Advanced Fertilizers Technologies

Lecture 4
Fertilizer recommendations for selected crops according to their needs

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INTRODUCTION

- Different crops need different amounts of nutrients.

Furthermore, the quantity of nutrients needed depends largely on the crop yield obtained (or expected).

Different varieties of a crop will also differ in their nutrient requirements and their response to fertilizers. A local crop variety will not respond so well to fertilizers as an improved variety; e.g. hybrid maize will often give a much better response to fertilizers and produce much higher yields than local varieties.

Other factors have to be taken into account in order to determine the real fertilizer requirement: e.g. ***the soil nutrient reserves as well as a possible unavailability of the applied nutrients to the plant roots due to fixation, leaching or other losses. T***herefore, the nutrient requirements are in general higher than the nutrient removal by crops.

How to determine fertilizer needs

To determine fertilizer needs for crops and soils you must know two things:

1. Which nutrients are needed in the fertilizer?

2. How much of each nutrient is needed to get the highest or most profitable (optimum) yield?

1. Nutrient hunger signs on growing crops (deficiency symptoms).

2. Soils tests or analyses to determine the fertilizer nutrients and amounts needed.

3.Plant and/or plant tissue tests in the field.

4. Fertilizer field trials

NUTRIENT HUNGER SIGNS IN PLANTS

If plants do not get enough of a particular nutrient they need, the symptoms show in the general appearance as well as in the color of the plant.

Very typical symptoms are: the nutrient deficient plants are stunted (small), the leaves have a pale **green color** or a **very dark bluish** green color, are yellowish or have **reddish spotting** or striping.

At harvest, yields are reduced, sometimes severely. Identification of nutrient deficiency (hunger signs) is easy in some cases, but difficult in others. The reason for this is that deficiency symptoms of two different nutrients can be nearly identical or that the deficiency of one nutrient is masking (hiding) the symptoms of another deficiency.

The hunger signs may also appear or disappear as the weather changes (change between 48 humidity and drought). It may also be the case that plants are suffering from not yet visible latent deficiency ("hidden hunger"). Furthermore, care should be taken not to confuse hunger signs with virus or fungus disease symptoms or damage caused by insects/animal pests. Clear symptoms will occur only in cases of extreme deficiency of one nutrient.

Indicated hunger signs of a deficient nutrient should be verified by soil tests, plant analysis, field tissue tests and/or field trials (pot experiments in the local experimental station).

SOIL TESTS

Soil testing is used to find out how much of a nutrient will be plant-available from the soil, and how much should be additionally applied in the form of a mineral fertilizer to reach an expected crop yield.

For a given nutrient and different soil test levels **Figure 1** presents a simple interpretation. The higher the level of a soil test in plant nutrient, the less is the amount needed from fertilizers. Even at high test levels some nutrients should come from fertilizers in order to maintain soil fertility and productivity.

Relative sources of nutrients at different soil test levels

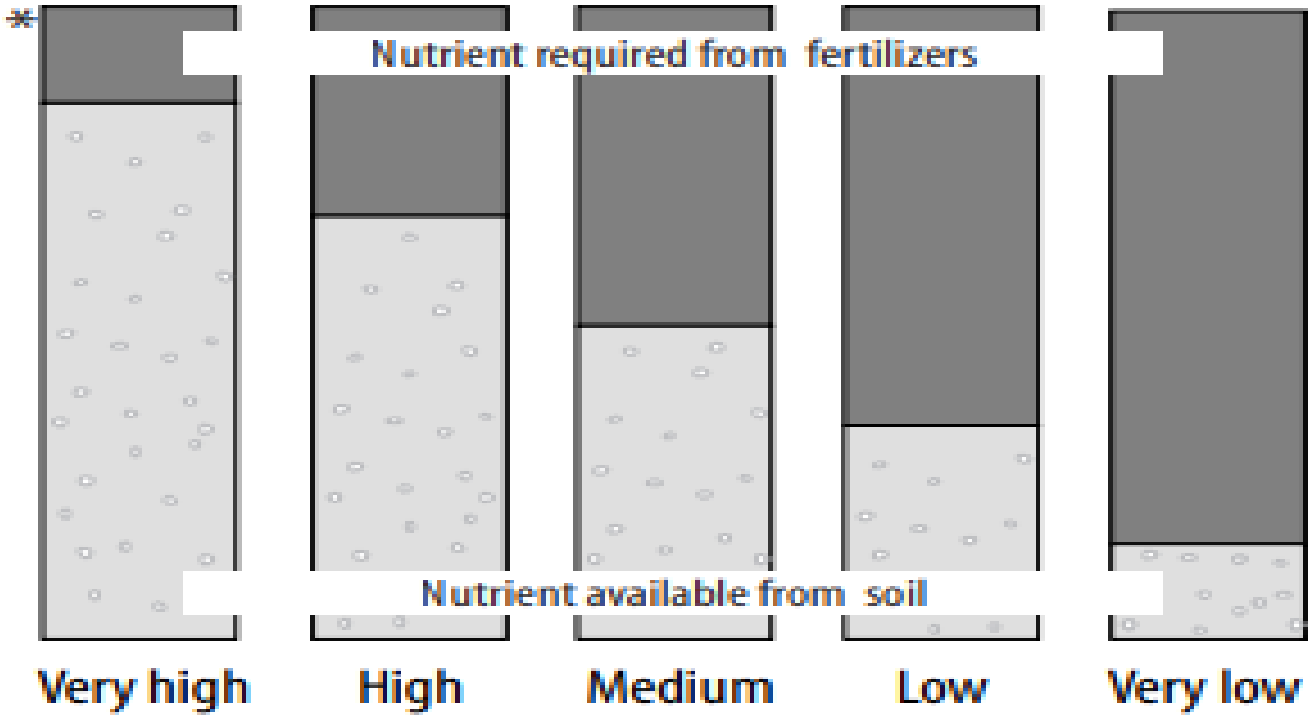

Figure 1: Fertilizers used at very high levels are for starter or maintenance purpose

There are different kinds of soil tests. However, the main problem is to relate suitable nutrient extraction methods for a given soil with the corresponding yields (calibration).

If your experimental station has conducted soil analyses and field experiments and has related (calibrated) the soil tests to crop responses to fertilizers. It will then be able to give a correct interpretation of the soil test result and the corresponding **fertilizer recommendation**

How the soil test works

A soil test by a **nutrient extraction** method chemically extracts and measures the amount of nutrients available to crops from a small sample of soil that is taken to the depth of the arable layer (ploughed depth).

The results found are related to fertilizer crop response data from corresponding field experiments. Based on such calibrated data the soil test result can be interpreted and fertilizer recommendations can be given (of course, also taking into account data from previous cropping/ crop rotation, fertilizer use and weather conditions).

Plant tissue testing in the field

Plant tissue tests are made on **green**/growing plants in the field.

The selected part of the plant, usually the (young, actively functioning) leaves or leaf stalks (petioles), is either cut up and shaken in an extract ant, or sap is squeezed onto a test paper and treated with appropriate chemicals (spot tests with extracts). The colors which develop, can be compared against known concentrations of nutrients or of healthy productive and well-established plants. **Plant tissue tests in the field are valuable for verifying deficiency symptoms.** Moreover, they help to discover "hidden hunger" which is not indicated by deficiency symptoms. They have the advantage that they can be made rapidly and directly on the growing crop, that they are inexpensive and that tests of plants or treatments can be compared directly in the field

FERTILIZER FIELD TRIALS

Whereas results from **plant analysis** and **plant tissue tests** in the field will indicate nutrient deficiencies, particularly 'hidden hunger' when compared to standards which are developed from well-growing productive plants, soil tests require correlation to crop yields. This correlation or calibration of test methods has to be done through fertilizer field trials.

Therefore, fertilizer field trials are indispensable to determine the nutrient needs of crops in relation to the final yield obtained. In such trials, fertilizers are applied at known rates of plant nutrients (and/or in line with the data found with soil or plant testing), crop responses are observed, and final yields are measured. Field trials have the following advantages:

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1. They are the best way to determine the nutrient needs of crops and soils for advising farmers on their fertilizer needs.
2. They will show you how accurate recommendations based on soil and plant testing are in relation to the yield obtained.
3. They permit an economic evaluation, i.e. the calculation of the return can be used as the most motivating argument to farmer to use fertilizers.
4. The growing crops can be photographed. The pictures can be used in publicity and demonstrations for many years.
5. Demonstrations or simple trials show the benefits of fertilizers to farmers and agricultural workers.