

SOUTH EAST JOHORE PROJECT

WORKING PAPERS.

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METHODS OF SOIL ANALYSIS
DEP. OF AGRIC. W. MALAYSIA

SOIL DESCRIPTIONS AND SOIL
ANALYSIS.

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SOIL ANALYSIS

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Reception and Preparation

Samples are received in numbered canvas bags containing about one kilogramme of soil in an inner polythene bag (NOTE 1). This inner bag preserves the canvas one from rotting and staining and keeps the sample in a moist field condition.

The bag numbers are listed in a register book and the samples are given a register number which is then used throughout the laboratory determinations. The place of origin, depth from which samples came, analyses to be done, and any other relevant information are noted.

The bags are opened, a sample of the soil as received is taken for pH determination, and the remainder is spread out on plastic sheets in wooden drying trays. After drying in the sun (3 to 4 days) the samples are ground by machine (NOTE 2) and sieved to various grades:

Greater than 10 mm	...	Stone
Between 2 and 10 mm	...	Gravel
Less than 2 mm	...	Coarse sand to clay

The soil which passes the 2 mm sieve (hereafter referred to as "fine soil") is collected in a waxed cardboard carton (NOTE 3) and the weight of each fraction is recorded.

Recording and Reporting of Results

Although bound Laboratory books may be safer for recording, reporting and preserving results, the cyclostyled sheets used for routine work make a more efficient system for use with well standardised methods. These sheets help to reduce mistakes which are often made during the transference of results from books to final compilation sheets. The foolscap size and thickness of paper also make it easy to take two or three copies of the final analytical report.

NOTES

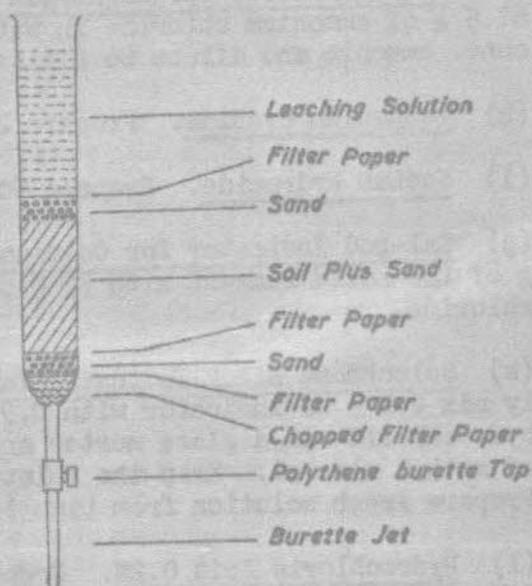
- 1 Canvas bags are about 8" x 11" and polythene bags about 9" x 12" in size.
- 2 The grinding machine used is of the type developed by the Rokhuia Agricultural Research Station, New Zealand. Samples are put in cylinders made of perforated (2 mm holes) stainless steel plate. A pair of metal rollers of different diameters (about 1 3/4" & 1") are put inside and the cylinders placed turning rollers. For preparing samples for special work such as trace element analysis, grinding is done in wooden and/or agate mortars and nylon sieves are used.
- 3 The waxed cardboard cartons hold about 800 g soil and are used during the course of laboratory work. They facilitate the mixing and withdrawal of representative sub-samples. After analysis the samples are kept for a few months and then either discarded or transferred to plastic bags or glass bottles for prolonged storage.

CATION EXCHANGE CAPACITY

(Based on Mehlich's method. J. Assoc. Off. Agric. Chem. 36, 2, 445)

Apparatus:

Leaching tubes. These can be made from 8" x 1" test tubes with a hole blown in the bottom and a glass tube sealed on to form an outlet. A polythene burette tap and glass jet provide accurate control of the dropping rate. A wooden rack serves to hold a row of these tubes for batch work.



Flasks For each leaching tube in use the following volumetric flasks are required: one 50 ml, one 100 ml, and one 200 ml. 250 ml Erlenmeyer flasks are best suited for the versenate titrations as the solutions form a thin layer in which it is easy to see the end point.

Beakers. 500 ml tall conical beakers are convenient for the precipitation of barium sulphate and subsequent evaporation.

REAGENTS

- (a) Barium Chloride - Triethanolamine. Dilute 90 ml of commercial triethanolamine with about one litre of distilled water and adjust to pH 8.1. This requires about 280 to 300 ml of normal hydrochloric acid. Make up to 2 litres and mix with 2 litres of a solution containing 100 g of barium chloride. Protect from the carbon dioxide of the atmosphere during storage.
- (b) Barium Chloride 0.1 N. Dissolve 12.22 g of barium chloride and make up one litre with distilled water.
- (c) Mixed Indicator. Triturate 0.05 g of bromocresol green with 8ml of 0.01 N ammonium hydroxide and dilute to 100 ml with distilled water. Dissolve 0.05 g of methyl red in 100 ml of 95% ethyl alcohol. Mix equal volumes

- (d) Barium precipitating reagent. Dissolve 50 g of ammonium acetate and 50 g of ammonium sulphate and make up to one litre with distilled water.
- (e) Ammonium Acetate-Normal. Dilute 576 ml of acetic acid (S.G. 1.056) to 5 litres and 540 ml of conc. ammonia (S.G. 0.88) to 5 litres. Standardise each by diluting an aliquot 10 times and titrating against standard alkali or acid using methyl red as an indicator. Adjust each to 2N and mix equal volumes. Then measure the pH and adjust to 7 if necessary.
- (f) Versenate-N/50. Dissolve 3.75 g of the disodium salt of ethylene-diamine-tetra-acetic acid in a litre of distilled water. Standardise against solutions of standard Calcium, Magnesium and Barium.
- (g) Ammonia Buffer for Magnesium Titration. Dissolve 67.5 g of ammonium chloride in water, add 570 ml of conc. ammonia and dilute to 2 litres.
- (h) Potassium Cyanide. Prepare 200 ml of a 3% solution,
- (i) Sodium Hydroxide. Prepare 500 ml of a 20% solution.
- (j) Cal-red Indicator for Calcium. Thoroughly mix 0.2 g of the solid reagent with 20 g of finely ground sodium chloride.
- (k) Solochrome Black Indicator for Magnesium. Thoroughly mix 0.1 g of indicator with 0.9 g of hydroxylamine hydrochloride in a glass mortar and triturate with 20 ml of methyl alcohol. Keep the solution in a refrigerator. Prepare fresh solution from time to time.
- (l) Hydrochloric Acid 0.2N. Prepare 2 litres of approx. 2 N Acid and standardise against sodium borate.
- (m) Standard Calcium. Dissolve 10.009 g of pure dry calcium carbonate in the minimum of hydrochloric acid and make up to one litre. This solution contains 0.2 milliequivalents Ca per ml.
- (n) Standard Magnesium. Dissolve 2.432 g of pure magnesium ribbon in the minimum of hydrochloric acid and make up to one litre. Alternatively, dissolve 24.649 g of pure magnesium sulphate in one litre of water. Both of these solutions contain 0.2 m. eq. Mg per ml.
- (o) Buffer solution for Barium. Dissolve 8.25 g of ammonium chloride in 113 ml of ammonia (S.G. 0.88) and make up to 900 ml with carbon dioxide free water. Take 10 ml of this solution and transfer to a flask. Add 10 ml of a 10% solution of magnesium chloride, 40 ml of water and 5 drops of indicator (N.B. reagent (p) for barium). Titrate this with an approximately 10% versenate solution to the first pure blue end-point. Add this titrated solution to the main bulk of the former solution and make up to one litre.
- (p) Indicator for Barium. Add 0.1 g of solochrome black to 25 ml of warm ethanol (40-60 degrees C), shake for 2 minutes, cool, filter and decant, rejecting the residue.

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Sand Preparation. Sieve good grade quartz sand through 15 and 30 mesh sieves and collect the fraction on the 30 mesh sieve (grain size between 1 and 0.5mm). Discard the coarse and fine fractions. Boil the sand with conc. hydrochloric acid for 2 hours and then wash with tap water. Boil again with conc. HCl and leave overnight. Wash with tap water and then with distilled water until free of chloride and dry the sand. It is convenient to use a Buchner funnel during washing.

Sample Preparation. Grind the soil gently and pass through a 1 mm sieve. Add any coarse material remaining on the sieve back to the ground sample and mix thoroughly. Weigh 5 g of soil and mix with 10 g of sand.

Filling Leaching Tubes. Put chopped filter paper at the bottom of the tube and cover with a disc of Whatman No. 5 filter paper (the disc being cut to fit the tube exactly). Pour a little pure sand into the tube and cover with another disc of filter paper. Add the sample of soil mixed with sand (a long-stemmed filter funnel facilitates the transfer of the sample). Finish off with a thin layer of sand and a disc of filter paper. A plunger, made from a glass rod with a rubber bung on the end is convenient for pushing the filter papers into place.

Leaching and Washing. Add an accurate aliquot of 25 ml of solution (a) to the leaching tube and allow the sample to soak for half an hour. After draining, add 25 ml of solution (b). The latter aliquot need not be so very accurate. Adjust the leaching rate to about 1 ml per minute. Wash with six approximately 10 ml aliquots of distilled water and collect all the leachate in a 250 ml Erlenmeyer flask. Rinse the stem of the tube to remove any barium solution.

Hydrogen Titration. Titrate the leachate with 0.2 N HCl to a pale rose colour, using 5 drops of mixed indicator. Titrate a mixture of 25ml each of solns. (a) & (b). From the difference between these readings, the m.eq. Hydrogen in the soil can be calculated.

$$4 \times \text{the diff. in reading} = \text{m.eq. H}/100\text{g soil.}$$

Separation of Barium. After the above titration, transfer the solution to a 500 ml conical beaker and reduce the volume to about 100 ml. Add 20 ml of 3 N HCl (this helps to reduce co-precipitation of calcium with barium) and bring to the boil on a hot plate. Add about 10 ml of solution (d) and after a few minutes remove the flask from the hot plate and allow it to cool. Filter through a Whatman No. 5 paper and wash three times with hot distilled water. Reduce the volume by evaporation and then make up to exactly 50 ml. Ca, Mg., K, and Na determinations are done on this solution.

Calcium Determination. Transfer a 5 ml aliquot to a 250 ml Erlenmeyer flask, add 20 ml of water, 2 ml of 20% sodium hydroxide and about 20 mg of indicator (j). Titrate with N/50 versenate. Take an aliquot of standard calcium solution and calculate the versenate standardisation factor (V.S.F.).

$$\text{On a 5 ml aliquot (equivalent to 0.5 g soil)} \\ \text{N/50 vers. used (ml)} \times \text{V.S.F.} \times 4 = \text{m.eq. Ca}/100\text{g.}$$

Magnesium Determination. Transfer a 5 ml aliquot to a 250 ml flask, add 1 ml of reagent (h), 10 ml of buffer solution (g) and 4 drops of indicator (k). Titrate with N/50 versenate. Likewise titrate an aliquot of standard magnesium solution and calculate the versenate standardisation factor (which may be slightly different from that found with the calcium titration). Subtract the volume of versenate used in the calcium titration and calculate the magnesium as follows:

Potassium Determination. Determine the potassium directly on the extract by flame photometry setting a standard solution containing 1 m. eq./litre to give maximum scale deflection. (1 m. eq./litre is equal to 39.1 ppm).

Sodium. As for potassium. Set a standard containing 2 m.eq./litre to give maximum scale deflection and dilute the unknown solution if necessary. (2 m.eq./litre is equal to 46 ppm.)

Cation Exchange Capacity. Leach out the barium in the soil by adding four 25 ml aliquots of N ammonium acetate and collect the leachate in a 100 ml flask. Make up to the mark and transfer a 5 ml aliquot to a 250 ml Erlenmeyer flask. Add 10 ml of buffer solution (o), 4 drops of indicator (p) and titrate with N/50 versenate. Use a standard solution of barium to determine the versenate standardisation factor (which should be the same as that of magnesium) and calculate as follows:-

$$N/50 \text{ vers. used (ml)} \times V.S.F. \times 4 = C.E.C.m.eq./100 \text{ g.}$$

Blank Determination. Do a blank determination with reagents and subtract this from the C.E.C. reading.

CARBON - Walkley and Black Method

Reagents.

- (a) N Potassium dichromate. Dissolve 49.04 g. of $K_2Cr_2O_7$ in water and dilute to one litre.
- (b) Sulphuric acid. Not less than 96 per cent strength.
- (c) Phosphoric acid. 85 per cent strength.
- (d) Diphenylamine. Dissolve 0.5 g diphenylamine in a mixture of 100 ml conc. sulphuric acid and 20 ml water.
- (e) N Ferrous sulphate. Dissolve 278.0 g of $FeSO_4 \cdot 7H_2O$ in distilled water, add 15 ml of concentrated sulphuric acid and dilute to 1 litre. Standardise by titrating against 10.5 ml of N potassium dichromate as described below. The ferrous sulphate solution should be standardised at least once a week.

Method. The soil sample should be ground to pass a 60 mesh screen and sufficient soil for both carbon and nitrogen determinations should be prepared. Weigh out 2 g of soil (or enough to contain between 10 and 25 mg of organic carbon) and place in a 500 ml Erlenmeyer flask. Add 10 ml of N potassium dichromate followed by 20 ml of concentrated sulphuric acid. Shake by hand for one minute and leave the flask to stand for 30 minutes. Then add 200 ml water, 10 ml of phosphoric acid and 1 ml of diphenylamine indicator solution. Titrate with ferrous sulphate until the solution is purple or blue. A magnetic stirrer is useful during titration. Continue to add the ferrous sulphate in small lots of about 0.5 ml until the colour changes to green. Then add 0.5 ml of N potassium dichromate and add ferrous sulphate drop by drop until the last trace of blue colour disappears. If more than 8 ml of the 10 ml of potassium dichromate originally taken have been reduced during the digestion, repeat the determination using a smaller quantity of soil.

Calculation. One ml of N potassium dichromate is equivalent to 3 mg of carbon. The amount of carbon oxidised, expressed as percentage of the soil is therefore given by the expression:

$$\frac{V_1 - V_2}{W} \times 0.3 \times 100.$$

Where V_1 = volume of N potassium dichromate
 V_2 = " " N ferrous sulphate
and W = weight of soil taken.

Multiply the result by the conventional factor 1.724 to obtain the percentage of organic matter.

NOTES:

1. Grinding and sieving the soil is done quickly and sufficiently fine by using a 60 mesh sieve. This ground soil should be oven-dried and kept in a closed container. Enough soil should be ground for the Carbon, Nitrogen and Phosphorus determinations. The weight of soil to be taken for carbon depends on the carbon content and this can be judged to some extent by the colour of the soil and/or the loss on ignition (see Note 2).

Weight to be taken

Normal soil	2.0 g
Dark "	1.0 g
Black "	0.5 g

2. If loss on ignition has been determined the weight of soil to be taken for C determination can be calculated as follows:-

CHLORIDE DETERMINATION

- Reagents
- (a) Silver nitrate. Dissolve 3.398 g AgNO₃ in distilled water and make up to 1 litre to get N/50 solution.
 - (b) Sodium carbonate - approx. N/20 solution.
 - (c) Sulphuric acid - " " "
 - (d) Phenolphthalein - 1% solution.
 - (e) Potassium chromate indicator. Dissolve about 5 g K₂CrO₄ in 80 ml water and add saturated AgNO₃ solution dropwise with stirring until a permanent red precipitate is produced. Filter and dilute the solution to 100 ml.

Method

After measuring the conductivity of the soil suspension, filter and collect the filtrate. If this is turbid filter again and, if the turbidity persists, acidify the solution slightly with a few drops of nitric acid, stir and allow to stand for 10 to 15 minutes, then filter through No.2 or No.5 Whatman paper.

Transfer an aliquot of the filtrate to a white porcelain basin (the size of the aliquot will depend on the chloride content and this can be estimated approximately from the conductivity reading - see table below). Add 1 drop of phenolphthalein solution and adjust the pH to 8.2 with either sodium carbonate or sulphuric acid, (Note 1) just colourless to the indicator. If a precipitate (usually iron) is obtained filter it off. Add one ml of chromate indicator and titrate with standard silver nitrate solution until the first permanent red coloration appears. Place a magnetic stirring bar in the solution and do the titration on a magnetic stirrer to obtain rapid mixing of the solutions and a clear indication of the end-point.

Do a blank titration with the same volume of chloride free distilled water and subtract this from the reading.

Calculation With a soil/solution ratio of 1:5 -

$$\frac{A \times 10}{B} = \text{milliequivalents chloride per 100g soil}$$

- where A = number of ml N/50 AgNO₃ used
- B = number of ml aliquot taken

Estimation of the Aliquot to be taken

<u>Conductivity</u>	<u>Aliquot</u>	<u>Conductivity</u>	<u>Aliquot</u>
500	20	4,000	10) (of ext.
1,000	10	6,000	5) dil. x 10)
1,500	5	12,000	10) (of ext.
3,000	10 (of ext. dil. x 5)	17,000	5) dil. x 50)

Note 1. Filtrates from Malayan soils are usually acid and will require the addition of sodium carbonate solution. Add this until a pink colour appears and then discharge this by adding one drop of sulphuric acid.

CONDUCTIVITY

Apparatus.

- (a) Conductivity Bridge.
- (b) Wide mouthed bottles for use in shaking machine and into which the electrode cell can be dipped directly.

Procedure

Weigh 20 g samples of fine soil and transfer to 250 ml wide mouthed bottles. Add 100 ml of distilled water (of conductivity less than 3.0×10^{-6} mhos.) and shake for one hour in an end-over-end shaker. Allow to stand for one hour before measuring the resistance by dipping the cell directly into the suspension.

Calculation

The cell constant (J) = the specific conductance (K) multiplied by the measured resistance in ohms (R). At 30°C K = 0.001552 for 0.01N potassium chloride solution.

$$\therefore J = 0.00155 \times R.$$

The conductivity of the soil suspension is given by the expression:

$$K_{T_0} = \frac{J}{R_s} \text{ (mhos/cm)} = \frac{J \times 10^6}{R_s} \text{ (mhos} \times 10^{-6}\text{)}$$

Multiply K_{T_0} by a factor to convert to K_{25°

<u>Temp. °C.</u>	<u>Correction factor</u>
25	1.000
26	0.979
28	0.941
30	0.906

After using the cell, rinse it and leave immersed in distilled water.

If the suspension gives a conductivity reading of over 200 mhos $\times 10^{-6}$, filter and do the determinations of chlorides and sulphates.

NOTE:

The conductivity water can be stored in an aspirator bottle with a wide-mouthed outlet and a similar arrangement to that in the potassium determination used to add the 100 ml aliquots of water to the soil.

MOISTURE CONTENT

Apparatus. Glazed silica basins measuring 52 by 42 by 18 mm are of a convenient size and their rectangular shape gives a closer packing inside ovens and furnaces than is obtained with circular basins.

Procedure. Weigh a 10 g sample of fine soil into a basin and dry in an oven at 105°C for five hours. Cool the basin in a desiccator, weigh and calculate the percentage moisture on the air-dry basis. Calculate the Moisture Factor and use this to multiply results obtained on air-dry soil.

LOSS ON IGNITION

Procedure. Take the basin with the oven-dry sample from moisture determination and transfer it to a muffle furnace. Raise the temperature to 750°C and maintain at this level for one hour. Do not open the door of the furnace during this time, otherwise the organic matter (of peaty soils especially) might burn off with a sudden flare resulting in loss of the sample. Allow the furnace to cool down and then transfer the basin to a desiccator. When cool, weigh and calculate the result on the oven-dry basis.

NOTES:

1. Rectangular shaped glazed silica basins are convenient for packing inside ovens and furnaces. They should be numbered permanently and a record kept of their weights, which do not vary much with use. Weighings should be done to the second decimal place and the weights of the basins checked weekly. The soil sample should be weighed out separately and then transferred to a basin. Examples of calculations are given below:

Weight of basin plus moist soil	...	30.96 g
" " " " oven-dry "	...	28.84
" " moisture in soil sample	...	2.12
" " soil	...	10.00

Moisture = 21.2 per cent

Weight of basin plus oven-dry soil	...	28.84 g
" " " " ignited soil	...	27.24
Loss on ignition	...	1.60
Weight of oven-dry soil	...	7.88

Loss on Ignition = $\frac{1.6}{7.88} \times 100 = 20.3$ per cent

2. The following arbitrary classification is used:-

Samples with over 65 per cent loss on ignition	are classified as	Peat.
" " between 65 & 35	" " " " "	" Muck.
" " less than 35	" " " " "	" "

Mineral Soil.

MECHANICAL ANALYSIS - Bouyoucos Hydrometer Method.

Apparatus and Chemicals.

- (a) A "Horlicks" type disperser with cups fitted with baffle plates. The stirring paddle becomes worn with use (especially with sandy soils) but spares can be easily made and the paddle should be replaced at frequent intervals.
- (b) A Soil Colloids Hydrometer.
- (c) Hydrometer cylinders about 2 1/2 inches in diameter and 17 inches tall marked at the 1130 ml level.
- (d) Tetron - as a dispersant. (Manufactured by Albright & Wilson Ltd.)

Procedure. Samples with a loss on ignition of over 35 per cent are classified as muck or peat and no further physical analysis is done on them.

Weigh a 50 g sample of fine mineral soil, place in a 500 ml beaker, add a little water (distilled water need not be used) and 5 ml of 40 vol. H₂O₂; stir and set aside for a few hours. Top up to about 200 ml, stir and allow to stand over-night. If the sample has a loss on ignition of over 15 per cent add an extra 10 ml of 40 volume hydrogen peroxide and heat on a water bath or asbestos covered hot-plate for an hour or until no more frothing occurs. Add further aliquots of hydrogen peroxide if necessary, then top up to 200 ml, stir and allow to stand over-night. In some instances the loss on ignition of the sample is less than 15 per cent and yet there is an amount of organic matter floating on the surface of the water in the beaker. This organic matter tends to obscure subsequent hydrometer readings and such samples are best treated with extra hydrogen peroxide.

Add 3 g of powder Tetron, stir, transfer the soil to a dispersion cup, and fill with water to about 1 1/2 inches from the top. Stir the contents with the dispersing unit for 5 minutes in the case of sandy soils and 10 minutes for all others except those which are very difficult to disperse; such soils should be stirred for 15 or even 20 minutes.

Pour the soil into a cylinder, wash out all the soil into the cylinder and fill it up with water to the 1130 ml mark with the hydrometer in it. Remove the hydrometer, place the dry palm of the hand over the mouth of the cylinder and shake the contents vigorously, turning the cylinder upside down a few times (Note 3). Place the cylinder on a bench, note the time, and take the first hydrometer reading after 4 minutes. Remove the hydrometer and take the reading after two hours.

Decant as much as possible of the clay and silt suspension taking care not to lose any of the sand fraction. Transfer the residue to a 600 ml tall beaker which is marked at 10 cm height. Fill to the mark with water (tap water may be used), stir and allow to stand for 8 minutes after the liquid motion has stopped. Siphon off about 75 per cent of the suspension and repeat this procedure, gradually reducing the time of standing to 4 minutes until a negligible amount of clay and silt remains. Transfer the sand to a porcelain dish and dry in an oven for 2 hours. Separate the coarse and fine sands by sieving through 70 mesh and weigh each fraction.

Calculation. If the hydrometer was calibrated in soil suspensions at 67°F a temperature correction, which is only approximate, must be included. For every 1°F above 67°F add 0.2 hydrometer unit. In Malaya, the suspension temperature seldom varies more than between 80°F and 82°F and a constant correction factor of plus 3 units can be used without serious error. The moisture content of the soil must be taken into account when converting hydrometer readings into percentages of clay or clay plus silt.

Taylor Soil Colloid Hydrometer Reading	PERCENTAGE SOIL MOISTURE									
	1	2	3	4	5	6	7	8	9	10
	PERCENTAGE CLAY OR CLAY PLUS SILT (CORRECTION FACTOR INCLUDED)									
-2	2	2	2	2	2	2	2	2	2	2
-1	4	4	4	4	4	4	4	4	4	4
0	6	6	6	6	6	6	6	7	7	7
1	8	8	8	8	8	9	9	9	9	9
2	10	10	10	10	11	11	11	11	11	11
3	12	12	12	12	13	13	13	13	13	13
4	14	14	14	15	15	15	15	15	15	15
5	16	16	17	17	17	17	17	17	18	18
6	18	18	19	19	19	19	20	20	20	20
7	20	20	21	21	21	21	21	22	22	22
8	22	22	23	23	23	23	24	24	24	25
9	24	25	25	25	25	26	26	26	26	27
10	26	27	27	27	27	28	28	28	28	29
11	28	28	29	29	30	30	30	30	31	31
12	30	31	31	31	32	32	32	33	33	33
13	32	33	33	34	34	34	34	35	35	35
14	34	35	35	35	36	36	37	37	37	38
15	36	37	37	37	38	38	39	39	39	40
16	38	39	39	40	40	40	41	41	42	42
17	40	41	41	42	42	42	43	43	44	45
18	42	43	43	44	44	45	45	46	46	47
19	44	45	45	46	46	47	47	48	48	49
20	47	47	47	48	48	49	49	50	50	51
21	48	49	49	50	51	51	52	52	53	53
22	51	51	52	52	53	53	54	54	55	55
23	53	53	54	54	55	55	56	57	57	57
24	54	55	56	56	57	57	58	59	59	60
25	57	57	58	58	59	60	60	61	61	62
26	59	59	60	60	61	62	62	63	64	65
27	61	61	62	62	63	64	65	65	65	67
28	63	63	64	65	65	66	67	67	68	68
29	65	65	66	67	68	68	69	70	70	71
30	67	67	68	68	68	70	71	72	72	73
31	69	69	70	71	72	72	73	74	75	75
32	71	71	72	73	74	75	75	76	76	77
33	73	73	74	75	76	76	77	78	79	80
34	75	75	76	77	78	78	80	80	81	82
35	77	77	77	79	80	81	82	83	83	84
36	79	80	80	81	82	83	84	85	85	87
37	81	82	83	83	84	85	86	87	88	89
38	83	84	85	85	86	87	88	90	90	91
39	85	86	87	87	88	89	90	91	92	93
40	87	88	89	90	91	92	92	93	95	95
41	89	90	91	92	93	94	95	96	97	98
42	91	92	93	94	95	96	97	98	100	100
43	93	94	95	96	97	98	99	100	-	-

NITROGEN

- Apparatus. (a) Markham distillation unit - see diagram
(b) Digestion stand
(c) Test Tubes 7" x 1" for digesting samples

Reagents. (Use A.R. wherever possible).

- (a) Catalyst tablets: 20 parts potassium sulphate } 0.2 g
20 " copper sulphate } of mixture
1 " selenium (pure) } per tablet.
- (b) Sodium hydroxide 50 per cent solution.
- (c) Sulphuric acid Nitrogen free
- (d) Boric acid 2 per cent solution
- (e) Sulphuric acid Made to N/70 strength.
- (f) Mixed indicator Mixed 5 parts of 0.1 per cent bromocresol green in 95 per cent ethyl alcohol, with 10 parts of 0.1 per cent methyl red in 95 per cent alcohol.

Method Weigh out a 1 g sample of fine soil ground to pass a 60 mesh sieve and oven dried and place in a 7" x 1" test tube. A smaller sample of 0.2 g or less of peat or other soils high in nitrogen should be taken. Add one catalyst tablet and a few drops of distilled water to wet the soil and leave for half an hour. Then add 5 ml of concentrated sulphuric acid and two glass beads (to prevent bumping during digestion). Heat the mixture, gradually increasing the temperature until it is boiling vigorously and continue the digestion for one hour after the solution turns milky white. Cool and make up to 50 ml with water in a test tube (graduated at 50 ml). Take a 10 ml aliquot and estimate the ammonia content in the Markham apparatus.

NOTES

It is usual to take 1.0 g of soil for analysis but if the soil is peaty only 0.2 g should be taken and if the soil has a high loss on ignition, only 0.5 g. The 5 ml aliquots of sulphuric acid can be added from a fast flowing pipette (using a rubber bulb to suck up the acid - not the mouth) or from a cut-off 5 ml. bulb pipette (i.e. with the stem removed to give a delivery volume of about 5 ml). A Kipp's pipette can be used to deliver the 5 ml aliquot of water and test tubes marked at the 50 ml level are sufficiently accurate for making up the solution to volume. Fast flowing pipettes can be used to add water, sodium hydroxide (use a suction bulb) and boric acid.

Distillation Procedure

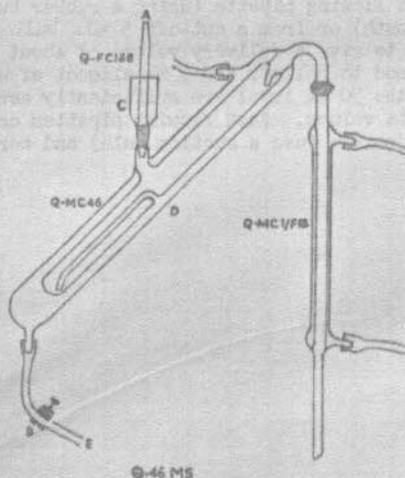
Open screw-clip B and remove plug A. Wash the aliquot of digest into the distillation flask D with 2 or 3 jets of distilled water through the funnel C. Replace the plug A and pour 10 ml 50 per cent sodium hydroxide into the funnel C. Place a bunsen burner under the flask serving as a steam generator and connect the steam supply to the top of D by a short rubber tube. When steam is evolved, close B and lift A slightly, letting the strong soda flow into the digest. Wash C with a little water and replace A. If necessary, add more soda until there is an excess (an excess is indicated when the digest turns black). Distil and collect the distillate in 10 ml boric acid in a 50 ml Erlenmeyer flask. When dealing with small quantities of ammonia it is undesirable to dip the tip of the condenser in the acid. No loss can be detected and therefore washing and subsequent increase in volume is avoided. Practically complete recovery of ammonia is obtained in 8 ml of distillate and it is both unnecessary and undesirable to collect more than 10 ml (this can be collected in 2½ minutes distillation). The temperature of the distillate should not be above 40°C. After completing the distillation, remove the burner and the liquid in D automatically flushes out through E. Pour distilled water into C and thus wash out D and then open A and B and run off the liquid in D.

In order to wash out the apparatus thoroughly, first flush out the digest from D then add 25 ml water to D (through C). Insert plug A and close B. Replace burner under steam supply flask and distil for 2 to 3 minutes. Remove the burner and at once insert the tip of the condenser in a flask of distilled water. The water will be sucked back into D and the liquid can then be drained out through E.

Titrate the distillate with N/70 sulphuric acid, adding two drops of indicator. Do a blank determination with every batch of unknowns and subtract this reading from each determination.

Calculation. 1 ml of N/70 H_2SO_4 = 0.2 mg N.

Markham Apparatus for Micro - Kjeldahl Distillation.
(Gallenkamp. Cat. No. NR-650)



pH DETERMINATION

Apparatus Pye tropicalised pH meter with wick type reference electrode (No. 11161) and spear type glass electrode (No. 11128).

Procedure Take 10 g of soil or a volume of fresh soil which approximates to 10 g and place it in a 100 ml beaker or plastic cup. Add 25 ml of distilled water and allow the sample to stand for two hours or over-night. After thoroughly stirring the sample with a rubber tipped glass rod measure the pH by inserting the electrodes and agitating the beaker until a steady reading is obtained.

General Wash the electrodes before taking readings and wash between readings. Check the setting of the instrument with buffer solutions (pH 3.9 and 6.9) before, during and at the end of a series of readings. Make sure that the solution in the reference electrode is saturated with potassium chloride. When not in use leave the electrodes immersed in a beaker of distilled water.

NOTES:

1. The sample of fresh soil should be taken to represent the whole bulk of the soil sample and it is preferable to take a volume rather than a weight for this determination. For this purpose a special tube sampler can be used. For all other determinations a weight of soil is taken.
2. The portion of soil is placed in a beaker or plastic cup and 25 ml of distilled water added. Some method for the automatic delivery of this volume should be used. A battery of automatic pipettes is suitable but cheaper and more rapid set-ups can be devised. Units of five plastic beakers mounted on a baseboard are convenient assemblies which help to eliminate unnecessary manual movements and thus speed up the determination.
3. The soil plus water can be allowed to stand over-night before stirring and measuring the pH. This is especially useful with clay soils as even the hardest lumps break down in this way and a smooth suspension is obtained easily.
4. The pH meter should be set carefully to zero and two standard buffers; these buffers should be freshly prepared every fortnight. The meter should remain constant throughout a series of readings but the buffers should be checked occasionally and there should be a final check at the end.
5. The most common faults with the Pye pH meter are:
 - (a) Unsaturated reference electrode. There should be an excess of KCl crystals and the electrode should be inverted to make sure that the solution is saturated.
 - (b) Cracked or dirty glass electrode. A generous supply of spares should be kept.

PHOSPHORUS - EASILY SOLUBLE - METHOD A
(Re Arnold, C.Y. & Kurtz, T. Soil Science 64, 103)

Reagents. (Use A.R. wherever possible)

- (a) Extracting Solution. Mix 100 ml of N hydrochloric acid with 30 ml of N ammonium fluoride and dilute to one litre. Adjust the pH to 1.8 and store the solution in a polythene bottle (after a few weeks the solution loses strength when stored in glass). The pH should be tested at fortnightly intervals and adjusted if necessary.
- (b) Molybdate Solution. Dissolve 25 g of ammonium molybdate in 300 ml of warm distilled water (temperature not exceeding 50°C). Filter and, after cooling, add 200 ml of distilled water and 500 ml of 20 N sulphuric acid.
- (c) Stannous Chloride. Dissolve 2.5 g of stannous chloride in 10 ml of concentrated hydrochloric acid and dilute to 100 ml with distilled water. Prepare fresh solution every second day. A stock solution of stannous chloride in concentrated hydrochloric acid will keep for at least two weeks and can be diluted as required. (Dissolve 12.5 g in 50 ml HCl). This saves time if analyses are done daily.

Method Weigh out 2 g of oven-dry 60 mesh sieved soil, place in a test tube and add 20 ml of solution (a). Shake for 1 minute (see Note 2), allow to stand 2 minutes and then filter through a No. 2 Whatman paper. Take a 10 ml aliquot from the filtrate and add 2 ml of solution (b). Make the volume up to about 45 ml with distilled water, add 0.4 ml of solution (c) and shake once before diluting to 50 ml. Shake well and allow colour to develop for 15 minutes and then measure the extinction.

Preparation of Standard Graph.

Phosphorus Standard. Either (a) Dissolve 0.2194 g of potassium dihydrogen phosphate (KH_2PO_4) in distilled water and dilute to one litre. Take a 20 ml aliquot and dilute to 500 ml. 5 ml of this final solution contain 0.01 mg of phosphorus, or

(b) Dissolve 0.2131 g of ammonium monohydrogen phosphate ($(\text{NH}_4)_2\text{HPO}_4$) in distilled water and make up to one litre. Take a 20 ml aliquot and dilute to 500 ml. 5 ml of this final solution contain 0.01 mg of phosphorus.

Method Take aliquots of the standard solution of phosphorus containing 0.005, 0.01, etc., up to 0.06 mg of P and transfer to 50 ml volumetric flasks. Take 20 ml aliquots of extracting solution (a), filter through Whatman No. 5 papers, take 10 ml aliquots and transfer them to the flasks containing the standard solutions. Add 2 ml of solution (b) and distilled water to approximately 45 ml. Add 0.4 ml of solution (c), shake once, and then dilute to 50 ml, shake well and allow colour to develop for 15 minutes, measure the extinction and plot a standard graph. Repeat two or three times to obtain an accurate estimation of the slope of the graph.

Two or three standard solutions should be included in each day's work in order to check the position of the line. With variations in reagents (e.g. stannous chloride) the position of the line may change a little but the slope should remain the same.

NOTES:

1. Apparatus. Many samples can be handled by making use of racks of matched test-tubes of 7/8 inch diameter and 6 inch length. 10 test-tubes are fixed in racks with their centres 2 1/2 inches apart. Several of these racks can be made and the test-tubes numbered permanently.

2. The 2 g soil samples are placed in the tubes and 20 ml of extracting solution added from another rack of 10 tubes (with the centres spaced at the same intervals). The tubes are then closed simultaneously by means of a wooden strip to which is attached soft porous rubber (Dunlopillo 3/8" sheet) covered with a sheet of polythene. Shaking is timed for 1 minute with a stop-watch and, to obtain uniformity, is done by inverting the rack 30 times in the minute. Variation between different operators is reduced by following this procedure. If the shaking is very vigorous more phosphorus is extracted from the soil.

The filtration step is done by using another rack of ten tubes with 2 inch diameter filter funnels placed in them.

3. The 20 ml aliquot of extracting solution can be added from automatic pipettes to a row of 10 empty test tubes. Simultaneous additions can then be made to the tubes carrying the soil samples. After carrying out the shaking procedure the soil extracts are filtered and can be collected in narrow bore test tubes of about 20 ml capacity. The aliquots of ammonium molybdate and stannous chloride can be added from automatic pipettes (e.g. B24 and BSS 572, Jencons, Scientific Ltd., Hemel Hempstead, Herts.)

4. The colorimeter should be set ready for operation and standards checked before the stannous chloride is added to the solutions so that readings can be taken exactly 15 minutes after the addition. Allow one minute between stannous chloride additions and take readings at one minute intervals.

PHOSPHORUS - EASILY SOLUBLE - METHOD B

REAGENTS

- (a) Leaching solution. Prepare 2N sodium chloride and 0.2N hydrochloric acid and mix equal volumes of each solution.
- (b) N Hydrochloric acid
- (c) 0.1N Sodium hydroxide
- (d) Sodium chloride
- (e) Chloromolybdate acid solution. Dissolve 15 g ammonium molybdate in 300 ml distilled water, add 350 ml of about 10 N hydrochloric acid and make up to one litre.
- (f) Stannous chloride. Dissolve 12.5 g stannous chloride in 50 ml concentrated hydrochloric acid. Take 5 ml of this solution and dilute to 50 ml.

METHOD Weigh out 2 g of air dry (60 mesh sieved) soil and transfer to a Whatman No. 42 filter paper in a funnel. Leach with 25 ml of reagent (a) and allow to drain. Transfer the soil plus filter paper to a 250 ml Erlenmeyer flask and add 100 ml of reagent (c). Cover the flask with a clock glass and digest on a steam-bath with occasional agitation at 15 minute intervals for one hour.

Remove the flask and add 0.5 g sodium chloride (use a volume measure) to assist flocculation. Allow to stand for an hour and then filter through No. 2 paper, discarding the first few millilitres. Collect about 50 ml filtrate in a test tube. When cool, pipette out a 25 ml aliquot and acidify with 5 ml N hydrochloric acid (3). Allow to stand for about one hour to flocculate organic matter and then filter, discarding the first few millilitres.

Transfer a 10 ml aliquot to a test tube graduated at 49.6 ml. Add 10 ml of reagent (e) (from an automatic pipette) and then distilled water to the mark. Pipette 0.4 ml of reagent (f) into the tube, stopper and shake well. Take the reading in a colorimeter exactly 10 minutes after adding the stannous chloride. Compare the reading with a standard graph of 0 to 60 ug P in 50 ml (maximum concentration 1.2 p.p.m. P)

NOTES:

1. Prepare standard phosphorus solution and graph as outlined in method A (Easily Soluble Phosphorus Determination).
2. A special cover can be made for the steam bath to take 20 flasks at a time.
3. The procedure can be speeded up at this stage by using old burettes (or cheap 25 ml ones) with a filtering plug of cotton wool at the bottom. Transfer the 25 ml aliquot to the burette, add 5 ml acid, shake and allow to stand for one hour. Run off the first few millilitres and then measure the next 10 ml (from the graduated range).
4. Colorimeter readings must be taken at an exact time after adding the stannous chloride.
5. Test tubes can be used instead of volumetric flasks, the loss of accuracy being considered unimportant (in soil analysis). Test tubes of the correct size can be placed directly into the tube compartment of a Fisher Colorimeter or the solution sucked directly into the inlet tube of a Unicam SP.1300.

POTASSIUM - EASILY SOLUBLE

Weigh a 10 g sample of fine soil and transfer to a 250 ml shaking bottle (half-pint milk bottles are of a convenient size and shape). Add 100 ml of N/2 acetic acid and shake in an end-over-end shaker for one hour. Filter the suspension through a suitable paper (Whatman No. 2 or Postlip 633A) and measure the concentration of potassium in the filtrate by means of a flame photometer.

Batch handling.

The determination is speeded up by using units of five bottles mounted in a frame which can be clipped directly on to the shaking machine. After shaking, the unit can be removed and the filtration step done quickly by simultaneously filling five filter funnels.

Flame Photometer.

Adjust the instrument with distilled water to read zero and a standard solution containing 50 p.p.m.K to give maximum deflection. Check the standard graph with standard solution of various concentrations. Take the reading of an unknown solution and check zero and maximum every five readings.

NOTE:

Units of five tubes can be made, each holding 100 ml so that the extracting solution can be added simultaneously and quickly to the shaking bottles.

SULPHATE DETERMINATION.

Take an aliquot of the filtered solution (see chloride determination) and add 2 ml of concentrated HCl. Heat to boiling and precipitate sulphate by adding 5 ml of 5 per cent barium chloride solution (a great excess of BaCl₂ should be avoided if possible otherwise subsequent washing to get rid of chloride will be time-consuming). Keep the solution boiling gently for five minutes and then allow to stand over-night. Filter off the precipitate through a Whatman No. 42 paper and test the filtrate by adding a little barium chloride solution. If there is a precipitate, repeat the former procedure and add to the precipitate already collected. Otherwise, wash the precipitate until the filtrate gives only a faint chloride test. Do not wash too much otherwise sulphate will be lost.

Place the filter paper in an ignited and weighed silica crucible, heat on a porcelain triangle with a small flame until dry, and slowly raise the temperature until the paper begins to char. The lid of the crucible should be slipped to one side to allow free access of air. When charring is complete, place the crucible (with lid on) in a muffle furnace, raise the temperature to 750°C for half an hour, cool in a desiccator and weigh. Ignite again for ten minutes and check for constant weight.

Calculation.

On 1:5 soil: water extract:-

$$\frac{\text{Wt. of BaSO}_4 \text{ (g)}}{\text{Aliquot (ml)}} \times 206 = \text{per cent sulphate in the soil}$$

<u>Conductivity</u>	<u>Approx. m.eq.</u> SO ₄ + Cl	<u>Aliquot</u>
500	4	25
1,000	9	10
1,500	15	5
3,000	25	25 (of ext.
6,000	50	10 dil. x 5)
12,000	100	5 "

If the chloride content is known, allowance can be made for it when estimating the aliquot to be taken for sulphate determination.

Determination of Calcium, Magnesium and Potassium
in the 6N HCl extract.

1. Pipette 50 ml. of the extract into a 100 ml Pyrex beaker and evaporate the extract to near dryness on a hot plate.
2. Then add 10 ml. of concentrated nitric acid to the sample and digest until dryness. At the initial stages of digestion it is best to cover the beaker with a watch glass.
3. Add 20 ml. of 3N HCl to the dry digest and warm for a few minutes until all the soluble matter is in solution. At the same time also add about 0.5 gm. of ammonium chloride to the sample. Allow all the solids to dissolve.
4. Then precipitate with 50% NH₄OH solution on a hot plate. Allow to boil for 1 to 2 minutes.
5. Filter into a 250 ml. conical flask using a No. 4 Whatman filter paper. Wash the precipitate in the filter paper with 2% NH₄Cl solution.
6. Evaporate the filtrate in the conical flask to dryness.
7. Digest with 10 ml. of conc. HNO₃, covering the mouth of the conical flask with a small watch glass on a hot plate. Digestion is completed when digest is clear.
8. Add 20 ml. of N. HCl. to the digest and warm gently.
9. Transfer digest into 50 ml volumetric flask and make up to volume.

64. Hydrochloric Acid Extraction of Soil

1. Weigh 5 gm. of oven dry soil (ground and sieved through 60 mesh screen) into a 100 ml. pyrex beaker.
2. The sample is ignited in the muffle at about 450°C for one hour.
3. At the end of one hour's ignition switch off the muffle furnace and allow the sample to cool.
4. Remove the sample from the furnace and add 50 ml. of 50% HCl (i.e. 6N. HCl).
5. Place the beaker of sample plus acid on the steam-bath and digest for not less than 3 hours. Place a slot glass stirrer in the beaker and cover it with a small watch-glass. Stir the digest at half hourly intervals.
6. Allow the digest to cool to room temperature before filtering. Use No. 2 or No. 4 Whatman filter paper.
7. Collect the filtrate in a 200 ml. volumetric flask. During filtration wash the soil and filter paper 4 or 5 times with distilled water. Make up to volume with distilled water.
8. Use the extract for the determination of total calcium, magnesium, potassium, phosphorus and iron.

10. The solution is ready for Ca, Mg and K determination.

Calcium Determination

1. Pipette 5 ml. of the solution into a 250 ml conical flask.
2. Add 20 ml. distilled water.
3. And add 2 ml. of 20% NaOH solution.
4. Add Cal-red indicator.
5. Titrate against N/100 EDTA (Versenate).
6. Calculation as in Cation Exchange Capacity det.

Magnesium Determination

1. Pipette 5 ml. of the solution into a 250 ml. conical flask.
2. Add 1 ml. of 3% KCN.
3. And add 10 ml. of Mg buffer solution.
4. Add 2 drops of Solochrome Black indicator.
5. Titrate against N/100 EDTA (Versenate).
6. Calculation as in Cation Exchange Capacity det.

Potassium Determination

Determine the K directly on the solution (any flame photometer) using the Lange flame photometer.

Determination of Ferric Oxide (Fe₂O₃)

1. Pipette 5 ml. of the 6N HCl extract into a 200 ml. volumetric flask and dilute to mark with distilled water. Shake thoroughly.
2. Pipette 2 ml. or 5 ml. of the diluted extract depending on the colour of the solution into a 50 ml. volumetric flask.
3. Add 1 ml. of glycine and 1 ml. of 2% Dipyridyl. (this will form a slight reddish colour)
4. Add one or two drops of strong ammonia solution for colour development.
5. Make up to volume (in 50 ml.) with 0.1N NH₄OAc (pH. 7.0) and shake thoroughly.
6. Determine the intensity of the colour developed with the Spekker Photoelectric Absorptionmeter.

Determination of Phosphorus

1. Pipette 2 ml. of the 6N HCl extract straight into the test tube and dilute with about 5 to 10 ml. H₂O.
2. Add a few small pieces of zinc (H.C. grade) into the solution (to reduce the ferric iron to ferrous iron) and allow to stand for $\frac{1}{2}$ hour or until the solution turns colourless.
3. Transfer the colourless solution into a 50 ml. volumetric flask washing the zinc and test tube.

4. Add 10 ml. of chloro-molybdate-acid solution.
5. Develop the colour with 0.4 ml. of stannous chloride solution, and make up to volume.
6. Taking the reading of the Nephelometer Blue colour so developed 10 minutes after the addition of the stannous chloride.
7. The Coleman Junior Spectrophotometer Model 6C is used for reading the percentage transmittance.

Notes on Soil Analyses / Costs

150 pits and 5 samples per pit = 750 samples

Determinations follow Malay Dept. Agric. as for Jengka.

Determinations No. 2102 WA Cost

- Particle size analysis for Ags. } 750 in 211 750
- Coarse sand, fine sand, silt, clay } 750
- pH soil-water suspension } 750
- pH soil: calcium chloride } 750
- Organic carbon (topsoil only) } 150 in 211 225
- Total nitrogen (topsoil only) } 150 in 211 225
- Easily soluble phosphorus } 750 in 211 375
- Exchangeable potassium, sodium } 750
- Calcium, magnesium, hydrogen } 1875

Hydrochloric acid extractable } 750

phosphorus, iron, potassium, calcium, magnesium

Selected samples for total trace element determinations by D.C. arc spectrographic method. 150

Clay mineralogy on selected samples. 100

Water analysis 50

200

7050

750

6300

Methods of analysis follow international standards and the maximum

Use is made of modern instruments
 notably flame absorption spectrophotometry

Details

All soils to be air-dried and ground to pass a 2mm sieve at the HQ in Malaya. A reference will have to be allocated for this.

2. Stones and concretions. BStu important in soil classification but not sufficient important to warrant sending back to UK.

3. Despatch in polythene bags packed in corrugated cardboard boxes except samples for trace elements which must be sent in Kraft paper bags supplied by lab.

4. Air freight implications

i) soil for detailed analysis
 250g x 750 = 200

(ii) Soil for Trace element details
 100 x 100g = 10

(iii) Clay mineralogy = 10

(iv) Water 50 x 500g = 25

Plus 10% for packing = 250 Kg
 = 275 Kg

Cost Air Freight @ 30/- per Kg = £275 + 140 = £415

Stability of flame oxosorption Spectrophotometry

2021

2021

2021

2021

Dr. Cooke's Visit: Field Trip to Johor & Malacca on 9th, 10th & 11th October 1969

YONG PENG SERIES

Estate: Kong Kong F.L.D.A. Field: Ek. B
 Clone: PR 107, RRIM 513, RRIM 605 Derivation: Insitu
 Geology: Volcanic Tuff

Site No: 16
 Year of Planting: 1964
 Soil Series: Yong Peng

Profile description of Model Yong Peng Series profile

Leaf Analysis

Type of Leaves	N %	P %	K %	Ca %	Mg %	Mn (p.p.m.)
Top leaves	3.20	.19	1.00	.65	.22	82

Soil Analysis

Depth	Cravel %	C.S. %	F.S. %	Silt %	Clay %	pH	Org. C %	Total N %	Total P (p.p.m.) Total Avail.	K (m.e.%) Total Exch.	Ca (m.e.%) Total Exch.	Mg (m.e.%) Total Exch.	Mn (p.p.m.)
0 - 6"		21.1	11.0	14.4	51.3	4.8	1.51	.114	136 6	.80 .10	.41 .26	.94 .16	128
6 - 18"		19.9	10.0	12.7	55.3	4.8	1.24	.103	147 13	1.00 .11	.88 .38	1.01 .16	143

Recommendation

Corrective

Routine

For the next three years

Apply RRIM Mag Mix X at 2½ lb/tree/annum for the next year, after which change to RRIM Mix Y at 2½ lb/tree/annum.

After 3 years

Change to RRIM Mix Mag Y at 2½ lb/tree/annum. If possible check by leaf analysis in 1972.

Apply Muriate of potash at 4 oz per tree per annum for the next 3 years only.
 Two equal application per year.

UIJU TIRAM SERIES

Estate: Kong Kong FLDA

Clone : PR 107 & RRIM 513

Geology: Older Alluvium

Site No: 4

Year of Planting: 1962/63

Soil Series: Ulu Tiram

Field: M.2

Derivation: alluvial

Profile description of local Ulu Tiram Series profile

Leaf Analysis

Type of leaves	N %	P %	K %	Ca %	Mg %	Mn (p.p.m.)
Low leaves	3.13	.19	.90	1.14	.26	26

Soil Analysis

Depth	Gravel %	C.S. %	F.S. %	Salt %	Clay %	pH	Org.C %	Total N %	P (p.p.m.) Total Avail.	K (m.o.s) Total Emb.	Ca (m.o.s) Total Emb.	Mg (m.o.s) Total Emb.	In (p.p.m.)		
														0-6"	6-12"
0-6"	26.1	Hot	Analyse	5.2	1.44	.101	60	6	.21	.05	.27	.15	.38	.11	24
6-12"	7.8	- do -	- do -	5.1	.63	.065	60	4	.22	.04	.21	.14	.39	.03	26

Recommendation

Fertiliser

For the next three years
Apply 1000 Mix Y at 2.5 lb/tree/annum.

After 3 years

Change to 1000 Mix Y at 2.5 lb per tree per annum
if possible, after check by analysis.

Fertiliser

Apply Murate of potash at 8 oz per tree per annum
for the next 3 years only.

Two equal applications per year.

Origin of Sample: On the way to Selayang Pak. 12.5. to Johore Bahru.

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Sample No.	Depth (ins)	Percentage				On Original Sample		pH on Air-dry Soil		Moisture %		Percentages				Easily Sol.		6N HCl Soluble						
		Clay	Silt	Fine Sand	Coarse Sand	Gravel	Stones	Distilled Water	0.01N KCl	Fresh Oven - dry	Air - dry Oven - dry	Loss on Ignition	Organic Matter	Carbon	Nitrogen	C/N Ratio	0.5N CH ₃ COOH Sol. Potassium p.p.m.	0.1N NaOH Sol. Phosphorus p.p.m.	Phosphorus p.p.m.	Iron Fe ₂ O ₃ %	Potassium m.eq./100g.	Calcium m.eq./100g.	Magnesium m.eq./100g.	
YONG	PEIR	SERIES																						
21 317	0-3	04	8	5	7	11/2	11/2	4.3	3.8	23	17.5	37.8	2.20	0.16	14	2.8	94	232	13.43	1.00	1.30	3.4		
22	3-17	05	7	0	5	"	"	4.6	4.0	14	15.3	1.07	1.09	0.09	12	8	38	196	12.72	1.00	1.50	2.4		
24	17-38	90	6	5	4	"	"	4.8	4.2	12	14.3	0.09	0.52	0.04	13	4	26	176	14.72	1.00	1.30	3.4		
26	38-60	87	0	5	5	"	"	4.9	4.3	15	14.2	0.64	0.37	0.04	9	4	19	160	14.50	1.00	1.30	3.4		
24 317	0-3	0.24	0.27	0.14	0.14	0.08	0.03	0.02	0.01	0.73					5		13.99							
24	3-17	0.14	0.08	0.03	0.03	0.02	0.01	0.02	0.01	0.27					3		10.70							
26	17-38	0.11	0.05	0.03	0.03	0.01	0.01	0.01	0.01	0.20					2		9.05							
26	38-60	0.16	0.03	0.03	0.03	0.01	0.01	0.01	0.01	0.23					3		7.08							

FIELD NO. KLK2-13	RAINFAL	LOCATION	VEGETATION	EROSION	PARENT MATERIAL	BOUNDARY	
LAB. NO.	GRID REF. 636584/124	248 Chains on Rentis KLK2 Bearing 360° (right of Kluang-Mersing Road) in Kluang Forest Reserve.	2° Jungle		Quartzite		
LANDFORM	ELEVATION	SLOPE AND TERRAIN CLASS	DRAINAGE/WATER TABLE	IDENTIFIABLE MINERALS	MOTTLES	STONES & CONCRETIONS	
							100' ASL
DISSECTED PENEPLAIN	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAYSKINS (C)		
ORIZONS	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAYSKINS (C)	
THICKNESS	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAYSKINS (C)	
DEPTH & NUMBER	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAYSKINS (C)	
Ah	10YR 4/4	sl	mfr	mfl-sbk	Many roots Few casts Few channels	1P Along ch.	
Ae	7.5YR 5/8	sl	mfr	colsbk	Many roots Ant casts Ant channels	2P Along ch.	fif pole yellow
Btj	"	scl	mfr	comlsbk	Few roots Few casts Few channels	2P "	
25-30+	Similar to Btj horizon except for slight visual change in colour (probably due to water table influence)						

SERIES ESTABLISHED/TENTATIVE

Serdang

PHASE

GROUP

Special Features/Notes:

DATE: 23-9-1967

Surveyor: S.S.U. A.H.

Revised Edition, December 1964.

40

1. Texture: Gravel.....g
 Very coarse sand.....vcos
 coarse sand.....cos
 sand.....s
 fine sand.....fs
 very fine sand.....vfs
 loamy coarse sand.....lcos
 loamy sand.....ls
 loamy fine sand.....lfs
 sandy loam.....sl
 fine sandy loam.....fsl
 coarse sandy clay loam.....coscl

Very fine sandy loam.....vfl
 Gravelly sandy loam.....gs1
 loam.....l
 Gravelly loam.....gl
 stony loam.....stl
 silt.....sl
 silt loam.....sls
 clay loam.....cl
 silty clay loam.....scl
 sandy clay loam.....scl
 fine sandy clay loam.....fsc1
 coarse sandy clay loam.....coscl

stony clay loam.....stc
 silty clay.....sio
 clay.....c
 muck.....m
 peat.....p
 mucky peat.....myp
 peaty muck.....pym

2. Consistence:

Wet Soil -
 non-sticky.....wso
 slightly-sticky.....wss
 sticky.....ws
 very sticky.....wvs
 non-plastic.....wpo
 slightly plastic.....wps
 plastic.....wp
 very plastic.....wvp

Moist Soil -
 loose.....ml
 very friable.....wvr
 friable.....wfr
 firm.....wfi
 very firm.....wvf1
 extremely firm.....wvfi

Cementation -
 weakly cemented.....ow
 strongly cemented.....os
 indurated.....oi

Structure:

Size -
 Very fine.....vfl
 fine.....fl
 medium.....m
 coarse.....c
 very coarse.....vo

Grade -
 structureless.....0
 platy.....pl
 prismatic.....pr
 blocky.....bk
 angular.....ang

Shape -
 subangular.....sbk
 blocky.....sbk
 granular.....gr
 crumb.....cr
 single grain.....sg
 massive.....m

Example: moderately to strongly developed medium and fine subangular blocky = m12-3sbk

4. Pores:

Few (1 - 3/sq. inch).....1p
 Many (4 - 14/sq. inch).....2p
 Abundant (more than 14/sq. inch).....3p

5. Clayskins:

Patchy clayskins on few beds and in some pores.....1c
 Discontinuous clayskins on some beds and in many pores.....2c
 Almost continuous clayskins on most beds and in most pores.....3c

6. Mottles:

Abundance -
 Few.....f
 many.....m
 abundant.....a
 profuse.....p

Size -
 fine.....1
 medium.....2
 coarse.....3

Contrast -
 faint.....f
 distinct.....d
 prominent.....p

Example: few medium prominent strong brown mottles = f2p1.5YR5/6.

7. Horizon boundaries:

Sharp.....sh
 Distinct.....ds
 Indistinct.....id
 Diffuse.....df

SOIL DESCRIPTION SHEET

FIELD NO.		RAINFALL		LOCATION		VEGETATION		Primary jungle			
B. NO.		GRID REF.		Kim Thye timber track Kluang - Mersing road.		EROSION		PARENT MATERIAL			
NDFORM		ELEVATION		SLOPE AND TERRAIN CLASS		DRAINAGE/WATER TABLE		Granite			
Mid-slope of hill		#124		3-4° C2		1		Nil			
ORIZONS	THICKNESS	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAY SKINS (C)	IDENTIFIABLE MINERALS	MOTTLES	STONES & CONCRETIONS	BOUNDARY
Ah	0-1"	10YR 4/2 to 3/2	sl	mvr	1f-msbk mf cr	abundant small roots	1P -	many quartz grits	-	-	ds
Ae	1-19"	10YR 6/6	scl	mfr	2msbk	Few small roots	1P -	"	-	-	id
Btj	19-39"	10YR 6/6	sc	mfi	1m-c sbk	few	1P 1C	"	-	-	id
Bt	39-60"	10YR 6/8	cos	mfi	1m-c sbk	nil	1P 2C	"	-	-	-
SPECIAL FEATURES/NOTES:											
SERIES ESTABLISHED/TENTATIVE								Rengam			
PHASE								GROUP			
SURVEYOR: CHIN FATT SSV/AH.						DATE: 8.3.68					

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1. Texture: Gravel.....g
 very coarse sand.....vcs
 coarse sand.....cos
 sand.....s
 fine sand.....fs
 very fine sand.....vfs
 loamy coarse sand.....lcos
 loamy sand.....ls
 loamy fine sand.....lfs
 sandy loam.....sl
 fine sandy loam.....fsl
 very fine sandy loam.....vfl
 gravelly sandy loam.....gsl
 Loam.....l
 gravelly loam.....gl
 stony loam.....stl
 silt.....sl
 silt loam.....sil
 clay loam.....cl
 silty clay loam.....scl
 sandy clay loam.....sol
 fine sandy clay loam.....fsl
 coarse sandy clay loam.....coscl

2. Consistence:

Wet Soil -
 non-sticky.....wso
 slightly sticky.....wss
 sticky.....ws
 very sticky.....wvs
 non-plastic.....wpo
 slightly plastic.....wps
 plastic.....wp
 very plastic.....wvp

Moist Soil -
 loose.....ml
 very friable.....wvfr
 friable.....wfr
 firm.....wfr
 very firm.....wvfr
 extremely firm.....wvfr

Cementation -
 weakly cemented.....ow
 strongly cemented.....os
 indurated.....oi

3. Structure:

Size -
 Very fine.....vf
 Fine.....f
 medium.....m
 coarse.....c
 very coarse.....vco

Grade -
 Structureless.....0
 platy.....pl
 prismatic.....pr
 blocky.....bk
 angular.....ang

Shape -
 subangular.....sbk
 blocky.....bk
 granular.....gr
 crumb.....cr
 single grain.....sg
 massive.....m

Example: moderately to strongly developed medium and fine subangular blocky = m12-3sbk

4. Pores:

Few.....f
 Many.....m
 Abundant.....ab
 (1 - 3/sq. inch).....1p
 (4 - 14/sq. inch).....2p
 (more than 14/sq. inch).....3p

5. Clayskins:

Patchy clayskins on few beds and in some pores.....10
 Discontinuous clayskins on some beds and in many pores.....20
 Almost continuous clayskins on most beds and in most pores.....30

Example: few medium prominent strong brown mottles = f2p7.5YR5/6.

6. Mottles:

Abundance -
 few.....f
 many.....m
 abundant.....a
 profuse.....p

Size -
 fine.....1
 medium.....2
 coarse.....3

Contrast -
 faint.....f
 distinct.....d
 prominent.....p

Horizon boundaries:
 Sharp.....sh
 Distinct.....ds
 Indistinct.....ld
 Diffuse.....df

SOIL DESCRIPTION SHEET

FIELD NO.	RAINFALL	LOCATION	VEGETATION	PARENT MATERIAL					
1		Rengam Forest Reserve Phase I Area. Map sheet 124.	Primary Jungle	Granodiorite					
AB. NO.	GRID REF. 558348 / #124	SLOPE AND TERRAIN CLASS	EROSION						
		slope 8°	Nil						
LANDFORM	ELEVATION	DRAINAGE/WATER TABLE	IDENTIFIABLE MINERALS	MOTTLES					
Dissected Peneplain	180'	Below 36"							
ORIZONS	SAMPLE DEPTH & NUMBER	COLOUR	TEXTURE	CONSIST-ENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAY SKINS (C)	STONES & CONCRETIONS	BOUNDARY
Ah	0-3" 358	10YR 4/4	Silt loam clay	very finable	2msbk	many roots, many channels	many pores	-	dist.
Ae	3-13" 359	10YR 5/8	silty clay	mfr	f-msbk	many roots (1mm) few casts, few channels	few pores 2 - 3C	-	dif.
Bt	13-36" 357	7.5YR 5/8	silty clay	mfr	2-3fsbk	few roots (1-2cm)	2 P 2 C	-	dist.
Btcn	36-50" RM 228	7.5YR 5/8	silty clay		fine granular Structure	Mixture of fragmental massive laterites	(1/2" - 1")	-	

SPECIAL FEATURES/NOTES:

Samples taken at depth:
 0-3 : 358
 3-13 : 359
 13-24 : 357
 24-36 : 356
 36-50 : RM 228

Btcn 80% laterite and 20% quartz.

SERIES ESTABLISHED/ TENTATIVE
 JRA/Clay Phase

PHASE GROUP

Revised Edition, December 1964.

SURVEYOR: SSU/A. Hitam

DATE: 6/4/69

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SUGGESTED ABBREVIATIONS

1. Texture: Gravel..... G
 Very coarse sand..... VCS
 Coarse sand..... CS
 Sand..... S
 Fine sand..... FS
 Loamy coarse sand..... LCoS
 Loamy sand..... LS
 Loamy fine sand..... LFS
 Sandy loam..... SL
 Fine sandy loam..... FSL
 Coarse sandy clay loam..... CoSCL

Very fine sandy loam..... VfsL
 Gravelly sandy loam..... GsL
 Loam..... L
 Gravelly loam..... GsL
 Stony loam..... SL
 Silt..... SL
 Silt loam..... SL
 Clay loam..... CL
 Silty clay loam..... SLCL
 Sandy clay loam..... SCL
 Fine sandy clay loam..... FSL
 Coarse sandy clay loam..... CoSCL

Stony clay loam..... stc
 Silty clay..... slc
 Clay..... c
 Muck..... m
 Muck peat..... mp
 Peat..... p
 Mucky peat..... myp
 Peaty muck..... pym

2. Consistence:

Wet Soil -
 non-sticky..... WSO
 slightly sticky..... WSS
 sticky..... WS
 very sticky..... WVS
 non-plastic..... WPO
 slightly plastic..... WPS
 plastic..... WP
 very plastic..... WVP

Moist Soil -
 loose..... ml
 very friable..... mvfL
 friable..... mfr
 firm..... mfr
 very firm..... mvfL
 extremely firm..... melf

Wet Soil -
 weakly cemented..... cwm
 strongly cemented..... cws
 indurated..... ci

3. Structure:

Grade -
 Shape -
 0 platy..... pl
 1 prismatic..... pr
 2 columnar..... cpr
 3 blocky..... bk
 angular
 blocky..... sbk
 single grain..... sg
 massive..... m

Very fine..... vfr
 Fine..... fr
 medium..... m
 coarse..... c
 very coarse..... vco

Structureless..... 0
 weak..... 1
 moderate..... 2
 strong..... 3

Example: moderately to strongly developed medium and fine subangular blocky = mfr-3sbk

4. Pores:

Few (1 - 3/sq. inch)..... 1P
 Many (4 - 14/sq. inch)..... 2P
 Abundant (more than 14/sq. inch)..... 3P

Clay skins:
 Patchy clay skins on few beds and in some pores..... 10
 Discontinuous clay skins on some beds and in many pores..... 20
 Almost continuous clay skins on most beds and in most pores..... 30

Example: moderately to strongly developed medium and fine subangular blocky = mfr-3sbk

5. Mottles:

Abundance -
 Few..... f
 many..... m
 abundant..... a
 profuse..... p

Size -
 Fine..... 1
 medium..... 2
 coarse..... 3

Contrast -
 faint..... f
 distinct..... d
 prominent..... p

Example: few medium prominent strong brown mottles = f2p7.5YR5/6.

7. Horizon boundaries:

Sharp..... sh
 Distinct..... ds
 Indistinct..... id
 Diffuse..... df

MIL/omt

Department of Agriculture,

States of Malaya,

Kuala Lumpur.

8.12.1964.

(origin of sample:-

Rengam Forest Reserve, Johor. Correlation

Classification:-

(JRA/C phase)

Sample No.	Horizon Symbol	Depth (ins)	Percentages				On Original Sample	pH	Percentages			C/N Ratio	Ammonium Nitrogen p.p.m.	Nitrate Nitrogen p.p.m.	Loss on Ignition.	Easily Sol.			Iron Fe ₂ O ₃ %	Potassium m.eq/100 g	Calcium m.eq/100 g	Magnesium m.eq/100 g						
			Clay	Silt	Fine Sand	Coarse Sand			Gravel	Stones	Distilled Water					1N. KCl	Organic Matter	Carbon					Total Nitrogen	0.5N CH ₃ COOH p.p.m.	0.1N NaOH Sol. Phosphorus p.p.m.	Phosphorus p.p.m.	6N HCl Soluble	
RV							No.1. pit Chontoh Knas untok correlation pada bulan May, 1969.																					
28T	Ah	0-3	71	9	7	16	Nil	4.2	3.7	7.89	4.59	0.33	14	21	86	42												
Sa	Ae	3-13	77	7	7	13	"	4.5	3.8	2.10	1.22	0.10	12	15	16	24												
Sb	Bt	13-24	83	6	6	10	"	4.7	3.9	0.89	0.52	0.07	7	14	16	13												
Sc	Btcn	24-36	82	6	6	11	0.8	5.1	4.2	0.64	0.37	0.04	9	14	10	13												
Sd	"	36-50	73	9	6	15	29.5	15.7	4.8	4.2				14	8	17												
RV																			Total Cations			Total K + Ca + Na + Mg			Percentage Saturation		Ratio	
28T			25.50					0.24	0.59	0.14	0.76	1.73	7															
Sa			11.19					0.06	0.19	0.05	0.05	0.35	3															
Sb			9.38					0.08	0.14	0.06	Nil	0.25	3															
Sc			7.74					0.04	0.08	0.05	"	0.17	2															
Sd			7.24					0.05	0.22	0.05	"	0.30	4															

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FIELD NO. Act No. 2		RAINFALL		LOCATION Rengam Forest Reserve		VEGETATION <i>woyged</i> Primary Jungle		PARENT MATERIAL		
S.B. NO. RV 29		GRID REF. 558548 / #124		SLOPE AND TERRAIN CLASS DRAINAGE/WATER TABLE		EROSION		granodiorite		
HORIZONS		ELEVATION		ROOTS, CASTS, CHANNELS, ETC.,		PORES (P) AND CLAYSKINS (C)		MOTTLES		
THICKNESS	SAMPLE DEPTH & NUMBER	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAYSKINS (C)	IDENTIFIABLE MINERALS	STONES & CONCRETIONS	BOUNDARY
Ah	0-2 355	10YR 4/3	Sandy loam <i>clay loam</i>	loose	1-m granular	roots abundant (1mm) cast few channels many	3 P 0 C	nil	nil	dis
Ae	2-8 354	10YR 5	sandy clay (loam)	mfr	f-msbk	roots many (1-2mm) cast few	1 C 2 P	nil	nil	df
Bt	8-14 353	10YR 6/8	sandy clay	mfr	2msbk	roots very fine channels few	2 C 2 P	nil	nil	dis
Btcn	14-38 352	5YR 6/8	lateritic bend in matrix SC-C	mfr	fine crumb	size of laterites (1-11 mm.)	nil	nil	nil	dis
C	38-55 C 726	5YR 6/8	co sc	mfr	1 co sbk breaking to msbk	roots nil cast and channels	1 C 2 P	nil	nil	dis

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SPECIAL FEATURES/NOTES: Samples taken at depth: 0-2 355 T
2-8 354 Sa
8-14 353 Sb
14-25 352 Sc
25-38 F509 Sd
38-53 C726 Se

SERIES ESTABLISHED/TENTATIVE Masai
PHASE GROUP

SUGGESTED ABBREVIATIONS

1. Texture: Gravel.....s
 very coarse sand.....voos
 coarse sand.....cos
 sand.....s
 fine sand.....fs
 very fine sand.....vfs
 loamy coarse sand.....loos
 loamy sand.....ls
 loamy fine sand.....lfs
 sandy loam.....sl
 fine sandy loam.....fsl
 coarse sandy clay loam.....coscl
 fine sandy clay loam.....fsc
 sandy clay loam.....scl
 silty clay loam.....sils
 clay loam.....cl
 silt loam.....sil
 silty loam.....sils
 stony loam.....stl
 mucky peat.....myp
 peat.....p
 mucky peat.....myp
 peaty muck.....pym
 muck.....m
 clay.....c
 silty clay.....scl
 stony clay loam.....stc
 very fine sandy loam.....vfls
 gravelly sandy loam.....gsl
 loam.....l
 gravelly loam.....gl
 muck.....m
 peat.....p
 mucky peat.....myp
 peaty muck.....pym
 stony clay loam.....stc
 silty clay.....scl
 clay.....c
 muck.....m
 peat.....p
 mucky peat.....myp
 peaty muck.....pym

2. Consistence:

Wet Soil -
 non-sticky.....wso
 slightly sticky.....wss
 sticky.....ws
 very sticky.....wvs
 non-plastic.....wpo
 slightly plastic.....wps
 plastic.....wp
 very plastic.....wvp
 Moist Soil -
 loose.....ml
 very friable.....mvfr
 friable.....mfr
 firm.....mfr
 very firm.....mvfr
 extremely firm.....mefr
 Cementation -
 weakly cemented.....cm
 strongly cemented.....cs
 indurated.....oi

Structure:

Size -
 Very fine.....vf
 Fine.....f
 medium.....m
 coarse.....co
 very coarse.....vco
 Shape -
 0 platy.....pl
 1 prismatic.....pr
 2 columnar.....cpr
 3 blocky.....bkr
 angular.....ang
 blocky.....bky
 subangular.....sbr
 blocky.....bky
 granular.....gr
 crumbly.....cr
 single grain.....sg
 massive.....m
 Example: moderately to strongly developed medium and fine subangular blocky = ml2-3sbr

4. Pores:

Few.....1p
 Many.....2p
 Abundant (more than 14/sq. inch).....3p
 (1 - 3/sq. inch).....1p
 (4 - 14/sq. inch).....2p
 (more than 14/sq. inch).....3p
 Clayskins:
 5. Patchy clayskins on few beds and in some pores.....10
 Discontinuous clayskins on some beds and in many pores.....20
 Almost continuous clayskins on most beds and in most pores.....30
 Mottles:
 Abundance -
 Few.....f
 many.....m
 abundant.....a
 profuse.....p
 Size -
 Fine.....1
 medium.....2
 coarse.....3
 Contrast -
 Faint.....f
 distinct.....d
 prominent.....p
 Example: few medium prominent strong brown mottles = f2p7.5YR5/6.

7. Horizon boundaries:

Sharp.....sh
 Distinct.....ds
 Indistinct.....id
 Diffuse.....df

1. Texture: Gravel.....g
 Very coarse sand.....lvcos
 coarse sand.....cos
 sand.....s
 fine sand.....fs
 Very fine sand.....vts
 loamy coarse sand.....lcos
 loamy sand.....ls
 loamy fine sand.....lfs
 sandy loam.....sl
 fine sandy loam.....fsl
 Very fine sandy loam.....vfls
 Gravelly sandy loam.....gsl
 loam.....l
 Gravelly loam.....gl
 stony loam.....stl
 silt.....sl
 silt loam.....sil
 clay loam.....cl
 silty clay loam.....scl
 sandy clay loam.....sol
 fine sandy clay loam.....fsl
 coarse sandy clay loam.....coscl

2. Consistencies:

Wet Soil -
 non-sticky.....wso
 slightly sticky.....wss
 sticky.....ws
 very sticky.....wvs
 non-plastic.....wpo
 slightly plastic.....wps
 plastic.....wp
 Very plastic.....wvp

Moist Soil -
 loose.....ml
 very friable.....mvfr
 friable.....mfr
 firm.....mfr
 very firm.....mvfr
 extremely firm.....mefr

Cementation -
 weakly cemented.....cm
 strongly cemented.....cs
 indurated.....cl

Structure:

Size -
 Very fine.....vfr
 Fine.....fr
 medium.....m
 coarse.....c
 very coarse.....vco

Grade -
 Shape -
 0 platy.....pl
 1 prismatic.....pr
 2 columnar.....opr
 3 blocky.....bkr
 angular.....sg
 blocky.....sbk
 subangular.....sbr
 blocky.....bkr
 granular.....gr
 crumb.....cr
 single grain.....sg
 massive.....m

Example: moderately to strongly developed medium and fine subangular blocky = ml2-3sbk

4. Pores:

Few
 Many (1 - 3/sq. inch).....1P
 (4 - 14/sq. inch).....2P
 Abundant (more than 14/sq. inch).....3P

5. Clayskins:

Patchy clayskins on few pedes and in some pores.....1C
 Discontinuous clayskins on some pedes and in many pores.....2C
 Almost continuous clayskins on most pedes and in most pores.....3C

Mottles:

Abundance -
 Few.....f
 many.....m
 abundant.....a
 profuse.....p

Size -
 fine.....1
 medium.....2
 coarse.....3

Contrast -
 faint.....f
 distinct.....d
 prominent.....p

Example: few medium prominent strong brown mottles = f2p7.5YR5/6.

Horizon boundaries:
 Sharp.....sh
 Distinct.....ds
 Indistinct.....ld
 Diffuse.....df

SOIL DESCRIPTION SHEET

FIELD NO. KLK 1-1
 AB. NO. RF 653
 RAINFAL
 GRID REF. 591545/124
 LOCATION ON RENTIS KIKI, Bearing 45° commencing from 590545
 Secondary Forest
 VEGETATION

LANDFORM
 Flood plain,
 near a stream
 SLOPE AND TERRAIN CLASS
 Level C1
 DRAINAGE/WATER TABLE
 Moderately well drain
 4'

HORIZONS SYMBOL	SAMPLE DEPTH & NUMBER	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAY SKINS (C)	IDENTIFIABLE MINERALS	MOTTLES	STONES & CONCRETIONS	BOUNDARY	PARENT MATERIAL
Ah	E 577	10YR 5/4 5/6	si cl	mfr	f2cr	Many roots Few cast/channels	-	-	-	-	id	Shale/Sandstone
Ae	E 46	10YR 7/6 6/6	si cl	mfr	mf2sbk & cpr	Few roots Few cast/channels	1P 2C	-	-	-	id	
Bt	E 511	10YR 6/8	si c	mfr - mfi	m2 sbk	Few roots & channels	1P 2-3C	-	-	-	id	
Btj	G 402	Variegated 10YR 6/8	si c	mfi	mf2 -3 abk	Few roots	- 1C	-	M2&sd 5YR 6/8 fld 10YR 8/1	-	ds	

SERIES ESTABLISHED/TENTATIVE
 PHASE GROUP
 Bungor slightly heavier

SPECIAL FEATURES/NOTES:
 * Correlation Needed
 * Sample

Texture tend to be heavy with depth.
 Although very close to a small stream, the soil here probably do not represent an recent alluvial origin as development is quite advanced.
 K/K been analysed

DATE: 15-9-1967
 SURVEYOR: Mohd Ar Amaran

SUGGESTED ABBREVIATIONS

1. Texture: Gravel.....g
 Very coarse sand.....voos
 coarse sand.....oos
 sand.....s
 fine sand.....fs
 very fine sand.....vfs
 loamy coarse sand.....loos
 loamy sand.....ls
 loamy fine sand.....lfs
 sandy loam.....sl
 fine sandy loam.....fsl
 coarse sandy clay loam.....cooscl

Very fine sandy loam.....vfls
 Gravely sandy loam.....gsl
 loam.....l
 Gravely loam.....gl
 stony loam.....stl
 silt.....sl
 silt loam.....sil
 clay loam.....cl
 silty clay loam.....slo
 sandy clay loam.....sol
 fine sandy clay loam.....fsl
 coarse sandy clay loam.....cooscl

stony clay loam.....stc
 silty clay.....slo
 clay.....c
 muck.....m
 beat.....b
 mucky beat.....myb
 peaty muck.....pym

2. Consistence:

Wet Soil -
 non-sticky.....wso
 slightly sticky.....wss
 sticky.....ws
 very sticky.....wvs
 non-plastic.....wpo
 slightly plastic.....wps
 plastic.....wp
 very plastic.....wvp

Moist Soil -
 loose.....ml
 very friable.....wvfr
 friable.....wfr
 firm.....wfr
 very firm.....wvfr
 extremely firm.....wvfr

Cementation -
 weakly cemented.....ow
 strongly cemented.....os
 indurated.....oi

3. Structures:

Grade -
 Shape -
 0 platy.....pl
 1 prismatic.....pr
 2 columnar.....opr
 3 blocky.....bkr
 angular.....agr
 blocky.....bkr
 subangular.....sbk
 granular.....gr
 crumb.....cr
 single grain.....sg
 massive.....m

Very fine.....vf
 fine.....f
 medium.....m
 coarse.....c
 very coarse.....vo

Structureless.....0
 weak.....1
 moderate.....2
 strong.....3

Example: moderately to strongly developed medium and fine subangular blocky = m12-3sbk

4. Pores:

Few.....f
 Many.....m
 Abundant (1 - 3/sq. inch).....1p
 (4 - 14/sq. inch).....2p
 Abundant (more than 14/sq. inch).....3p

Patchy clayskins on few beds and in some pores.....1c
 Discontinuous clayskins on some beds and in many pores.....2c
 Almost continuous clayskins on most beds and in most pores.....3c

6. Mottles:

Abundance -
 Size -
 f.....f
 m.....m
 many.....ma
 abundant.....a
 profuse.....p

1.....1
 2.....2
 3.....3

Contrast -
 faint.....f
 distinct.....d
 prominent.....p

Example: few medium prominent strong brown mottles = f2p7.5YR5/6.

7. Horizon boundaries:

Sharp.....sh
 Distinct.....ds
 Indistinct.....id
 Diffuse.....df

1.....1
 1.....1
 1.....1

TL/omt

Department of Agriculture,

States of Malaya,

Kuala Lumpur.

U-12.1964.

SOIL DESCRIPTION SHEET

FIELD NO. NJ 37		RAINFAL 100"+		LOCATION Kg. Ayer Hitam Batu satu		VEGETATION Under belukar & resam																
LAB. NO. RS 455		GRID REF. 302 320		Map sheet 123f N.S.																		
ANDFORM		ELEVATION		SLOPE AND TERRAIN CLASS		DRAINAGE/WATER TABLE																
dissected peneplain		50' A.S.L.		6 - 12 C 3		good below 5'																
EROSION		IDENTIFIABLE MINERALS		MOTTLES		PARENT MATERIAL																
negligible		-		-		shales																
EROSION	IDENTIFIABLE MINERALS	MOTTLES	STONES & CONCRETIONS	BOUNDARY	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAY SKINS (C)	STRUCTURE	CONSISTENCE	TEXTURE	COLOUR	SAMPLE DEPTH & NUMBER	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAY SKINS (C)	IDENTIFIABLE MINERALS	MOTTLES	STONES & CONCRETIONS	BOUNDARY	
th	4"	4"	Yellowish brown (10YR 5/4)	F. sandy clay loam (clay)	fine to firm	medium crumb	Abundant roots many casts & channels.	2 (P) 3 (C)			0 - 4"	Yellowish brown (10YR 5/4)	F. sandy clay loam (clay)	fine to firm	medium crumb	Abundant roots many casts & channels.	2 (P) 3 (C)					sharp
bt	18"	18"	reddish yellow (7.5YR 6/8)	clay loam to clay (clay)	firm to compact	medium subangular blocky	Many roots, many casts & channels	2 (P) 3 (C) (good)			4" - 22"	reddish yellow (7.5YR 6/8)	clay loam to clay (clay)	firm to compact	medium subangular blocky	Many roots, many casts & channels	2 (P) 3 (C) (good)	fine quartz grains	mostly clay skin mottles			distinct
bc	26"	26"	reddish yellow (5YR 6/8)	clay	firm to compact	fine to medium blocky	few roots few casts few channels	1 (P) 2 (C)			22" - 48"	reddish yellow (5YR 6/8)	clay	firm to compact	fine to medium blocky	few roots few casts few channels	1 (P) 2 (C)	Laterite (soft) quartz grains	somewhat variegated	Quartz & laterite		dist.

ECIAL FEATURES/NOTES: Considered to be a modal profile
 Texture - check with Analysis results -

SERIES ESTABLISHED/TENTATIVE DURIAN
 PHASE GROUP
 50
 DATE: 2/12/66
 SURVEYOR: H.A. Smallwood
 M. Mokhtar.

stony clay loam	stcl	very fine sandy loam	vfls
silty clay	sic	travelyly sandy loam	gstl
clay	o	loam	l
muck	m	travelyly loam	gl
mucky peat	mp	stony loam	stl
peat	p	silt loam	sl
peaty muck	py	clay loam	cl
		silty clay loam	sicl
		sandy clay loam	scil
		fine sandy clay loam	fscl
		coarse sandy clay loam	coscl

Wet Soil -	wso	loose	ml
non-sticky	wso	very friable	wvfr
slightly sticky	wss	friable	wfr
sticky	ws	firm	wf
very sticky	wvs	very firm	wvfr
non-plastic	wpo	extremely firm	wvfr
slightly plastic	wps		
plastic	wp		
very plastic	wvp		

Structure:		Shape -	
Size -		platy	pl
Very fine	vf	prismatic	pr
fine	f	angular	ang
medium	m	blocky	bk
coarse	o	subangular	sbk
very coarse	vo		
Grade -			
structureless	0		
weak	1		
moderate	2		
strong	3		
very coarse	vo		
Example: moderately to strongly developed medium and fine subangular blocky = m12-3sbk			

Pores:			
Few	1P		
Many	(4-14/sq. inch)		
Abundant	(more than 14/sq. inch)		
Clayskins:			
Patchy clayskins on few beds and in some pores	10		
Discontinuous clayskins on some beds and in many pores	20		
Almost continuous clayskins on most beds and in most pores	30		

Mottles:			
Abundance -			
Few	f		
many	m		
abundant	a		
Size -			
fine	1		
medium	2		
coarse	3		
Contrast -			
Faint	f		
distinct	d		
prominent	p		
Example: few medium prominent strong brown mottles = f2p7.5YR5/6.			

Department of Agriculture,
 States of Malaya,
 Kuala Lumpur.
 8.12.1964.

SOIL DESCRIPTION SHEET

ELD NO. NJ/23		RAINFAL	110"+	LOCATION	VEGETATION	Secondary Jungle					
B. NO. RU 378		GRID REF.	033056	Near Forest Dept. access road 8; approx: 90 kms. Nersing - Endau Road. Map sheet 118b.							
NDFORM		ELEVATION		SLOPE AND TERRAIN CLASS	DRAINAGE/WATER TABLE	EROSION					
Dissected Peneplain		75' + ASL		6 - rolling, G3	Well drained-water table below profile						
HORIZONS	SAMPLE DEPTH & NUMBER	COLOUR	TEXTURE	CONSIST-ENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAYSKINS (C)	IDENTIFIABLE MINERALS	MOTTLES	STONES & CONCRETIONS	BOUNDARY
a	0-10 cm E 923	10YR 4/3-5/3	sl	loose to med. friable	1 crumb	abundants roots, some casts and channels	2P	quartz grains			dist
e	10-20 cm R 418	2.5Y 5/2	sl-scl	m. friable	weakly developed Therudal sbk	many roots, some channels	2P	quartz grains			dist
b	20-38 cm F 12	2.5Y 6/4	scl	mfr-fi	1 sbk	many roots, some casts and channels	2P 1C	quartz grains	very few faint mottles		dist
t	38-68.5RB 808 cm	2.5Y 7/4	scl	mfr	co-m/sbk	many to few roots	2P 2C	quartz grains	faint to distinct brownish yellow mottles.		diff
c	68.5-127 cm A 619	2.5Y 6/2	sc	mfi	m-co 1sbk	very few roots	1C 1P	quartz grains	distinct brownish yellow mottles	some lateri- sed vein quartz	diff
SPECIAL FEATURES/NOTES: For correlation. Sample taken 24/7/68											
SERIES ESTABLISHED/TENTATIVE					Pohol						
PHASE					GROUP						
SURVEYOR: H. Smallwood											
DATE: 25/8/66											

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SUGGESTED ABBREVIATIONS

1. Texture: Gravel.....G
 Very coarse sand.....VCS
 coarse sand.....CS
 sand.....S
 fine sand.....FS
 very fine sand.....VFS
 loamy coarse sand.....LCS
 loamy sand.....LS
 loamy fine sand.....LFS
 sandy loam.....SL
 fine sandy loam.....FSL
 Very fine sandy loam.....Vfsl
 Gravelly sandy loam.....Gsl
 Loam.....L
 Gravelly loam.....Gl
 stony loam.....Stl
 silt.....Sl
 silt loam.....Sll
 clay loam.....Cl
 silty clay loam.....Sll
 sandy clay loam.....Scl
 fine sandy clay loam.....Fsl
 coarse sandy clay loam.....Coscl

2. Consistence:

Wet Soil -
 non-sticky.....Wso
 slightly sticky.....Wss
 sticky.....ws
 very sticky.....wvs
 non-plastic.....wpo
 slightly plastic.....wps
 plastic.....wp
 very plastic.....wvp

Moist Soil -
 loose.....ml
 very friable.....wvfl
 friable.....wfl
 firm.....wfl
 very firm.....wvfl
 extremely firm.....wvfl

Cementation -
 weakly cemented.....cw
 strongly cemented.....cs
 indurated.....cl

3. Structure:

Size -
 Very fine.....vf
 fine.....f
 medium.....m
 coarse.....c
 very coarse.....vc

Grade -
 Structureless.....0
 platy.....pl
 prismatic.....pr
 columnar.....opr
 blocky.....bk
 angular.....ag
 blocky.....abk

Shape -
 platy.....pl
 prismatic.....pr
 blocky.....bk
 granular.....gr
 crumb.....cr
 single grain.....sg
 massive.....m

Example: moderately to strongly developed medium and fine subangular blocky = ml-2-3sbk

4. Pores:

few.....1p
 many.....2p
 abundant.....3p
 (1 - 3/sq. inch).....1p
 (4 - 14/sq. inch).....2p
 abundant (more than 14/sq. inch).....3p

Clay skins:
 Partly clay skins on few beds and in some pores.....10
 Discontinuous clay skins on some beds and in many pores.....20
 Almost continuous clay skins on most beds and in most pores.....30

5. Mottles:

Abundance -
 few.....f
 many.....m
 abundant.....a
 profuse.....p

Size -
 fine.....1
 medium.....2
 coarse.....3

Contrast -
 faint.....f
 distinct.....d
 prominent.....p

Example: few medium prominent strong brown mottles = f2p7.5YR5/6.

Horizon boundaries:
 Sharp.....sh
 Distinct.....ds
 Indistinct.....ld
 Diffuse.....df

Sample No.	Horizon Symbol	Depth (ins)	Origin of sample:-					Near Forest Department access Road 8. Approx. 90gms. Mersing Endau RD. Map sheet 118b.					Classification:- Pohoi by H. Smallwood 25/8/66															
			Clay	Silt	Fine Sand	Coarse Sand	Original Sample	Gravel	Stones	Distilled Water	IN.	KCl	Air-dry	Organic Matter	Carbon	Total Nitrogen	C/N Ratio	Ammonium Nitrogen	Nitrate Nitrogen	Total K + Ca + Na + Mg	Hydrogen	Percentage Saturation	Ratio					
		cm																										
RJ 378T	Ah	0-10	20	10	36	37	Grid ref: 033056	Nil	Nil	4.3	3.7	1.05	0.61	0.04	0.08	15	2.08	1.21	0.08	0.59	0.08	0.39	0.59	7	0.59	0.08	0.39	
Sa	Ae	10-20	20	10	47	28	"	"	"	4.7	4.0	0.50	0.29	0.05	0.05	10	0.50	0.29	0.05	0.42	0.05	0.29	0.42	7	0.42	0.05	0.29	
Sb	Ab	20-38	30	8	40	25	"	"	"	4.8	4.1	0.29	0.17	0.03	0.03	6	0.29	0.17	0.03	0.41	0.03	0.31	0.41	7	0.41	0.03	0.31	
Sc	Bt	38-68.5	36	11	30	25	"	"	"	4.8	4.0									0.57	0.03	0.26	0.57	8	0.57	0.03	0.26	
Sd	Bc	68.5-127	40	11	31	23	"	"	"	4.8	4.0									0.57	0.03	0.26	0.57	8	0.57	0.03	0.26	
RJ 378T																												
Sa																												
Sb																												
Sc																												

Origin of sample:-

Near Forest Department access Road 8. Approx. 90gms. Mersing Endau RD. Map sheet 118b.

Classification:-
Pohoi by H. Smallwood 25/8/66

6N HCl Soluble

Percentages

pH

Original Sample

Percentages

Depth (ins)

Ammonium Nitrogen

Nitrate Nitrogen

Total Nitrogen

Carbon

Organic Matter

Total Nitrogen

C/N Ratio

Ammonium Nitrogen

Nitrate Nitrogen

Total Nitrogen

Carbon

Organic Matter

Carbon

Total Nitrogen

Organic Matter

Total Nitrogen

C/N Ratio

Ammonium Nitrogen

Nitrate Nitrogen

Total Nitrogen

Carbon

Organic Matter

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Organic Matter

Carbon

Total Nitrogen

Organic Matter

Total Nitrogen

C/N Ratio

Ammonium Nitrogen

Nitrate Nitrogen

Total Nitrogen

Carbon

Organic Matter

Carbon

SOIL DESCRIPTION SHEET

FIELD NO. NJ/4		RAINFALL 90-100"		LOCATION Pit located on small knoll north east of Agricultural Station Ayer Hitam on road to Kluang.		VEGETATION Lalang			
GRID REF. 316 343		ELEVATION 50 ASL		SLOPE AND TERRAIN CLASS 5-20°		DRAINAGE/WATER TABLE below 5' - or at greater depth.			
ANDFORM strongly dissected Penneplain		TEXTURE Clay		CONSISTENCE very firm		ROOTS, CASTS, CHANNELS, ETC., many fibrous roots with some earth worm activity			
ORIZONS	THICKNESS	SAMPLE DEPTH & NUMBER	COLOUR	STRUCTURE	PORES (P) AND CLAYSKINS (C)	IDENTIFIABLE MINERALS	MOTTLES	STONES & CONCRETIONS	BOUNDARY
A ₁	0-10 cm		10YR 5/1 -5/2	Subangular blocky	2P 3C		some brownish yellow 10YR 6/6	-	Sharp to dist
A ₂	10-31 cm		10YR 7/4	massive	1P 3C			-	dist
B ₂	31-61 cm		10YR 8/4 to 7/4	massive	1C		some reddish yellow 7.5YR 6/6	thinly disposed band of laterite con-	indist
C	61-122 cm		10YR 8/3 to 8/2	massive			many large weak red 2.5YR 4/2 blotches and mottles	some 20ft laterite con-	dist
<p>SERIES ESTABLISHED/TENTATIVE Batu Anam</p> <p>PHASE GROUP</p> <p>SPECIAL FEATURES/NOTES: Below the C horizon there is the beginning of a pallid zone at 122 cm. The area appears to have been abandoned and lalang has encroached and become the dominant vegetation.</p>									

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1. Texture: Gravel.....	gs	Very fine sandy loam.....	vtsl
Very coarse sand.....	vcos	Gravelly sandy loam.....	gs1
Coarse sand.....	cos	Loam.....	l
Sand.....	s	Gravelly loam.....	gl
Fine sand.....	fs	Stony loam.....	stl
Very fine sand.....	vfs	Silt.....	st
Loamy coarse sand.....	lcos	Silt loam.....	s1l
Loamy sand.....	ls	Clay loam.....	cl
Loamy fine sand.....	lfs	Silty clay loam.....	stol
Sandy loam.....	sl	Sandy clay loam.....	sc1
Fine sandy loam.....	fs1	Fine sandy clay loam.....	fscl
		Coarse sandy clay loam.....	coscl

2. Consistence:			
Wet Soil -			
non-sticky.....	wso	loose.....	wml
slightly sticky.....	wss	very friable.....	wvtr
sticky.....	ws	friable.....	wtr
very sticky.....	wvs	firm.....	wf
non-plastic.....	wpo	very firm.....	wvfl
slightly plastic.....	wps	extremely firm.....	wvfm
plastic.....	wp		
very plastic.....	wvp		

3. Structure:			
Size -			
Very fine.....	vf	Structureless.....	0
Fine.....	f	Weak.....	1
Medium.....	m	Moderate.....	2
Coarse.....	c	Strong.....	3
Very coarse.....	vc		
Example: moderately to strongly developed medium and fine subangular blocky = m12-3sbk			
Shape -			
Very fine.....	pl	platy.....	0
Fine.....	pr	prismatic.....	1
Medium.....	opr	columnar.....	2
Coarse.....	bk	blocky.....	3
Very coarse.....	sbk	blocky.....	sbk
		angular.....	
		single grain.....	sg
		massive.....	m

4. Pores:			
Few.....	1p	(1 - 3/sq. inch).....	1p
Many.....	2p	(4 - 14/sq. inch).....	2p
Abundant.....	3p	(more than 14/sq. inch).....	3p
Clayskins:			
Patchy clayskins on few beds and in some pores.....	1c		
Discontinuous clayskins on some beds and in many pores.....	2c		
Almost continuous clayskins on most beds and in most pores.....	3c		

5. Mottles:			
Abundance -			
Few.....	1	fine.....	1
Many.....	2	medium.....	2
Abundant.....	3	coarse.....	3
Example: few medium prominent strong brown mottles = r2p7.5YR5/6.			
Contrast -			
Faint.....	f	faint.....	f
Distinct.....	d	distinct.....	d
Prominent.....	p	prominent.....	p

Horizon boundaries:
 Sharp..... sh
 Distinct..... ds
 Indistinct..... ld
 Diffuse..... df

FIELD NO. KLK2-3		RAINFALL		LOCATION 50 chains on Rentis KIK 2 Bearing 360°		VEGETATION 20 Jungle						
TAB. NO.		GRID REF. 636542/124		SLOPE AND TERRAIN CLASS C1		DRAINAGE/WATER TABLE Well drained						
LANDFORM Undulating Dissected peneplain		ELEVATION 50-100' A.S.L.		SLOPE AND TERRAIN CLASS C1		DRAINAGE/WATER TABLE Well drained						
HORIZONS SYMBOL	SAMPLE DEPTH & NUMBER	COLOUR	TEXTURE	CONSISTENCE	STRUCTURE	ROOTS, CASTS, CHANNELS, ETC.,	PORES (P) AND CLAYSKINS (C)	IDENTIFIABLE MINERALS	MOTTLES	PARENT MATERIAL	STONES & CONCRETIONS	BOUNDARY
Ah	0-7" RL 691	10YR 5/4	sl	loose	cr	Abundant roots No casts root channels	-	-	-	Granite Older Alluvium.	-	ds
Ae	7-11 E 44	10YR 5/6	sl-scl	mfr	mllsbk	Many roots No casts root channels	2P	quartz	-		-	id
Btj	11-22 E 49	7.5YR 5/8	coscl	mfr-fi	comlsbk	Many roots ant casts some channels	2P	rounded qtz (abundant)	faint mottles		-	id
Bc	22-34 E 388	"	grc	mfi	massive to colabk	Few roots few ant casts some ant ch.	2P	qtz rounded	-		-	
Cm	34-46+ A 962		gravelly clay			(Along root & ant ch.)						

SERIES ESTABLISHED/TENTATIVE HFW.
 PHASE GROUP
 SPECIAL FEATURES/NOTES: Sample taken for analysis
 Termitic activities in Btj & Bc horizons resulting in some humus staining
 * Correlated

DATE: 22-8-1967

SURVEYOR: S.S.U.
A.H.

Revised Edition, December 1964.

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SUGGESTED ABBREVIATIONS

1. Texture: Gravel	vs	Very fine sandy loam	vsfsl
very coarse sand	vsos	Gravelly sandy loam	vsfsl
coarse sand	cos	loam	l
sand	s	Gravelly loam	gl
fine sand	fs	stony loam	stl
very fine sand	vfs	silt	sl
loamy coarse sand	lcos	silt loam	sl
loamy sand	ls	clay loam	cl
loamy fine sand	lfs	silty clay loam	slcl
sandy loam	sl	sandy clay loam	slcl
fine sandy loam	fsl	fine sandy clay loam	fslcl
		coarse sandy clay loam	coscl

2. Consistence:

Wet Soil -	ws	loose	ml
non-sticky	wsn	very friable	mvfr
slightly sticky	wsst	friable	mfr
sticky	ws		
very sticky	wsst	firm	mfr
non-plastic	wps	very firm	mvfr
slightly plastic	wps	extremely firm	mvfr
plastic	wp		
very plastic	wvp		

Structure:

Size -		Shape -	
Very fine	vt	structureless	0
fine	f	platy	pl
medium	m	prismatic	pr
coarse	c	columnar	col
Very coarse	vc	blocky	bk
		angular	ang
		subangular	sub
		blocky	sbk
		granular	gr
		crumb	cr
		single grain	sg
		massive	m

Example: moderately to strongly developed medium and fine subangular blocky = m2-3sbk

4. Pores:

Few	1 - 3/sq. inch	1p
Many	(4 - 14/sq. inch)	2p
Abundant	(more than 14/sq. inch)	3p

5. Clayskins:

Platy clayskins on few beds and in some pores	10
Discontinuous clayskins on some beds and in many pores	20
Almost continuous clayskins on most beds and in most pores	30

Notes:

Abundance -		Size -	
Few	f	fine	1
many	m	medium	2
abundant	a	coarse	3
profuse	p		

Example: few medium prominent strong brown mottles = r2p7.5YR5/6.

Horizon boundaries:

Sharp	sh
Distinct	ds
Indistinct	ld
Diffuse	df

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Department of Agriculture,

States of Malaya,

Malaya Lumpur.

0.12.1964.

1. Texture: Gravel.....g
 very coarse sand.....vcos
 coarse sand.....cos
 sand.....s
 fine sand.....fs
 very fine sand.....vfs
 loamy coarse sand.....loos
 loamy sand.....ls
 loamy fine sand.....lfs
 sandy loam.....sl
 fine sandy loam.....fsl
 very fine sandy loam.....vfl
 gravely sandy loam.....gsi
 loam.....l
 gravely loam.....gl
 stony loam.....sl
 silt.....sl
 silt loam.....sil
 clay loam.....cl
 silty clay loam.....sicl
 sandy clay loam.....scl
 fine sandy clay loam.....fsl
 coarse sandy clay loam.....coscl

stony clay loam.....stc
 silty clay.....sio
 clay.....c
 muck.....m
 peat.....p
 mucky peat.....myp
 peaty muck.....pym

2. Consistence:

Wet Soil -
 non-sticky.....wso
 slightly-sticky.....wss
 sticky.....ws
 very sticky.....wvs
 non-plastic.....wpo
 slightly plastic.....wps
 plastic.....wp
 very plastic.....wvp

Moist Soil -
 loose.....ml
 very friable.....wvfr
 friable.....wfr
 firm.....wfi
 very firm.....wvfi
 extremely firm.....wefi

Cementation -
 weakly cemented.....cm
 strongly cemented.....cs
 indurated.....ci

3. Structure:

Grade -
 Shape -
 0 platy.....pl
 1 prismatic.....pr
 2 columnar.....opr
 3 blocky.....bk
 angular.....sg
 blocky.....sbk

Very fine.....vf
 Fine.....f
 medium.....m
 coarse.....c
 very coarse.....vo

Structureless.....0
 weak.....1
 moderate.....2
 strong.....3

Example: moderately to strongly developed medium and fine subangular blocky = ml-3sbk

4. Pores:

few (1 - 3/sq. inch).....1p
 many (4 - 14/sq. inch).....2p
 abundant (more than 14/sq. inch).....3p

5. Clayskins:

fatchy clayskins on few beds and in some pores.....10
 discontinuous clayskins on some beds and in many pores.....20
 almost continuous clayskins on most beds and in most pores.....30

6. Mottles:

Abundance -
 few.....f
 many.....m
 abundant.....a
 profuse.....p

Size -
 fine.....1
 medium.....2
 coarse.....3

Contrast -
 faint.....f
 distinct.....d
 prominent.....p

Example: few medium prominent strong brown mottles = f2p7.5YR5/6.

Horizon boundaries:
 Sharp.....sh
 Distinct.....ds
 Indistinct.....ld
 Diffuse.....df

