AGRI UPDATE
Information from the *KZN Department of Agriculture, Environmental Affairs & Rural Development*
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SOIL TESTING FOR BETTER CROPS

Victor Roberts – Soil Fertility Research

Poor soil fertility is one of the most limiting constraints to crop and pasture growth in KwaZulu-Natal. Soil tests indicate the amount of nutrients in the soil which are available for crop growth and reflect soil acidity levels. It can be thus be determined which nutrient is the most limiting and this one can then be corrected first. This can be illustrated by considering a bucket with holes in it. Unless the hole at the bottom is closed first, the bucket will never be filled up. And soil tests show us which hole is the one in the bottom of the bucket!

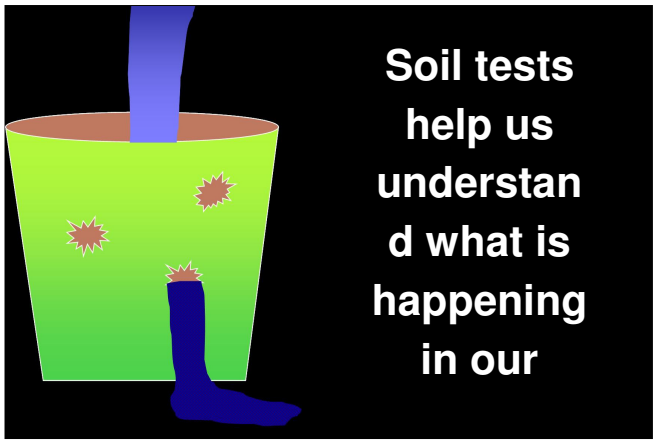

Figure 1: *Soil testing lets a person understand what is happening in the soil. It shows us which holes are in our bucket so we can close them.*

Soil testing lets us understand what is happening in the soil and consequently it is possible to correct problems for the current season, before yield losses are incurred. Soil testing enables more efficient use of fertilizers and lime, thus avoiding unnecessary expenditure. Where capital for purchasing fertilizers and lime are in short supply, soil tests enable the farmer to direct expenditure to those factors which are most limiting and it enables a farmer to apply up-to-date research information on his fields.

The usefulness of soil analysis, however, depends on representative samples being supplied to the laboratories. Even in small areas and apparently uniform fields, soil properties can vary. We thus need to use the correct soil sampling procedure to ensure that a good soil sample is submitted to the laboratory. The sampling procedure outlined below is designed to minimize the effects of soil variation and help you collect a representative sample.

How to take a good soil sample

To take a good soil sample we must do it properly. Always follow sampling instructions provided by the laboratory, including sampling techniques for problem areas. The following guidelines will assist you to take a good soil sample.

Use the right equipment

To take a good soil sample, you need to use a beater soil sampler. This will allow you to accurately control the depth of the soil sample and to easily take sufficient sub-samples to obtain a good representation of the field being tested. Use a clean plastic bag or bank bag on the sampler to collect the soil.

Figure 2: *Using a beater soil sampler with a 15 cm bit to take a soil sample.*

Take sufficient sub-samples

Take cores from at 30 to 40 points evenly distributed over the field. Take the points in a zigzag pattern across the field, mix the cores thoroughly and submit the composite sample. Don't take a point on the edge of a field, start a little way into the field. For a small garden this may be 1 to 2 meters and for a big field this may be 10 meters. This is to avoid areas where fertilizer spillage may have occurred. For row crops, take the soil sample from between the rows, not where the fertilizer was banded last season. If the soil gets stuck in the bit, remove the bag before pushing something down it to get the soil out, then put the bag back on again. Once the sample has been taken and adequately mixed, it must be poured into a soil sample box (freely obtainable form Cedara) and submitted to the laboratory at Cedara.

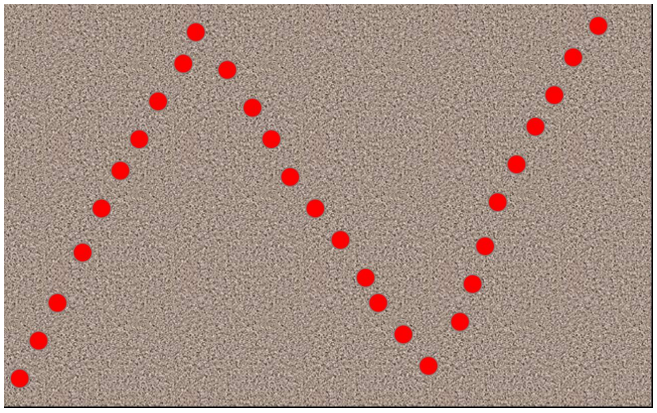

Figure 3: *Use a zig-zag pattern for sampling the field.*

Sample to the correct depth

For the establishment of crops, soil samples need to be taken to 15 cm depth. When sampling cultivated land or new crops the soil may be "fluffed-up". Ensure that you get cores that are a full 15 cm depth by firming the soil with your foot prior to sampling. This is the depth where most of the feeding roots will be found, the depth to which fertilizer would be incorporated and the recommendation given are based on field trials with samples to this depth. For the topdressing of pastures, soil samples need to be taken to 10 cm depth. This is due to the fact that the fertilizer will not be incorporated and most of the feeding roots in pastures are concentrated in the top 10 cm.

Sampling to the incorrect depth can have serious implications, as shown in Table 1. The soil sample taken to 23 cm depth had lower amounts of P and K due to the inclusion of the subsoil. This would result in more than required fertilizer being applied at an increased cost of R70 per hectare. However, the undetected acidity in the topsoil would have decreased the yield of maize by 2.5 t/ha. Sampling to the wrong depth has thus cost more money and resulted in less yield!

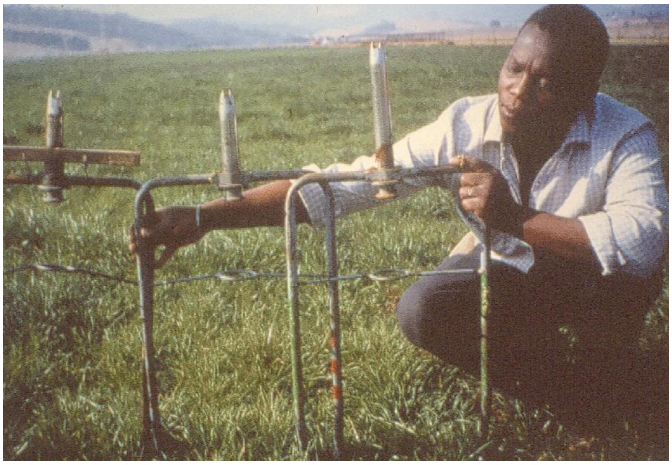

Figure 4: *This picture shows 3 different sampling depth bits. The bit in the middle is the 15 cm depth that is required for taking samples for the establishment of crops. The bit on the left has being reduced to 10 cm depth with a spacer for the sampling of pastures for top-dressing. The bit on the right is 23 cm depth – which is the incorrect depth for topsoil samples.*

Table 1: *Soil sampling of no-till maize on Cedara*

Sampling depth (cm)	P mg/L	K mg/L	Acid sat %
15	18	78	51
23	12	67	28

Fertilizer cost diff. per ha for 15 vs 23 cm depth:
R70
Yield loss due to undetected acidity:
2.5 t/ha

For the establishment of most fruit crops cores should be taken from 0-15 cm (topsoil) and in 15 cm increments to 90 cm depth (subsoil samples). For the sampling of bearing orchards, from each of the index trees (used for leaf sampling) collect two sub samples (cores) midway between the stem and dripline from both the sunny and shady sides of the tree. Samples should be taken to 30 cm depth, with at least 30 sub samples per sample

(*For more details on soil sampling for fruit crops see Agri Update: Soil sampling for fruit crops*).

Figure 5: *Where problem areas are encounted within a field, a separate sample of these areas should be taken. The area in the foreground had high soil acidity causing the poor maize growth.*

Sample heterogeneous areas separately

Soils are tested for many reasons and there is no single rule for determining which areas should be sampled. Even in small areas and apparently uniform paddocks, soil properties can vary and thus a soil sample should be taken for each different area – if they are large enough to be fertilized separately. These could be differences due to slope, soil colour, past cropping practices and previous fertilizer application varying. Sometimes soil testing is used to investigate specific problems. In these cases it is often helpful to contrast the situation by taking a sample from both the problem and a non-problem area.

Maintain records

As areas are re-sampled the effects of land management on soil fertility can be assessed. In this way a case history can be developed for each sampling area and adjustments can be made to recommendations on a site specific basis. Furthermore, if problems arise during the season, the soil analyses are available to assist with trying to diagnose the problem.

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FERTILIZER ADVISORY SERVICE

KZN Department of Agriculture and Environmental Affairs; Soil Fertility and Analytical Services; Private Bag X9059, Pietermaritzburg 3200. Tel : 033-3559194. Fax : 033-3559454. Enquiries:Ruby Punwasi

CLIENT DETAILS
Roberts V
Soil Science
Cedara

Phone :

ADVISOR DETAILS
De Jager Elise
Soil Science
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Phone :

SUMMARY OF ANALYTICAL RESULTS
(These results may not be used in litigation)

Batch : 686 Year : 2009 Printed : 2010/05/07

Your sample ID	Lab number	Sample density g/mL	P mg/L	K mg/L	Ca mg/L	Mg mg/L	Exch. acidity cmol/L	Total cations cmol/L	Acid sat. %	pH (KCl)	Zn mg/L	Mn mg/L	Cu mg/L	MIR clay %	MIR org. C %	MIR N %
BA 1	D1616	1.03	21	216	805	135	1.60	7.28	22	3.97	5.2	19	5.5	43	2.8	0.23
2	D1617	1.03	18	191	752	104	1.86	6.96	27	3.94	8.8	14	4.9	43	2.4	0.19
3	D1618	1.05	20	232	948	142	0.90	7.39	12	4.17	10.4	11	4.7	46	2.8	0.23
4	D1619	0.99	18	267	841	138	0.91	6.92	13	4.11	6.8	12	4.8	45	2.7	0.22
5	D1620	1.00	15	191	718	109	0.78	5.75	14	4.00	6.1	12	4.2	43	2.7	0.21

Comments:

(1) Recommended rates of fertilizer and lime for the relevant crops are reported on the following pages. No recommendation will be given for crops not entered on the submission form.
(2) Recommendations are not provided for subsoil samples.
(3) It is assumed that samples submitted for crops and for the establishment of pastures were taken from the top 15 cm of soil. For the maintenance of established pastures, a sampling depth not exceeding 10 cm is assumed.
(4) It is assumed that the lime to be used has a neutralising value equal to 75% of that of pure calcium carbonate. Dolomitic lime is recommended if soil Mg levels are low, and calcitic lime, if soil Mg exceeds 0.6 x soil Ca. Where Mg is sufficient, but not excessive, either type of lime may be used. If lime is not necessary, but the soil Mg level is suboptimal for the intended crop, this is indicated under the "Lime type" heading with the comment "low Mg". Consult your advisor for the most cost-effective method of improving Mg status.
(5) Phosphorus recommendations are based on a water-soluble P source.
(6) The recommendations are based on the assumption that the soil sample is trully representative of the land and that other growth factors are not limiting.
(7) Organic carbon, total nitrogen and clay percentage, estimated by mid-infrared (MIR) spectroscopy, is given for most samples. MIR measurements should be viewed as reasonably reliable estimates. Actual C, N and clay percentages (as well as S concentrations) can be determined (at extra cost) on request.

Figure 6: *This is an example of a print-out of the result from a soil analysis.. These should be kept as a record of that particular field to build up a case history for each individual field.*

Timing of the taking of soil samples

When deciding to take soil samples, it must be remembered that it takes a minimum of three weeks for the analysis to be completed, recommendation made and results returned. Fertilizer and lime then needs to be purchased and, if lime is required, a further waiting period of 6 weeks is required from the application of the lime to the planting of the crop for the lime to neutralize excess acidity. Soil samples must thus be taken sufficiently early to allow for these waiting periods before the planting of the desired crop. For agronomic crops samples are normally taken between seasons in winter. For pastures, samples can be taken at any time of the year, provided they are always taken at the same time in subsequent years to be able to monitor fertility trends. Where soil samples are to be taken in problem areas in a field, the sample must be taken while the crop is still on the field or locating these low fertility patches becomes problematic.

Information required by the laboratory

Make sure that your name and the sample name is clearly recorded on the sample box. The submission form must be correctly completed. This includes having the same name and sample number as recorded on the box and a valid address to which the results can be posted. Results can also be e-mailed or faxed if this information is supplied. A choice of three crops can be given for fertilizer recommendations. It must be noted that fertilizer recommendations are only given for topsoil samples.

(*For more details on filing in the submission forms see Agri Update: Completing soil sample submission forms*).

Figue 7 & 8: *These show the beater soil sampler being thrust into the soil and the forcing of the subsample (core) from the sampling bit into the plastic bag.*

Further Information

For more information on soil fertility or soil testing, contact:

Bright Mashiyana, Alan Manson, Victor Roberts or Guy Thibaud at Cedara 033 355 9515

KZN Agriculture, Environmental Affairs and Rural Development

Sample Submission Form
SOIL FERTILITY ANALYSIS

Soil Fertility Laboratory
Private Bag X9059, Pietermaritzburg, 3200
Tel: 033 3559 515/455 Fax: 033 3559 454

Date:

Name **OWNER**	**Name** **ADVISER**
Address	**Address**
Postal code	**Postal code**
Telephone / **Fax**	**Telephone** / **Fax**
Email	**Email**

Fertilizer options? (Y / N) Nutrient recommendations are calculated to bags of fertilizer per hectare

BioClimatic Group

See back of form for crop codes

Sampling depth codes: (recommendations for topsoil samples only)
1. 0 - 150mm (topsoil) 2. 150 - 300mm
3. 300 - 450mm 4. >450mm

	Sample ID (Maximum of 10 characters)	Laboratory ID	Prior Crop code	Crop choices:- Maximum of three			Crop Irrigated (Y/N)	Sample depth code	No Till field (Y/N)	GPS Co-ordinates
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										

Crop codes to complete form on reverse side.
Please note that lime and fertilizer recommendations can be given for these crops only.

Crop	Est*	Maint	Crop	Est*	Maint
Apple	121	151	**M**acadamia	108	138
Asparagus	78		Maize grain (limited input options)	40	
Avocado	101	131	Maize silage	42	
Banana	102	132	Maize grain	41	
Beetroot	88		Mango	109	139
Brassica fodder crops	85		Melon	81	
Broccoli	67		Mint	76	
Brussels sprout	79		**O**nion	61	
Cabbage	63		Other tropical grasses (Teff, Rhodes, etc)	19	39
Carrot	70		**P**apaya	110	140
Cauliflower	80		Parsley	74	
Celery	64		Parsnip	89	
Citrus	103	133	Pea	90	
Clover (pure stand)	10	30	Peach	122	152
Cocksfoot	12	32	Pecan	111	141
Cocksfoot with clover	13	33	Pepper	66	
Coffee	104	134	Perennial ryegrass with clover	8	28
Cotton	46		Perennial ryegrass	7	27
Cucumber	82		Pineapple	112	
Cut Flowers	175	176	Potato	43	
Cynodon spp. (K11, Star, etc)	14	34	Proteaceae	173	174
Digitaria spp. (Smuts etc)	15	35	Pumpkin	68	
Dry bean	50		**R**adish	84	
Eggplant	69		Roses	171	172
Endive	77		**S**orghum _ grain	53	
Eragrostis curvula	2	22	Soybean	47	
Fescue with clover	4	24	Spinach	75	
Fescue	3	23	Squash	83	
Fodder sorghum, babala, millet	16		Strawberry	71	
Granadilla	105	135	Sunflower	49	
Green bean	72		Sweet potato	54	
Groundnut	48		**T**emperate fodder cereals	9	29
Guava	106	136	Tomato	62	
Italian ryegrass with clover	6	26	Turnip	87	
Italian ryegrass	5	25	**W**heat _ winter	45	
Jap. Radish	86		**Y**oungberry	73	
Kikuyu	1	21			
Lettuce	65				
Litchi	107	137			
Lucerne	11	31			
Lupin	51				

BioClimatic Groups of KwaZulu-Natal Region:

1. Coast Lowlands
2. Coast Hinterland
3. ***Mist Belt***
4e. ***Highland Sourveld (moist)***
4f. ***Highland Sourveld (dry)***
5. Montane
6. ***Upland (moist)***
7. Riverine (Tugela)
8. ***Upland (drier)***
9. Lowland to Upland (Zululand)
10. Riverine + Interior Lowland
11. Arid Lowland

Cost per sample : R50

*Est: Establish- crop to be planted.
Maint: Maintenance- crop to be top dressed.