Balanced Fertilization

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Concept

To achieve its growth cycle, a crop needs a full range of nutrient elements. There are 18 nutrient elements which are considered as essential for plant. Nine nutrients are required in relatively high amounts. Their concentrations in the plant tissue represent up to a few percent of the fresh plant weight. These are the macronutrients: carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium and sulphur. Nine other nutrients are required in much smaller amounts, in the magnitude of mg per kg of fresh plant weight. These are called micronutrients: iron, copper, zinc, manganese, boron, chlorine, molybdenum, cobalt and nickel. All of these nutrients fulfil specific functions in plants and cannot replace each other. This means that any lack of one single of these nutrients will hinder crop growth even if all other nutrients are fully available. As a consequence, a balanced supply of all these nutrients is essential to grow healthy crops that produce high yields of good quality.

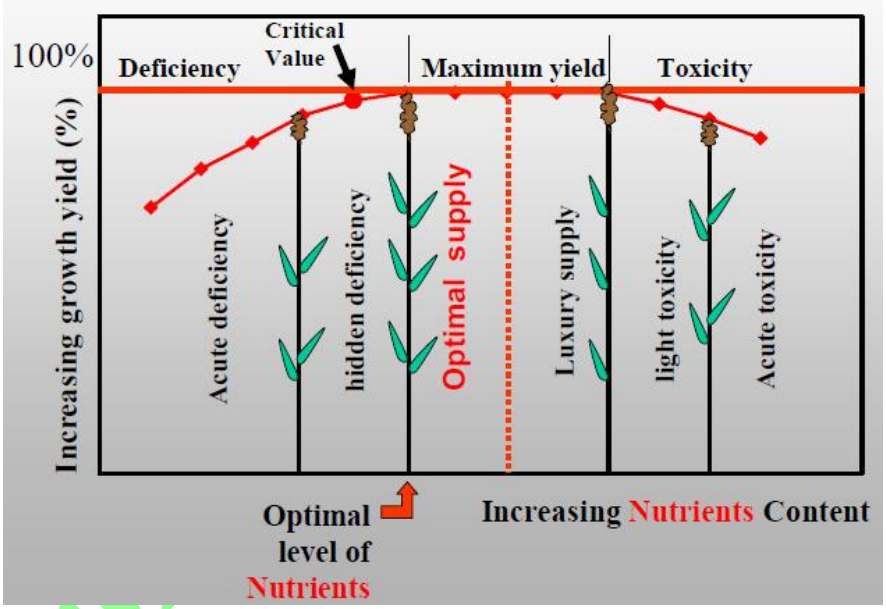

Fig. 1 Plant growth and yield relationship with nutrient supply

It is essential to encourage the use of nitrogenous, phosphatic and potassic fertilizers, so as to achieve the desirable consumption of fertilizer to maintain the soil health and to sustain the crop productivity.

Balanced fertilization means application of essential plant nutrients, particularly the major nutrients, N, P and K plus other nutrients such as magnesium (Mg), sulphur (S) and micronutrients in optimum quantity through correct method and time of application in right proportion as determined by soil tests and crop requirements.

or

Application of appropriate fertilizer in optimum proportion at proper time and through correct methods according to plant need is termed as balanced fertilization.

In a broader sense Balanced Fertilization is not the supply of a single or a couple of nutrients BUT rather to provide a Crop or a Cropping system with optimum and adequate quantities of required nutrients at appropriate time to achieve a goal or a set of goals that might include:

- Increased yield
- Increased crop quality
- More profitable farming business
- Maintaining or improving soil fertility
- Improving the quality of the environment: soils, ground / surface waters, etc.

The importance of balanced fertilization

Nitrogen being *'the motor of plant growth*' will usually show its efficiency soon after application: the plants develop a dark green color and grow more vigorously. However, unbalanced, excess nitrogen in cereals may result in lodging, greater weed competition and pest attacks, with substantial losses of cereal or paddy production (in other crops it will decrease quality, particularly storage ability). In addition, the nitrogen not taken up by the crop is likely to be lost to the environment.

Where the financial resources of the farmer are limited or no credit facilities are available and if his tenure of the land is insecure, and urea, for example, is offered on the market at a comparatively attractive price per unit of nitrogen, the farmer - expecting an immediate and evident return - will supply his crops exclusively with nitrogen. In the short term this is a logical decision. Consequently, most of the increase in world nitrogen consumption has been accounted for through the use of urea.

Such a one-sided or unbalanced preference may be justified on soils rich in plant-available phosphate, potassium and all other necessary secondary and microelements. However, higher yields will also take up greater amounts of the other nutrients (mainly phosphorus and potassium) from the soil. Thus increased yields through application of nitrogen alone deplete the soils of the other plant nutrients. IRRI research suggests that under intensive rice-rice cropping systems the demand for phosphorus and potassium increases over time. Research showed that, without phosphorus and potassium application, nitrogen efficiency declined, whereas when all nutrients were applied together phosphorus and potassium efficiency increased steadily, thereby indicating interactions between these nutrients. Thus, on all depleted soils, which have been cultivated for a long time, in addition to unavoidable losses, unbalanced fertilization in favor of nitrogen is not only contrary to good agricultural practices, it is also a waste of labor and capital, environmentally detrimental and not sustainable. Therefore, for optimum fertilizer use efficiency, balanced fertilization is necessary. Plants are like people: a balanced diet is needed and it is not beings eventually fall ill. The same happens to plants. Moreover, plants cannot move around to find the nutrients they lack. Therefore, conditions must be made as favorable as possible in the immediate surroundings where they grow. An effort should be made to keep the soil pH at an optimum level by liming or application of gypsum (on alkaline soils), and to supply organic matter, water and a balanced fertilization.

It has been demonstrated that primary, secondary or micronutrients which are the most deficient in the soil limit the yield and/or affect the quality; they cannot be substituted by any other nutrient. Therefore, for good agricultural practices, balanced fertilization primarily means a supply of nitrogen, phosphorus and potassium in line with soil reserves, the requirements and expected yield of the crop, with the addition of magnesium, sulfur and microelements where necessary.

Furthermore, fertilizer use integrated into good agricultural practices should provide the needed plant nutrients in sufficient quantities, in balanced proportions, in available form and at the time when the plants require them. The easiest way to achieve this is through the use of NPK complex fertilizers containing the guaranteed grade/formula of primary nutrients in each granule. These fertilizers also permit an even application due to their stable granule quality and their consistent granule size. NPK complex fertilizers are usually more expensive than mixtures/blends. However, under practical farm conditions, the loss in crop yield and quality can easily be much higher than that of the savings obtained through buying and applying products of lower quality. The farmer should be aware of these consequences, because the most persuasive argument for farmers in developing as well as in developed countries is still the return the farmer will receive through the application of fertilizer to his crop during the season of application. Therefore, in any promotion of balanced plant nutrition, the challenge is to demonstrate the economic benefits of balanced fertilization to the farmer.

Effect of imbalanced fertilization

- Imbalanced fertilization causes a negative effect on crop growth and development. A nutrient element cannot fulfill the functions of other nutrient. So fertilizers are used in imbalanced way it hamper the plant growth.
- Imbalanced use of fertilizer ultimately reduces the crop yield.
- Use of any fertilizer elements in excess amount may hamper the absorption of other nutrient elements; e.g.
    - Excess N in soil accelerate the deficiency of Cu. Excessive use of N in soil facilitates the absorption of P and K and decrease the fertility.
    - Excess amount of P decrease the availability of Zn, Fe and Cu
    - Deficiencies of K or Na led to excess uptake of Mg by plants which cause negative consequences. In contrary, balanced use of K prevents the damages of excess N (lodging) and excess P (early maturity).
    - Excessive Cu and S in soil retard the uptake of Mo. Again, deficiency of Cu inhibits the photosynthesis and deficiency of S inhibit NO_3^- uptake.
    - Excessive Zn, Mg and Cu cause Fe deficiency, while balanced application of Zn accelerate the availability of P and K. Excessive amount of Zn, Cu and Fe in soil retards the absorption of Mg which lead to decrease in photosynthesis.
    - Excessive Ca in soil (liming) may cause reduction in B absorption. On the other hand, plants cannot uptake adequate N due to ca deficiency.
- Imbalanced fertilization destroys the properties of soil. The supply of other nutrients will then be of no use, and these will accumulate in the soil leading to potential environmental problems.
- Excessive amount of some nutrient elements hamper the biochemical activities in plants of may also cause death of plant.
- If the balance of nutrients applied is not adequate, the crop won't be able to grow properly and its overall uptake of nutrients will be limited.
- Imbalanced fertilization facilitates the infestation of insect pests.
- Imbalanced fertilization reduces the quality of crops, e.g. deficiency as well as excessive application of nitrogen lowers the protein content of crop.
- Imbalanced use of fertilizer causes pollution which results a harmful effect on environment.

Beneficial effect of balanced fertilization

- Balanced fertilization ensures the supply of nutrients in proper way which results the proper growth and development of crops.
- Balanced fertilization boost up the yield of crop.

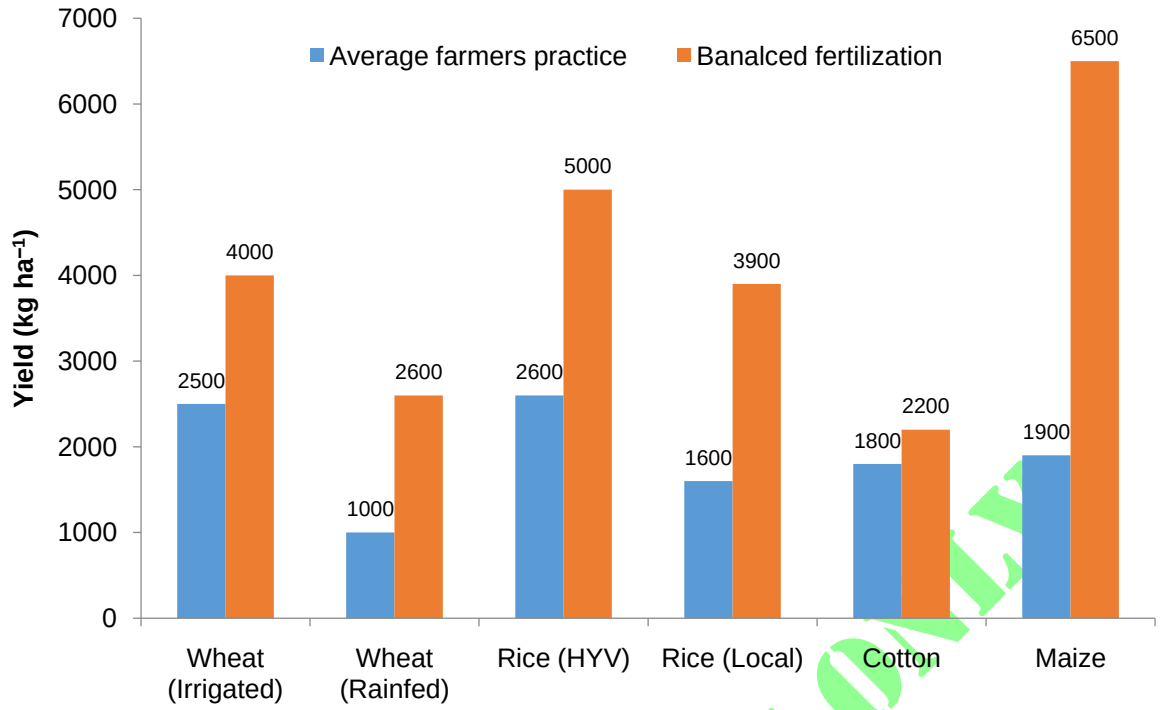

Fig. 1 Comparative effect of farmers practice and balanced fertilization on the yield of some major crops

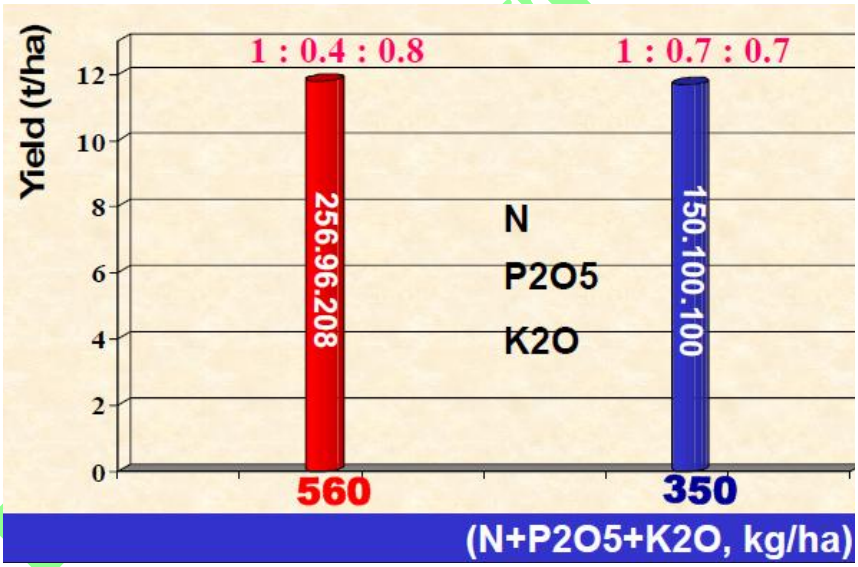

Fig. 2 Effect of unbalanced and high rates of applied plant nutrients compared with balanced and more appropriate rates

- Balanced fertilization ensures the quality of crops.
- A balanced fertilization not only guarantees optimal crop production and benefits for the growers, it is also the best solution to minimize the risk of nutrient losses to the environment.
- Balanced fertility results in increased nutrient use efficiency and therefore less likelihood of nutrient loss to the environment due to leaching and/or runoff.
- Balanced fertilization maintains the fertility of soil.
- It ensures lower production costs, better profitability, and improved chances for producing a good yield under adverse climatic and soil conditions.