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NUTRIENT ANALYSIS OF SOIL AND MANURES TO ENHANCE CROP PRODUCTIVITY IN ORGANIC FARMING-AN INSIGHT

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ABSTRACT:
It is crucial to increase crop production to improve the resilience of the food production systems in farms across the world to achieve the holistic Sustainable Development Goals (SDG) of no poverty, zero hunger, good health and well-being. The optimum use of resources in organic farming is of paramount importance. It is equally important to understand the dynamic nature of the plant nutrients in the soil and manure; their impact on the preferred crop, soil health, soil biomes and water resources. Application of insufficient or excessive organic manures in soils can be economically wasteful and environmentally unsustainable. Manures differ in their nutrient content vastly depending on their sources, types, climatic conditions etc. Therefore, for an optimum crop production, the nutrient analysis of manure is as indispensable as soil nutrient analysis. The selection and use of manures or their combinations should be made discerningly along with the choice of cropping systems to pack the soil with an optimum supply of nutrients for crop uptake and removal.

Keywords: - Crop Productivity, Environment, Manure Testing, Organic Farming, Soil Testing, Sustainable Development Goals.

INTRODUCTION :

Way back in 1940 Sir Albert Howard, the father of organic farming cautioned us in his famous book, *An Agricultural Testament*, that "the maintenance of the fertility of the soil is the first condition of any permanent system of agriculture. In the ordinary processes of crop production fertility is steadily lost: its continuous restoration using manuring and soil management is therefore imperative." If only we had paid heed to his advice, many of the ecological imbalances would not have occurred today. Since Independence India has come a long way in successfully attaining food sufficiency. Sure as it can be, the Green revolution of the '60s played an important role by introducing HYV seeds and inorganic fertilizers in increasing food production and alleviating poverty and hunger in then underdeveloped countries like India. But somewhere along the journey towards food sufficiency and appreciation of inorganic fertilizers and pesticides, the importance of organic manures in crop production was overlooked. The possible soil and human health hazards were also ignored because an urgency prevailed to feed the hungry. The green revolution was a necessity despite its cons.

An intelligent, intensive and environmentally sustainable scientific approach should be taken by all the stakeholders to achieve the SDG (Sustainable Development Goals) to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere by 2030 (United Nations, 2022). It is crucial to increase crop productivity to feed a nutrient-deficient population and improve the resilience of the food production systems in farms across the world to achieve the SDG of no poverty, zero hunger,

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good health and well-being. But the injudicious and retrogressive application of chemical fertilizers and pesticides for decades, erratic rainfall, soil erosions, and other climatic aberrations have taken their toll on the fertile soil leaving behind a dead unproductive soil devoid of the essential plant nutrients to support crop growth thus plummeting the productivity. Therefore to attain food sufficiency with sustainability in an agroecosystem, shifting from dependence on an inorganic system of farming to organic farming is imperative. Soil testing and manure testing are the most important aspects of the crop production system to increase productivity, however, it is the least thought in present agri systems.

Importance of Soil Testing:

Recently, the growing consciousness about the health effects of hazardous chemicals, decreasing productivity of land and the rising demand for organically produced kitchen supplies has motivated severyal farmers and governments to embrace a sustainable organic farming system. Organic farming focuses on some key practices viz., chemical-free farming, use of cover crops, crop rotation, crop diversification, tillage and use of organic amendments for fertility and crop protection. These practices are adopted in the most scientific way to bring about the best land use with an optimum yield to feed the population besides maintaining environmental sustainability (Tully and McAskill, 2019). An understanding of the basic phenomena of the various physical, bio-chemical and pedological processes of soil along with their optimum management is necessary to derive high yield from the soil (Foth, 1990). The dynamic nature of essential nutrients in soil and manure, especially NPK, must be understood for proper management of organic sources of nutrients**.** Organic matter, Nitrogen, Phosphorus and Potash are the chief constituents of manure, which must be supplied to the soil. Nitrogen is of the first importance in crop production. The soil absorbs nitrogen from the atmosphere and makes it available to living beings in the form of grain and fodder; men and cattle derive energy from the consumption of these and the nitrogen taken from the soil are returned to it in the form of organic manures of various kinds, thus completing the nitrogen cycle. Plants absorb phosphates from the soil which are returned to it through animal and human excreta, decayed plants, their ashes and the bones of dead animals. Indian soils, while deficient in nitrogen and phosphates are generally rich in potash. Lack of potash does not, therefore, present a serious problem at present (Mansinghka, 2019). The soils of India are facing four main threats viz organic carbon change, erosion, salinization and sodification, and nutrient imbalance (Montanarella, *et al.*, 2016) If soil is managed poorly, it is impossible to be optimistic about the future (Richter and Marketwitz, 2001; Admunson, *et al.*,2015). Insufficient or negligible application of organic manures and depleted essential nutrient elements over the years have caused widespread nutrient deficiencies and decreased soil fertility (Parewa,*et al.*, 2016). Lack of awareness, insufficient facility and in many cases negligence of the cultivators lead to nutrient supplementation without knowing the soil and manure nutrient status. Soil testing gives the actual status of nutrients in the field which forms the basis on which crop planning and management decisions should be taken. This checks over and underutilization of nutrient supplements besides augmenting crop yield. In many cases, organic systems require more intensive soil sampling than conventional systems, since they often have a greater diversity of crops and rotations (Phillips, 2009). Crop rotation being the prime strategy of organic farming, samples must be collected to correlate to a crop sequence within the rotation. The year-

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to-year changes in soil test values of fields, when sampled consistently in the same manner, would help in management practices in the long run.

Importance of Testing Manures

Generally, soil health management systems advocate manure application in the conventional system of farming. The manurial application rate in the ground depends upon the availability, ease of access and farmers' buying capacity. Often farmers' ignorance regarding the benefits of manure keeps their farms deficient in organic matter as they apply no or little manure. According to one report, the present level crop production system removes 125kg /ha/annum while the addition is not more than 75 kg per annum (Chandra, 2005). It is no wonder that there are reports of alarmingly low productivity and crop failures in organic farms. Analysis of the manure for total nutrients before application in the field, and evaluation of whether or not the quantity applied is sufficient to sustain the crop need during its entire growth period including losses due to climatic factors is paramount.

Manure is composed of animal faeces and urine and may contain livestock bedding, additional water and wasted feed. It is a valuable fertilizer that contains a broad range of macro and micronutrients. Unlike inorganic fertilizers, there are no universal norms for the accuracy and uniformity of nutrient contents of manure. The different types of manure like farmyard manure, vermicompost, and green manures also differ in their nutrient content. The nutrient content is affected by the source of manure like cattle manure, poultry manure, goat manure, pig manure etc. Even manures obtained from the same breed of livestock vary in nutrient content based on the type of feed, the age of the animal and the age of manure etc. Furthermore, the species, diet composition, management and climatic conditions of the region affect the nutrient content in manures(Wilson, 2021; Modderman, 2021.; Faasen and Dijk, 1987). Lorimor and Powers(2004) have also elaborated on the type of animal feed, and method of manure preparation as the factors responsible for bringing differences in manure quality. Similar variance in nutrient content is found in Green manures, oilcake, bonemeals etc. where the source determines the concentration of different nutrients. Green manure residue quality is dependent on the species used (N_2-fixing species have usually lower C/N compared with non-legume species), nutrient content and the age of the crop used as green manure, which affects the size, fibre content, lignin content and C/N ratio (Dinesh and Dubey,1998.; Valadares, *et al.*, 2016). The Oilcakes derived from different plant sources are also non-uniform in their nutrient contents (Manwatkar *et al.* 2007; Kolesarova *et al.*, 2011., Islam *et al.* 2020). The waste used for vermicompost and the earthworm species both plays determining role in its composition(Goswami,1996; 2002). The use of artificial manures and poison sprays either reduces or eliminates the earthworm population (Howard, 1945). Some experts recommend the use of surface-dwelling epigeic species for vermicomposting, while others recommend the burrowing anecics and endogeics(S (Gajalakshmi & Abbasi 2004). Some of the popular species used for vermicomposting worldwide are *Eisenia foetida, Eudrilus, Eugenie* and *Perionyx excavatus*. But it is always advisable to use local species as they are well adapted to the local conditions and are easily available (Ismail,1994; Goswami,2002).

Testing manure coupled with soil tests for nutrient content helps meet crop nutrient needs efficiently. Organically managed farms rely on manure application to supply the necessary nutrients to crops. The water, nutrient and organic matter contents of manures, however, vary greatly like Slurry manure, liquid manure, semi-solid manure, and solid manure making

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them more difficult to manage than synthetic fertilizers. The aim of using organic manure as a source of the nutrient should be to maximize the use of the manure nutrients by crop, conservation of soil physical and chemical properties and minimize the risk of polluting surface and groundwater. Therefore the intelligent use of both solid and liquid manure is advised for best results. Solid manures help in maintaining and improving the soil tilth, soil structure, infiltration rate, nutrient and water holding capacity and reduce soil erosion. The application of liquid organic manure enhances the amount of readily available nutrients to the plants(Manoj *et al.*, 2020), but at the same time, it is more likely to pollute water. Therefore, liquid organic manure or industrial chemical fertilizers can never be an alternative to solid organic manure because of its dual advantage in soil.

Farmers must test their manure to know the amount of nutrients present in the manure, and the release characteristics of the amendments and adjust the application rate based on the nutrient uptake by the choice of crop. This will also ensure need-based application and minimise contamination of surface and groundwater sources through leaching or runoff (Wortmann, *et al.,* 2014). Therefore, manure analysis is an additional BMP that will help farmers fine-tune the crop nutrient availability in soil (Murphy, 2006). As a thumb rule set by the protagonist of organic farming, manure should be tested each year for the first three years of operation; then every three or four years. The nutrient estimation tables of manure give only a general idea of nutrient contents. However, the individual sample quality varies based on localized factors like animal diet, storage etc.

The role of decomposers

The role of decomposers and nitrogen-fixing organisms present in the soil and root nodules, crop diversification and crop rotation in soil fertility management is also a very important aspect to be considered while formulating a manurial program for sustainable farming. The soil's organic carbon plays a vital role in maintaining soil fertility, which is intrinsic to organic farming systems. Organic carbons in manures improve microbial biomass Carbon and mineralizable Carbon in the soil. A continuous supply of organic substrates' nutrient cycling is mediated by a multitude of soil microbes. A low organic matter decreases the total carbon content in the soil and imbalance the soil ecosystem. So a farmer must analyze the nutrient content of his soil and manure in every crop season and estimate the proportion of different manures required to ensure optimum crop production based on availability and of course benefit-cost ratio. It may however not be practically possible to test manure and soil for all fields every year. However, it is strongly recommended that these tests must be done once in three years.

Concern for the human and environment

The environmental impact of applied organic plant nutrients should also be considered while applying manures in the field. The excess nitrates, Ammonium (NH_4) and ammonia (NH_3) contained in manure can leach out into the water bodies and destroy the aquatic ecosystem due to eutrophication. Nitrate and nitrite can reach the body through the consumption of contaminated water either directly or indirectly. The accumulation of these compounds in the body, in the long run, leads to health problems, *viz*; as digestive disorders, cancers, and other health issues in children (Marhamati, *et al.,* 2020) like “blue baby” syndrome in infants. The need-based manurial application is hence advocated for soil, crop, and environmental sustainability to support sound human and animal health.

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CONCLUSION:

The development of a successful soil and manure testing service with adequate background research is a prerequisite for sustainable farming. Periodic nutrient content analysis empowers farmers to evaluate the nutrient strength of their resources and take farm management decisions accordingly. Testing soil and manure will help organic farmers to evaluate the impact of their management decisions on the properties of their soils. Intensive extension endeavours and legislative actions are required for sensitizing the need for soil and manure testing at least once in three years.

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