.
4. All participating growers had samples in the 1000-1499, 1500-1999 and 2000-2499 ppm nitrate. A total of four samples from Greens in Cambridgeshire were also in the 2500-2999 and 3500-3999 ppm nitrate bandings.

Part II: Comparison of four nitrogen fertiliser rates on nitrate levels in fresh red beet

Red beet, cultivar Crimson Globe, was drilled in early June and top dressed in early July to achieve 140, 175, 210 and 250 kg/ha Nitrogen, representing the range of fertiliser rates used by commercial producers. The residual soil nitrogen level from 1992 was about 50 kg/ha N. Samples were taken on 30 July, 12 August, 23 August, 6 September, 23 September and 4 October and sent to Lancrop Laboratories. Samples of both baby (1"-1½") and medium (1¾"-2½") sized beet were collected at both 9 am and 3 pm.

Results

The results for the comparison of four rates of nitrogen fertiliser are presented in Figures 9 and 10.

FIG 9. NITRATE LEVELS IN BEETROOT 1993

Site: Stockbridge House (based on 96 samples)

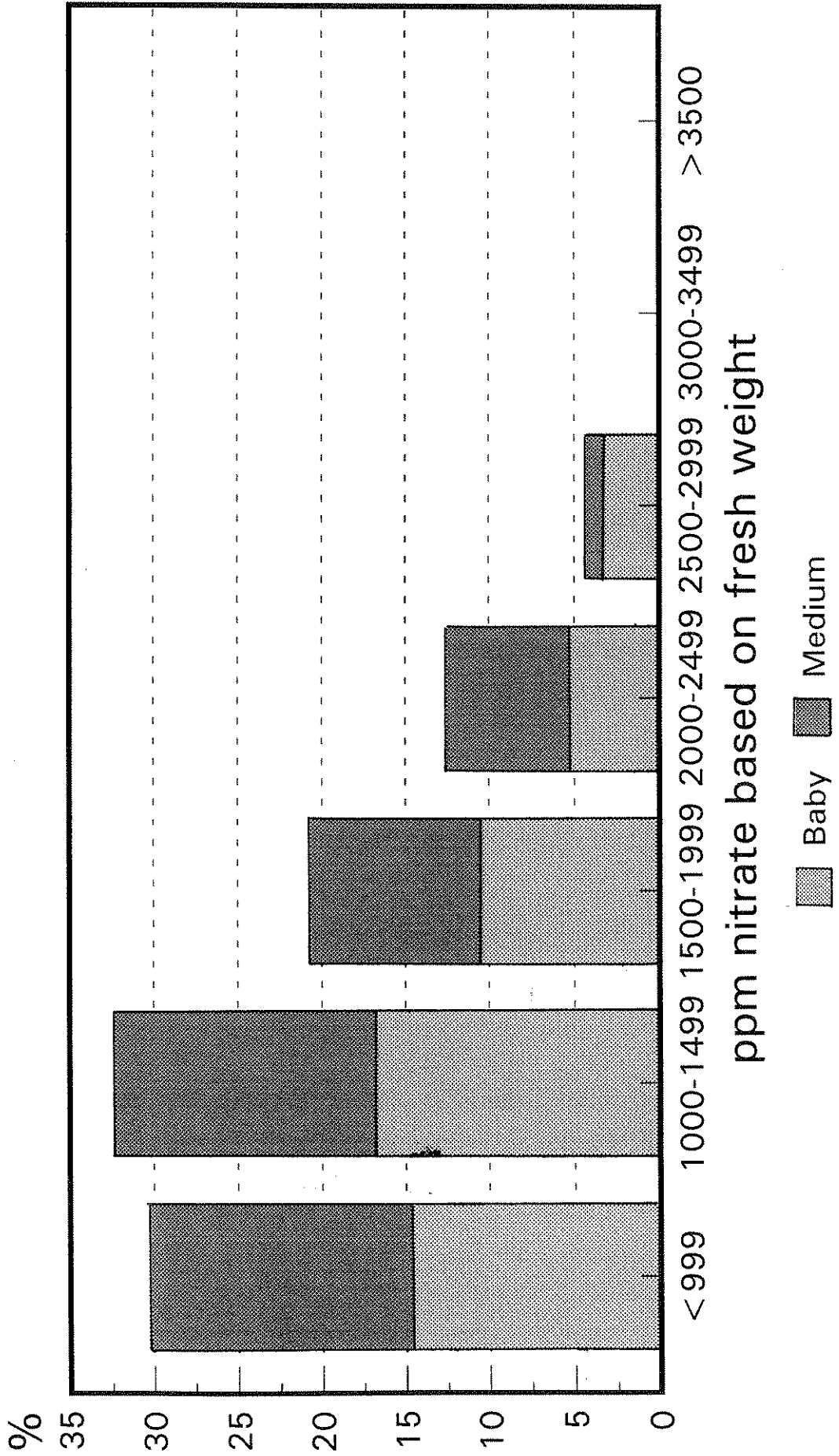
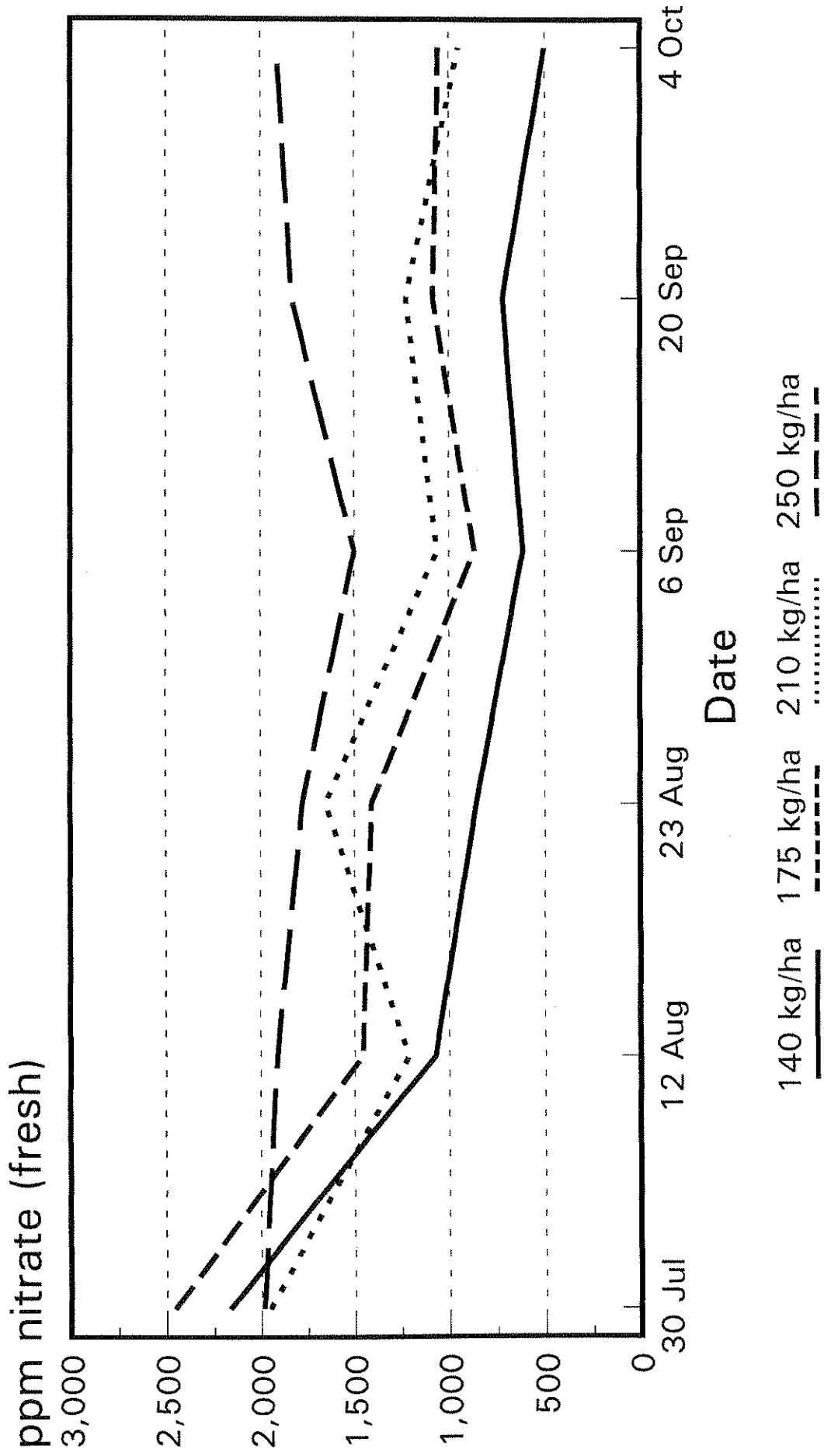


FIG 10. NITRATE LEVELS IN BEETROOT 1993

Site: Stockbridge House



Conclusions

1. Nitrate residue levels in all samples were below 3,000 ppm nitrate even when grown at 250 kg/ha nitrogen.
2. The red beet grown at 250 kg/ha nitrogen had a similar level of nitrate throughout the period 30 July to 4 October whilst those grown at the 3 lower rates tended to decline during the summer.

Part III: Additional Studies

Further samples were taken in November and December to determine the amount of variation between carefully selected identical samples sent to two laboratories and the effect of cooking on nitrate levels as there was some suggestion that the nitrate content of red beet could increase during processing.

Identically sized samples from the highest rate of nitrogen fertiliser were taken on 4 November and sent to two laboratories as there was a suggestion that variation between samples could be greater than differences between fertiliser rates.

Further identical samples were also taken on 6 December and boiled for about 45 minutes in distilled water as there had been a suggestion that nitrate levels increased during processing and samples which were below 3,000 ppm in the field could exceed the proposed maximum level after processing. Samples were also sent which had not been cooked.

Results

The results for the identical samples sent to two laboratories are given below:

Table 1: Nitrate levels (ppm nitrate based on fresh weight) on 4 November.

Sample	Lancrop	ADAS
1	1887	1840
2	1665	1750
3	2050	2260
Mean	1867	1950

The results for the raw and cooked red beet harvested on 6 December are given in Table 2.

Table 2: Nitrate levels (ppm nitrate based on fresh weight) on 6 December.

Sample	Raw	Cooked
1	1838	1811
2	2409	2259
3	2090	1532
Mean	2112	1867

Conclusions

1. The variation between laboratories was generally low but there did appear to be considerable variation between samples despite careful selection and grading.
2. There did not appear to be any increase in the nitrate levels during processing by boiling despite a commercial grower obtaining an increase from 934 to 1458 ppm. However, most processors use steam to cook the red beet and this technique may give a different result to boiling.

Overall Conclusions

1. In a season characterised by cool and frequent wet weather the nitrate levels in the crop were generally within the 3000 ppm limit.
2. The effect of the rate of nitrogen fertiliser followed an expected pattern with lower nitrate levels in red beet grown with lower rates of nitrogen fertiliser. Even for the highest fertiliser rate the levels did not exceed 3000 ppm.
3. There is considerable variation between identical samples and in future three samples of each treatment should be sent for analysis.

Recommendations for Future Work

1. Continue to monitor red beet crops and to determine the effect of varieties, weather conditions and soil type on nitrate levels in the crop.
2. Evaluate the affect of repeated applications of liquid fertiliser to help maximise leaf growth to aid top lifting whilst at the same time minimising nitrate levels in the crop at harvest.
3. Develop a reliable field test to help growers to schedule harvesting to minimise nitrate levels.

APPENDIX I:
MONITORING NITRATE LEVELS IN COMMERCIAL CROPS

SITE: MICHAEL HOLMES

Results

(ppm nitrate based on fresh weight)

	BABY		MEDIUM		LARGE	
	AM	PM	AM	PM	AM	PM
30 Jul	1687	877	1391	1142	2135	979
12 Aug	764	575	749	741	1848	1240
23 Aug	1506	1300	1356	1965	1762	2344
6 Sep	1083	598	1798	1164	1582	1523
20 Sep	1516	586	863	650	636	1072
4 Oct	1079	-	1388	-	1936	-
	1517		1959		1104	

SITE: JAMES GRANT

Results

(ppm nitrate based on fresh weight)

	BABY		MEDIUM		LARGE	
	AM	PM	AM	PM	AM	PM
30 Jul	-	-	-	-	-	-
12 Aug	-	-	-	-	-	-
23 Aug	1535	1904	1871	1900	2405	2097
6 Sep	1447	1346	1404	1475	1463	1540
20 Sep	1591	1275	1871	2076	1942	1950
4 Oct	1722	1477	1737	1956	2199	2311

SITE: GREENS OF SOHAM

Results

(ppm nitrate based on fresh weight)

	BABY		MEDIUM		LARGE	
	AM	PM	AM	PM	AM	PM
30 Jul	345	350	394	385	1050	1072
12 Aug	1156	2343	1368	2391 [#]	2378	3844 [#]
23 Aug	1594	1064	1502	1450	1634	1953
6 Sep	2331	407	2884	858	2732	3503
20 Sep	1875	498	1416	1800	1708	2422
4 Oct	1014	1581	678	2124	-	-

[#] 12 August - Wrong labelling but presumed last 2 samples were taken at 4.30.

SITE: STAN WHITE

Results

(ppm nitrate based on fresh weight)

	BABY		MEDIUM		LARGE	
	AM	PM	AM	PM	AM	PM
30 Jul	1461	-	1895	-	2033	-
12 Aug	1501	-	1506	-	1647	-
23 Aug	1466	-	1887	-	2033	-
6 Sep	1050	-	886	-	1027	-
20 Sep	1882	-	1413	-	1709	-
4 Oct	-	-	-	-	-	-

APPENDIX II:
COMPARISON OF FOUR NITROGEN FERTILISER RATES
AT HRI STOCKBRIDGE HOUSE

SITE: HRI STOCKBRIDGE HOUSE

Results

(ppm nitrate based on fresh weight)

	BABY		MEDIUM	
	AM	PM	AM	PM
30 Jul				
140 kg/ha N	2405	2719	2228	1311
175 kg/ha N	2662	2387	2316	2453
210 kg/ha N	2387	1842	2139	1444
250 kg/ha N	2613	1373	2626	1329
12 Aug				
140 kg/ha N	1395	850	1373	673
175 kg/ha N	1727	1732	912	1457
210 kg/ha N	1528	1417	350	1554
250 kg/ha N	1678	1825	2059	2086
23 Aug				
140 kg/ha N	801	907	741	973
175 kg/ha N	1275	1411	1534	1408
210 kg/ha N	1674	1671	1255	2014
250 kg/ha N	1864	1358	1973	1914
6 Sep				
140 kg/ha N	565	605	569	715
175 kg/ha N	942	604	863	1054
210 kg/ha N	1225	767	1000	1257
250 kg/ha N	1193	1429	1464	1913
20 Sep				
140 kg/ha N	549	467	819	1042
175 kg/ha N	1185	848	1515	789
210 kg/ha N	1039	1209	1394	1267
250 kg/ha N	2260	1267	1902	1898
4 Oct				
140 kg/ha N	278	359	677	697
175 kg/ha N	1111	1374	909	833
210 kg/ha N	776	1099	1074	853
250 kg/ha N	1934	2108	1805	1813