

INTEGRATED SOIL FERTILITY MANAGEMENT FOR SUSTAINABLE AGRICULTURE

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In the recent year, in an over zealous pursuit of organic farming with concern for protecting the environment, use of fertilizers and agricultural chemicals in agriculture is discouraged and emphasis is given to supply all the plant nutrients through organic manures alone. Total organic farming may be a desirable proposition but it would not be feasible under high-productive commercial agriculture.

Commercial agriculture at high levels of crop production with high quality produces could be sustainable only, the principle of integrated agriculture were adopted as high yielding and high quality varieties of crops must be chosen and grown; improved agronomic practices from suitable land preparation to efficient harvest technology must be adopted; and integrated soil fertility management practices to improve the physical, chemical and biological properties of the soil using organic manures, fertilizers and biofertilizers. These should be efficient soil-oriented + crop oriented water management; cost-effective environment friendly weed control measures; integrated and effective pests and diseases control measures; conservation of natural resources like soil and water; and environment protection.

Plant nutrition: The plants absorb all the nutrients as inorganic ionic forms only, irrespective of the sources through which they are supplied. The plants do not and cannot differentiate between the nutrients supplied through manures and fertilizers. The nutrients supplied through organic and inorganic sources do not behave or interact differently after being absorbed by the plants. For example, plant can absorb nitrogen either as NH_4^+ ions or as NO_3^- ions, irrespective of the source of these ions being a nitrogen fertilizer or a manure. The behaviour and functions of the nutrients within the plant will also be same irrespective of their sources. The nutrients from the organic and inorganic sources differ only in their relative availability as most of the fertilizers are water-soluble while the nutrients supplied through organic manures would become available for crop uptake slowly and gradually but would be available for longer duration due to slow decomposition of the organic manures and gradual release of the nutrients into the labile pool. After being released into the labile pool, the nutrients from the fertilizers as well as the manures will

behave and interact similarly.

Soil fertility: A soil can be said to be fertile only if that soil could supply all the essential plant nutrients in sufficient and optimum amounts and in desirable proportions as required for the normal growth of the plants besides being free from any toxic substance. A soil may contain all the essential elements in sufficient amount and desirable proportions but if it contains sodium or aluminum in excess, the soil would be rendered barren because of the toxicity of these unwanted elements.

In the recent past with the enthusiasm to increase the crop production to the maximum possibility, a few of the nutrients *viz.*, nitrogen, phosphorus and potassium alone are applied through the fertilizers regularly adopting blanket schedules irrespective of the status and availability of these nutrients in arable soils. This lopsided fertilization practice has led to imbalances in the status and availability of plant nutrients in the soil due to excesses of certain other nutrients.

Integrated soil fertility management: The soil must be made loamy in texture by mixing sand and silt in clayey soil, in highly sandy soil to facilitate granular and crumb structure. When the soil is loamy in texture and granular in structure all the physical properties *viz.*, water-holding capacity, drainage, aeration, temperature etc. would be conducive for normal growth of any crop. The soil must be non-saline ($< 1 \text{ dsm}^{-1}$) with neutral reaction having pH in the range of 6.5-7.5 at which all the plant nutrients will be in labile forms at normal levels without toxicity or deficiency, of course if present in the soil.

In spite of such importance of organic manures to maintain the overall fertility and health of the soil, intensive agriculture at commercial scale can not be sustained for long with organic manures alone, as the demands of the crops for certain nutrients in comparatively higher amounts can not be met with the organic manure only. Integrated soil fertility management must be adopted to ensure balanced supply of all the essential plant nutrients in sufficient amounts and desirable proportions through optimum amounts of manures, fertilizers and biofertilizers besides managing the physical, chemical and biological properties of the soil through appropriate practices to keep the texture of the soil loamy or at least as clayey loam or sandy loam, structure of the soil as granular as possible,

reaction of the soil in the pH range of 6.5-7.5, salinity of the soil as non saline or lowly saline and the organic matter status of the soil not less than 2%.

Using fertilizers and biofertilizers alongwith the manures in judicious combinations will facilitate restoration, improvement and maintenance of soil productivity which in turn will ensure profitable and intensive agriculture as a sustainable profession without exhausting or polluting the natural resources of soil, water and atmosphere. Integrated soil fertility management will ensure agricultural production at high levels with high quality produces as well. The agriculture on commercial scale can not be sustainable without fertilizers and the fertilizers when used at optimum levels properly based on soil and crop requirements will certainly complement the natural resources of manures and crop residues.

Over - fertilization as well as under fertilization must be avoided as the former will result in wasting of nutrients besides causing deleterious effects on the soil and crops while under - fertilization will be inadequate to meet the nutrient requirements of the crop resulting in poor growth and low yields. Both under - fertilization and over - fertilization practices will distort the overall fertility and health of the soil. Total organic farming in due course of time will lead to under fertilization with regard to certain major nutrients viz., nitrogen and potassium that are need in relatively larger amounts by the crops and total inorganic farming will end up in over fertilization with regard to the nutrients that are applied repeatedly through certain fertilizers containing a few nutrients alone irrespective of their status in the soil and their requirements for the crops, becoming hazardous in the long run.

Both the total organic and total inorganic ways of soil fertility management are not desirable. So, integrated soil fertility management to keep the physical, chemical and biological properties of the soil as conducive as

possible besides supplying all the plant nutrients, involving manures, fertilizers and biofertilizers in judicious combinations is the desirable, viable and feasible proposition to improve the fertility and health of the farm lands and to maximize the agricultural production in harmony with nature. Agriculture at high levels of productivity per unit area in unit time could be possible and sustainable only through integrated way and not through organic or inorganic way of soil fertility management.

Summary : Before the advent of inorganic fertilizers plant nutrients were supplied through manures viz., farmyard manure, composts, green manures etc. and ordinary varieties of crop were grown adopting traditional method of cultivation. Crop yield were low because of subsistence farming. Organic farming, through desirable cannot be practiced under high productive commercial agriculture.

Use of fertilizers as main sources of plant nutrients since late 1960's as helped to improve the soil fertility and to increase the crop production manifold. However, application of certain fertilization alone containing a few nutrients only, as distorted the soil fertility leading to depletion of some nutrients not applied through fertilizers over these years. Soil productive as declined due to improper and sometimes distorted soil fertility management practices. Now it has become immediate necessity to restore the soil productivity by improving the over all, fertility and health of the arable lands through integrated soil fertility management using manures, fertility and biofertilizers at appropriate combinations depending upon soil crop requirements to ensure conducive physical, chemical and biological properties of the soil and balanced supply of the essential plant nutrients for the normal growth and performance of the crop.

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