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Review Article

Nutrient Status in Relation to Organic Farming Practices: A Review

Nisar A. Bhat[1], S. Iqbal[1], S.K. Sharma[2]

[1]Govt. Holkar Science (DAVV) Indore, (M.P)
[2]R.V.S.K.V.V. Agriculture College Indore, (M.P)

Corresponding Author: Nisar A. Bhat

ABSTRACT

Soil organic matter is an important ecosystem property, regulating nutrient supply to plants and microbes, soil moisture, and long term C storage. Soil organic carbon, available nitrogen, available phosphorus and available potassium contents were significantly influenced by the application organic matter. Soil organic carbon, available nitrogen, available phosphorus and available potassium contents were significantly influenced by the application organic matter.

Key Words: Soil organic carbon, organic matter, Available nitrogen

INTRODUCTION

Soil fertility management by organic farming is gaining support to overcome the problems faced by chemical fertilizers like soil pollution, nutrient leaching and over dependent of costly external inputs. In temperate regions studies have shown that organic management increases soil fertility in spite of minimum nutrient inputs. [1-2] Organic farming thus could be an option to reverse the trend of dwindling soil fertility that conventional farming systems are facing.

Organic management is combination of local and traditional knowledge with scientific agriculture technologies. Nutrient availability in organic farming principally depends on microbial activity on organic matter (biologically-derived nutrients) instead of readily soluble forms of nutrients. Compost, green manure, crop residues and bio-solids are important sources of nutrients for organic management practices. FYM is one of commonly used organic input, but development of several compost production technologies like phosphor compost, vermicomposting etc. boosts the nutrient-bearing mineral and other additives. These nutrients rich manures have the capacity to meet the demand of crops by enhance the activity of micro and macro flora [3] and makes nutrients available to plants. The concept in organic farming is to enhance the ecosystem functioning and make them less dependent on external inputs by reducing the nutrient losses. It is, therefore, considered more environment-friendly and sustainable than the conventional system.

Soil Organic Carbon

A major soil property influenced by organic farming practice is Soil organic carbon. In the long term conventional farming decreased the SOC of soils in India [4-5] as well as in other countries. For instance, two decades of cultivation depleted 50 % of SOC in Australian soils. [6] Thus, agricultural soil usually has a carbon deficiency compared to uncultivated soil. Integrated and organic farming systems sequester carbon. [7-9] Increasing the Soil organic carbon stocks has beneficial effects on yields [10] and is an important measure to mitigate climate change. [11-12] However, in sub-tropical climates less biomass is converted into SOC due to higher decomposition rates within the hot and semi-arid tropical climates [13,14] Therefore, transferring the wide spectrum of findings regarding soil organic carbon dynamics in temperate climates to tropical climates is a challenge. For this reason, the nature of carbon binding within aggregates across time and land use change in subtropical and tropical climates is still being debated. [15-16] Soil organic carbon influences soil structure through its interactions with soil minerals and its high water absorption capacity. In Vertisols, carbon accumulation by surface sorption on clay particles is a major stabilization mechanism. [17-22]

Soil carbon dynamics play a crucial role in sustaining soil quality, promoting crop production and protecting the environment. [23] Soil organic matter is an established indicator of soil quality. [24-25] Organic matter is a key component of the soil because it carries out many functions in agroecosystem. [26] The soil organic carbon pool a significant indicator of soil quality, has many direct and indirect effects on such quality. The significance of soil organic matter is based on its role in soil structural stability, water infiltration, permeability, water holding capacity biological activity, and nutrient storage and release and mitigate the effects of climate. [27-29] Soil organic matter trends may be evaluated on a total-organic-C basis; however, total soil organic matter-C tends to respond slowly to management changes. Both the quantity and quality of soil organic matter largely determines fertility and productivity of a soil. [30] SOM is a heterogeneous, dynamic substance that varies in C and N content, molecular structure, decomposition rate, and turnover times. [20] It is considered to be composed of several discrete pools with a negative relationship between pool size and decomposition rate. The pool size that is small has rapid turnover and is termed labile and the larger pool size with slow turnover is termed recalcitrant. The liability of SOM is defined as the ease and speed with which it is decomposed by microbes and depends on both chemical recalcitrance and physical protection from microbes [31] and this is an important source of energy for the below ground ecosystem and is sensitive to agricultural management changes. [32]

Nutrient status

Mixed kinds of reports have been found regarding nutrient status under organic farm management system in India and elsewhere. The low nitrogen (N) availability can constrain yields; organic farmer can improve N supply through legumes and green manures. Organic management helps to reduce nutrient leaching because of slow mineralization of available nutrients for the plants, which otherwise cause's soil acidification and contaminate ground water supplies. [33] In an Australian study of mixed farming systems, soil available N was found to be maintained in the organic system but increased in conventional system in a 8-year trial with different crop rotations. [34] Continuous application of FYM increased the organic carbon content as well as nitrogen contents. [35-36]

A slight but consistent increase in organic carbon by addition of organic manures even under tropical condition had been reported by. [37] Vermicompost application increases soil organic carbon as compared to chemical fertilisers alone. [38] In a Vertisols, application of 5 t/ha each of FYM, sun hemp, subabul and sorghum stubbles for successive three years recorded organic carbon per cent of 0.68, 0.61, 0.66 and 0.53 respectively, against the initial level of 0.48 per cent, [39] same trend is also observed by application of subabul and sorghum stubbles at Bijapur. [40] Soil organic carbon and available phosphorus contents were also found to be significantly increased due to organic farming practice over control as well as chemical fertilizer application. [41] Soil organic carbon, available nitrogen, available phosphorus and available potassium contents were significantly influenced by the application of 50 per cent N through subabul and FYM, in conjunction with 50 per cent RDF under pearl millet-pigeonpea cropping system. [42] Addition of FYM recorded higher value of available nitrogen, phosphorus and potassium in soil as compared to other organic manure treatments like wheat straw and pressmud compost treatments including control, in cotton-soybean cropping system. [43]

Application of green manure continuously increases the soil pH of the organic farming increased from 7.6 to 8.3 than conventional farming (pH 5.7 to 6.6) after continuously receiving treatments for four cropping systems. [44] In a long term field experiment with different manurial treatments, decline in soil pH and EC was observed in maize- mustard cropping system. Maximum reduction was recorded in the plot receiving 100 per cent recommended N through FYM in rainy season (maize) and 100 % recommended N, P_2O_5 through inorganic fertilizer in winter season (mustard) which may be attributed to the formation of acid during decomposition of organic matter. [45] Treatment receiving 100 manure application was at par with integrated management with 75 and 50 % manure level; however exhibit higher level of available N, P_2O_5, K_2O, Fe, Cu, Mn and Zn at the end of two cropping cycle in maize- soybean cropping system. [46] Application of manures irrespective of rates and sources increases the of available N, P_2O_5 and K_2O and soil organic carbon as compared to control. [47]

Soil available phosphorus (P) is a more serious limiting factor in organic farming, particularly in India with naturally low P levels in soils. The sorption and precipitation reactions of phosphorous makes phosphorous limiting factor even after applying chemical fertilizers. [48-50] Therefore there is urge for alternate sources of phosphorous, like rockphosphate which can enhance the available soil phosphorous. [51] The low P availability seen in some organic systems is a consequence of reduced P inputs due to the low solubility of rock phosphate and to the higher input cost of non-acidulated rock phosphatesources. The clearest differences were found in the concentration of extractable soil nutrients, especially the concentration of Phosphorus and Sulphur were low in organic farmed fields. Similarly, the inorganic soil nitrogen content was significantly higher in inorganic farmed field. [52]

Recent research into soil chemical changes in intensive vegetable productions showed that although the available P was lower in the organic system compared to the conventional, the available P increased from the baseline status in the organic plots and the P level was more than adequate for vegetable growing. [53] Continuous application of FYM at 15 t ha^{-1} for 3 years increased zinc level from 0.48 to 0.87 percent. [53] Biogas slurry poultry manure compost and pressmud have been found to be superior sources of Zn as compared to zinc sulphate, particularly in Zn deficient calcareous soil. [54] Azolla incorporation increased the availability of Fe and Mn in soils. [55]

Another major soil property impacted by farming is pH, which is influenced by the cations adsorbed to the surface of soil particles. In tropical climates, salinization poses major risks to soil fertility. [56] The effect of salinization on soil structure strongly depends on the nature of the accumulated salt. Sodic salts mostly disperse soil aggregates, whereas calcic and magnesium salts mostly stabilize aggregates. [14,57-58] Depending on to the diversity of fertilization and soil reactions, the influence of farming systems on soil structure is, therefore, highly interrelated to pH.

CONCLUSION

Improving resource use efficiency without discernible negative effects on quality of agricultural produce and system sustainability can aid in agricultural development. The two major strategies are low input systems such as organic agriculture or improved conventional 'integrated' systems. From the different papers reviewed, organic farming seems to be practical premise for sustainable management of essential nutrient supply in agriculture ecosystems. FYM and manure application is old age agriculture practice in rural India, but combining these with modern scientific techniques can play an important role in ecofriendly nutrient supply. The overall resource use efficiency in organic management can help in long run to maintain and restore soil nutrients for sustainability of crop production.

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