CONTRACT REPORT

FV112

BULB ONIONS
PILOT STUDY
ON BULB SOFTNESS

Commercial in Confidence

ADAS

Agricultural Development and Advisory Service

Report to:	Horticultural Development Council 18 Lavant Street Petersfield Hants GU32 3EW
ADAS Contract Manager:	D S Lancaster ADAS Kirton 24 Willington Road Kirton BOSTON Lincs PE20 1EJ
Period of investigation:	August 1991-March 1992
Date of issue of report:	August 1992
No. of pages in report:	15
No. of copies of report:	7

ADAS

PRINCIPAL WORKERS

D S Lancaster	ADAS Kirton
F McInnes	ADAS Kirton
W Lawes	ADAS Kirton
I Young	ADAS Kirton
J Towerton	ADAS Kirton

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.

..... Date 16/10/92

David Lancaster - Contract Manager

Report authorised by:

.....

S W Perkins
ADAS Cambridge
Brooklands Avenue
Cambridge
CB2 2BL

Tel: 0223 462762

HDC PROJECT FV 112 BULB ONIONS

PILOT STUDY ON BULB SOFTNESS

SUMMARY

Three pieces of equipment were assessed for measuring onion bulb softness. The Food Research Institute Portable Pendulum appeared to give the most accurate and repeatable results.

Pressure damage was scored on 16 samples of drilled onions, representing different varieties, soil types and localities. 50 bulbs, between 50-70 mm diameter, were measured per sample.

The results indicate no strong correlations between penetration and size, dry matter and nitrate content, only possible trends. The softest and hardest bulbs within the study came from onions grown on peat soils.

INTRODUCTION

Pressure bruising of onions stored in bulk has been an occasional problem often attributable to mechanical damage during harvest or loading, store construction or excessive stack height.

More recently, softness of bulbs has been a feature of production in a number of growing areas. Pressure damage typically occurs at various depths in the onion stack, often quite near the top and does not appear to be related to a handling problem. Incidence has varied between crops grown on different fields on the same farm.

OBJECTIVES

To identify those factors which may predispose bulbs to pressure bruising by gathering cultural data and sampling crops at harvest, coupled with bulb assessment at the loading stage and after storage. To seek suitable methods

for the qualitative measurement of bulb softness, and to estimate the scale on which this defect occurs.

DESCRIPTION OF WORK

Samples of 100 onion bulbs were collected at harvest from farms representing a range of localities and soil types. Information was collated on cultural practices and harvest operations which might have relevance to pressure bruising.

ie.	Previous cropping	Nitrogen rates and application dates
	Soil type	Irrigation dates and quantities
	Drilling/Harvest Dates	Rainfall, if available
	Variety	Harvest system
		Crop Maturity Assessment

Pressure damage was scored on 16 samples. 50 bulbs within each sample, between 50 and 70 mm diameter were assessed for firmness using equipment found to be most appropriate for this purpose.

3 pieces of equipment were assessed.

A. <u>The Shore Durometer</u>

Originally designed for measuring the identation hardness of rubber, an indentor is applied to the surface of an onion, and pressure applied until the indentor is flush with a back plate. Resistance to this is measured.

This equipment failed to produce consistent results because of the curved nature of an onion bulb; the indentor continually slipped off the edge giving false readings.

B. <u>Fruit Pressure Tester</u>

Used primarily in the top fruit industry, it measures the pressure necessary to force a plunger of specified size into the flesh of the onion. The plunger is placed against the onion, and then pressed with increasing

strength until the plunger tip has penetrated into the flesh up to a pre-determined mark.

Results indicated that there was an initial ressistance to pressure applied by the plunger from the onion skin/skins, but as soon as these broke, the plunger moved into the onion beyond the pre-determined mark on the plunger, making it difficult to give repeatable results.

C. The Food Research Institute (FRI) Portable Pendulum

The pendulum was designed and developed at FRI Norwich primarily for an assessment of potato damage susceptibility. Tubers are impacted under standard physical conditions similar to those found in harvesting, and an electronic readout after impact provides an instantaneous indication of the amount of structural damage produced.

The portable pendulum consists of two main parts.

1. A pendulum with an angular displacement transducer, sample holding system and arm release.

2. Control box containing the electronics and display units connected by cable to the angular displacement transducer.

The following physical factors are measured and electronically displayed:-

1. Rebound angle of the pendulum after impact

2. Maximum deformation of the sample after impact

3. Time taken by the indentor to reach maximum deformation from the point of initial contact

4. Time taken by the indentor to return to the point of initial contact from maximum deformation

Through consultation with colleagues who had used the machine previously, the decision was made to only measure the maximum deformation of the sample after impact.

Standardisation

At the beginning and end of each experiment, the performance of the pendulum was tested by checking the readouts of a deformation of a standard material.

Deformation is checked by measuring the difference in counter reading between the standard indentor (zeroed against a flat surface, eg a rubber bung held in the normal tuber position) and the indentor plus a standard space (10mm).

Tested and standardised at the FRI, with the arm fixed at the 5cm position, pendulum No.3, and electronic unit No.1, the unit gave the following counter reading:

Deformation with 19mm spacer = 738 ± 1.0%.

Method

Onion softness was measured using the FRI pendulum; each of 50 bulbs was measured for deformation on each of 4 sides, giving 200 readings per sample. 16 samples of drilled crops were assessed, representing different varieties, soil types and localities. Samples were also assessed for nitrate and dry matter content, using standard laboratory techniques.

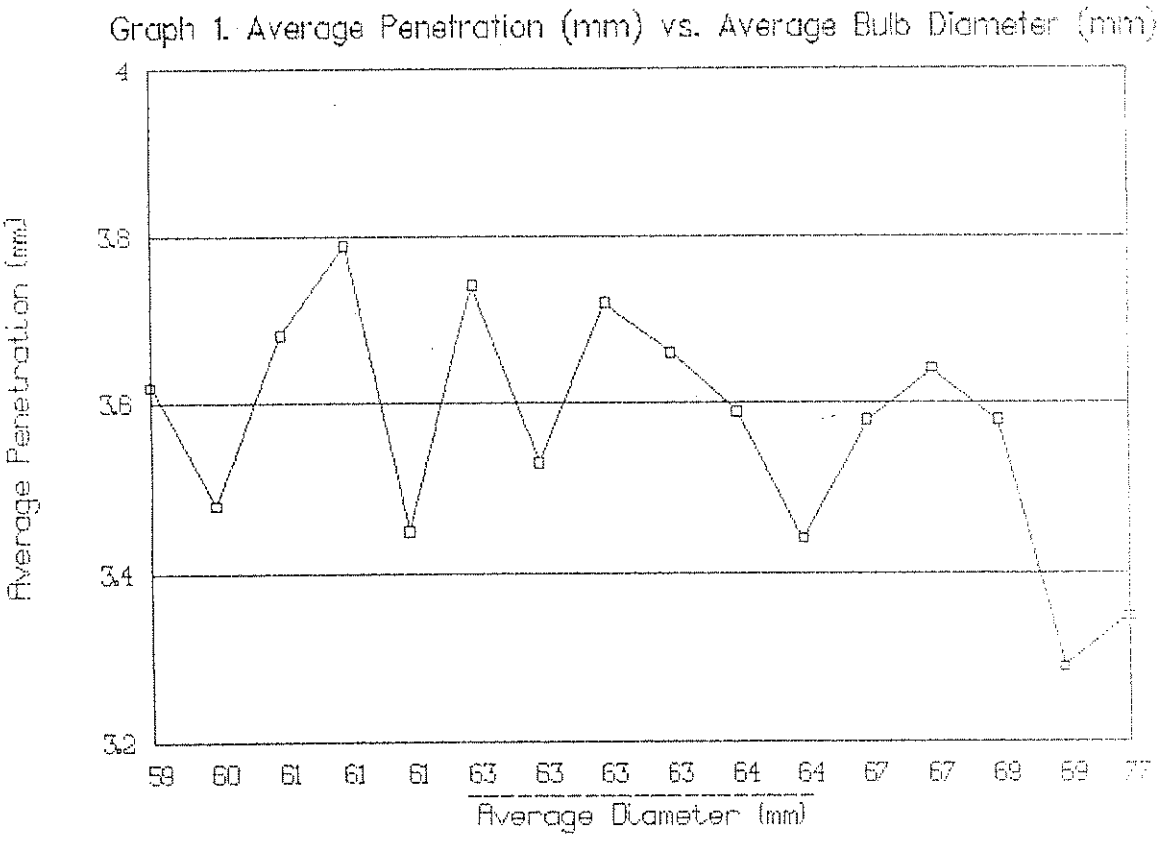
Results

Full details of results are shown in Appendix I with means for each sample shown below:-

Sample No.	Soil type P = Peat Sa = Sand S = Silt	Average penetration (mm)	Range penetration (mm)	Average diameter (mm)	DM Oven %	N03-N mg/kg
7	P	3.45	2.61-4.09	61	12.4	245
8	Sa	3.74	3.21-4.48	63	11.6	70
9	Sa	3.35	3.05-3.93	77	12.4	194
10	S	3.79	3.16-4.36	61	12.4	175
11	S	3.48	3.16-3.82	60	13.0	124
12	S	3.64	3.16-4.58	67	11.8	57
13	Sa	3.58	3.14-4.24	67	11.7	68
14	Sa	3.58	3.16-4.20	69	11.5	85
15	S	3.66	3.29-3.98	63	12.7	66
16	Sa	3.62	3.23-4.18	59	12.5	93
17	Sa	3.44	3.03-3.90	64	11.5	112
18	Sa	3.68	3.15-4.36	61	12.0	104
19	S	3.29	2.87-3.74	69	13.2	173
20	P	3.59	2.78-4.47	64	11.1	152
21	P	3.53	2.93-4.77	63	11.8	77
22	P	3.72	3.26-4.80	63	12.2	42

Graphs are illustrated plotting average penetration against diameter, dry matter and nitrate content.

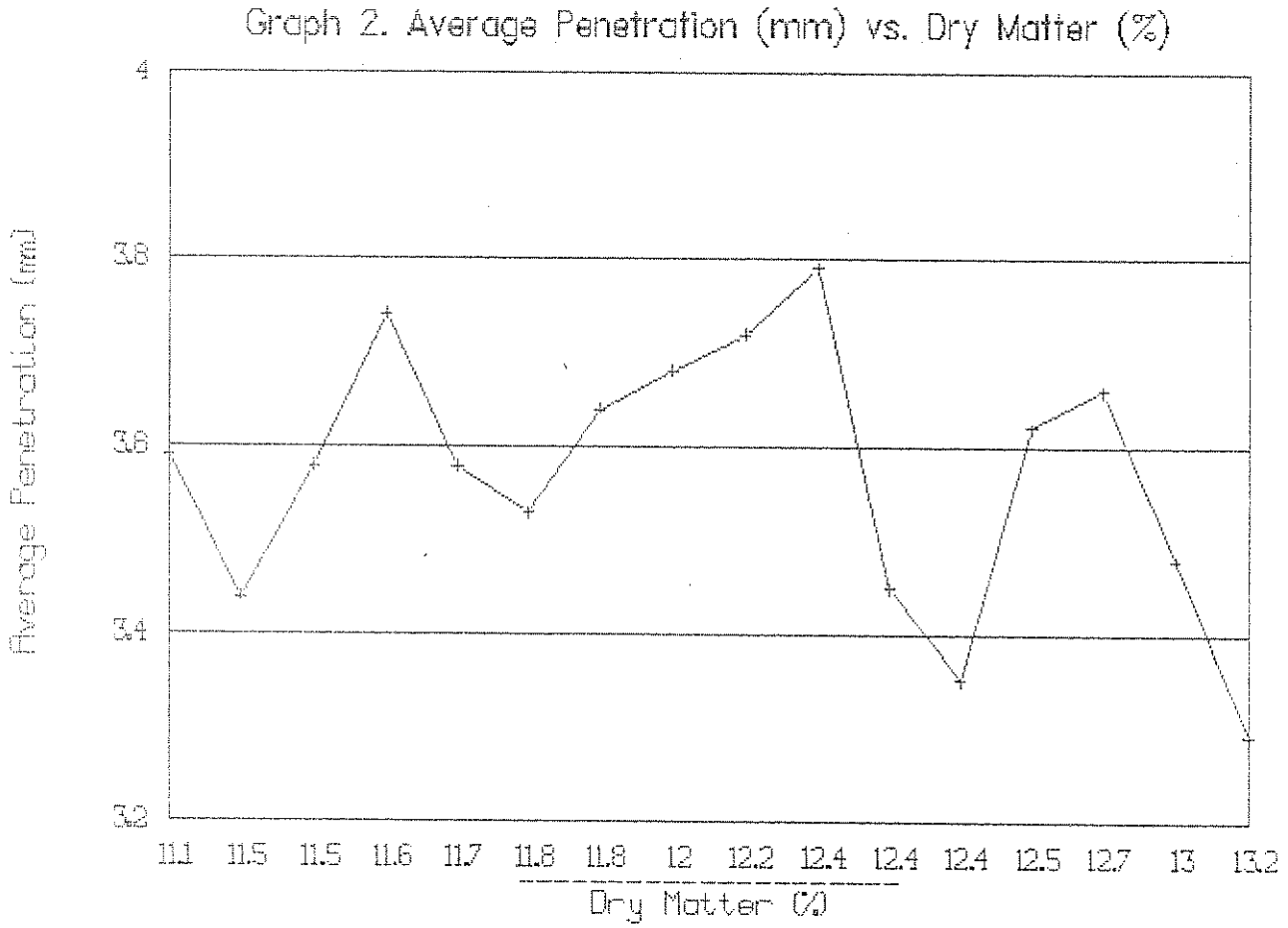
Graph 1. Average Diameter



The graph shows a trend towards a larger diameter bulb giving a lower penetration score, indicating the larger the bulb, the harder the onion.

ADAS

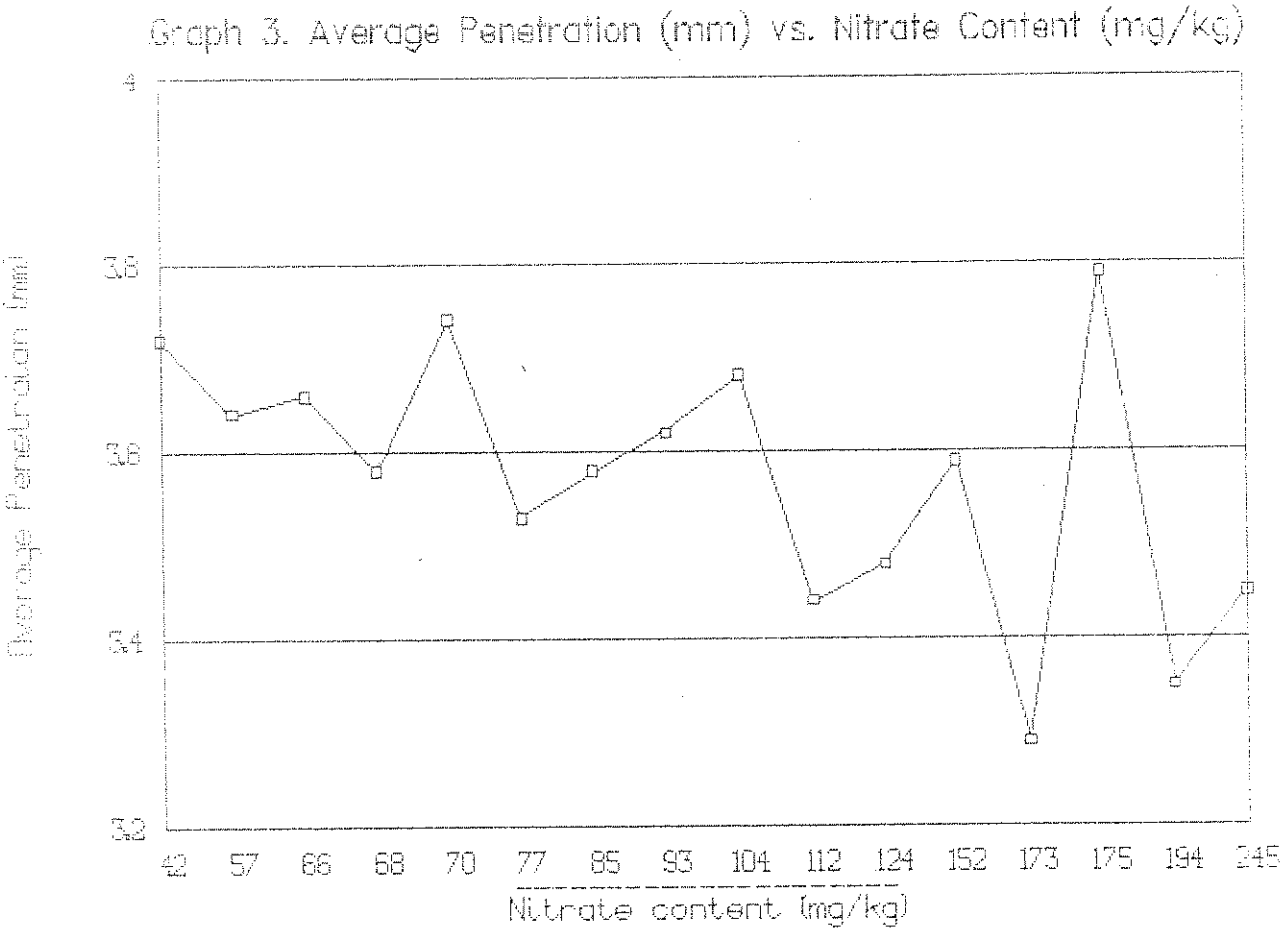
Graph 2. Dry Matter %



The graph indicates a trend towards higher dry matter content, giving lower penetration scores, ie the higher the DM content, the harder the bulb.

ADAS

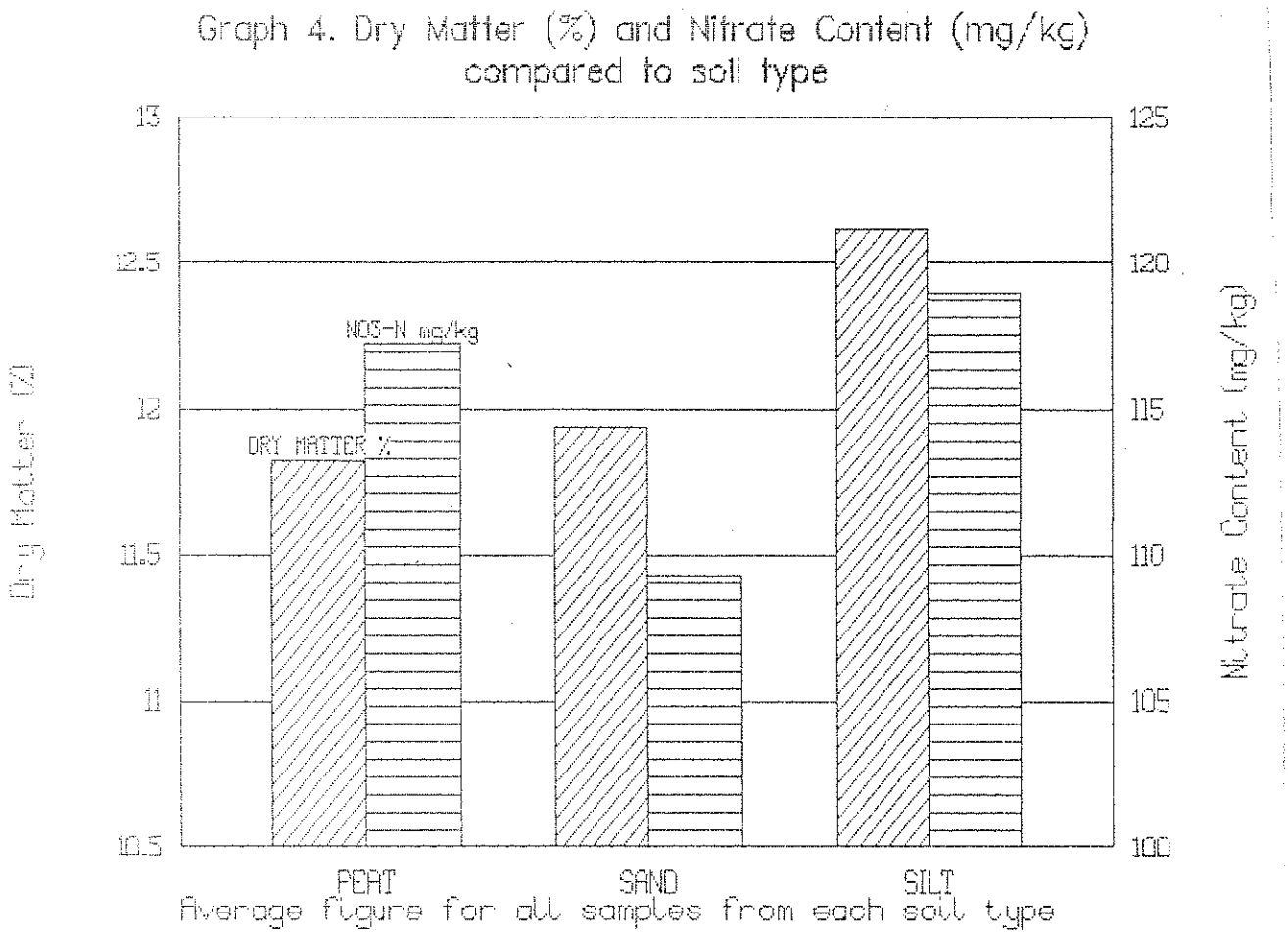
Graph 3. Nitrate Content



The graph shows a trend towards the higher the nitrate content of the bulb, the harder the bulb. This appears contrary to previous studies on this relationship.

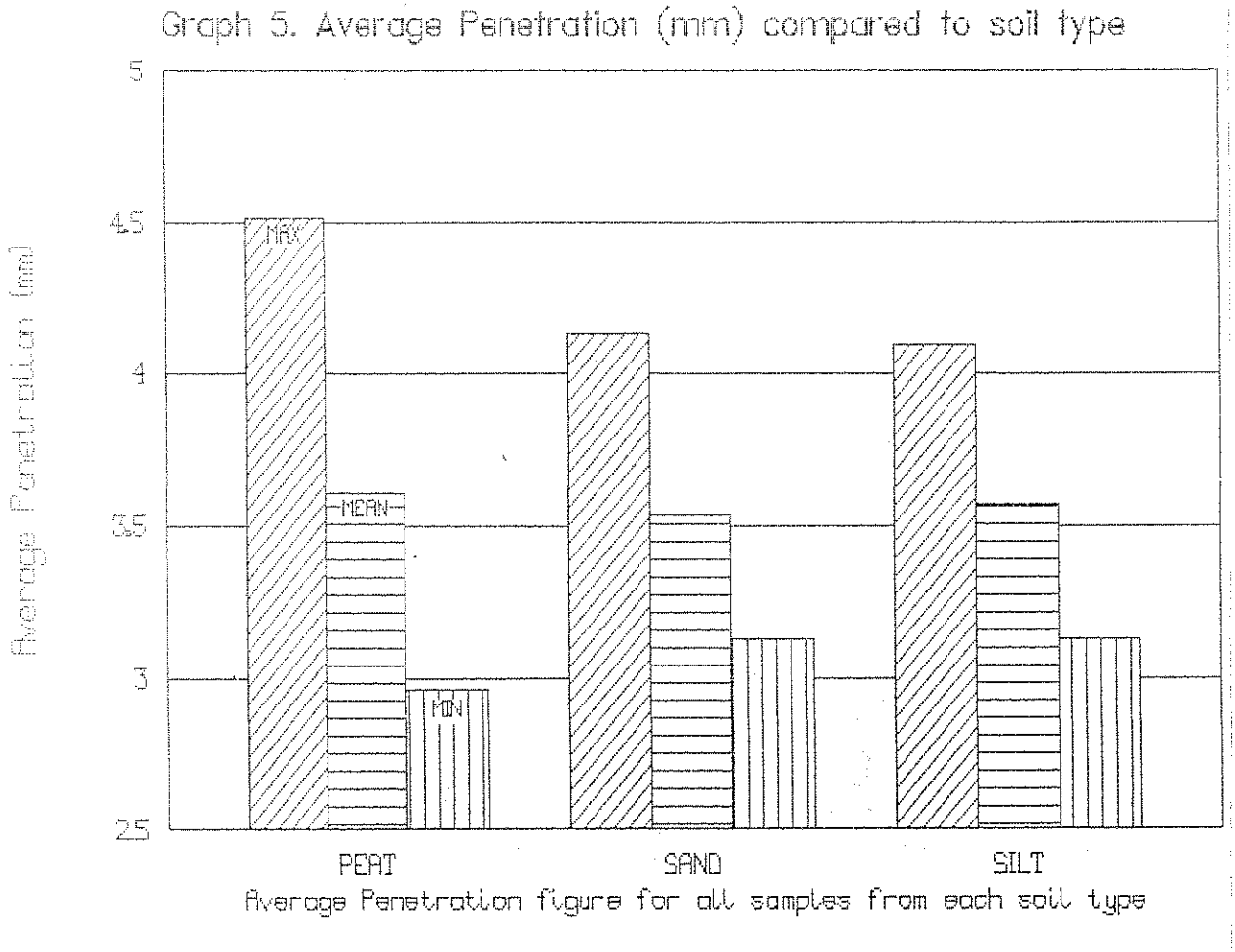
ADAS

Graph 4. Dry matter and Nitrate Content Compared to Soil Type



The graph illustrates the lower mean nitrate content on sandland compared to peats or silts. The mean dry matter content of bulbs grown on silt soils is higher than on sands or peats.

Graph 5. Average Penetration Compared to Soil type



Mean penetrations across peat, sand and silt soil types are very similar. However, there is more variation on peats, indeed within the study, onions grown on peat soils produced the softest and hardest bulbs.

DISCUSSION

1. High nitrogen has been suggested in the past as a probable cause of bulb softness. Within the study a wide range of nitrate contents within samples was found, with a strong trend to high nitrate being linked with the harder bulbs. This appears contrary to previous studies on this relationship.

2. High dry matter is believed to encourage firmness within a bulb, and results from this study appeared to support this.

3. The dry matter and nitrate content of bulbs grown on silt land was on average 5-10% higher than the dry matter and nitrate content of bulbs grown on sand land. However, this did not affect bulb softness.

4. Other factors which may influence bulb softness but, because of sample size, were unable to be explored within the study are:-

   i. Irrigation

      Late irrigation or heavy rain close to harvest may encourage the bulbs to swell with water, making the bulb softer.

   ii. Varieties

      Varieties are known to differ in susceptibility to pressure damage.

   iii. Harvest date

      Early or late harvesting, together with bulb 'maturity' may be an important factor in influencing compression damage.

   iv. Maleic hydrazide

      Early, late or no applications of MH, may affect bulb softness.

CONCLUSIONS

1. Three pieces of equipment were assessed for measuring onion bulb softness but the smooth surface and curvature of the onion bulb, did not suit all equipment. The Food Research Institute Portable Pendulum appeared to give the most accurate and repeatable results.

2. The results indicate from a sample number of 16, a range of average penetration scores (3.29-3.79).

3. The greatest variation in penetration scores came from those onions grown on peat soils, producing both the softest and the hardest bulbs within the study.

4. The assocation between penetration and size, dry matter, and nitrate content was explored with possible trends apparent.

5. There appeared to be differences across soil types, particularly with respect to dry matter and nitrate content, but this did not correlate directly with bulb softness or hardness.

DL59250

Oct