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Impact of inorganic and biofertilizers on soil properties: A review

Neeharika Parmar[1], Harmanpreet Kaur[2], Meera Thakur[3]
[1-3] Maharishi Markandeshwar University Sadopur, Ambala, Haryana, India

Abstract
Fertilization is done worldwide to improve soil fertility and to increase more yield per unit area. The single application of chemical fertilizers affects the soil properties and it may also causes acidification and decreased soil productivity on the long term. Number of reasons like the excessive use of chemical fertilizers, higher cost, shortage in supply, its polluting effect on environment as well as on soil health has lighted the attention towards other soil fertilization to increase crop production. In this paper we discuss the impact of inorganic and biofertilizers on soil properties and balanced fertilization. Biofertilizers supplements the essential plant nutrients for sustainable agriculture and economy. Numerous literature search revealed that these fertilizers can clean the environment and used together with inorganic fertilizers in balanced form can enhance the productive capacity of land and reducing the amount of chemical fertilizer consumption and improve plant growth and soil properties.

Keywords: inorganic fertilizers, biofertilizers, soil fertility, soil productivity, fertilization, soil properties, chemical fertilizers

Introduction

An inorganic fertilizer is used to increase the soil fertility. N, P, K fertilization aims for high economic return of the investment by getting the optimum yield and quality and to increase the soil productivity. Applying fertilizers causes many changes in the soil properties, which can positively or negatively influence its productiveness. Only a fraction of fertilizers are taken up by the plants, the rest either remain in the soil or lost through leaching or other processes (Christian Hera, 1995). Inorganic fertilizer supports global population, almost half the people are fed because of artificial nitrogen fertilizer use (Erisman *et al.,* 2008) [2]. Commercial and subsistence farming has been and is still relying on the use of inorganic fertilizers for growing crops. This is because they are easy to use, quickly absorbed and utilized by crops (Masarirambi *et al.,* 2010) [5]. Biofertilizer contains living microorganisms, when applied promotes growth of the plant by increasing the availability of primary nutrients to the host plant (Vessey J. Kevin). They add nutrients through natural processes namely nitrogen fixation, solubilizing phosphorus in soil and stimulating plant growth through the synthesis of growth-promoting substances. Biofertilizers can be expected to reduce and replace the use of synthetic fertilizers and pesticides. The microorganisms help to restore the soil's natural nutrient cycle and also build soil organic matter. They are very useful in enriching soil fertility and fulfill the plant nutrient requirements by supplying the organic nutrients through microorganism and their byproducts. Hence, biofertilizers do not contain any chemicals which are harmful to the living soil (Schultz *et al*., 1995; Socolow 1999; Vance, 2001) [8, 10, 12]. The need for the use of biofertilizer with other inorganic chemicals, due to increase in the use of fertilizers leads to increased crop productivity and increased usage of chemical fertilizer leads to damage in soil texture and raises other environmental problems. Biofertilizers are low cost, renewable sources of plant nutrients which supplement and complement chemical fertilizers and accessible to marginal and small farmers. Biofertilizers are one of the promising and best modern tools for agriculture. Biofertilizer is an important component of integrated nutrient management they are cost effective and renewable sources of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. The organism proliferates under both anaerobic and aerobic conditions. It do not form root nodules and live inside plant roots. It stimulates for the production of growth promoting substance (IAA), disease resistance and drought tolerance (Vande Broek *et al*., 2000) [13]. The incorporation of biofertilizers (N fixers) plays major role in improving soil fertility and yield. Their application in soil improves soil biota and reduces the use of chemical fertilizers (Subashini *et al*., 2007). The growing concern about environmental hazards and threats to sustainable agriculture growing Indian government has been trying to increase the application of bio fertilizers along with modern agrochemicals for better soil property, health and yield. In India different types of fossil fuel based chemical fertilizers at the farm level are available at farm level can be afford only through imports and subsidies. At present biofertilizers is better alternative for chemical fertilizers due to their eco-friendly, easy to apply, non-toxic, non-residual and cost effective properties. In additions they make nutrients abundant in soil or atmosphere for plants and also act as supplements to agrochemicals.

Impact of Inorganic and biofertilizers on soil properties

Baba *et al.,* (2006) [1] conducted an field experiment at Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir India to study the effect of inorganic and biofertilizers on the soil physic chemicals and nutrient availability and concluded that the combined effect of nitrogen, phosphorus and biofertilizers have significantly lower pH, higher organic carbon and also recorded Zinc availability was not influenced by any treatments. The combined application of different level of

fertilizers had significantly affected the soil reaction, electrical conductivity and organic carbon.

Baral *et al.,* (2013) recorded that only inoculation of Azotobacter increased 15 to 35% grain yield over non inoculated treatments. The benefit of Azotobacter inoculation was higher in the absence of chemical fertilizer application.

Kalhapure *et al.,* (2011) [4] conducted an experiment with the application of 25 per cent recommended dose of fertilizer in combination with biofertilizers, green manuring for increasing production with sustainability and analysed that the incorporation of compost improves soil physico chemical properties and resulted in improving the nutrient status of soil in respect of organic carbon and NP. Maize grain yield also increased. Maximum B: C ratio observed in combined use of 25 per cent recommended dose of fertilizer, compost, biofertilizers and green manuring and it was followed by application of 100 per cent recommended dose of fertilizer which was responsible for deterioration of nutrient status of soil.

Kalhapure *et al.,* (2013) [4] at Rahuri studied that combined application of organic and inorganic sources of nutrients revealed that application of 25% recommended dose of fertilizers (RDF) in combination with biofertilizers (Azotobacter chroococcum+ phosphate solubilizing bacteria), green manuring with sunhemp and incorporation of compost improves soil properties (viz. decrease, bulk density and increase in infiltration rate). This was also responsible for improving the nutrient status of soil in respect of organic carbon, available N and available P.

Nath *et al.,* (2009) an experiment was conducted at Udaipur during rainy season. The soil was clay loam having alkaline reaction (pH 7.8). It was medium in total nitrogen (260.40 kg/ha), available phosphorus (18.26 kg/ha) and high in available potassium (283.30 kg/ha). As per treatment vermicompost was broadcast and incorporated in plots a day prior to sowing. The entire quantity of phosphorus and half quantity of nitrogen through fertilizers as drilled in crop rows through DAP and urea while sowing and remaining half nitrogen was top dressed one month after sowing.

Ramalakshmi *et al.,* (2008) [6] an experiment was conducted at Tamil Nadu Agricultural University, Coimbatore on the influence of biofertilizers on soil physic-chemical and biological properties during cropping period and recorded the shift in the pH reducing the alkalinity slightly and the organic carbon content increased slightly in all the biofertilizer inoculated treatments compared to uninoculated soil. The available nitrogen in soil was higher in *Azospirillum* treated soil. The soils of the biofertilizer inoculated plots has higher soil biological activity,

Ramesh *et al.,* (2014) [7] The long term residual effect of integrated use of organic and inorganic nutrient sources on soil fertility was studied at Division of Soil Science, ICAR Research Complex for NEH Region, Meghalaya. The integrated nutrient management experiment was conducted during 2000-2005. Application of lime and FYM along with 75% recommended NPK increased the soil pH (5.02) and decreased the exchangeable Al whereas, control plot receiving 100% recommended NPK showed the lowest pH (4.19) and highest exchangeable Al. Combined application of FYM and biofertilizers along with 75% recommended NPK increased the organic carbon content whereas organic carbon content was decreased in the treatment receiving lime and biofertilizers along with 75% recommended NPK. Application of lime and FYM along with 100% recommended NPK increased P content whereas, it decreased P content with zero NPK. Similarly, K content was increased in the treatment receiving FYM and biofertilizer along with 75% recommended NPK while it decreased in control receiving zero NPK. Exchangeable base content was low under control with 100% recommended NPK however, highest value was observed with the treatment receiving lime and FYM along with zero NPK.

Sepat *et al.,* (2010) [9] found that the application of fertilizers (inorganic alone or inorganic with FYM) recorded significantly higher mean yield attributes and grain yield over control. Recommended dose of fertilizers (RDF) along with 5 tonnes FYM per ha + Biofertilizer (Azotobacter, PSB and VAM) + 25 kg ZnSO4 per ha produced higher yield attributes resulting in 22% more grain yield than RDF. The higher yield led to higher NPK uptake by wheat. The available NPK content of soil also increased in INM treatment over control.

Sharma *et al.,* (2008) at Jabalpur observed that the conjunctive use of inorganic fertilizers and organic manure along with bio fertilizers and micronutrients improved uptake of nutrients.

Tetarwal *et al.,* (2012) [11] analyzed an experiment on the integrated nutrient management on productivity, profitability, nutrient uptake and soil fertility in rainfed maize (*Zea mays* L.) and resulted that the application of 150 per cent recommended dose of fertilizer produced significantly higher plant height, dry matter, number of cobs/plant, number of grains/cob, grain and biological yield, net return and B: C ratio, N, P, Zn uptake compared to control. Combined application of recommended dose of fertilizer and farm yard manure 10 t/ha produced higher plant height, dry matter, number of cobs/plant, number of grains/cob, grain, biological yield.

Conclusion

The blind and unbalanced use of chemical fertilizers may lead to health and ecological hazards, degradation of soil physicochemical properties and ultimately poor crop yields. To solve this problem in context of the cost and environment impact use of both chemical and biofertilizers is better option for farmers to increase productivity per unit area without the negative impact on the soil properties. In order to increase the importance and understanding of the role of various root associated organisms in plant growth and health as well as use of beneficial features as biofertilizers in plant production. More experiments and information is urgently needed on the interactions among plants and rhizosphere microorganisms.

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