A STUDY OF THE DISTRIBUTION OF NUTRIENTS DURING THE GROWTH OF CAYENNE PINEAPPLES UNDER FIELD CONDITIONS

THESIS

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Frontispiece: Pineapple lands at the farm Whitney Estate in the Alexandria district of the Eastern Cape.

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CHAPTER I

INTRODUCTION AND GENERAL LITERATURE

1. Introduction

The purpose of this study was to determine the uptake and distribution of nutrients during the growth of the Cayenne cultivar of Ananas comosus (L) Merr under field conditions in the Eastern Cape. The study was also done to help explain the apparent drop in the nutrient levels in the basal section of the "D"- leaf of the pineapple plant during the winter months and to determine the best part or parts of the plant to sample in order to measure the nutrient status of the pineapple plant at any stage of its growth.

The investigation was conducted by selecting a plot within a production land on two farms in the pineapple growing region of the Eastern Cape. Plants were sampled from each plot at regular intervals from planting of the pineapple tops until the harvesting of the fruit of the first plant crop. Plant growth was measured and the nutrient concentrations in each section of the plant were determined. The total amounts of nutrients for each plant part were calculated and the nutrient uptake was compared and plotted on distribution diagrams.

Previous work in the Eastern Cape has been done by Steyn (1957) who studied the errors involved in sampling and analysing pineapple plants, van Lelyveld (1964) who measured the effects of different levels and intervals of application of ammonium sulphate on the growth, chemical composition and yield of cayenne and queen pineapples under field conditions and Marr (1972) who studied the effects of fumigants, applied fertilizers and climate on the growth and nutrient levels of cayenne pineapples. All these workers measured the nutrient status of the plant by analysing the mid third of the basal section of the "D"- leaf of the plant. Ashton (1970) in a research project (unpublished) measured the distribution of nutrients in the pineapple plant for three different groups of plants of varying ages sampled at the same time of the year.

2. General literature

In order to understand better the nutrient status of plants many workers have studied the nutrient distributions within the plant during growth and the changes in this distribution with different applied nutrients and with time.

Addiscott (1974) working on potato plants varied potassium and potassium plus magnesium and measured the potassium, calcium and magnesium concentration in the tubers, stems and leaves, finding that added potassium hardly altered the total magnesium uptake but caused magnesium to be diverted to the tubers, and that added potassium decreased calcium uptake but did not alter calcium in the tubers. Austin (1973) measured the pattern of dry matter during development of two types of sweet potato, and showed that the rates at which assimilates move is more important to storage and root development than for increase in leaf area. Cantliffe (1974) used different forms and amounts of nitrogen fertilizer on table beet, and determined the nitrogen concentrations in leaf blades, petioles and roots, while Draycott and Durrant (1971) investigated the effects of nitrogen fertilization, plant population and irrigation on sugar beet, measuring the nutrient levels in the tops and in the roots. They showed that the nitrogen concentration and uptake was greatly increased by nitrogen fertilization and irrigation but not by plant population. Friis-Nielsen (1966), (1969) and (1973) examined the connection between the nutrient ratio, the absorption of nutrients and the corresponding dry matter yield on rye grass and on tomato, both in the vegetative and the generative stages. He studied the distribution and the redistribution of nutrients in the plants during the growing season under different growing conditions. He also worked on the relations between the distribution of dry matter and the concentrations of the nutrient elements in tomato plants, and stated that interpretation of chemical plant analysis must be based on total yield curves showing dry matter yield as a composite function of the nutrients and of the applied growth factor. He showed that the results of distribution patterns of contents of dry matter and nutrient elements indicate that water supply affects not only production of dry matter and absorption of nutrients but also distribution and translocation, hence large supplies fof nutrients can be utilized to the full only at optimal water levels. Hanway (1962) working on the growth of corn measured the uptake of nitrogen, phosphorus and potassium, and their distribution in different plant parts in relation to the stage of growth showed that, while grain yields are primarily a function of leaf area, leaf area is a function of the nutrient status of the plant which is reflected in the chemical composition of the leaves. Dry weight of the entire plant and of the grain were directly related to the weight of leaves and differences in soil fertility influenced the amounts of nitrogen, phosphorus and potassium taken up by corn plants but did not markedly change the seasonal pattern of uptake and distribution of these elements in the plants.

McIntosh, Crooks and Simpson (1973) measured the distribution of magnesium

in grass as affected by applied nitrogen, potassium and magnesium, and Roy and Wright (1973) and (1974) working on sorghum growth measured dry matter accumulation patterns, yield and nitrogen content as well as nitrogen, phosphorus and potassium uptake patterns by various plant parts, notably the stem, leaf and head. They stated that an understanding of seasonal nutrient accumulation patterns under varying fertility levels is important for planning an efficient fertilizer program. Singh and Steenberg (1974) using Zn^{65} and Mn^{54} measured the uptake, distribution and translocation of these elements as well as their interaction in maize and barley. Manganese content was reduced by zinc applications and the effect of zinc on manganese uptake and translocation is predominant at transport site and not in internal distribution or translocation. Manganese played very little role either in the transport or translocation of zinc in the plants. Spratt and Gasser (1970) measured the effect of nitrogen fertilization and water supply on the distribution of dry matter and nitrogen between the different parts of wheat - notably the grain, chaff, stems and leaves.

Williams (1955) working on oats, grapes and tobacco measured the redistribution of mineral elements during development while Turner and Barkus (1973) measured the loss of nutrients from banana pseudostems after harvest, and showed that if lost nutrients were translocated to growing sucker, as is likely, they would contribute more than 40 percent of its requirements for all elements except magnesium and zinc.

Langston (1956) using radioisotopes investigated distribution patterns in tomato plants. He stated: "A precise knowledge of the distribution of mineral elements in plants would be an important aid in interpreting their functions". He demonstrated how plants accumulate radioisotopes in specific areas. Cresswell (1958) investigated the effects of increasing the concentrations of sodium, potassium and calcium in the nutrient supply on the external appearance and uptake and distribution in lemon plants grown in culture solutions. Some of his observations were:

(i) The level of sodium influenced the distribution of sodium in the leaves. The sodium content of the leaf, stem and root tissues gave a good reflection of the level of sodium supplied.

(ii) There was antagonism between sodium and calcium and between sodium and potassium.

(iii) Sodium interfered with magnesium uptake.

(iv) The sodium content in the upper leaves was higher than in lower leaves when high concentrations of sodium were applied to the nutrient solution.

(v) Potassium ions were mobile while calcium and magnesium were comparatively non mobile.

Leece (1972), (1974) and (1975) found that plants accumulate radioisotopes in specific areas, and he gives standard levels and seasonal changes of copper, iron, zinc and phosphate in peach and other stone fruit, showing that nitrogen, phosphorus, potassium, copper and zinc concentrations decreased with age while calcium, magnesium, iron, manganese and aluminium concentrations increased with tissue age.

McClung and Lott (1956) measured the mineral composition as effected by age and the presence of a fruit crop in the leaves of peach trees. Batjer and Westwood (1958) working on Alberta peach measured the nutrients in the leaves throughout the season and like Leece (1974) found a large seasonal variation.

In pineapples the nutrient uptake and distribution was measured extensively by Sideris (1950), Sideris and Young (1945), (1946a), (1946b), (1950), (1951) and (1956) and Sideris, Young and Kraus (1939a), (1939b) and (1943). They measured the effects of various different concentrations of nutrient supply on the growth and ash contents of the various sections of pineapple plants. They showed that increase in nitrogen in association with potassium and calcium increased the weights of leaves and stem while root growth was increased by low nitrogen. High nitrogen and calcium produced fruit at regular season while high nitrogen and potassium maintained vegetative stage longer. They showed that with advancing physiological age nitrogen increased in the chlorophyllous and decreased in the non chlorophyllous basal leaf sections. The total nitrogen in the non chlorophyllous sections and in the stems corresponded positively with the concentration in the nutrient solution, and was greater in pre than in post flowering stage. Teiwes and Grüneberg (1963) point out that pineapple has a particularly high potash requirement and potassium is to be found everywhere in the plant where large physiological work is in progress. Sideris and Young (1950) show that with advancing age potassium increases in the chlorophyllous but decreases in the non chlorophyllous basal leaf sections, and that the largest proportion of potassium is in the leaves. When potassium is in abundant supply most of the potassium is found in the older leaves but when in short or deficient supply the D and E leaves have higher potassium concentrations than the older leaves. In all the leaves the potassium concentration increased from the base to the tip. Teiwes and Grüneberg point out that whilst the quantity

of nitrogen at the disposal of the plant largely determines the weight of the fruit, potassium is the factor controlling the quality of the fruit. Sideris and Young (1950) found calcium ion to increase in the basal and in the chlorophyllous sections of the leaves with age but decreases with age in the stem. The calcium in the stem correlated inversely with potassium and there was a much greater calcium concentration in the stem in preflowering than in postflowering plants. Teiwes and Grüneberg (1963) state that the reduction of potassium and the accumulation of calcium in the leaves is characteristic of the ageing and maturation of the plant. They also point out that magnesium is an integrating constituent of chlorophyll and hence most magnesium is found in the upper leaf sections. Sideris and Young (1950) showed that the amount of translocated iron from the roots to the leaves was considerably lower in cultures supplied with manganese.

Lyman and Dean (1942) studied the distribution of zinc throughout the pineapple plant for different aged plants and revealed that the meristematic tissue contained the greatest concentrations of zinc. The growing parts of a zinc deficient pineapple plant were found to contain less zinc than normal or slightly deficient plants and the concentration was found to be related to the degree of zinc deficiency. In the Eastern Cape Ashton (1970) measured distribution of the nutrient levels in the different parts of the pineapple plant for plants of three different ages, and like Sideris and Young (1950) found that in general concentrations of nitrogen, phosphorus, potassium, copper and zinc decreased with age in the leaves while concentrations of calcium, magnesium, iron and manganese increased with age.

The nutrient requirements of plants have been studied extensively by many workers. Magnitski (1961) diagnosed the nutritional status of plants according to results obtained from the chemical composition of the leaves. He states that: "The analysis of stems, leaves and their separate parts gives a more accurate notion of the status of plant nutrition than the analysis of the total mass of plant". Ollagnier and Prevot (1961) used a law of the minimum and balanced nutrition to determine the nutritional status of plants. In his studies into criteria for the diagnosis of nutrient conditions in citrus and other crops Chapman (1961) and (1967) sets up tables and ranges of nutrient concentrations for a large number of elements, and gives values where leaf deficiency symptoms occur. In his interpretation of leaf analysis Holland (1966) used trilinear co-ordinates to determine nitrogen, phosphorus and potassium and potassium, calcium and magnesium balances. Working initially on rubber plantations and then on maize Beaufils (1971), (1972), (1973) and (1974) and then Sumner (1974) and

Sumner and Beaufils (1975) in a series of papers develop a "Diagnoses and Recommendation Integrated System" which could be used to determine the nutrient requirements of crops in general. Bould (1961) used discs taken out of leaves in leaf analysis as a guide to the nutritional status of soft fruit crops. He states that: "Before using chemical leaf analysis for diagnostic purposes it is essential to know the effect of the age, position and stage of growth of leaves in their nutrient concentrations". Beyers (1962) developed optimum ranges of nutrients in leaves of deciduous fruit trees.

Marr (1972) points out how the nutrient requirements of the pineapple plant have been established for commercial production in many countries. A comprehensive review of the literature has been compiled by Teiwes and Grüneberg (1965). The amount of fertilizer required by the plant varies considerably with soil and climatic conditions. Sanford (1964) and Nightingale (1942a) report that nitrogen requirements may vary by as much as 75 percent in different seasons in the same locality to give the same yields. Nightingale (1942a) and (1942b), Sideris and Young (1946b), Sandord (1964) and van Lelyveld (1964) point out that nitrogen is required in relatively large quantities for good growth and yields of pineapple. Recommendations vary from none on bush soils in Zululand Nyenhuis (1967) to 672 kg nitrogen per hectare in Hawaii Collins (1960). Samuals et.al. (1955) found 186 kg nitrogen per hectare gave the best yields in Puerto Rico while Marr (1972) reports that the Pineapple Research Institute in Hawaii recommends between 560 and 672 kg nitrogen per hectare. van Lelyveld (1964) showed that between 542 and 723 kg nitrogen per hectare gave the highest plant crop yields under Eastern Cape conditions. Sanford (1961) found that NH_4-N was more readily available to the plant than NO_3-N and Sanford (1961) and Nightingale (1942) report that nitrogen applied after flower bud emergence did not increase plant crop yield. Collins (1960) gives the amount of potassium applied to plant crop to be between 220 and 260 kg potassium per hectare depending on available soil reserves. Sanford (1961) and Samuals et.al. (1955) applied potassium in the sulphate form either as preplant, basal leaf or foliar spray applications. Collins (1960) states that in Hawaii between 75 and 123 kg phosphorus per hectare is applied. Montenegro, Torres and da Silva (1967) found no response to phosphorus when applied at 44 kg phosphorus per hectare and a significant depressing effect at 88 kg phosphorus per hectare. Nyenhuis (1967) recorded yield increases with applications of up to 93 kg phosphorus per hectare. Nightingale (1942) states that the depressing effect often encountered could be caused by the suppressing effect of applied phosphorus in nitrogen absorption. Sanford (1961) states that the calcium

and magnesium needs are determined by soil analyses and are corrected by applying lime and magnesium sulphate. Trace elements of iron and zinc are applied in the sulphate form as foliar sprays. Sanford (1961) states that rates vary from 5,6 to 9 kg Fe SO_4 per hectare and 1 kg Zn SO_4 per hectare applied every two to four weeks.

The methods of application, uptake and utilization of nutrients for pineapple plants have been studied in detail particularly by Nightingale (1942a) and (1942b), Sideris, Young and Krauss (1943), Sideris and Young (1945), (1946a), (1946b) and (1956) and Sanford (1964). Sanford (1964) found that ferrous sulphate and zinc sulphate applied as foliar sprays were far better than soil applications, and foliar sprays of nitrogen, phosphorus and potassium were advantageous over dry side dressings in that spray applications afford an alternative path of entry of the nutrients into the plants and can be applied together with zinc and iron.

In South Africa basic fertilizer requirements of nitrogen, potassium and phosphorus applied in dry form have been determined by van Lelyveld (1964) and Nyenhuis (1967). Marr (1972) measured the effects of soil fumigants, applied fertilizer and climate on the growth and nutrient levels in Cayenne pineapples under field conditions in the Eastern Cape. He found that 560 kg nitrogen per hectare was adequate for plant crop and higher amounts delayed the crop. 74 kg phosphorus increased rattoon crop yields when analysis had shown 4 ppm phosphorus available in the soil, however 50 kg phosphorus per hectare had a depressing effect on plant crop yields when 10 ppm phosphorus was available in the soil. Increasing potassium fertilization from 191 to 308 kg potassium per hectare did not increase yields when analysis showed 66 ppm potassium in the soil. Also 336 kg potassium did not increase yields when soil potassium level was 210 ppm, however at the end of the growth cycle soil potassium had dropped to 57 ppm. Positive results both in plant weight and yield were obtained when 39,2 kg iron per hectare was applied, and when 6,3 kg zinc per hectare was applied monthly as foliar sprays there was a small increase in plant weight but a significant increase in fruit yields.

Magnitski (1961) points out that the best leaves to sample for analysis to determine the nutrient status of pineapple plants, are leaves that have finished growth and which are physiologically active. It has been generally accepted that the so called "D"-leaves give the best indications of the nutritional status of the pineapple plant. The basal white tissue has been used for the quantitative determination of all elements by Nightingale (1942) and Steyn (1957) and (1961) while Sanford (1964) reports that phosphorus,

potassium, calcium and magnesium are determined in the basal white tissue and nitrogen and iron are determined in the middle third of the "D"-leaf. Zinc is also determined in the basal white section except where a deficiency exists, it is then determined in the apical meristem.

Growth of pineapples and leaf measurements were measured by Tan and Wee (1973), Tay and Tan (1971) and Marr (1972). Tan and Wee (1973) investigated the influence of size of pineapple slips on plant growth and fruit weight but found no significant differences between graded and ungraded slips. Errors in sampling of plants and in chemical analyses of the samples was investigated extensively by Steyn (1957) and by Bradfield and Bould (1963), who give methods of preparation and storage of leaf samples prior to analysis.

3. Introductory discussion of experimentation

For the present investigation plants were sampled on two farms in the Eastern Cape - Whitney Estate in the Alexandria district and at Shelford Pineries at Kidds Beach near East London. Plants were sampled at regular intervals from the time of planting of pineapple tops until the harvesting of the first fruit crop. The plants were transported to the Pineapple Research Unit laboratory at Rhodes University, Grahamstown, where they were stripped into sections. Each section was weighed, dried and analysed for nutrients. Growth rates were measured and the leaf areas of plants from Whitney Estate were measured.

To summarise the present study was done to determine the distribution of nutrients within the pineapple plant, from the time of planting until the first fruit was harvested, in order to throw more light onto the uptake and utilization of nutrients within the pineapple plant, and to measure how these varied with growth in order to best determine the nutrient status of the plant, and to help understand more fully the changing nutrient requirements of the Cayenne pineapple plant under Eastern Cape climatic conditions.

CHAPTER II

MATERIALS AND METHODS

1. Location and climate

Plants were sampled on the farm Whitney Estate in the Alexandria district of the Eastern Cape, and on the farm Shelford Pineries in the Kidds Beach area near East London. Both farms are situated near the coast and the elevation of the farms varies between 60 and 120 meters above mean sea level.

The climate of the area is classified as cool temperate oceanic. The climate is however very variable as the area lies between the summer and winter rainfall areas of the coastal belt. The annual rainfall averages about 700mm with more rain falling during the summer than the winter. Shelford Pineries lies more towards the summer rainfall area than Whitney Estate. During the winter, antarctic cold fronts periodically sweep across the area reducing temperatures to near zero. Hot berg wind conditions are also experienced. These extreme conditions are interspersed with mild weather. The mid summer months are usually hot and dry with variable winds.

The mean monthly maximum and minimum temperatures and the rainfall figures for the period of the experiment were obtained from the Department of Agriculture and Technical Services research stations at Bathurst, 30 kilometers east of Whitney, and at East London, 15 kilometers north east of Shelford. These values are given in Tables 1 and 2 and illustrated in Figures 1 and 2.

2. Materials and farming practices used

i) Soil fumigants, weedicides and insecticides.

At Whitney Estate the following were applied:

Soil fumigants:- 44,1 litres EDB (Ethylene dibromide), 92% E.C. formulation, per hectare as a preplant treatment.

Weedicides:- 3,4 kg Hyvar per hectare as a post plant treatment.

Insecticides:- 5,6 kg Aldrin per hectare as a preplant treatment.

At Shelford Pineries the following were applied:

Soil fumigants:- 2,8 kg DBCP (1,2-dibromo-3-chloropane), 80% E.C. formulation, dissolved in 198 litres diesel per hectare.

Weedicides:- 4,5 kg Hyvar per hectare just after planting and a further 2,2 kg Hyvar plus 2,2 kg Karmex per hectare on the 18th October 1973.

Insecticides:- 5,6 kg Aldrin per hectare as a preplant treatment.

ii) Planting material

Ungraded pineapple tops were used as planting material on both farms. Tan and Wee (1973) using slips as planting material found that there was no advantage using graded planting material over mixed planting material on plant growth and fruit quality.

At Whitney the tops were planted 53,3 cm apart in double rows 30,5 cm apart on ridges. The distance between ridges was 99,1 cm giving a population of 42,978 plants per hectare.

At Shelford the tops were planted 53,3 cm apart in double rows 28,6 cm apart on ridges. The distance between the ridges was 106,7 cm giving a population of 43,225 plants per hectare.

iii) Fertilizers

Fertilizer applications were based on work done in various parts of the world by Sideris, Young and Krauss (1943), Sideris and Young (1945), (1946a), (1946b) and (1956), and Sanford (1964), and in the Eastern Cape by van Lelyveld (1964) and Marr (1972) and adapted as standard procedures on the farms concerned. All fertilizers applied to the plants were commercially available preparations. In preplant applications the fertilizer was applied to the soil surface in the solid form and worked into the top 15 cm. Hand applications were applied to the basal leaves of the plant. In foliar applications the fertilizers were dissolved in water, the pH adjusted to 5,8 by the addition of citric acid to prevent the precipitation of ferrous sulphate. This solution was applied to the field by means of a boom spray.

The fertilizer programs used on each of the farms was as follows:

a) Whitney Estate.

No preplant fertilizer was used. Hand applications consisted of one application of ammonium sulphate during November, 1972 of 245 kg per hectare and two applications of a 3:2:1 premix during February and September, 1973. This gave a total of 102 kg nitrogen, 13 kg phosphorus and 32 kg potassium per hectare. Fifteen fertilizer spray applications were applied giving a total of 150 kg nitrogen, 126 kg potassium, 73 kg iron and 15 kg zinc per hectare. Spray applications were started during December 1972 and were applied monthly, except for March and July 1973, until April 1973.

b) Shelford Pineries.

The following preplant fertilizer was applied:

71 kg nitrogen per hectare as ammonium sulphate,
65 kg phosphorus per hectare as granular super phosphate and
121 kg potassium per hectare as potassium sulphate.

Eight fertilizer spray applications were applied giving a total of 208 kg nitrogen, 143 kg potassium, 62 kg iron, and 4 kg zinc per hectare. Spray applications were started on the 13th January 1973 and applied at six weekly intervals until the 18th October 1973. No fertilizer applications were made after flower differentiation.

iv) Hormones

The flower induction hormones applied at Shelford Pineries by means of a boom spray were:-

B.H.E.H. (Beta-Hydroxy ethylhydrazine)

at the rate of 2500 litres per hectare of a 2500 ppm solution on the 3rd January, 1974, followed by

A.N.A. (α-Naphthyl acetic acid)

at the rate of 2500 litres per hectare of a 10 ppm solution on the 19th January, 1974.

3. Soil Analysis

Many workers have pointed out the importance of soil analysis to determine the fertilizer requirements of crop plants, Chapman (1967), Jackson (1958), Piper (1950a), Marr (1972), Steyn (1958), and Ashton (1970). Soil samples were taken of the fields in which the experimental plots formed a part. The analyses were done by Messrs African Explosives and Chemical Industries Ltd, according to recommendations of the Analytical Sub-committee of the Fertilizer Society of South Africa Agronomic Committee. The methods used for sampling and analyses are described by Marr (1972). The results of these analyses are given in Table 3.

4. Sampling and transporting of plants

The technique of sampling plants and leaves has been extensively investigated. Steyn (1957) and (1961) in his statistical studies points out that any field must be sampled extensively for the results to be statistically reliable. Leece (1972), gives errors associated with a standard and a simplified sampling procedure for peach trees. He sampled leaves from 20 trees in a 0,5 hectare block sampling diagonally across the block. Kenworthy (1969) and Piper (1950a) also give guides to collecting foliar samples.

In the present study sampling was done on a selected block of pineapple plants, forming part of a production land on both farms. At Whitney Estate samples were taken at six weekly intervals to begin with and at eight weekly intervals after differentiation. At Shelford Pineries samples were taken at three monthly intervals. As some of the plants differentiated early, due to hormoning at Shelford and to precocious fruiting at Whitney, samples were taken of both early differentiated plants and natural plants on both farms. Sampling was done on Monday or Tuesday mornings. Steyn (1957) found a variation in the basal section of the plants D-leaf according to the time of day the samples were taken, hence sampling was always done before 10 a.m. in the mornings in the present study.

The plants were sampled on the bases of their being healthy representatives of the plot on gross morphological characteristics such as uniform size and appearance. To begin with 20 plants were sampled at Whitney and 10 at Shelford, however as the size of the plants increased this was reduced to 5 plants per sample. Sampling was done by digging each plant out with a spade, and extracting as much of the root material as possible. The loose soil was was shaken from the plant. The sampling dates and numbers of plants sampled are as follows:

Whitney		Shelford	
Sampling date	Number of plants sampled	Sampling date	Number of plants sampled
11/10/1972	20	15/7/1972	10
13/11/1972	20	30/1/1973	10
8/1/1973	20	30/9/1973	10
19/2/1973	20	30/7/1973	10
2/4/1973	20	5/11/1973	10
14/5/1973	15	28/1/1974	7
26/6/1973	15	29/4/1974*	5+5
7/8/1973	15	29/7/1974*	5+5
18/9/1973	15	28/10/1974*	5+5
29/10/1973	15	28/1/1975	3
10/12/1973	15		
21/1/1974	10		
26/3/1974	10		
21/4/1974*	5+5		
15/7/1974*	5+5		
9/9/1974*	5+5		
4/11/1974*	5+5		
24/2/1975	5		

* From the 21/4/1974 until the 4/11/1974 at Whitney, and from the 29/4/1974 until the 28/10/1974 at Shelford samples were taken of both plants that showed early fruiting and plants showing natural fruiting.

The plants were transported by road to the Pineapple Research Unit at Rhodes University where they were stored in a cool room at 4°C until they were stripped, washed, weighed and dried.. Each plant was processed the same week as sampling. Leece (1972) points out that storage in a refrigerator is necessary where oven drying cannot commence on the day of sampling while Bradfield and Bould (1963) found that leaves could not be stored without refrigeration for more than two days before drying.

5. Stripping of plants

The typical leaves of a non fruiting pineapple plant can be divided into six categories on the basis of size, position and age. These divisions are given by Martin-Prevel (1959),Teiwes and Grüneberg (1963), and Ashton (1970).

In the present study the plants were stripped by pulling each individual leaf from the stem starting at the base of the plant. To assist in the stripping some of the leaves had to be carefully cut from the stem. The leaves were divided into six different categories:-

(i) A-leaves: Old dead leaves at base of plant
(ii) B-leaves: Old dying leaves
(iii) C-leaves: Fully mature leaves usually forming the bulk of the leaves on the plant
(iv) D-leaves: The 8 longest fully mature leaves
(v) E-leaves: The next 4 longest of the immature and still growing leaves
(vi) F-leaves: the rest of the immature and apical leaves.

Ground suckers, suckers, slips and tops, when present, were pulled off the plant and divided in a similar way.

These categories of leaves are illustrated in Plates III to IX for plants at six monthly intervals.

6. Leaf area measurements

The leaves of five plants from Whitney Estate were used to measure leaf areas. This was done by pressing the leaves between two sheets of glass and casting a shadow on light sensitive paper. The shadowed area was cut out and weighed and the leaf area calculated. Method is described by Blackman (1968). Tay and Tan (1971) used a similar method on leaves from pineapple plants in Malaya.

7. Washing, weighing and drying of plants

Steyn (1957) found differences in most nutrient levels between washed and unwashed leaves while Jacques et.al. (1974) found only a difference in the level of iron. Leece (1972) states that washing is necessary but must be done on fresh material. The washing methods used in the present study were essentially the same as those recommended by Steyn (1957) and also used by Ashton (1970). Each leaf was individually washed in distilled water to which a 0,1% solution of teepol had been added. The surface dirt was removed by gently scrubbing with cotton wool. The leaves were then rinsed successively in distilled water and three lots of distilled deionised water. The excess water was wiped off with cotton wool between each rinsing. The leaves were then placed on sheets of clean paper. Each category of leaf was bulked and the leaves divided into basal, mid and upper or into bottom and top sections as shown in the plates. These samples were weighed and a sub sample was taken and reweighed and put into a large petri dish in a Memmert forced draft oven set at 65°C for drying.

The plant stems were washed in the same manner. The roots were then cut off and the stem divided into eight sections:

(i) Base of stem - that part of the stem below ground level that contained all the roots
(ii) Bottom part of stem stele
(iii) Mid part of stem stele
(iv) Top part of stem stele
(v) Bottom part of stem cortex
(vi) Mid part of stem cortex
(vii) Top part of stem cortex
(viii) The stem apex consisting of the terminal centimeter of the stem

These sections are illustrated in Plates III to IX for stems at six monthly intervals. The sections were weighed and then subsampled as was the case with the leaves. These subsamples were cut into small cubes to facilitate the drying process, they were then weighed and dried in the same manner as the leaves. The roots were weighed and a subsample consisting of four to six roots was taken from each plant. These roots were rewashed, weighed and dried. Fruit and peduncle when formed were treated in the same manner as the stem. The peduncle being divided into bottom, middle and top sections, and the fruit, when fully formed into eight sections. These sections are all illustrated in the plates.

Samples when dried were all reweighed and the dry weights and percentage moisture of each section determined.

8. Grinding of dried material

Leaf samples were ground in a Casella mill of stainless steel construction fitted with a 0,53 mm sieve. The dried leaf samples were first crushed into small pieces in a linen bag. The stem, root and fruit samples were ground in a Culatti bench size hammer mill of stainless steel construction. The samples were collected and stored in glass bottles.

Samples were redried in an oven for at least five hours before weighing and ashing for chemical analysis. These drying and grinding procedures are as developed by Steyn (1957) for routine leaf analysis at the Pineapple Research Unit at Rhodes University. Steyn (1957) records that the leaf power may be safely stored for up to two months before ashing without significant deterioration, though after this length of time the powder deteriorates rapidly. Bradfield and Bould (1963) state that powder may be stored for up to two years. In the present study the leaf powder was never stored for more than one month.

9. Chemical analytical methods

All the chemical analysis was done by methods adapted for routine leaf analysis in the Pineapple Research Unit laboratory at Rhodes University by Hasses (1971).

Nitrogen determination was done on the dried powder by the standard micro-kjeldahl method as described by Scott and Hallet (1939) and Steyn (1957) with slight modifications in the amount of reagents used. These modifications are given by Hasses (1971), Ashton (1970) and Marr (1972).

Powder was dry ashed at 490 $\pm$ 5^{o}C for at least 4 hours. Concentrated hydrochloric acid was added to the ash which was then evaporated to dryness on a water bath. The ash was then redissolved in a 1,6N Nitric acid solution and the subsequent chemical analyses done on this solution.

Phosphorous was determined on a Beckman DB spectrophotometer using the vanado-molybdate-phosphate method as described by Jackson (1958), Marr (1972) Hasses (1972) and Ashton (1971).

Potassium was determined by flame emission and calcium,magnesium, sodium, iron, manganese, zinc and copper by atomic absorption spectroscopy, using a Techtron AA4 spectrophotometer fitted with a digital readout and a digital printout. Operating parameters for the instrument were set up by Hasses

(1971) and described by Ashton (1970) and Marr (1972). The theory and operation of atomic absorption spectrophotometry is described in detail by Slavin (1968) and Ramirez-Munoz (1968). In the determination of calcium, lanthanum oxide was used to overcome any interferences from phosphate.

Although most of the chemical analyses were done in duplicate, in some cases not enough dried material was available and only single determinations were done on these samples.

CHAPTER III

DESCRIPTION OF CLIMATE AND PLANT GROWTH

1. Mean temperatures and rainfall during growth of plants

The mean monthly temperatures and rainfall for Bathurst during the experimental period are shown in Figure 1 and those for East London in Figure 2. The maximum, minimum and mean temperature and rainfall figures for Bathurst are given in Table 1 and those for East London in Table 2.

Mean temperatures for both Bathurst and East London showed an almost identical trend over both seasons with a minimum of about 15°C in August-September and a maximum of about 22°C in February-March.

Rainfall was generally low in the first year, and varied between the two regions. Bathurst had much less rain than East London in this first year. This was especially so in February, March, and April, 1973. After July, 1973 both areas had adequate rainfalls. In March 1974, Bathurst experienced flood conditions and had a rainfall of 343 mm falling over 18 days. During the same period East London had 104 mm rain falling over 11 days.

2. General description of plant growth

A. Qualitative description of plant growth

On both Whitney Estate and Shelford Pineries pineapple tops were used as planting material. The growth of the plants from these tops is illustrated in plates III to IX. These plates show plants growing at Whitney at six monthly intervals.

During the first winter (June, July and August 1973) there was a large amount of damage in the apical meristems. This was possibly due to a combination of the cold climate and a drying out of the meristematic tissue due to prolonged drought in the area. This breakdown in the apex of the stems caused a large number of plants to produce ground suckers. This was a lot more prevalent at Whitney than at Shelford. This breakdown is shown in area 25 in Plate V. The formation of ground suckers and the subsequent recovery of the stem around the dead area is illustrated in area 22 in Plate VI.

Plants at Shelford were hormoned to induce flower differentiation in January 1974 and about 40% of the plants differentiated at this stage. At Whitney about 2% of the plants in the land showed precocious fruiting by

differentiating at the same stage. The growth of these plants is illustrated in Plates VIIA and VIIIA. These plants produced fruit in October and November 1974. In natural fruiting plants the fruit was harvested in February and March 1975.

At the time of harvesting of the fruit the early fruiting plants had produced suckers and some new ground suckers but no slips. Natural fruiting plants had produced slips, suckers and ground suckers when the fruit was harvested. These are illustrated in Plates VIIIA and IX.

B. Quantitative description of plant growth

The quantitative measurement of plant growth has been described by many workers. In the present study the formulae as developed by Briggs (1920) and by Blackman (1968) have been used.

$$RGR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1} \qquad 1$$

$$NAR = \frac{\log_e A_2 - \log_e A_1}{t_2 - t_1} \times \frac{W_2 - W_1}{A_2 - A_1} \qquad 2$$

$$LAR = \frac{RGR}{NAR} \qquad 3$$

where RGR is relative growth rate, NAR is net assimilation rate, LAR is leaf area ratio, W_2 is plant dry weight at time of second sampling t_2, W_1 is plant dry weight at time of first sampling t_1, and A_2 and A_1 are total leaf area at t_2 and t_1 respectively. The plant dry weights were calculated from the moisture determinations of the sub samples and time period $t_2 - t_1$ was taken to be the number of days between samples. This was used as the period between sampling varied.

Marr (1972) used plant fresh weights to determine the RGR. Tay and Tan (1971) dried whole plants in an oven and used these weights to determine RGR. They determined leaf areas by tracing the outline of all the leaves of the plant onto brown paper and weighing the cut out sections of the paper. They also found a correlation between the total leaf area of the plant and the area of certain selected leaves as measured by the product of the leaf length and width at half length.

The mean plant weights, leaf areas, RGR, NAR and LAR for plants from Whitney are given in Table 4 and are illustrated in Figures 3 and 5. The mean plant weights and RGR for plants from Shelford are given in Table 5 and illustrated in Figures 4 and 6.

3. Growth of pineapple plants at Whitney Estate

The tops used as planting material on the 8th August, 1972 are shown in Plate II. The plants were first sampled on the 11th October, 1972. They had just started to grow and had produced roots of up to 4 cm long. On the 13th November 1972 the plant leaves had started to show growth. New growth and broadening of the basal sections of the C, D and E leaves was observed. The F leaves had a very large section of white merestamatic tissue and roots had increased to about 15 cm long. On the 8th of January the appearance of the plants was as illustrated in Plate III. There had been good growth in the D, E and F leaves. D leaves were now much longer than the older C leaves. Plant stems had started to show growth at this stage. By the 19th February 1973 the plants had continued to grow vigorously. E and F leaves were broader with very large sections of white basal meristamatic tissue present. By the 2nd April, 1973 the D, E and F leaves had shown further good growth and a lot of new root material had grown. The roots were now up to 30 cm long. On the 14th May, 1973 the state of the plants was much the same as on the previous sampling, however some dead areas had begun to appear on the D leaves. On the 25th June 1973 the plants appeared to not have grown much since the previous sampling. The base of the C, D, E and F leaves, however had much less white meristamatic tissue, and had become considerably thicker. Twelve out of the twenty plants sampled had started to show some sign of an internal breakdown in the apical sections of the stem. On the 7th August 1973 the appearance of the plants were as illustrated in Plate IV. By this stage most leaves had shown some degree of die back at the leaf tips. The leaves showed thickening at their bases, and there was very little white meristamatic tissue at the base of the C and D leaves. The stem apices still showed an internal breakdown which is only slightly illustrated in section 25 in Plate IV. On the 18th September 1973 the plants had a yellow appearance in the field. There had been very little appearance of any further growth except for the bases of the E and F leaves. On the 29th October 1973 the plants had again shown growth. Stems had grown above the dead area. D leaf bases had broadened and E and F leaves had grown considerably. Stems had become thicker and dormant sucker buds had appeared between the C and D leaves. On the 10th December, 1973 the plants had continued to show good growth. The D leaves were now all above the dead area in the stems. A lot of extra E and F leaves had grown, and a lot of new roots had grown. Ground suckers had started to appear on about 25% of the plants. The state of the plants on the 21st January 1974 are illustrated in Plate VI. They had shown good growth since the previous sample and had a very green appearance. The stem had grown well above the dead area. This is illustrated in section 22 in Plate VI. The ground suckers had continued

to grow. By the 26th March 1974 the C leaves had formed the bulk of the plant. D, E and F leaves had continued to show good growth. Stems had broadened near the top and had continued to show good growth. On the 21st May 1974 the plants had continued to grow well since the previous sampling. Between 1% and 2% of the plants in the field had differentiated and were showing precocious fruiting. These plants were sampled separately and formed an additional sample. At this stage they appeared very much as natural fruiting plants did on the 4th November 1974, which are illustrated in Plate VIII. In these precocious fruiting plants the D leaves had drier and harder white basal meristematic sections than those for natural fruiting plants, and the E leaves had harder drier and much smaller basal sections. The F leaves in the precocious fruiting plants were sampled from the peduncle. In the natural fruiting plants the growth of the stems and leaves had continued. The plants sampled on the 15th July 1974 are illustrated in Plate VII for natural fruiting plants and in Plate VIIA for precocious fruiting plants. The natural fruiting plants had differentiated. The precocious fruiting plants now had fruit with a small top present, and suckers had started to form. On the 9th September, 1974 a large amount of leaf die back and yellowing was observed in the field. In natural fruiting plants little or no new leaf growth was observed. D and E leaves had small white meristematic basal sections. The F leaves were now present on the growing peduncle. The F leaves showed a different shape from the previous F leaves. Ground suckers for these plants had continued to grow. In the precocious fruiting plants the D and E leaves had a very much smaller white meristematic section and were smaller than those of the other plants. The F leaves showed a pink colouration and were present on the peduncle. The fruit, top and suckers had all grown. Some new ground suckers had started to appear. On the 4th November 1974 the natural fruiting plants were larger than the precocious fruiting plants. The plants are illustrated in Plates VIII and VIIIA. At this stage the natural fruiting plants had produced a peduncle and young fruit but not as yet a top. In the precocious fruiting plants the fruit was ready to be harvested. Fruit tops and suckers were completely formed but no slips were present. A number of new ground suckers were present. On the 24th February the natural fruiting plant was as illustrated in Plate IX. The fruit was ready to be harvested. The peduncle had started to dry out and fruit top, slips and suckers were present. New ground suckers had appeared on many of the plants.

4. Growth of plants at Shelford Pineries

Pineapple tops were planted at Shelford Pineries on the 15th July, 1972, however the planting material was only analysed on the 19th September, 1972.

The tops had dried out considerably by this stage. On the 30th January 1973 the plants had shown much the same growth as those from Whitney. There was however a much greater variation in size and growth. On the 30th March, 1973, the plants had shown good growth from the previous sampling. They were very similar to plants from Whitney at the same period. On the 30th July 1973 the plants were again very similar to those at Whitney. There was however less dead area in the apex of the stems. On the 5th November 1973 the plants seemed to have grown slightly better than those at Whitney. On the 28th January 1974 the plants had shown very good growth since the last sampling. There was a very large variation in plant size. Plants had less ground suckers than those from Whitney. None of the plants sampled had ground suckers. The roots were not as well developed as those of plants from Whitney. By the 29th April, 1974 the plants had shown further good growth, however there were a lot of broken B and C leaves on the plants. This had been caused by strong winds. The field had been hormoned in January and about 40% of the plants had differentiated. These fruiting plants were much the same as the plants showing precocious fruiting at Whitney. Separate samples were taken of plants that had differentiated and of the rest of the plants. On the 29th July 1974 the plants had shown a lot of wind damage and leaf die back. The natural fruiting plants had differentiated and were very similar to those at Whitney at the same time. On the 29th October 1974 the fruit on the plants that had been hormoned was ready to be harvested. The plants were very similar to those at Whitney except a greater amount of damage due to wind had occurred. They also had a less developed root system as compared to plants from Whitney. On the 28th January 1975 the final sample of the natural fruiting plants was taken at Shelford. The fruit was now ready to be harvested. The plants were again similar to those at Whitney. There were, however, more slips (an average of 3,7 per plant) on the plants at Shelford than on the plants at Whitney (2,9 slips per plant).

5. Discussion

i) Mean monthly temperatures and rainfall

Temperature is one of the most important climatic factors influencing the growth of plants, and can be the decisive factor which limits pineapple plant growth to definite geographical areas, Collins (1960). The climatic requirements of pineapples are characterised by their sensitivity to frost and to intense isolation, Teiwes and Grüneberg (1963). Marr (1972) points out that limiting and optimum temperatures have been referred to in a number of publications which are not always consistent. Malan (1954) gives optimum temperatures of between 23,9°C and 29,4°C according to Clark and between 15,6°C and 32,2°C according to Johnson. Collins (1960) states that

growth largely ceases when soil temperatures are below 20°C and there is little or no root growth below 22,5°C or above 41,2°C. Sanford (1964) states that the minimum temperatures for root and leaf growth is 20°C and the optimum 32°C. The cool winters in the experimental area prompted van Lelyveld (1964) to state that there was no sign of growth during June, July and August, however he seemed to have made no actual growth measurements. Marr (1972) found no increase in the fresh weights of plants during this period.

The pineapple plant is very resistant to drought, but the rainfall during summer should amount to at least 760 mm Teiwes and Grüneberg (1963). In Hawaii a rainfall of 1100 to 1300 mm is regarded as the optimum. When rainfall exceeds 2540 mm it has a detrimental effect on the quality and keeping properties of the fruit.

In the present study the mean monthly temperatures varied between 14,4°C and 22,4°C for Bathurst and between 14,5°C and 22,1°C for East London. From Figures 1 and 2 it can be seen that there was very little difference in temperatures between the two regions.

Monthly rainfall figures between the two regions did, however, show a fairly large difference. In the plants first year, August 1972 until July 1973 the rainfall at Bathurst was lower than that at East London. The total from August 1972 until July 1973 was 412,1 mm at Bathurst and 779,1 mm at East London. After this first year rainfall in the two regions was very similar except in March 1974 when Bathurst experienced flood conditions and had a total of 343,0 mm falling over 18 days. The total from August 1973 until July 1974 was 1163,4 mm at Bathurst and 1172,5 mm at East London.

ii) Growth of plants

In Figures 3 and 4 we wee that there was continual increase in the total amount of dry matter in the plants from both Whitney and Shelford, throughout the plants life cycle. The percentage dry matter in the plants was greatest in October and November each year and least in February and March. The percentage dry matter was generally higher for plants from Whitney than from plants from Shelford. The total amount of dry matter was however, almost identical for plants from both farms.

When plants differentiated early there was an initial increase in the amount of dry matter as compared to undifferentiated plants. This difference, however, did not exist at the time the fruit was harvested.

Marr (1972) found a steady growth in plants until the May after planting. He then recorded very little growth until November. He measured fresh plant weights up to differentiation. He also found a slight loss in the plant fresh weight in winter and concluded that this was due to the drying out of plants and to the leaf die back in the plants. After November he observed a rapid increase in the plant weight until flower differentiation.

The relative growth rate (RGR), net assimilation rate (NAR) and leaf area ratio (LAR) are shown in Figure 5 for plants from Whitney and the relative growth rate (RGR) is shown in Figure 6 for plants from Shelford. In Figure 5 we see that the RGR increased rapidly until March, 1973, and then decreased until October 1973 in a fairly regular way. After this it increased again in the second summer, and decreased rapidly for the second winter (June and July 1974). Plants that showed precocious fruiting had an initial higher RGR than normal plants. The NAR followed the same pattern as the RGR. The LAR increased initially and then showed a regular decrease.

From Figure 6 we find that the RGR of plants at Shelford followed the same general pattern as those at Whitney. The RGR was, however, lower during September, October and November 1973 and higher in February and March 1974 than that of plants from Whitney. As the time between taking of samples was longer at Shelford than at Whitney the variation in the RGR is not as well illustrated at Shelford.

Marr (1972) found that the RGR declined steeply between February and June and then increased from August to February of the following summer. From February until flower differentiation in May he measured a slowing down of the RGR. Tay and Tan (1971) on slips grown in Malaya found the RGR to rise steeply from the fourth month from planting to a peak between the sixth and seventh month and then to drop gradually to the tenth month. Although the general pattern between the findings of Tay and Tan (1971) were similar to those in the present study the actual values varied. In Malaya the RGR increased to 107×10^{-4} gg $^{-1}$ day^{-1} after six months whereas in the present study the RGR increased to 80×10^{-4} gg $^{-1}$ day^{-1} at Whitney after eight months. Net assimilation rate for the two regions was very similar with a maximum of 150×10^{-6} g cm^{-2} day^{-1} in Malaya and 149×10^{-6} g cm^{-2} day^{-1} at Whitney.

The leaf area ratio decreased from 70 to 60 cm^2 g^{-1} in Malaya and from 60 to 40 cm^2 g^{-1} at Whitney in the 6 to 10th month period. The difference in these values must be partly due to the difference in the climate between the

two regions. Malaya which is situated baout 5°N has avery small variations in temperatures when compared with the local pineapple growing areas which are situated as far south as 33°30'S. Mean temperatures for Malaya and Bathurst are 25,6°C and 16,2°C respectively which result in comparatively slower growth under local conditions and a longer period to maturity.

Since RGR and NAR are interrelated it is possible that not only falling temperatures but also the shortening of daylight hours during winter affect the RGR of pineapples grown under local conditions.

In the present study the RGR as seen in Figures 5 and 6 follow the mean temperatures shown in Figures 1 and 2 very closely. Marr found a lag in the change in the RGR when compared to the temperature. He attributed this lag to the lack of uptake of nutrients.

In July 1972 there was evidence of internal breakdown in apices of the stems of the plants. This was more prevalent in plants at Whitney than those at Shelford. This breakdown was probably due to a combination of the very dry period experienced at Whitney together with the cold temperatures during the winter months. Plants at Shelford did not dry out to such an extent. As a consequence of the breakdown in the meristematic tissue of the stems in the plants the plants started producing ground suckers during this second year of growth. Many more ground suckers were found on plants at Whitney than on plants at Shelford.

The average fruit weight at Whitney was 1,46 kg. This was made up of 2% precocious fruit with an average weight of 2,31 kg and 98% natural fruit with an average weight of 1,44 kg. The plant population at Whitney was 42 978 plants per hectare which gave a yield of 62,6 tonnes per hectare for the plant crop. At Shelford the average fruit weight was 1,64 kg made up of 40% hormonal fruit with an average weight of 1,99 kg and 60% natural fruit with an average weight of 1,57 kg. Plant population was 43 225 plants per hectare which gave a plant crop yield of 70,8 tonnes per hectare. Both of these yields are above average for the region and hence farming practices, fertilizer applications and nutrient levels in the plant can be considered as being satisfactory.

CHAPTER IV

CONCENTRATION AND ABSORPTION OF NUTRIENTS

1. General description

The changes in the moisture and nutrient concentrations, and the increase in the total amounts of dry matter and nutrients within the plant during growth were calculated from the values obtained in the dried sub samples and from the total amount of each section in the plant. These values are shown in Figures 7 to 26. The broken lines represent plants that showed early fruiting.

i) Nitrogen

In Figures 7 and 8 we see that the total amount of nitrogen in the plants from both Whitney and Shelford showed a regular increase. Plants on both farms had very similar values. When the plants showed early fruiting there was a marked increase in the amount of nitrogen in the plants. This was more evident in plants from Whitney.

The average nitrogen concentration in the plants on both farms showed a seasonal variation with maximums of around 1,8% during April and May of both summers in plants from Whitney, and of around 2,0% during April and May 1973 and during October and November 1973 in plants from Shelford. At Whitney the concentration of nitrogen decreased fairly rapidly from 1,7% to 1,2% after May of the second summer. At Shelford the concentration of nitrogen decreased from 1,9% to 1,2% after October of the second summer. These decreases were due to the fact that no fertilizer sprays were applied after the start of these periods.

ii) Phosphorus

In Figures 9 and 10 we see that the total amount of phosphorus in the plants increased irregularly on both farms. Initially the rate of uptake was very low, but this increased as the plants got older. In plants from Whitney there was a slight overall decrease until March 1973. This was followed firstly by a slight increase and then a further decrease until September 1973. After this the total amount of phosphorus in the plant increased rapidly from just under 0,1g to 0,7g. In the plants from Shelford there was a fairly regular uptake of phosphorus. The uptake of phosphorus in early fruiting plants was greater than in plants that had not differentiated.

The mean concentration of phosphorus in plants differed between the two farms. In the plants from Whitney the concentration was initially high (0,2%) and then dropped rapidly to 0,07%. The concentration then showed a seasonal

variation from 0,07% during September 1973 to 0,12% in March 1974. At Shelford the phosphorus concentration remained relatively constant around the 0,11% level throughout the plants growth. It did, however, show a tailing off to 0,09% towards fruit harvest.

iii) Potassium

In Figures 11 and 12 we see that the total amount of potassium in the plants increased irregularly on both farms. Whitney had less potassium per plant than Shelford. In October 1974 plants at Whitney contained only 10 g potassium per plant whereas plants at Shelford contained 17 g potassium per plant. In both cases there was little or no increase in the amount of potassium in the plants during winter. In the plants that showed early fruiting at Whitney there was a slightly greater uptake of potassium than in non-fruiting plants. At Shelford there was slightly less uptake. This was possibly caused by plants at Whitney being slightly short of potassium or of plants at Shelford having a slight excess of potassium.

The mean potassium concentration in the plants varied with time. Concentrations in the plants from Shelford were higher than those in plants from Whitney. There was a maximum in April and May 1973 of 3% and 4,5% in the plants from Whitney and Shelford respectively. This maximum tailed off to 1% and 2%, in plants from Whitney and Shelford respectively, at the time of harvesting the fruit.

iv) Calcium

In Figures 13 and 14 we see that the total calcium showed an irregular increase with time. There was little or no increase in winter. The total amount in plants from Shelford was slightly higher, 4,0 g per plant during October 1974, than that in plants from Whitney, 3,2 g per plant. Little difference was noted in early fruiting plants at Whitney. Uptake was less in early fruiting plants at Shelford.

Calcium concentration in the plants was greatest in the first summer, 1% in January 1972 at Whitney and 0,9% in March 1972 at Shelford, and then gradually decreased to 0,4% at Whitney and 0,5% at Shelford in October 1974 when fruit was harvested.

v) Magnesium

In Figures 15 and 16 we see that the total amount of magnesium showed an irregular increase with time. During the first winter at Whitney there

was a decrease in the total magnesium in the plant. At Shelford there was a continual increase in the total amount of magnesium. At Whitney there was very little difference between early and natural fruiting plants, whereas at Shelford early fruiting plants contained less magnesium than natural fruiting plants. Plants at Shelford contained slightly more magnesium than plants at Whitney, 1,8 g per plant and 1,5 g per plant in October 1974 respectively.

The magnesium concentration at Whitney varied from a maximum of 0,38% in January and February 1973 to a minimum of 0,19% in August of the same year. A second maximum of 0,3% was measured in February and March 1974 and the concentration then decreased to 0,18% in October 1974. The magnesium concentration in plants at Shelford did not show as much seasonal variation. It decreased from a maximum of 0,41% in February and March 1973 to a minimum of 0,22% at the time of fruit harvest in October 1974.

vi) Sodium

In Figures 17 and 18 we see that the total amount of sodium varied to a large degree in the plants from Whitney. The amount of sodium showed an irregular increase to 0,77 g for early fruiting plants in June and July 1974 and then decreased rapidly to 0,20 g in October 1974 when the fruit was ready to be harvested. The plants at Shelford showed a more regular increase to 0,5 g per plant in July 1974, followed by a rapid decrease to under 0,3 g per plant in October 1974 when the fruit from the hormoned plants was ready to be harvested. The amount of sodium in the plants at Shelford was less than that in the plants at Whitney. Early fruiting plants initially contained a greater amount of sodium than naturally fruiting plants.

The mean concentration of sodium in the plants varied on both farms. It showed a rapid decrease from a maximum of 0,25% to 0,05% at the time of fruit harvest for early fruiting plants at Whitney and from 0,17% to 0,03% for plants at Shelford. The sodium concentration seemed to depend on rainfall and climatic conditions to a large extent.

vii) Iron

In Figures 19 and 20 we see that the total amount of iron in the plants on both farms increased at a fairly regular rate to 0,016 g per plant in January 1974. After which the rate of increase increased greatly until fruit harvest of early fruiting plants when the total amount of iron in the plants was 0,05 g. The plants on both farms had similar values.
Early fruiting plants showed a much greater uptake of iron than non fruiting plants.

The mean iron concentration showed a maximum of just over 300 parts per million in December 1972 and January 1973, and then decreased regularly to about 70 parts per million at the time of fruit harvest.

viii) Manganese

In Figures 21 and 22 we see that the total amount of manganese showed an irregular increase with time. Plants from Whitney contained much more manganese than those from Shelford. In plants at Whitney there was none or very little increase in manganese content in winter. A rapid increase, from 0,2 g per plant in August 1973 to 1,5 g per plant for early fruiting plants in April 1974 was observed. This was followed by a rapid decrease in manganese content towards fruit harvest when plants only contained 0,5 g manganese. At Shelford the corresponding increase was from 0,1 g to 0,5 g per plant and a decrease to 0,1 g per plant at fruit harvest. In the early fruiting plants from Whitney there was initially an increase in the total amount of manganese per plant as compared to non fruiting plants. This, however, eventually decreased to below that of the non fruiting plants. At Shelford the early fruiting plants contained less manganese than the other plants.

The mean concentration of manganese at Whitney increased irregularly to over 2500 ppm in February and March 1974 and then decreased to 600 ppm in October 1974. In the same period the mean concentration of manganese in the plants at Shelford increased more regularly to 1000 ppm and then decreased to under 100 ppm.

ix) Zinc

In Figures 23 and 24 we see that the total amount of zinc in the plants from both farms increased steadily with time. Between October 1973 and September 1974 plants at Whitney contained greater amounts of zinc than plants at Shelford. Natural fruiting plants at Whitney contained 8 mg zinc in August 1973 whereas plants at Shelford only contained 5 mg zinc per plant. In the early fruiting plants there was a greater uptake of zinc than in non fruiting plants. The mean concentration of zinc remained fairly constant at between 15 and 20 ppm in plants at Whitney and between 10 and 15 ppm for plants at Shelford. Plants at Whitney had more irregular values than those at Shelford. A drop in the zinc concentration to 10 ppm was observed after differentiation at Whitney. At Shelford the concentration of zinc tended to decrease fairly regularly to 8 ppm in October 1974.

x) Copper

In Figures 25 and 26 we see that the total amount of ocopper in the plants at both farms showed a very regular and similar increase with time. At the time of harvesting early fruit the total amount of copper in the plants was almost identical at 5 mg per plant on both farms. Early fruiting plants initially contained slightly more copper than the rest.

The mean concentration of copper showed a seasonal variation with the highest concentrations in the first two summers of 14 ppm and 9 ppm respectively and the lowest concentrations during the two winters of 5 to 7 ppm.

2. Discussion

i) Nitrogen (Figures 7 and 8)

As expected nitrogen increases regularly up to differentiation. The amount of nitrogen in the plants at both farms agree closely with those obtained by Follet-Smith and Bourne but are less than those obtained by Kraus as given by Teiwes and Grüneberg (1963). After 18 months the amount of nitrogen at Whitney and Shelford were 3,25 g and 3,52 g per plant respectively (Tables 17 and 18), whereas Follet-Smith and Bourne, and Kraus obtained 4,29 g and 16,30 g nitrogen per plant respectively. The increase in nitrogen continued throughout the first winter due to the regular fertilizer spray applications. During the second winter there was no increase at Whitney, and a reduced rate of increase at Shelford in the amount of nitrogen. As spray applications were not applied after differentiation this suggests that, during the colder winter months, none or very little nitrogen is absorbed from the soil. Teiwes and Grüneberg (1963) illustrate that Krauss found a fall in the nitrogen content in the plant during winter. At Whitney the plants that differentiated early contained initially more nitrogen indicating a greater assumption of nitrogen after differentiation by these plants than by the non fruiting plants. At Shelford this effect was not observed. This could be due to the fact that spray applications were discontinued earlier at Shelford and the extra nitrogen was not readily available to the plant.

The decrease in the overall nitrogen concentrations after differentiation is partly due to no additional nitrogen being applied as a spray for some time before differentiation. Only nitrogen in the soil being available to the plant. As spray applications were discontinued earlier at Shelford this

accounts for the concentration decreasing earlier in these plants than in plants from Whitney. As the mean temperatures in the two regions was almost identical, the higher concentration of nitrogen at Shelford during the second summer could be due to the wetter soil conditions during winter. This is in accordance with Friis-Nielson (1969) who points out that in tomatoes large supplies of nitrogen can be utilized to the full only at optimal water levels and vice versa.

ii) Phosphorus (Figures 9 and 10)

Initially the uptake of phosphorus was very low on both farms and at Whitney there was an initial decrease in phosphorus in the plants. After twelve months plants at Whitney and Shelford contained only 0,08 g and 0,09 g phosphorus (0,18 g and 0,21 g K_2O_5) per plant respectively (Tables 13 and 27), while Teiwes and Grüneberg (1963) report Follet-Smith and Bourne, and Krauss giving values in the order of 1,99 g and 2,71 g P_2O_5 per plant respectively. These low values could be due to the initial phosphorus in the soil at Shelford being 5 ppm and at Whitney being 10 ppm. Plants at Shelford, however, received 65 kg per hectare phosphorus as a preplant application. Plants at Whitney received hand applications of 13 kg phosphorus per hectare during February and September 1973. The first of these hand applications did not become available to the plant during its first year due to the dry conditions experienced. The initial decrease in phosphorus at Whitney can be accounted for by the loss of dead leaf material. The rapid increase in phosphate during the second summer is due to the phosphorus in the two fertilizer hand applications becoming available to the plant after the good rainfall in August 1973. Sideris and Young (1945), found that phosphorus was more abundant in the plant with higher values of potassium in the nutrient solution, but despite potassium being more abundant at Shelford than at Whitney there was no marked increase in phosphorus at Shelford. The lack of phosphorus uptake during the winter months must be caused by the inability of the root system to function efficiently at cooler temperatures. This was especially true during the first year when it was particularly dry as well as being cold. Plants that differentiated early had a greater amount of phosphorus than the rest of the plants showing a need for phosphorus during fruit formation. This is born out by Teiwes and Grüneberg (1963) and by Nightingale (1942b) who point out that it is necessary to place sufficient quantities of phosphorus at the disposal of the plant, particularly at the time of differentiation of the tissues of the inflorescence and at flowering time. They also point out that heavy dressings of phosphate advance the formation of fruit. Teiwes and Grüneberg (1963) point out

that the phosphate requirement of the pineapple, according to Krauss, appears to be approximately the same during all stages of growth while Follet-Smith and Bourne found that the phosphate absorption is largely adjusted to the absorption of nitrogen even though it remains considerably below the absorption of nitrogen. These observations seem to be borne out at Shelford but not at Whitney as the supply of phosphorus at Whitney was low.

The concentration of phosphorus at Shelford remained relatively constant as there was an adequate supply throughout, whereas, at Whitney there was an initial large decrease in the concentration from a much higher level than Shelford, and then a much larger seasonal variation than at Shelford. This is again due to the two hand applications of phosphorus only becoming available to the plants at Whitney during their second season.

iii) Potassium (Figures 11 and 12)

Plants at Shelford contained much higher amounts of potassium than at Whitney due to the greater amount of potassium available at Shelford. Soil analysis showed soils contained 100 parts per million potassium at Shelford and 70 parts per million at Whitney. In addition Shelford received 264 kg potassium per hectare (121 kg as a preplant and 143 kg in foliar spray applications) and Whitney received 158 kg potassium per hectare (32 kg in hand applications and 126 kg in foliar spray applications). The amounts of potassium in the plants at Shelford were less than those found by Follet-Smith and Bourne. Namely after 18 months plants at Shelford contained 5,10 g potassium (6,15 g K_2O) per plant (Table 29) while Follet-Smith and Bourne found plants contained 16,7 g K_2O per plant. In contrast to these values, 18 month old plants at Whitney contained only 3,18 g potassium (3,83 g K_2O) per plant (Table 17) while Krauss found plants contained a massive 56,0 g K_2O per plant. The values of Follet-Smith and Bourne, and of Krauss are as given by Teiwes and Grüneberg (1963). During the winter months very little increase was measured in the amount of potassium due to the potassium in the soil being less available to the plants. Teiwes and Grüneberg (1963) illustrate that Krauss found a decrease in the amount of potassium during both winters. In the present study an actual decrease was observed only during the second winter when no potassium was being supplied by means of foliar sprays. The difference in the amounts of potassium in early fruiting and the other plants was not large which seems to indicate that the pineapple plant does not require any additional potassium during the fruiting stage. This does not agree with Teiwes and Grüneberg (1963) who point out that the pineapple has a particularly high potash requirement which is manifest soon after planting and is highest at time of fruit formation and ripening.

The concentration of potassium at Shelford was higher than at Whitney due mainly to the greater amount of potassium available to the plants at Shelford. Towards fruit harvest the concentration of potassium in the plants at Whitney decreased more rapidly than at Shelford.

iv) Calcium (Figures 13 and 14)

The irregular increase of calcium in the plants, with only a slight increase during winter, is again due to this nutrient not being readily available from the soil during the cooler winter months. The plants at Shelford contained more calcium than at Whitney as the soils at Shelford contained 260 parts per million calcium as against 240 parts per million calcium at Whitney. The plants at Whitney contained more sodium than the plants at Shelford. This would contribute to the greater uptake of calcium at Shelford. Nanawati (1973) and Cresswell (1958) both found that an increase in salt decreases the uptake of calcium. The plants at Shelford contained more calcium than plants at Whitney despite also having a higher potassium content. Teiwes and Grüneberg (1963) and Sideris and Young (1945) found that both calcium and magnesium were higher in pineapple plants with less potassium in the nutrient supply.

As the calcium in plants that showed early fruiting was slightly less than that in the rest of the plants it seems that there is no great demand for calcium during the formation of fruit.

The concentration of calcium was greatest during the first summer. This was followed by an overall decrease as the rate of increase was less than the rate of growth of the plant.

v) Magnesium (Figures 15 and 16)

As with calcium and other nutrients absorbed through the root system there was very little uptake during winter. At Whitney there was an actual decrease in the total magnesium during winter. The amounts of magnesium in the plants at Shelford were less than those at Whitney. This is because the soil at Shelford contained 100 parts per million while tat Whitney it contained 70 parts per million magnesium and also because high potassium in nutrient supply decreases the magnesium content, Sideris and Young (1945). This was the case in spite of sodium being higher in plants at Whitney, as Nanawati (1973), and Creswell (1958) showed that sodium interferes with the absorption of magnesium. In early fruiting plants at Shelford there was slightly less magnesium than in the rest of the plants, showing that there was no great demand for magnesium during fruit formation.

The concentration of magnesium in the plants was greatest during the summer months when it was more readily available from the soil.

vi) Sodium (Figures 17 and 18)

Despite the soil containing 67 parts per million sodium at Shelford and 10 parts per million sodium at Whitney plants at Whitney had a higher sodium content than at Shelford. This was due to the much drier conditions experienced at Whitney where a great deal of the moisture availabel was in the form of dew which, being close to the sea, contained large amounts of salt. After fruit formation the amount of sodium in the plants at both farms decreased illustrating that with a large amount of moisture available, due to the heavy rains experienced, very little sodium was absorbed and the plant managed to rid itself of excess amounts.

The concentration of sodium in the plant was very variable but was highest when the rainfall was at its lowest.

vii) Iron (Figures 19 and 20)

While regular foliar spray applications of iron were being applied the amount in the plants increased regularly with growth. Both farms received similar amounts of iron in the foliar sprays (73 kg per hectare at Whitney and 62 kg per hectare at Shelford). During the second winter, after foliar spray applications had ceased, plants at Whitney showed very little increase in the amount of iron, while the amount at Shelford continued to increase but at a slightly reduced rate. This is caused because the only iron available was that which was in the soil. At Whitney soils contained greater amounts of manganese, and hence less iron was transported within the plant. This is in agreement with Sideris (1950) who in experiments using Fe^{59} established that the amounts of translocated iron from the roots to the leaves was considerably lower in cultures supplied with manganese, and that iron is precipitated in large quantities in the exodermal tissues of the root and only part of the absorbed iron is conducted to the leaves if excess manganese is present in the nutrient supply. Plants that showed early fruiting contained much greater amounts of iron than the rest of the plants. This indicates a high demand for iron at this stage of growth.

The average concentration of iron in the plant was high during the first summer and then decreased to fruit harvest.

viii) Manganese (Figures 21 and 22)

There was again little or no increase in the total amount of manganese during winter illustrating the inability of the plant to absorb nutrients in the soil during the colder winter months. Plants at Whitney contained much greater amounts of manganese than at Shelford. Although this element was not measured during the soil analysis it is fairly safe to assume that soils at Whitney contained more manganese than those at Shelford. Both Sideris (1950) and Singh and Steenberg (1974b) found that increases of manganese in the nutrient supply greatly increased the manganese in the plants. There was a general decrease in the amount of manganese towards fruit harvest, showing that the plant managed to rid itself of excess amounts of manganese, as large amounts were lost to the plant in the top sections of dead and dying leaves. Manganese appeared to be comparatively non mobile.

ix) Zinc (Figures 23 and 24)

While regular foliar fertilizer sprays were applied there was a regular increase in the amount of zinc on both farms. When spray applications were no longer given there was a more irregular increase with little or no increase during the colder winter months. Plants at Whitney contained more zinc than plants at Shelford as 15 kg per hectare of zinc were supplied at Whitney and only 4 kg per hectare of zinc was supplied at Shelford. Singh and Steenberg (1974a) showed that uptake of Zn^{65} was greater with increasing zinc applications. Early fruiting plants contained slightly greater amounts of zinc than the rest of the plants showing a demand for zinc during fruit formation.

The concentration of zinc at Shelford showed a fairly regular drop, whereas at Whtiney the concentration of zinc was more irregular with a greater concentration in summer. Both farms showed a decrease in zinc concentration towards fruit harvest after the last foliar spray application.

x) Copper (Figures 25 and 26)

The regular increase in copper, with slightly lower rate of increase in winter, within the plants was as expected.

The concentration showed a seasonal variation with higher values in summer when more copper was available to the plant from the soil. The concentration at Shelford was slightly higher than at Whitney. According to Teiwes and Grüneberg (1963), Steyn and Eve found an antagonism between zinc and copper and as plants at Whitney had higher zinc concentrations than at Shelford they had lower copper concentrations.

CHAPTER V

DISTRIBUTION OF MOISTURE AND NUTRIENTS

1. General description

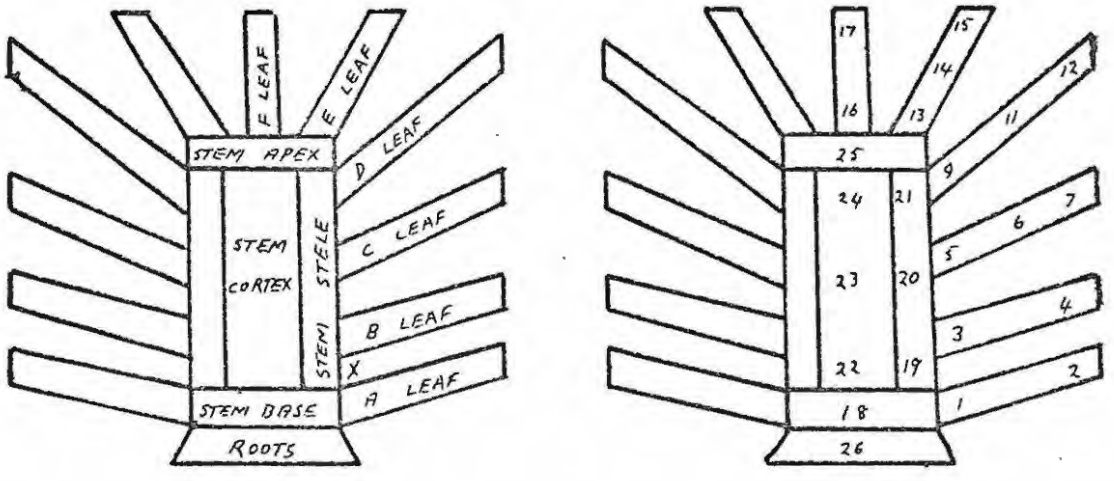
The distribution of dry matter and of nutrients within the pineapple plants on both farms are given in Tables 6 to 33. These distributions are also pictorially represented in the diagrams. This diagrammatic way of representing nutrients within a plant was developed as no other suitable method was found in the literature. Ashton (1970), measured the nutrients distribution in different sections in the pineapple plants at three different ages and showed his results in tables. Singh and Steenberg (1974), Langston (1956), and Cannel (1956) measured distribution using radioisotopes and represented their results in pictorial form, while other workers such as Batjer and Westwood (1958), Durrant and Draycott (1971), Hanway (1962), Roy and Wright (1973), Spratt and Gasser (1970), Williams (1955) and Cresswell (1958) all used figures plotting concentrations of nutrients and dry matter against time for sections such as roots, stems, leaves, grain and chaff. None of these workers measured the amounts of nutrients in more than six different sections. Other workers such as Austin and Aung (1973) used histograms to show the different amounts of nutrients in the roots, stem and leaf of sweet potatoes.

In the present study the diagrams used to represent the different sections of the pineapple plant before and after flower differentiation at each sampling date are as follows:

DIAGRAMMATIC REPRESENTATION OF PINEAPPLE PLANT

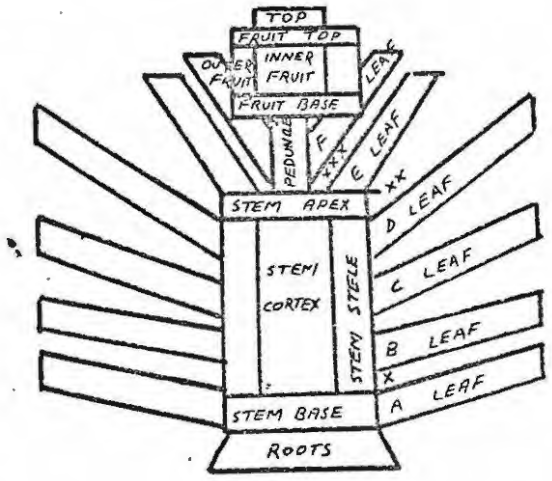
A. Before differentiation

(i) Sections of plant (ii) Sampling areas

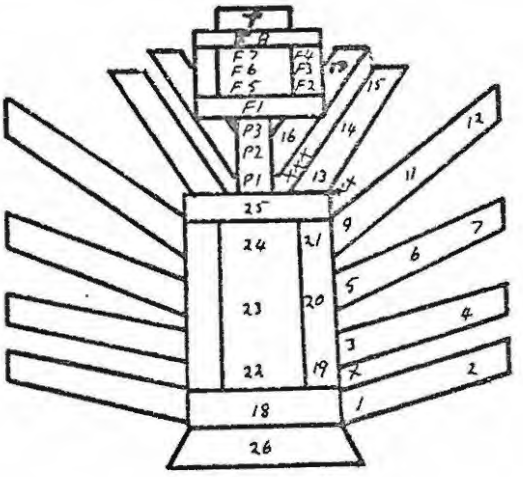


B. After differentiation

(i) Sections of plant



(ii) Sampling areas



x ground sucker xx sucker xxx slip.

One of the disadvantages of using this pictorial system is that it does not clearly show the growth of the plant, as the diagram representing the pineapple top used as planting material is the same as that used to represent the plant almost two years later when flower differentiation is about to take place. This disadvantage is partly overcome by also representing the total amount of dry matter and the percentage dry matter within each section in the diagrams. In the diagrams showing the distribution of nutrient concentrations lines or "isonutrients" have been drawn to divide areas of different nutrient concentration. The D-leaf base was divided into three sections (numbers 8, 9 and 10) and only the values in the middle section (number 9) is shown in the diagrams.

i) Moisture

a) Whitney Estate

The bulk of the plant contained between 10 and 20 percent dry matter. Dry regions of greater than 20 percent, and wet regions of less than 10 percent dry matter, however, existed.

At the time of taking the first sample, 11th October, 1972, a large portion of the plant, including all of the stem, contained more than 20 percent dry matter. The mean for the plant at this stage was 19,3 percent dry matter. None of the sections sampled had less than 10 percent dry matter. By the 13th November 1972 the upper stem and apical meristem had less than 20 percent dry matter, and the base of the D, E and F leaves had less than 10 percent dry matter. On the 19th February 1972 only the roots and A leaves had

greater than 20 percent dry matter. The base of the C, D, E and F leaves and the upper regions of the stem all had less than 10 percent dry matter. The mean for the plant at this stage was 14,7 percent dry matter. The plants then started to "dry out", and on the 18th September 1973, when internal breakdown in the apical meristem was observed only the E and F leaf bases had less than 10 percent dry matter. The A leaves, B and C leaf bases and the stem, excluding the apex and top of outer section, all contained more than 20 percent dry matter. The mean for the plant at this stage was 17,5 percent dry matter. As the plant grew during its second summer the greater than 20 percent dry matter region "moved" down the plant, and the bases of the D, E and F leaves all contained less than 10 percent dry matter by mid summer. Only the A leaves, stem base and roots had greater than 20 percent dry matter. The mean for the plant on the 26th March 1974 was 15,0 percent dry matter. A similar pattern as in the first winter was observed during the second winter. On the 15th July 1974 only the E and F leaf bases had less than 10 percent dry matter and the stem, excluding the apex and top of outer section, roots and A leaf had greater than 20 percent dry matter. The mean for the plant at this stage was 16,6 percent dry matter. As fruit was produced the following summer, all the lower sections maintained a high percentage dry matter, with initially only the peduncle and then only the top sections of the fruit having less than 10 percent dry matter. At the time of harvesting the natural fruit crop on the 24th February 1972 the mean for the plant was 16,9 percent dry matter.

b) Shelford Pineries

The plants at Shelford showed a very similar dry matter pattern as those at Whitney especially after the first year. The region of the stem with a greater than 20 percent dry matter content did not, however, extend as high up the stem during the first winter. On the 30th July the bases of the D, E and F leaves all had less than 10 percent dry matter and only the stem base, bottom and mid sections, the roots and the A leaf tips had greater than 20 percent dry matter. Generally the plants at Shelford did not "dry out" as much as those at Whitney during the first winter. The mean for the plants at Shelford on the 30th July 1973 was 14,8 percent dry matter, and that for Whitney on the 8th August 1973 was 16,2 percent dry matter.

ii) Nitrogen

a. Whitney Estate

The distribution of nitrogen within the plant showed a seasonal variation. At the time of the first sample, 11th October 1972, the regions of low nitrogen concentration of less than 1,0 percent included the A leaves, mid sections of the D and E leaves, and the top of the F leaves. The regions

of high nitrogen concentration, of greater than 2,0 percent nitrogen, consisted of the base of the E and F leaves and the apical meristem. The mean concentration for the plant at this stage was 1,28 percent nitrogen. By the 2nd April 1973 the mean had increased to 1,78 percent nitrogen, and the region of high nitrogen concentration included the top sections of the stem, the base of the C leaves, the base and mid section of the D leaves and the base of the E and F leaves. During the first winter on the 18th September the mean decreased to 1,48 percent nitrogen and only the stem apex and base of the E and F leaves had a concentration of greater than 2 percent nitrogen. This distribution pattern was repeated during the second year. On the 21st January 1974 the mean was 1,63 percent nitrogen and the base of the D, E and F leaves, the top of the D leaves, and the stem apex, top and outer mid sections had a concentration of greater than 2,0 percent nitrogen, while the A leaves, roots and bases of the B and C leaves all contained less than 1,0 percent nitrogen. On the 15th July 1974 the mean was 1,27 percent nitrogen and only the apex of the stem had a nitrogen concentration of greater than 2,0 percent while the A leaves, B, C and D leaf bases and roots all had less than 1,0 percent nitrogen. After differentiation the apex of the stem and peduncle had a very high nitrogen concentration while the concentration in the rest of the plant remained low. The young fruit also had a high concentration of nitrogen and at time of harvesting of the fruit, 24th February 1975, most of the plant except for the fruit top, slips, suckers and the mid and top sections of the C, D, E and F leaves, had less than 1,0 percent nitrogen. The mean at this stage was 0,91 percent nitrogen.

The total amount of nitrogen increased at different rates in the different plant sections. At the time the fruit was harvested the plant contained 7858 mg nitrogen of which 1159 mg was in the fruit, 274 mg in the fruit top, 235 mg in the slips, 716 mg in the suckers and 86 mg in the ground suckers.

b. Shelford Pineries

As in plants at Whitney the distribution of nitrogen showed a seasonal variation and the distribution in plants at Shelford showed a very similar pattern to that in plants at Whitney. At all stages there was a slightly greater concentration of nitrogen at Shelford than at Whitney.

The planting material had a mean nitrogen concentration of 1,24 percent and the only regions with a concentration of greater than 2,0 percent were the stem apex and the base of the E and F leaves. On the 30th January 1972, the mean was 1,73 percent, and large sections contained more than 2,0 percent nitrogen. These sections included all of the stem except its base, the base of the C leaves, and the base and mid sections of the D, E and F leaves.

The nitrogen concentration within the plant reached a maximum of 2,00 percent on the 30th April 1973 and then fell to 1,63 percent on the 30th July 1973. At this stage only the stem top sections, stem apex, base of D, E and F leaves, and the mid and top sections of the C leaves contained more than 2 percent nitrogen. By the 5th November 1973 the mean concentration had increased to 1,93 percent and on the 28th January 1974 it was 1,78 percent. At this stage the stem mid and top sections, stem apex, the base of E and F leaves, the base and mid section of the D leaves and the top section of the C leaves contained more than 2,0 percent nitrogen. The mean concentration decreased rapidly after this period and on the 29th July 1974 it was 1,21 percent and only the apex of the stem had more than 2,0 percent nitrogen. As at Whitney the fruit initially had a high nitrogen concentration. At the time of harvesting the fruit on the 28th January 1975 the mean for the plant had decreased to 1,05 percent. At this stage the areas having more than 1,0 percent nitrogen were the mid and top sections of the B, C, D, E anf F leaves, fruit top, slips, suckers and the stem except for the mid section of the cortex.

As at Whitney the total amount of nitrogen increased at different rates in the different sections. At the time of harvesting the fruit the plant contained 11424 mg nitrogen of which 1184 mg were in the fruit, 308 mg in the top, 637 mg in the slips, 617 mg in the suckers and 18 mg in the ground suckers.

iii) Phosphorus

a. Whitney Estate

The distribution of phosphorus within the plant showed a seasonal variation. At the time of taking the first sample, 11th October 1972, the regions of low phosphorus concentration of less than 0,1 percent phosphorus included the A leaves and the top sections of the B, C, D, E and F leaves. The regions of high phosphorus concentration of greater than 0,3 percent consisted of all of the stem except its base, and the basal sections of the E and F leaves. The mean at this stage was 0,182 percent phosphorus. By mid summer the low phosphorus concentration regions included roots, stem base, base of A leaves, and the top sections of the C, D, E and F leaves. The mid and top sections of the stem, stem apex and the basal sections of the E and F leaves had a concentration of greater than 0,3 percent phosphorus. The mean on the 10th February 1973 was 0,117 percent phosphorus. By mid winter only the stem apex had a high phosphorus concentration. The rest of the plant except for the upper regions of the stem and the basal regions of the D, E and F leaves had a phosphorus

content of less than 0,1 percent. By the 18th September the mean had dropped to 0,065 percent phosphorus. The same general pattern was repeated for the following year. The mean phosphorus concentration in summer was 0,120 percent on the 26th March 1974. At this stage the roots, stem base and the A, B and C leaves all had a phosphorus concentration of less than 0,1 percent, and the base of the E and F leaves, the stem mid and top sections and the stem apex had a phosphorus content of greater than 0,3 percent. In winter the mean concentration was 0,108 percent. On the 15th July 1974 only the stem apex contained more than 0,3 percent phosphorus and the roots, stem base, A, B and C leaves and the tops of the D, E and F leaves all contained less than 0,1 percent phosphorus. After differentiation the peduncle and fruit had an initial high phosphorus content. At the time of harvesting the fruit most of the plant except the stem upper sections, D and E leaf mid and top sections, F leaf top section and the top of the fruit had a low phosphorus content. The mean at this stage was 0,088 percent.

The total amount of phosphorus initially decreased and then increased at different rates in the different plant sections. At the time of harvesting the fruit, the plant contained 761 mg phosphorus of which 158 mg was in the fruit, 45 mg in the top, 32 mg in the slips, 91 mg in the suckers and 12 mg in the ground suckers.

b. Shelford Pineries

Different levels of phosphorus were found in the different plant sections in the plants from Shelford compared to the plants from Whitney. Similar trends in the nutrient movement were, however, observed. In the planting material the regions of low phosphorus content consisted of the A and B leaves, the mid and top sections of the C, D and E leaves and the top section of the F leaves. Only the mid section of the stem cortex had a phosphorus content of greater than 0,3 percent. By mid summer, on the 30th January 1973, the top and mid sections of the stem, stem apex, and the base of the D, E and F leaves all contained more than 0,3 percent phosphorus. The mean at this stage was 0,125 percent. By mid winter on the 30th July 1973 only the stem apex, top of stem cortex, and the base of the E leaves contained more than 0,3 percent phosphorus. The mean for the plant was 0,105 percent at this stage. During the following summer there was no change in the regions containing a high phosphorus content and on the 28th January 1974 the mean concentration was 0,106 percent. During the following winter only the stem apex had more than 0,3 percent phosphorus and on the 29th July 1974 the mean was 0,093 percent. As at Whitney the peduncle and young fruit initially had a high phosphorus content and when the fruit was

harvested on the 28th January 1975 only the top sections and the apex of the stem had more than 0,3 percent phosphorus. The mean for the plant was only 0,079 percent at this stage.

The total amount of phosphorus increased irregularly in the different plant sections. At the time of harvesting the fruit, the plant contained 856 mg phosphorus of which 115 mg was in the fruit, 36 mg in the tops, 63 mg in the slips, 55 mg in the suckers and 2 mg in the ground suckers.

iv) Potassium

a. Whitney Estate

At the time of the first sampling of plants at Whitney on the 11th October 1972 only the A leaves had less than 1,0 percent potassium. The D leaf tops and the base sections of the E and F leaves contained more than 3,0 percent potassium. The average concentration at this stage was 2,01 percent. During summer the stem base, roots and A leaves had a low potassium content. All of the D leaves and the base of the E and F leaves had a high concentration. The mean on the 19th February 1973 was 2,29 percent. During the first winter the roots, base, bottom and mid sections of the stem, A leaf and the base of the C leaves all had a low concentration of potassium. The mid and top sections of the C leaves, the top of the D leaves and the base of the E and F leaves had a potassium content of greater than 3,0 percent. The average on the 18th September 1973 was 2,24 percent. During the second summer only the base sections of the E and F leaves had a high potassium concentration whereas the regions of low potassium concentration were the same as in the first winter. The mean was 1,80 percent on the 26th March 1974. By mid winter in the second year no sections had more than 3,0 percent potassium and all of the stem except for its apex, the A leaves and the base of the B and C leaves had a potassium content of less than 1,0 percent. The average on the 15th July 1974 was 1,62 percent. Initially the peduncle and young fruit had a high potassium content. At the time the fruit was harvested all of the plant except for the mid and top sections of the D leaves, top of F leaves, fruit outer sections, ground sucker, sucker, slip and top had a potassium content of less than 1,0 percent. The mean concentration at this stage was 0,85 percent.

The total amount of potassium in the plant at the time fruit was harvested amounted to 7349 mg of which 1699 mg was in the fruit, 292 mg in the top, 244 mg in the slips, 764 mg in the suckers and 156 mg in the ground suckers.

b. Shelford Pineries

The distribution of potassium in the plants at Shelford was very similar to that in plants at Whitney. Higher concentrations were found in most sections. At the time of planting only the A leaves had less than 1,0 percent potassium and the mid sections of the D and C leaves, the base and mid sections of the E leaves and the F leaves had a concentration of greater than 3,0 percent. At this stage the average concentration was 1,74 percent potassium. By mid summer only the top section of the A leaves had low concentrations and the rest of the plant except for the stem and base of the A leaves had a high potassium concentration of over 3,0 percent. The average was 3,23 percent. During winter on the 30th July 1973, the average was 3,08 percent and the stem base and bottom of the cortex, and the roots contained less than 1,0 percent potassium. The mid and top sections of the C leaves, the D leaves, the base and tops of the E leaves and the base of the F leaves contained more than 3,0 percent potassium. By mid summer in the second year the mean concentration had dropped to 2,59 percent. The roots, stem base and bottom sections and the top of the A leaves had low concentrations while the mid and top of the C leaves, the D leaves and the base of the E and F leaves all had a high potassium content of over 3,0 percent. On 29th July 1974 the mean was 2,30 percent and the stem except for the midsection, top of cortex and apex, and the top section of the A leaves had less than 1,0 percent while the tops of the C, D and E leaves had greater than 3,0 percent potassium. When fruit initially formed it and the bottom section of the peduncle had a high potassium content and when the fruit was harvested the mean potassium concentration for the plant was 1,70 percent. Only the top sections of the D and E leaves contained more than 3,0 percent potassium at this stage.

At the time of harvesting the fruit the total potassium in the plant amounted to 18449 mg. Of this amount 2277 mg was contained in the fruit, 383 mg in the top, 882 mg in the slips, 842 mg in the suckers, and 33 mg in the ground suckers.

v) Calcium

a. Whitney Estate

A high concentration region of greater than 1,0 percent calcium existed in most of the stem up until fruiting. Low concentration regions of less than 0,5 percent calcium were usually restricted to the old leaves and to the top sections of the young leaves. On the 11th October 1972 the average concentration was 0,51 percent. The stem except for its base contained more than 1,0 percent calcium. All the rest of the plant except for the tops of

the A, B and C leaves, base of the E and F leaves and stem base had less than 0,5 percent calcium. In the first summer the mean had increased to 1,14 percent. The stem except for its base, the D leaves and the base of the E leaves contained more than 1,0 percent calcium while the rest of the plant except for the stem base, top of C leaves and base of F leaves all contained less than 0,5 percent. During the first winter the average concentration of calcium decreased and on the 18th September the average was 0,50 percent. The stem except for its base and bottom of the cortex still had a high concentration, but the rest of the plant, except for the stem base and bottom of the cortex, the top of the B leaves, the mid and top of the C leaves, the E leaves and the base of the F leaves all had a low calcium concentration of less than 0,5 percent. During the second summer the regions of high and low calcium concentration did not alter and on the 21st January 1974 the average was 0,55 percent. During the following winter changes in the calcium concentration in the different sections occurred and on the 15th July 1974 the stem except for the base, and mid and top sections of the stele had a concentration of over 1,0 percent while the rest of the plant except for the top of the B leaves and the mid and top of the C leaves had less than 0,5 percent calcium. When fruit started to form it initially had a high calcium content and at time of harvest the plant contained an average of 0,43 percent calcium. Only the bottom sections of the stem and the top of the E leaves had a high calcium content of over 1,0 percent at this stage. The rest of the plant except for the stem base, and mid section of the cortex, the mid and top sections of the C and D leaves, the mid section of the E leaves, the top of the F leaves, suckers and tops had less than 0,5 percent calcium.

At the time of harvesting the fruit the total calcium in the plant amounted to 3769 mg of which 196 mg was in the fruit, 114 mg in the top, 64mg in the slips, 348 mg in the suckers, and 15 mg in the ground suckers.

b. Shelford Pineries

The distribution of calcium in plants at Shelford was very similar to that in plants at Whitney. The plants at Shelford, however, had a slightly greater calcium concentration than the plants at Whitney. On the 15th July 1972 the mean calcium concentration at Shelford was 0,63 percent. All of the stem except for its base had more than 1,0 percent calcium while the rest of the plant except the stem base and the top of the A leaves contained less than 0,5 percent calcium. On the 30th January 1973 the mean was 0,69 percent and in addition to the stem, the base of the C, D and E leaves had more than 1,0 percent calcium. The rest of the plant except the stem base,

base of F leaves and the top of the C and D leaves had a low calcium content of less than 0,5 percent. By the middle of the first winter, on the 30th July 1973, all the stem and the top sections of the B and C leaves had a high concentration while only the roots, A leaves, base of B leaves, mid section of D leaves, mid and top sections of the E leaves and top sections of the F leaves had a low calcium concentration. During the following summer in addition to the stem, excluding its base, the base of the D and E leaves had a high calcium content and the rest of the plant except for the roots, base sections of the A, B and C leaves, the mid and top sections of the D and E leaves and the F leaves all had a low calcium content. The average calcium concentration on the 28th January 1974 was 0,60 percent. On the 29th July 1974 the mean was 0,59 percent and the stem excluding its base and the mid a and upper stele sections, and the top of the A leaves had a high calcium content while the rest of the plant except these sections and the top of the B, C and D leaves had a low calcium content of less than 0,5 percent. When the fruit started forming it initially had a high calcium content but on the 28th January 1975 only the bottom section of the stem and top section of the F leaves contained more than 1,0 percent calcium, while almost all of the rest of the plant except for the mid and top sections of the C, D and E leaves and the suckers contained less than 0,5 percent calcium.

At the time of harvesting the fruit at Shelford the total amount of calcium in the plant amounted to 5370 mg, of which 317 mg was contained in the fruit, 100 mg in the tops, 184 mg in the slips, 291 mg in the suckers, and 4 mg in the ground suckers.

vi) Magnesium

a. Whitney Estate

No regions in the plant with a high magnesium concentration of greater than 0,7 percent were found on the 11th October 1972 and only the top of the C and D leaves, the base of the E and F leaves and the stem stele and apex had more than 0,3 percent magnesium. The average for the plant was 0,26 percent. By mid summer in the first year the base sections of the D, E and F leaves had a high magnesium content and only the A leaves, tops of E and F leaves and the stem base, cortex and bottom of stele had a low magnesium concentration of less than 0,3 percent. The average on the 19th February 1973 was 0,39 percent. The magnesium concentration decreased during winter and on the 18th September 1973 the average was 0,19 percent. None of the plants had a high magnesium content and only the stem apex, base of the E and F leaves and top of the B and C leaves had more than 0,3 percent magnesium. On the 21st January 1973 the mean was 0,24 and only the base of the D, E and F leaves, the top of the B and C leaves, the stem apex and mid and top sections

of the stele did not have less than 0,3 percent magnesium. By mid winter there was very little change and the average on the 15th July 1973 was still 0,24 percent. All of the plant except for the stem apex, the base of the E and F leaves and the top of the B, C and D leaves had less than 0,3 percent magnesium. Initially the fruit and the peduncle had a high magnesium concentration, but when fruit was harvested all of the plant except for the mid and top sections of the D and E leaves and the top of the F leaves had less than 0,3 percent. The average concentration had fallen to 0,18 percent.

At the time of harvesting the fruit the total amount of magnesium in the plant was 1564 mg, of which 161 mg was contained in the fruit, 47 mg in the top, 33 mg in the slips, 146 mg in the suckers and 15 mg in the ground suckers.

b. Shelford Pineries

The concentrations of magnesium in plants at Shelford were slightly higher than those at Whitney, the same general pattern was, however, observed. In the planting material no regions had more than 0,7 percent and only the stem cortex, base of A leaves and tops of D and E leaves had less than 0,3 percent magnesium. The average concentration for the plant was 0,37 percent. On the 30th January 1973 the base sections of the C, D, E and F leaves, and stem apex and top of stele had a high magnesium content, while the roots, the A leaves and the stem base and bottom and mid sections of the cortex had less than 0,3 percent. The mean was 0,41 percent. On the 30th July 1973 only the base of the E leaves contained more than 0,7 percent magnesium. After this stage no areas contained more than 0,7 percent. The average was 0,34 percent and the stem except for its apex and top of stele, base of A leaves, mid of D leaves, mid and top of E leaves and top of F leaves contained less than 0,3 percent. On the 28th January 1974 the mean was 0,32 percent and only the top of the B leaves, mid and top of the C leaves, base of the D and E leaves, F leaves, and the stem apex and mid and top of stele contained more than 0,3 percent. On the 29th July 1974 the mean had decreased to 0,27 percent and only the tops of the A, B, C and D leaves, the base of the F leaves, and the stem apex and stele contained more than 0,3 percent magnesium. When the fruit was harvested, on the 28th January 1975, the mean was 0,22 percent and only the top of the C, D, E and F leaves and mid section of the E leaves contained more than 0,3 percent.

At the time of harvesting the fruit the total amount of magnesium in the plant was 2382 mg, of which 231 mg was contained in the fruit, 61 mg in the top, 102 mg in the slips, 108 mg in the suckers, and 3 mg in the ground suckers.

vii) Sodium

a. Whitney Estate

Regions of high sodium concentrations were confined to the leaf extremities, old leaves, and to the base sections of the stem throughout most of the period. In winter however the upper regions of the stem had high sodium concentrations. On 11th October 1972 all of the plant except the tops of all the leaves, the stem base and roots had a low sodium content of less than 0,05 percent. The mean at this stage was 0,040 percent. By the 19th February 1973 the mean had increased to 0,173 percent and the tops of the B, C, D and E leaves had a high sodium content of over 0,2 percent, while the A leaves, base of B, C, D, E and F leaves, mid E leaves and the stem excluding the base and apex had less than 0,05 percent sodium. By the 26th June 1973 the mean had increased to 0,228 percent and large areas had a high sodium concentration. The stem base, bottom sections and mid section of cortex, top of B leaves, C leaves and top of D leaves all had more than 0,2 percent sodium while only the base of the D, E and F leaves had less than 0,05 percent. After this the sodium concentration decreased and on the 21st January 1974 the average was 0,192 percent. The bottom half of the plant consisting of the A and B leaves, the mid and top of the C leaves and the stem base, had a high sodium content of greater than 0,2 percent. The base and mid sections of the D leaves, the E and F leaves, and the stem mid and top sections and apex all contained less than 0,05 percent sodium. On the 15th July 1974 the average had dropped to 0,131 percent. The only changes in the distribution were the mid section of the D leaves and top of E leaves which now had more than 0,05 percent. When fruit was harvested only the top of the A leaves had more than 0,2 percent sodium, and the rest of the plant except for the top of the B leaves, mid and top of the C, D and E leaves, F leaves, stem base and the top had less than 0,05 percent sodium. The mean at this stage had dropped to 0,054 percent.

At the time of harvesting the fruit the total amount of sodium in the plant was 469 mg, of which 19 mg was contained in the fruit, 15 mg in the top, 4 mg in the slips, 7 mg in the suckers, and 2 mg in the ground suckers.

b. Shelford Pineries

The concentration of sodium in the plants at Shelford was always less than that in plants at Whitney. In the planting material the average was 0,031 percent and only the tops of the A, B and C leaves contained more than 0,05 percent. By the 30th January 1973 the average was 0,165 percent, and the tops of the D and E leaves contained more than 0,2 percent, while only the roots, A leaves, and the base of B, D, E and F leaves had less than 0,05

percent. By mid winter on the 30th July 1974 the average was 0,154 percent and the A and B leaves, mid and top of C leaves, top of D leaves and the stem base and middle section of cortex all contained more than 0,2 percent while only the base of D leaves, base and mid E leaves and F leaves contained less than 0,05 percent. On the 28th January 1974 the mean was 0,140 percent. The A and B leaves, mid and top of C leaves and the stem base and middle of cortex contained more than 0,2 percent sodium while the upper sections of the plant consisting of base and mid of D leaves, E and F leaves and the apex and top of the stem had less than 0,05 percent. The sodium concentration decreased after this and on the 29th July 1974 the average was 0,088 percent. The tops of the A and B leaves and stem base still contained more than 0,2 percent while the mid and top of the D leaves, E and F leaves, and all of the stem except base and bottom section of cortex had less than 0,05 percent. By the time fruit was harvested the mean had fallen to 0,037 percent and all of the plant except for the top of the B and E leaves, the mid and top of the C leaves, stem base and the top had less than 0,05 percent sodium.

At the time of harvesting the fruit the total amount of sodium in the plant was 402 mg of which 13 mg was contained in the fruit, 12 mg in the top, 7 mg in the slips, 5 mg in the suckers, and 1 mg in the ground suckers.

viii) Iron

a. Whitney Estate

The iron concentration in most of the plant parts varied seasonally. At the time of taking the first sample the high concentration regions of greater than 100 parts per million included the D, E and F leaf tops, all of the A leaf and the stem base and outer sections. Areas of low iron concentration of less than 50 parts per million included the B, C and D leaf bases, the centre of the C leaf and the middle of the stem. The mean concentration for the plant at this stage was 73 parts per million. By the 19th February 1973 the high concentration region included the stem base, roots, A leaves and tops of the B, C and D leaves. This region remained the same until fruit harvest. Low iron concentration regions included the stem centre and the base sections of the B and C leaves. This low concentration region then "spread" to the D, E and F leaf bases and to the apex and top regions of the stem and then remained the same until fruit formation. The mean iron concentration was 141 parts per million at this stage, it then decreased to 111 parts per million on the 7th August 1973 and to 79 parts per million on the 21st January 1974 and finally to 67 parts per million on the 15th July 1974, just prior to fruit formation. Initially fruit had a fairly

high iron concentration. At the time of fruit harvest the roots, A leaf and B leaf top sections had a high iron concentration, whereas the rest of the plant except the stem base, C leaf mid and top sections, E leaf top section, and the outer sections of the fruit had a low iron concentration. The mean at this stage was 67 parts per million.

At the time of harvesting the fruit the total amount of iron in the plant was 58,3 mg, of which 10,3 mg was contained in the fruit, 0,9 mg in the top, 1,1 mg in the slips, 2,7 mg in the suckers, and 0,5 mg in the ground suckers.

b. Shelford Pineries

The concentration of iron in plants at Shelford followed a similar trend to those at Whitney. The actual amounts were, however, slightly higher at Shelford. The planting material contained 92 parts per million iron and the stem base, tops of the B, C, D and E leaves, base of D and E leaves and F leaves all had a high iron concentration of greater than 100 parts per million, while only the base and mid sections of the C leaves had a low iron content of less than 50 parts per million. On the 30th January 1973 the plant contained 316 parts per million iron. The outer sections and top of plant all had a high concentration, while only the base of the B leaves and stem cortex had a low concentration of iron. On the 30th July 1973 the average had fallen to 127 parts per million and now only the bottom extremities of the plant consisting of the roots and tops of A and B leaves had a high iron content while the centre of the plant consisting of the base of the C, D, E and F leaves and the stem excluding its apex, top of stele and base had a low iron content. By the 28th January 1974 the mean had dropped to 84 parts per million, and only the roots, A leaves and tops of B leaves had a high iron content. The rest of the plant except for the base of the B leaves, mid and top of the C leaves, top of the D leaves, and the stem base had a low iron content. During the following winter the high iron concentration regions "moved" up the plant and on the 29th July 1974 the mean was 84 parts per million, and the roots, A and B leaves and mid and top of C leaves had a high iron content. The base of the C, D and E leaves, mid section of D leaves, top of E leaves, F leaves and the stem except for its base had a low iron content. Initially the fruit had a fairly high iron concentration. At the time of harvesting the fruit the average for the plant was 84 parts per million. The roots, A leaves, top of B leaves and stem base had a high iron content while the base of the B, C, D and E leaves, the mid and top of D leaves, mid E leaves and the stem apex and cortex all had a low iron content.

At the time of harvesting the fruit the total amount of iron in the plant was 91,0 mg, of which 12,9 mg was contained in the fruit, 1,1 mg in the top, 3,3 mg in the slips, 3,4 mg in the suckers, and 0,1 mg in the ground suckers.

ix) Manganese

a. Whitney Estate

Although there was a seasonal variation in the manganese concentration there was an overall increase throughout the growting period. High concentrations were found mainly around the stem apex and at the extremities of the leaves. On the 11th October 1972 the average was 362 parts per million and all of the plant except the tops of the B, C and E leaves had a low manganese content of less than 500 parts per million. There was very little change by the 19th February 1973 but on the 7th August 1973 the mean had increased to 1309 parts per million and the tops of the B and C leaves and the stem apex had a high manganese content of over 2000 parts per million while only the A leaves, base of B leaves and the stem base, bottom sections and mid section of the cortex had a low manganese content. On the 21st January 1974 the mean had increased to 1892 parts per million and most of the plant mid sections, consisting of top of B leaves, base and top of D leaves, base of E and F leaves and the stem apex, top sections, and mid section of stele, had a high manganese content, while the bottom of the plant consisting of A leaves, base of B leaves, and stem base and bottom of cortex had a low manganese content. On the 15th July only the top of the C, D and E leaves and the stem apex had a high manganese content, while the base of the A and B leaves, the roots and the stem bottom and bottom of cortex had a low content. The mean at this stage had decreased to 1540 parts per million. When fruit started forming the young peduncle and new leaves had a high manganese content, but when fruit was harvested the only part of the plant with a high manganese content was the top section of the E leaves, while the rest, except for the mid and top of the C and D leaves, the mid E leaves, the top of the F leaves, the top and the suckers, had a low manganese content. The mean for the plant at this stage was 601 parts per million.

The total amount of manganese in the plant at the time fruit was harvested was 521 mg of which 27 mg was contained in the fruit, 12 mg in the tops, 7 mg in the suckers, and 1 mg in the ground suckers.

b. Shelford Pineries

The concentration of manganese in the plants at Shelford was very much lower than in the plants at Whitney. At no stage did any plant sections have a high manganese concentration of over 2000 parts per million. The average in the planting material was 199 parts per million and only the top of the

C leaves had a concentration of greater than 500 parts per million. On the 30th January 1973 the mean was 249 parts per million and only the top of the D leaves contained more than 500 parts per million. By the 30th July 1973 the mean had increased to 543 parts per million and only the tops of e the B, C and D leaves, base of E leaves and stem apex had more than 500 parts per million manganese. On the 28th January 1974 the mean had increased to 757 parts per million and only bottom sections of the plant, consisting of the base of the A and B leaves, roots and the stem base, bottom sections and mid section of cortex, had a low manganese content. On the 29th July 1974 the mean had decreased to 528 parts per million and now the only sections having a manganese content of above 500 parts per million were the tops of all the leaves and the apex of the stem. At fruit harvest the mean for the plant was 111 parts per million. No sections had a manganese concentration of greater than 500 parts per million.

The total amount of manganese in the plant at the time fruit was harvested was 121 mg of which 9 mg was contained in the fruit, 2 mg in the top, 3 mg in the slips, 3 mg in the suckers, and less than 1 mg in the ground suckers.

x) Zinc

a. Whitney Estate

At the time of planting no high concentration regions of greater than 100 parts per million zinc were found in the plant. Regions of low zinc concentration of less than 20 parts per million covered most of the plant except the roots, stem apex and base, and the E and F leaf bases. The mean at this stage was 13,9 parts per million. On the 19th February 1973 the stem apex had a high zinc concentration and this remained the case until fruit formation. Low concentration regions at this stage consisted of the rest of the plant except for the stem upper regions, the D and E leaf bases and the F leaf. The mean was now 14,8 parts per million. On the 21st January 1974 the average was 18,3 parts per million and the B and C leaves, D leaf mid and top sections, and the E leaf top section contained less than 20 parts per million zinc. At the onset of fruit formation there was an initial high level of zinc in the fruit. At the time of fruit harvest no sections had a high zinc concentration of above 100 parts per million. Most of the plant except for the B, C and E leaf bases, A leaf and the stem bottom section had a low zinc concentration of less than 20 parts per million. The mean at this stage had dropped to 12,2 parts per million.

The total amount of zinc in the plant at the time fruit was harvested was 10,5 mg of which 1,6 mg was contained in the fruit, 0,3 mg in the tops, 0,3 mg

in the slips, 0,9 mg in the suckers and 0,1 mg in the ground suckers.

b. Shelford Pineries

The distribution of zinc in plants at Shelford, although slightly lower amounts were present, followed a very similar pattern to that in plants at Whitney. Mean zinc concentration in the planting material was 11,9 parts per million and no sections contained more than 100 parts per million. All of the plant except the stem and base of the E and F leaves contained less than 20 parts per million. On the 30th January 1973 the mean was 16,1 parts per million and the stem apex contained more than 100 parts per million zinc. The rest of the plant except for stem top regions and the base of C, D, E and F leaves contained less than 20 parts per million. By mid winter the concentration had decreased to 14,0 parts per million and the stem apex as well as the top section of the cortex had a high zinc content while the rest of the plant except for roots, stem base and cortex , base of E and F leaves had a low zinc content. On the 28th January 1974 the average was 13,8 parts per million. The stem apex and top of cortex still had a high zinc content, while the rest of the plant, except for stem cortex and top of stele, base of D, E and F leaves, top of F leaves and A leaves, had a low zinc content. The mean decreased after this stage and on the 29th July 1974 it was 9,7 parts per million. No sections had over 100 parts per million zinc and all of the plant, except for stem apex and top of cortex, had less than 20 parts per million zinc. At time of fruit harvest the mean was 10,6 parts per million and the only sections with more than 20 parts per million zinc were the base of the A, E and F leaves, the stem apex, the outer sections of the fruit, the top, slips and the suckers.

The total amount of zinc in the plant at the time fruit was harvested was 11,5 mg, of which 2,1 mg was contained in the fruit, 0,3 mg in the tops, 0,6 mg in the slips, 0,6 mg in the suckers and less than 0,1 mg in the ground suckers.

xi) Copper

a. Whitney Estate

The differences in copper concentrations in the various parts of the plant were never very large. On the 11th October 1972 the mean was 7,7 parts per million and the stem base and cortex, A and F leaves, and the top section of the E leaves had a high copper concentration of over 10 parts per million, while the base and mid sections of the C leaves and the mid section of the E leaves had a low copper concentration of below 5 parts per million. The copper concentration then increased and on the 10th January 1973 the

mean was 13,2 parts per million and all the plant except for the roots, top of B leaves, mid and top of C leaves and the mid section of the D leaves had a high concentration. On the 7th August 1973 the mean concentration had decreased to 6,9 parts per million and only the A leaves, base of D and E leaves and the stem apex had a high copper concentration while the roots, base of B leaves and mid and top sections of the C, D and E leaves had a low concentration. During the following summer, on the 21st January 1974, the mean was 8,2 parts per million. The A and F leaves, base of D leaves, base and mid sections of E leaves and the stem mid sections and top of cortex had a high concentration, while no sections had less than 5 parts per million. On the 15th July the mean was 8,6 parts per million and the A leaves, base of D, E and F leaves and the stem apex and bottom and mid sections of the cortex had a high concentration while only the roots had low concentration. When peduncle started to form it initially had a high copper content and at fruit harvest the mean for the plant was 6,2 parts per million. The base of A leaves, stem cortex bottom section and stele top section and the ground suckers had more than 10 parts per million copper while the F leaves, tops of E and B leaves, outer sections of fruit and the peduncle had less than 5 parts per million copper.

The total amount of copper in the plant at the time fruit was harvested was 5,4 mg of which 1,0 mg was contained in the fruit, 0,2 mg in the top, 0,1 mg in the slips, 0,5 mg in the suckers, and 0,1 mg in the ground suckers.

b. Shelford Pineries

Both the amounts and the distribution of copper in the plants at Shelford were very similar to those at Whitney. Planting material had a mean copper concentration of 8,1 parts per million. No sections had less than 5 parts per million while only the base and mid sections of the D leaves, the mid and top sections of the E leaves, and top of F leaves and the stem apex and stele had less than 10 parts per million. On the 30th January 1973 all of the plant except the C leaves had a high copper concentration. The mean was 14,4 parts per million. In the following winter the average dropped to 7,0 on the 30th July 1973 and although no sections had a low copper content, only the A leaves, base of E leaves and the stem apex and mid and top sections of the cortex had a high concentration. On the 9th January 1974 the mean was 9,4 parts per million and the high concentration region now consisted of the A leaves, base of C and D leaves, base and mid sections of the E leaves, F leaves and all of the stem except its base and the bottom of the stele. On the 29th July 1974 the mean was 8,3 parts per million and the region of high concentration consisted of all the leaves near the stem, namely, A leaves, base of B, C and D leaves, E leaves and base of

F leaves. The roots and tops of the F leaves contained less than 5 parts per million copper. At time of fruit harvest the mean was 7,7 parts per million and the A leaves, base of B, C, D, E and F leaves and the suckers all had a high copper concentration of greater than 10 parts per million, while the fruit, peduncle, top of F leaves and the top part of the stele all had a low copper concentration of below 5 parts per million.

The total amount of copper in the plant at the time fruit was harvested was 8,3 mg of which 0,8 mg was contained in the fruit, 0,2 mg in the top, 0,3 mg in the slips, 0,3 mg in the suckers and less than 0,1 in the ground suckers.

2. Discussion

i) Moisture

The distribution of moisture in the stem showed a seasonal variation as was expected. During the winter months larger areas had greater than 20 percent dry matter than in summer. At Whitney (Chart 1 and Tables 6 to 23) during the first winter the stem dried out more than at Shelford (Chart 2 and Tables 24 to 33) due to the drier conditions experienced at Whitney. Hence, on the 18th September 1973 the average dry matter content for plants at Whitney was 17,5 percent and all of the stem except the apex and upper sections of the stele had a dry matter content of greater than 20 percent (Table 14), whereas at Shelford on the 5th November 1973 the average was 15,7 percent dry matter, and the stem apex plus the top sections of the cortex and stele had a dry matter content of less than 20% (Table 28). The dry matter content in the base of the leaves varied seasonally. In summer when greatest growth was experienced the base sections of all the C, D, E and F leaves contained less than 10 percent dry matter whereas in winter the base sections of the older leaves at times contained more than 20 percent dry matter. The same general pattern was found by Sideris and Young (1945) and by Sideris, Young and Krauss (1943) who found that in one year old plants areas of less than 10 percent solids consisted of D leaf base and E leaf base and mid sections, while only the stem base and mid section contained greater than 20 percent dry matter. Other than the base of the leaves the rest of the leaves except for dead A leaves, which generally had greater than 20 percent dry matter, showed very little seasonal variation in dry matter content, due mainly to the water storage tissue found in the leaves. Dry matter content was always between 10 and 20 percent. In the planting material at Shelford, which was only analysed on the 31st September 1972, after it had dried out in the field since 15th July 1972, large areas contained more than 20 percent dry matter. Because of the high sugar content in the fruit, difficulty was experienced in drying sections and obtaining the

percentage dry matter. Lodh et.al. (1975) working on kew pineapples found that the percentage dry matter at ripe stage was 10,6 percent. In the present study values of 11,2 percent, 15,0 percent, 13,0 percent and 11,6 percent were obtained for early and normal fruit at Whitney and for early and normal fruit at Shelford respectively (Tables 22A, 23, 32A, and 33 respectively).

ii) Nitrogen

The more active growing regions in the younger plants contained the higher nitrogen concentrations during summer, when nitrogen foliar spray applications were being given. During this stage larger sections of the plant contained a higher nitrogen concentration than during the winter months and in older plants where the upper sections of the leaves contained a higher nitrogen concentration. These observations are in agreement with Sideris and Young (1950) and (1951) who found that the nitrate concentration in the stem and in the non chlorophylous basal tissue of the leaves increase in proportion to the concentration in the substrate and that with advancing physiological age nitrogen increases in chlorophylous, but decreases in the non chlorophylous basal leaf sections. They found that the total nitrogen in the non chlorophylous leaf sections and in the stem corresponded positively with the concentration in the nutrient solution and was greater in the pre than in the post flowering stage, which was in agreement with the findings in the present study. When fruit was forming the amount of nitrogen in the stem and base of the leaves decreased. The amounts in the mid and top sections of the leaves remained the same or continued to increase showing that nitrogen in these sections of the plant is in a much less mobile form than in the stem and base sections. Sideris, Krauss and Young (1939a) and (1939b) also found less nitrogen in the base of the C, D, E and F leaves and in the stem in fruiting plants than in plants at one year but higher amounts in the top sections of the leaves.

In the present study the trends in nutrient concentration in the various sections of the plant at sixteen months are in agreement with Sideris, Krauss and Young (1939a) of plants at twelve months, and with Ashton (1972). In the C and D leaves an increase from base to top was found while the concentration of nitrogen in the youngest leaves decreases from base to the apex. In the stem of sixteen month old plants Ashton (1972) reports a decrease in concentration from the base to the apex. He does, however, find an increase from stem base to apex in 4½ month and in 41 month old plants. Sideris, Krauss and Young (1939a) found as I did a large increase from the base to the apex of the stem.

iii) Phosphorus

The highest phosphorus concentration regions were always in the upper regions of the stem and in the basal sections of the young leaves. This is in accordance with other workers. Langston (1956) found that tomato plants accumulate radioisotopes in specific areas and phosphorus was accumulated in the younger leaf tissue and in the stems of the older leaves. Lodh et.al. (1975) working with kew pineapples found irregular phosphorus concentrations throughout the plant. Ashton (1972) found that the concentration in the stems of pineapples decreased from the base to the apex whereas at all stages in the present study there was a much higher concentration in the stem apex. His other observations, however, agree with findings in the present study. Namely, the phosphorus concentration in the leaf bases increases from the oldest to the youngest leaves, but there is very little difference in the bases of the E and F leaves and there was a slight increase from the base to the apex in the older leaves, but in the D and younger leaves there was a decrease from the base to the apex.

The lower sections of the plant and the A and B leaves contained very little P, hence preventing the loss of P from the plant in dead and dying leaves. All the above observations suggest that most of the phosphorus in the plant is in a fairly mobile form and is used mainly in areas of growth. The extent of the areas of high phosphorus concentration within the plant decreased throughout, and just prior to differentiation the only region that contained more than 0,3 percent phosphorus was the stem apex.

During the formation of fruit, slips and suckers the amount of phosphorus decreased in the stem and in all of the C and D leaves. This illustrates again the mobile nature of phosphorus within the plant.

iv) Potassium

As potassium is to be found everywhere in the plant where large physiological work is in progress, Teiwes and Grüneberg (1963), the distribution of potassium showed a seasonal variation. Only the basal sections of the D, E and F leaves had high concentrations during the winter months, but this region expanded to include the mid and upper sections of the D and C leaves during the summer months. Sideris and Young (1945) found that the largest portion of potassium is accumulated in the eleaves, chiefly the older leaves such as the B and mature C leaves when potassium is in an abundant supply, but when potassium is deficient the D and E leaves had a higher potassium content than the older leaves. They found that in all leaves potassium increased from the base to the tip. In the present study the E, D and younger C leaves contained the greater amounts of potassium. In plants

at Whitney the potassium increased from the base to tip in the C and older leaves during most stages of growth, but decreased from the base to tip in the D and younger leaves. At Shelford where the supply of potassium was greater there was very little difference in the regions of the D leaf. Ashton (1972) obtained results similar to these except that he found an increase from the base to the apex in the E and F leaves. He also found a decrease from base to the apex of the stem. In the present study there was always an increase in potassium from base to stem apex where there is greater physiological activity. After foliar spray applications of fertilizer had ceased the regions containing high potassium concentration decreased as expected.

During the formation of fruit large amounts of potassium were lost from the C and D leaf bases and mid sections, illustrating that potassium in these sections was in a mobile form.

v) Calcium

Regions having a high calcium concentration could be divided into two distinct areas, the stem-including the base of the D, E and F leaves in summer, and the top sections of the older leaves. These findings are in agreement with Teiwes and Grüneberg (1963) who state that the reduction of the potassium content and the accumulation of calcium in the leaves is characteristic with the ageing and maturation of the plant. Sideris and Young (1945) and (1946b) found calcium distributed uniformly over the whole surface of the leaf and no difference between calcium concentration of the part of the leaf devoid of chlorophyll and that of the green tissue of the leaf. They found that the calcium content of both parts of the leaf correlated with the calcium content of the nutrient solution and that in the tissues of the stem the calcium content was twice as high as that of the leaves. In agreement with Ashton (1972) the calcium content was found to increase from the base to the apex in the older leaves and to decrease from the base to the apex in the D and younger leaves. Ashton, however, found a decrease in the calcium content from the base to the apex of the stem whereas at all stages prior to fruit formation an increase from base to apex was measured in the present study. Sideris and Young (1950) found that calcium decreases with age in the stems and that there was a much greater accumulation of calcium in the stems of preflowering than in postflowering plants. They attribute this to the retarded movement of calcium from the stem to the leaves during the preflowering stage.

When fruit was formed the amount of calcium in the mid and upper leaves did not decrease. There was a slight decrease of calcium in the base of the

leaves and a larger decrease in the stem. Sideris and Young (1950) found that after the formation of the fruit calcium gradually appeared in the stem of the crown though the calcium content of the leaves also increased.

vi) Magnesium

Two areas in the plant had high magnesium concentrations, namely the upper portions of the B, C and D leaves, and the stem apex, upper parts of stele or outer stem and the basal sections of young and most active leaves. The leaves contained a greater amount of magnesium than the stem. This is to be expected as Teiwes and Grüneberg (1963) point out that magnesium is an integrating constituent of chlorophyll. In agreement with the present work Ashton (1972) found an increase in magnesium in the base sections of the leaves from the oldest to the youngest, an increase from the base to the apex in the older leaves, a decrease from the base to the apex in the D and younger leaves, and an increase from the base to the apex of the stem. The overall concentration in the plant decreased as the plant got older.

When fruit was formed in plants at Whitney there was a loss in the amount of magnesium in all sections of the B and C leaves and in the basal section of the D leaves but not in the stem. There was no loss in the amount of magnesium in the parts of the plant at Shelford, however the total magnesium in the plants at Shelford increased much more than those at Whitney.

vii) Sodium

During the earlier stages of growth two areas contained high sodium concentrations, namely the tips of the leaves and the lower sections of the stem. As more sodium and less water became available to the plants these regions expanded to include some of the adjoining regions. At Whitney during the first winter the stem base, bottom sections and mid section of the cortex, all of the C leaf, mid and top sections of the D leaf, and the top sections of the A, B and E leaves all contained more than 0,2 percent sodium (Tables 13 and 14 and Chart 1). This was due to the dry conditions and relatively large sodium supply contained in sea spray and dew. Cresswell (1958) found that the sodium content of the upper leaves of lemon plants was higher than in the lower leaves when a high concentration of sodium was applied to nutrient solution. During the second summer and subsequently the plant managed to rid itself of sodium as new leaves contained low concentrations of sodium, hence at differentiation only the tips of the A and B leaves contained more than 0,2 percent sodium (Table 19). Generally there was an increase in sodium from the base to the tips of all leaves, and a decrease from the base to the apex of the stem. In the leaf bases there was an increase from the older to the C leaves and a decrease to the younger leaves until after the first winter, then there was a decrease from the old

to the young leaves. Ashton (1972) found slightly different trends, however, the plants he studied contained much less sodium. In 16 month old plants he found an average concentration of 0,111 percent while 16 month old plants at Whitney contained 0,257 percent sodium.

The amount of sodium within the plant at Whitney decreased from 472 mg per plant just before differentiation to 402 mg per plant at fruit harvest. At this stage most of the sodium was contained in the top sections of the B and C leaves where it would eventually be lost to the plant when these leaves died.

viii) Iron

During most stages of growth high iron concentration regions were found in the roots, stem base and A leaf base, and in the upper sections of the leaves, especially the older leaves. Langston (1956) found that in tomatoes most young leaves at the plant apex had less iron than older leaves. The high quantities of iron in the roots and basal section of the stem are caused by high manganese concentrations which precipitate iron. Sideris (1950) in experiments with Fe^{59} established that iron is precipitated in large quantities when manganese is in excess. After the last spray application of iron only the upper sections of the older leaves contained high iron concentrations together with the roots and stem bases. Generally except for the A leaf base there was a small increase before differentiation and a small decrease after differentiation in the basal sections from the older to the younger leaves. The stem base and, at times, the bottom section of the stem had a high iron concentration but otherwise there was an increase in iron concentration from the lower to the upper sections of the stem. Iron concentration increased from the base to the apex in all leaves and the iron concentration in the mid and top sections decreased from the older to the younger leaves.

The total amount of iron increased from 32,9 mg to 58,3 mg Fe per plant at Whitney and from 44,9 mg to 91,0 mg Fe per plant at Shelford between differentiation and fruit harvest. There was no decrease in the amount of iron in the leaves of the plant except in their bases. The amount of iron in the plant stem decreased slightly. This seems to illustrate that the iron in the plants is not in a mobile form.

ix) Manganese

High concentration regions consisted mainly of the tops of the B, C and D leaves and the stem apex and basal sections of the D and E leaves. The concentration of manganese increased throughout growth until differentiation.

Generally there was a concentration increase in the base sections from the older to the younger leaves, but with a decrease between the E and F leaves, an increase from base to apex of the stem, and an increase from the base to tops of leaves, except in the D and younger leaves where there was a decrease from the base to the mid section and then an increase to the top. These observations were in contrast to distributions found by Ashton (1972), who found a decrease from the base to the apex of the stem and a decrease from the base to the apex in the D and younger leaves. Both plants from Shelford and Whitney, however, contained much higher amounts of manganese than found by Ashton showing that supply of manganese was in excess.

x) Zinc

The areas of high zinc concentrations were the stem apex and base of the young leaves. This is in agreement with Lyman and Dean (1942) who in a study of the distribution of zinc throughout the pineapple plant revealed that the meristematic tissues contained the greatest concentration of zinc. Other areas in the present study with a high zinc concentration were the dead leaves, but this could be due to the difficulty of washing these leaves. Generally it was found that in the basal sections of the leaves the zinc concentration increased from the older to the younger leaves, except for the high values obtained in the bases of the A leaves. Zinc concentration increased from the base to the apex of the stem and decreased from the base to the apex of the leaves, except in the C leaves in plants from 12 to 18 months when there was very little difference between the base and the apex. These distributions were in agreement with those found by Ashton (1972), except in sixteen month old plants, where he observed a decrease from the base to the apex of the stem. This was possibly due to a zinc deficiency in these plants. When foliar spray applications of zinc ceased the concentration in all sections of the plant decreased.

The amount of zinc in the plants at Whitney increased from 7,5 mg to 10,5 mg per plant between differentiation and fruit harvest (Tables 20 and 23). The amounts of zinc in the stem and in the leaves decreased during the same period, and contributed towards the zinc in the fruit, slips, suckers and tops. At Shelford the corresponding increase in the plants was from 5,2 mg to 11,5 mg per plant (Tables 31 and 33) and no drop in the amount of zinc in the leaves was observed.

xi) Copper

No very distinct copper distribution pattern was found in the plant. In agreement with Ashton (1972), however, it was found that copper concentration generally increased in the basal sections from the older to the younger leaves, increased from the basal section to the top of the stem but not always to the apex, and copper concentration decreased from the base to the apex of the leaves.

The amount of copper in the plants at Whitney increased from 4,3 mg to 5,4 mg per plant between differentiation and harvesting of fruit (Tables 20 and 23). This increase in the plant was accompanied by a drop in the amount of copper in most of the old vegetative regions of the plant and especially in the C and D leaf mid and upper sections. At Idlewild the total amount in the plant increased from 4,5 mg to 8,3 mg per plant (Tables 31 and 33) in the same period and there was no decrease in the amount of copper in the leaves.

CHAPTER VI

SUMMARY OF RESULTS AND CONCLUDING REMARKS

1. Summary of Results

The experiment was carried out on the two farms, Whitney Estate in the Alexandria district, and Shelford Pineries at Kidds Beach near East London. Standard scientific farming methods used on both farms were:- Pineapple tops were planted during July and August 1972 on ridges which had been treated with soil fumigants, weedicides and insecticides. Soil samples were taken for analysis and chemical fertilizers were applied both in solid form and as spray applications. The soil at Whitney Estate as determined from a neutral ammonium acetate extract contained 10 ppm P, 70 ppm K, 240 ppm Ca, 70 ppm Mg, and 10 ppm Na, and at Shelford it contained 5 ppm P, 100 ppm K, 260 ppm Ca, 100 ppm Mg, and 67 ppm Na. Chemical fertilizers applied at Whitney Estate were: 252 kg N, 13 kg P, 160 kg K, 73 kg Fe and 15 kg Zn per hectare applied between planting and flower differentiation and at Shelford Pineries were 279 kg N, 65 kg P, 263 kg K, 62 kg Fe and 4 kg Zn per hectare applied between planting and forcing of flowering. Flower induction hormones were applied to 18 month old plants during January 1974 at Shelford Pineries. About 40% of the plants were induced into flowering. At Whitney about 2% of the plants differentiated naturally at the same time as the hormoned plants at Shelford. Fruit was harvested during October 1974 from the early fruiting plants and during February 1975 from the natural fruiting plants.

i) Experimental methods

At Whitney plants were sampled at 6 weekly intervals until early in 1974 and thereafter at 8 weekly intervals, and at Shelford plants were sampled at 3 monthly intervals, from planting until harvesting of the plant crop fruit. When plants differentiated early samples of both early fruiting and natural fruiting plants were taken. The plants were sampled on the basis of their being healthy representatives of the plot on gross morphological characteristics such as uniform size and appearance. To begin with 20 plants were sampled at Whitney and 10 at Shelford, however as the size of the plants increased this was reduced to 5 plants per sample. Due to the bulk of the samples and to the limited resources available a full and adequate sampling program of duplication of samples was not taken and this therefore precluded a statistical analyses of the data obtained. Measurements in growth, nutrient concentrations and distribution patterns, however, showed very regular trends between subsequent samples, hence it

seems reasonable to assume that most of the measurements gave a fairly accurate account of plant growth, and nutrient and moisture concentrations and distributions. The plants were stripped into sections at the Pineapple Research Unit at Rhodes University. Leaf area measurements were taken of plants from Whitney. Plant sections were washed and weighed, and sub samples taken of each section were weighed, dried and reweighed. The dried material was ground to a powder and analysed for N, P, K, Ca, Mg, Na, Fe, Mn, Zn and Cu. Analyses were done in duplicate except when in a few samples not enough material was available.

ii) Climate and plant growth

The climate in the area is cool temperate oceanic but is very variable. Mean monthly temperatures varied between 14,4°C and 22,4°C at Bathurst near Whitney, and between 14,5°C and 22,1°C at East London. There was never any large difference between the temperatures of the two regions during the experiment. These temperatures are considerably lower than temperatures regarded as ideal for growth in any other pineapple growing region. The mean annual rainfall for Bathurst is 663 mm and for East London 739 mm. During the experiment, however, 412,1 mm fell during the first year and 1163,4 mm fell during the second year at Bathurst, while 779,1 mm fell during the first year and 1172,5 mm fell during the second year at East London. Except for the low rainfall at Whitney during the first year, the rainfall can be regarded as quite adequate for good growth of pineapples. The rainfall during the second year is within the range of 1100 to 1300 mm which is regarded as optimum in Hawaii, Teiwes and Grüneberg (1963).

The growth of plants on both farms showed seasonal trends. There was, however, a continual increase in the amount of dry matter per plant, although the rate of increase was less during the winter months. There was practically no increase in the plant fresh weight during the winter months, hence the increase in dry matter assimilation during these months was accompanied by a loss of moisture. The percentage dry matter was greatest during October just before the summer growth and least in March at the end of the summer growth. The percentage dry matter was higher at Whitney than at Shelford during the first year. The total amount of dry matter in the plants from both farms was, however, almost identical. The higher percentage dry matter in the plants at Whitney was due to the lower rainfall during the first year. On differentiation there was an initial increase in the rate of dry matter production. At Whitney the RGR increased until March 1973, and then decreased during winter until October 1973. It again increased during the second summer, but decreased rapidly during the

second winter. The NAR followed the same general pattern as the RGR. The LAR increased initially to a maximum and then decreased regularly. The RGR of plants at Shelford showed the same general trends as that at Whitney. It was, however, lower during September, October and November 1973 and higher during February and March 1974. The variation in the RGR follows the variation of the mean temperatures of the region as expected. The RGR on both farms was lower than that found in warmer climates. For example in Malaya the RGR increased to 107 x 10^{-4} gg^{-1} day^{-1} after six months, whereas at Whitney it only increased to 80 x 10^{-4} gg^{-1} day^{-1} after eight months. This no doubt is due to the lower temperatures at Whitney. Mean temperature for Malaya and Bathurst being 25,6°C and 16,2°C respectively which results in slower growth under local conditions and a longer period to maturity. During the first winter there was a certain amount of breakdown in the tissue in the apex of the stem. This was greater at Whitney than at Shelford and was due to a combination of low temperatures together with the dry conditions experienced during this period. As a result of this breakdown plants at Whitney produced many more ground suckers than plants at Shelford during the second summer.

The mean fruit weights were 1,46 kg at Whitney and 1,64 kg at Shelford which resulted in yields of 62,5 and 70,8 tonnes per hectare respectively. These yields are considered to be above average for the region and hence indicate that adequate fertilizers and good farming methods were applied.

iii) Concentration and absorption of nutrients

a. Nitrogen

The plants absorbed large quantities of nitrogen up to differentiation. The amounts of nitrogen in the plants on both farms was very similar. After 18 months plants at Whitney and Shelford contained 3,25 g and 3,52 g nitrogen respectively. The amount of nitrogen in the plants increased regularly during the first winter while fertilizer sprays were being applied, but there was no increase during the second winter after sprays had been discontinued. There was very little absorption from the soil during the colder winter months. Plants that had differentiated contained more nitrogen than undifferentiated plants, and there was an overall decrease in nitrogen concentration in the plant from differentiation until fruit harvest.

b. Phosphorus

The initial absorption of phosphorus by the plants was very low, and after 12 months plants at Whitney and Shelford contained only 0,08 and 0,09 g

phosphorus per plant respectively. Absorption increased during the second summer. There was almost a complete lack of absorption of phosphorus during the winter months indicating that nutrients are not absorbed by the root system during the colder winter months. Plants that differentiated early contained greater amounts of phosphorus than the rest of the plants. The concentration of phosphorus in plants at Shelford remained fairly constant while at Whitney there was a large seasonal variation in phosphorus concentration.

c. Potassium

The plants absorbed large quantities of potassium. The amount in plants at Shelford was, however, greater than in plants at Whitney. 18 month old plants at Shelford and Whitney contained 5,10 and 3,18 g potassium per plant respectively. The increase in the amount of potassium within the plants was not regular in that the rate of increase was less during the first winter and there was an actual decrease during the second winter when fertilizer spray applications had been discontinued. The concentration of potassium in the plants at Shelford was higher than in plants at Whitney. The concentration showed a seasonal variation and decreased after differentiation to fruit harvest.

d. Calcium

The amount of calcium in the plants increased irregularly with little or no increase during the colder winter months again indicating that nutrients are not absorbed by the root system during these months. Plants at Shelford contained greater amounts of calcium than plants at Whitney. The concentration of calcium in the plants was highest during the first summer and decreased until fruit harvest.

e. Magnesium

Like calcium the amount of magnesium in the plants increased irregularly with little or no increase in winter. At Whitney there was an actual decrease in the total magnesium during the first winter. Plants at Shelford contained less magnesium than plants at Whitney. The concentration was highest during the first summer and decreased until fruit harvest.

f. Sodium

The amount of sodium in the plants increased very irregularly until the second winter and then decreased. Plants at Whitney contained greater amounts of sodium than plants at Shelford due mainly to the dry conditions experienced at Whitney during the first year. The concentration of sodium

in the plants was greatest from the beginning of the first winter until the middle of the second summer and then decreased until fruit harvest.

g. Iron

The amount of iron in the plants at both farms increased regularly as long as the fertilizer sprays were applied. During the second winter after spray applications had ceased iron in plants at Whitney remained constant and iron in plants at Shelford increased at a lower rate. Plants that had differentiated early contained much more iron than the rest of the plants. The concentration of iron in the plants was highest during the first summer and then decreased until fruit harvest.

h. Manganese

The total amount of manganese in the plants increased irregularly until differentiation. There was very little increase during winter. Plants at Whitney contained much greater amounts of manganese than plants at Shelford. There was a general decrease in the amount of manganese in the plants between differentiation and fruit harvest. The concentration of manganese in the plants increased irregularly until February/March 1974 and then decreased until fruit harvest.

i. Zinc

The total amount of zinc in the plants on both farms increased regularly as long as the fertilizer sprays were applied. During the second winter after spray applications had ceased there was little or no increase. Plants at Whitney contained greater amounts of zinc than plants at Shelford. The concentration of zinc in the plants at Shelford was fairly constant but showed a regular slight drop between the first summer and fruit harvest. The concentration in plants at Whitney was more irregular and only decreased between differentiation and fruit harvest.

j. Copper

The amount of copper in the plants showed a fairly regular increase, but with a slightly reduced rate during winter. The concentration of copper in the plants showed a seasonal variation with the highest concentrations during the summer months. The values were higher during the first year than during the second year.

iv) Distribution of moisture and nutrients

a. Moisture

The distribution of moisture in the plant showed a seasonal variation with

larger areas of high dry matter content during winter than during summer. During the first winter plants at Whitney had larger areas of high dry matter content than plants at Shelford due to the lower rainfall in the area. The percentage dry matter in the base of the leaves varied seasonally, and in summer larger areas contained less than 10% dry matter i.e. the base of all of the C, D, E and F leaves, whereas in winter the base of the A, B and C leaves at times contained more than 20% dry matter. Other than the base of the leaves and the dead A leaves the rest of the leaves showed very little seasonal variation. The stem base always contained higher percentage dry matter than the apex. During winter, however, the percentage dry matter increased in the upper regions of the stem. The percentage dry matter determinations on the fruit were inaccurate due to interference in the drying caused by the high sugar content.

b. Nitrogen

In the younger plants the more active regions contained high nitrogen concentrations, while in the older plants the upper regions of the leaves had higher nitrogen concentrations. During the summers while fertilizer spray applications were being given larger areas of the plant contained high nitrogen concentrations than during winter. With advancing physiological age nitrogen increased in the chlorophyllous (from the F to D leaves and then decreased from C to A leaves), but decreased in the non chlorophyllous basal leaf sections. In 12 month old plants the nitrogen concentration increased from the base to the top of the C, D and older leaves but decreased from the base to the top in the younger leaves. The nitrogen concentration always increased from the base to the apex of the stem and on the formation of fruit the total amount of nitrogen in the stem and base esections of the leaves decreased, while the total amount of nitrogen in the mid and top sections of the leaves remained constant.

c. Phosphorus

The highest concentrations of phosphorus were always in the upper regions of the stem and in the basal sections of the younger leaves. Phosphorus concentration in the leaf base sections increased from the oldest to the youngest leaves. There was, however, very little difference between the E and F leaf bases. (Note:- these leaves were both still growing). There was a slight increase from the base to the apex of the older leaves and a large decrease from the base to the apex of the younger leaves. This indicates that only a small proportion of phosphorus in the plant is not mobile. The lower sections of the plant and the A and B leaves contained

very little phosphorus thus preventing the loss of phosphorus from the plant when these leaves died. When fruit was formed the total amount of phosphorus decreased in the stem and in all of the C and D leaves again illustrating the mobile nature of phosphorus in the plants.

d. Potassium

The distribution of potassium throughout the plant showed large seasonal variations. During the winter months only the basal sections of the D, E and F leaves had high potassium concentrations, whereas in summer these high concentration regions had spread to include the mid and upper sections of the C and D leaves. The younger of the C leaves, D and E leaves contained the largest amounts of potassium. The concentration increased from the base to the top of the C and older leaves but decreased from the base to the top of the D and younger leaves. At Shelford, however, there was no difference between the base and top of the D leaves. Potassium concentration increased from the base to the apex of the stem. The areas containing high concentrations decreased when fertilizer spray applications were discontinued. When fruit was formed large amounts of potassium were lost from the C and D leaf base and mid sections.

e. Calcium

Areas of high calcium concentration in the plant can be divided into two regions. The stem, including the base of the D, E and F leaves during summer, and the top sections of the older leaves. Concentration increased from the base to the apex of the older leaves and decreased from the base to the apex in the D and younger leaves. It increased from the base to the apex of the stem until fruit formation. There was a greater accumulation of calcium in the stems in preflowering than in postflowering plants. When fruit was formed the amount of calcium decreased in the stem and also decreased slightly in the basal sections of the leaves.

f. Magnesium

Areas of high magnesium concentrations in the plant can be divided into two regions. The stem apex, upper stele and the basal sections of the young and most active leaves, and the upper portions of the B, C and D leaves. The leaves contained greater amounts of magnesium than the stem. The concentration in the basal sections of the leaves increased from the oldest to the youngest. There was an increase from the base to the apex in the older leaves, but a decrease from base to apex in the younger leaves. Magnesium concentration increased from the base to the apex of the stem. When fruit was formed there was a decrease in the amount of magnesium in all sections of the B and C

leaves, and in the basal sections of the D leaves in the plants at Whitney, but not in the plants at Shelford.

g. Sodium

During the early stages two regions had high sodium concentrations. The tips of all the leaves and the lower sections of the stem. The regions containing high sodium concentrations increased until the end of the first winter and then subsequently decreased. Generally there was an increase in sodium concentration from the base to the top of all leaves and a decrease from the base to the apex of the stem. In the leaf bases there was an increase from the older to the C leaves and a decrease from the C to the younger leaves until the end of the first winter, after which there was a decrease from the older to the younger leaves.

h. Iron

There was a high concentration of iron in the roots, stem base and A leaf base, and in the upper sections of the leaves, especially the older leaves. After fertilizer spray applications were discontinued only the upper sections of the older leaves, roots and stem base contained high iron concentrations. Other than the stem base, and at times the bottom section, which had a high iron concentration, there was an increase from the bottom to the apex of the stem. The concentration increased from the base to the top of all leaves, and, in the mid and top sections, decreased from the older to younger leaves. The concentration in the base sections increased from the older to the younger leaves, except for the A leaves. When fruit was forming there was a slight decrease in the total amount of iron in the stem and leaf base sections.

i. Manganese

Two sections of the plant had a high manganese concentration. The tops of the B, C and D leaves, and the stem apex and basal sections of the D and E leaves. The concentration in all regions increased until the plant differentiated. The concentration iin the basal sections of the leaves increased from the older to the younger leaves and also from the base to the top of the older leaves, but decreased from the base to the mid sections and then increased to the top in the D and younger leaves. The amount of manganese in the plants was much higher than that found by other workers and the distribution was different indicating that an excess of manganese was present.

j. Zinc

High zinc concentrations were found in the stem apex and in the basal sections of the younger leaves. In the basal sections of the leaves concentration

increased from the older to the younger leaves and decreased from the base to the apex in all leaves, except in the C leaves of 12 to 18 month old plants when there was very little difference between the base and the apex. Concentration increased from the base to the apex of the stem. When fruit was forming the total amount of zinc in the stem and leaves decreased at Whitney but not at Shelford.

k. Copper

There were no large differences in the distribution of copper concentrations in the plant. In general there was an increase in the basal sections from the older to the younger leaves, and a decrease from the base to the apex in all leaves. In the stem there was an increase from the base to the top sections but not always to the apex. When fruit was forming there was a drop in the total amount of copper in the older vegetative regions in the plants at Whitney but not in the plants at Shelford.

2. Concluding remarks

i) The yield from the plants in the experiment were above average for the region indicating that the farming methods and fertilizer applications were adequate to meet the requirements of the plant.

ii) Although no statistical treatment was done on the results the consistency in plant growth, and in nutrient concentration, absorption and distribution between subsequent samples suggest that the results obtained gave a fairly accurate measurement of these parameters.

iii) Despite low mean temperatures during the winter months there was a continual increase in dry matter production in the plants.

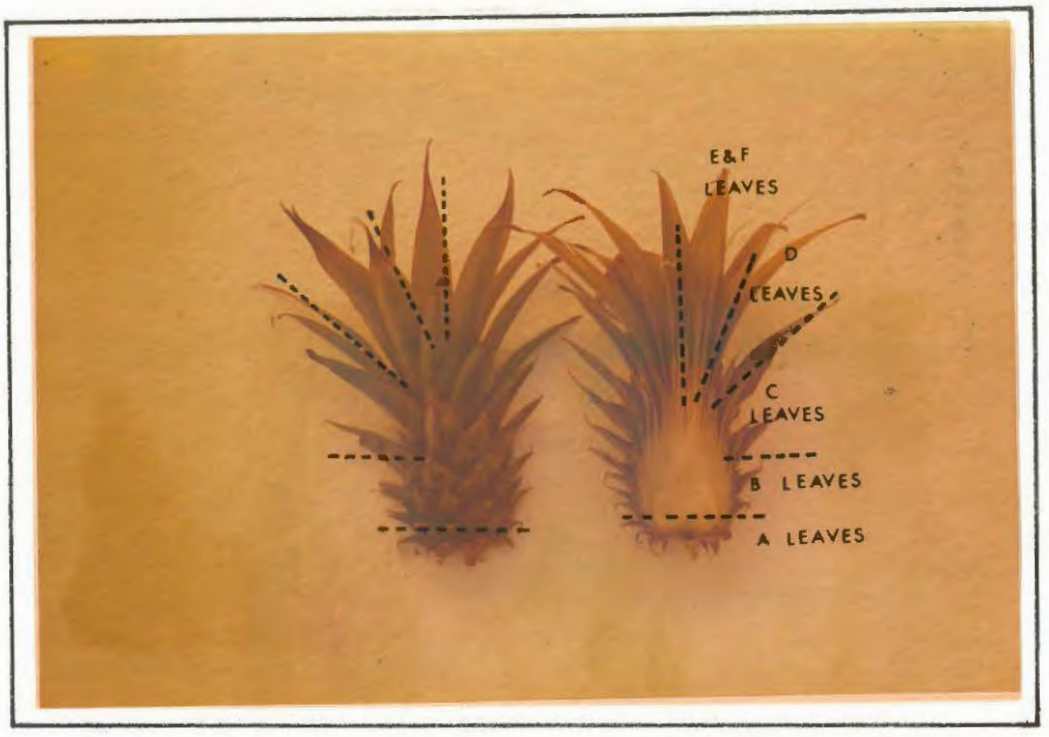
iv) When fertilizers were applied as a foliar spray they continued to be absorbed by the plant during the colder winter months, whereas nutrients in the soil were not absorbed.

v) An adequate supply of moisture was necessary for the efficient absorption of nutrients and good plant growth.

vi) In the chlorophylous leaf sections the concentrations of Ca, Mg, Na, Fe and Mn increased with physiological age while the concentrations of P, Zn and Cu decreased and concentrations of N and K firstly increased and then decreased with physiological age. In the stems and non chlorophylous basal leaf sections all the elements measured except sodium decreased with physiological age.

vii) During the formation of the fruit the amounts of P, K, Zn and Mg decreased in leaves and stem, whereas the amount of N, Cu and Fe only decreased in the stem and basal sections of the leaves.

PLATE II.- A pineapple plant from Whitney Estate from which leaves have been removed to show appendages of the stem.



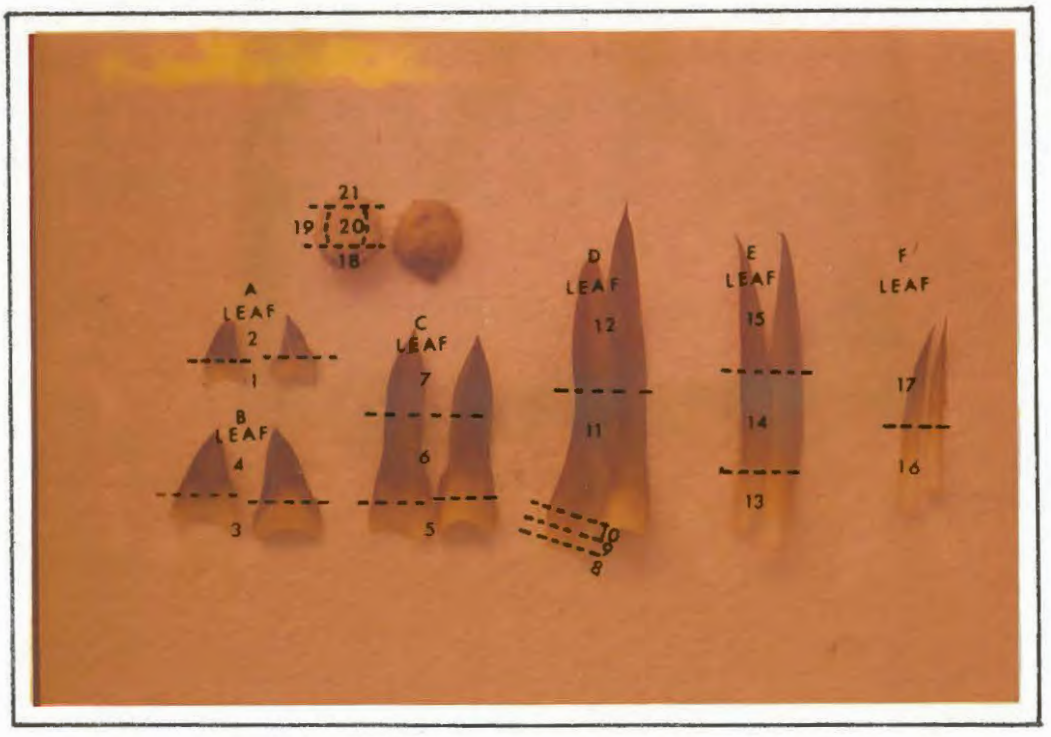


PLATE III.- Pineapple top used as planting material at Whitney Estate showing parts of plant sampled for analysis. Tops planted on 8th August, 1972.

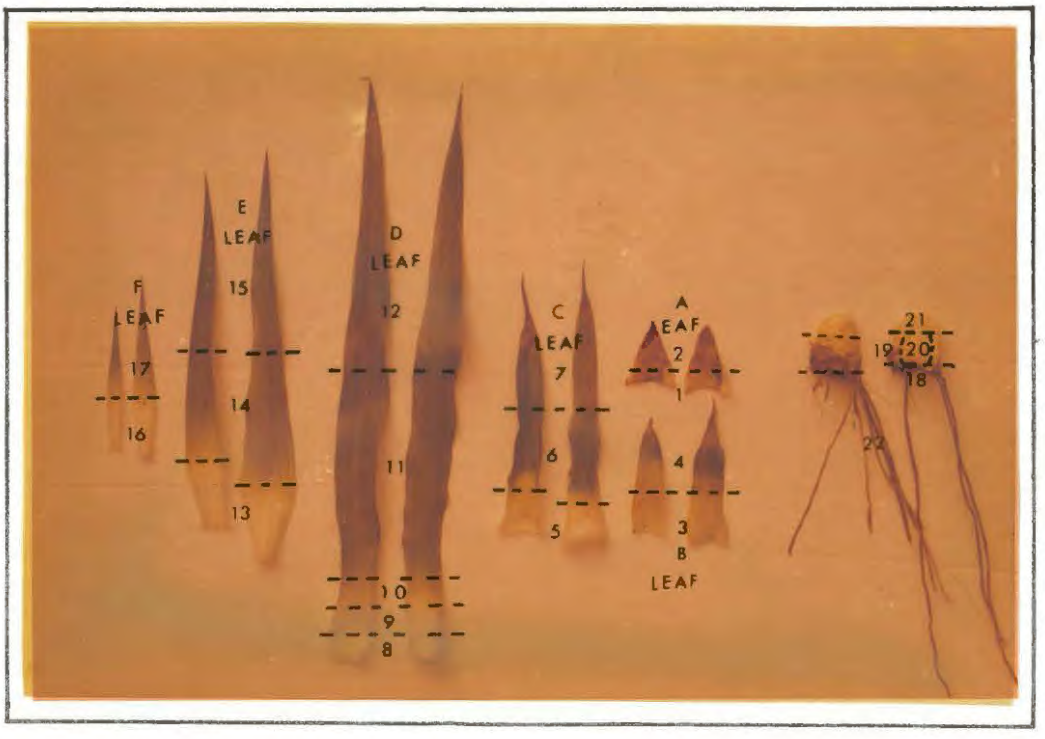


PLATE IV.- Six month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 10th January, 1973.

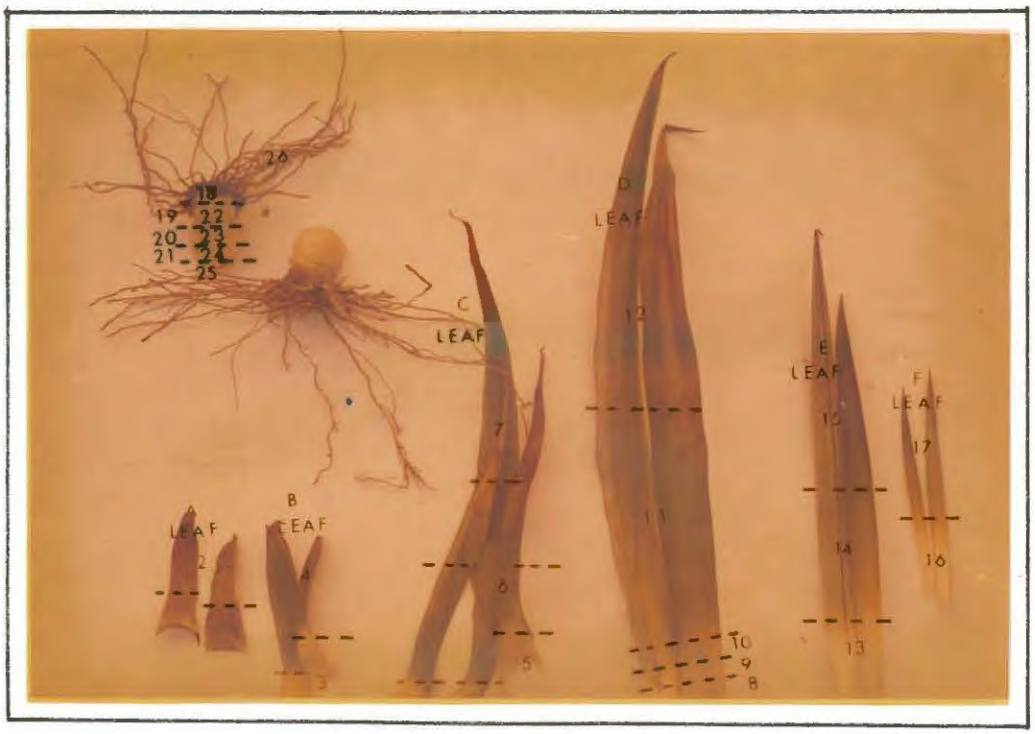
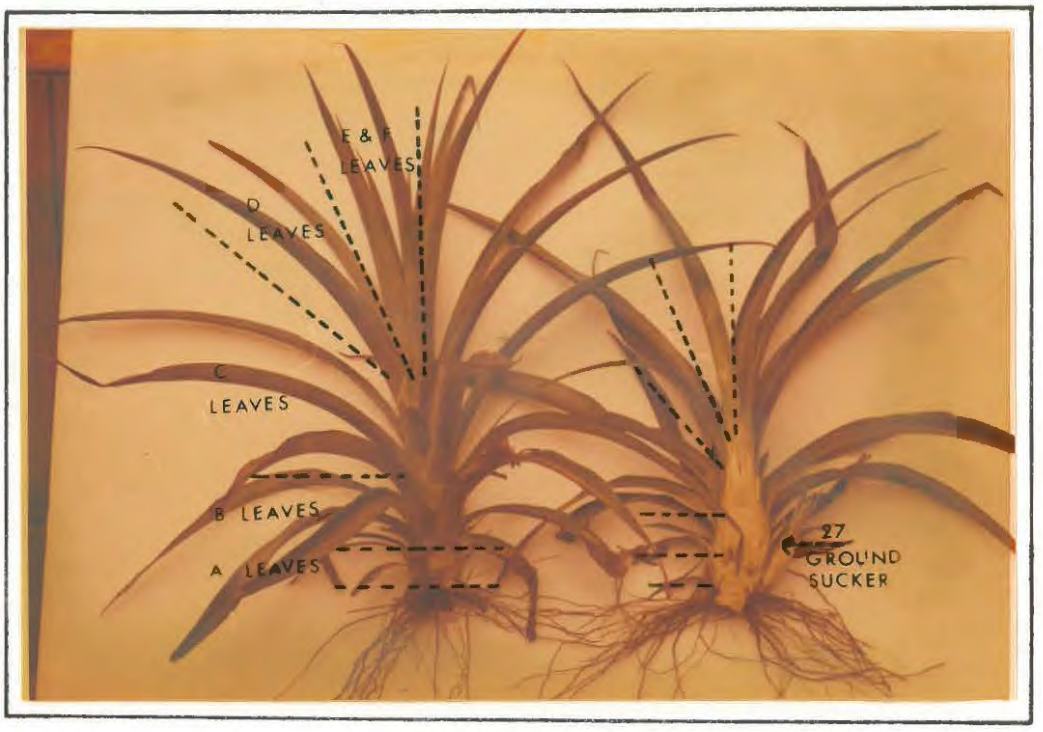


PLATE V.- Twelve month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 7th August, 1973.



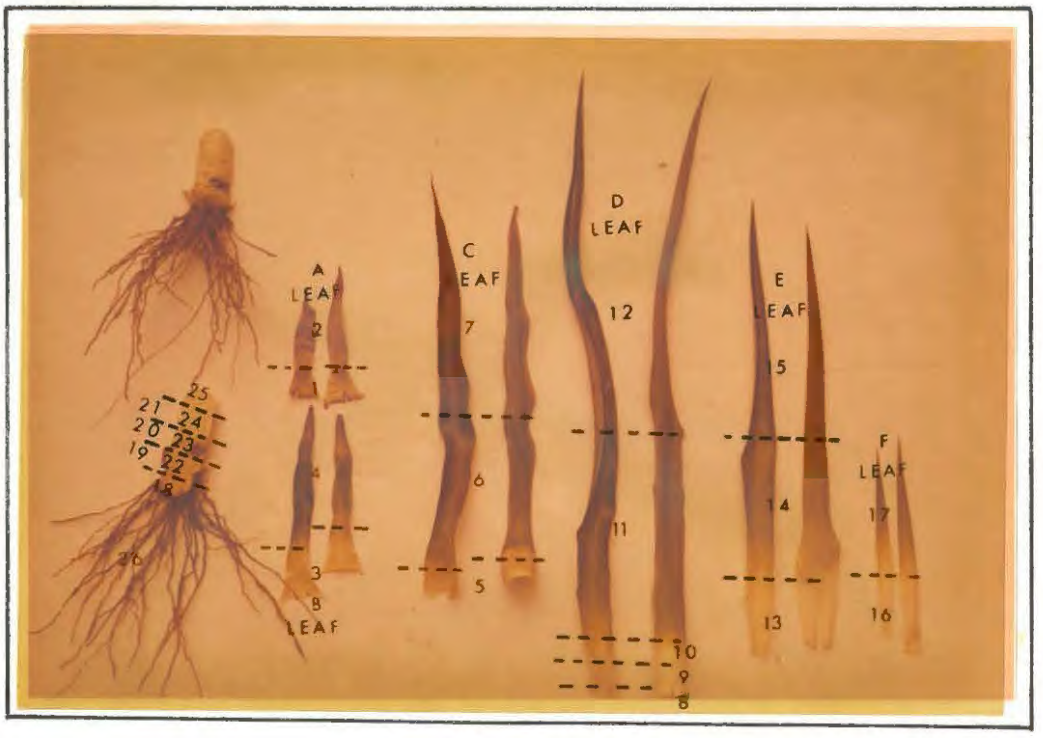


PLATE VI.- Eighteen month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 21st January, 1974.

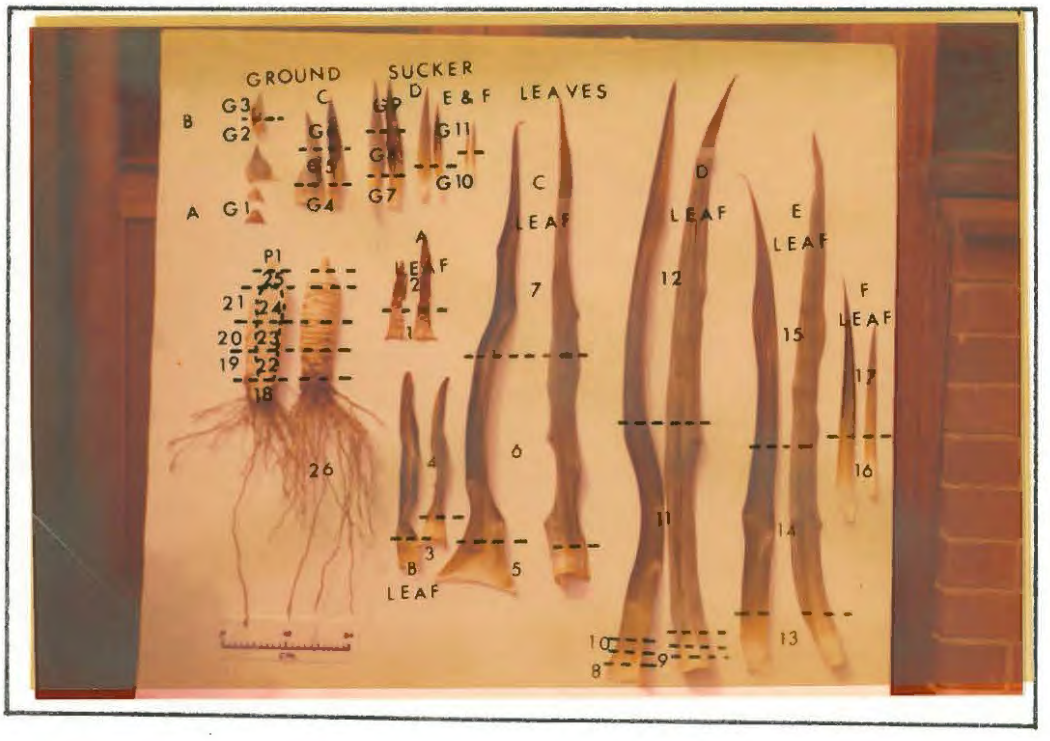
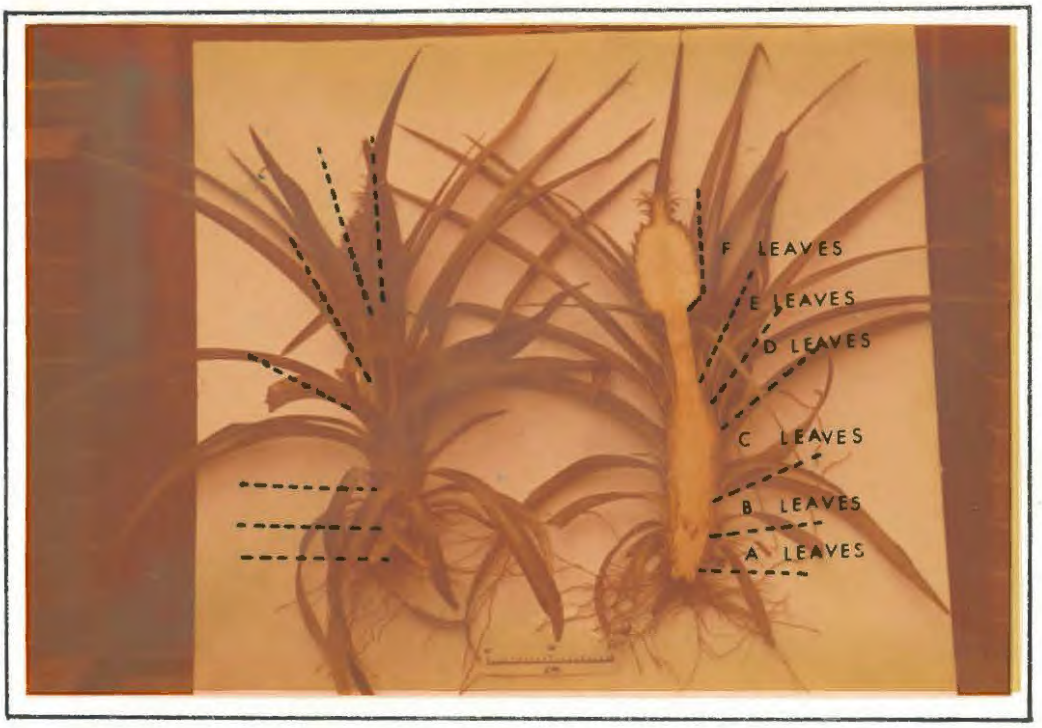


PLATE VII.- Twenty-four month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 15th July, 1974.



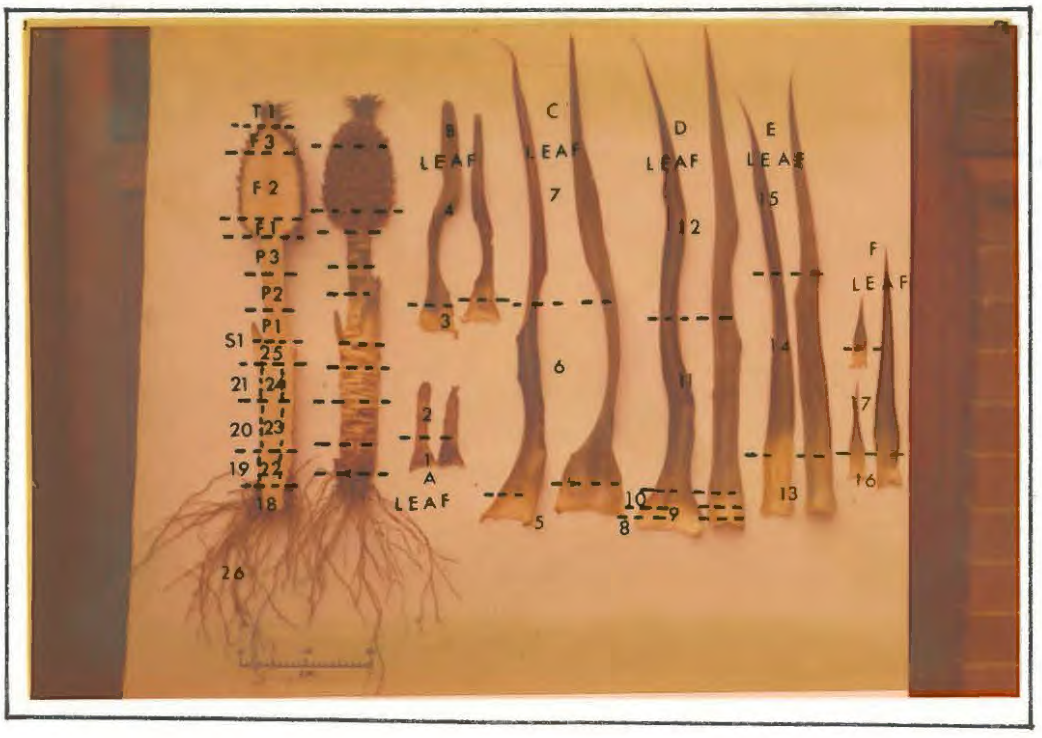


PLATE VIIA.- Twenty-four month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 15th July, 1974. Plants having shown precocious fruiting.

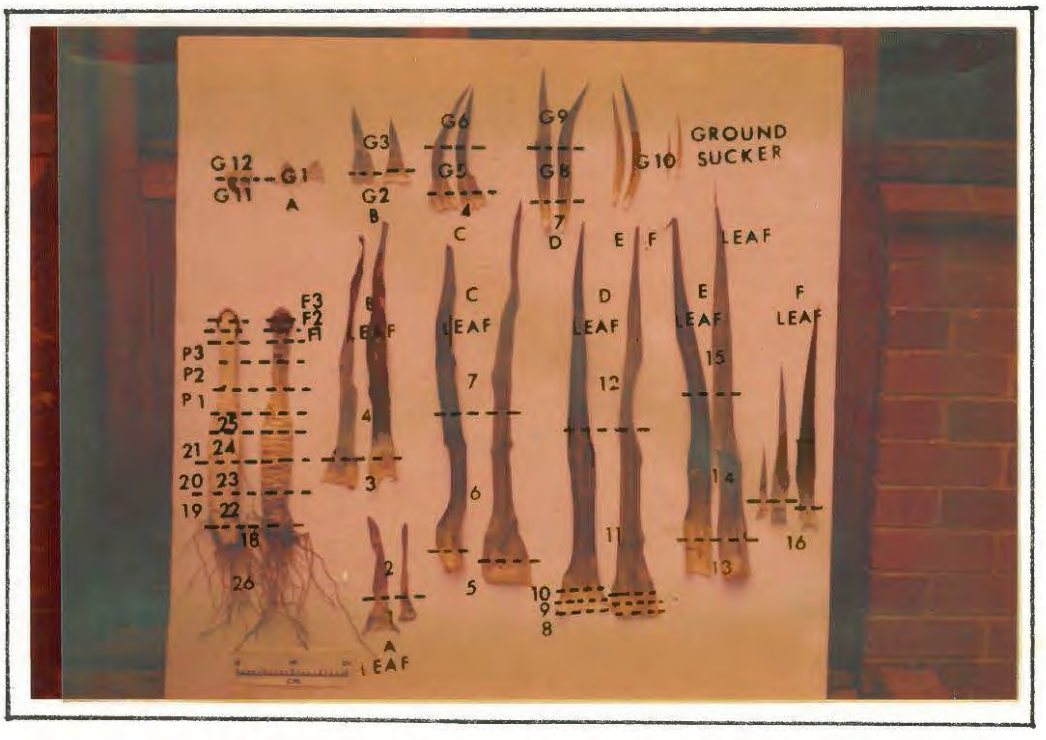


PLATE VIII. Twenty-seven month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 4th November, 1974. Plants having shown natural fruiting.

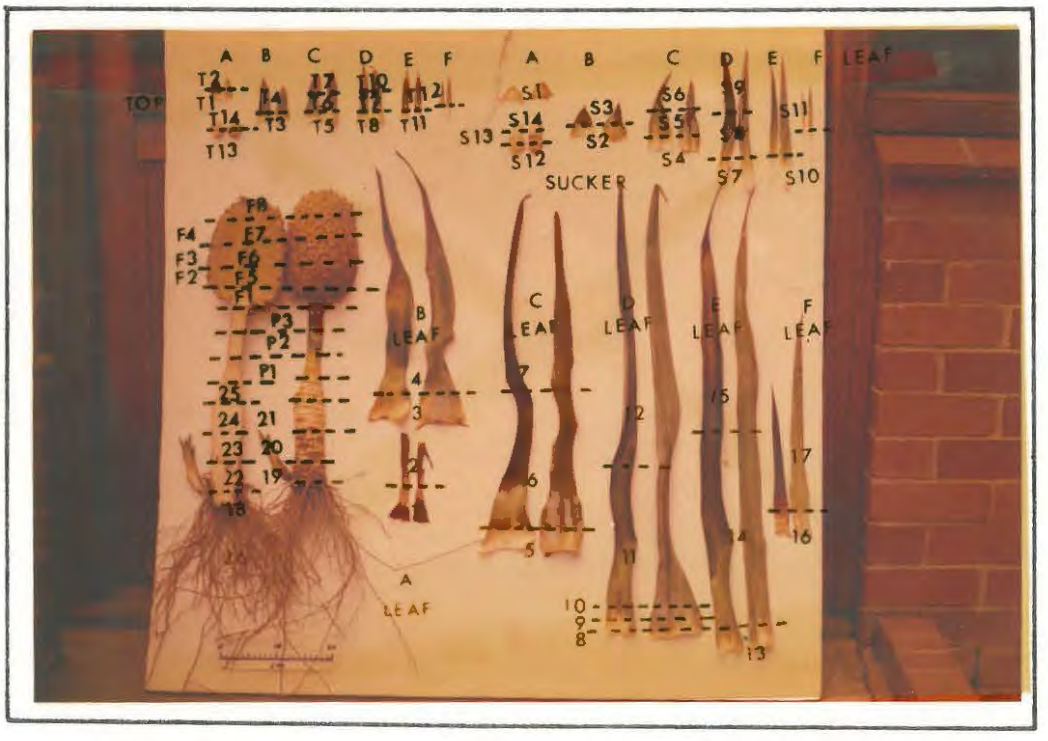
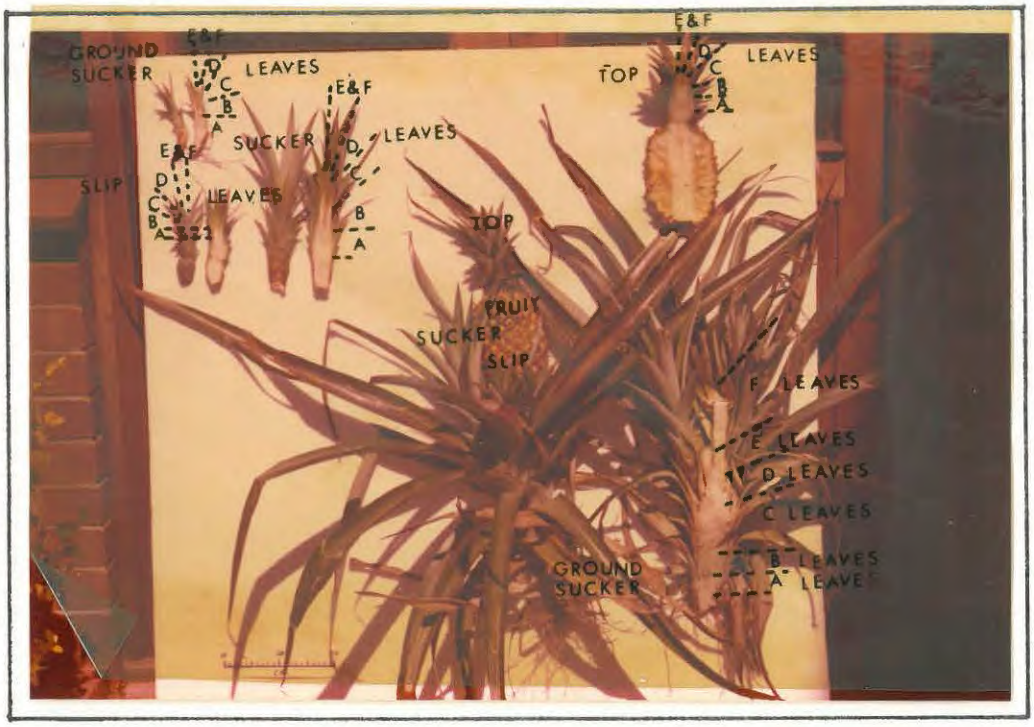


PLATE VIIIA.- Twenty-seven month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 4th November, 1974 just prior to fruit harvest. Plants having shown precocious fruiting.



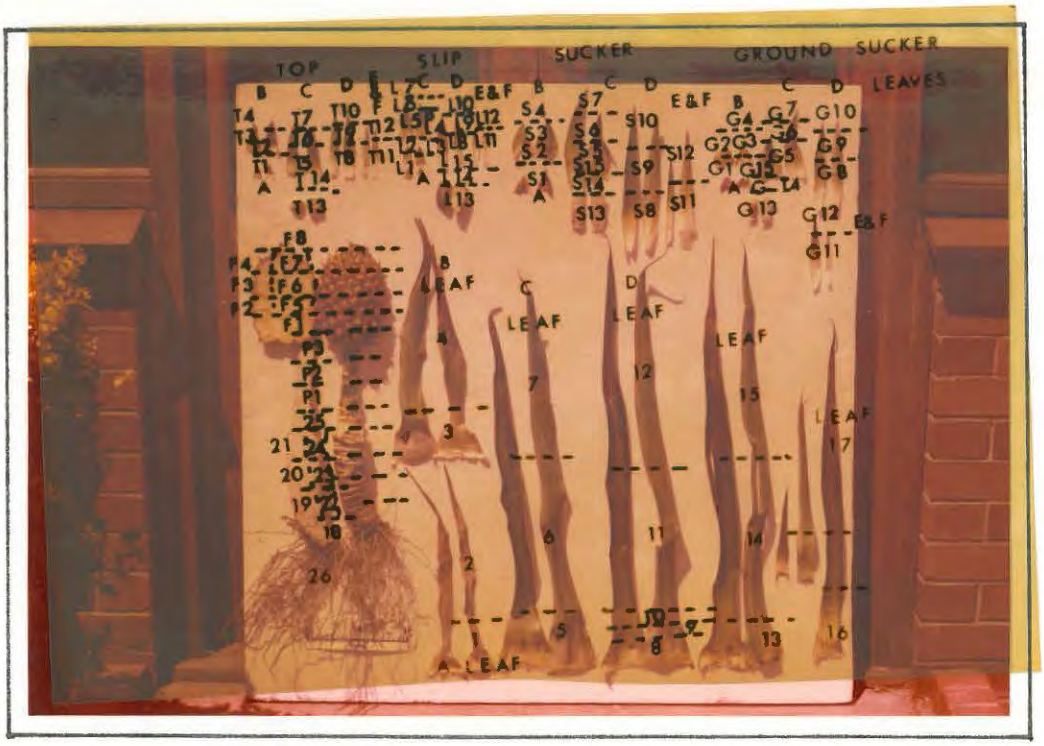


PLATE IX.- Thirty-one month old pineapple plant from Whitney Estate showing parts of plant sampled for analysis. Plants sampled on 24th February, 1975 just prior to fruit harvest. Plants having shown natural fruiting.

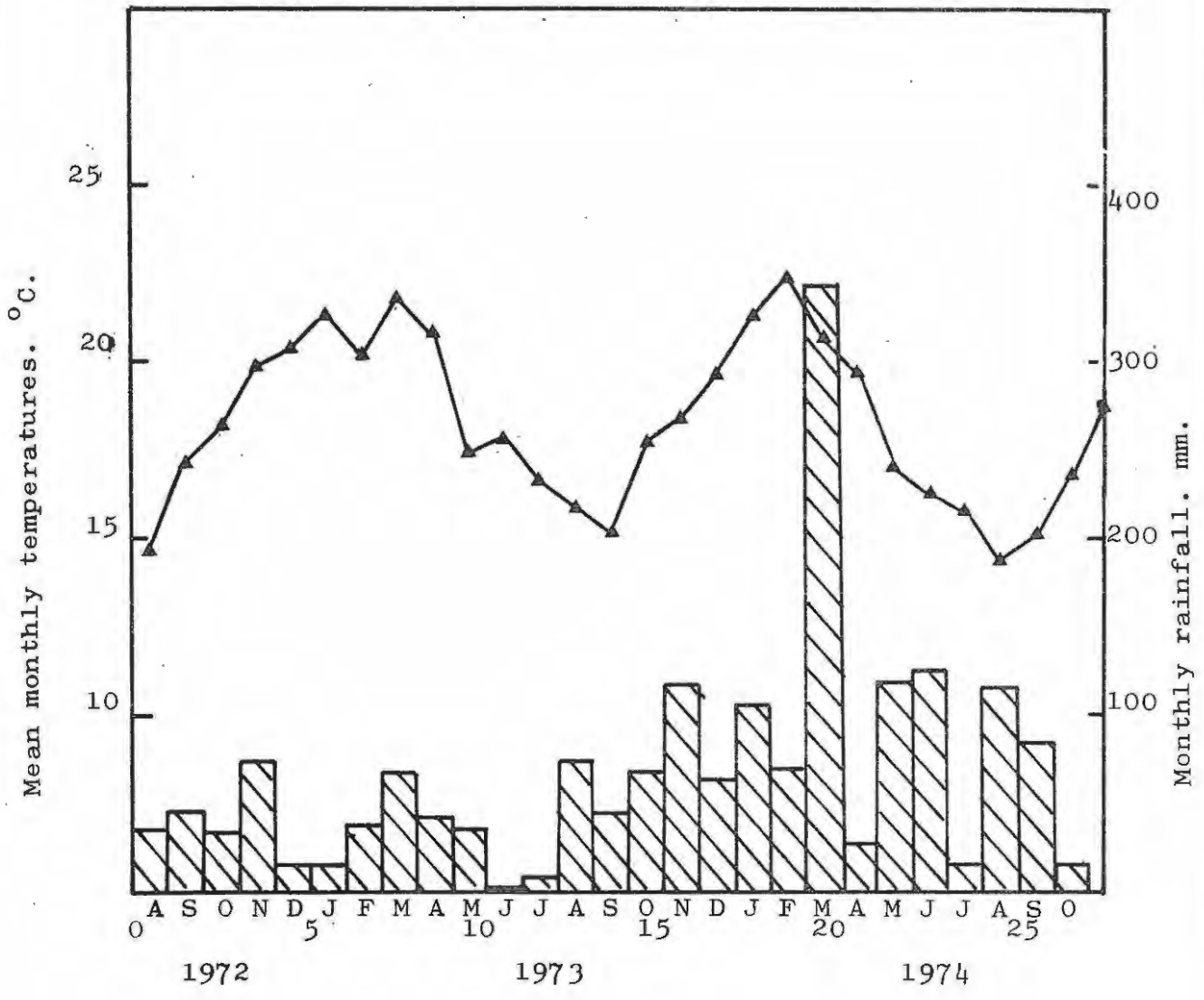


Fig.1. Mean monthly temperatures and rainfall for Bathurst during experimental period.

Temperatures. Rainfall.

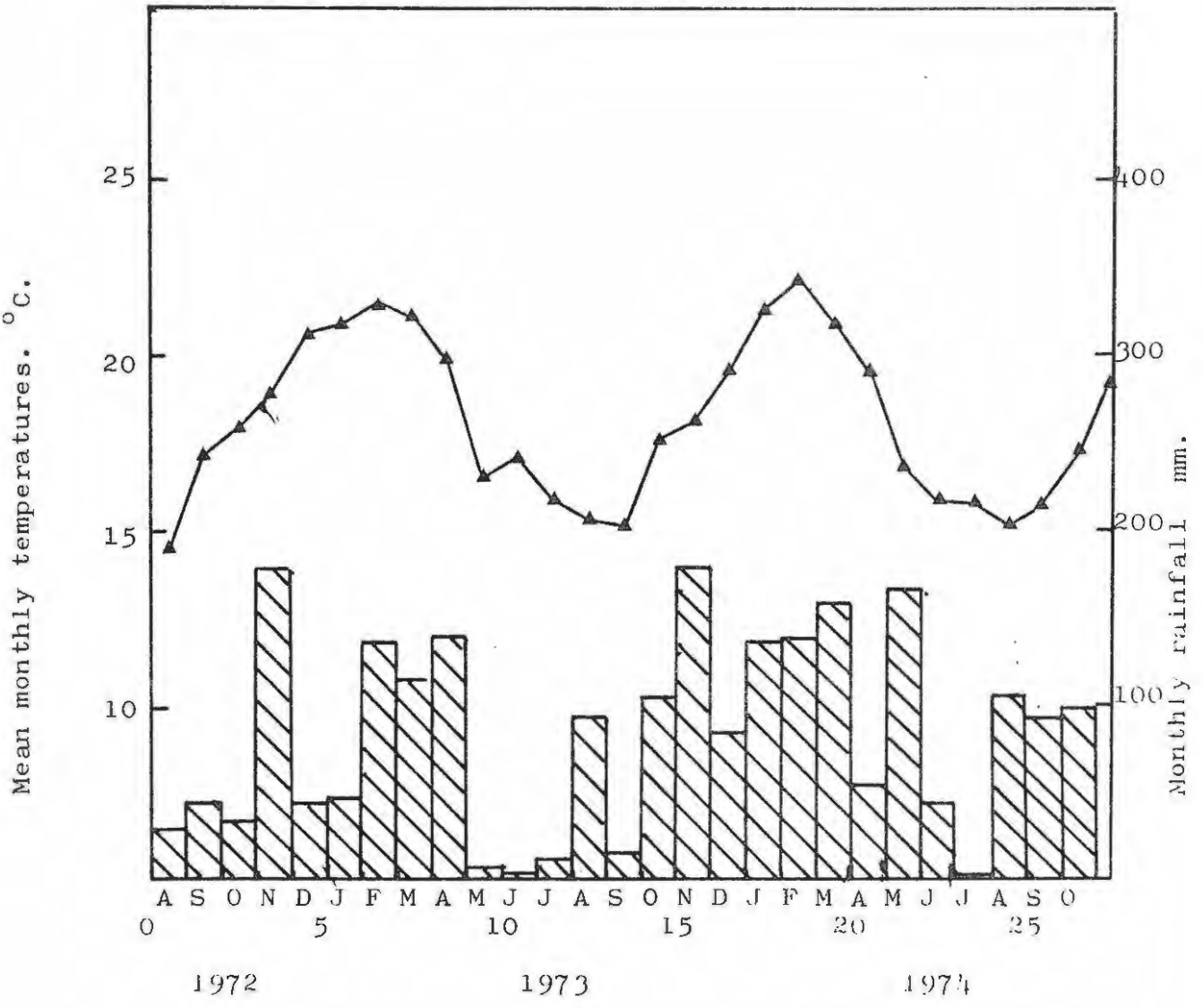


Fig. 2. Mean monthly temperatures and rainfall for East London during experimental period.

Temperatures. Rainfall.

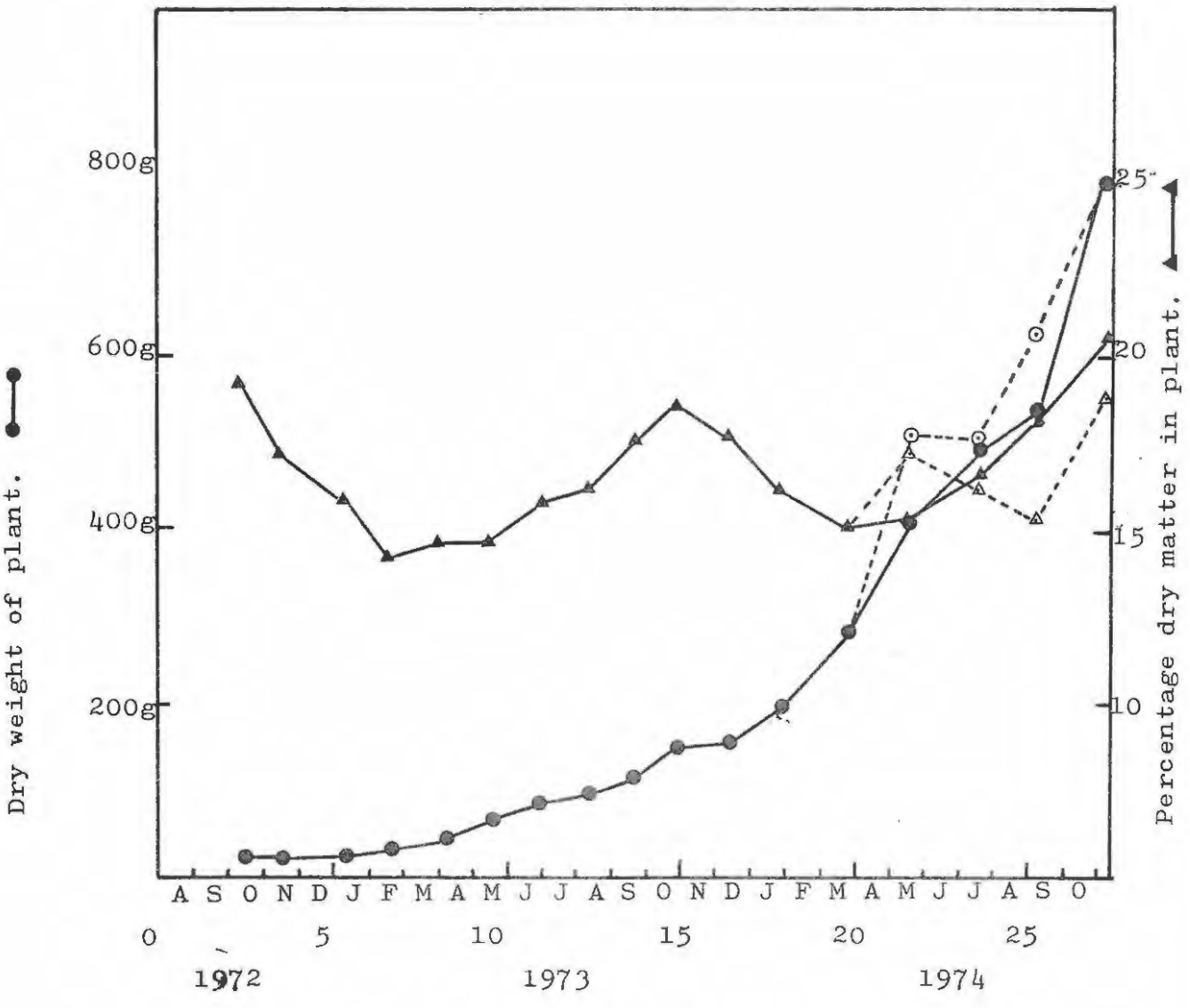


Fig.3. Variation of plant dry weight and percentage dry matter with time in pineapple plants from Whitney Estate.

——— Plants showing natural fruiting. ------ Plants showing early fruiting.

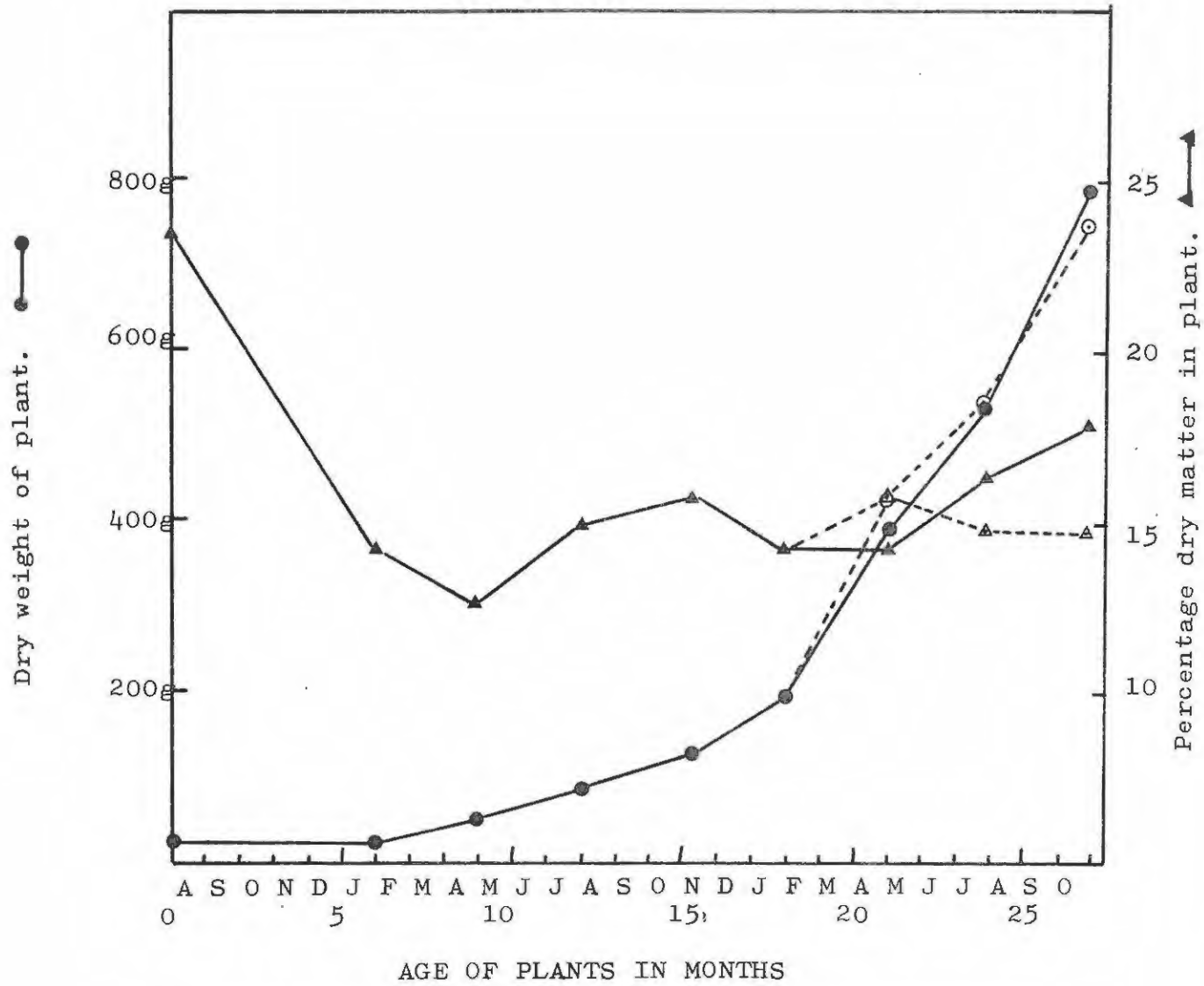


Fig.4. Variation of plant dry weight and percentage dry matter with time in pineapple plants from Shelford Pineries.

——— Plants showing natural fruiting. ------ Plants showing early fruiting.

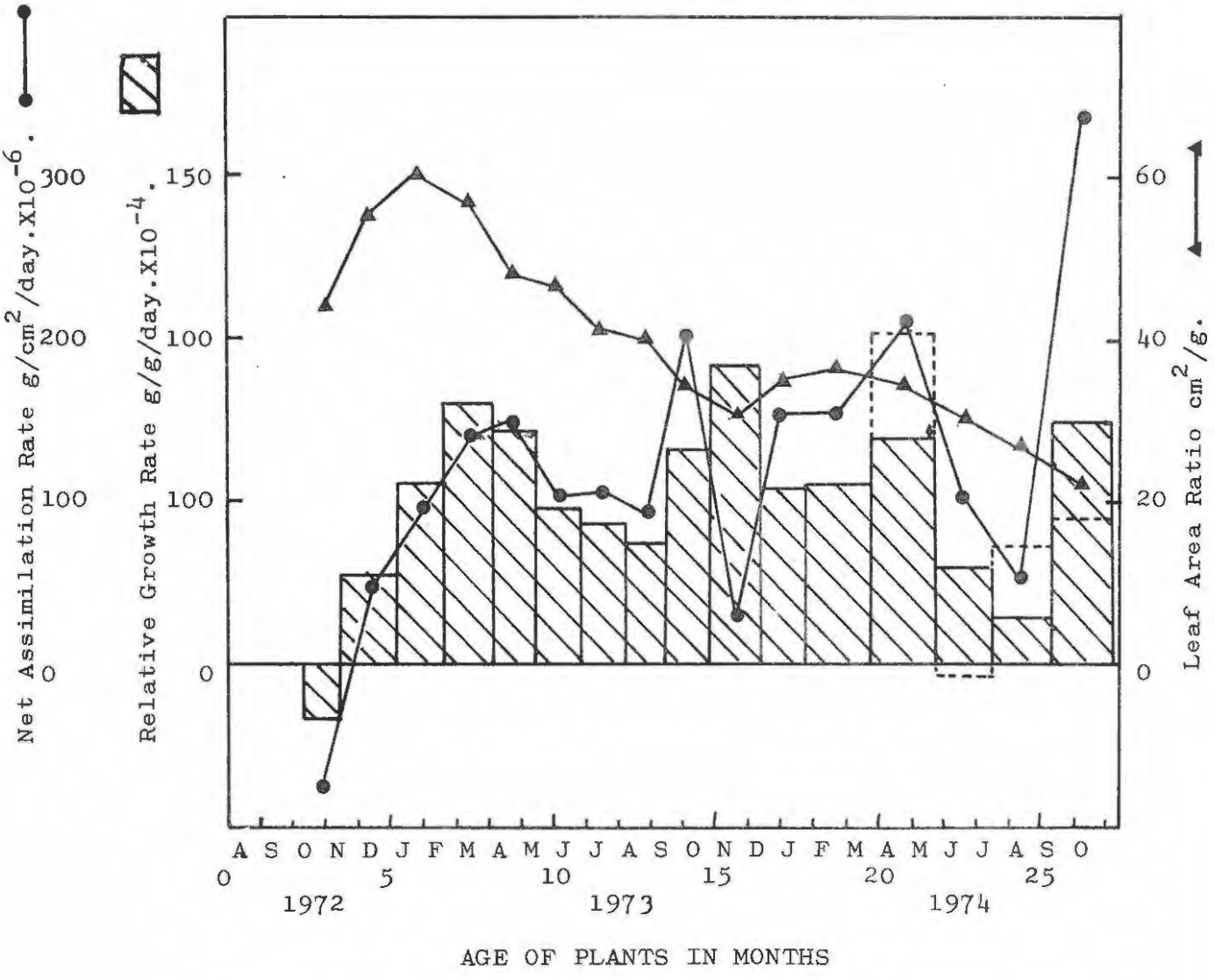


Fig. 5. Variation in relative growth rate (RGR), net assimilation rate (NAR), and leaf area ratio(LAR), with time in pineapple plants sampled at Whitney Estate.

Plants showing natural fruiting. Plants showing early fruiting.

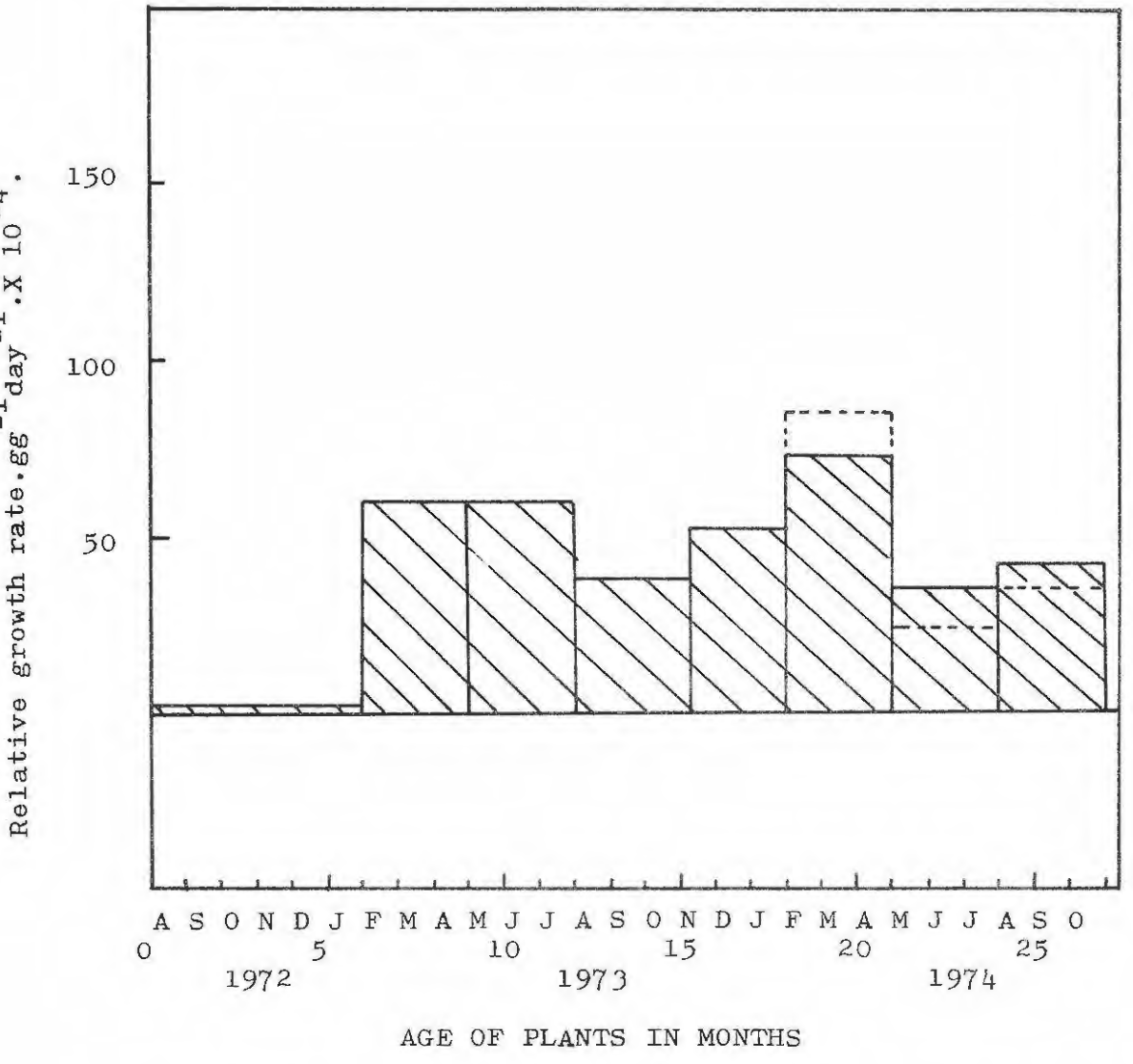


Fig. 6. Variation in relative growth rate (RGR), with time in pineapple plants sampled at Shelford Pineries.

Plants showing natural fruiting.

Plants showing early fruiting.

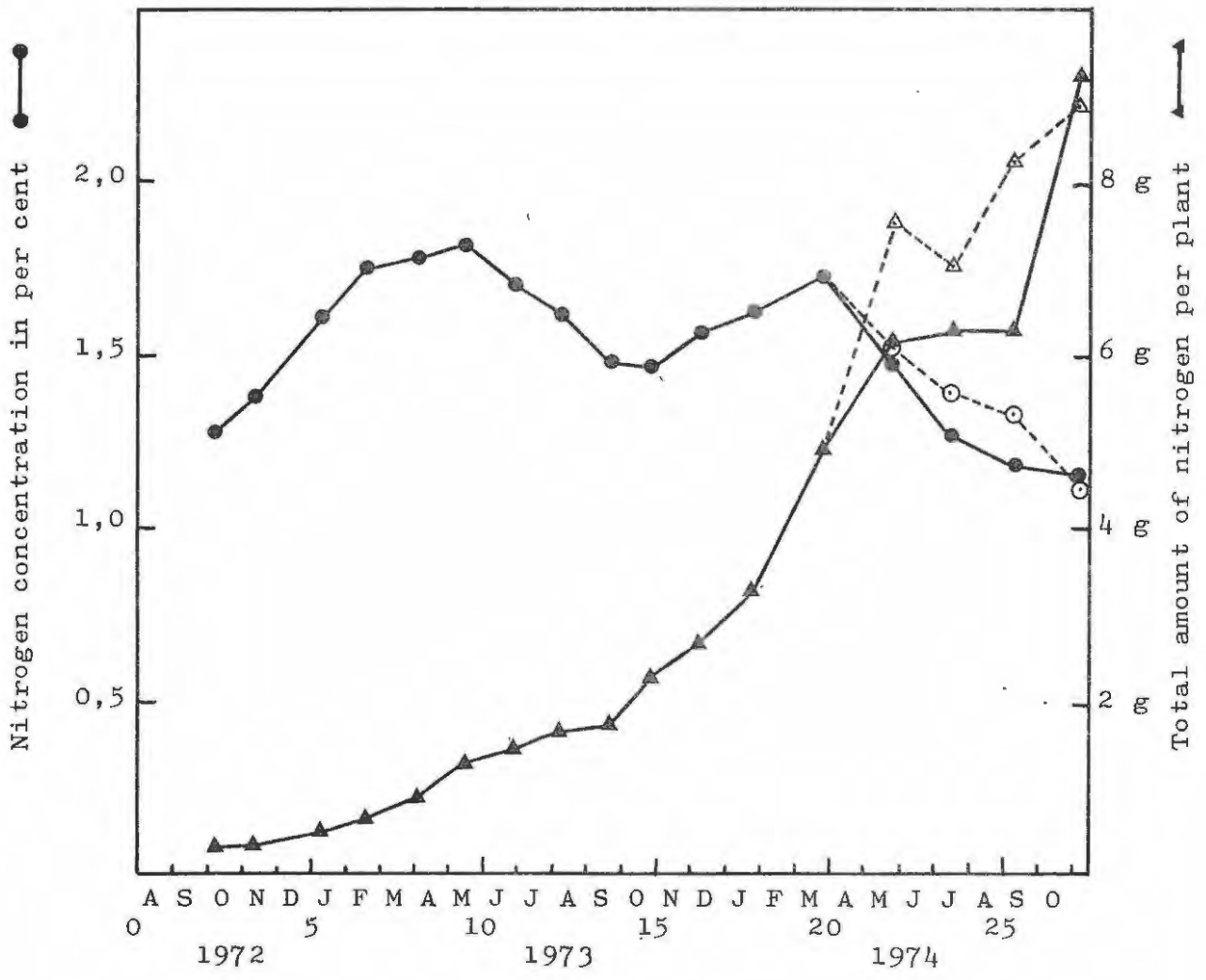


Fig. 7. Variation of nitrogen with time in pineapple plants from Whitney Estate

——— Plants showing natural fruiting

------ Plants showing early fruiting

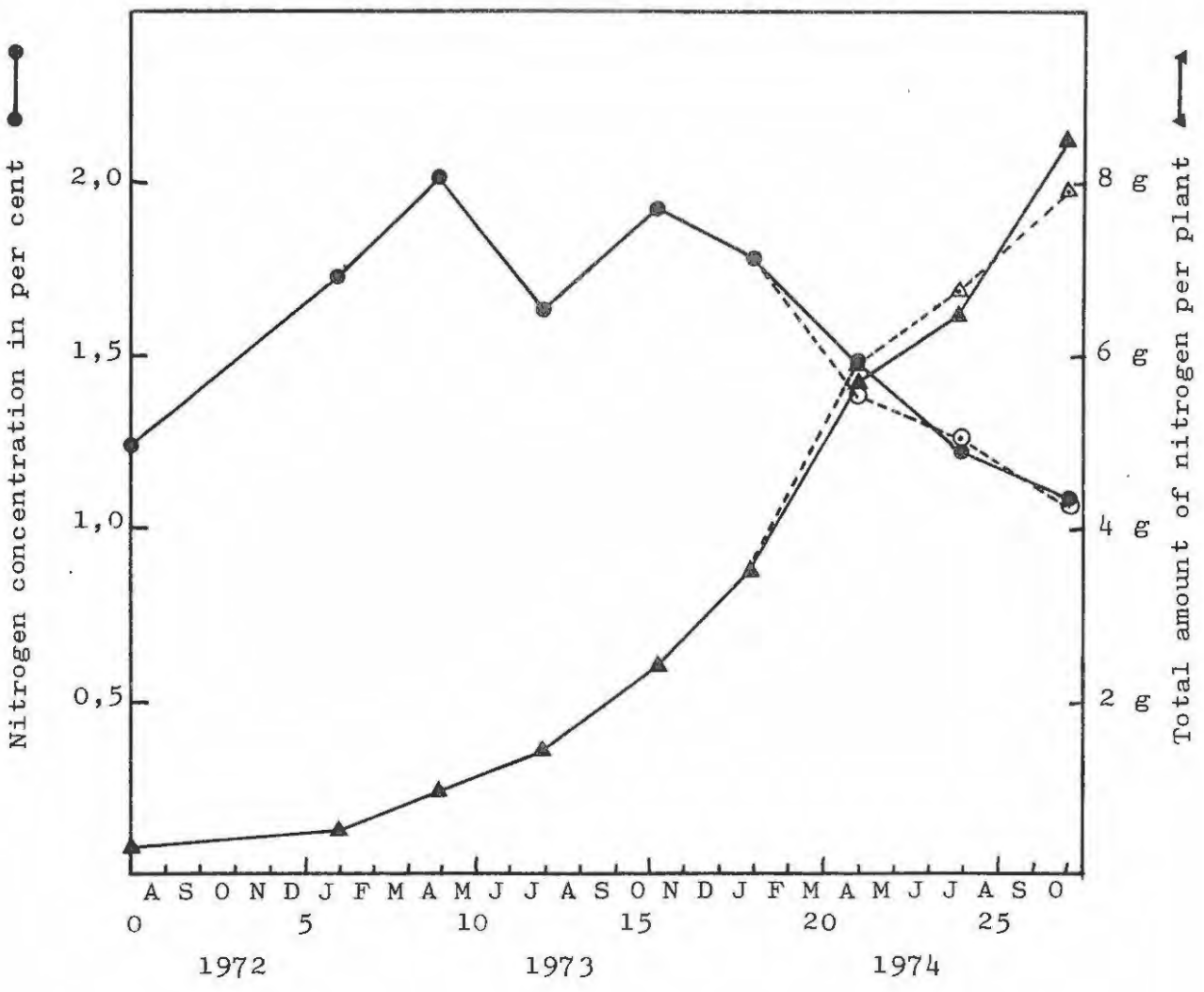


Fig.8. Variation of nitrogen with time in pineapple plants from Shelford Farm

——— Plants showing natural fruiting

- - - - - Plants showing early fruiting

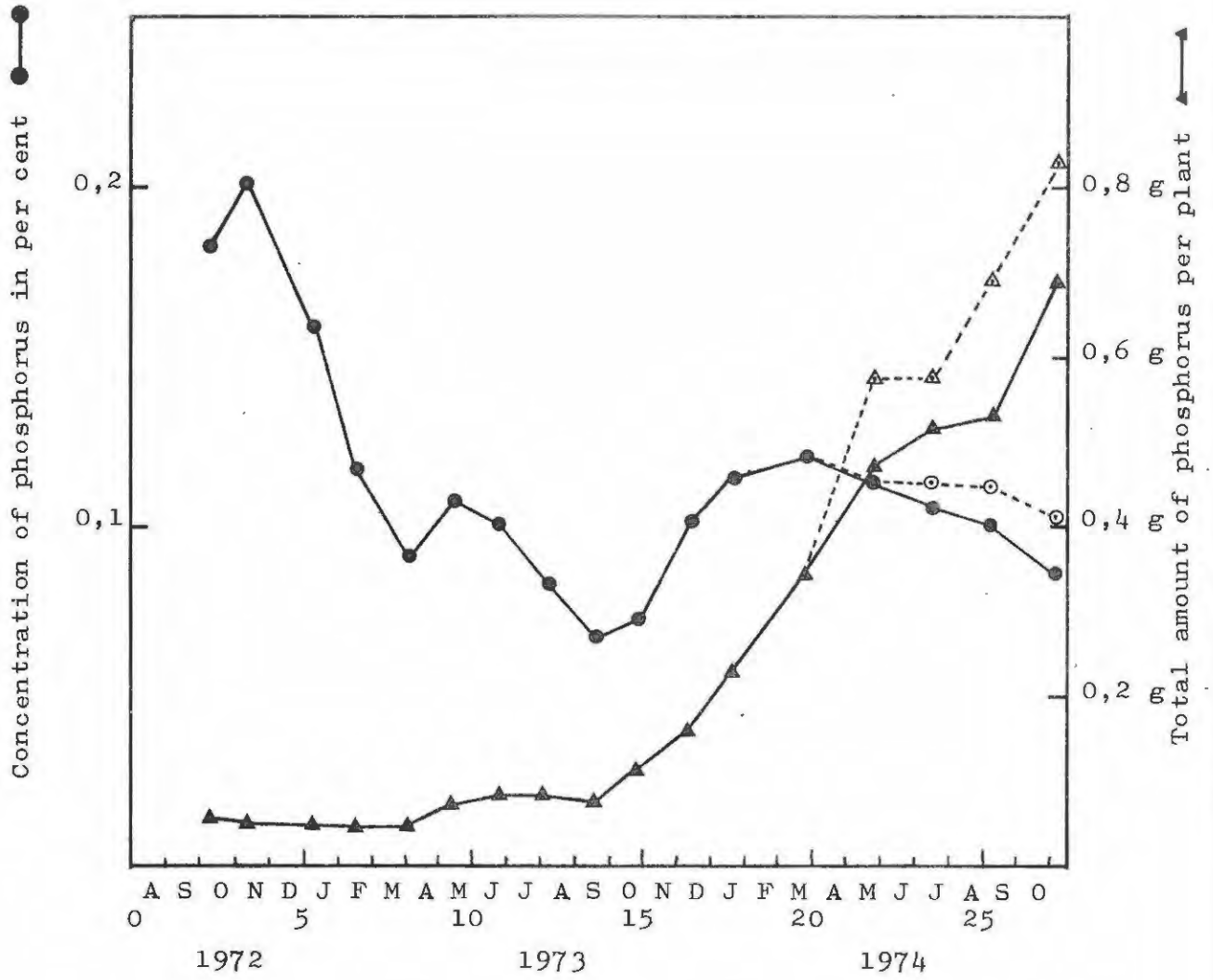


Fig. 9. Variation of phosphorus with time in pineapple plants from Whitney Estate

——— Plants showing natural fruiting

- - - - - Plants showing early fruiting

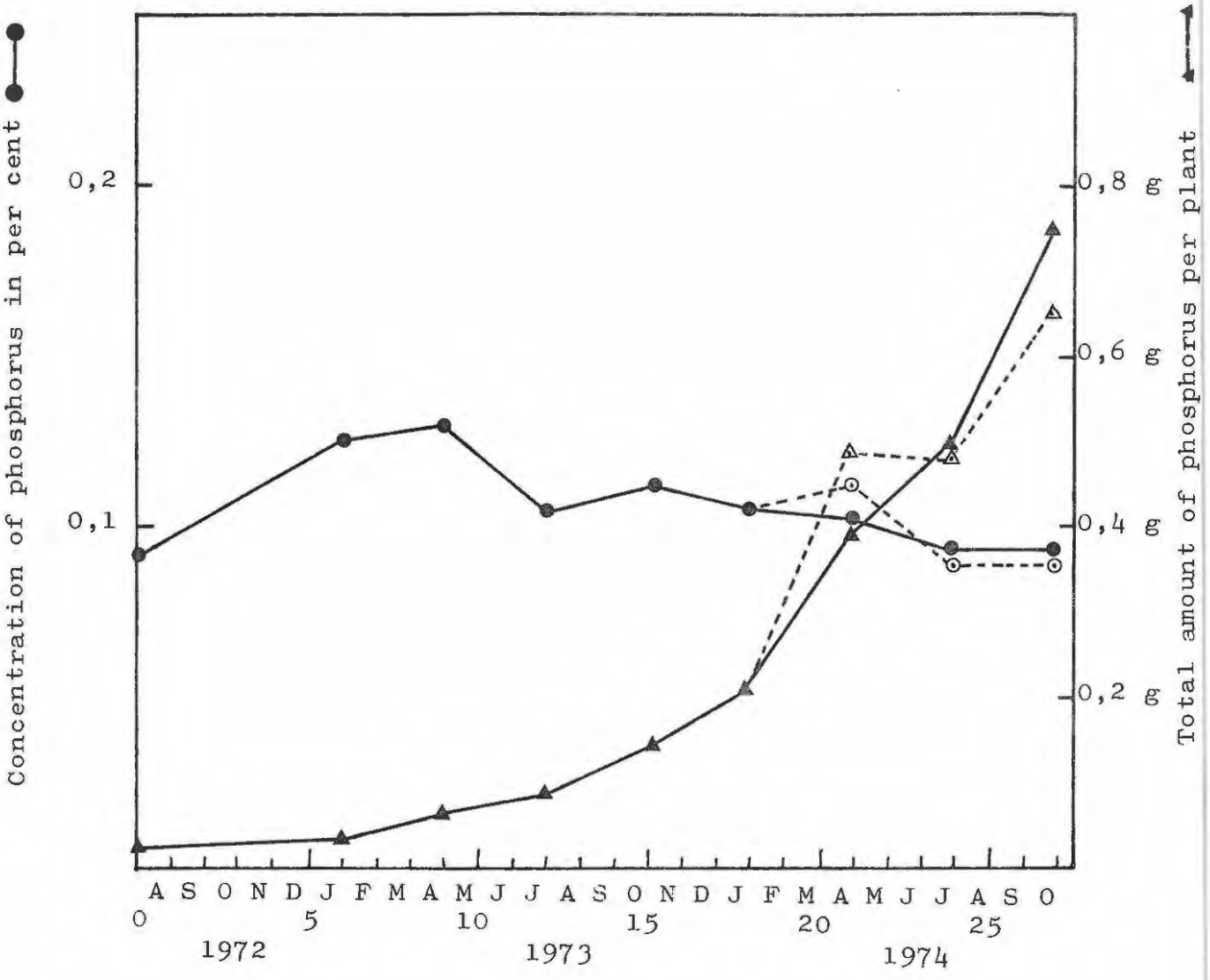


Fig. 10. Variation of phosphorus with time in pineapple plants from Shelford Farm

——— Plants showing natural fruiting

- - - - - Plants showing early fruiting

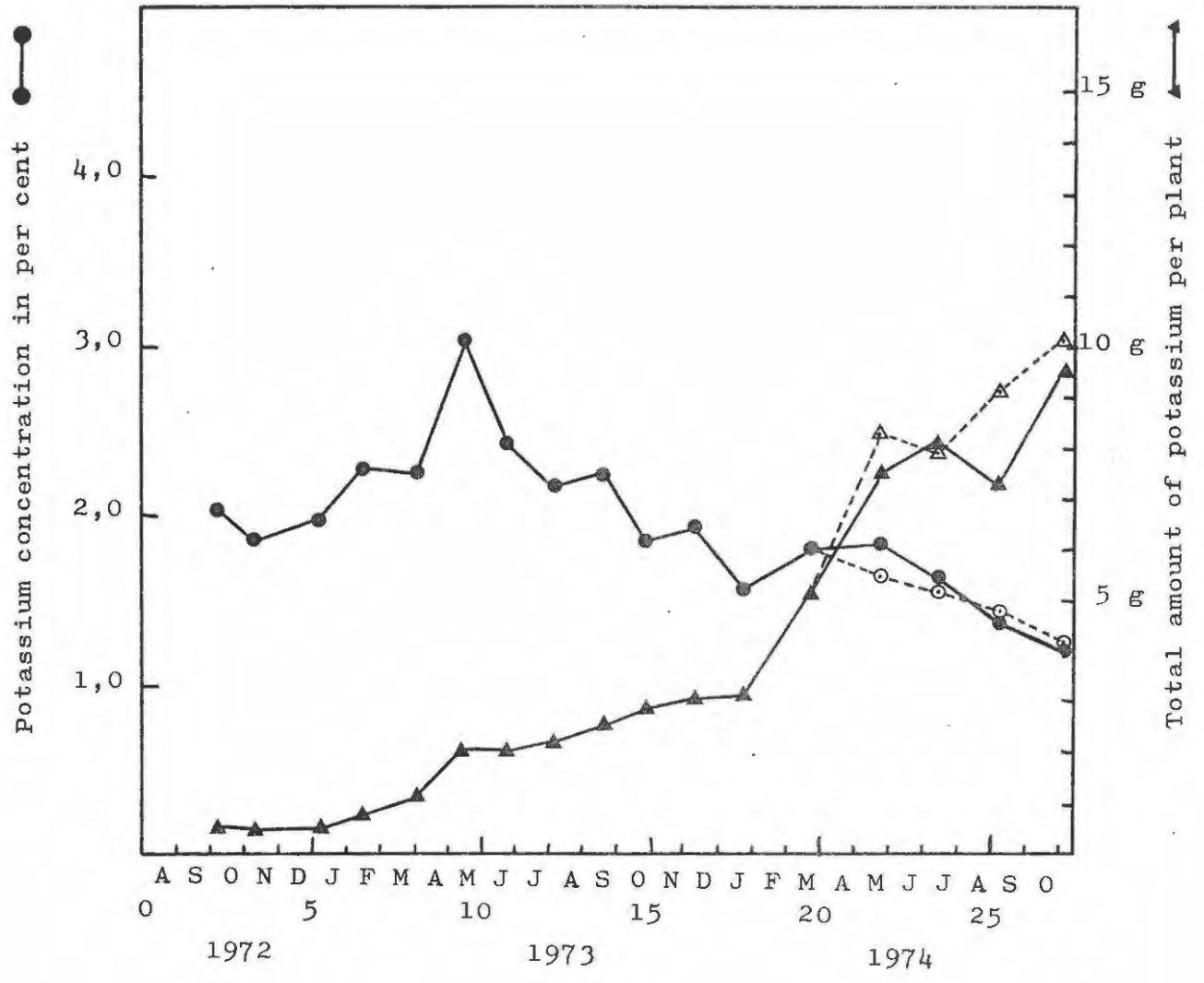


Fig. 11. Variation of potassium with time in pineapple plants from Whitney Estate

——— Plants showing natural fruiting

- - - - - - Plants showing early fruiting

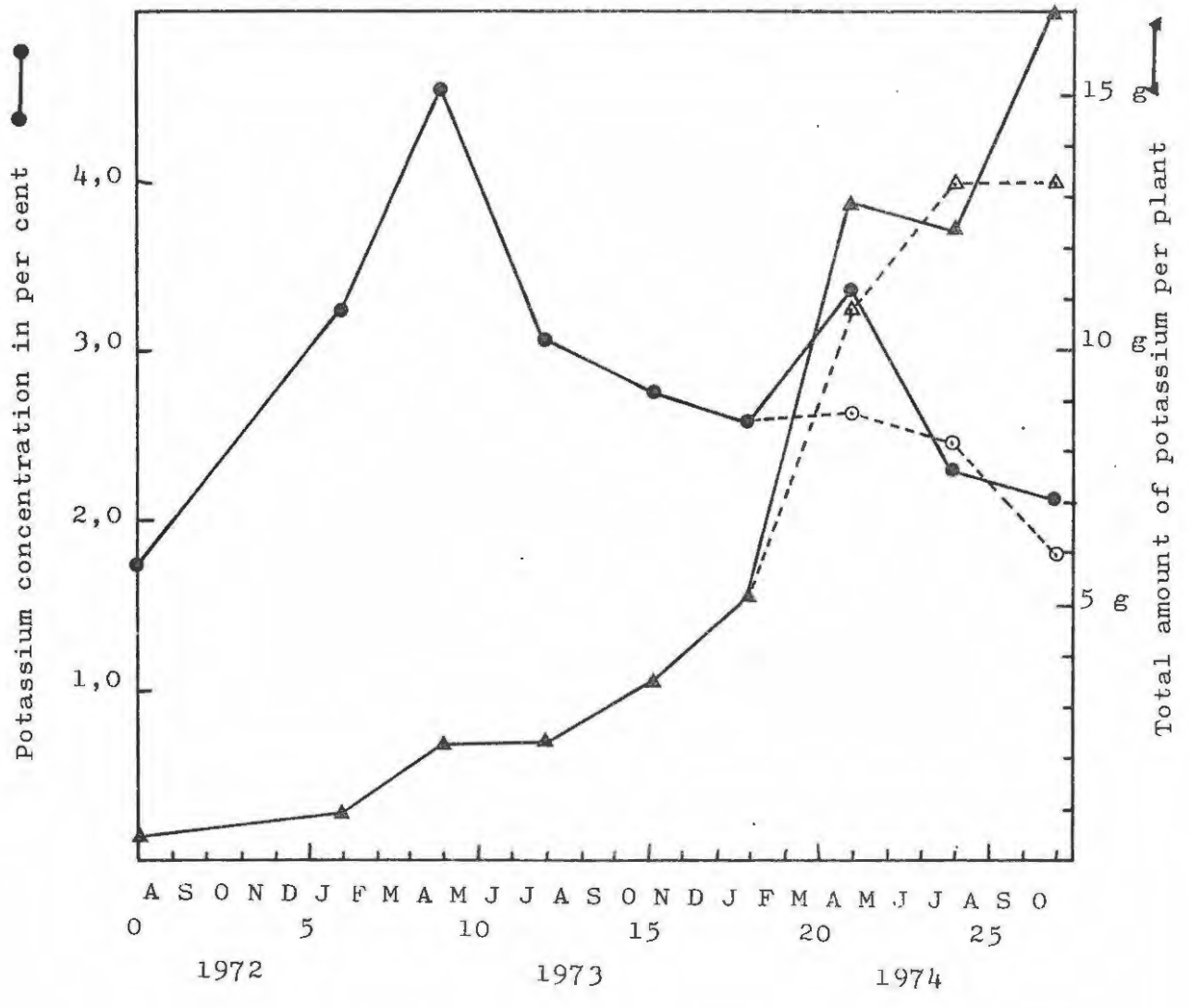


Fig.12. Variation of potassium with time in pineapple plants from Shelford Farm

——— Plants showing natural fruiting

- - - - - - Plants showing early fruiting

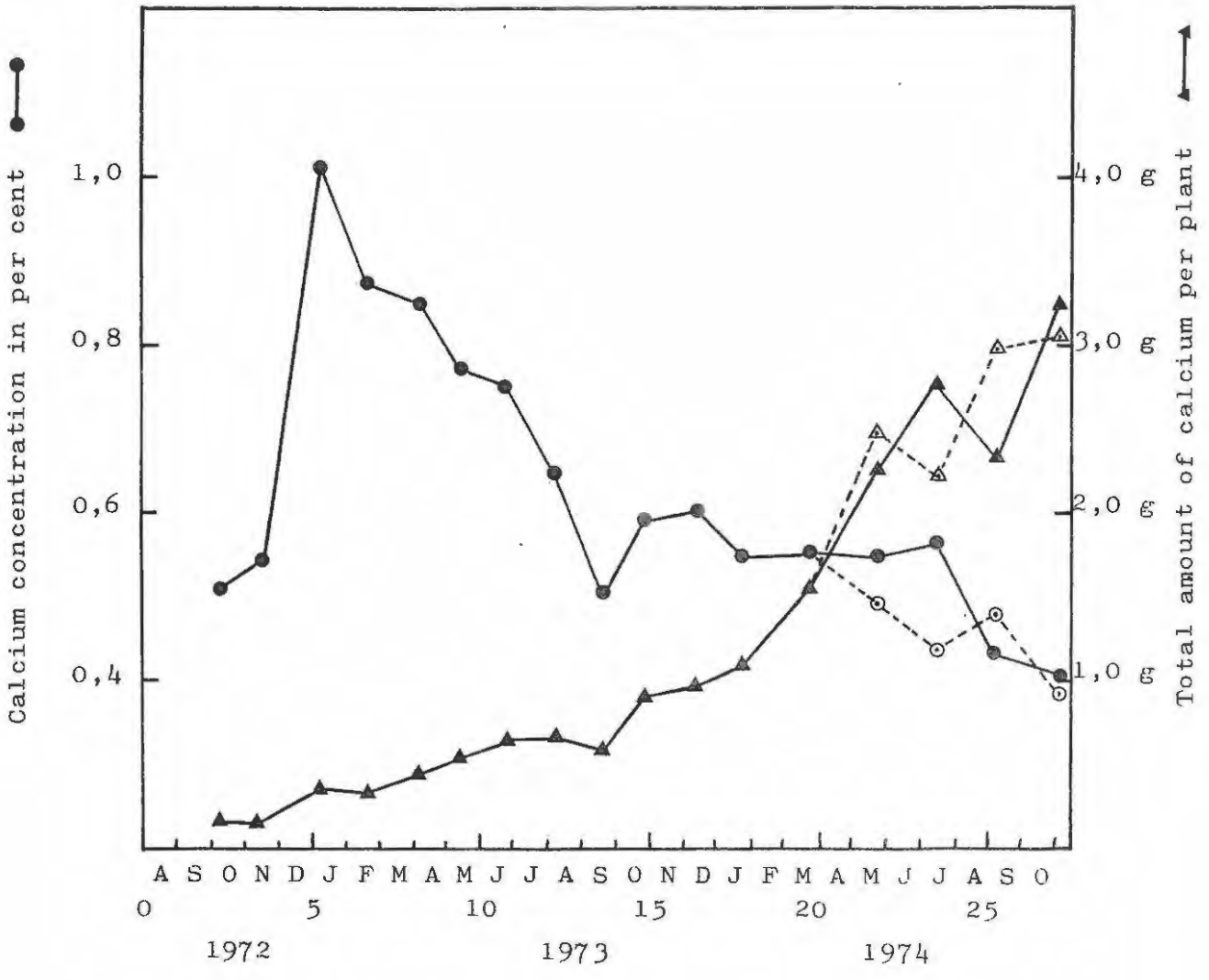


Fig. 13. Variation of calcium with time in pineapple plants from Whitney Estate

——— Plants showing natural fruiting

- - - - - - Plants showing early fruiting

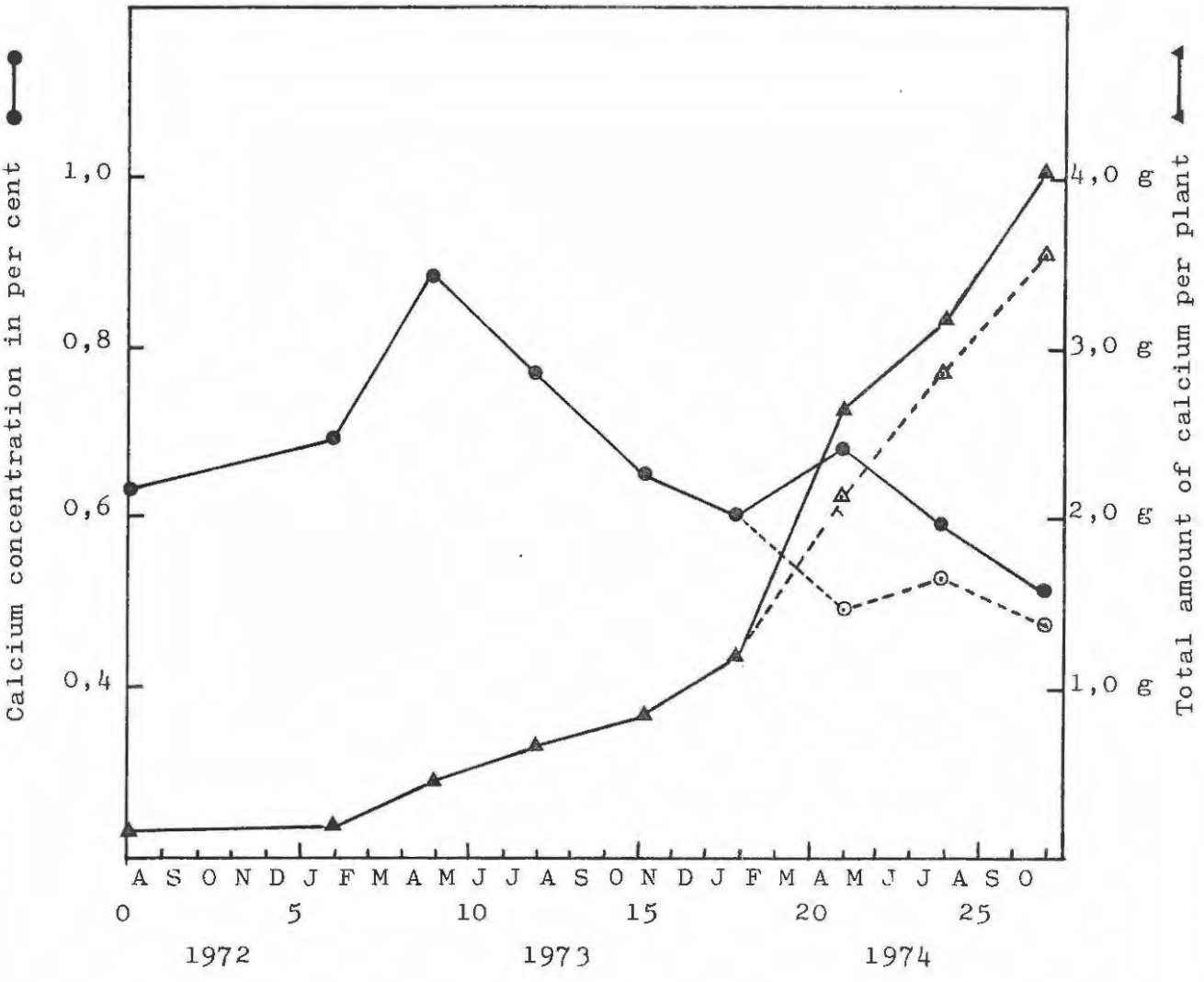


Fig.14. Variation of calcium with time in pineapple plants from Shelford Farm

——— Plants showing natural fruiting

- - - - - - Plants showing early fruiting

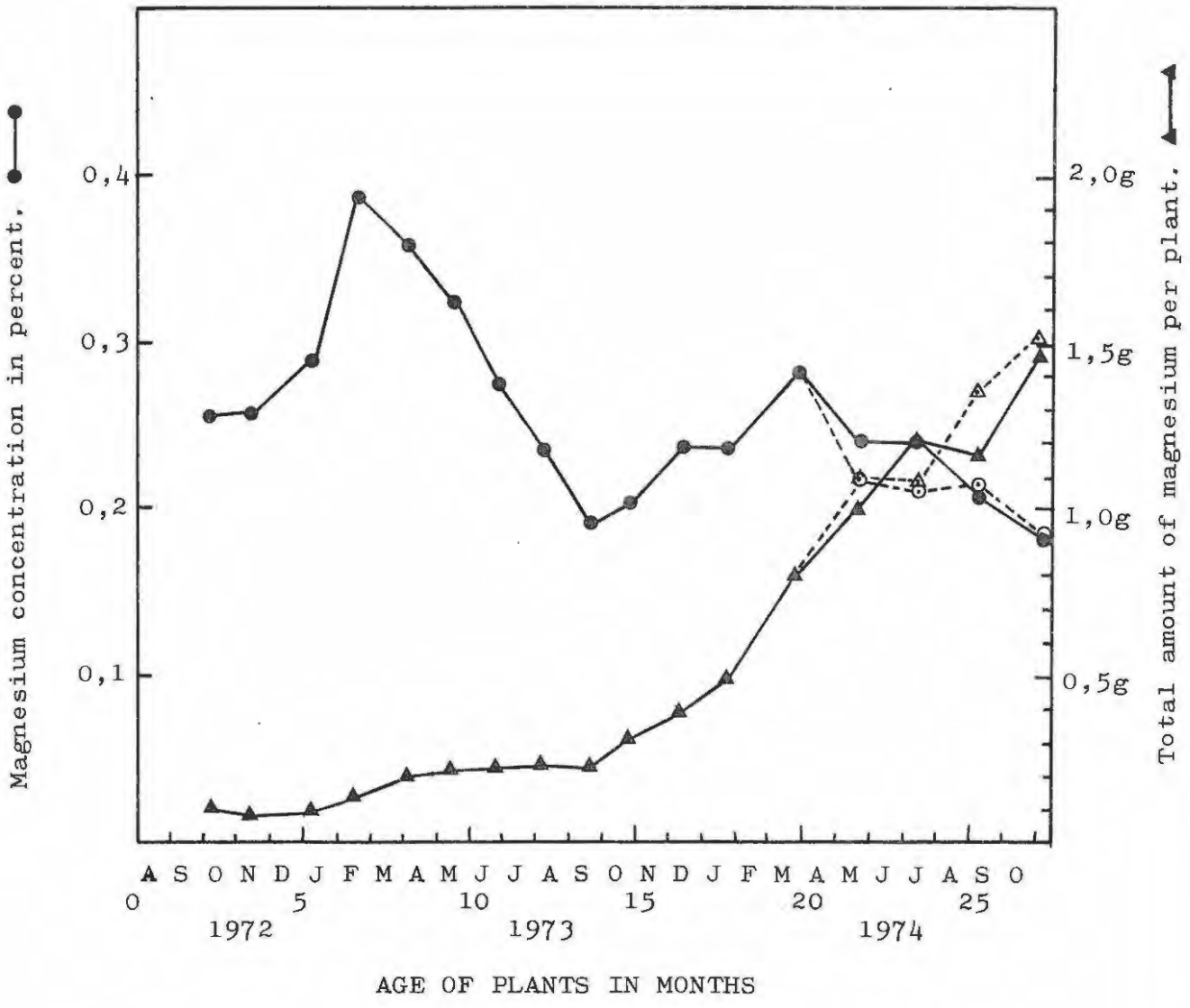


Fig. 15. Variation of magnesium with time in pineapple plants from Whitney Estate.

——— Plants showing natural fruiting

------ Plants showing natural fruiting

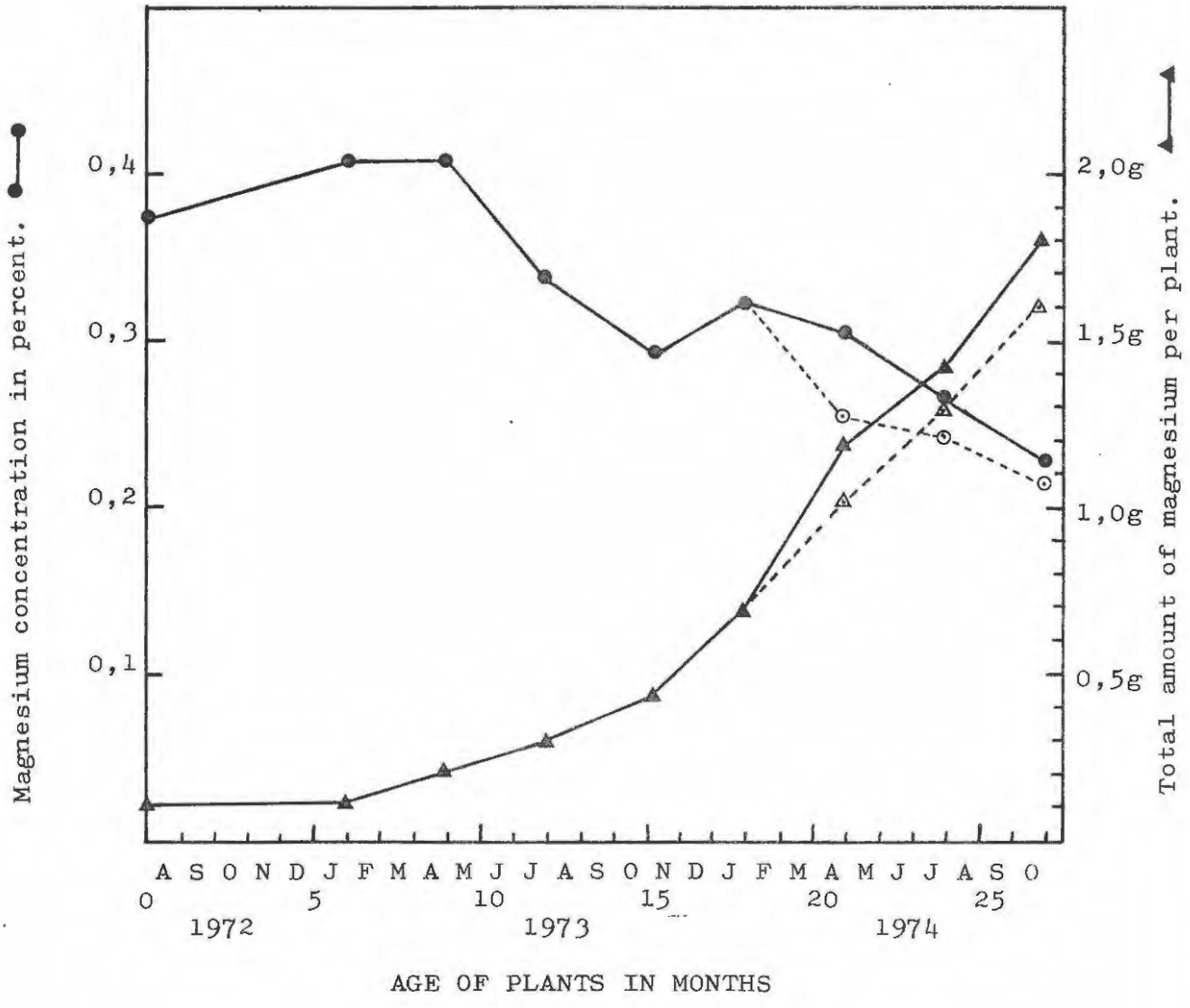


Fig. 16. Variation of magnesium with time in pineapple plants from Shelford Pineries.

——— Plants showing natural fruiting

------ Plants showing early fruiting

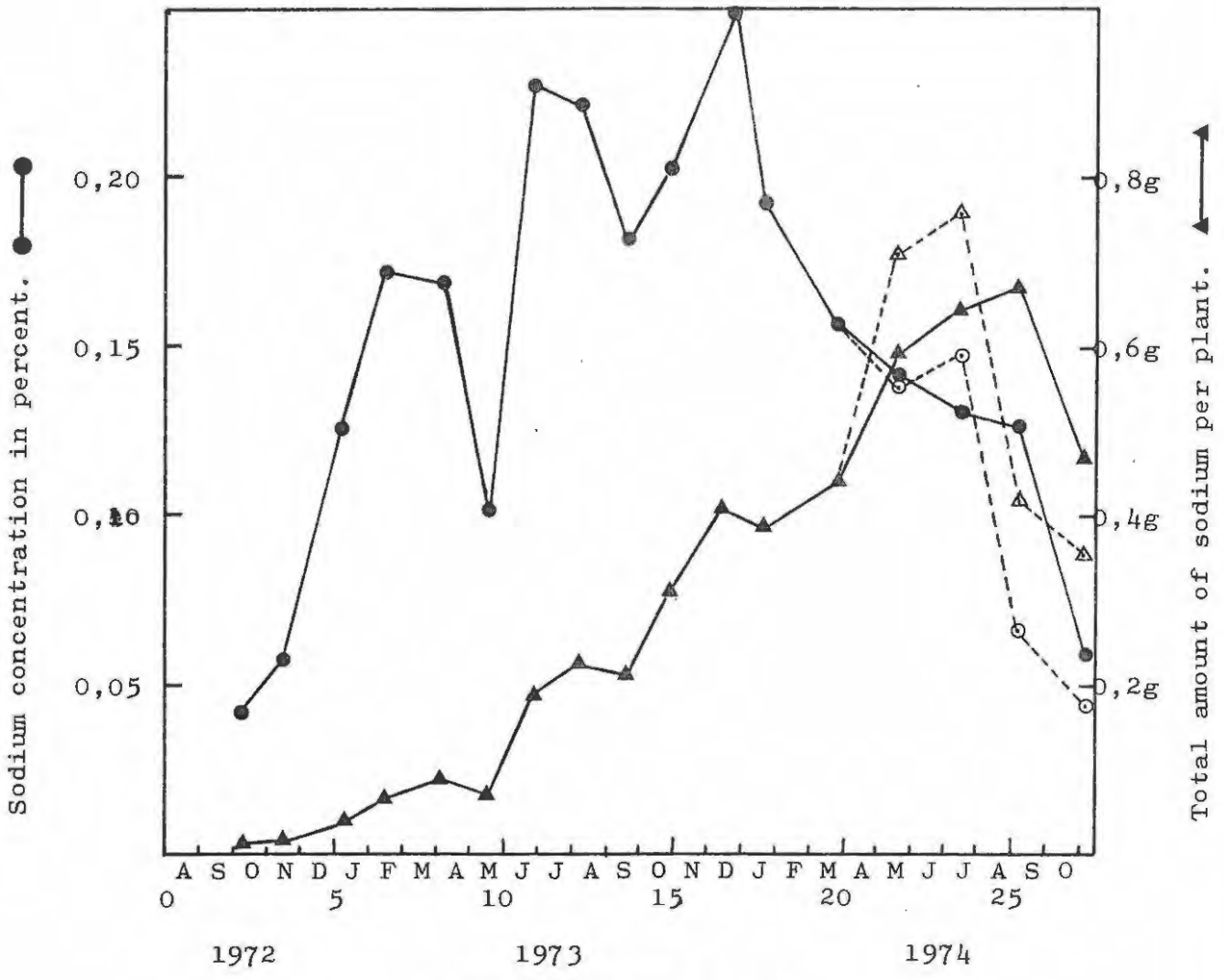


Fig. 17. Variation of sodium with time in pineapple plants from Whitney Estate.

——— Plants showing natural fruiting

------ Plants showing early fruiting

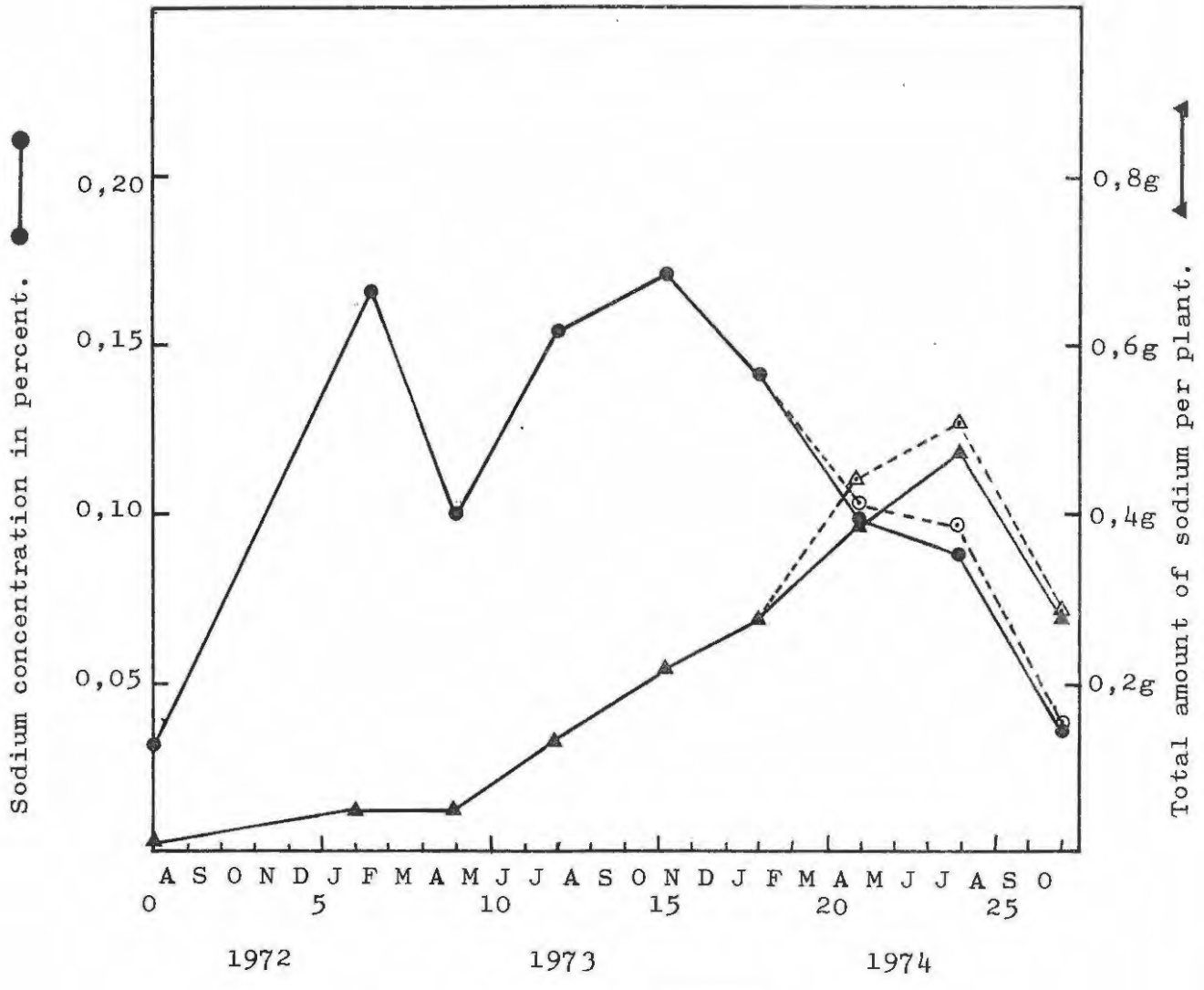


Fig. 18. Variation of sodium with time in pineapple plants from Shelford Farm.

——— Plants showing natural fruiting

- - - - - - Plants showing early fruiting

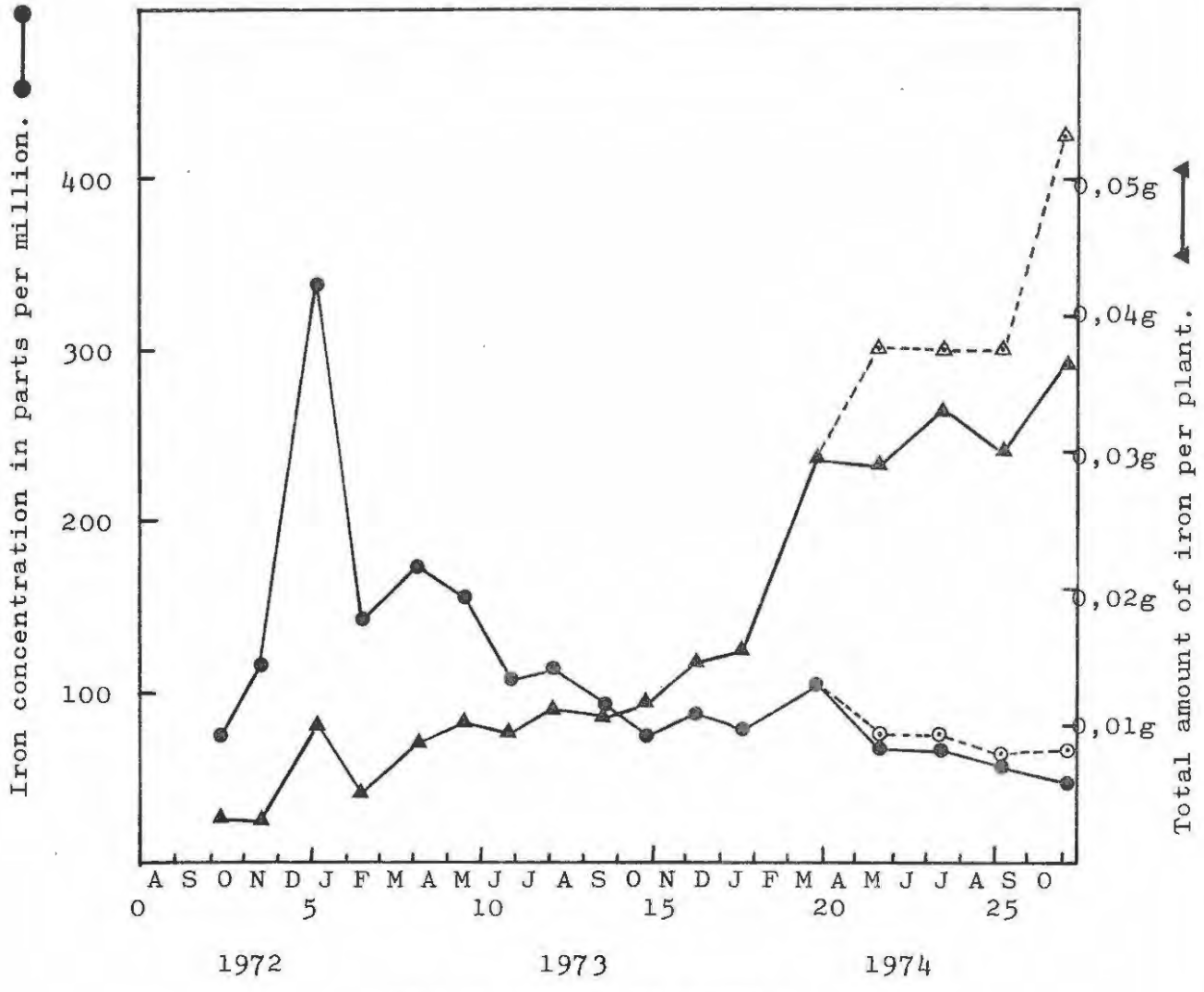


Fig.19. Variation of iron with time in pineapple plants from Whitney Estate.

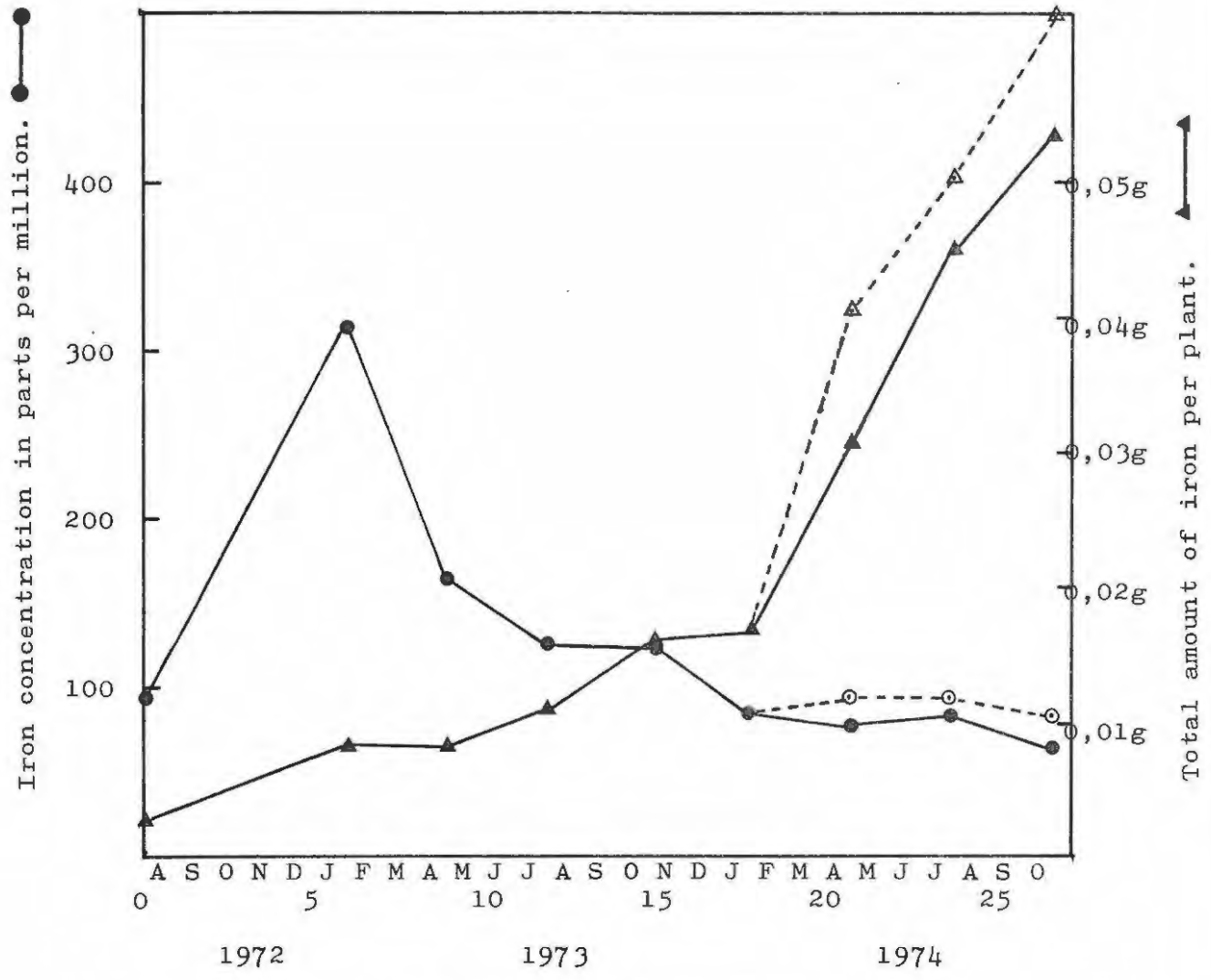


Fig. 20. Variation of iron with time in pineapple plants from Shelford Farm.

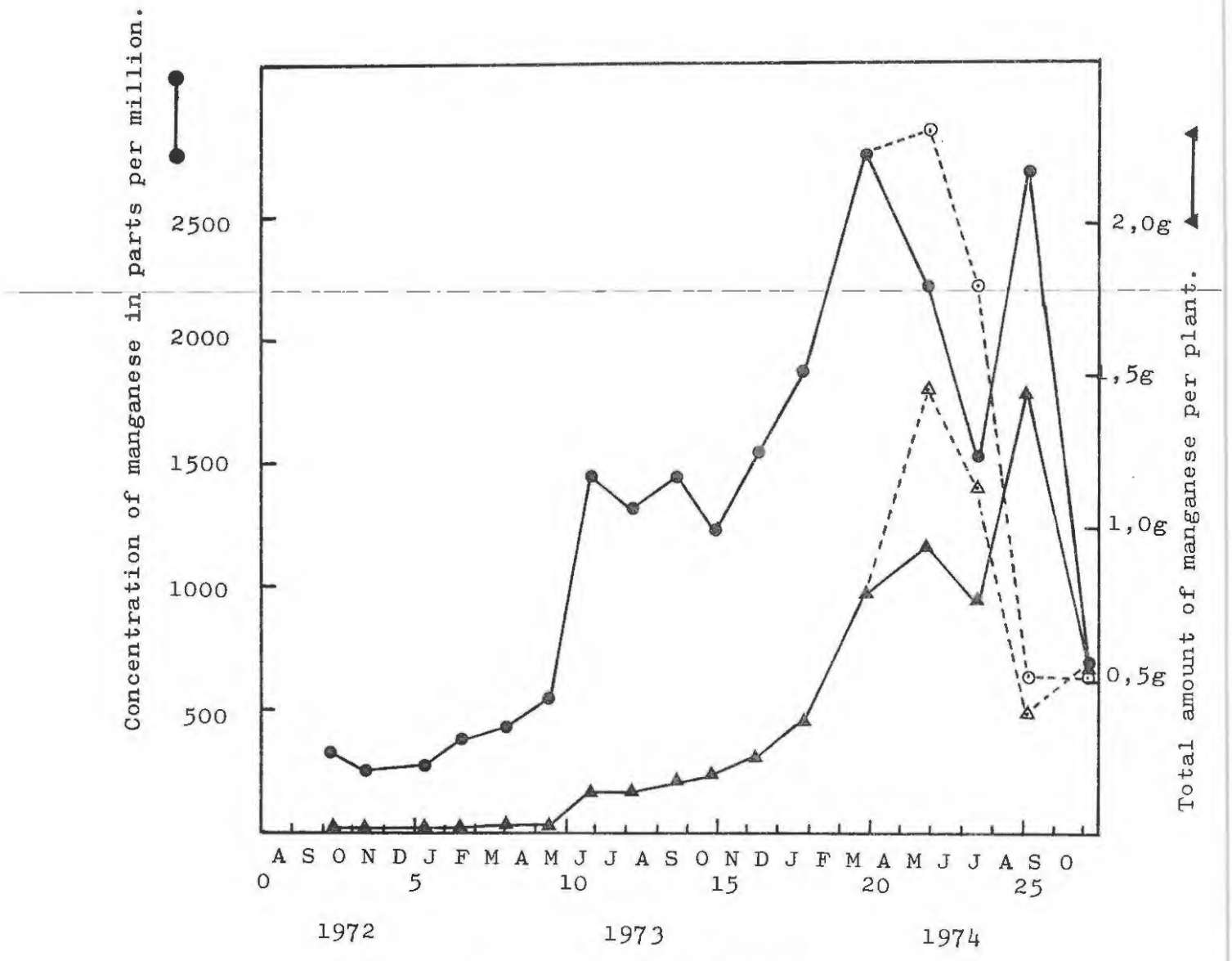


Fig. 21. Variation of manganese with time in pineapple plants from Whitney Estate.

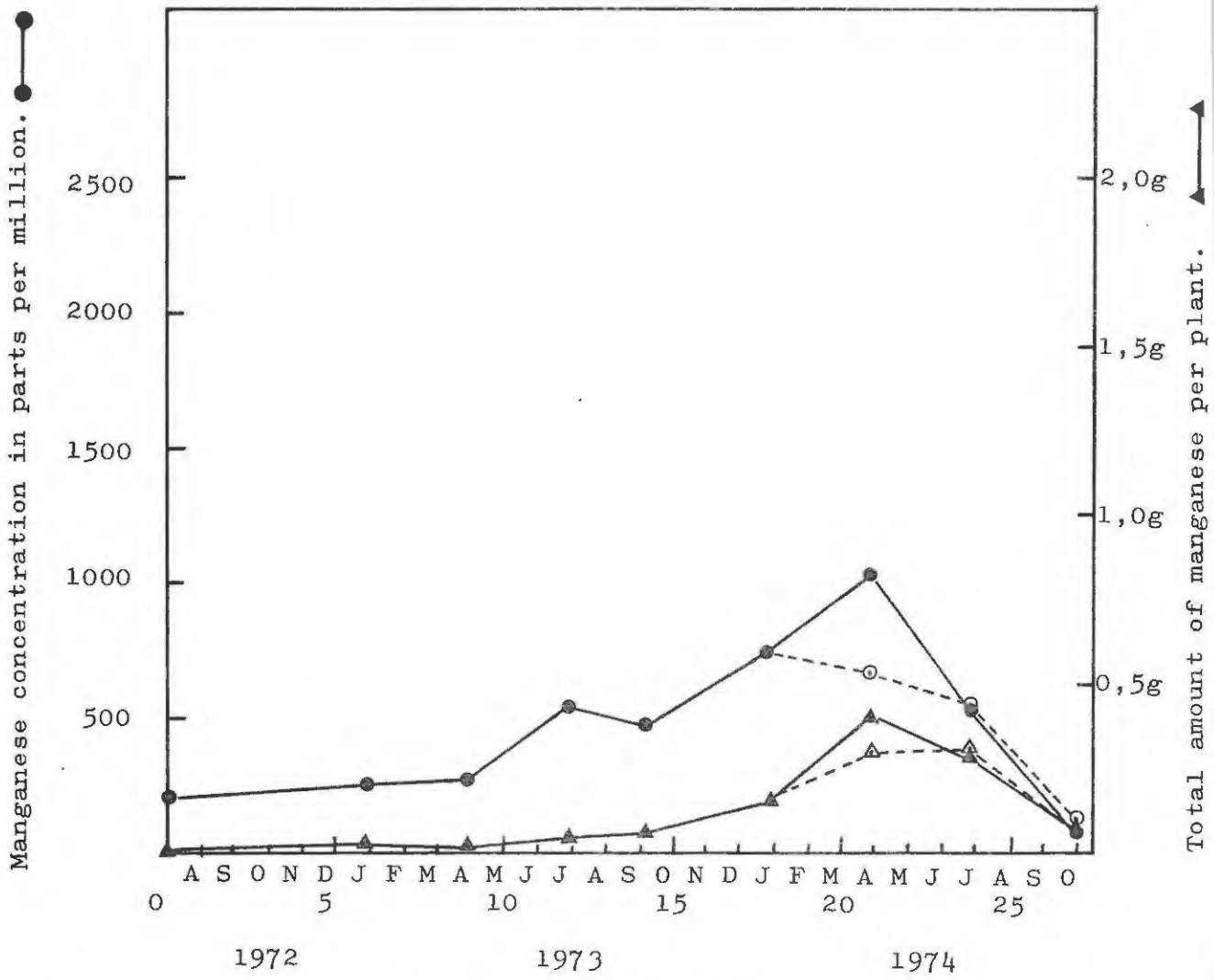


Fig. 22. Variation of manganese with time in pineapple plants from Shelford Farm.

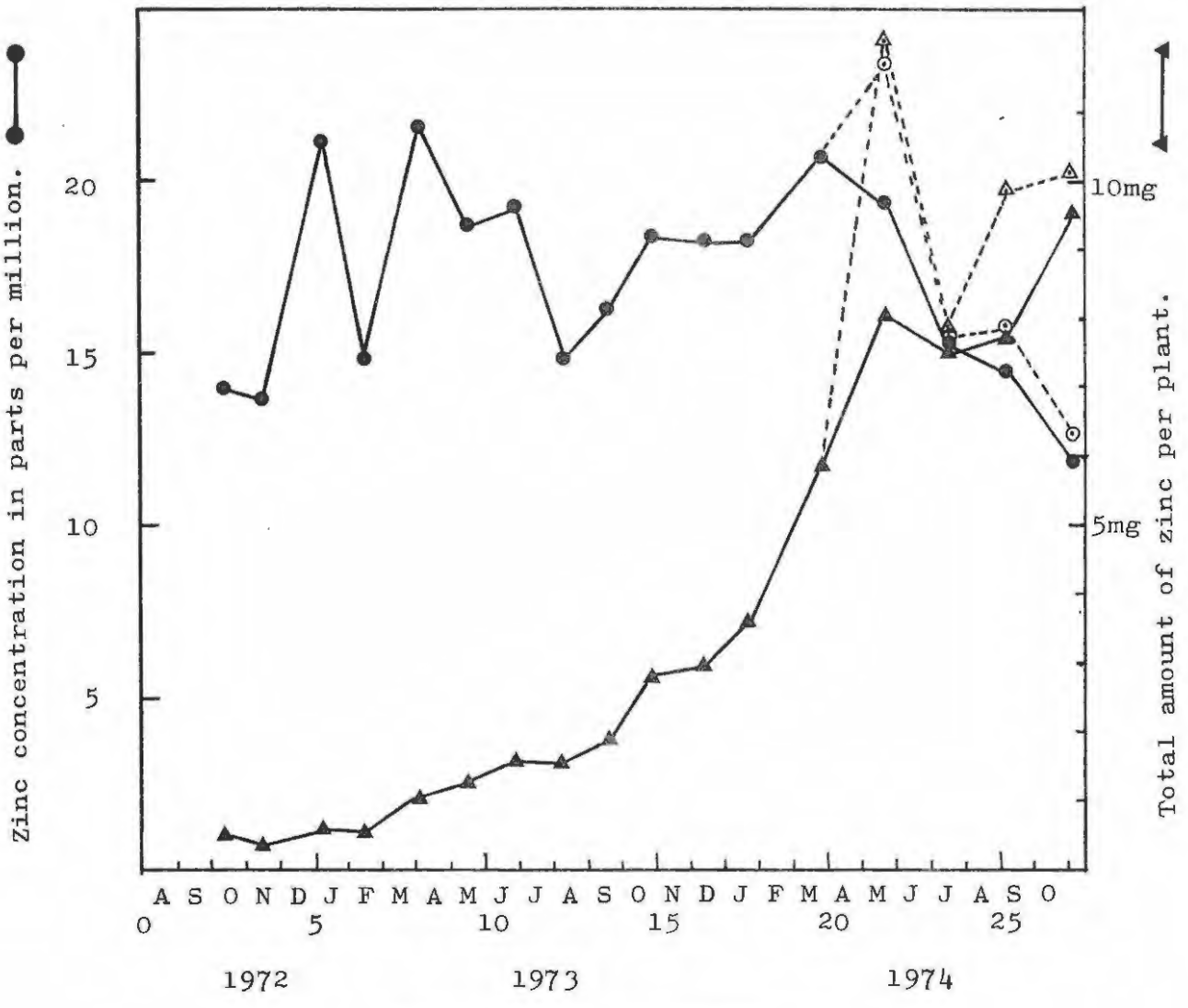


Fig. 23. Variation of zinc with time in pineapple plants from Whitney Estate.

——— Plants showing natural fruiting

- - - - - - Plants showing early fruiting

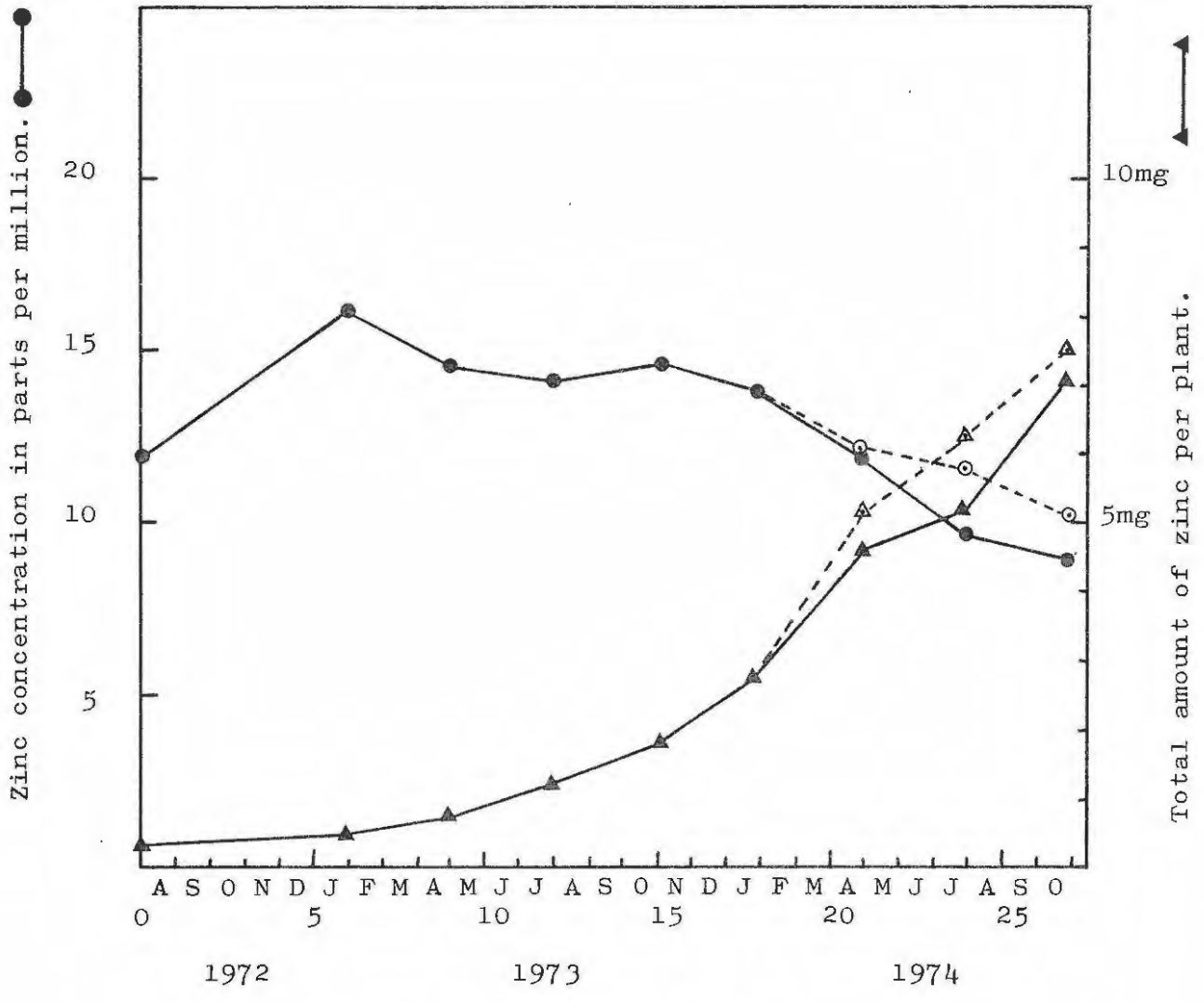


Fig. 24. Variation of zinc with time in pineapple plants from Shelford Farm.

——— Plants showing natural fruiting

------ Plants showing early fruiting

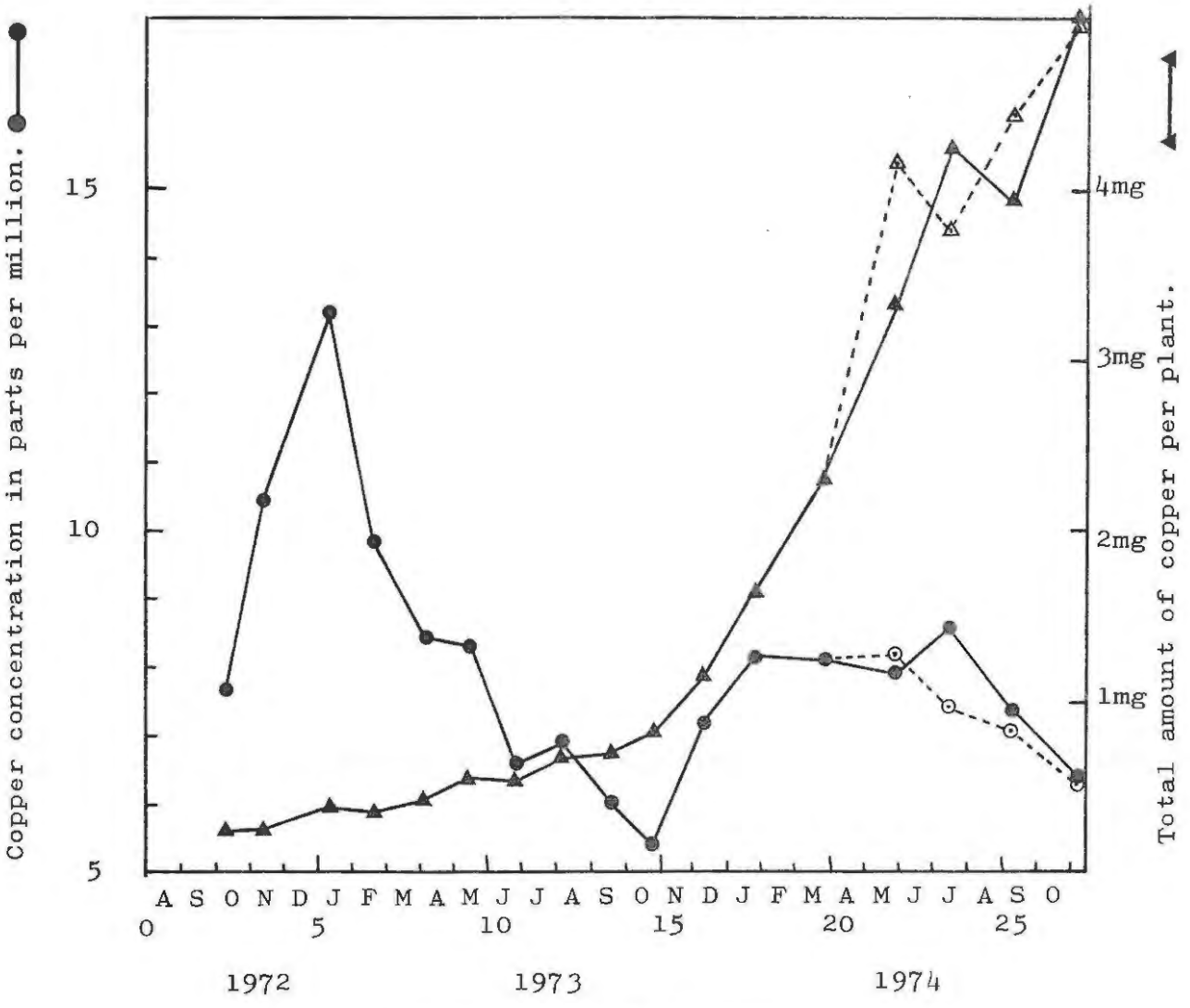


Fig. 25. Variation of copper with time in pineapple plants from Whitney Estate.

——— Plants showing natural fruiting

- - - - - - Plants showing early fruiting

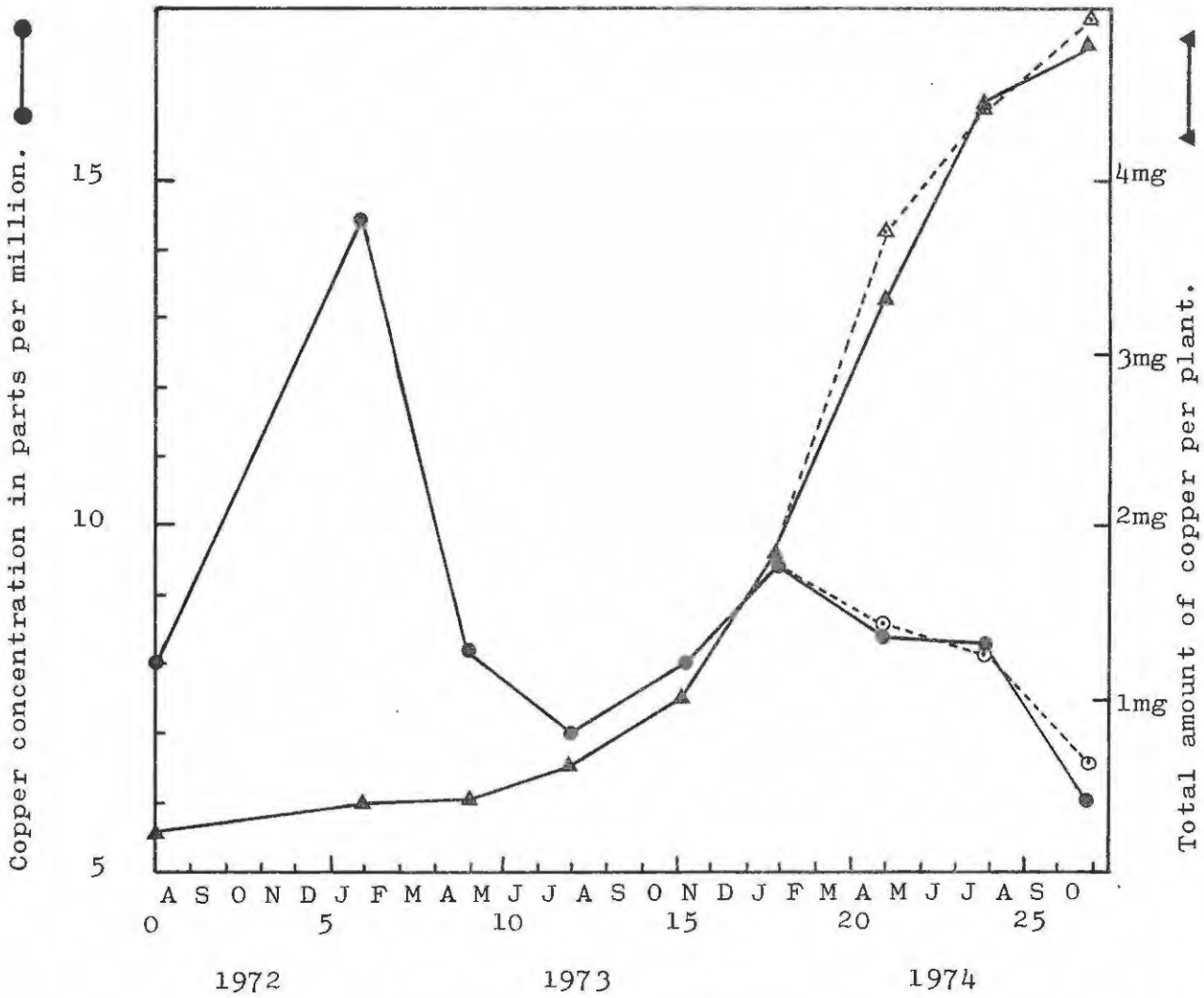


Fig. 26. Variation of copper with time in pineapple plants from Shelford Farm.

——— Plants showing natural fruiting

------ Plants showing early fruiting

TABLE 1. MEAN MONTHLY TEMPERATURES AND RAINFALL FOR BATHURST DURING EXPERIMENTAL PERIOD AUGUST, 1972 - FEBRUARY, 1975

	Temperature °C			Rainfall	
	Max.	Min.	Mean	mm	Days
Aug	19,8	9,6	14,7	35,5	8
Sep.	22,7	11,7	17,2	45,7	8
Oct.	23,8	12,4	18,1	32,1	10
Nov.	25,1	14,6	19,9	72,5	7
Dec.	26,4	14,4	20,4	16,5	6
Jan.	26,1	16,6	21,4	16,5	10
Feb.	23,2	17,2	20,2	38,0	13
March	26,5	17,0	21,8	68,9	5
April	25,5	16,1	20,8	41,3	6
May	22,4	12,3	17,4	36,4	8
June	23,3	12,2	17,8	0,2	1
July	22,1	11,0	16,6	8,5	7
Aug.	21,2	10,5	15,9	71,4	9
Sep.	20,3	9,9	15,1	45,2	5
Oct.	22,7	12,8	17,8	67,5	6
Nov.	22,2	14,3	18,3	117,5	16
Dec.	24,0	15,4	19,7	61,3	13
Jan.	25,3	17,3	21,3	103,6	11
Feb.	26,5	18,2	22,4	69,6	12
March	24,6	16,8	20,7	343,0	18
April	24,1	15,3	19,7	28,3	8
May	21,1	12,8	17,0	118,6	17
June	20,5	11,8	16,2	122,0	9
July	20,8	10,7	15,8	15,4	3
Aug.	19,2	9,6	14,4	113,9	11
Sep.	19,7	10,5	15,1	82,7	11
Oct.	21,4	12,3	16,9	16,0	9
Nov.	23,4	14,2	18,8	74,8	11
Dec.	25,6	15,4	20,5	25,3	9
Jan.	25,4	16,2	20,8	52,7	13
Feb.	26,7	17,9	22,3	65,4	12

TABLE 2. MEAN MONTHLY TEMPERATURES AND RAINFALL FOR EAST LONDON DURING EXPERIMENTAL PERIOD AUGUST, 1972 - JANUARY, 1975

	Temperature °C			Rainfall	
	Max.	Min.	Mean	mm	Days
Aug.	19,7	9,2	14,5	29,4	7
Sep.	22,2	12,0	17,1	41,6	5
Oct.	22,2	13,6	17,9	31,4	8
Nov.	22,8	15,0	18,9	177,9	11
Dec.	24,6	16,5	20,6	43,6	7
Jan.	24,4	17,3	20,9	46,3	14
Feb.	25,2	17,7	21,5	133,1	18
March	24,7	17,5	21,1	113,7	15
April	24,3	15,4	19,9	139,2	9
May	21,4	11,6	16,5	8,6	6
June	22,9	11,3	17,1	3,5	1
July	21,6	10,0	15,8	10,8	8
Aug.	20,5	10,1	15,3	91,3	11
Sep.	20,2	9,9	15,1	14,4	5
Oct.	22,2	12,9	17,6	104,1	11
Nov.	21,8	14,6	18,2	179,0	16
Dec.	23,6	15,5	19,6	82,9	12
Jan.	25,1	17,4	21,3	137,1	16
Feb.	25,6	18,5	22,1	138,8	14
March	24,5	17,3	20,9	158,0	17
April	23,8	15,2	19,5	53,7	6
May	20,9	12,7	16,8	167,2	16
June	21,0	10,7	15,9	44,8	8
July	21,0	10,6	15,8	1,2	1
Aug.	20,4	9,9	15,2	105,2	12
Sep.	19,9	11,4	15,7	93,7	12
Oct.	21,4	13,2	17,3	33,7	10
Nov.	23,0	15,1	19,1	99,5	13
Dec.	24,5	15,9	20,2	30,1	12
Jan.	24,9	17,0	21,0	42,4	11

TABLE 3. SOIL ANALYSIS OF AVAILABLE NUTRIENTS (ppm) TAKEN BEFORE PLANTING

	P	K	Ca	Mg	Na	pH (N-KCl)
Whitney Estate	10	70	240	70	10	4,0
Shelford Pineries	5	100	260	100	67	4,1

TABLE 4. MEAN PLANT WEIGHTS, LEAF AREAS, RELATIVE GROWTH RATES (RGR), NET ASSIMILATION RATES (NAR) AND LEAF AREA RATIOS (LAR) OF PINEAPPLE PLANTS SAMPLED AT WHITNEY ESTATE

Date sampled	Fresh weight g	% dry matter	Dry weight g	Leaf area cm^2	RGR $g\ g^{-1}\ day^{-1}$ x 10^{-4}	NAR $g\ cm^{-2}\ day^{-1}$ x 10^{-6}	LAR $cm^2\ g^{-1}$
11.10.72	149	19,3	29	1152			
13.11.72	150	17,1	26	1171	-34	-78	44
8.1.73	187	15,9	30	1738	26	48	55
19.2.73	255	14,2	36	2199	56	95	60
2.4.73	345	14,7	51	2690	80	140	57
14.5.73	466	14,7	68	3315	71	149	48
26.6.73	524	15,8	83	3599	46	101	46
7.8.73	618	16,1	100	3879	43	105	41
18.9.73	668	17,5	117	3874	37	91	40
29.10.73	828	18,5	153	5125	67	200	34
10.12.73	902	17,7	159	5296	92	30	31
21.1.74	1241	16,1	200	7186	53	153	35
26.3.74	1883	15,0	283	10148	55	151	36
21.5.74	2705	15,5	419	13284	70	208	34
21.5.74*	2977	17,1	510	-	105	-	-
15.7.74	2986	16,6	495	13884	30	102	30
15.7.74*	3161	16,1	508	-	-1	-	-
9.9.74	2939	18,1	533	13442	14	52	27
9.9.74*	4080	15,3	622	-	36	-	-
4.11.74	3863	20,7	800	15886	75	338	22
4.11.74*	5374	14,9	801	-	45	-	-
24.2.75	5136	16,9	868	15351	7	38	19

* Plants showing early fruiting.

TABLE 5. MEAN PLANT WEIGHTS AND RELATIVE GROWTH RATES (RGR) OF PINEAPPLE PLANTS SAMPLED AT SHELFORD PINERIES

Date sampled	Fresh weight g	% Dry matter	Dry weight g	RGR $g\ g^{-1}\ day^{-1}$ $\times 10^{-4}$
15.7.72	144	23,4	27	
30.1.73	196	14,2	28	1
30.4.73	393	12,6	50	60
30.7.73	580	14,8	86	60
5.11.73	810	15,7	127	39
28.1.74	1385	14,2	197	52
29.4.74	2724	14,2	387	74
29.4.74*	2765	15,5	430	85
29.7.74	3267	16,4	535	35
29.7.74*	3650	14,8	539	24
28.10.74	4401	17,9	789	42
28.10.74*	5067	14,7	743	35
28.1.75	6807	15,9	1084	34

* Plants showing early fruiting.

TABLE 6. DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 11th OCTOBER, 1972

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf	Base	1	0,8	29,4	0,43	0,011	0,24	0,25	0,13	0,035	113	147	18,5	16,4
	Top	2	1,5	31,4	0,68	0,062	0,26	0,56	0,20	0,073	143	409	17,8	9,9
B Leaf	Base	3	1,6	18,6	1,04	0,176	1,57	0,31	0,19	0,006	33	269	12,8	5,7
	Top	4	2,5	17,1	1,68	0,092	2,12	0,55	0,37	0,096	64	603	13,1	7,3
C Leaf	Basal	5	3,5	23,1	1,14	0,175	1,48	0,24	0,19	0,003	33	300	10,1	4,9
	Mid	6	3,0	14,5	1,06	0,152	2,51	0,30	0,23	0,036	39	365	12,1	4,6
	Top	7	1,9	17,4	1,59	0,093	2,25	0,55	0,38	0,095	96	655	11,9	6,5
D Leaf	Bottom of Basal	8		21,1	2,11	0,269	2,20	0,55	0,38	0,006	41	514	16,0	8,3
	Middle of Basal	9	2,0	23,1	1,35	0,218	2,19	0,30	0,26	0,004	40	310	11,0	6,5
	Top of Basal	10		24,5	1,00	0,192	2,13	0,19	0,19	0,003	52	236	13,9	3,7
	Mid	11	2,0	15,0	0,96	0,155	2,71	0,26	0,23	0,025	54	389	11,2	7,2
	Top	12	1,7	19,5	1,30	0,116	3,07	0,33	0,27	0,103	103	495	11,1	8,5
E Leaf	Basal	13	0,3	11,6	2,90	0,561	5,41	0,66	0,64	0,008	71	323	25,7	6,6
	Mid	14	1,1	15,0	0,81	0,150	2,88	0,20	0,20	0,012	57	305	10,5	5,0
	Top	15	1,0	20,1	1,11	0,088	2,66	0,29	0,25	0,078	122	307	10,6	10,3
F Leaf	Base	16	0,1	10,4	4,03	0,637	6,20	0,68	0,79	0,012	94	236	35,7	13,7
	Top	17	0,7	17,3	0,95	0,089	2,48	0,25	0,24	0,035	126	493	12,7	15,8
Stem	Base	18	0,9	23,7	1,37	0,200	1,50	0,80	0,22	0,059	137	162	22,0	9,6
	Stele	19	1,8	23,3	2,07	0,380	1,46	1,42	0,31	0,020	106	208	18,5	9,3
	Cortex	20	1,6	28,4	1,88	0,480	1,52	1,23	0,16	0,012	37	53	16,8	12,3
	Apex	21	0,5	21,2	2,31	0,380	1,87	1,81	0,36	0,006	58	236	33,7	6,5
Roots		22	0,1	28,3	1,03	0,064	1,64	0,11	0,24	0,069	1193	168	42,1	5,7
Mean for Plant				19,3	1,28	0,182	2,01	0,51	0,26	0,040	73	362	13,9	7,7
Total for Plant			28,7		0,42g	0,06g	0,67g	0,16g	0,09g	14mg	3,3mg	8mg	0,6mg	0,2mg

TABLE 7

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 13th NOVEMBER 1972

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	0,5	24,3	0,37	0,010	0,17	0,28	0,11	0,035	190	91	18,9	35,1
Top	2	1,1	26,3	0,70	0,010	0,17	0,59	0,13	0,047	363	280	18,3	24,6
B Leaf Base	3	1,3	17,8	0,88	0,198	1,34	0,33	0,20	0,010	29	156	11,5	8,8
Top	4	2,0	16,3	1,43	0,099	1,61	0,62	0,34	0,148	70	385	11,1	7,6
C Leaf Basal	5	2,9	19,6	1,08	0,200	1,49	0,37	0,25	0,004	42	222	12,9	4,5
Mid	6	3,7	16,2	0,75	0,164	1,79	0,25	0,18	0,029	42	209	10,2	6,7
Top	7	2,2	16,6	1,67	0,125	2,52	0,57	0,36	0,164	93	512	8,8	7,2
D Leaf Bottom of Basal	8		8,7	3,39	0,474	4,36	0,56	0,55	0,009	83	361	29,6	10,7
Middle of Basal	9	0,8	9,1	2,11	0,398	4,19	0,39	0,36	0,007	62	258	19,1	11,7
Top of Basal	10		5,9	1,31	0,312	3,12	0,33	0,26	0,004	50	190	15,9	13,6
Mid	11	1,8	14,7	0,79	0,187	2,52	0,23	0,19	0,024	57	168	9,7	8,1
Top	12	1,6	17,7	1,51	0,137	3,08	0,38	0,28	0,172	139	408	10,2	10,2
E Leaf Basal	13	0,3	7,4	2,62	0,443	6,04	0,53	0,46	0,006	48	204	28,5	14,1
Mid	14	0,8	12,6	1,00	0,177	3,00	0,27	0,22	0,026	59	164	14,2	17,1
Top	15	0,8	17,2	1,48	0,121	2,75	0,39	0,26	0,118	174	416	10,4	20,9
F Leaf Base	16	0,2	8,5	2,75	0,388	6,00	0,46	0,46	0,005	54	236	29,3	9,6
Top	17	0,3	16,2	1,08	0,096	2,94	0,28	0,36	0,033	102	295	13,3	6,9
Stem Base	18	1,1	22,2	1,06	0,169	0,96	0,92	0,21	0,078	189	88	11,3	9,2
Stele	19	1,5	19,1	2,03	0,402	0,95	1,74	0,30	0,027	50	128	16,8	9,2
Cortex	20	1,4	24,3	3,06	0,438	0,94	1,54	0,13	0,013	27	22	16,3	11,2
Apex	21	0,3	14,8	2,60	0,450	1,64	2,27	0,41	0,007	56	186	56,2	7,7
Roots	22	0,9	31,8	1,89	0,032	0,45	0,05	0,05	0,024	2086	111	9,5	39,7
Mean for Plant			17,1	1,38	0,201	1,87	0,54	0,26	0,058	117	250	13,6	10,4
Total for Plant		25,6		0,35g	0,05g	0,48g	0,14g	0,07g	15mg	3,0mg	6mg	0,3mg	0,3mg

TABLE 8

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 10th JANUARY 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	35,6	0,34	0,003	0,20	0,15	0,06	0,031	287	82	14,5	21,7
Top	2	2,5	47,8	0,73	0,009	0,15	0,27	0,07	0,043	744	293	19,4	45,2
B Leaf Base	3	0,6	13,3	0,77	0,068	1,30	0,21	0,28	0,013	46	147	11,2	10,3
Top	4	2,3	16,6	1,62	0,085	1,50	0,76	0,38	0,170	133	688	11,0	7,2
C Leaf Basal	5	1,1	7,7	2,55	0,312	2,86	0,82	0,65	0,014	55	410	18,7	10,3
Mid	6	3,4	13,4	1,47	0,154	1,24	0,29	0,23	0,105	93	219	12,6	8,5
Top	7	3,8	18,1	1,68	0,106	1,21	0,47	0,35	0,185	219	514	10,3	7,3
D Leaf Bottom of Basal	8		7,3	5,08	0,505	5,14	1,74	1,33	0,017	70	880	50,0	12,3
Middle of Basal	9	0,5	5,8	3,65	0,387	6,31	1,45	0,99	0,021	54	750	34,4	16,3
Top of Basal	10		6,3	2,71	0,291	5,85	0,99	0,71	0,027	73	598	32,4	10,9
Mid	11	2,5	11,6	2,15	0,167	3,85	0,35	0,28	0,113	79	204	14,3	8,3
Top	12	4,0	20,6	1,70	0,102	3,44	0,46	0,32	0,254	234	503	10,2	11,6
E Leaf Basal	13	0,2	6,8	4,38	0,411	7,08	1,12	0,83	0,014	65	627	41,7	12,3
Mid	14	0,7	9,6	2,10	0,146	4,27	0,35	0,33	0,064	61	249	18,4	12,1
Top	15	0,9	17,2	2,03	0,126	3,68	0,39	0,28	0,514	99	385	12,5	16,7
F Leaf Base	16	0,1	7,7	3,71	0,362	6,06	0,71	0,66	0,014	71	416	33,1	13,4
Top	17	0,4	13,5	1,70	0,104	3,06	0,23	0,26	0,093	91	277	19,6	15,5
Stem Base	18	1,4	21,1	1,22	0,107	0,81	0,74	0,16	0,068	201	75	14,0	10,6
Bottom of Stele	19	0,5	14,5	2,17	0,293	1,03	1,60	0,29	0,094	67	90	14,2	12,5
Middle of Stele	20	0,4	11,6	2,79	0,421	1,23	2,08	0,37	0,039	60	127	16,2	13,5
Top of Stele	21	0,2	10,2	2,99	0,493	1,77	2,92	0,52	0,022	69	275	26,4	13,6
Bottom of Cortex	22	0,4	14,5	1,75	0,417	1,25	1,59	0,13	0,038	24	57	11,2	18,3
Middle of Cortex	23	0,3	11,8	1,70	0,555	1,54	2,33	0,15	0,028	28	64	18,7	19,9
Top of Cortex	24	0,2	10,8	1,77	0,565	1,65	3,80	0,24	0,050	30	133	105,8	19,8
Apex	25	0,2	11,3	1,48	0,474	1,65	4,35	0,60	0,033	93	451	167,8	17,2
Roots	26	2,3	44,2	0,51	0,030	0,52	0,04	0,08	0,034	2059	117	81,6	5,5
Mean for Plant			15,9	1,60	0,159	1,98	1,14	0,29	0,126	339	316	21,1	13,2
Total for Plant		29,7		0,48g	0,05g	0,59g	0,34g	0,09g	37mg	10,1mg	9mg	0,6mg	0,4mg

TABLE 9

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 19th FEBRUARY 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	27,8	0,31	0,009	0,14	0,22	0,07	0,031	179	111	12,0	15,5
Top	2	2,4	32,4	0,56	0,014	0,06	0,38	0,09	0,026	377	276	17,3	22,4
B Leaf Base	3	0,7	12,7	0,71	0,057	1,20	0,35	0,31	0,014	38	171	6,6	7,0
Top	4	2,5	15,0	1,46	0,083	1,54	1,13	0,54	0,208	102	1120	10,0	6,2
C Leaf Basal	5	1,3	7,7	2,25	0,237	2,23	1,51	0,63	0,038	38	362	13,2	9,7
Mid	6	3,7	13,2	1,78	0,135	2,36	0,56	0,57	0,146	100	300	9,9	5,2
Top	7	4,3	18,0	1,60	0,104	2,80	0,74	0,36	0,256	173	675	8,0	5,0
D Leaf Bottom of Basal	8		6,7	4,87	0,359	3,39	2,73	1,27	0,016	87	758	39,7	7,0
Middle of Basal	9	0,7	5,9	3,66	0,277	4,25	2,23	0,83	0,022	55	607	21,8	10,4
Top of Basal	10		6,6	2,59	0,204	3,77	1,69	0,81	0,027	55	461	16,7	11,3
Mid	11	4,4	12,7	2,14	0,119	3,14	0,65	0,46	0,101	61	224	11,8	5,8
Top	12	5,5	18,0	1,86	0,099	3,25	0,69	0,38	0,411	105	342	10,3	5,4
E Leaf Basal	13	0,3	6,0	4,27	0,361	6,15	1,50	0,87	0,016	57	486	32,5	9,1
Mid	14	1,4	9,8	1,92	0,115	2,86	0,51	0,50	0,022	56	223	17,0	5,1
Top	15	1,6	15,9	2,00	0,089	2,71	0,56	0,28	0,349	84	318	12,4	7,0
F Leaf Base	16	0,2	6,5	3,96	0,359	5,73	1,06	0,84	0,013	72	387	31,1	8,0
Top	17	1,0	12,9	1,72	0,083	2,51	0,41	0,29	0,097	100	218	20,2	10,7
Stem Base	18	1,5	19,4	1,09	0,082	0,82	1,06	0,16	0,139	176	86	26,8	8,0
Bottom of Stele	19	0,6	13,3	2,18	0,198	1,16	2,32	0,24	0,127	78	149	11,6	9,2
Middle of Stele	20	0,3	10,5	2,65	0,321	1,20	3,42	0,38	0,045	61	233	14,1	7,9
Top of Stele	21	0,2	9,8	2,91	0,422	1,52	5,08	0,57	0,052	84	370	22,7	10,1
Bottom of Cortex	22	0,4	13,3	2,82	0,134	1,17	2,26	0,12	0,051	34	44	7,0	12,1
Middle of Cortex	23	0,2	10,4	2,94	0,408	1,46	3,90	0,14	0,070	42	53	11,6	12,0
Top of Cortex	24	0,2	10,4	3,05	0,396	1,46	6,25	0,24	0,155	59	146	140,2	14,6
Apex	25	0,3	11,2	3,25	0,355	1,38	6,89	0,56	0,046	99	453	188,1	8,1
Roots	26	1,5	24,5	0,63	0,032	0,55	0,11	0,14	0,094	497	80	11,3	53,7
Mean for Plant			14,2	1,75	0,117	2,29	0,87	0,39	0,173	141	373	14,8	9,8
Total for Plant		36,2		0,63g	0,04g	0,83g	0,32g	0,14g	63mg	5,1mg	14mg	0,5mg	0,4mg

TABLE 10

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 2nd APRIL 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	25,1	0,31	0,005	0,18	0,21	0,06	0,037	202	103	11,6	11,9
Top	2	2,8	32,9	0,61	0,013	0,12	0,38	0,11	0,027	562	202	27,1	29,0
B Leaf Base	3	0,8	12,5	0,71	0,046	1,24	0,32	0,27	0,024	59	184	16,9	6,0
Top	4	2,4	16,3	1,33	0,069	1,16	1,05	0,54	0,224	147	690	8,2	4,8
C Leaf Basal	5	1,5	7,6	2,03	0,102	1,45	1,69	0,68	0,096	68	514	32,5	5,0
Mid	6	5,2	14,9	1,90	0,099	2,89	0,81	0,44	0,160	80	336	9,8	4,9
Top	7	5,4	18,8	1,66	0,087	2,66	0,85	0,48	0,245	184	651	8,7	6,6
D Leaf Bottom of Basal	8		7,3	4,83	0,305	3,23	1,86	0,93	0,017	48	935	41,3	15,2
Middle of Basal	9	1,3	6,6	3,31	0,210	3,74	1,41	0,72	0,023	51	732	27,6	7,9
Top of Basal	10		7,5	2,28	0,144	3,08	1,01	0,52	0,028	39	568	17,4	18,0
Mid	11	7,4	13,7	2,11	0,092	2,90	0,59	0,30	0,087	63	336	12,1	9,7
Top	12	8,4	18,5	1,97	0,088	2,84	0,81	0,41	0,382	95	557	9,3	5,9
E Leaf Basal	13	0,5	6,0	4,09	0,379	6,44	0,94	0,72	0,017	44	571	32,7	13,5
Mid	14	2,4	10,2	1,69	0,093	2,80	0,60	0,26	0,033	48	318	14,8	6,4
Top	15	2,7	15,8	2,12	0,084	2,40	0,48	0,27	0,192	84	449	16,8	5,5
F Leaf Base	16	0,4	6,4	3,59	0,354	5,70	0,69	0,68	0,015	67	479	28,7	7,7
Top	17	1,5	12,8	1,64	0,082	2,29	0,42	0,30	0,085	136	350	25,3	11,1
Stem Base	18	1,5	19,7	1,18	0,040	0,66	1,03	0,14	0,167	186	102	12,1	6,7
Bottom of Stele	19	0,6	13,0	1,98	0,086	0,96	2,34	0,30	0,159	75	196	15,9	6,3
Middle of Stele	20	0,3	10,7	2,36	0,195	1,21	0,39	0,40	0,092	64	411	14,6	7,5
Top of Stele	21	0,3	10,4	2,78	0,268	1,34	0,53	0,50	0,117	73	713	32,5	9,5
Bottom of Cortex	22	0,5	13,1	2,51	0,087	0,94	2,57	0,11	0,126	40	82	8,9	9,9
Middle of Cortex	23	0,3	10,7	2,67	0,165	1,29	4,31	0,14	0,213	33	107	31,8	13,7
Top of Cortex	24	0,3	11,6	2,79	0,256	1,41	5,96	0,24	0,180	98	397	182,0	12,8
Apex	25	0,4	11,7	3,25	0,313	1,54	5,59	0,53	0,093	61	822	196,0	10,6
Roots	26	3,0	24,5	0,56	0,030	0,45	0,09	0,10	0,098	897	134	94,0	8,5
Mean for Plant			14,7	1,78	0,091	2,25	0,84	0,36	0,168	172	418	21,6	8,4
Total for Plant		50,6		0,90g	0,05g	1,14g	0,43g	0,18g	85mg	8,7mg	21mg	1,1mg	0,4mg

TABLE 11

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 14th MAY 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	28,1	0,38	0,016	0,41	0,18	0,50	0,036	307	108	11,5	16,9
Top	2	3,1	45,5	0,59	0,020	0,41	0,35	0,67	0,035	911	242	21,5	62,4
B Leaf Base	3	1,1	13,5	0,64	0,047	1,46	0,19	0,71	0,036	51	145	17,2	2,2
Top	4	2,9	16,7	1,34	0,072	1,76	1,01	0,35	0,183	195	1255	8,8	6,5
C Leaf Basal	5	1,8	9,0	1,52	0,076	1,74	1,28	0,21	0,118	54	700	23,3	4,3
Mid	6	6,0	14,4	2,15	0,105	3,60	0,84	0,34	0,140	91	550	9,3	4,7
Top	7	6,1	19,3	1,82	0,093	3,54	0,96	0,07	0,194	180	1100	8,7	4,4
D Leaf Bottom of Basal	8		7,9	4,31	0,337	3,91	1,28	0,15	0,011	39	1050	36,2	8,8
Middle of Basal	9	2,2	7,4	2,69	0,224	4,13	0,90	0,12	0,017	48	750	23,6	7,4
Top of Basal	10		8,6	1,76	0,150	3,48	0,64	0,52	0,021	52	560	24,1	6,3
Mid	11	11,5	13,9	2,04	0,109	3,72	0,42	0,52	0,054	69	322	10,8	5,8
Top	12	10,5	17,7	2,07	0,100	3,99	0,70	0,39	0,187	93	770	9,4	5,0
E Leaf Basal	13	0,7	6,6	3,56	0,407	7,30	0,88	0,65	0,010	45	497	28,8	9,5
Mid	14	4,0	10,4	1,69	0,116	3,79	0,29	0,20	0,019	49	267	12,8	5,6
Top	15	4,5	16,1	1,96	0,107	3,26	0,36	0,20	0,076	68	416	12,2	4,5
F Leaf Base	16	0,7	7,0	3,46	0,358	5,60	0,55	0,45	0,010	47	436	29,4	6,8
Top	17	2,7	12,2	1,50	0,098	2,87	0,30	0,22	0,025	91	330	18,9	5,8
Stem Base	18	1,9	20,0	1,27	0,050	0,78	0,93	0,12	0,128	76	101	17,4	6,0
Bottom of Stele	19	0,9	15,1	1,73	0,090	1,11	1,99	0,27	0,097	51	239	14,4	5,9
Middle of Stele	20	0,6	13,1	2,10	0,190	1,32	3,02	0,30	0,076	49	580	12,7	8,3
Top of Stele	21	0,5	11,6	2,73	0,258	1,69	4,23	0,45	0,065	51	1091	29,8	9,1
Bottom of Cortex	22	0,7	16,8	2,02	0,096	0,91	1,98	0,07	0,100	16	76	8,1	9,8
Middle of Cortex	23	0,7	15,1	2,12	0,174	1,42	2,97	0,09	0,151	16	104	30,7	11,7
Top of Cortex	24	0,6	13,6	2,60	0,300	1,67	4,46	0,20	0,091	22	424	162,0	12,1
Apex	25	0,5	12,0	3,33	0,394	1,92	4,39	0,48	0,038	43	1205	185,0	9,0
Roots	26	3,3	23,2	0,67	0,056	1,09	0,10	0,12	0,051	675	222	71,4	5,0
Mean for Plant			14,7	1,82	0,108	3,02	0,77	0,32	0,101	156	540	18,6	8,3
Total for Plant		68,3		1,24g	0,07g	2,06g	0,53g	0,22g	69mg	10,6mg	37mg	1,3mg	0,6mg

TABLE 12

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 26th JUNE 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	29,9	0,36	0,016	0,45	0,23	0,08	0,119	251	273	15,2	26,1
Top	2	2,8	49,7	0,57	0,022	0,17	0,42	0,15	0,120	693	553	26,3	19,6
B Leaf Base	3	1,2	16,2	0,56	0,049	1,09	0,23	0,19	0,145	37	333	17,6	3,0
Top	4	2,6	17,2	1,35	0,068	1,65	0,96	0,46	0,467	213	2475	8,2	5,4
C Leaf Basal	5	2,7	12,1	1,25	0,074	1,10	0,94	0,37	0,242	41	1590	17,9	4,6
Mid	6	7,7	15,3	2,03	0,094	3,17	0,98	0,42	0,374	80	1510	9,0	5,5
Top	7	7,4	19,2	1,78	0,083	3,00	1,08	0,51	0,481	138	2970	8,7	5,6
D Leaf Bottom of Basal	8		9,6	3,24	0,279	2,27	1,15	0,47	0,015	24	2490	30,3	14,5
Middle of Basal	9	3,6	9,5	1,96	0,170	2,27	0,70	0,33	0,019	32	1700	25,1	6,6
Top of Basal	10		11,0	1,36	0,116	1,99	0,45	0,23	0,028	31	1225	25,1	5,4
Mid	11	13,5	14,2	1,94	0,102	3,09	0,39	0,20	0,147	56	1040	11,4	6,2
Top	12	12,4	17,4	1,95	0,090	3,11	0,62	0,28	0,289	69	1895	9,0	5,2
E Leaf Basal	13	0,8	7,5	3,26	0,351	4,60	0,85	0,47	0,018	32	1924	33,7	9,9
Mid	14	5,0	12,0	1,48	0,100	2,78	0,31	0,19	0,050	46	985	13,9	5,6
Top	15	5,3	16,3	1,86	0,108	2,75	0,36	0,20	0,179	65	1480	9,7	4,8
F Leaf Base	16	0,8	7,6	3,24	0,321	4,87	0,59	0,40	0,013	37	1404	27,0	8,9
Top	17	3,1	12,8	1,51	0,109	2,50	0,32	0,23	0,094	69	1230	19,6	6,7
Stem Base	18	2,3	24,6	1,23	0,059	0,61	0,96	0,10	0,310	42	318	19,4	6,0
Bottom of Stele	19	1,2	20,5	1,49	0,084	0,83	1,87	0,18	0,241	29	605	39,5	5,5
Middle of Stele	20	1,0	17,6	1,80	0,154	0,99	2,51	0,23	0,191	31	1350	38,4	8,6
Top of Stele	21	0,7	15,0	2,42	0,211	1,21	3,16	0,32	0,149	32	2475	30,0	8,6
Bottom of Cortex	22	1,1	24,2	1,58	0,081	0,62	1,55	0,06	0,221	14	216	8,2	8,0
Middle of Cortex	23	1,1	21,5	1,72	0,143	0,91	2,26	0,09	0,319	13	282	52,0	11,1
Top of Cortex	24	0,9	18,1	2,18	0,237	1,20	3,34	0,16	0,164	24	1360	153,5	11,2
Apex	25	0,6	14,2	3,06	0,359	1,85	3,47	0,39	0,066	36	2845	154,0	8,9
Roots	26	4,6	29,8	0,59	0,048	0,92	0,10	0,10	0,167	356	617	56,2	5,6
Mean for Plant			15,8	1,70	0,100	2,41	0,75	0,27	0,228	107	1447	19,3	6,6
Total for Plant		83,0		1,41g	0,08g	2,00g	0,62g	0,23g	189mg	8,9mg	120mg	1,6mg	0,5mg

TABLE 13.

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 7th AUGUST, 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,6	23,9	0,41	0,017	0,55	0,20	0,87	0,142	217	240	17,4	18,1
Top	2	2,4	35,2	0,62	0,019	0,23	0,27	0,08	0,145	656	353	30,2	36,7
B Leaf Base	3	2,1	20,5	0,51	0,035	1,03	0,14	0,13	0,126	26	223	6,7	4,9
Top	4	3,1	15,8	1,36	0,060	2,06	0,98	0,47	0,378	179	2370	8,4	5,5
C Leaf Basal	5	5,1	17,8	0,86	0,045	0,79	0,54	0,21	0,163	22	965	6,6	6,6
Mid	6	8,7	14,8	2,00	0,078	2,85	0,77	0,35	0,426	125	1520	9,5	4,5
Top	7	7,1	16,8	1,96	0,078	3,19	1,07	0,49	0,456	123	2895	8,5	3,9
D Leaf Bottom of Basal	8		9,7	3,01	0,224	2,03	0,97	0,43	0,017	21	2295	20,3	14,0
Middle of Basal	9	4,9	10,9	1,67	0,125	1,90	0,47	0,25	0,018	19	1425	12,6	11,9
Top of Basal	10		13,2	1,05	0,076	1,56	0,30	0,17	0,025	21	1030	10,3	9,0
Mid	11	16,6	13,6	1,98	0,081	3,06	0,34	0,20	0,170	80	1090	10,9	5,2
Top	12	12,3	16,0	1,95	0,084	3,32	0,55	0,28	0,298	85	1945	8,9	4,1
E Leaf Basal	13	0,9	7,3	3,24	0,311	4,27	0,81	0,47	0,012	30	1938	25,8	9,3
Mid	14	5,9	12,4	1,52	0,091	2,44	0,27	0,17	0,085	63	965	12,4	4,6
Top	15	5,3	15,5	1,94	0,105	2,84	0,33	0,20	0,217	65	1555	10,9	3,1
F Leaf Base	16	0,7	7,6	3,45	0,301	4,63	0,58	0,40	0,017	37	1526	25,0	8,9
Top	17	3,1	12,2	1,33	0,080	2,34	0,27	0,21	0,079	66	1130	15,6	6,7
Stem Base	18	2,7	29,1	0,99	0,018	0,47	0,74	0,09	0,193	90	343	10,0	6,0
Bottom of Stele	19	1,7	26,0	1,30	0,059	0,66	1,05	0,15	0,178	88	344	9,0	3,6
Middle of Stele	20	1,6	21,6	1,57	0,110	0,79	1,91	0,20	0,138	41	1085	9,8	5,6
Top of Stele	21	1,0	17,2	2,19	0,169	1,00	2,47	0,31	0,105	32	1920	18,4	6,2
Bottom of Cortex	22	1,6	29,9	1,28	0,058	0,55	1,06	0,05	0,168	43	180	17,0	5,2
Middle of Cortex	23	1,8	26,2	1,49	0,090	0,75	1,59	0,07	0,231	19	225	31,0	7,9
Top of Cortex	24	1,3	20,9	1,92	0,193	0,94	2,70	0,15	0,105	21	1160	134,5	9,4
Apex	25	0,9	13,6	3,02	0,341	1,56	3,63	0,39	0,056	38	3115	156,0	9,5
Roots	26	6,3	32,3	0,55	0,029	0,55	0,10	0,08	0,168	206	620	14,3	3,5
C Leaf Dry Ends	27	2,3	57,2	1,22	0,036	1,10	0,83	0,34	0,367	435	1755	20,5	35,9
Mean for Plant			16,2	1,62	0,082	2,19	0,64	0,23	0,221	111	1309	14,8	6,9
Total for Plant		99,9		1,62g	0,08g	2,19g	0,64g	0,23g	221mg	11,1mg	131mg	1,5mg	0,7mg

TABLE 14

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 18th SEPTEMBER 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	0,6	23,1	0,44	0,015	0,70	0,16	0,07	0,139	221	323	15,9	18,3
Top	2	2,6	38,0	0,63	0,014	0,34	0,33	0,09	0,097	704	585	32,4	36,0
B Leaf Base	3	1,7	26,1	0,50	0,028	1,13	0,10	0,10	0,118	24	257	6,2	4,3
Top	4	3,8	16,4	1,37	0,052	2,55	0,78	0,41	0,387	210	2580	8,4	4,6
C Leaf Basal	5	7,9	24,4	0,69	0,032	0,83	0,30	0,13	0,085	15	865	6,4	4,7
Mid	6	10,2	15,3	1,91	0,068	3,46	0,66	0,28	0,350	123	1655	9,0	4,8
Top	7	8,5	17,4	1,82	0,068	3,57	0,86	0,39	0,414	127	3125	8,0	4,2
D Leaf Bottom of Basal	8		9,8	3,13	0,201	2,38	0,68	0,38	0,010	18	2580	18,0	15,3
Middle of Basal	9	6,2	11,6	1,66	0,102	1,90	0,34	0,21	0,015	15	1575	11,8	9,8
Top of Basal	10		14,5	1,09	0,065	1,57	0,22	0,15	0,021	19	1075	9,8	6,4
Mid	11	18,7	14,5	1,75	0,067	2,78	0,24	0,16	0,153	64	1165	9,7	5,1
Top	12	15,0	16,9	1,82	0,069	3,20	0,40	0,21	0,264	86	2140	7,8	4,7
E Leaf Basal	13	1,0	7,9	2,89	0,262	4,16	0,59	0,39	0,017	22	2170	21,3	10,0
Mid	14	6,3	13,8	1,43	0,076	2,38	0,22	0,13	0,078	63	1140	11,0	5,2
Top	15	5,5	16,3	1,78	0,092	2,81	0,27	0,13	0,288	64	1830	10,5	5,8
F Leaf Base	16	0,7	8,0	3,17	0,276	4,78	0,50	0,39	0,017	38	2019	34,3	7,3
Top	17	3,0	13,6	1,32	0,078	2,44	0,21	0,16	0,108	80	1440	15,8	5,4
Stem Base	18	3,3	32,6	0,97	0,036	0,59	0,62	0,06	0,183	90	290	27,0	4,7
Bottom of Stele	19	2,4	29,6	1,06	0,050	0,66	1,03	0,16	0,144	27	503	36,0	3,3
Middle of Stele	20	2,0	23,7	1,47	0,077	0,81	1,42	0,18	0,093	23	1350	18,4	5,7
Top of Stele	21	1,1	17,7	1,97	0,128	1,01	1,72	0,27	0,051	22	2150	16,3	6,7
Bottom of Cortex	22	2,1	34,1	1,15	0,042	0,63	0,90	0,06	0,138	15	196	26,5	4,4
Middle of Cortex	23	2,3	28,9	1,37	0,062	0,80	1,15	0,08	0,141	11	331	62,0	6,4
Top of Cortex	24	1,4	20,9	1,82	0,142	1,03	2,41	0,14	0,054	16	1645	130,5	7,9
Apex	25	0,9	13,5	2,90	0,296	1,81	2,83	0,36	0,021	27	3635	131,0	8,4
Roots	26	7,5	40,1	0,45	0,023	0,50	0,08	0,08	0,187	188	472	28,4	4,2
Mean for Plant			17,5	1,48	0,068	2,24	0,50	0,19	0,182	93	1454	16,3	6,0
Total for Plant		116,5		1,73g	0,08g	2,61g	0,58g	0,22g	212mg	10,8mg	170mg	1,9mg	0,7mg

TABLE 15

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 29th OCTOBER 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,5	23,7	0,45	0,026	0,62	0,19	0,08	0,173	245	314	19,6	16,5
Top	2	1,5	34,4	0,60	0,017	0,03	0,29	0,06	0,170	673	414	41,5	18,6
B Leaf Base	3	4,9	29,5	0,44	0,027	0,71	0,14	0,09	0,118	20	230	5,0	3,8
Top	4	5,7	16,9	1,35	0,053	2,26	0,99	0,49	0,367	165	2090	6,6	4,7
C Leaf Basal	5	13,8	27,0	0,70	0,035	0,47	0,30	0,11	0,070	14	595	5,1	5,0
Mid	6	16,1	15,7	1,94	0,076	3,00	0,76	0,32	0,342	87	1430	8,2	4,2
Top	7	13,3	18,3	1,77	0,075	3,02	1,03	0,45	0,385	116	2810	7,6	4,8
D Leaf Bottom of Basal	8		10,3	3,02	0,212	2,06	0,56	0,29	0,011	24	1895	20,7	15,5
Middle of Basal	9	9,2	13,2	1,56	0,110	1,62	0,32	0,18	0,013	19	1125	12,5	9,2
Top of Basal	10		15,4	1,05	0,082	1,44	0,23	0,13	0,021	26	860	12,2	7,7
Mid	11	23,0	15,5	1,82	0,080	2,34	0,32	0,16	0,178	58	1060	9,9	4,7
Top	12	17,8	17,3	1,81	0,082	2,87	0,46	0,23	0,306	78	1995	7,3	3,5
E Leaf Basal	13	1,2	7,8	2,74	0,300	2,91	0,53	0,37	0,012	24	1935	26,2	12,0
Mid	14	5,6	14,2	1,40	0,087	2,03	0,29	0,15	0,083	65	960	14,8	7,1
Top	15	5,4	17,2	1,76	0,100	2,06	0,30	0,16	0,346	67	1560	9,7	5,9
F Leaf Base	16	0,8	7,8	2,84	0,281	4,17	0,43	0,35	0,011	33	1380	29,3	7,6
Top	17	2,7	14,4	1,26	0,076	1,92	0,21	0,14	0,115	71	1005	21,4	6,5
Stem Base	18	3,4	34,8	0,93	0,038	0,33	0,64	0,06	0,237	56	203	72,3	4,9
Bottom of Stele	19	3,0	32,0	1,06	0,046	0,41	0,98	0,09	0,149	24	282	27,6	3,6
Middle of Stele	20	4,0	24,3	1,40	0,073	0,59	1,59	0,16	0,071	23	910	35,7	5,7
Top of Stele	21	1,6	15,8	2,29	0,151	0,98	1,75	0,27	0,030	24	1330	16,4	7,3
Bottom of Cortex	22	2,4	37,0	1,19	0,039	0,33	0,98	0,04	0,135	15	163	45,9	3,4
Middle of Cortex	23	4,5	31,5	1,28	0,053	0,58	1,25	0,07	0,103	12	224	77,5	6,5
Top of Cortex	24	2,1	18,3	2,09	0,159	1,15	2,38	0,15	0,030	20	1280	90,5	9,9
Apex	25	0,9	12,7	2,08	0,306	1,86	2,37	0,36	0,020	71	2695	92,0	8,2
Roots	26	10,0	41,7	0,52	0,027	0,29	0,08	0,05	0,161	172	366	43,2	4,5
Mean for Plant			18,5	1,47	0,074	1,84	0,59	0,20	0,202	75	1242	18,4	5,3
Total for Plant		153,4		2,26g	0,11g	2,83g	0,90g	0,31g	310mg	11,5mg	191mg	2,8mg	0,8mg

TABLE 16

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 10th DECEMBER 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	0,3	22,5	0,54	0,029	0,68	0,15	0,12	0,243	276	330	21,5	12,7
Top	2	0,8	33,2	0,76	0,036	0,29	0,33	0,12	0,338	890	611	49,4	17,7
B Leaf Base	3	5,4	27,8	0,42	0,019	0,56	0,16	0,13	0,222	28	316	4,8	5,4
Top	4	6,6	16,5	1,43	0,064	2,19	1,02	0,48	0,505	231	2645	8,2	5,4
C Leaf Basal	5	14,7	23,0	0,73	0,045	0,66	0,30	0,12	0,075	14	755	7,6	6,1
Mid	6	20,2	15,4	2,18	0,098	2,86	0,72	0,34	0,386	120	1850	8,9	5,9
Top	7	16,6	17,8	2,01	0,093	2,93	0,93	0,41	0,415	135	3355	7,7	5,7
D Leaf Bottom of Basal	8		8,9	3,56	0,323	2,73	0,56	0,40	0,015	27	2190	31,8	16,2
Middle of Basal	9	7,5	10,6	1,89	0,208	2,17	0,38	0,26	0,018	24	1485	20,2	13,3
Top of Basal	10		12,7	1,31	0,157	1,81	0,27	0,18	0,031	36	1100	17,7	10,2
Mid	11	21,7	16,7	1,94	0,110	2,30	0,33	0,19	0,210	75	1185	12,0	7,4
Top	12	18,2	18,1	2,16	0,104	2,55	0,45	0,26	0,454	86	2160	8,7	7,0
E Leaf Basal	13	1,1	7,2	3,47	0,437	4,76	0,54	0,49	0,014	33	2370	36,6	11,4
Mid	14	4,6	13,1	1,49	0,136	2,20	0,24	0,20	0,086	70	1135	18,9	8,1
Top	15	4,7	18,1	1,76	0,109	2,02	0,27	0,18	0,291	67	1510	14,0	7,7
F Leaf Base	16	1,3	7,4	3,04	0,354	4,61	0,41	0,44	0,015	34	1895	31,3	10,5
Top	17	3,1	13,5	1,39	0,112	1,99	0,19	0,19	0,091	63	1155	21,0	7,7
Stem Base	18	5,1	33,6	1,02	0,041	0,42	0,69	0,08	0,305	26	207	77,5	5,1
Bottom of Stele	19	3,0	25,8	1,27	0,065	0,59	1,21	0,16	0,160	28	835	15,4	6,1
Middle of Stele	20	3,2	19,0	1,78	0,122	0,74	1,93	0,24	0,093	28	1590	17,7	10,8
Top of Stele	21	1,4	13,1	2,53	0,264	1,08	1,63	0,19	0,027	32	2215	33,5	10,2
Bottom of Cortex	22	2,6	32,4	1,28	0,064	0,51	1,09	0,06	0,237	21	164	15,3	8,3
Middle of Cortex	23	3,9	23,9	1,62	0,139	0,84	1,56	0,10	0,131	20	570	71,5	14,2
Top of Cortex	24	1,6	14,2	2,38	0,148	1,71	2,37	0,29	0,028	24	1885	97,5	17,1
Apex	25	1,1	12,1	3,42	0,409	1,85	2,06	0,45	0,021	42	3030	128,0	10,7
Roots	26	10,5	32,8	0,57	0,040	0,59	0,07	0,07	0,157	118	695	31,0	6,7
Ground Sucker	GS1	0,1	10,5	2,24	0,239	0,32	0,40	0,29	0,063	46	1200	31,0	12,0
Mean for Plant			17,7	1,66	0,101	1,93	0,60	0,24	0,257	88	1564	18,2	7,2
Total for Plant		159.4g		2,65g	0,16g	3,07g	0,96g	0,38g	409mg	14,0mg	249mg	2,9mg	1,1mg

TABLE 17

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 21st JANUARY 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,4	22,1	0,42	0,032	0,62	0,15	0,10	0,207	210	288	37,0	18,4
Top	2	1,4	36,5	0,62	0,022	0,18	0,30	0,10	0,226	824	334	54,7	38,0
B Leaf Base	3	4,6	22,0	0,37	0,031	0,52	0,20	0,11	0,214	33	350	9,9	4,5
Top	4	9,6	15,8	1,47	0,074	1,76	1,02	0,54	0,451	170	2705	12,3	7,5
C Leaf Basal	5	20,6	17,9	0,75	0,056	0,70	0,23	0,14	0,055	15	750	12,2	8,7
Mid	6	33,1	15,0	2,11	0,103	2,10	0,56	0,26	0,284	87	2010	12,1	6,8
Top	7	29,2	17,8	2,01	0,099	2,29	0,79	0,36	0,342	100	3665	9,1	6,1
D Leaf Bottom of Basal	8		7,3	3,81	0,385	2,58	0,70	0,56	0,011	33	4065	40,6	16,6
Middle of Basal	9	6,3	8,2	2,11	0,275	2,26	0,44	0,35	0,012	29	2845	26,2	16,3
Top of Basal	10		9,9	1,41	0,224	1,89	0,33	0,27	0,017	34	2185	22,6	13,3
Mid	11	18,2	13,8	1,76	0,159	2,15	0,24	0,19	0,087	59	1535	15,4	9,1
Top	12	16,1	17,3	2,09	0,119	1,86	0,30	0,20	0,243	65	2155	11,2	7,7
E Leaf Basal	13	1,2	6,2	3,26	0,391	4,16	0,72	0,65	0,016	35	4110	32,9	13,8
Mid	14	4,6	10,7	1,50	0,162	1,80	0,23	0,21	0,030	51	1880	20,3	13,1
Top	15	4,5	16,0	1,70	0,122	1,71	0,21	0,18	0,101	56	1870	13,4	8,7
F Leaf Base	16	1,4	6,7	3,05	0,138	3,56	0,53	0,53	0,017	34	2925	27,3	12,2
Top	17	3,4	11,7	1,30	0,112	1,42	0,21	0,23	0,028	46	1665	21,4	9,6
Stem Base	18	5,5	29,3	1,15	0,042	0,37	0,92	0,07	0,267	37	345	33,1	5,6
Bottom of Stele	19	5,3	20,9	1,53	0,088	0,57	1,41	0,19	0,096	44	1250	26,4	8,4
Middle of Stele	20	2,3	15,0	2,06	0,215	0,68	1,31	0,33	0,033	38	2050	37,3	10,2
Top of Stele	21	1,4	11,2	2,52	0,302	0,93	1,05	0,44	0,022	44	3015	44,6	8,4
Bottom of Cortex	22	4,7	25,2	1,51	0,087	0,60	1,12	0,07	0,226	20	350	28,3	9,4
Middle of Cortex	23	2,7	16,7	1,83	0,332	1,16	1,52	0,18	0,041	21	1285	49,2	13,5
Top of Cortex	24	2,1	13,8	1,97	0,414	1,19	1,67	0,24	0,023	21	2620	72,0	12,2
Apex	25	1,4	11,1	3,33	0,442	1,39	2,15	0,48	0,020	52	4760	155,0	8,5
Roots	26	16,8	30,2	0,63	0,043	0,58	0,08	0,08	0,134	158	779	23,0	4,6
Ground Sucker A Leaf	GS1	0,1	17,8	0,71	0,036	1,30	0,10	0,07	0,093	118	160	34,0	5,5
B Leaf Base	GS2	0,2	11,9	0,95	0,083	1,62	0,10	0,09	0,027	29	354	16,7	11,5
Top	GS3	0,2	13,7	1,05	0,100	1,75	0,15	0,13	0,043	45	404	18,5	11,9
C Leaf Base	GS4	0,2	8,1	1,74	0,220	2,92	0,24	0,21	0,018	24	810	17,5	9,8
Top	GS5	0,4	11,4	1,28	0,130	1,97	0,12	0,13	0,029	32	558	12,5	8,1
D Leaf Base	GS6	0,1	7,0	2,37	0,275	4,00	0,26	0,35	0,027	38	1343	24,3	10,4
Top	GS7	0,3	11,9	1,33	0,116	1,97	0,23	0,16	0,025	29	781	14,4	9,9
E & F Leaf	GS8	0,2	9,2	1,95	0,200	2,70	0,26	0,31	0,023	31	1185	20,7	10,0
Stem Base	GS9	0,2	19,0	0,97	0,127	1,00	0,18	0,10	0,021	60	185	10,8	7,3
Top	GS10	0,4	11,9	2,24	0,313	1,85	0,82	0,25	0,019	47	821	23,8	9,8
Mean for Ground Sucker			11,6	1,49	0,167	2,02	0,28	0,18	0,032	42	659	18,2	9,4
Total for Ground Sucker		2,4		0,04g	0,004g	0,05g	0,007g	0,004g	0,8mg	0,10mg	1,6mg	0,04mg	0,02mg
Mean for Plant			16,1	1,63	0,114	1,59	0,55	0,24	0,192	79	1892	18,3	8,2
Total for Plant		199,4		3,25g	0,23g	3,18g	1,09g	0,47g	382mg	15,8mg	377mg	3,6mg	1,6mg

TABLE 18

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 26th MARCH 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	23,0	0,52	0,025	0,63	0,19	0,11	0,278	345	425	30,7	13,5
Top	2	2,4	38,2	0,80	0,023	0,29	0,38	0,14	0,212	910	750	44,0	17,6
B Leaf Base	3	3,6	17,4	0,49	0,031	0,77	0,19	0,14	0,346	68	615	13,5	6,9
Top	4	12,0	16,8	1,56	0,069	1,53	0,96	0,54	0,409	224	4145	9,1	6,2
C Leaf Basal	5	22,2	12,8	0,81	0,073	0,91	0,29	0,20	0,076	28	1660	20,8	9,8
Mid	6	56,7	15,5	2,07	0,103	2,06	0,55	0,29	0,233	109	2765	13,1	6,5
Top	7	44,1	18,0	2,10	0,104	2,22	0,65	0,35	0,272	136	4510	9,5	6,4
D Leaf Bottom of Basal	8		7,1	3,55	0,405	3,17	0,65	0,58	0,008	31	4645	39,9	15,1
Middle of Basal	9	7,7	7,8	2,04	0,261	2,75	0,44	0,39	0,009	31	3500	24,0	17,1
Top of Basal	10		9,4	1,46	0,200	2,19	0,34	0,19	0,013	40	2765	21,2	15,9
Mid	11	26,5	13,3	1,81	0,140	2,32	0,30	0,25	0,031	92	2490	16,9	8,8
Top	12	24,5	16,3	2,21	0,116	2,37	0,35	0,29	0,125	79	3460	12,7	7,8
E Leaf Basal	13	1,6	6,3	3,06	0,367	4,51	0,56	0,61	0,016	33	4280	30,7	13,4
Mid	14	7,4	10,7	1,51	0,137	2,28	0,26	0,25	0,022	107	2035	19,4	9,1
Top	15	8,0	16,0	1,85	0,112	2,25	0,29	0,25	0,037	67	2950	13,8	7,7
F Leaf Base	16	2,8	6,6	2,88	0,316	4,16	0,42	0,55	0,013	32	3060	27,2	9,1
Top	17	10,6	11,9	1,38	0,104	1,76	0,23	0,27	0,020	65	2195	19,5	7,3
Stem Base	18	5,2	23,9	1,22	0,046	0,58	0,73	0,10	0,458	26	635	34,7	6,5
Bottom of Stele	19	6,0	18,0	1,51	0,100	0,73	1,53	0,27	0,127	51	1990	17,5	10,4
Middle of Stele	20	3,6	14,5	1,78	0,217	0,68	1,02	0,37	0,033	43	2345	33,2	11,6
Top of Stele	21	2,4	10,6	2,52	0,352	0,99	1,20	0,48	0,019	48	4230	49,5	10,7
Bottom of Cortex	22	5,4	18,6	1,75	0,147	0,81	1,55	0,13	0,189	24	720	27,9	13,8
Middle of Cortex	23	5,0	16,1	1,63	0,313	1,10	1,28	0,15	0,038	21	1490	42,6	14,8
Top of Cortex	24	3,7	12,1	2,20	0,403	1,25	2,40	0,27	0,022	38	4660	106,5	12,5
Apex	25	1,7	10,8	3,40	0,436	1,58	2,13	0,52	0,014	39	6445	165,0	8,8
Roots	26	16,6	37,9	0,52	0,032	0,32	0,05	0,06	0,055	206	730	50,8	4,2
Ground Sucker A Leaf	GS1	0,1	27,4	0,61	0,015	0,00	0,05	0,10	0,143	193	250	40,0	17,5
B Leaf Base	GS2	0,1	13,7	0,63	0,048	1,08	0,10	0,12	0,045	33	878	13,3	10,4
Top	GS3	0,1	13,8	0,92	0,082	1,79	0,11	0,10	0,063	55	661	13,9	11,1
C Leaf Base	GS4	0,2	9,5	1,10	0,215	1,85	0,24	0,29	0,018	27	1575	17,8	11,0
Top	GS5	0,5	12,5	1,18	0,127	1,86	0,20	0,17	0,040	59	1345	10,1	11,5
D Leaf Basal	GS6	0,1	7,2	2,01	0,356	3,25	0,31	0,40	0,038	49	2125	28,8	13,8
Mid	GS7	0,3	10,3	1,10	0,138	1,85	0,17	0,18	0,024	40	1087	12,9	10,7
Top	GS8	0,3	13,7	1,27	0,109	1,71	0,24	0,19	0,036	63	2350	9,7	6,9
E & F Leaf Base	GS9	0,1	8,4	2,30	0,279	3,50	0,34	0,47	0,046	52	1900	27,0	16,5
Top	GS10	0,3	11,9	1,20	0,109	1,69	0,22	0,21	0,025	49	1444	13,1	9,7
Stem Base	GS11	0,1	20,3	0,90	0,090	0,63	0,19	0,11	0,077	100	750	23,8	11,9
Top	GS12	0,3	13,8	1,78	0,257	1,06	1,11	0,27	0,019	31	1734	32,5	9,4
Mean for Ground Sucker			I4,0	1,26	0,150	1,72	0,31	0,21	0,037	52	1446	16,6	10,7
Total for Ground Sucker		2,3		0,03g	0,003g	0,04g	0,007g	0,005g	0,9mg	0,12mg	3,4mg	0,04mg	0,02mg
Mean for Plant			15,0	I,74	0,120	1,80	0,55	0,28	0,156	104	2794	20,8	8,1
Total for Plant		282,8		4,93g	0,34g	5,09g	1,57g	0,79g	440mg	29,3mg	790mg	5,9mg	2,3mg

TABLE 19

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 21st MAY 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,9	18,8	0,56	0,028	1,05	0,18	0,14	0,301	166	382	40,7	15,0
Top	2	2,6	31,5	0,65	0,018	0,37	0,34	0,18	0,290	733	587	38,2	22,6
B Leaf Base	3	4,2	17,3	0,54	0,034	1,10	0,26	0,15	0,339	52	415	12,1	7,7
Top	4	11,3	15,8	1,39	0,059	1,4[illegible]	1,24	0,52	0,517	205	3000	9,2	5,2
C Leaf Basal	5	33,2	12,8	0,68	0,068	0,92	0,30	0,16	0,055	22	1275	19,8	8,7
Mid	6	80,7	15,1	1,78	0,094	2,19	0,58	0,26	0,253	87	2045	11,5	6,1
Top	7	61,4	16,9	2,04	0,104	2,32	0,65	0,34	0,276	82	4005	10,2	7,5
D Leaf Bottom of Basal	8		8,1	2,29	0,288	2,12	0,59	0,45	0,007	24	3570	30,3	13,8
Middle of Basal	9	10,7	8,8	1,37	0,208	1,97	0,37	0,30	0,009	22	2735	19,0	17,2
Top of Basal	10		10,0	1,01	0,161	1,67	0,27	0,23	0,018	21	2210	14,3	16,8
Mid	11	32,6	13,3	1,38	0,133	2,39	0,23	0,21	0,039	47	1970	12,7	8,8
Top	12	31,6	16,5	1,91	0,111	2,60	0,35	0,26	0,114	53	3555	9,7	7,6
E Leaf Basal	13	2,4	7,3	2,00	0,291	3,24	0,52	0,51	0,014	24	2940	25,5	12,5
Mid	14	11,2	11,9	1,15	0,125	2,08	0,25	0,23	0,028	35	1990	12,1	8,1
Top	15	13,8	16,2	1,57	0,104	2,50	0,31	0,25	0,074	52	3065	10,8	6,9
F Leaf Base	16	4,3	7,0	2,01	0,266	3,98	0,43	0,52	0,012	32	2520	23,2	10,0
Top	17	25,7	12,9	1,18	0,102	2,08	0,21	0,23	0,026	33	1995	11,2	7,2
Stem Base	18	7,4	28,9	1,14	0,045	0,48	0,88	0,09	0,160	27	470	18,4	6,3
Bottom of Stele	19	11,6	23,4	1,21	0,081	0,62	1,21	0,21	0,068	27	1315	12,9	7,6
Middle of Stele	20	7,1	19,4	1,32	0,158	0,72	0,72	0,22	0,021	32	1240	29,0	9,3
Top of Stele	21	4,6	12,8	1,93	0,263	0,91	0,99	0,35	0,012	36	2950	29,9	8,8
Bottom of Cortex	22	11,6	25,4	1,25	0,130	0,89	1,03	0,11	0,086	12	495	14,9	10,8
Middle of Cortex	23	11,5	23,0	1,10	0,216	1,01	0,83	0,09	0,019	10	705	26,9	10,2
Top of Cortex	24	9,8	17,4	1,66	0,285	1,01	1,71	0,16	0,010	17	2820	81,5	10,2
Apex	25	2,5	12,1	2,69	0,376	1,40	2,31	0,18	0,010	34	5895	184,0	8,9
Roots	26	20,7	42,4	0,41	0,026	0,37	0,06	0,05	0,048	118	334	7,2	4,0
Ground Sucker A Leaf	GS1	0,1	21,2	0,76	0,035	2,25	0,13	0,18	0,219	191	350	46,3	28,8
B Leaf Base	GS2	0,3	14,5	0,62	0,044	1,81	0,05	0,11	0,032	33	409	20,6	27,8
Top	GS3	0,3	14,5	0,96	0,056	2,06	0,09	0,09	0,069	43	347	11,7	8,6
C Leaf Base	GS4	0,4	11,0	1,10	0,132	2,73	0,10	0,17	0,017	24	1008	10,8	10,8
Top	GS5	1,1	12,4	1,21	0,104	2,50	0,08	0,10	0,030	42	849	8,3	8,8
D Leaf Basal	GS6	0,2	8,9	1,78	0,232	4,00	0,19	0,34	0,019	35	1750	17,5	11,4
Mid	GS7	0,6	11,3	1,09	0,094	2,75	0,10	0,14	0,028	30	1088	9,3	8,6
Top	GS8	0,5	13,1	1,45	0,110	2,70	0,15	0,15	0,048	34	1513	7,8	7,9
E & F Leaf Base	GS9	0,2	9,6	2,12	0,226	3,83	0,18	0,40	0,046	50	1658	23,3	11,7
Top	GS10	0,3	12,7	1,08	0,077	2,00	0,14	0,16	0,028	31	1193	10,8	8,0
Stem Base	GS11	0,2	27,2	0,69	0,065	0,88	0,11	0,14	0,098	101	344	24,4	8,8
Middle	GS12	0,6	19,9	1,22	0,166	1,38	0,35	0,16	0,025	39	861	12,2	9,3
Top	GS13	0,1	11,9	2,99	0,360	3,27	1,59	0,61	0,101	112	5304	63,1	21,0
Mean for Ground Sucker			13,7	1,23	0,119	2,39	0,18	0,16	0,042	45	1081	14,1	10,9
Total for Ground Sucker		5,0		0,06g	0,006g	0,12g	0,009g	0,008g	2,1mg	0,23mg	5,4mg	0,07mg	0,05mg
Mean for Plant			15,5	1,47	0,112	1,83	0,54	0,24	0,141	68	2247	19,4	7,9
Total for Plant		418,6		6,16g	0,47g	7,65g	2,27g	1,01g	592mg	28,3mg	940mg	8,1mg	3,3mg

TABLE 19A

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 21st MAY 1974. PLANT SHOWING EARLY FRUITING

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,9	20,1	0,45	0,026	0,67	0,13	0,12	0,225	207	496	27,3	27,0
Top	2	2,5	29,7	0,61	0,018	0,15	0,28	0,14	0,256	765	821	30,0	15,0
B Leaf Base	3	4,6	17,2	0,42	0,032	0,69	0,16	0,12	0,272	64	670	15,8	11,4
Top	4	17,0	17,6	1,32	0,058	1,22	1,09	0,27	0,431	178	3905	7,0	6,1
C Leaf Basal	5	30,7	13,1	0,58	0,052	0,71	0,18	0,15	0,053	22	1350	20,3	9,2
Mid	6	91,9	16,4	1,72	0,092	1,95	0,40	0,22	0,219	95	2590	10,0	7,2
Top	7	72,3	18,3	1,98	0,095	2,00	0,52	0,29	0,310	93	4750	8,9	7,9
D Leaf Bottom of Basal	8		9,9	1,61	0,192	1,40	0,32	0,26	0,007	22	3560	29,7	15,2
Middle of Basal	9	9,7	10,6	1,10	0,173	1,53	0,38	0,21	0,012	22	2685	21,9	17,5
Top of Basal	10		11,5	0,84	0,141	1,51	0,19	0,18	0,029	30	2255	19,4	12,9
Mid	11	36,1	15,3	1,71	0,126	2,46	0,29	0,24	0,060	80	2995	14,6	7,8
Top	12	29,3	17,1	2,16	0,123	2,54	0,37	0,30	0,159	60	4860	10,3	8,5
E Leaf Basal	13	4,0	9,9	1,25	0,202	2,14	0,19	0,19	0,010	18	2980	16,8	17,6
Mid	14	11,4	13,4	1,32	0,130	2,38	0,23	0,22	0,035	84	2575	14,7	9,3
Top	15	11,2	16,9	1,90	0,113	2,48	0,30	0,25	0,095	51	4425	10,2	8,0
F Leaf Base	16	4,6	12,3	0,82	0,087	1,61	0,09	0,13	0,027	24	1280	20,1	9,3
Top	17	20,4	15,3	1,68	0,145	2,56	0,35	0,28	0,040	51	3840	13,5	6,7
Stem Base	18	11,6	30,2	1,10	0,052	0,42	0,90	0,09	0,230	33	780	26,3	6,8
Bottom of Stele	19	17,2	26,9	1,15	0,091	0,52	1,09	0,18	0,055	22	1380	12,9	8,5
Middle of Stele	20	11,8	23,5	1,15	0,150	0,61	0,42	0,20	0,011	25	1330	55,7	8,2
Top of Stele	21	6,5	16,0	1,76	0,248	0,77	0,80	0,28	0,012	36	3345	32,1	9,4
Bottom of Cortex	22	20,2	30,0	1,22	0,128	0,63	0,99	0,08	0,097	15	575	39,1	10,8
Middle of Cortex	23	19,4	25,6	1,08	0,200	1,00	0,93	0,12	0,010	12	1450	43,4	9,8
Top of Cortex	24	12,9	19,8	1,48	0,253	1,29	1,06	0,15	0,006	12	3300	67,5	10,0
Apex	25	4,5	12,9	2,36	0,321	1,63	1,04	0,45	0,006	29	5615	57,5	8,2
Roots	26	33,3	39,3	0,50	0,028	0,46	0,04	0,05	0,041	116	425	7,4	4,2
Peduncle Bottom	P1	3,5	7,6	2,18	0,210	3,36	0,18	0,51	0,009	23	4035	18,9	8,6
Mid	P2	4,3	8,8	1,00	0,112	2,14	0,09	0,18	0,011	21	2480	9,2	7,0
Top	P3	4,8	9,0	1,08	0,140	2,17	0,15	0,29	0,016	23	4315	12,1	6,8
Mean for Peduncle			8,5	1,36	0,150	2,49	0,13	0,31	0,012	22	3615	13,0	7,4
Total for Peduncle		12,6		0,17g	0,019g	0,31g	0,017g	0,039g	1,6mg	0,28mg	45,4mg	0,16mg	0,09mg
Fruit Bottom	F1	2,9	10,1	1,98	0,201	1,93	0,55	0,46	0,014	40	6760	28,1	7,7
Mid	F2	8,5	11,1	2,45	0,230	2,36	0,85	0,48	0,012	38	5985	31,7	8,0
Top	F3	2,0	12,4	2,85	0,277	2,83	0,99	0,41	0,016	49	5615	32,8	7,7
Mean for Fruit			11,1	2,41	0,231	2,34	0,81	0,46	0,013	40	6096	31,1	7,9
Total for Fruit		13,4		0,32g	0,031g	0,31g	0,108g	0,062g	1,8mg	0,54mg	81,6mg	0,42mg	0,11mg
Mean for Plant			17,1	1,49	0,113	1,63	0,49	0,22	0,139	74	2874	23,4	8,2
Total for Plant		510,0		7,59g	0,57g	8,32g	2,48g	1,11g	707mg	37,5mg	1466mg	12,0mg	4,2mg

TABLE 20

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 15th JULY 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	20,4	0,52	0,027	0,92	0,20	0,17	0,380	190	426	41,1	28,5
Top	2	1,7	37,8	0,65	0,023	0,42	0,42	0,23	0,261	703	536	49,3	27,9
B Leaf Base	3	5,9	16,5	0,48	0,035	0,98	0,22	0,15	0,293	58	429	15,3	8,6
Top	4	16,8	16,6	1,40	0,059	1,67	1,00	0,45	0,466	218	1965	10,2	7,8
C Leaf Basal	5	35,2	13,9	0,64	0,079	0,98	0,31	0,19	0,058	25	890	20,4	9,7
Mid	6	83,6	15,4	1,53	0,082	1,94	0,51	0,26	0,244	84	1445	12,1	8,6
Top	7	63,3	17,7	1,78	0,082	2,02	0,69	0,36	0,265	83	2210	8,8	7,9
D Leaf Bottom of Basal	8		11,2	1,28	0,193	1,17	0,44	0,30	0,006	20	1810	21,2	14,6
Middle of Basal	9	16,3	11,9	0,88	0,149	1,39	0,28	0,24	0,010	20	1280	14,9	18,3
Top of Basal	10		12,3	0,75	0,124	1,30	0,26	0,21	0,020	23	1220	12,9	11,7
Mid	11	40,2	14,2	1,22	0,129	2,12	0,29	0,23	0,042	49	1460	12,3	8,4
Top	12	35,9	16,6	1,63	0,085	2,32	0,41	0,30	0,106	49	2780	9,2	7,5
E Leaf Basal	13	3,2	9,1	1,33	0,221	2,00	0,36	0,33	0,008	24	1515	19,1	13,6
Mid	14	16,0	13,6	1,05	0,129	2,02	0,28	0,23	0,027	31	1335	10,6	7,4
Top	15	15,1	17,1	1,42	0,083	2,22	0,37	0,27	0,081	49	2500	9,8	6,9
F Leaf Base	16	4,5	8,7	1,48	0,226	2,63	0,30	0,39	0,009	31	1390	21,8	11,9
Top	17	31,7	14,7	1,09	0,104	1,96	0,25	0,23	0,032	41	1395	9,7	6,7
Stem Base	18	8,8	30,3	1,08	0,054	0,44	1,02	0,09	0,214	25	327	30,2	7,1
Bottom of Stele	19	14,3	26,2	1,10	0,082	0,58	1,26	0,19	0,073	30	815	11,2	8,1
Middle of Stele	20	10,7	24,3	1,08	0,134	0,62	0,58	0,20	0,023	36	790	13,9	8,4
Top of Stele	21	7,3	17,7	1,50	0,202	0,65	1,00	0,27	0,015	28	1655	27,5	8,1
Bottom of Cortex	22	13,7	28,3	1,22	0,128	0,60	1,26	0,10	0,109	14	360	14,9	12,8
Middle of Cortex	23	15,0	26,4	1,00	0,188	0,79	1,06	0,10	0,023	13	755	26,7	10,5
Top of Cortex	24	14,8	22,6	1,31	0,248	0,74	1,60	0,15	0,012	13	1680	57,0	8,4
Apex	25	2,9	13,5	2,42	0,398	1,40	2,30	0,37	0,011	41	1840	105,5	9,6
Roots	26	20,5	38,7	0,42	0,027	0,59	0,06	0,07	0,041	249	245	14,1	3,6
Ground Sucker A Leaf	GS1	0,2	24,4	0,54	0,034	1,37	0,09	0,10	0,216	183	175	38,1	11,9
B Leaf Base	GS2	0,4	16,9	0,63	0,038	1,27	0,07	0,06	0,034	37	221	8,5	8,1
Top	GS3	0,6	15,1	0,82	0,055	2,13	0,13	0,10	0,099	77	253	16,7	19,9
C Leaf Base	GS4	1,2	13,8	0,73	0,121	1,88	0,16	0,16	0,021	21	432	9,0	10,7
Top	GS5	3,8	13,2	1,01	0,092	2,22	0,20	0,13	0,048	36	445	6,3	4,1
D Leaf Basal	GS6	0,8	9,7	1,30	0,217	3,23	0,19	0,28	0,023	26	679	12,1	11,4
Mid	GS7	2,3	11,7	0,88	0,100	2,40	0,13	0,14	0,031	32	382	6,6	6,2
Top	GS8	2,1	13,5	1,29	0,103	2,34	0,21	0,15	0,049	38	760	6,7	5,8
E & F Leaf Base	GS9	0,5	9,6	1,53	0,169	2,58	0,20	0,31	0,031	43	623	15,7	8,2
Top	GS10	2,1	11,7	1,04	0,096	2,34	0,19	0,19	0,029	38	610	8,1	6,9
Stem Bottom	GS11	1,0	27,4	0,74	0,086	0,88	0,23	0,11	0,046	65	207	23,5	9,0
Middle	GS12	1,2	18,5	1,39	0,221	1,27	1,21	0,20	0,017	41	585	12,2	9,7
Top	GS13	0,2	12,5	2,36	0,410	3,00	2,93	0,63	0,059	92	2492	30,0	8,3
Mean for Ground Sucker			14,1	1,03	0,116	2,13	0,30	0,17	0,041	41	594	10,3	7,5
Total for Ground Sucker		16,5		0,17g	0,019g	0,35g	0,049g	0,027g	6,7mg	0,6mg	8,6mg	0,17mg	0,10mg
Mean for Plant			16,6	1,27	0,105	1,62	0,56	0,24	0,131	67	1340	13,2	8,6
Total for Plant		494,5		6,28g	0,52g	8,03g	2,78g	1,19g	645mg	32,9mg	761mg	7,5mg	4,3mg

TABLE 20A

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 15th JULY 1974. PLANT SHOWING EARLY FRUITING

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,5	22,1	0,42	0,028	0,75	0,15	0,15	0,389	289	345	25,9	8,2
Top	2	1,4	37,8	0,78	0,021	0,57	0,40	0,23	0,434	659	606	35,7	11,0
B Leaf Base	3	5,1	18,2	0,42	0,035	0,79	0,15	0,11	0,346	67	615	13,5	7,3
Top	4	16,4	16,1	1,40	0,058	1,56	0,97	0,41	0,512	156	3255	8,8	5,9
C Leaf Basal	5	28,6	13,7	0,54	0,050	0,71	0,14	0,12	0,068	21	950	19,9	6,3
Mid	6	74,2	15,7	1,64	0,080	1,97	0,39	0,21	0,282	95	1955	9,8	6,4
Top	7	57,0	17,9	1,91	0,081	2,02	0,51	0,19	0,323	119	3610	8,4	7,0
D Leaf Bottom of Basal	8		11,2	0,97	0,135	0,77	0,26	0,26	0,008	20	2545	26,0	14,9
Middle of Basal	9	10,1	11,6	0,76	0,143	0,99	0,20	0,21	0,020	22	1910	22,2	12,9
Top of Basal	10		11,8	0,68	0,126	1,19	0,18	0,19	0,079	47	1645	21,7	7,3
Mid	11	35,3	15,1	1,68	0,134	2,25	0,28	0,24	0,085	78	2315	13,2	7,6
Top	12	29,0	17,4	2,12	0,111	2,20	0,38	0,31	0,202	63	3680	9,3	7,3
E Leaf Basal	13	4,1	10,6	0,82	0,172	1,45	0,17	0,19	0,016	19	2140	15,4	7,3
Mid	14	12,1	13,7	1,38	0,149	2,30	0,24	0,22	0,042	65	2085	12,7	9,1
Top	15	11,7	17,2	1,90	0,108	2,42	0,33	0,27	0,138	56	3610	8,3	6,8
F Leaf Base	16	3,1	10,3	0,76	0,089	1,70	0,10	0,12	0,088	31	1225	21,6	11,7
Top	17	24,2	15,0	1,75	0,175	2,64	0,39	0,31	0,097	59	3345	12,9	6,2
Stem Base	18	10,8	33,6	0,99	0,058	0,45	0,89	0,10	0,250	23	610	22,1	6,5
Bottom of Stele	19	15,6	29,3	1,07	0,089	0,51	0,86	0,18	0,095	22	1085	14,3	8,6
Middle of Stele	20	11,3	26,6	1,08	0,136	0,54	0,39	0,19	0,091	34	830	16,4	9,2
Top of Stele	21	8,7	20,2	1,48	0,202	0,63	0,63	0,27	0,012	57	2135	34,6	9,8
Bottom of Cortex	22	17,3	31,7	1,15	0,123	0,58	0,99	0,10	0,096	19	565	19,4	9,1
Middle of Cortex	23	16,3	28,0	1,04	0,182	0,89	0,80	0,13	0,012	18	910	29,4	10,8
Top of Cortex	24	17,8	25,7	1,06	0,214	1,02	0,81	0,13	0,008	15	2115	40,3	10,2
Apex	25	7,1	17,9	1,63	0,253	0,89	0,61	0,29	0,009	38	4120	38,8	9,6
Roots	26	27,4	41,3	0,40	0,029	0,42	0,05	0,06	0,041	223	390	14,1	4,5
Peduncle Bottom	P1	5,6	9,8	1,08	0,133	1,69	0,10	0,32	0,011	27	2395	8,4	4,3
Mid	P2	4,7	10,1	0,65	0,067	1,80	0,09	0,15	0,019	20	1450	5,4	4,5
Top	P3	5,4	9,7	0,73	0,089	1,91	0,13	0,20	0,017	39	2445	8,1	4,5
Mean for Peduncle			9,9	0,83	0,098	1,80	0,11	0,23	0,015	29	2130	7,4	4,4
Total for Peduncle		15,7		0,13g	0,015g	0,28g	0,017g	0,035g	2,4mg	0,45mg	33,4mg	0,12mg	0,07mg
Fruit Bottom	F1	8,6	9,1	1,27	0,144	1,62	0,32	0,29	0,021	36	3290	19,3	7,1
Mid	F2	26,4	8,4	1,50	0,167	1,71	0,34	0,28	0,016	36	2890	18,9	7,7
Top	F3	8,8	9,1	1,78	0,196	2,10	0,43	0,24	0,017	51	2795	20,0	6,6
Mean for Fruit			8,7	1,51	0,168	1,77	0,36	0,28	0,018	39	2949	19,2	7,4
Total for Fruit		43,8		0,66g	0,074g	0,77g	0,156g	0,121g	7,6mg	1,70mg	129,1mg	0,84mg	0,32mg
Sucker	S1	0,8	11,5	2,01	0,227	1,90	0,54	0,40	0,027	51	4337	21,0	6,3
Fruit Top	T1	2,3	11,6	2,01	0,255	2,34	0,38	0,20	0,026	51	1980	27,2	6,1
Mean for Plant			16,1	1,39	0,113	1,56	0,44	0,21	0,149	70	2223	15,5	7,4
Total for Plant		507,8		7,04g	0,57g	7,95g	2,21g	1,07g	756mg	37,3mg	1129mg	7,9mg	3,7mg

TABLE 21

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 9th SEPTEMBER 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	1,0	19,5	0,53	0,035	0,85	0,19	0,16	0,403	141	724	89,4	13,2
Top	2	1,9	28,6	0,78	0,035	0,27	0,36	0,23	0,541	619	807	61,4	12,6
B Leaf Base	3	8,6	19,4	0,43	0,036	0,65	0,21	0,12	0,209	44	573	20,4	6,3
Top	4	26,9	16,5	1,47	0,062	1,60	0,92	0,47	0,416	156	4050	12,3	7,3
C Leaf Basal	5	38,9	18,8	0,52	0,059	0,60	0,17	0,12	0,030	20	1165	19,3	8,1
Mid	6	82,3	16,1	1,44	0,081	1,69	0,35	0,22	0,195	85	2590	12,7	6,2
Top	7	58,1	17,5	1,53	0,079	1,70	0,48	0,31	0,238	61	4865	10,9	7,6
D Leaf Bottom of Basal	8		14,5	1,05	0,140	0,68	0,33	0,20	0,007	21	2740	16,1	8,6
Middle of Basal	9	16,9	17,4	0,73	0,120	0,75	0,18	0,17	0,011	16	1840	14,1	7,9
Top of Basal	10		17,6	0,66	0,109	0,80	0,15	0,15	0,024	19	1825	10,9	6,9
Mid	11	41,6	14,9	1,10	0,117	1,89	0,20	0,19	0,072	40	2675	11,5	6,6
Top	12	32,3	17,3	1,74	0,088	2,10	0,40	0,19	0,130	55	5290	10,3	5,8
E Leaf Basal	13	4,4	11,2	1,12	0,194	1,33	0,29	0,23	0,010	19	2715	17,8	13,0
Mid	14	18,4	15,3	0,97	0,119	1,75	0,20	0,19	0,046	30	2375	11,9	9,3
Top	15	15,9	17,4	1,45	0,088	2,26	0,32	0,27	0,131	48	4900	10,9	6,1
F Leaf Base	16	4,8	9,0	1,35	0,237	2,35	0,28	0,29	0,013	30	2805	22,5	12,1
Top	17	44,1	15,8	1,17	0,126	2,05	0,24	0,23	0,076	38	3285	10,2	8,0
Stem Base	18	10,0	32,7	1,14	0,046	0,40	0,82	0,08	0,332	26	605	8,1	5,7
Bottom of Stele	19	17,2	29,1	0,94	0,074	0,51	1,02	0,19	0,061	30	1070	10,8	7,4
Middle of Stele	20	13,8	26,2	1,05	0,109	0,46	0,39	0,18	0,013	37	1085	14,6	8,5
Top of Stele	21	7,6	14,6	1,48	0,161	0,64	0,58	0,24	0,011	27	2510	19,0	8,4
Bottom of Cortex	22	15,6	30,5	1,09	0,116	0,53	0,91	0,10	0,109	15	290	13,0	9,6
Middle of Cortex	23	19,4	29,7	0,96	0,151	0,54	0,76	0,11	0,012	16	1020	15,8	8,0
Top of Cortex	24	18,7	24,9	1,22	0,223	0,52	1,06	0,14	0,007	13	3155	40,9	7,7
Apex	25	2,6	13,0	2,48	0,420	1,37	2,09	0,42	0,009	35	6900	90,2	9,7
Roots	26	23,0	44,1	0,40	0,032	0,37	0,06	0,08	0,043	136	505	10,2	5,7

TABLE 21 . contd

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
					N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
Peduncle		P1	0,9	10,0	3,72	0,562	3,52	1,26	0,34	0,010	66	9339	52,5	12,7
Ground Sucker	A Leaf	GS1	0,1	18,9	0,52	0,100	2,00	0,05	0,25	0,210	463	500	125,0	92,5
B Leaf	Base	GS2	0,4	18,0	0,50	0,053	1,11	0,05	0,14	0,035	34	552	14,9	11,8
	Top	GS3	0,4	14,5	0,87	0,087	2,22	0,12	0,12	0,082	52	944	13,3	10,5
C Leaf	Basal	GS4	0,6	17,4	0,66	0,104	1,60	0,12	0,17	0,017	18	124	11,3	11,7
	Mid	GS5	1,3	16,1	0,71	0,099	1,87	0,08	0,09	0,030	23	87	8,9	5,8
	Top	GS6	0,8	13,3	1,32	0,117	2,72	0,20	0,16	0,083	43	238	9,6	8,2
D Leaf	Basal	GS7	0,2	9,8	1,26	0,272	3,30	0,36	0,31	0,024	42	255	22,0	15,0
	Mid	GS8	1,0	13,2	0,78	0,119	2,28	0,12	0,14	0,029	31	118	7,8	8,5
	Top	GS9	0,9	14,2	1,18	0,107	2,23	0,17	0,15	0,066	34	214	8,4	10,0
E & F Leaf	Base	GS10	0,1	10,0	1,56	0,268	4,33	0,33	0,42	0,050	68	200	30,0	29,2
	Top	GS11	1,0	13,2	0,97	0,108	2,33	0,15	0,19	0,036	36	161	9,2	10,8
Stem	Bottom	GS12	0,2	28,1	0,64	0,089	1,00	0,13	0,18	0,179	91	44	71,9	16,9
	Middle	GS13	0,6	22,1	1,20	0,155	0,94	0,59	0,19	0,051	31	132	20,3	12,0
	Top	GS14	0,1	12,1	2,13	-	-	-	-	-	-	-	-	-
Mean for Ground Sucker				15,1	0,95	0,113	2,02	0,17	0,16	0,050	40	218	14,2	11,0
Total for Ground Sucker			7,9		0,07g	0,009g	0,16g	0,013g	0,012g	3,9mg	0,31mg	1,7mg	0,11mg	0,09mg
Mean for Plant				18,1	1,18	0,100	1,37	0,43	0,21	0,127	56	2712	14,5	7,4
Total for Plant			532,9		6,30g	0,531g	7,30g	2,31g	1,12g	677mg	29,9mg	1445mg	7,7mg	3,9mg

TABLE 21A

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 9th SEPTEMBER 1974. PLANT SHOWING EARLY FRUITING

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,9	20,1	0,47	0,028	1,02	0,18	0,13	0,160	131	106	25,9	14,5
Top	2	1,7	25,2	0,66	0,031	0,75	0,27	0,18	0,311	370	122	48,6	13,9
B Leaf Base	3	7,1	18,1	0,51	0,035	0,79	0,19	0,12	0,120	49	172	15,4	8,4
Top	4	27,2	16,3	1,58	0,063	1,77	1,04	0,41	0,220	202	1200	9,7	5,9
C Leaf Basal	5	24,1	15,3	0,55	0,048	0,70	0,20	0,13	0,023	23	223	22,2	9,8
Mid	6	62,8	15,2	1,72	0,072	1,73	0,48	0,22	0,151	97	730	11,4	6,8
Top	7	55,2	17,7	1,92	0,080	1,83	0,69	0,32	0,161	98	1375	11,0	7,1
D Leaf Bottom of Basal	8		13,3	0,78	0,080	0,76	0,27	0,19	0,005	22	407	31,6	11,4
Middle of Basal	9	11,1	14,3	0,66	0,092	0,83	0,25	0,17	0,010	23	366	24,3	10,0
Top of Basal	10		14,6	0,66	0,088	0,99	0,24	0,18	0,019	32	354	24,0	6,4
Mid	11	34,4	15,2	1,64	0,119	2,00	0,39	0,24	0,069	64	870	12,8	8,0
Top	12	28,8	17,5	2,15	0,094	1,87	0,61	0,37	0,109	56	1495	10,0	7,0
E Leaf Basal	13	4,7	12,6	0,79	0,116	1,20	0,22	0,19	0,012	18	416	18,5	6,9
Mid	14	13,8	13,8	1,47	0,123	2,13	0,35	0,25	0,029	72	805	15,6	9,3
Top	15	12,7	17,3	1,98	0,104	1,97	0,54	0,34	0,082	55	1440	10,1	7,0
F Leaf Base	16	4,5	12,1	0,73	0,077	1,55	0,15	0,13	0,024	31	313	19,2	9,0
Top	17	31,0	15,2	1,76	0,137	2,69	0,54	0,34	0,038	49	1185	12,3	6,6
Stem Base	18	10,7	33,2	0,98	0,054	0,43	0,86	0,08	0,256	32	122	11,0	6,5
Bottom of Stele	19	19,7	30,1	1,00	0,089	0,51	0,89	0,16	0,024	27	209	14,5	9,0
Middle of Stele	20	16,5	28,8	1,08	0,119	0,50	0,40	0,16	0,007	24	155	15,9	9,2
Top of Stele	21	9,8	21,3	1,44	0,155	0,62	0,57	0,21	0,006	28	285	24,6	10,1
Bottom of Cortex	22	21,0	32,3	1,20	0,129	0,51	0,95	0,08	0,043	15	113	16,8	9,6
Middle of Cortex	23	23,1	31,1	0,97	0,149	0,72	0,77	0,10	0,006	11	163	20,3	9,1
Top of Cortex	24	21,9	28,6	1,06	0,172	0,78	0,65	0,13	0,004	13	328	49,0	7,8
Apex	25	10,8	20,2	1,14	0,170	0,90	0,38	0,19	0,004	26	429	24,7	7,6
Roots	26	25,4	42,0	0,43	0,131	0,45	0,06	0,06	0,019	135	73	10,4	4,0
Peduncle Bottom	P1	6,8	11,9	0,81	0,075	1,53	0,12	0,23	0,006	18	372	5,7	6,6
Mid	P2	5,1	11,2	0,65	0,055	1,79	0,12	0,13	0,012	15	266	5,8	3,1
Top	P3	5,2	10,4	0,72	0,063	1,99	0,17	0,16	0,011	18	406	6,9	3,0
Mean for Peduncle			11,3	0,73	0,065	1,75	0,14	0,18	0,009	17	351	6,1	4,5
Total for Peduncle		17,0		0,13g	0,011g	0,30g	0,023g	0,031g	1,6mg	0,29mg	6,0mg	0,10mg	0,08mg
Fruit Bottom	F1	10,8	9,3	1,04	0,116	1,82	0,26	0,23	0,008	32	468	14,1	4,6
Mid	F2	85,4	8,4	1,10	0,145	1,63	0,21	0,20	0,007	35	335	16,2	5,7
Top	F3	11,2	10,2	1,21	0,140	1,78	0,25	0,14	0,012	54	316	25,2	4,7
Mean for Fruit			8,7	1,11	0,142	1,66	0,22	0,19	0,007	36	346	16,9	5,5
Total for Fruit		107,4		1,19g	0,152g	1,79g	0,238g	0,208g	7,7mg	3,90mg	37,2mg	1,82mg	0,59mg
Ground Sucker	GS1	0,5	12,9	1,42	0,151	2,56	0,33	0,21	0,022	134	396	39,6	9,2
Sucker	S1	9,4	13,3	1,70	0,191	1,97	0,54	0,26	0,018	59	885	23,6	5,5
Fruit Top	T1	8,9	15,8	1,64	0,229	1,73	0,26	0,16	0,029	70	343	17,8	5,2
Mean for Plant			15,3	1,33	0,111	1,45	0,48	0,22	0,066	61	632	15,8	7,1
Total for Fruit		622,0		8,26g	0,692g	9,02g	2,97g	1,35g	412mg	37,6mg	393mg	9,9mg	4,4mg

TABLE 22

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 4th NOVEMBER 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	1,2	21,6	0,49	0,033	0,77	0,16	0,14	0,236	169	106	34,3	17,3
Top	2	3,4	27,4	0,70	0,036	0,45	0,23	0,19	0,329	437	191	37,0	11,4
B Leaf Base	3	17,3	27,0	0,40	0,035	0,52	0,15	0,09	0,059	29	149	13,5	8,3
Top	4	37,2	17,4	1,39	0,056	1,35	0,43	0,28	0,204	140	1030	10,1	5,1
C Leaf Basal	5	71,2	25,4	0,43	0,047	0,47	0,13	0,10	0,016	19	217	12,4	6,2
Mid	6	108,1	17,1	1,39	0,078	1,65	0,33	0,21	0,100	54	810	9,4	7,3
Top	7	83,1	18,9	1,66	0,074	1,42	0,47	0,28	0,131	54	1360	8,6	6,7
D Leaf Bottom of Basal	8		17,8	0,81	0,088	0,69	0,23	0,15	0,006	24	394	16,2	9,0
Middle of Basal	9	26,8	23,1	0,57	0,082	0,59	0,15	0,12	0,009	21	276	11,6	6,5
Top of Basal	10		22,8	0,55	0,075	0,62	0,14	0,10	0,020	26	273	10,0	5,9
Mid	11	49,3	16,2	1,22	0,103	1,83	0,26	0,19	0,052	38	750	10,5	6,4
Top	12	39,2	17,5	1,72	0,088	2,02	0,48	0,31	0,084	37	1440	9,8	6,3
E Leaf Basal	13	7,4	15,9	0,78	0,133	0,96	0,25	0,18	0,008	14	640	15,0	8,6
Mid	14	21,4	16,2	1,09	0,108	1,76	0,27	0,20	0,034	28	730	8,9	6,8
Top	15	17,6	17,8	1,58	0,089	2,26	0,48	0,30	0,094	51	1495	9,3	5,5
F Leaf Base	16	7,3	12,9	0,85	0,116	1,45	0,20	0,19	0,017	26	650	18,8	10,7
Top	17	56,8	16,8	1,35	0,095	2,01	0,43	0,23	0,040	32	1070	8,7	4,7
Stem Base	18	13,9	39,8	1,07	0,048	0,50	0,92	0,08	0,067	45	123	9,3	4,9
Bottom of Stele	19	29,6	35,2	0,97	0,064	0,54	0,83	0,15	0,015	36	249	10,6	5,1
Middle of Stele	20	23,7	32,1	0,96	0,078	0,49	0,32	0,14	0,005	34	202	11,0	6,9
Top of Stele	21	17,7	24,1	1,20	0,119	0,51	0,37	0,13	0,004	32	323	14,5	6,4
Bottom of Cortex	22	30,0	35,9	1,01	0,101	0,49	0,81	0,09	0,020	17	85	11,9	7,7
Middle of Cortex	23	35,4	34,8	0,89	0,107	0,51	0,54	0,08	0,005	21	167	14,6	6,3
Top of Cortex	24	36,1	31,5	0,96	0,131	0,60	0,62	0,07	0,002	17	355	23,3	5,5
Apex	25	10,2	21,2	1,49	0,201	0,81	0,99	0,17	0,003	30	1005	34,2	6,0
Roots	26	24,7	43,8	0,43	0,025	0,42	0,05	0,04	0,016	140	35	8,0	4,6
Peduncle Bottom	P1	6,4	12,4	1,77	0,218	1,50	0,39	0,34	0,002	30	1160	23,1	7,1
Mid	P2	4,4	12,6	0,94	0,111	1,44	0,16	0,17	0,006	24	860	8,0	5,3
Top	P3	4,3	12,8	1,03	0,105	1,70	0,26	0,22	0,006	28	1145	13,0	4,0
Mean for Peduncle			12,6	1,32	0,155	1,54	0,28	0,25	0,004	28	1067	15,8	5,7
Total for Peduncle		15,1		0,20g	0,023g	0,23g	0,043g	0,038g	0,6mg	0,42mg	16,1mg	0,24mg	0,09mg

TABLE 22 contd.

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
Fruit	Bottom	F1	1,8	12,1	1,65	0,171	1,92	0,49	0,24	0,006	59	915	22,5	7,0
	Mid	F2	5,5	12,9	2,23	0,227	2,00	0,95	0,30	0,005	47	985	31,5	7,7
	Top	F3	1,3	14,9	2,70	0,273	2,36	1,24	0,31	0,005	88	1095	39,3	8,6
Mean for Fruit				13,2	2,18	0,222	2,04	0,90	0,29	0,005	56	987	30,8	7,7
Total for Fruit			8,5		0,18g	0,019g	0,17g	0,076g	0,025g	0,4mg	0,47mg	8,4mg	0,26mg	0,07mg
Ground Sucker	A Leaf	GS1	0,1	20,3	0,62	0,024	2,00	0,05	0,05	0,202	210	242	96,8	112,9
B Leaf	Base	GS2	0,5	24,6	0,43	0,034	1,15	0,05	0,05	0,010	23	90	10,5	7,2
	Top	GS3	0,5	19,8	0,75	0,062	1,53	0,08	0,05	0,026	30	110	8,5	6,7
C Leaf	Basal	GS4	0,6	21,3	0,61	0,079	1,50	0,09	0,10	0,005	25	209	9,2	6,8
	Mid	GS5	1,0	19,6	0,56	0,096	1,34	0,05	0,05	0,010	31	133	6,6	6,4
	Top	GS6	0,5	14,1	1,44	0,104	2,58	0,20	0,11	0,033	47	504	6,3	8,5
D Leaf	Basal	GS7	0,3	9,6	1,46	0,223	3,28	0,22	0,18	0,008	42	564	12,9	10,4
	Mid	GS8	0,8	14,9	0,66	0,099	1,71	0,11	0,09	0,013	47	251	7,6	6,8
	Top	GS9	0,8	17,4	1,19	0,101	2,16	0,19	0,12	0,035	44	553	5,9	6,1
E & F Leaf		GS10	0,7	13,6	1,51	0,124	2,21	0,24	0,17	0,013	68	569	11,5	8,2
Stem	Bottom	GS11	0,3	31,1	0,61	0,036	0,90	0,18	0,07	0,026	99	155	11,0	10,5
	Top	GS12	0,9	22,0	1,21	0,157	1,12	0,74	0,14	0,004	41	395	12,2	7,8
Mean for Ground Sucker				18,7	0,93	0,101	1,70	0,21	0,10	0,018	45	320	9,9	8,5
Total for Ground Sucker			7,0		0,07g	0,007g	0,12g	0,015g	0,007g	1,3mg	0,31mg	2,2mg	0,07mg	0,06mg
Sucker		S1	1,1	12,9	2,05	0,233	1,57	0,78	0,35	0,011	48	1280	29,4	6,3
Mean for Plant				20,7	1,15	0,086	1,20	0,40	0,18	0,059	46	690	11,9	6,4
Total for Plant			800,3		9,20g	0,685g	9,57g	3,24g	1,45g	468mg	36,4mg	552mg	9,5mg	5,1mg

TABLE 22A

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 4th NOVEMBER 1974. PLANT SHOWING EARLY FRUITING

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	1,5	19,4	0,43	0,030	0,55	0,16	0,14	0,183	149	140	31,3	17,8
Top	2	6,4	35,8	0,76	0,031	0,53	0,42	0,30	0,255	631	381	27,0	12,9
B Leaf Base	3	8,9	17,0	0,43	0,035	0,60	0,19	0,11	0,068	40	239	18,8	11,9
Top	4	33,6	16,4	1,68	0,069	1,72	0,94	0,38	0,171	192	1340	9,3	5,9
C Leaf Basal	5	23,6	13,8	0,55	0,054	0,53	0,18	0,13	0,018	20	290	22,5	8,4
Mid	6	57,8	14,1	1,82	0,092	1,70	0,46	0,23	0,109	96	870	11,9	6,1
Top	7	48,8	17,0	2,01	0,085	1,63	0,60	0,30	0,135	93	1465	8,2	5,8
D Leaf Bottom of Basal	8		11,5	0,78	0,078	0,69	0,24	0,18	0,006	21	595	38,8	11,1
Middle of Basal	9	10,7	12,1	0,66	0,095	0,79	0,21	0,17	0,013	21	555	31,1	8,9
Top of Basal	10		12,5	0,61	0,092	0,94	0,21	0,15	0,025	52	515	30,6	5,6
Mid	11	32,7	13,4	1,95	0,166	1,92	0,51	0,29	0,059	63	1365	16,2	8,4
Top	12	30,9	17,1	2,16	0,104	1,55	0,79	0,42	0,090	54	2200	10,4	6,0
E Leaf Basal	13	4,4	10,9	0,66	0,101	1,11	0,16	0,15	0,021	23	615	23,9	5,7
Mid	14	12,7	12,2	1,68	0,170	2,34	0,50	0,31	0,035	112	1255	21,7	9,5
Top	15	13,2	16,6	2,13	0,117	1,89	0,71	0,42	0,077	52	1990	11,4	6,5
F Leaf Base	16	3,9	12,6	0,68	0,075	1,46	0,12	0,10	0,042	49	450	23,0	9,7
Top	17	28,5	15,5	1,91	0,157	2,32	0,68	0,41	0,042	49	1865	11,7	5,1
Stem Base	18	15,5	33,2	0,98	0,051	0,20	0,69	0,06	0,075	281	117	13,7	6,1
Bottom of Stele	19	19,7	29,0	1,11	0,098	0,38	0,10	0,17	0,016	29	260	13,9	9,7
Middle of Stele	20	16,6	28,4	1,12	0,147	0,38	0,42	0,17	0,007	32	168	13,4	10,0
Top of Stele	21	12,6	21,9	1,58	0,197	0,49	0,63	0,23	0,006	38	318	27,1	11,8
Bottom of Cortex	22	21,5	31,6	1,12	0,121	0,40	1,16	0,08	0,024	27	108	25,8	9,4
Middle of Cortex	23	21,6	29,9	1,01	0,175	0,68	0,85	0,10	0,006	12	156	24,0	10,1
Top of Cortex	24	21,9	26,0	1,07	0,201	0,91	0,66	0,12	0,004	19	383	32,3	10,0
Apex	25	10,2	18,5	1,35	0,230	1,09	0,32	0,22	0,004	30	498	21,4	9,0
Roots	26	32,1	46,7	0,39	0,027	0,24	0,07	0,05	0,017	148	99	6,4	3,5
Peduncle Bottom	P1	7,6	11,0	0,86	0,073	1,82	0,16	0,24	0,012	23	434	6,5	7,8
Mid	P2	5,4	11,8	0,75	0,074	1,92	0,11	0,11	0,019	25	240	5,4	4,4
Top	P3	5,7	11,9	0,97	0,121	2,39	0,15	0,19	0,018	20	266	6,4	3,4
Mean for Peduncle			11,6	0,86	0,088	2,02	0,14	0,17	0,016	23	327	6,1	5,5
Total for Peduncle		18,6		0,16g	0,016g	0,38g	0,026g	0,031g	2,9mg	0,42mg	6,1mg	0,11mg	0,10mg
Fruit Base	F1	18,6	12,9	0,84	0,099	1,62	0,15	0,14	0,007	37	320	9,3	2,9
Bottom of Outer	F2	27,7	12,3	0,89	0,092	1,55	0,13	0,10	0,011	40	189	7,6	2,6
Middle of Outer	F3	21,0	12,4	0,85	0,075	1,39	0,12	0,08	0,009	43	161	7,4	2,0
Top of Outer	F4	27,5	12,5	0,89	0,083	1,35	0,12	0,07	0,011	52	169	7,5	2,1
Bottom of Inner	F5	52,2	10,7	0,80	0,069	1,06	0,07	0,13	0,003	52	208	7,3	5,1
Middle of Inner	F6	49,0	10,1	0,84	0,083	1,06	0,06	0,10	0,004	20	178	6,0	3,1
Top of Inner	F7	47,2	10,2	0,78	0,089	1,19	0,06	0,11	0,003	20	184	6,6	3,3
Top	F8	15,3	11,8	0,89	0,099	1,45	0,13	0,10	0,012	47	243	9,3	2,6
Mean for Fruit			11,2	0,84	0,084	1,26	0,091	0,11	0,006	37	198	7,3	5,4
Total for Fruit		258,5		2,16g	0,216g	3,25g	0,236g	0,271g	15,9mg	9,49mg	51,2mg	1,88mg	1,39mg

TABLE 22A contd

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
Ground Sucker	G1	4,3	12,2	2,28	0,132	2,22	0,29	0,19	0,029	67	373	17,5	10,1
Sucker A Leaf	S1	0,6	19,2	0,59	0,378	0,70	0,14	0,13	0,081	108	479	21,4	22,2
B Leaf Base	S2	0,7	13,5	1,31	0,096	1,41	0,34	0,24	0,014	32	1107	15,4	11,9
Top	S3	1,2	15,6	1,30	0,093	1,77	0,26	0,20	0,026	56	1070	9,9	8,5
C Leaf Basal	S4	0,7	9,4	2,64	0,253	2,60	0,67	0,42	0,005	34	1625	18,9	10,0
Mid	S5	1,3	13,2	1,35	0,105	1,94	0,23	0,19	0,012	42	835	9,2	6,2
Top	S6	1,1	14,4	1,22	0,136	2,82	0,55	0,33	0,020	38	2488	6,5	5,4
D Leaf Basal	S7	0,4	7,9	2,91	0,306	4,36	1,07	0,66	0,009	50	1209	28,9	10,2
Mid	S8	0,9	11,8	4,08	0,116	2,48	0,38	0,29	0,008	52	938	11,2	6,5
Top	S9	1,1	15,4	1,26	0,118	2,67	0,54	0,29	0,016	42	1983	7,7	5,1
E & F Leaf Base	S10	0,4	8,9	2,69	0,117	2,53	0,31	0,29	0,014	63	891	12,0	7,3
Top	S11	0,6	13,0	0,97	0,249	3,46	0,62	0,48	0,010	68	814	27,5	9,0
Stem Bottom	S12	0,9	19,5	2,51	0,220	0,73	0,31	0,18	0,009	52	344	10,6	8,7
Mid	S13	0,9	12,7	2,97	0,448	1,17	2,15	0,34	0,006	29	1625	22,2	8,8
Top	S14	0,3	11,1	1,51	0,495	1,56	4,05	0,58	0,008	63	3219	65,9	7,8
Mean for Sucker			13,8	1,91	0,198	2,09	0,68	0,30	0,016	49	1305	15,4	8,5
Total for Sucker		11,1		0,21g	0,022g	0,23g	0,075g	0,033g	1,8mg	0,54mg	14,5mg	0,17mg	0,09mg
Top A Leaf Base	T1	0,8	23,0	1,68	0,136	0,88	0,13	0,10	0,009	39	368	10,5	4,8
Top	T2	1,3	18,3	0,66	0,136	1,19	0,40	0,19	0,084	54	755	15,1	4,7
B Leaf Base	T3	1,3	28,1	0,84	0,164	0,93	0,07	0,09	0,004	29	215	6,7	4,2
Top	T4	1,9	17,2	1,51	0,156	1,36	0,23	0,16	0,084	48	478	12,0	5,5
C Leaf Basal	T5	2,5	34,7	1,00	0,140	0,83	0,03	0,07	0,002	25	110	5,3	4,5
Mid	T6	2,2	20,0	0,75	0,158	1,13	0,07	0,09	0,025	42	156	7,5	4,7
Top	T7	1,4	18,5	0,72	0,101	1,24	0,16	0,13	0,169	65	352	10,2	5,0
D Leaf Basal	T8	1,1	33,0	1,58	0,145	1,03	0,26	0,07	0,003	26	105	6,6	4,3
Mid	T9	1,1	21,3	0,77	0,137	1,15	0,05	0,08	0,019	32	120	7,1	4,7
Top	T10	0,6	18,4	1,56	0,077	1,30	0,12	0,14	0,196	59	320	11,0	5,3
E & F Leaf Base	T11	0,9	20,3	0,71	0,183	1,24	0,08	0,17	0,005	43	281	9,2	5,6
Top	T12	1,9	17,7	1,01	0,093	1,21	0,09	0,11	0,036	54	237	8,5	5,6
Stem Base	T13	0,7	23,5	1,34	0,303	1,38	0,26	0,17	0,015	118	336	14,2	6,1
Top	T14	1,0	27,0	1,90	0,341	1,04	0,35	0,12	0,004	45	201	8,5	6,4
Mean for Top			23,1	1,09	0,154	1,12	0,14	0,11	0,043	45	275	12,4	5,0
Total for Top		18,8		0,20g	0,029g	0,21g	0,028g	0,021g	8,1mg	0,84mg	5,2mg	0,23mg	0,09mg
Mean for Plant			14,9	1,11	0,103	1,26	0,38	0,19	0,044	66	639	12,6	6,2
Total for Plant		800,6		8,89g	0,83g	10,10g	3,04g	1,49g	353mg	53,2mg	511mg	10,1mg	5,0mg

TABLE 23

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT WHITNEY ESTATE ON THE 24th FEBRUARY 1975

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	5,5	18,9	0,35	0,024	0,38	0,16	0,12	0,181	153	102	25,4	17,2
Top	2	24,1	48,5	0,65	0,016	0,10	0,21	0,16	0,201	522	211	10,3	9,4
B Leaf Base	3	8,5	17,0	0,32	0,024	0,41	0,13	0,10	0,044	34	138	21,5	8,5
Top	4	21,7	15,5	0,99	0,044	0,37	0,45	0,24	0,166	172	351	7,8	3,5
C Leaf Basal	5	23,3	15,5	0,33	0,035	0,27	0,12	0,10	0,024	33	179	20,8	6,3
Mid	6	49,5	14,0	1,18	0,068	0,77	0,59	0,24	0,137	73	990	11,2	5,5
Top	7	36,8	17,1	1,42	0,078	0,70	0,86	0,26	0,164	74	1670	8,5	5,5
D Leaf Bottom of Basal	8		15,3	0,35	0,041	0,39	0,11	0,12	0,012	23	175	15,1	6,6
Middle of Basal	9	16,4	17,5	0,36	0,045	0,41	0,12	0,11	0,022	21	177	13,5	6,2
Top of Basal	10		17,1	0,41	0,044	0,47	0,14	0,11	0,045	29	183	12,8	6,8
Mid	11	35,9	14,2	1,27	0,113	1,29	0,66	0,30	0,083	49	1130	13,1	6,9
Top	12	30,4	18,3	1,55	0,100	1,18	0,77	0,38	0,109	45	1890	9,5	6,0
E Leaf Basal	13	6,0	14,7	0,41	0,045	0,65	0,14	0,14	0,039	20	251	21,6	7,9
Mid	14	18,2	15,4	1,20	0,111	1,31	0,86	0,37	0,080	30	1415	14,0	5,7
Top	15	16,3	18,9	1,47	0,101	1,44	1,12	0,50	0,116	54	2350	13,0	5,3
F Leaf Base	16	8,0	15,4	0,43	0,049	0,85	0,09	0,10	0,062	32	177	16,7	5,3
Top	17	57,6	17,8	1,35	0,144	1,64	0,89	0,38	0,096	35	1740	9,7	4,9
Stem Base	18	10,6	31,6	1,11	0,040	0,25	0,93	0,08	0,065	93	111	17,3	5,6
Bottom of Stele	19	15,6	25,9	1,12	0,053	0,28	1,36	0,19	0,023	57	252	8,7	7,9
Middle of Stele	20	15,0	24,8	1,06	0,065	0,34	0,41	0,18	0,007	39	176	10,3	9,2
Top of Stele	21	13,0	19,2	0,96	0,101	0,37	0,29	0,18	0,007	41	172	13,5	11,0
Bottom of Cortex	22	18,1	28,1	1,12	0,074	0,47	1,10	0,10	0,027	23	77	23,4	10,9
Middle of Cortex	23	22,6	26,1	0,95	0,086	0,63	0,60	0,10	0,006	35	138	11,7	5,3
Top of Cortex	24	25,8	26,1	0,84	0,121	0,78	0,23	0,09	0,003	15	271	14,8	6,6
Apex	25	10,9	20,6	0,97	0,149	0,71	0,31	0,18	0,009	40	307	19,0	7,0
Roots	26	26,8	53,4	0,39	0,017	0,21	0,05	0,03	0,018	201	87	15,1	5,5
Peduncle Bottom	P1	7,3	16,1	0,55	0,070	0,80	0,13	0,16	0,013	41	185	6,3	3,8
Mid	P2	4,5	15,6	0,49	0,057	1,24	0,11	0,11	0,025	22	210	5,9	3,1
Top	P3	4,6	16,4	0,53	0,089	1,59	0,13	0,07	0,018	23	216	6,3	3,4
Mean for Peduncle			16,0	0,53	0,072	1,14	0,12	0,12	0,017	31	201	6,2	3,5
Total for Peduncle		16,4		0,08g	0,011g	0,19g	0,020g	0,020g	2,9mg	0,50mg	3,3mg	0,10mg	0,06mg
Fruit Base	F1	25,3	18,4	0,58	0,100	1,07	0,09	0,07	0,007	53	94	8,2	3,8
Bottom of Outer	F2	24,4	16,6	0,66	0,120	1,11	0,12	0,06	0,010	54	108	10,9	4,1
Middle of Outer	F3	17,0	12,8	0,73	0,129	1,14	0,13	0,06	0,012	54	106	9,9	3,5
Top of Outer	F4	12,7	11,7	0,81	0,119	1,06	0,18	0,07	0,018	67	156	8,0	2,8
Bottom of Inner	F5	50,9	17,7	0,40	0,032	0,47	0,04	0,07	0,009	28	97	4,9	4,9
Middle of Inner	F6	44,1	15,2	0,43	0,041	0,57	0,06	0,08	0,004	55	106	6,1	5,6
Top of Inner	F7	25,2	11,4	0,50	0,057	0,63	0,07	0,09	0,008	34	171	7,5	6,3
Top	F8	16,9	9,5	0,62	0,106	1,06	0,21	0,10	0,017	70	264	10,5	4,3
Mean for Fruit			15,0	0,54	0,073	0,78	0,09	0,07	0,009	48	126	7,5	4,7
Total for Fruit		216,6		1,16g	0,158g	1,70g	0,196g	0,161g	19,4mg	10,28mg	27,2mg	1,63mg	1,02mg

TABLE 23 contd

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
Ground Sucker														
A Leaf	Base	GS1	0,2	17,4	0,46	0,055	1,20	0,09	0,12	0,037	57	115	13,5	12,0
	Top	GS2	0,2	22,0	0,43	0,043	1,20	0,06	0,10	0,098	158	60	26,5	27,0
B Leaf	Base	GS3	0,6	13,9	0,43	0,048	1,27	0,05	0,11	0,013	32	91	12,4	14,9
	Top	GS4	1,0	12,8	0,66	0,078	1,52	0,06	0,08	0,041	62	90	10,4	14,5
C Leaf	Basal	GS5	0,8	11,9	0,80	0,134	1,70	0,05	0,10	0,006	29	98	14,2	15,7
	Mid	GS6	1,3	13,9	0,56	0,052	1,49	0,04	0,07	0,013	23	58	8,9	3,5
	Top	GS7	1,0	14,2	1,18	0,135	2,14	0,10	0,14	0,028	30	143	8,2	5,1
D Leaf	Basal	GS8	0,3	8,2	1,54	0,301	2,85	0,19	0,28	0,010	49	253	28,0	18,8
	Mid	GS9	0,6	10,6	0,85	0,101	2,02	0,11	0,14	0,012	45	148	12,1	10,5
	Top	GS10	0,8	13,2	1,23	0,097	2,15	0,15	0,19	0,018	61	229	10,6	8,3
E & F Leaf	Base	GS11	0,3	8,8	1,55	0,378	3,29	0,25	0,41	0,011	54	254	23,9	12,1
	Top	GS12	0,5	11,5	0,95	0,096	1,54	0,16	0,21	0,014	51	261	12,4	8,5
Stem	Bottom	GS13	0,6	25,0	0,55	0,075	0,35	0,14	0,19	0,048	58	81	6,3	12,1
	Mid	GS14	1,0	16,5	1,11	0,228	1,02	0,43	0,16	0,008	49	92	9,3	12,4
	Top	GS15	0,2	9,6	3,12	0,483	2,50	1,75	0,85	0,030	563	600	56,3	26,3
Mean for Ground Sucker				13,9	0,90	0,125	1,64	0,16	0,16	0,022	56	135	13,0	11,3
Total for Ground Sucker			9,5		0,09g	0,012g	0,16g	0,015g	0,015g	2,1mg	0,54mg	1,3mg	0,12mg	0,11mg
Sucker														
A Leaf	Base	S1	1,1	32,4	0,33	0,016	0,15	0,10	0,05	0,034	67	99	18,2	12,2
	Top	S2	1,1	30,2	0,43	0,021	0,14	0,11	0,07	0,060	161	115	22,0	30,0
B Leaf	Base	S3	4,8	18,7	0,34	0,044	0,60	0,17	0,11	0,008	22	220	13,2	7,3
	Top	S4	6,6	18,2	0,78	0,082	0,94	0,32	0,15	0,016	45	393	10,7	7,9
C Leaf	Basal	S5	5,4	9,6	1,28	0,242	1,92	0,56	0,31	0,003	33	800	18,6	11,1
	Mid	S6	7,1	12,8	0,82	0,115	1,22	0,28	0,16	0,011	49	393	11,1	6,7
	Top	S7	6,0	14,2	1,56	0,128	1,78	0,61	0,27	0,015	55	1130	9,3	7,0
D Leaf	Basal	S8	1,9	7,1	1,89	0,352	2,99	0,96	0,51	0,005	37	1297	25,2	9,7
	Mid	S9	4,2	10,3	1,02	0,125	1,58	0,42	0,24	0,008	41	463	13,6	9,0
	Top	S10	5,7	13,9	1,35	0,113	1,38	0,56	0,25	0,012	51	974	11,7	6,0
E & F Leaf	Base	S11	2,3	7,4	1,94	0,261	2,87	0,74	0,48	0,009	59	952	19,7	6,0
	Top	S12	4,5	11,8	0,95	0,087	1,03	0,43	0,26	0,009	42	813	13,3	6,7
Stem	Bottom	S13	4,8	23,3	0,82	0,103	0,27	0,35	0,13	0,015	32	202	9,2	7,5
	Mid	S14	4,6	14,5	1,87	0,301	0,61	1,06	0,29	0,004	39	2110	17,2	9,8
	Top	S15	1,6	11,5	3,11	0,409	1,08	3,78	0,54	0,003	36	880	78,5	6,8
Mean for Sucker				14,7	1,16	0,147	1,24	0,56	0,24	0,011	45	742	15,2	8,2
Total for Sucker			61,8		0,72g	0,091g	0,76g	0,348g	0,146g	7,1mg	2,75mg	45,8mg	0,94mg	0,51mg

TABLE 23 contd

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
					N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
Slip A Leaf	Base	SL1	0,5	17,0	0,66	0,135	0,53	0,15	0,08	0,013	34	172	15,5	9,2
	Top	SL2	0,5	16,8	1,04	0,133	0,89	0,17	0,10	0,031	49	174	23,6	7,5
B Leaf	Base	SL3	1,0	14,0	0,76	0,165	0,87	0,17	0,12	0,005	29	215	11,7	8,9
	Top	SL4	1,4	14,7	1,48	0,162	1,34	0,12	0,11	0,016	46	145	15,9	7,5
C Leaf	Basal	SL5	1,2	9,0	1,21	0,266	1,59	0,47	0,28	0,005	41	559	16,9	8,6
	Mid	SL6	1,5	11,9	1,00	0,184	1,50	0,18	0,12	0,007	49	244	14,0	7,5
	Top	SL7	1,1	13,0	2,05	0,155	1,64	0,32	0,17	0,019	49	413	13,5	8,2
D Leaf	Basal	SL8	0,5	7,4	1,96	0,355	2,90	0,69	0,41	0,015	62	875	28,2	8,8
	Mid	SL9	0,6	9,9	1,24	0,177	1,77	0,33	0,21	0,011	53	442	16,3	6,5
	Top	SL10	0,8	12,4	1,58	0,142	1,40	0,42	0,20	0,015	37	588	16,8	7,9
E & F Leaf	Base	SL11	0,5	8,2	2,25	0,326	3,13	0,68	0,47	0,021	87	553	26,9	9,7
	Top	SL12	0,7	11,2	2,37	0,121	1,27	0,39	0,25	0,016	58	604	18,9	9,9
Stem	Bottom	SL13	2,6	11,2	0,55	0,103	1,08	0,22	0,18	0,040	87	325	8,3	4,7
	Mid	SL14	4,1	9,4	1,58	0,140	1,33	0,26	0,15	0,028	83	405	9,7	6,1
	Top	SL15	1,0	13,4	1,21	0,471	0,98	1,57	0,33	0,009	50	825	26,8	12,4
Mean for Slip				11,6	1,32	0,180	1,37	0,36	0,19	0,020	63	411	14,5	7,4
Total for Slip			17,8		0,24g	0,032g	0,24g	0,064g	0,033g	3,6mg	1,11mg	7,3mg	0,26mg	0,13mg
Top A Leaf	Base	T1	0,4	21,9	0,65	0,068	0,42	0,46	0,11	0,050	52	411	14,5	7,9
	Top	T2	0,6	19,2	0,89	0,175	0,68	1,16	0,33	0,296	55	390	19,5	3,6
B Leaf	Base	T3	1,5	22,9	0,57	0,144	0,59	0,29	0,15	0,015	26	299	12,7	7,4
	Top	T4	2,3	17,8	1,54	0,173	1,10	0,66	0,26	0,183	40	965	14,2	6,4
C Leaf	Basal	T5	2,8	16,6	0,83	0,209	1,12	0,33	0,20	0,006	34	403	15,0	8,5
	Mid	T6	4,1	17,2	0,96	0,188	1,33	0,22	0,14	0,037	35	300	12,8	7,9
	Top	T7	2,9	16,6	2,02	0,159	1,58	0,51	0,26	0,172	47	1000	11,8	7,1
D Leaf	Basal	T8	0,6	9,7	1,42	0,379	2,64	0,53	0,34	0,011	58	696	20,2	8,5
	Mid	T9	1,1	13,1	1,00	0,190	1,71	0,22	0,16	0,017	46	300	14,0	7,0
	Top	T10	1,2	15,7	1,29	0,130	1,43	0,25	0,17	0,053	41	372	12,7	7,3
E & F Leaf	Base	T11	0,5	9,3	1,82	0,368	3,50	0,53	0,36	0,016	71	817	25,2	7,8
	Top	T12	1,3	13,3	0,96	0,128	1,41	0,23	0,17	0,016	39	351	14,0	8,4
Stem	Base	T13	1,0	21,4	1,19	0,268	1,33	1,10	0,24	0,012	46	431	10,9	10,7
	Top	T14	1,5	18,7	1,99	0,429	1,09	1,75	0,29	0,006	39	885	29,1	8,1
Mean for Top				16,8	1,24	0,202	1,33	0,52	0,21	0,067	41	570	14,9	7,7
Total for Top			22,1		0,27g	0,045g	0,29g	0,113g	0,046g	14,6mg	0,90mg	12,6mg	0,33mg	0,17mg
Mean for Plant				16,9	0,91	0,088	0,85	0,43	0,18	0,054	67	601	12,2	6,2
Total for Plant			868,0		7,85g	0,76g	7,35g	3,76g	1,56g	468mg	583,3mg	521mg	10,5mg	5,4mg

TABLE 24

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 15th JULY 1972

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf	Base	1	W	-	0,43	0,014	0,59	0,33	0,20	0,024	88	102	16,4	12,5
	Top	2	E	79,6	0,85	0,031	0,92	0,91	0,53	0,071	79	435	12,2	13,4
B Leaf	Base	3	I	19,7	1,34	-	-	-	-	-	-	-	-	-
	Top	4	G	53,9	0,82	0,022	1,65	0,52	0,51	0,070	146	321	10,9	12,4
C Leaf	Basal	5	H	21,0	1,31	0,128	2,59	0,38	0,43	0,007	37	278	14,9	18,6
	Mid	6	T	16,2	1,15	0,067	3,04	0,35	0,37	0,021	50	356	10,5	10,5
	Top	7		80,0	0,76	0,021	1,60	0,45	0,54	0,063	260	367	10,5	14,7
D Leaf	Bottom of Basal	8		23,3	2,47	0,258	3,50	0,58	0,73	0,010	230	417	20,5	22,9
	Middle of Basal	9	N	20,9	1,61	0,196	2,92	0,30	0,38	0,006	144	278	12,5	6,7
	Top of Basal	10	O	21,3	1,33	0,149	2,87	0,26	0,34	0,004	106	231	12,0	7,2
	Mid	11	T	16,2	1,02	0,075	3,41	0,29	0,31	0,014	65	385	9,3	6,5
	Top	12		36,1	0,79	0,036	2,04	0,16	0,23	0,048	231	158	10,6	10,4
E Leaf	Basal	13	M	13,4	3,06	0,300	6,44	0,47	0,68	0,012	211	303	37,7	13,0
	Mid	14	E	16,3	0,91	0,085	3,50	0,24	0,32	0,013	64	334	8,9	6,0
	Top	15	A	27,3	0,78	0,038	2,00	0,19	0,23	0,034	139	246	10,6	7,0
F Leaf	Base	16	S	13,6	3,06	0,300	6,44	0,47	0,68	0,012	211	303	37,7	13,0
	Top	17	U	17,6	0,87	0,058	3,18	0,26	0,31	0,013	118	431	13,4	5,8
Stem	Base	18	R	39,0	1,69	0,128	1,73	0,95	0,33	0,029	426	135	21,3	10,6
	Middle	19	E	22,1	2,27	2,270	2,11	1,55	0,42	0,011	80	139	19,9	8,7
	Apex	20	D	27,1	2,00	0,311	1,94	1,39	0,21	0,009	66	56	24,0	13,1
Roots		21		21,6	2,40	0,210	2,45	1,62	0,44	0,008	90	174	39,8	7,3
Mean for Plant				23,4	1,24	0,094	1,74	0,63	0,37	0,031	92	199	11,9	8,1
Total for Plant			27,3g		0,34g	0,03g	0,47g	0,17g	0,10g	8mg	2,5mg	5mg	0,3mg	0,2mg

TABLE 25. DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 30th JANUARY 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	30,5	0,38	0,014	0,25	0,17	0,16	0,025	210	53	11,5	6,6
Top	2	2,6	35,9	0,82	0,025	0,13	0,42	0,21	0,035	1026	257	20,2	31,2
B Leaf Base	3	0,5	9,3	1,31	0,094	2,36	0,31	0,60	0,013	49	218	13,2	11,8
Top	4	2,1	16,0	1,10	0,064	1,86	0,41	0,41	0,067	249	409	15,6	12,5
C Leaf Basal	5	0,6	0,6	3,07	0,257	3,94	1,38	0,93	0,052	69	306	26,9	8,9
Mid	6	2,7	12,6	1,74	0,129	4,25	0,40	0,32	0,143	78	109	12,7	6,8
Top	7	3,4	17,5	1,70	0,104	3,91	0,63	0,49	0,166	213	520	9,1	7,2
D Leaf Bottom of Basal	8		6,6	4,89	0,495	6,00	1,84	1,58	0,048	130	350	62,5	25,0
Middle of Basal	9	0,4	5,2	3,74	0,385	7,50	1,45	1,35	0,049	200	338	55,0	58,8
Top of Basal	10		5,4	2,84	0,299	7,13	1,25	0,98	0,044	139	244	30,0	26,3
Mid	11	3,0	11,4	2,07	0,136	4,41	0,41	0,33	0,111	76	83	13,1	11,1
Top	12	4,5	18,6	1,74	0,104	4,40	0,63	0,46	0,458	296	395	11,6	9,8
E Leaf Basal	13	0,2	5,6	4,25	0,453	9,17	1,16	1,18	0,033	143	208	50,0	37,5
Mid	14	1,0	9,1	2,00	0,142	4,88	0,41	0,39	0,070	73	104	18,5	14,4
Top	15	1,2	15,7	2,01	0,116	4,38	0,46	0,38	0,420	123	206	12,4	9,5
F Leaf Base	16	0,1	6,2	3,82	0,500	8,25	0,73	1,18	0,025	135	150	42,5	60,0
Top	17	0,6	12,6	1,71	0,113	3,70	0,30	0,34	0,109	109	126	17,0	15,5
Stem Base	18	1,1	18,5	1,18	0,079	1,01	0,89	0,27	0,075	460	42	10,0	11,7
Bottom of Stele	19	0,5	12,7	2,25	0,194	1,39	1,87	0,44	0,083	82	40	12,9	11,5
Middle of Stele	20	0,4	9,6	3,09	0,350	1,88	2,38	0,63	0,060	69	83	17,3	13,3
Top of Stele	21	0,2	8,6	3,19	0,463	2,38	3,42	0,76	0,050	95	309	23,4	16,6
Bottom of Cortex	22	0,4	12,9	2,89	0,239	1,91	1,43	0,22	0,041	29	16	9,1	18,7
Middle of Cortex	23	0,3	9,6	3,15	0,446	2,32	2,45	0,27	0,066	28	20	10,7	19,6
Top of Cortex	24	0,2	9,2	3,28	0,518	2,50	4,35	0,38	0,170	50	40	87,5	29,5
Apex	25	0,2	10,1	3,49	0,434	2,00	5,54	0,71	0,083	94	253	155,3	11,5
Roots	26	0,9	23,9	0,59	0,043	0,82	0,09	0,16	0,049	2102	91	13,4	43,4
Mean for Plant			14,2	1,73	0,125	3,23	0,69	0,41	0,165	316	249	16,1	14,4
Total for Plant		27,9g		0,48g	0,03g	0,90g	0,19g	0,11g	46mg	8,8mg	7mg	0,4mg	0,4mg

TABLE 26. DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 30th APRIL 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,2	20,8	0,57	0,023	1,35	0,19	0,17	0,046	878	103	20,3	11,0
Top	2	1,2	31,6	0,67	0,019	0,67	0,26	0,13	0,041	1708	212	19,6	22,9
B Leaf Base	3	0,5	8,7	1,31	0,091	3,79	0,49	0,49	0,086	64	173	16,7	18,1
Top	4	2,3	16,6	1,52	0,085	3,03	0,93	0,60	0,094	206	626	7,1	6,0
C Leaf Basal	5	0,9	6,9	2,01	0,108	3,81	1,70	0,87	0,178	46	301	8,8	10,3
Mid	6	4,1	13,1	2,24	0,106	5,16	0,92	0,47	0,110	82	144	7,1	5,8
Top	7	4,6	18,5	1,84	0,095	4,62	1,03	0,56	0,196	146	482	6,9	5,3
D Leaf Bottom of Basal	8		6,5	4,00	0,432	5,98	1,78	0,90	0,019	45	416	29,1	12,5
Middle of Basal	9	1,6	6,2	2,84	0,308	6,23	1,32	0,69	0,030	39	318	16,2	15,5
Top of Basal	10		7,0	2,33	0,227	5,58	0,95	0,51	0,037	42	250	11,4	13,3
Mid	11	9,5	11,7	2,10	0,127	5,26	0,54	0,31	0,062	63	141	7,5	8,3
Top	12	10,1	16,1	2,07	0,104	5,54	0,82	0,42	0,143	76	346	6,7	6,4
E Leaf Basal	13	0,6	5,7	3,97	0,463	8,95	0,90	0,68	0,015	40	205	28,9	14,7
Mid	14	3,0	8,7	1,80	0,134	4,82	0,39	0,28	0,015	34	120	9,5	7,8
Top	15	3,3	14,4	2,04	0,119	4,42	0,53	0,31	0,078	50	279	7,7	5,0
F Leaf Base	16	0,5	6,4	3,52	0,379	7,71	0,61	0,57	0,013	41	147	30,0	14,8
Top	17	1,4	11,2	1,67	0,114	3,85	0,39	0,33	0,043	203	200	14,3	7,0
Stem Base	18	1,2	17,9	1,49	0,055	1,18	1,19	0,21	0,129	299	65	25,1	8,8
Bottom of Stele	19	0,6	12,1	2,06	0,100	1,96	2,02	0,38	0,147	80	116	12,9	7,1
Middle of Stele	20	0,4	10,1	2,23	0,245	2,25	3,21	0,57	0,120	71	305	11,9	9,8
Top of Stele	21	0,3	9,6	2,83	0,296	1,95	4,63	0,63	0,115	60	405	23,2	8,3
Bottom of Cortex	22	0,4	12,5	2,49	0,131	1,79	2,22	0,17	0,177	20	44	8,3	17,4
Middle of Cortex	23	0,4	11,0	2,45	0,315	2,57	3,43	0,19	0,273	32	48	38,3	22,3
Top of Cortex	24	0,3	10,7	2,94	0,456	2,64	4,57	0,29	0,165	27	136	173,9	17,7
Apex	25	0,4	10,9	3,40	0,441	2,45	4,55	0,55	0,060	59	372	163,4	9,4
Roots	26	1,7	18,1	0,83	0,062	1,63	0,10	0,28	0,034	1073	219	79,5	11,1
Mean for Plant			12,6	2,00	0,128	4,56	0,88	0,41	0,099	165	263	14,5	8,3
Total for Plant		49,5g		0,99g	0,06g	2,26g	0,44g	0,20g	49mg	8,2mg	13mg	0,7mg	0,4mg

TABLE 27

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 30th JULY 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	0,4	17,7	0,76	0,040	2,08	0,14	0,21	0,246	58	191	14,4	12,9
Top	2	0,9	35,9	0,58	0,028	2,00	0,14	0,45	0,295	105	245	14,8	11,3
B Leaf Base	3	1,2	14,5	0,92	0,057	1,74	0,36	0,31	0,297	74	197	6,2	6,2
Top	4	4,2	17,2	1,49	0,070	2,75	1,02	0,60	0,270	195	1395	7,8	6,2
C Leaf Basal	5	2,6	11,4	1,47	0,085	1,85	0,94	0,41	0,164	44	427	6,3	10,0
Mid	6	8,2	13,1	2,06	0,083	4,32	0,86	0,42	0,230	78	411	6,6	6,2
Top	7	7,0	16,4	1,97	0,086	4,12	1,14	0,59	0,269	90	1530	7,1	5,5
D Leaf Bottom of Basal	8		9,1	3,56	0,358	3,38	1,25	0,77	0,014	42	745	20,7	17,5
Middle of Basal	9	3,6	9,4	2,06	0,233	3,14	0,80	0,52	0,015	38	397	18,5	7,5
Top of Basal	10		11,4	1,43	0,148	2,38	0,51	0,31	0,022	41	301	20,3	6,8
Mid	11	15,8	13,5	1,64	0,099	3,55	0,40	0,25	0,094	60	262	6,4	6,7
Top	12	13,1	15,5	1,81	0,081	4,14	0,71	0,36	0,200	60	955	5,7	6,8
E Leaf Basal	13	0,8	7,2	3,20	0,356	5,43	0,90	0,70	0,019	40	402	22,2	11,6
Mid	14	5,0	11,7	1,29	0,112	2,78	0,30	0,22	0,032	60	215	8,5	6,8
Top	15	4,9	14,9	1,55	0,091	3,38	0,40	0,26	0,107	52	410	6,5	5,5
F Leaf Base	16	0,7	7,9	2,81	0,282	4,91	0,61	0,54	0,017	38	321	20,5	7,5
Top	17	2,2	12,2	1,06	0,082	2,66	0,29	0,27	0,041	94	259	10,1	8,0
Stem Base	18	2,2	26,0	1,31	0,060	0,80	1,00	0,16	0,220	70	75	22,9	7,2
Bottom of Stele	19	1,4	24,2	1,24	0,069	0,90	1,12	0,23	0,171	43	115	6,8	4,8
Middle of Stele	20	1,5	21,1	1,48	0,150	0,84	1,93	0,24	0,138	38	261	6,5	7,2
Top of Stele	21	0,8	16,1	2,15	0,229	1,10	3,04	0,36	0,126	50	436	12,5	7,7
Bottom of Cortex	22	1,4	28,3	1,31	0,090	0,77	1,07	0,10	0,186	25	42	6,1	8,2
Middle of Cortex	23	1,5	24,5	1,51	0,194	0,97	1,68	0,10	0,288	16	44	36,8	11,8
Top of Cortex	24	1,0	18,8	2,12	0,367	1,19	3,00	0,20	0,135	26	132	122,0	13,7
Apex	25	0,8	13,8	2,99	0,443	1,63	4,68	0,47	0,065	59	640	161,5	9,0
Roots	26	4,7	35,1	0,55	0,042	0,67	0,11	0,10	0,076	1264	216	54,6	6,8
Mean for Plant			14,8	1,63	0,105	3,08	0,77	0,34	0,154	127	543	14,0	7,0
Total for Plant		85,9g		1,40g	0,09g	2,64g	0,66g	0,29g	133mg	10,9mg	47mg	1,2mg	0,6mg

TABLE 28

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 5th NOVEMBER 1973

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,7	17,2	0,74	0,041	1,58	0,18	0,17	0,331	275	176	11,0	10,3
Top	2	1,9	38,1	0,90	0,024	0,74	0,70	0,29	0,249	970	609	14,3	12,0
B Leaf Base	3	2,1	21,5	0,58	0,034	1,03	0,23	0,16	0,245	86	111	4,1	7,5
Top	4	4,2	16,0	1,64	0,065	3,14	0,95	0,27	0,329	186	610	6,8	5,9
C Leaf Basal	5	8,3	19,1	0,84	0,044	0,78	0,44	0,21	0,096	29	211	6,0	10,5
Mid	6	14,9	13,8	2,15	0,082	4,14	0,67	0,37	0,236	75	322	6,6	7,7
Top	7	13,2	16,1	3,20	0,085	4,08	1,05	0,49	0,226	93	1520	6,9	6,8
D Leaf Bottom of Basal	8		7,9	3,88	0,313	3,93	0,85	0,60	0,012	32	422	24,2	14,5
Middle of Basal	9	6,0	9,2	2,00	0,178	2,94	0,49	0,34	0,017	19	281	12,5	12,7
Top of Basal	10		10,7	1,40	0,130	2,39	0,34	0,25	0,023	32	229	10,3	11,1
Mid	11	21,4	14,6	2,01	0,102	3,14	0,35	0,26	0,124	122	232	9,8	8,4
Top	12	19,8	16,4	2,26	0,089	3,48	0,53	0,32	0,254	105	755	6,4	7,2
E Leaf Basal	13	0,9	6,4	3,56	0,347	6,60	0,81	0,75	0,020	37	419	31,7	13,2
Mid	14	3,9	11,3	1,52	0,113	2,93	0,29	0,27	0,047	55	230	16,4	8,2
Top	15	4,7	15,8	2,17	0,119	3,16	0,34	0,28	0,188	84	359	10,8	4,8
F Leaf Base	16	0,7	7,2	3,01	0,290	4,91	0,49	0,54	0,030	36	268	24,5	9,2
Top	17	1,6	11,9	1,40	0,096	2,51	0,25	0,29	0,113	92	267	30,4	10,9
Stem Base	18	2,5	30,6	0,93	0,046	0,46	0,72	0,12	0,180	49	62	95,0	6,9
Bottom of Stele	19	2,1	28,9	1,08	0,053	0,51	0,91	0,16	0,158	46	123	16,8	4,3
Middle of Stele	20	2,9	21,0	1,58	0,107	0,67	1,58	0,23	0,120	30	203	19,7	7,8
Top of Stele	21	1,2	13,3	2,55	0,227	1,05	2,48	0,37	0,068	36	277	22,2	9,4
Bottom of Cortex	22	1,7	33,5	1,16	0,048	0,37	0,83	0,06	0,213	35	39	7,8	5,5
Middle of Cortex	23	2,6	24,9	1,64	0,121	0,67	1,46	0,08	0,187	13	44	30,3	10,7
Top of Cortex	24	1,5	14,7	2,52	0,322	1,26	2,92	0,20	0,068	21	189	110,0	13,6
Apex	25	0,8	11,4	3,45	0,386	2,02	3,36	0,51	0,028	39	470	126,0	10,3
Roots	26	7,0	29,6	0,57	0,042	0,59	0,09	0,09	0,067	602	221	29,9	4,9
Mean for Plant			15,7	1,93	0,111	2,75	0,65	0,29	0,171	126	471	14,7	8,0
Total for Plant		126,9g		2,45g	0,14g	3,50g	0,83g	0,37g	217mg	15,9mg	60mg	1,8mg	1,0mg

TABLE 29

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 28th JANUARY 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	0,5	17,5	0,74	0,032	1,15	0,23	0,18	0,594	589	413	30,4	21,2
Top	2	1,2	36,6	0,85	0,017	0,33	0,60	0,28	0,208	1692	693	29,0	26,4
B Leaf Base	3	2,6	14,1	0,74	0,037	1,18	0,29	0,21	0,333	63	197	6,5	8,8
Top	4	10,0	14,7	1,71	0,070	2,97	1,01	0,60	0,264	104	1025	7,2	6,5
C Leaf Basal	5	13,1	11,7	1,05	0,067	1,25	0,33	0,21	0,088	37	340	8,5	12,9
Mid	6	33,2	14,4	2,01	0,085	3,11	0,54	0,35	0,207	84	565	8,2	8,9
Top	7	32,0	17,1	2,06	0,082	3,17	0,62	0,40	0,251	75	1410	7,0	9,1
D Leaf Bottom of Basal	8		6,4	4,18	0,420	4,49	0,95	0,74	0,011	37	1395	41,2	15,3
Middle of Basal	9	5,9	6,5	2,62	0,290	4,23	0,72	0,52	0,010	32	1095	24,5	14,9
Top of Basal	10		8,0	1,87	0,206	3,20	0,49	0,38	0,015	30	805	18,4	14,6
Mid	11	23,3	12,4	1,96	0,122	2,97	0,31	0,27	0,033	43	615	13,8	8,3
Top	12	27,2	16,9	1,82	0,093	3,13	0,40	0,33	0,117	52	915	8,6	8,4
E Leaf Basal	13	1,5	5,7	3,29	0,325	5,50	0,70	0,68	0,016	38	1083	28,0	13,9
Mid	14	4,7	9,7	1,51	0,120	2,81	0,27	0,29	0,021	33	555	17,1	12,4
Top	15	5,2	15,6	1,60	0,104	2,52	0,32	0,29	0,044	49	780	10,5	9,6
F Leaf Base	16	1,4	6,6	2,87	0,274	4,16	0,40	0,50	0,017	31	615	23,4	12,6
Top	17	2,6	10,7	1,26	0,099	2,09	0,24	0,32	0,022	44	520	20,8	11,6
Stem Base	18	3,2	25,4	1,33	0,039	0,51	0,80	0,13	0,252	79	112	6,4	6,6
Bottom of Stele	19	4,1	18,4	1,68	0,086	0,75	1,75	0,23	0,154	43	334	8,4	7,9
Middle of Stele	20	1,8	11,7	2,25	0,246	1,30	2,06	0,42	0,069	42	670	17,0	10,6
Top of Stele	21	1,2	9,7	2,67	0,316	1,74	1,87	0,66	0,030	56	1344	24,4	8,4
Bottom of Cortex	22	3,6	19,3	1,90	0,129	1,02	1,62	0,08	0,210	35	109	20,7	12,2
Middle of Cortex	23	2,4	12,6	2,30	0,368	1,99	2,58	0,13	0,093	21	250	42,6	15,1
Top of Cortex	24	1,8	10,8	2,77	0,440	2,34	2,92	0,16	0,034	20	985	104,0	14,3
Apex	25	1,3	10,7	3,53	0,412	1,93	2,99	0,61	0,023	47	1735	167,5	10,2
Roots	26	13,5	33,4	0,49	0,030	0,41	0,05	0,08	0,040	256	258	23,3	5,7
Mean for Plant			14,2	1,78	0,106	2,59	0,60	0,32	0,140	84	757	13,8	9,4
Total for Plant		197,2g		3,52g	0,21g	5,10g	1,18g	0,63g	277mg	16,7mg	149mg	2,7mg	1,9mg

TABLE 30.

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 29th APRIL 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	1,0	18,7	0,73	0,032	1,33	0,21	0,15	0,689	603	277	14,4	11,7
Top	2	4,9	40,2	0,93	0,014	1,17	1,06	0,50	0,297	661	840	9,9	7,9
B Leaf Base	3	4,2	12,9	0,76	0,028	1,73	0,30	0,18	0,252	127	301	5,6	10,3
Top	4	21,2	16,3	1,66	0,062	3,43	1,04	0,49	0,212	133	1615	4,6	6,9
C Leaf Basal	5	0,2	10,3	0,93	0,081	2,33	0,46	0,24	0,076	42	700	10,2	17,5
Mid	6	74,6	13,9	1,60	0,092	4,08	0,44	0,29	0,121	82	775	7,0	7,3
Top	7	68,5	16,8	1,76	0,082	4,24	0,69	0,41	0,162	79	1750	8,2	7,2
D Leaf Bottom of Basal	8		7,0	2,85	0,360	5,16	0,64	0,52	0,012	28	1481	32,1	14,4
Middle of Basal	9	9,3	7,7	1,84	0,232	4,20	0,48	0,36	0,009	27	1095	18,6	16,0
Top of Basal	10		9,1	1,33	0,166	3,21	0,36	0,27	0,014	37	919	15,0	17,3
Mid	11	34,4	11,9	1,32	0,103	3,48	0,33	0,24	0,024	48	870	11,0	10,3
Top	12	37,5	16,6	1,50	0,081	4,15	0,50	0,35	0,058	48	1560	8,1	7,6
E Leaf Basal	13	1,9	6,2	2,60	0,316	6,33	0,64	0,62	0,016	41	1300	27,7	11,1
Mid	14	9,6	10,1	1,15	0,099	3,23	0,30	0,26	0,015	35	795	11,9	8,6
Top	15	11,2	15,2	1,29	0,084	3,51	0,37	0,28	0,030	26	1300	8,2	5,2
F Leaf Base	16	3,9	6,7	2,35	0,261	5,56	0,45	0,53	0,010	23	910	20,9	6,1
Top	17	15,5	11,9	1,10	0,087	2,95	0,31	0,31	0,019	32	960	12,9	7,1
Stem Base	18	4,8	23,0	1,29	0,043	0,76	0,92	0,13	0,209	40	144	7,9	6,9
Bottom of Stele	19	8,2	18,9	1,44	0,084	0,88	2,16	0,21	0,139	44	295	5,5	8,6
Middle of Stele	20	5,1	13,7	1,62	0,194	1,74	1,58	0,31	0,044	43	800	24,4	7,7
Top of Stele	21	3,8	10,7	2,00	0,256	1,90	1,87	0,49	0,020	39	1685	32,9	7,8
Bottom of Cortex	22	8,1	20,5	1,66	0,141	1,17	1,86	0,06	0,157	13	94	8,4	11,6
Middle of Cortex	23	8,2	15,2	1,83	0,275	2,39	2,23	0,09	0,041	11	206	48,7	8,4
Top of Cortex	24	6,3	12,9	2,12	0,317	2,93	2,62	0,27	0,020	17	1180	67,3	9,3
Apex	25	2,1	11,4	2,92	0,360	2,55	2,62	0,52	0,027	58	2314	139,5	9,1
Roots	26	18,9	40,0	0,60	0,020	0,52	0,05	0,06	0,028	232	160	6,6	3,7
Mean for Plant			14,2	1,48	0,101	3,34	0,68	0,31	0,099	79	1048	11,8	8,4
Total for Plant		387,3g		5,75g	0,39g	12,92g	2,63g	1,18g	384mg	30,6mg	406mg	4,6mg	3,3mg

TABLE 30A

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 29th APRIL 1974. PLANT SHOWING EARLY FRUITING

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
					N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf	Base	1	0,9	18,7	0,77	0,042	1,32	0,17	0,16	0,552	642	319	11,3	10,6
	Top	2	3,9	40,3	0,76	0,023	0,93	0,51	0,37	0,243	960	411	7,0	7,1
B Leaf	Base	3	3,6	14,1	0,71	0,038	1,61	0,24	0,18	0,275	110	167	4,3	9,1
	Top	4	17,0	15,9	1,44	0,064	3,07	0,87	0,48	0,253	131	580	5,5	6,5
C Leaf	Basal	5	23,8	11,8	0,84	0,064	1,82	0,29	0,17	0,072	39	244	9,0	13,7
	Mid	6	77,7	15,9	1,49	0,092	2,64	0,29	0,20	0,150	110	371	7,3	6,6
	Top	7	62,5	18,0	1,73	0,090	3,12	0,52	0,32	0,200	85	1450	6,7	8,0
D Leaf	Bottom of Basal	8		9,1	1,58	0,211	2,94	0,50	0,30	0,008	31	700	28,2	17,2
	Middle of Basal	9	11,0	10,4	1,10	0,158	2,40	0,35	0,21	0,012	30	460	19,7	18,6
	Top of Basal	10		11,3	1,00	0,122	2,28	0,28	0,20	0,028	42	395	15,9	19,0
	Mid	11	36,5	14,1	1,28	0,131	3,16	0,27	0,22	0,037	58	625	10,3	9,6
	Top	12	36,4	16,9	1,56	0,100	3,94	0,44	0,34	0,103	50	1250	7,2	8,1
E Leaf	Basal	13	3,6	9,3	1,08	0,161	3,03	0,22	0,22	0,009	27	397	15,3	16,4
	Mid	14	10,0	11,8	1,10	0,112	3,00	0,30	0,24	0,022	42	640	9,8	9,8
	Top	15	10,7	16,9	1,37	0,084	3,72	0,43	0,33	0,067	43	1215	6,8	6,8
F Leaf	Base	16	3,4	12,6	0,76	0,079	1,96	0,12	0,15	0,026	39	152	20,7	8,6
	Top	17	13,5	15,0	1,32	0,127	3,16	0,46	0,36	0,029	40	965	10,6	7,4
Stem	Base	18	6,3	28,6	1,24	0,049	0,57	0,86	0,11	0,197	79	110	11,6	7,5
	Bottom of Stele	19	14,3	23,1	1,26	0,095	0,83	1,10	0,17	0,078	46	182	11,8	8,4
	Middle of Stele	20	7,2	17,1	1,41	0,194	1,37	0,72	0,22	0,024	43	243	12,1	6,0
	Top of Stele	21	4,5	12,5	1,99	0,300	2,05	1,16	0,41	0,015	41	775	36,3	8,0
	Bottom of Cortex	22	15,4	25,0	1,44	0,170	1,00	1,18	0,07	0,072	23	76	30,8	11,8
	Middle of Cortex	23	11,4	18,4	1,38	0,270	2,49	1,05	0,11	0,019	13	130	32,3	11,5
	Top of Cortex	24	7,4	13,7	1,85	0,329	3,73	1,34	0,19	0,012	16	407	53,3	12,0
	Apex	25	2,6	10,3	2,46	0,312	4,60	1,00	0,60	0,009	27	1055	48,2	9,5
Roots		26	20,7	38,0	0,47	0,025	0,53	0,04	0,07	0,027	462	157	4,8	3,8
Peduncle	Bottom	P1	3,7	6,7	1,82	0,164	5,34	0,21	0,44	0,011	35	476	13,1	8,4
	Mid	P2	4,3	8,2	0,88	0,095	2,88	0,10	0,19	0,009	18	277	7,3	6,1
	Top	P3	5,1	8,4	0,96	0,116	2,88	0,17	0,31	0,010	27	675	9,4	6,1
Mean for Peduncle				7,9	1,17	0,122	3,57	0,16	0,31	0,010	26	513	9,7	6,7
Total for Peduncle			13,1		0,15g	0,016g	0,47g	0,020g	0,040g	1,3mg	0,34mg	6,7mg	0,13mg	0,09mg
Fruit	Bottom	F1	2,5	9,8	1,83	0,176	2,39	0,72	0,62	0,007	44	1540	44,0	8,5
	Mid	F2	8,0	11,2	2,39	0,228	2,55	0,79	0,61	0,007	49	1540	40,6	8,8
	Top	F3	1,8	12,4	2,42	0,252	3,02	0,92	0,53	0,010	56	1385	38,3	8,1
Mean for Fruit				11,1	2,28	0,221	2,58	0,79	0,59	0,007	49	1517	41,0	8,6
Total for Fruit			12,3		0,28g	0,027g	0,32g	0,097g	0,073g	0,9mg	0,60mg	18,6mg	0,50mg	0,11mg
Mean for Plant				15,5	1,39	0,113	2,63	0,49	0,25	0,103	94	676	12,2	8,6
Total for Plant			429,6g		5,96g	0,49g	11,28g	2,12g	1,09g	441mg	404mg	290mg	5,2mg	3,7mg

TABLE 31

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 29th JULY 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	1,0	19,8	0,72	0,029	1,14	0,29	0,19	0,637	561	413	15,9	11,0
Top	2	3,3	44,2	0,79	0,017	0,36	1,04	0,51	0,234	1472	825	11,3	22,9
B Leaf Base	3	8,9	16,3	0,58	0,032	1,13	0,31	0,15	0,157	103	155	6,8	11,2
Top	4	34,2	16,3	1,39	0,061	2,58	0,97	0,49	0,239	138	790	5,1	6,8
C Leaf Basal	5	27,9	13,3	0,66	0,057	1,29	0,33	0,16	0,056	28	206	10,3	12,7
Mid	6	74,1	14,8	1,22	0,083	2,78	0,39	0,24	0,129	111	445	7,8	7,5
Top	7	67,3	17,2	1,53	0,065	3,12	0,74	0,40	0,170	101	1240	6,5	7,0
D Leaf Bottom of Basal	8		12,0	1,30	0,164	1,66	0,31	0,24	0,008	24	310	15,4	15,5
Middle of Basal	9	19,6	13,1	0,90	0,126	1,72	0,24	0,19	0,010	22	253	11,6	15,5
Top of Basal	10		13,1	0,81	0,096	1,67	0,23	0,17	0,017	33	246	10,1	13,7
Mid	11	45,9	14,2	1,10	0,092	2,64	0,30	0,20	0,040	49	334	8,8	8,2
Top	12	42,0	17,3	1,49	0,074	3,51	0,57	0,36	0,092	56	930	6,9	8,2
E Leaf Basal	13	4,6	9,7	1,38	0,217	2,46	0,25	0,28	0,010	23	305	14,2	18,5
Mid	14	17,2	13,4	1,07	0,091	2,72	0,27	0,22	0,038	67	309	10,0	10,4
Top	15	18,5	17,2	1,20	0,072	3,03	0,36	0,28	0,041	43	675	10,1	10,6
F Leaf Base	16	5,7	8,3	1,62	0,215	2,96	0,29	0,45	0,008	28	455	19,4	9,9
Top	17	54,6	15,2	1,18	0,085	2,80	0,30	0,29	0,026	41	575	8,8	5,4
Stem Base	18	6,9	28,8	1,28	0,051	0,47	0,96	0,11	0,223	55	103	6,6	6,7
Bottom of Stele	19	15,5	25,7	1,04	0,081	0,60	1,22	0,17	0,040	40	129	4,6	7,0
Middle of Stele	20	11,1	21,6	1,07	0,127	0,66	0,73	0,18	0,016	33	119	6,5	6,9
Top of Stele	21	8,9	16,7	1,50	0,180	0,75	0,94	0,33	0,011	34	229	15,7	5,9
Bottom of Cortex	22	17,0	27,0	1,23	0,130	0,69	1,27	0,08	0,034	16	64	7,3	10,2
Middle of Cortex	23	17,5	24,4	1,09	0,180	1,13	1,15	0,09	0,029	12	64	14,1	8,1
Top of Cortex	24	17,0	21,1	1,42	0,238	1,23	1,51	0,19	0,010	13	172	36,7	8,0
Apex	25	2,9	12,4	3,03	0,446	2,51	2,04	0,61	0,008	34	1100	94,0	8,4
Roots	26	13,9	42,0	0,38	0,023	0,56	0,08	0,08	0,028	443	149	5,8	5,3
Mean for Plant			16,4	1,21	0,093	2,30	0,59	0,27	0,088	84	528	9,7	8,3
Total for Plant		535,5		6,49g	0,50g	12,33g	3,17g	1,43g	472mg	44,9mg	283mg	5,2mg	4,5mg

TABLE 31A

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 29th JULY 1974. PLANT SHOWING EARLY FRUITING

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
A Leaf Base	1	0,9	20,6	0,76	0,032	1,21	0,25	0,16	0,703	562	355	23,5	18,6
Top	2	3,3	50,1	0,86	0,022	0,88	0,64	0,35	0,311	1177	585	9,9	9,7
B Leaf Base	3	6,9	17,8	0,60	0,035	1,23	0,23	0,14	0,158	835	180	5,7	11,8
Top	4	28,6	16,6	1,62	0,059	3,35	0,86	0,42	0,249	135	695	5,6	6,7
C Leaf Basal	5	15,4	14,3	0,65	0,047	1,49	0,22	0,13	0,069	35	153	7,2	11,9
Mid	6	44,1	16,2	1,38	0,071	3,18	0,37	0,25	0,204	127	365	6,3	7,4
Top	7	41,7	18,5	1,63	0,064	3,55	0,75	0,38	0,227	89	1395	4,9	7,9
D Leaf Bottom of Basal	8		11,2	0,97	0,085	1,51	0,37	0,18	0,015	28	240	18,3	13,2
Middle of Basal	9	11,8	12,2	0,85	0,087	1,66	0,29	0,16	0,024	27	233	16,0	17,6
Top of Basal	10		12,6	0,88	0,074	1,88	0,26	0,15	0,046	50	244	12,1	15,9
Mid	11	39,0	14,7	1,43	0,090	3,66	0,41	0,27	0,082	62	575	8,2	9,0
Top	12	40,9	17,6	1,66	0,075	3,81	0,63	0,40	0,163	60	1240	7,5	9,5
E Leaf Basal	13	5,5	11,5	0,88	0,109	2,04	0,21	0,16	0,017	22	270	13,7	15,1
Mid	14	15,6	13,6	1,30	0,88	3,43	0,36	0,24	0,058	45	530	9,2	9,4
Top	15	15,3	16,8	1,62	0,079	4,01	0,51	0,35	0,116	47	1155	6,8	9,1
F Leaf Base	16	3,8	12,2	0,80	0,066	2,30	0,12	0,09	0,057	59	210	14,9	10,2
Top	17	27,8	15,6	1,56	0,099	3,95	0,55	0,35	0,077	36	1075	8,3	7,3
Stem Base	18	10,6	33,2	1,08	0,047	0,44	0,94	0,09	0,177	59	111	6,3	8,1
Bottom of Stele	19	15,1	29,0	1,15	0,073	0,60	1,11	0,13	0,040	33	135	5,0	7,1
Middle of Stele	20	12,2	26,4	1,00	0,116	0,84	0,59	0,14	0,020	28	108	5,5	6,5
Top of Stele	21	7,7	19,1	1,43	0,158	1,01	0,95	0,22	0,012	48	240	16,0	6,5
Bottom of Cortex	22	16,4	30,0	1,31	0,118	0,57	1,20	0,06	0,067	13	72	8,6	10,6
Middle of Cortex	23	15,2	26,4	0,49	0,161	1,15	1,01	0,08	0,021	18	86	17,7	9,2
Top of Cortex	24	17,1	23,6	0,84	0,195	1,73	0,90	0,11	0,010	22	139	25,6	11,0
Apex	25	6,8	16,5	0,72	0,189	2,40	0,61	0,23	0,010	30	275	19,5	9,8
Roots	26	20,4	46,0	1,15	0,019	0,35	0,06	0,05	0,029	464	179	5,7	4,8
Peduncle Bottom	P1	8,6	10,0	1,22	0,049	3,16	0,09	0,16	0,010	14	151	6,6	3,5
Mid	P2	7,0	10,1	1,50	0,037	2,65	0,08	0,08	0,014	15	101	6,0	2,4
Top	P3	7,7	9,5	0,65	0,048	2,89	0,12	0,11	0,020	17	120	5,6	4,1
Mean for Peduncle			9,9	1,12	0,045	2,92	0,09	0,12	0,015	15	126	6,1	3,4
Total for Peduncle		23,3		0,26g	0,011g	0,68g	0,022g	0,028g	3,4mg	0,36mg	2,9mg	0,14mg	0,08mg
Fruit Bottom	F1	12,3	8,7	0,94	0,089	1,90	0,28	0,24	0,015	49	515	34,0	6,5
Mid	F2	57,1	7,7	1,10	0,107	1,98	0,27	0,24	0,011	58	495	28,3	6,9
Top	F3	9,8	9,2	1,22	0,119	2,20	0,34	0,21	0,018	71	575	15,4	5,7
Mean for Fruit			8,0	1,09	0,106	2,00	0,28	0,24	0,012	58	508	27,6	6,7
Total for Fruit		79,2		0,86g	0,083g	1,58g	0,224g	0,188g	9,8mg	4,62mg	40,2mg	2,19mg	0,53mg
Ground Sucker	GS1	0,7	13,2	1,39	0,134	2,64	0,24	0,18	0,070	70	375	12,7	7,9
Sucker	S1	0,7	12,0	1,75	0,154	2,65	0,44	0,35	0,023	31	1000	18,1	7,0
Top	T1	9,3	13,2	1,56	0,199	2,18	0,34	0,25	0,026	87	645	15,0	6,9
Mean for Plant			14,8	1,26	0,089	2,47	0,53	0,24	0,095	93	559	11,6	8,2
Total for Plant		538,5		6,77g	0,48g	13,31g	2,83g	1,29g	514mg	50,1mg	301mg	6,3mg	4,4mg

TABLE 32

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 28th OCTOBER 1974

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	1,1	19,2	0,61	0,033	1,19	0,24	0,14	0,269	633	50	10,2	11,7
Top	2	5,2	53,1	0,78	0,018	0,47	0,52	0,31	0,102	1340	155	9,4	16,7
B Leaf Base	3	15,5	21,2	0,43	0,033	0,98	0,18	0,11	0,051	57	21	5,8	8,0
Top	4	37,0	15,6	1,07	0,051	2,47	0,40	0,31	0,122	125	54	5,5	5,4
C Leaf Basal	5	53,9	16,8	0,50	0,057	1,10	0,19	0,10	0,013	23	26	8,0	9,4
Mid	6	109,4	14,3	1,17	0,080	3,08	0,43	0,27	0,056	72	97	7,4	5,4
Top	7	97,5	17,4	1,33	0,073	3,23	0,75	0,40	0,067	63	239	6,0	5,2
D Leaf Bottom of Basal	8		15,3	0,85	0,119	1,33	0,19	0,17	0,004	22	31	11,3	6,5
Middle of Basal	9	22,6	17,9	0,66	0,112	1,28	0,14	0,13	0,005	26	28	10,3	6,4
Top of Basal	10		16,8	0,60	0,097	1,33	0,14	0,11	0,010	60	34	8,5	8,6
Mid	11	46,6	14,1	1,08	0,086	3,04	0,30	0,22	0,024	38	79	8,2	6,4
Top	12	37,3	16,5	1,35	0,085	3,48	0,47	0,33	0,037	49	200	7,2	6,0
E Leaf Basal	13	5,7	12,2	0,98	0,159	1,85	0,23	0,21	0,005	22	65	12,3	12,1
Mid	14	20,4	15,6	1,04	0,084	2,88	0,29	0,22	0,020	54	89	7,9	4,2
Top	15	15,8	16,9	1,32	0,082	3,53	0,47	0,34	0,032	52	216	7,4	6,0
F Leaf Base	16	7,7	11,2	1,03	0,115	2,02	0,20	0,22	0,011	40	60	17,6	7,5
Top	17	59,0	15,9	1,22	0,095	3,06	0,49	0,31	0,026	41	169	7,1	3,7
Stem Base	18	11,2	35,0	1,12	0,057	0,43	0,85	0,10	0,079	108	21	7,1	6,5
Bottom of Stele	19	28,6	31,2	0,96	0,075	0,64	1,01	0,13	0,020	44	20	3,4	5,2
Middle of Stele	20	25,1	27,1	0,89	0,098	0,69	0,48	0,13	0,006	35	15	5,6	4,4
Top of Stele	21	15,2	20,3	1,34	0,174	0,91	0,73	0,20	0,005	25	22	10,1	5,2
Bottom of Cortex	22	37,9	32,6	1,11	0,130	0,79	0,97	0,06	0,020	16	9	14,5	7,6
Middle of Cortex	23	40,9	30,2	1,03	0,142	1,03	0,71	0,07	0,006	13	7	9,6	5,5
Top of Cortex	24	35,7	25,8	0,99	0,180	0,40	0,64	0,09	0,003	14	11	19,0	7,1
Apex	25	6,2	14,3	1,97	0,221	2,03	1,12	0,33	0,003	20	73	31,3	7,2
Roots	26	24,8	49,0	0,43	0,027	0,39	0,09	0,06	0,010	359	33	5,6	5,2
Peduncle Bottom	P1	6,3	9,9	2,35	0,213	3,61	0,53	0,64	0,003	25	125	25,6	7,0
Mid	P2	4,9	9,7	1,28	0,132	2,56	0,29	0,35	0,006	53	108	11,0	6,1
Top	P3	4,5	10,5	1,19	0,132	2,18	0,27	0,42	0,005	44	156	12,3	4,9
Mean for Peduncle			10,0	1,68	0,164	2,87	0,41	0,49	0,005	39	129	17,2	6,1
Total for Peduncle		15,7		0,26g	0,026g	0,45g	0,064g	0,077g	0,7mg	0,61mg	2,0mg	0,27mg	0,10mg
Fruit Bottom	F1	2,4	11,3	1,76	0,195	2,15	0,71	0,40	0,005	84	153	24,6	8,7
Mid	F2	6,4	12,1	2,42	0,250	2,31	1,12	0,44	0,005	54	175	28,1	3,0
Top	F3	1,6	13,4	2,59	0,281	2,63	1,34	0,39	0,005	63	186	32,9	8,1
Mean for Fruit			12,1	2,29	0,242	2,56	1,06	0,42	0,005	62	172	28,0	8,2
Total for Fruit		10,4		0,24g	0,025g	0,27g	0,111g	0,044g	0,5mg	0,65mg	1,8mg	0,29mg	0,09mg
Ground Sucker	GS1	1,6	16,7	0,81	0,115	2,29	0,08	0,10	0,012	82	25	9,2	4,8
Sucker	S1	0,4	11,7	2,05	0,259	2,80	0,72	0,54	0,011	62	205	25,0	8,0
Mean for Plant			17,0	1,09	0,094	2,13	0,52	0,23	0,035	68	94	8,9	6,1
Total for Plant		788,9g		8,57g	0,74g	16,81g	4,08g	1,81g	279mg	53,4mg	74mg	7,0mg	4,9mg

TABLE 32A

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 28th OCTOBER 1974. PLANT SHOWING EARLY FRUITING

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	1,2	18,2	0,66	0,033	1,03	0,23	0,14	0,246	564	45	22,0	13,9
Top	2	6,2	45,3	0,85	0,020	1,07	0,74	0,36	0,174	1254	135	8,5	10,6
B Leaf Base	3	9,0	19,5	0,54	0,034	0,86	0,24	0,11	0,052	63	44	7,4	9,1
Top	4	27,6	14,6	1,58	0,066	2,96	0,83	0,42	0,115	150	169	5,6	6,2
C Leaf Basal	5	19,0	13,4	0,66	0,046	1,19	0,25	0,12	0,027	32	56	9,4	10,7
Mid	6	48,3	13,7	1,49	0,090	2,76	0,50	0,28	0,089	148	127	8,2	7,3
Top	7	46,3	17,2	1,68	0,074	2,57	0,83	0,40	0,100	130	321	6,3	6,7
D Leaf Bottom of Basal	8		13,1	0,82	0,074	0,93	0,33	0,15	0,007	32	47	18,6	10,4
Middle of Basal	9	16,3	14,2	0,71	0,076	0,90	0,25	0,14	0,011	29	50	14,9	12,7
Top of Basal	10		13,2	0,79	0,068	1,28	0,26	0,13	0,025	78	59	11,4	13,4
Mid	11	38,0	12,8	0,55	0,119	2,94	0,52	0,30	0,061	77	153	9,8	8,9
Top	12	40,4	16,2	1,78	0,095	2,94	0,80	0,44	0,078	76	331	7,0	7,9
E Leaf Basal	13	7,7	14,4	0,75	0,084	1,16	0,22	0,17	0,011	41	63	13,8	13,0
Mid	14	17,0	12,1	1,44	0,100	2,75	0,43	0,26	0,031	62	164	11,2	9,0
Top	15	15,5	15,3	1,73	0,084	3,23	0,71	0,41	0,063	59	315	8,2	7,3
F Leaf Base	16	4,4	14,0	0,79	0,059	1,77	0,15	0,12	0,028	94	57	15,9	8,2
Top	17	28,4	14,7	1,74	0,130	3,79	0,73	0,46	0,036	44	320	8,6	5,6
Stem Base	18	9,4	31,6	1,09	0,044	0,17	1,01	0,09	0,076	62	21	8,3	7,4
Bottom of Stele	19	17,8	28,8	1,00	0,094	0,36	1,02	0,13	0,020	41	27	4,8	8,1
Middle of Stele	20	16,9	27,7	1,07	0,121	0,43	0,61	0,14	0,007	27	25	5,2	6,4
Top of Stele	21	12,5	22,8	1,47	0,158	0,45	0,88	0,19	0,004	33	34	13,6	7,0
Bottom of Cortex	22	17,7	29,9	1,30	0,119	0,41	1,20	0,06	0,021	22	12	11,4	9,3
Middle of Cortex	23	23,4	28,4	1,08	0,162	0,71	0,94	0,08	0,008	17	12	16,8	8,0
Top of Cortex	24	25,8	28,9	1,12	0,167	0,81	0,88	0,11	0,004	12	16	22,1	7,9
Apex	25	8,1	20,2	1,45	0,186	1,29	0,92	0,23	0,005	31	61	18,2	6,7
Roots	26	18,4	41,9	0,34	0,016	0,18	0,08	0,05	0,013	391	25	5,3	3,8
Peduncle Bottom	P1	8,3	10,8	0,98	0,056	2,89	0,13	0,22	0,012	28	43	6,3	6,5
Mid	P2	6,7	12,3	0,82	0,047	2,73	0,10	0,10	0,015	29	30	3,9	2,2
Top	P3	6,8	12,3	0,87	0,069	3,03	0,13	0,10	0,016	30	32	3,8	2,2
Mean for Peduncle			11,7	0,90	0,057	2,89	0,12	0,14	0,014	29	36	4,8	3,3
Total for Peduncle		21,8		0,20g	0,012g	0,63g	0,027g	0,031g	3,1mg	0,63mg	0,8mg	0,10mg	0,08mg
Fruit Base	F1	20,9	12,6	0,72	0,069	1,75	0,16	0,15	0,009	78	70	17,2	4,2
Bottom of Outer	F2	25,1	11,0	0,66	0,078	1,47	0,15	0,11	0,009	80	64	7,8	4,1
Middle of Outer	F3	21,9	10,3	0,74	0,086	1,45	0,18	0,11	0,012	96	66	8,6	3,1
Top of Outer	F4	21,1	10,5	0,80	0,091	1,39	0,19	0,10	0,014	110	72	8,0	3,0
Bottom of Inner	F5	43,9	12,0	0,59	0,044	1,15	0,08	0,13	0,006	33	55	8,5	7,2
Middle of Inner	F6	39,9	11,1	0,57	0,054	1,36	0,08	0,15	0,005	19	56	21,3	4,6
Top of Inner	F7	30,4	9,7	0,64	0,048	1,35	0,07	0,13	0,004	15	49	7,7	2,6
Top	F8	15,6	10,3	0,88	0,090	1,69	0,20	0,14	0,016	104	87	7,6	3,5
Mean for Fruit			11,0	0,66	0,066	1,40	0,12	0,13	0,008	57	63	13,3	4,6
Total for Fruit		218,8		1,44g	0,143g	3,07g	0,268g	0,290g	18,2mg	12,44mg	13,7mg	2,90mg	1,02mg

TABLE 32A contd

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
Ground Sucker														
A Leaf		GS1	0,4	21,0	0,65	0,034	1,15	0,14	0,10	0,095	610	38	24,8	26,3
B Leaf	Base	GS2	0,4	15,3	0,66	0,042	1,53	0,09	0,11	0,012	36	52	8,8	10,3
	Top	GS3	0,4	14,0	0,84	0,055	1,96	0,09	0,11	0,023	65	59	6,6	8,0
C Leaf	Basal	GS4	0,3	12,9	1,09	0,112	1,77	0,11	0,15	0,006	30	87	11,1	10,0
	Mid	GS5	0,6	4,3	0,58	0,050	1,52	0,06	0,08	0,010	36	50	7,5	7,7
	Top	GS6	0,4	12,3	1,11	0,123	2,23	0,14	0,15	0,022	34	94	5,0	6,0
D Leaf	Basal	GS7	0,1	8,3	2,19	0,251	3,83	0,30	0,55	0,021	62	175	17,5	13,3
	Mid	GS8	0,4	11,7	0,84	0,067	2,64	0,11	0,16	0,009	45	71	7,3	7,7
	Top	GS9	0,4	12,5	1,24	0,123	3,10	0,22	0,26	0,019	29	146	7,2	3,9
E & F Leaf		GS10	0,4	11,7	1,25	0,074	0,86	0,16	0,11	0,042	33	54	8,2	8,6
Stem	Bottom	GS11	0,5	25,6	0,73	-	SAMPLE	-	LOST	-	-	-	-	-
	Top	GS12	0,7	12,4	1,50	-	SAMPLE	-	LOST	-	-	-	-	-
*Mean for Ground Sucker				13,6	1,00	0,080	1,93	0,13	0,15	0,024	87	75	9,4	9,5
*Total for Ground Sucker			5,0		0,05g	0,003g	0,08g	0,005g	0,006g	0,9mg	0,34mg	0,3mg	0,04mg	0,04mg
Sucker														
A Leaf		S1	0,2	19,6	0,74	0,330	0,60	0,29	0,30	0,067	241	120	20,0	6,5
B Leaf	Base	S2	0,2	13,0	1,31	0,074	1,36	0,46	0,40	0,015	40	179	11,8	7,1
	Top	S3	0,4	16,0	1,12	0,062	1,83	0,31	0,28	0,039	77	211	11,5	5,0
C Leaf	Basal	S4	0,3	9,3	2,76	0,196	2,71	0,64	0,51	0,009	40	236	18,2	7,1
	Mid	S5	0,4	13,0	1,00	0,075	2,29	0,26	0,27	0,021	50	146	11,1	5,9
	Top	S6	0,3	14,1	1,89	0,105	2,85	0,48	0,36	0,041	62	383	7,8	7,7
D Leaf	Basal	S7	0,1	7,5	3,14	0,256	2,83	0,93	0,75	0,018	55	250	35,8	10,8
	Mid	S8	0,3	10,9	1,32	0,098	2,19	0,36	0,32	0,015	45	159	13,4	7,2
	Top	S9	0,3	14,2	1,99	0,256	3,66	0,70	0,68	0,017	73	133	45,0	19,2
E & F Leaf	Base	S10	0,1	7,7	3,33	0,110	2,55	0,53	0,36	0,030	68	352	9,1	6,6
	Top	S11	0,2	12,3	1,35	0,104	2,25	0,39	0,38	0,026	105	238	22,5	11,3
Stem	Bottom	S12	0,2	18,4	1,67	0,205	0,88	0,46	0,20	0,018	53	56	15,6	6,3
	Top	S13	0,6	13,0	3,53	0,293	1,41	1,94	0,43	0,009	30	141	26,9	7,2
Mean for Sucker				13,0	1,94	0,167	2,13	0,68	0,39	0,024	66	195	19,3	8,2
Total for Sucker			3,7		0,07g	0,006g	0,08g	0,025g	0,014g	0,9mg	0,24mg	0,7mg	0,07mg	0,03mg

* Mean and total amounts of nutrients in ground sucker calculated without lost samples.

TABLE 32A contd

Plant Section Sampled			Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
						N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
Top	A Leaf	Base	T1	0,8	21,0	0,72	0,113	0,95	0,21	0,15	0,017	53	128	8,4	5,1
		Top	T2	1,1	17,2	1,62	0,143	1,41	0,45	0,26	0,130	81	242	12,7	3,8
	B Leaf	Base	T3	1,8	27,1	1,82	0,139	0,87	0,10	0,11	0,006	25	81	6,4	3,7
		Top	T4	1,8	16,6	1,45	0,149	1,78	0,35	0,24	0,096	61	216	10,6	5,1
	C Leaf	Basal	T5	2,8	26,2	0,73	0,126	0,97	0,08	0,12	0,003	27	55	5,5	4,8
		Mid	T6	2,5	17,8	0,84	0,122	1,40	0,12	0,13	0,033	46	82	7,4	5,8
		Top	T7	1,4	16,9	1,68	0,109	1,49	0,26	0,20	0,162	90	194	9,5	5,1
	D Leaf	Basal	T8	0,9	17,0	1,00	0,173	1,59	0,11	0,16	0,003	31	74	6,7	4,8
		Mid	T9	1,0	16,0	0,86	0,111	1,36	0,09	0,14	0,028	48	70	6,3	2,5
		Top	T10	0,7	16,9	1,41	0,096	1,66	0,20	0,22	0,150	47	158	8,9	5,2
	E & F Leaf	Base	T11	0,5	11,6	1,56	0,245	2,49	0,22	0,33	0,006	74	172	12,5	8,3
		Top	T12	1,5	14,8	1,07	0,087	1,53	0,15	0,17	0,042	76	110	7,6	6,0
	Stem	Base	T13	0,2	17,4	1,22	0,242	2,08	0,50	0,22	0,012	45	108	9,2	3,3
		Mid	T14	1,0	22,4	1,82	0,338	1,14	0,72	0,18	0,005	30	75	8,1	6,8
		Top	T15	0,3	20,0	1,96	0,308	1,38	0,83	0,31	0,016	56	100	18,1	9,4
Mean for Top					19,6	1,23	0,144	1,36	0,22	0,17	0,048	50	118	8,2	5,2
Total for Top				18,3		0,23g	0,026g	0,25g	0,041g	0,032g	8,8mg	0,92mg	2,2mg	0,15mg	0,09mg
Mean for Plant					14,7	1,07	0,088	1,79	0,48	0,22	0,038	84	116	10,1	6,6
Total for Plant				743,0g		7,92g	0,65g	13,28g	3,55g	1,60g	281mg	62,5mg	86mg	7,5mg	4,9mg

TABLE 33

DISTRIBUTION OF NUTRIENTS WITHIN PINEAPPLE PLANT

PLANT SAMPLED AT SHELFORD PINERIES ON THE 28th JANUARY, 1975

Plant Section Sampled	Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
				N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
A Leaf Base	1	4,0	18,7	0,58	0,032	0,98	0,14	0,11	0,202	330	30	20,9	16,4
Top	2	19,9	63,1	0,74	0,016	0,28	0,28	0,20	0,133	752	108	12,1	14,6
B Leaf Base	3	13,1	14,5	0,27	0,028	0,81	0,13	0,09	0,033	46	21	9,3	9,8
Top	4	48,9	16,1	1,10	0,045	1,53	0,28	0,25	0,136	172	56	8,0	6,2
C Leaf Basal	5	37,3	13,8	0,52	0,039	0,88	0,18	0,09	0,017	26	38	10,2	11,6
Mid	6	95,3	13,8	1,23	0,070	2,38	0,61	0,29	0,078	53	146	8,8	8,2
Top	7	82,5	17,3	1,35	0,068	2,45	0,90	0,44	0,079	62	360	6,4	7,0
D Leaf Bottom of Basal	8		13,6	0,64	0,053	0,85	0,14	0,11	0,006	31	27	15,0	10,6
Middle of Basal	9	22,5	17,6	0,56	0,053	0,80	0,13	0,11	0,009	23	28	13,3	9,8
Top of Basal	10		11,7	1,25	0,043	0,99	0,13	0,09	0,019	60	32	11,3	15,3
Mid	11	43,1	13,7	1,50	0,072	2,86	0,52	0,29	0,037	37	129	10,4	8,0
Top	12	37,9	16,9	1,58	0,082	3,18	0,86	0,44	0,047	44	361	7,2	6,2
E Leaf Basal	13	6,5	13,2	0,66	0,046	1,36	0,13	0,15	0,017	42	30	20,6	11,6
Mid	14	19,2	15,0	1,25	0,076	2,80	0,61	0,36	0,030	40	144	9,7	9,9
Top	15	17,4	19,0	1,54	0,079	3,18	0,86	0,45	0,051	65	333	7,4	7,1
F Leaf Base	16	7,8	14,1	0,66	0,043	1,33	0,12	0,10	0,045	103	31	21,9	10,1
Top	17	58,5	17,3	1,35	0,104	2,93	1,01	0,47	0,044	44	307	8,0	5,3
Stem Base	18	12,7	33,3	0,96	0,039	0,29	0,76	0,10	0,052	104	11	10,8	6,2
Bottom of Stele	19	25,9	26,8	1,01	0,053	0,44	1,19	0,14	0,018	57	18	5,0	7,2
Middle of Stele	20	24,0	22,1	1,05	0,079	0,78	0,48	0,15	0,008	54	18	4,4	5,2
Top of Stele	21	20,4	19,5	1,22	0,121	0,92	0,43	0,19	0,005	56	10	9,0	5,3
Bottom of Cortex	22	35,9	33,1	1,11	0,079	0,57	1,05	0,05	0,021	32	8	11,8	8,5
Middle of Cortex	23	44,0	28,0	0,89	0,113	1,10	0,56	0,06	0,006	20	8	10,2	7,7
Top of Cortex	24	50,5	26,8	0,96	0,125	1,49	0,26	0,06	0,002	17	10	18,5	9,2
Apex	25	13,9	17,6	1,18	0,105	1,87	0,27	0,16	0,006	27	22	23,5	9,6
Roots	26	30,7	45,5	0,53	0,017	0,33	0,07	0,06	0,012	451	37	9,3	4,9
Peduncle Bottom	P1	11,8	12,8	0,85	0,058	2,15	0,13	0,18	0,015	160	23	8,0	4,4
Mid	P2	6,1	11,5	0,66	0,050	2,24	0,13	0,14	0,015	85	24	6,0	4,3
Top	P3	6,0	11,7	0,81	0,063	2,22	0,21	0,13	0,017	114	29	5,2	3,1
Mean for Peduncle			12,2	0,79	0,057	2,19	0,15	0,16	0,015	129	25	6,8	4,2
Total for Peduncle		23,9		0,19g	0,014g	0,52g	0,036g	0,037g	3,7mg	3,10mg	0,6mg	0,16mg	0,10mg
Fruit Base	F1	17,2	12,5	0,73	0,082	1,54	0,17	0,10	0,007	115	47	26,9	5,3
Bottom of Outer	F2	22,2	11,6	0,80	0,099	1,30	0,22	0,09	0,010	103	65	11,2	4,6
Middle of Outer	F3	15,9	10,9	0,83	0,102	1,29	0,27	0,09	0,010	152	80	18,1	4,2
Top of Outer	F4	15,3	10,5	0,86	0,104	1,27	0,25	0,09	0,017	130	75	10,4	3,9
Bottom of Inner	F5	45,0	14,1	0,43	0,034	0,99	0,09	0,13	0,003	25	35	6,9	4,8
Middle of Inner	F6	31,8	11,0	0,56	0,051	1,20	0,14	0,16	0,003	41	50	8,9	4,0
Top of Inner	F7	22,9	9,4	0,63	0,065	1,37	0,17	0,17	0,008	30	70	10,0	4,3
Top	F8	11,3	9,4	0,89	0,094	1,60	0,30	0,15	0,016	100	74	8,2	5,2
Mean for Fruit			11,6	0,65	0,063	1,25	0,17	0,13	0,008	71	43	11,4	4,5
Total for Fruit		181,8		1,18g	0,115g	2,28g	0,317g	0,231g	13,8mg	12,88mg	7,9mg	2,08mg	0,82mg

TABLE 33 contd

Plant Section Sampled		Section Number	Dry Weight g	% Dry Matter	PERCENTAGE N	P	K	Ca	Mg	Na	PARTS PER MILLION Fe	Mn	Zn	Cu
Ground Sucker		GS1	1,8	12,8	1,03	0,112	1,85	0,25	0,16	0,010	82	51	8,2	5,9
Sucker														
A Leaf	Base	S1	1,2	24,2	0,43	0,027	0,55	0,12	0,11	0,020	153	20	18,3	14,0
	Top	S2	0,9	23,1	0,58	0,036	0,75	0,15	0,17	0,036	413	39	19,7	17,2
B Leaf	Base	S3	1,5	14,3	1,00	0,143	3,14	0,39	0,27	0,011	27	57	31,5	5,1
	Top	S4	3,4	16,4	0,95	0,078	1,76	0,31	0,20	0,013	73	87	11,8	8,7
C Leaf	Basal	S5	2,6	8,7	1,71	0,175	2,95	0,58	0,35	0,004	52	96	19,0	13,3
	Mid	S6	3,6	12,3	1,03	0,083	1,24	0,33	0,21	0,010	63	63	11,0	7,8
	Top	S7	2,8	13,9	1,56	0,110	1,02	0,60	0,30	0,020	43	159	8,8	7,3
D Leaf	Basal	S8	1,3	7,0	2,34	0,266	4,64	0,75	0,48	0,007	50	123	23,2	11,2
	Mid	S9	2,1	10,0	1,18	0,107	1,25	0,33	0,22	0,007	44	78	13,4	9,1
	Top	S10	2,5	12,9	1,45	0,093	1,91	0,49	0,27	0,012	31	144	9,4	7,3
E & F Leaf	Base	S11	1,5	7,6	2,63	0,266	3,14	0,58	0,42	0,006	29	88	21,0	8,5
	Top	S12	2,0	11,5	1,05	0,086	2,66	0,40	0,28	0,009	34	88	12,9	9,1
Stem	Base	S13	6,6	19,8	0,99	0,098	2,18	0,30	0,12	0,011	56	21	7,2	7,2
	Mid	S14	3,3	12,8	2,24	0,205	1,82	1,20	0,34	0,005	50	69	14,5	9,7
	Top	S15	3,6	10,8	3,79	0,324	3,50	2,14	0,53	0,007	78	171	53,9	9,2
Mean for Sucker				13,9	1,58	0,142	2,16	0,75	0,28	0,013	65	86	37,1	14,3
Total for Sucker			39,0		0,62g	0,055g	0,84g	0,292g	0,108g	5,0mg	2,51mg	3,4mg	0,62mg	0,35mg
Slip A Leaf	Base	SL1	1,6	14,2	0,74	0,064	1,14	0,23	0,12	0,008	67	25	12,3	9,1
	Top	SL2	2,2	15,0	1,30	0,119	1,28	0,19	0,11	0,026	124	32	22,3	8,8
B Leaf	Base	SL3	1,9	12,1	0,98	0,104	1,31	0,23	0,17	0,005	49	44	13,1	9,4
	Top	SL4	3,9	13,2	1,80	0,170	1,71	0,20	0,15	0,018	55	53	17,0	10,0
C Leaf	Basal	SL5	2,5	8,0	1,57	0,192	2,21	0,49	0,33	0,006	60	113	16,5	10,1
	Mid	SL6	3,2	10,1	1,20	0,142	1,95	0,23	0,18	0,012	66	65	14,6	7,1
	Top	SL7	3,0	11,8	2,34	0,172	2,03	0,44	0,25	0,022	50	125	13,9	8,5
D Leaf	Basal	SL8	1,5	6,6	2,05	0,288	3,33	0,59	0,42	0,007	45	129	20,5	8,7
	Mid	SL9	1,7	8,8	1,40	0,142	2,12	0,35	0,23	0,009	60	88	16,1	10,1
	Top	SL10	2,0	11,2	1,98	0,134	1,92	0,50	0,28	0,014	47	136	12,8	9,5
E & F Leaf	Base	SL11	1,2	7,0	2,67	0,317	3,52	0,56	0,45	0,008	57	117	26,9	12,7
	Top	SL12	1,6	9,8	1,45	0,122	1,77	0,43	0,29	0,010	52	119	16,3	10,2
Stem	Base	SL13	5,1	10,7	0,77	0,080	2,21	0,23	0,18	0,025	86	33	7,8	5,3
	Mid	SL14	8,2	8,7	1,04	0,089	2,35	0,24	0,20	0,020	113	56	8,8	5,5
	Top	SL15	3,3	11,3	2,63	0,306	2,00	1,87	0,42	0,006	78	86	15,6	10,8
Mean for Slip				10,6	1,49	0,148	2,06	0,43	0,24	0,015	75	73	13,9	7,5
Total for Slip			42,8		0,64g	0,063g	0,88g	0,184g	0,102g	6,6mg	3,32mg	3,1mg	0,59mg	0,32mg

TABLE 33 contd

Plant Section Sampled			Section Number	Dry Weight g	% Dry Matter	PERCENTAGE						PARTS PER MILLION			
						N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
Top	A Leaf	Base	T1	0,6	20,7	0,60	0,064	0,73	0,41	0,17	0,026	61	70	9,3	7,7
		Top	T2	1,2	18,3	1,47	0,113	1,06	0,85	0,36	0,157	73	224	14,7	6,5
	B Leaf	Base	T3	1,5	21,6	0,66	0,110	0,99	0,30	0,20	0,010	38	60	10,3	7,7
		Top	T4	3,3	17,6	1,47	0,140	1,47	0,57	0,31	0,116	74	147	12,0	6,2
	C Leaf	Basal	T5	2,2	14,0	1,03	0,169	1,58	0,30	0,25	0,004	34	86	11,6	8,0
		Mid	T6	3,6	15,7	0,95	0,125	1,39	0,18	0,16	0,030	48	59	11,0	6,6
		Top	T7	2,5	15,3	1,80	0,134	2,00	0,46	0,31	0,139	43	142	11,4	7,2
	D Leaf	Basal	T8	0,6	3,7	1,58	0,274	2,95	0,37	0,36	0,006	47	143	16,6	8,9
		Mid	T9	1,0	11,8	1,17	0,133	1,98	0,19	0,21	0,016	55	69	11,8	8,8
		Top	T10	1,1	14,7	1,44	0,123	1,77	0,22	0,23	0,056	45	95	13,0	7,6
	E & F Leaf	Base	T11	0,7	8,3	2,28	0,344	3,57	0,37	0,40	0,006	32	141	24,6	6,4
		Top	T12	2,4	16,2	1,18	0,121	1,73	0,19	0,21	0,015	43	89	13,8	6,6
	Stem	Bottom	T13	0,9	17,6	1,44	0,233	1,90	1,15	0,33	0,009	53	72	7,5	11,5
		Top	T14	1,4	16,0	2,23	0,345	1,93	1,71	0,39	0,007	42	87	15,3	10,7
Mean for Top					15,9	1,34	0,157	1,66	0,43	0,26	0,052	46	105	11,8	7,5
Total for Top				23,1		0,31g	0,036g	0,38g	0,100g	0,060g	12,0mg	1,06mg	2,4mg	0,27mg	0,17mg
Mean for Plant					15,9	1,05	0,079	1,70	0,50	0,22	0,037	84	111	10,6	7,7
Total for Plant				1084,5g		11,42g	0,86g	18,45g	5,37g	2,38g	402mg	91,0mg	121mg	11,5mg	8,3mg

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