The Role of Soil Analysis in Modern Farming

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The use of soil analyses to optimize fertilization practices is common practice and is used since 1940. Soil analyses especially gained momentum when agricultural production gradually changed from subsistence farming to large scale production farming.

In a similar way that a house needs a foundation, soil analyses are the foundation of soil chemical management. Soil is the nutrient medium for all plants and millions of micro-organisms.

The nutrient needs of plants have to be supplied by the soil to enable optimum yields and to ensure high quality products. It makes one wonder whether we are fertilizing the plant or fertilizing the soil.

Why are soil analyses important?

- Soil analyses give an indication of the nutrients which are potentially available for plant uptake.
- Nutrients which are available in inadequate or excessive quantities can have an adverse effect on the production or quality of the crop.
- Plants remove nutrients from the soil and should be supplemented to maintain or improve the nutrient status of the soil.
- Nutrient deficiencies can be artificially supplemented by fertilizer substances, lime and other nutrient sources.
- It is important to supplement the correct nutrients and also quantities to enable an economically viable return.
- A soil scientist or agricultural adviser will need soil analyses to support producers with crop specific nutrient recommendations.
- Good recording of nutrient status of the soil is very important for sustainable crop production.
- Sub soil acidity can be identified in advance before it leads to crop losses.

How is a soil sample taken?

The method in which a soil sample is taken depends on the purpose of the soil analysis. Soil samples are usually taken after the harvest since the lands are more accessible and also so that the time of sampling can correspond with historical soil sampling.

- Use a farm map with clear field names and indicate the direction which was walked to take the samples.
- Mix sub samples of the top soil (0-25 cm) and subsoil (25-75 cm) thoroughly in a clean mixing bucket(Figure 1).
- The depth of sampling must correspond with what done in the past, or else the analysis values could be lower as a result of dilution (eg. Earlier sampled to 15 cm and now sampled to 25 cm). ensure that the depth of sampling is correct for comparison with historical data.
- Keep topsoil and subsoil samples apart and clearly marked.
- Soil samples can also be taken on a precision grid where soil samples' GPS positions are determined for later processing.

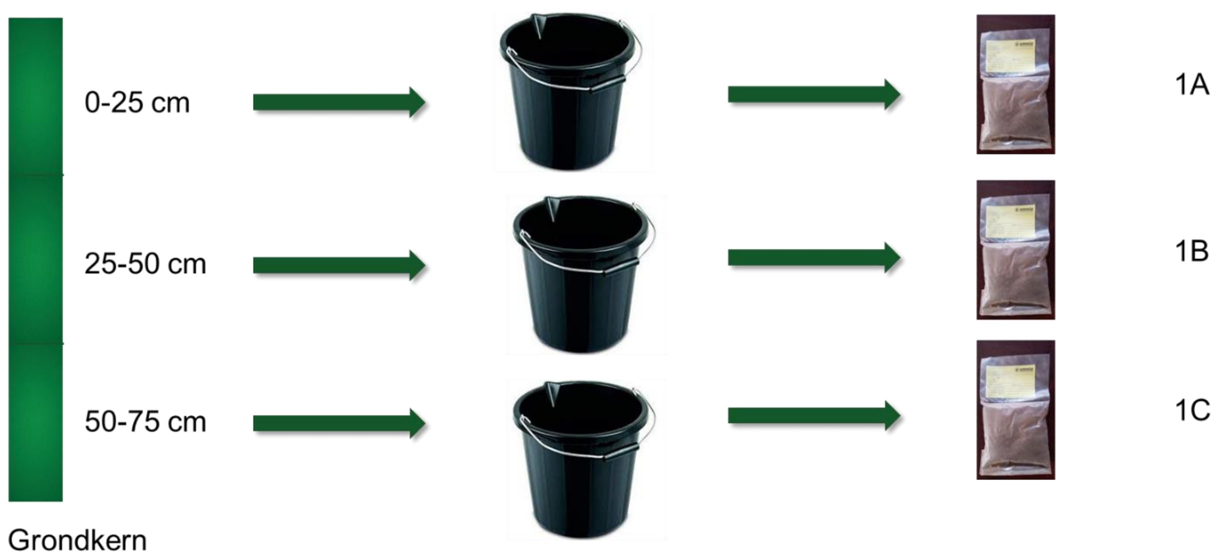


Figure 1. Schematic representation of how soil samples are taken at different depths in the field.

What needs to be analysed for?

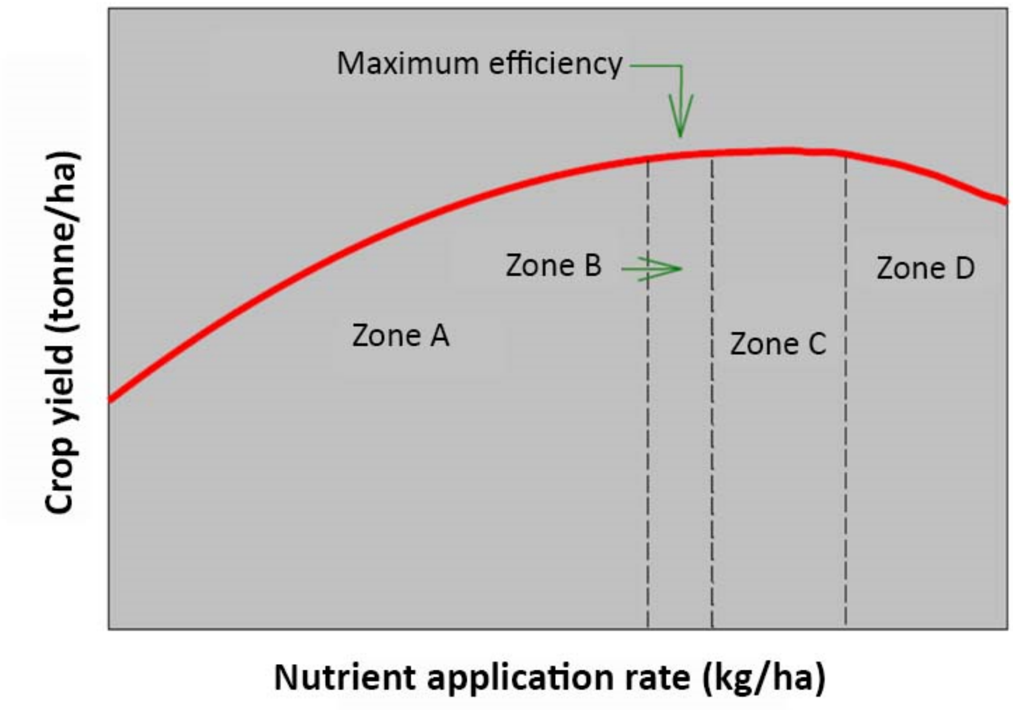
The different chemical analyses which are done on a soil sample and also what the result is needed for are given in Table 1. Together with the chemical analyses there are also certain calculations done to determine the following: CEC (cation exchange capacity), calcium, magnesium, potassium and sodium percentages as well as certain ratios between cations. Certain physical and biological properties can have a large influence on the chemical analyses of soil.

Table1. Different soil analyses and what the results are used for.

Chemical analysis	Use results for
pH(KCl), pH(H_2O)	Soil acidity. Use for lime requirement determination.
P(mg/kg) (Bray 1), P(Olsen) high pH soils, P (Mehlich 3)	phosphate content(P) . Use for crops and yield specific fertilizer
S(mg/kg) ($Ca(H_2PO_4)_2$), (Mehlich 3)	Sulphur content(S). Use for crop and yield specific fertilizer planning.
Ca(mg/kg) (Ammonium acetate) (Mehlich 3)	Calcium content(Ca). use to determine lime type or gypsum.
Mg(mg/kg) (Ammonium acetate) (Mehlich 3)	Magnesium content (Mg) . use to determine which type of lime.
K(mg/kg) (Ammonium acetate) (Mehlich 3)	Potassium content (K). use for crop- and yield specific fertilizer planning.
Na(mg/kg) (Ammonium acetate) (Mehlich 3)	Sodium content(Na). use to determine gypsum requirement.
Cu, Fe, Mn, Zn (mg/kg) (DTPA), (Melihlich 3)	copper- (Cu), Iron- (Fe), Manganese- (Mn) and Zinc (Zn). Use for crop and yield specific fertilizer planning.
B(mg/kg) (Hot water)	Boron content(B). use for crop and yield specific fertilizer planning.
N nitrate (NO_3^-) en ammonium (NH_4^+)	Nitrogen content (N)
Organic carbon (C%)	Organic carbon content in the soil. Can be converted to organic matter.

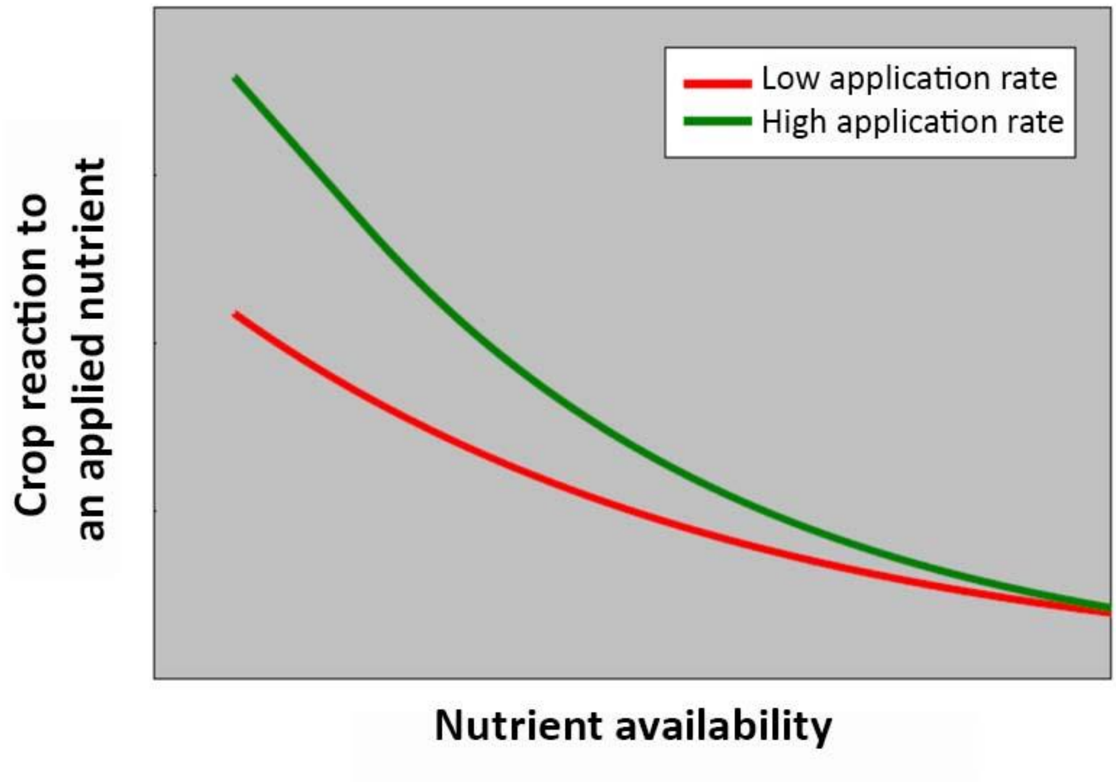
How are soil analyses interpreted?

'A soil analysis does not mean much without having done calibration trials which can be crop and cultivar specific. Calibration trials are conducted te determine the crop reaction in yield or quality in respect of a single or a series of applied nutrients. (Graph 1).   The FERTASA fertilizer handbook can be consulted for the fertilization of various crops.



Graph 1. Relationship between yield and applied nutrient.

Graph 1. Indicates that nutrient application level (kg/ha) is optimal in zone B. the chance to end in Zone B every year is almost impossible. The target is therefore to annually fertilize with a specific fertilizer between Zone B and Zone C to utilize the environmental potential . the economic turning point should also be observed to ensure thar fertilization should not only be to obtain maximum yield but also maximum profit.



Graph 2. Relationship between crop reaction (yield or quality) against nutrient availability (eg soil analysis of a certain nutrient)

Over fertilization as well as under fertilization is harmful. in Graph 1 should be used to aim to obtain maximum effectivity. Crop reaction either yield or quality is basically driven by two critical components viz the nutrient status of the soil (soil analysis) and the fertilization level. (Graph 2).

The assumption is therefore to ensure that available nutrients should be actually utilised and that all limiting factors (eg correct tillage, soil acidity etc) should be eliminated . plant roots should gain access to natural fertility and also fertilizer to ensure effectivity.

A low application rate at a low nutrient status will not give an optimal reaction. At the low nutrient status the high application rate gives a much better crop reaction. As soon as the nutrient status is however higher and available for plant uptake ther is almost no difference between a high and a low application rate.

A good practice is to take samples after every third crop for rainfed situations and more regularly under irrigation.

The interpretation of analyses is just as important. Ensure that a skilled adviser looks at the results and compiles a scientifically founded fertilization plan which ensures optimal effectivity.

Soil sampling and analysis has been and always will play an important role in healthy soil chemistry. The modern farmer cannot do without it.

To measure is to know.

This will ensure that the next generation plucks the fruit of sustainable practices.

REFERENCES:

FERTASA FERTILIZER HANDBOOK , 2016. Fertilizer Association of Southern Africa. Eighth revised edition PO Box 75510 Lynnwoodridge 0040 South Africa.