A review on impact of integrated nutrient management practices on soil quality

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Abstract

Soil productivity is the results of its physical, chemical and biological properties and any change in these properties adversely affect the soil environment leading to decline in crop yield. In these concern of proper soil management practice is likely to be helpful which increase the properties of the soil. Complementary use of organic and inorganic fertilizer has an important role in the improvement of soil ecosystem resulting in higher crop productivity without deteriorating soil qualities.

Keywords: productivity, Soil, management, practices

Introduction: Physical characteristics of soil

Hati et al. (2006)⁸ reported that application of 10 Mg farm yard manure and recommended NPK to soybean for three consecutive years had larger mean weight diameter and a higher percentage of water stable aggregates. Increase in percentage of macro aggregates and reducing in percentage of micro aggregates with FYM application was likely due to conversion of some of the micropores to macropores as a result of cementing action of organic acid, polysaccharides formed during the decomposition of organic residues (Mishra and Sharma, 1997)⁴¹.

Significantly lower bulk density was recorded under 50% nitrogen through poultry manure + 25% N through urea + biofertilizer + Zn applied plot (Kumar et al., 2018). Das and Patel (2012)⁶ reported that integrated nutrient management treatments generally decreased the bulk density of soil as compared to these under inorganic treatment and the reason might be due to the higher soil organic carbon in these treatments. Similarly, working on acid clay loam soil under maize-mustard cropping system. Saha et al. (2010)⁴¹ reported that a reduction in bulk density of soil with integrated nutrient management practices. Addition of NPK fertilizer along with FYM, lime and biofertilizer, resulted in an increase in the infiltration rate of the soil (Saha et al., 2010)⁴¹. Similarly, Malik et al. (2014) reported an improvement in infiltration rate with the incorporation of vermicompost and chopped crop residue.

The results of a five year field experiment carried out to study the effect of continuous application of N, P and K alone or in combination with lime, FYM and biofertilizer revealed an increase in water retention capacity of soil with integrated nutrient management (Saha et al., 2010)⁴¹

Chemical properties of soil

The soil pH at 0-15 cm soil depth varied significantly after twenty-ninth cycle of rice crop. The lowest pH in the surface soil was registered under control while the highest pH to the tune of 8.19 was recorded due to NPK + FYM. There was no remarkable variation in soil pH due to various treatments of nutrient management through chemical fertilizer alone or in combination with FYM (Bhatt et al., 2017)⁵¹. Similarly, Chouhan et al., 2017⁵ reported a slight increase in treatments of inorganic nutrient application alone while slight decrease in soil pH was recorded in the treatment receiving FYM along with inorganic nutrients. The electrical conductivity of soil after harvest of soybean and wheat crop was not affected significantly by the treatments of long term application of nutrients. The value of electrical conductivity did not show remarkable alteration and this may be attributed to low residual effect of applied input and high buffering capacity of soil (Chouhan et al., 2017)⁵. Similarly, Bhatt et al. (2017)⁵¹ reported a lowest value of electrical conductivity (0.27 dSm⁻¹) in control plot and highest EC (0.33 dSm⁻¹) in treatments NPK + FYM. Addition of NPK fertilizer increases accumulation of salt concentration in soil which contributes to increased elemental conductivity. Kumar et al. (2012) also reported that application of FYM, rice straw and green manure along with inorganic fertilizer decrease soluble salt concentration compared to fertilizer alone in rice-wheat cropping system.

Sharma et al. (2000) reported that incorporation of crop residues and inorganic fertilizers showed significant increase in cation exchange capacity over the initial value. The increase in CEC was due to improvement in organic carbon content of the soil (Sharma et al., 2000). Similarly, Chouhan et al. (2017)⁵ reported that long term application of nutrient along with organic manure significantly increased the cation exchange capacity of soil. Higher CEC in the treatment of long term application of nutrient along with FYM was might be due to higher organic carbon under these treatments.

The addition of FYM and integrated nutrient use of FYM with chemical fertilizers resulted in significantly higher organic carbon accumulation over inorganic fertilizers alone after harvest of maize in an alfisols (Kumari et al., 2013). Similarly, Ravankar et al., 2005⁵⁰ reported that maximum amount of organic carbon was found in the plot receiving inorganic fertilizer in combination
with organic and it was attributed to the direct incorporation of organic matter, better root growth and more plant residue addition. Jadhao et al. (2019) also reported an improvement in the organic carbon status of the soil with conjoint use of organics and fertilizers.

Incorporation of FYM along with fertilizers enhanced the available N content in soil as compared to control and this may be attributed to mineralization of FYM (Chandel et al., 2014). Kumar et al. (2008) reported that the application of crop residue along with FYM and green manure significantly increased the available N content of soil over 100% NPK alone in the treatment. Similar improvement in the availability of soil N with the conjoint use of inorganic fertilizer along with organics was also reported by Jadhao et al. (2019).

Swarup and Yaduvanshi (2000) reported that there was significant improvement in available phosphorus status of soil with addition of crop residue and FYM. The build-up of available phosphorus in the soil may be ascribed to the residual effect of applied fertilizers and the mineralization of FYM. Similarly, Chesti et al. (2015) reported that incorporation of FYM along with 100% NPK recorded significantly higher available P as compared to all other treatments.

Higher value of available potassium in the treatment receiving chemical fertilizers, crop residue and compost may be due to higher organic matter content which retained available K+ on exchangeable site (Kumari et al., 2017). Chesti et al. (2015) also reported that available K status declined in almost all the treatments except 100% NPK + FYM @ 10 t ha⁻¹ as compared to initial status. The increase in available potassium under irrigated treatment might be due to addition of organic matter that reduces K fixation and released K due to interaction of organic matter with clay. Similar improvement in available K status of soil with integrated use of organic and inorganic fertilizers was also reported by Jadhao et al., (2019).

Maximum available sulphur (S) was noticed when 150% NPK of the recommended dose was applied in conjunction with compost and crop residue and this might be due to addition of sulphur through SSP and mineralization of organic S (Pandey and Kumar, 2018). The available calcium (Ca) and magnesium (Mg) were found superior when applied with organic and inorganic fertilizer. The increase in exchangeable Ca and Mg content of soil might be due to release of these nutrients from added organic sources (Sanjivkumar, 2014).

Chandel et al. (2014) concluded that under wheat maize cropping sequence combined application of 50 kg N + 10 t FYM was found to be beneficial in increasing the ability of zinc (Zn) status in soil as compared to sole application of fertilizers. The availability of boron (B) decrease significantly with increasing level of chemical fertilizers and incorporation of compost and crop residue alone or in combination significantly increased the soil available B (Chander et al., 2007). Use of FYM, wheat straw and green manure along with chemical fertilizers significantly superior over alone and or recommended dose of chemical fertilizers application (Kumari et al., 2017). Kumari et al. (2017) reported that highest iron (Fe) and manganese (Mn) content was recorded in the treatment with the application of 50% mineral fertilizers supplemented with 50% N through FYM as compared to control.

**Microbiological properties of soil**

The bacterial population increased by approximately whereas the fungal population almost doubled in the INM system in comparison to recommended dose of chemical fertilizers alone. The increase in microbial population is due to the conductive soil environment formed by the organic addition, increasing the magnitude of easily degradable carbonaceous compound in the INM system supporting nutrition of soil inhabitants (Sharma et al., 2017). Ghosahl and Singh (1995) reported that maximum increase in microbial biomass due to the application of FYM and inorganic fertilizers alone or in combination was observed under the manure + fertilizer treatment followed in decreasing order by manure alone and fertilizer alone.

Application of 50% recommended dose of NPK + vermicompost @ 2 t ha⁻¹ resulted in highest soil dehydrogenase enzyme activity and this might be due to increased microbial activity and microbial biomass carbon in the same treatment (Kumar et al., 2017).

**References**


