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# AVOCADO SOILS ON MATAFFIN

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*(H.L. Hall & Sons, Mataffin)*

## 1. INTRODUCTION

This paper serves to summarise the work done on avocado soils on H.L. Hall and Sons from 1970 to 1973. Some work which verifies the findings made on Hall's, but has not been done here, is reported briefly or cited.

For the sake of an orderly report, the results are not presented in chronological order, but under subject headings.

This paper covers select aspects from the following investigations:

1.1 An investigation into the avocado decline problem in Land 1 on Marathon Farm.

1.2 Investigation into apparent differences in avocado tree condition on Marathon Farm.

1.3 The avocado rootrot problem on H.L. Hall & Sons.

1.4 A survey of soils in the Nelspruit area (Mataffin) for H.L. Hall & Sons, Limited.

1.5 A survey of contrasting tree condition in some of the orchards on Mataffin.

## 2. SOILS

### 2.1 *Soil Surveys, Compaction and Stone Lines*

The trees in Land 1 Marathon were very poor on the eastern side of the orchard and good on the western side. A clear line could be drawn down the middle. Two soil pits were opened up, one in each section. These pits provided a classical illustration of the need for soil classification before planning an orchard.

In the poor area the soil was grey and fairly sandy at the surface and mottled and gravelly further down. At about 1 metre, the soil was very damp and the hole later filled up with water. The soil was identified as a Longland Form.

In the food area a deep red uniform soil was excavated to a depth of over 2 metres. There was no sign of water accumulation at all. This type of soil is known as the Hutton Form, and is well drained.

These observation were followed by a detailed survey of the soils in Lands 6 and 10 on Marathon. Here no great differences in soil form were found. All the soil is of the Hutton Form but with big differences in effective soil depth. In some places in Land 10 there are large outcrops of granitic rock. Soil pits showed that in several areas of the orchard rock or decomposing rock comes to within a few hundred millimetres of the soil surface. This soil is then known as a Hutton Form overlying rock or decomposing rock (R or C material). These areas have severe limitations and serve to fragment the orchard concerned as the water requirements, fertility, and possible rooting depth are very different from the true deep Hutton Form soil.

In Land 6, no limitation in effective soil depth was found. This fact alone might explain the great differences in tree condition in these two orchards. While examining the soil in these two orchards, two other limiting factors in the Hutton Form came to light.

The first is the severely compacted layer which occurs in the lower limits of the top soil (A horizon) and the top portion of the sub-soil (B horizon). This compacted zone can severely limit root penetration and the percolation of water through the soil profile, resulting in a "temporary perched water table' which can be severely limiting to plant growth, especially avocados.

The second finding was the presence of stone lines in the soil profile. The significance of this finding was only realised at a later date. (See Beyleveld's work.)

These surveys of two very small areas emphasised the need for a detailed soil survey of the entire farm to establish the suitability of uncultivated land for further intensification.

This survey showed very clearly that where avocados were planted on Hutton Form soils the tree condition was reasonably good, while avocados on other soil forms were in poor condition. It also showed that there is little soil left in this Pambili-Woodhouse area which is suitable for future avocado expansion.

This survey confirmed the presence of a compacted layer in Hutton Form soil and the presence of stone lines.

A publication called "A Tentative Evaluation of some Soil Types for Avocado Growing in South Africa' by B.N. Wolstenholme and J. le Roux lists the Hutton Form as a low hazard soil for avocado production. The only other soil forms which have been found on Hall's which could be suitable for avocado production are the Griffin Form (Topsoil on yellow on red sub-soils) and Clovelly Form (Topsoil on yellow sub-soil). The former is given a low hazard rating and the latter a moderate hazard rating. Both these soils are found only as small pockets of soil in the areas surveyed so far.

While looking at the nutrient status of the soils in good, moderate and poor areas in individual avocado orchards, Beyleveld, a Horticultural Science student from the University of Natal, noted the presence of more stone lines in the soil profile in poor areas than in good areas. In his examination of 48 soil pits in 4 different orchards he found that 6% of the pits in the good areas had stone lines present, 28% in the moderate areas, and 61% in the poor areas. These figures indicate clearly that stone lines are more prevalent in the poor areas than in better areas. If a parallel is now drawn between stone lines and sand lenses — both being coarser structured areas in a fine grained soil media — the explanation given by Goodall *et al* (1960) regarding sand lenses, would explain the deleterious effect of stone lines in an otherwise fairly uniform soil profile. "... any abrupt change in soil texture causes impairment of internal drainage.

Thus a sand lens can create a perched water table above it". Thus providing an ideal media for growth and development of *Phytophthora cinnamoni* and an environment not suitable for the health of avocado roots.

## 2.2 *pH and Nutrient Status*

In the comparison of Land 6 and 10 Marathon, soil samples were drawn from the topsoil and sub-soil in each of the soil pits and submitted for detailed nutrient analysis. The results for P and K showed very great variation in levels recorded, probably as a result of contamination by the recent fertilizer applications, but no trend favouring either orchard.

The Calcium analysis and the pH values recorded show clearly that Land 6 is less acid, as a result of more Calcium in the soil, than Land 10. In Land 6 all the soil pH's (in KCl) are above 5,5 while in Land 10 the topsoil pH is from 4,3 to 5,1 and the sub-soil pH from 4,0 to 5,5. The Calcium levels in Land 6 range from 1 000 to 1 600 ppm. in the topsoil, and 400 to 1 000 ppm. in the 8 horizon. In Land 10 the topsoil and sub-soil Calciums are from 200 to 800 ppm. The big differences in subsoil Calciums is that in Land 6, 80% of soil samples had Calcium values above 600 ppm. compared with only 13% in Land 10.

Leaf analysis of Fuerte leaves taken in Lands 6 and 10 confirmed the differences in soil Calcium levels. The leaf sample from Land 6 and 1,76% Ca. compared with 1,54% Ca. in Land 10. The accepted norm is 1,0 3,0% Ca. so no deficiency as such exists in Land 10.

Some of the soil samples having low pH's were analysed for exchangeable Aluminium. The results obtained show that at these lower pH's the amount of exchangeable Aluminium present ranges from acceptable (0,10 me %) to extremely high (1,15 me %), with the suggested borderline of Aluminium toxicity being about 0,20 me %. It is, however, not known at present how sensitive the avocado root is to Aluminium toxicity.

In an attempt to confirm the definite results obtained comparing the pH's and Calcium values in Lands 6 and 10, a survey of good, moderate and poor areas within single avocado orchards was undertaken by Beyleveld. Soil samples were taken from 4 different orchards containing contrasting tree condition and submitted for analysis.

pH differences showed no correlation with tree condition over the entire survey. The pH's recorded, however, varied from neutral down to very acid readings as low as 4,2 (in water), the average reading being between 5,0 and 5,5.

It has been reported by Koen and Smart (1971) that in pot experiments using Duke avocado seedlings "that the best growth was obtained with a soil pH above 6,0 but below 7,0". At a pH of 5,3, the seedlings were about half the size of seedlings grown at pH 6,4.

It can be assumed that the optimum pH for seedling growth in a pot and for grafted trees in the field will not be very different. If this optimum pH of 6,4 is compared with the overall average of 5,2 recorded in Beyleveld's work and the figures quoted for Lands 6 and 10 Marathon, it can be seen that the pH values recorded are far from optimum.

### 2.3 *For the future*

From the foregoing work and discussion it would seem that the following conclusions can be made:

2.3.1 That the correct selection of soils, which are both well drained and of adequate depth, is of paramount importance.

2.3.2 That soil preparation, to break up both the compacted zone and any possible stone lines, is an essential part of ensuring good tree growth.

2.3.3 That the correction of soil acidity by the use of lime be considered an essential part of soil preparation.


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**Table 1**

*The pH and Calcium status in Topsoil*

| Orchard | Horizon | pH in KC1 | Percentage sample having Ca. status | | |
|---|---|---|---|---|---|
| | | | 1000 ppm. | 600 ppm. | 400 ppm. |
| 6 | Topsoil | 5,5–6,1 | 100 | 100 | 100 |
| | Sub-soil | 5,5–6,1 | 0 | 80 | 100 |
| 10 | Topsoil | 4,3–5,1 | 0 | 50 | 90 |
| | Sub-soil | 4,0–5,5 | 0 | 13 | 60 |

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