

## SOIL SAMPLING IN OIL PALM PLANTATIONS

Dr. Murom Banabas

### Introduction

Because of the structure of the palms and the way they are planted and managed in the field, soil properties vary under the palms. There are five general managed zones under the palms and soil properties vary within and between the zones. The zones are;

- Frond piles – this is the zone where pruned fronds are placed and is also referred to as windrows where felled palms are placed at during felling for replant.
- Weeded circles – this is the cleared area of 1.0 to 2 m radius from the palm base that facilitates harvesting of palms.
- Frond tips – this is the area between two adjacent palms along a row where in box frond piling, frond tips are placed at. This is also the area where empty fruit bunches are placed at.
- Harvest path – this is the avenue running between two rows of palms that facilitates access into the block for upkeep, fertiliser application and harvesting and moving of crops to the road sides.
- Between zone – this is the area between weeded circles, frond tips and harvest paths which is not accounted for as a specific zone. The proportion of this zone varies with dimensions of the other four zones.

### Disadvantages of sampling in specific zones under the palms

The previous method of soil sampling involved getting soils from selected zones (frond piles and weeded circles) at two depths around selected palms. However this method of sampling had several disadvantages;

- The zones occupy relatively different proportions of the area under the palms and therefore the consolidated sample is not representative of the whole area in the block.
- Inter zone differences are not captured in the sampling process.
- Areas that received fertilisers are generally not visible and therefore trends and management over time cannot be captured from the sampling procedure.
- The relative sizes of the zones change with time until when the palms mature and there after remain relatively constant. Because of the change in the sizes of zones, extrapolating of results from zones with time can be misleading.
- Sampling over time especially over more than one crop cycle is not comparable because of change in planting distances and lining alignments or both at replant changes which results in changes in the position of the zones.

### Literature review

Nelson *et al* 2015 devised a practical soil sampling method that takes into consideration the above mentioned limitations to current soil sampling procedure. They geometrically evaluated a transect sampling method which captured all the different zones under the palms and looked at several options of different transect distances and sampling density. The soil properties evaluated were soil respiration, pH, bulk density, total carbon and effective cation exchange capacity. By increasing the number sampling points from 10 to 50, with an acceptable transect length of 5.57 times the palm spacing, the deviations from the maximum deviation decreased from 15.9 % to 5.6% for respiration, 4.4% to 0.2% for pH, 3.2% to 0.6% for bulk density, 6.9% to 0.6% for total carbon and 7.5% to 0.5% for effective cation exchange capacity. The reduction in deviation showed that it is better to take 50 points along the transect than 10 points along the transect. The sampling method is outlined here for oil palm plantations.

### Aim

To take soil samples which will be fairly representative of the planted area that will allow for tree-scale variability. Results can then be used to monitor trends in soil properties with time.

### Method and Materials

#### Materials

Auger 5.5 cm diameter, 50 m tape measure, permanent markers, plastic bags 90 cm x 45 cm, plastic bags 45 cm x 45 cm, sievers 5 mm sizes, 50 x 1.5 m long pegs, 1x nylon string of 60 m long 1 cm diameter and bush knives.

#### Selection of sampling locations and points

First locate the blocks for sampling on a plantation map. In a block, there will be three sampling locations spaced out diagonally across the block (Figure 1). The first sampling location will be on the left hand of the block. Location 2 will be in the middle of the block and at 16<sup>th</sup> or 17<sup>th</sup> palm from the road in a normal 33 palms per row block.

#### For further information contact:

HEAD OF AGRONOMY  
Papua New Guinea Oil Palm Research Association  
Inc.

Dami Research Station  
West New Britain  
Papua New Guinea.

Tel: +675 985 4015/4009

Fax: +675 985 4040

e-mail: [murom.banabas@pngopra.org.pg](mailto:murom.banabas@pngopra.org.pg)

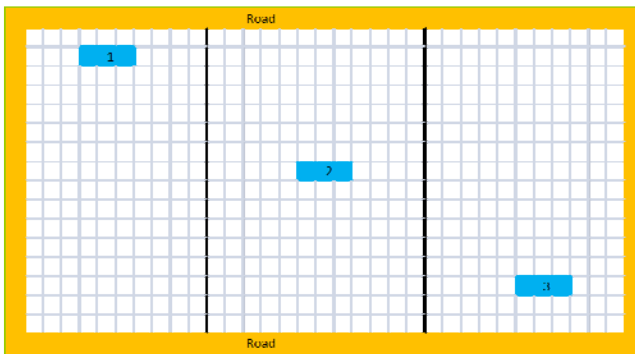


Figure 1. Three sampling locations in a typical rectangular block

Location 3 will be at the other end of the block. All samples for each of the 3 locations for each of the required depths will be a composite sample after sampling is done.

### Selection of palms and marking of sampling points

At the block, for Location 1, count 5 palm rows from edge of the block along a road and then 5 palms in (Figure 2).

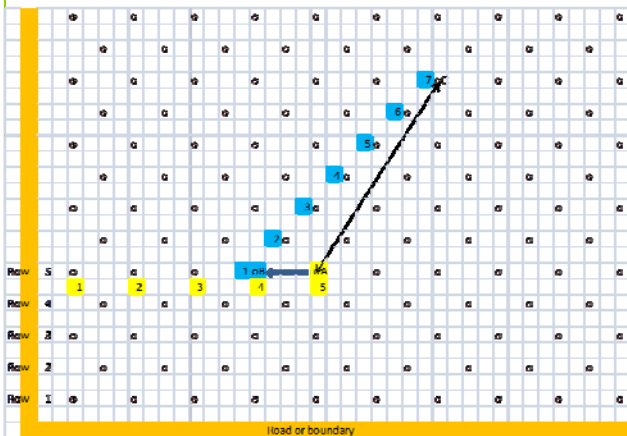


Figure 2. Diagrammatic representation of choosing a sampling point

At the 5<sup>th</sup> palm in from road side labelled as A, choose the palm on the left on the same row labelled as B (which is actually the 4<sup>th</sup> palm from the road).

Then count 7 palms including the selected palm down the block but towards the right side to the 7<sup>th</sup> palm labelled as C.

And then tie a string from the chosen 5<sup>th</sup> palm labelled A to the 7<sup>th</sup> palm labelled C which was counted from the palm on the left of A.

And then using a tape measure along the string from A to C, at every 1 m, put a peg which will be the sampling point. There should be 50 sampling points along the marked transect.

Soil samples are then collected using the auger at 0-20 cm and 20-40 cm depths and placed separately into two separate labelled plastic bags respectively. This is done for all the marked 0 sampling points along the transect and is repeated for the other 2 locations as well.

The same procedure is followed for Location 2 but it will be in the centre of the block at palm 16 or 17 from the road for a 33 palm per row planting.

For location 3, the direction of sampling will be back into the field, opposite to Location 1 set up.

### Sample processing

At the end of sampling a block, there will be two sample bags (one for each of the two sampling depths) per location, totalling six bags for the three locations in a block. The three bags for 0-20 cm depth for the three locations will be processed together while the other three for the 2<sup>nd</sup> depth will be processed separately. Note each bag will contain about 25 kg of fresh soil samples. At the laboratory, the soils will be sieved and all roots, gravel and stones are removed.

The sieved soils are thoroughly mixed by pouring on top of each other forming a ridge of about 2.0 m long on a table. After the ridge is formed, a second ridge is formed by taking the soils from one end of the 1<sup>st</sup> ridge. This is repeated again to form a 3<sup>rd</sup> ridge. After the 3<sup>rd</sup> ridge is formed, it is divided into 4 quarters. The opposite two quarters are discarded and the remaining two quarters are then used to form another ridge, repeating the whole process again twice. After every third ridge, there is a discard of two opposite quarters.

After the 3<sup>rd</sup> discard, final three ridges are formed and the 3<sup>rd</sup> ridge is divided into four quarters. Samples of about 0.75 kg to 0 -1 kg is taken from the two opposite quarters and put into labelled plastic bags for air drying. The remaining two quarters are discarded.

After the soils are air dried, the samples are divided into original and duplicate samples. About 150 grams of soils labelled as original are sent for analysis. Duplicate sample is stored away. Some of the precautions to take note of during the sampling process are as follows;

In the palm selection process if the 4<sup>th</sup> or the 5<sup>th</sup> palms are missing, then select the next best palm with six surrounding palms.

Between point B and C if there is any missing palm, count the missing space as a palm.

If palms A and C have ponds or logs or a drain in the middle then, select next palm where there is nothing in the way.

If the block is narrow or other shapes other than normal rectangular shape, then use judgement and have the locations to be fairly representative of the block.

Some of the blocks could run into a separate soil type, in such situations treat as one MU or block.

Use same size auger to collect soil samples and augers with 5.5 cm internal diameter is recommended. This will result in sufficient soil samples collected for mixing. Smaller augers maybe adequate but when sampling in pumice and gravel areas can result in less soils for analysis after sieving.

### Reference

Nelson PN, Webb MJ, Banabas M, Nake S, Goodrick I, Gordon J, O'Grady D, Dubos B (2014b) Methods to account for tree-scale variation in soil- and plant-related parameters in oil palm plantations. *Plant Soil* 374:459-471

Nelson PN, Banabas M, Iain Goodrick I, Webb MJ, Huth N, O'Grady D, (2015) *Soil sampling in oil palm plantations: a practical design that accounts for systematic lateral variability at the tree scale.* *Plant and Soil*, pages 2490-2499