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THE ROLE OF BIOFERTILIZER IN SOILS HEALTH AND THEIR INFLUENCE ON PLANT GROWTH—A REVIEW

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ABSTRACT Biofertilizer technology involves the use of microorganism which is inoculated in soils to improve availability of nutrients either making it soluble as in Phosphate solubiling bacteria or by nitrogen fixation like *Azotobacter*. Base on the literature review it has been stated that the application of biofertilizers together with inorganic fertilizer or green manure enhanced the proper utilization of inorganic or mineral fertilizer by the plant as a result of the dynamic action of microbial actions. They are capable of improving the water holding capacity of soils, EC and an increase in NPK and the organic carbon content of the soils in addition to modifying the soil reaction. The microbes present in biofertilizers are capable of making the nutrients in soil readily available for plant to use. The use of biofertilizers with NPK fertilizer enhanced the growth and yield of crops.

KEYWORDS :

Introduction

Biofertilizers are one of the best modern tools and gift of agriculture as a substitute to inorganic fertilizer. There is an enormous increased in the use of inorganic fertilizer globally in modern farming technology. The use of this inorganic fertilizer has a negative effect on the surrounding ecosystem including the ground water and the atmosphere by emitting harmful gases to the atmosphere Dolfode (2017). The introduction of modern farming techniques which include the use of biofertilizers provide an alternative solution to maintaining soil fertility in addition to being a eco- friendly and environmentally safe and more to that they help to sustain soil fertility and improve productivity by enhancing rapid uptake of nutrients that were not readily available. The following write up are collections of various literatures on the influence of biofertilizer on soils and crop growth.

Lukas *et al*., (2018) conducted an experiment with a view to improving crop yield and nutrients use efficiency via biofertilizer. Base on that they conducted a meta- analysis to quantify benefits of biofertilizers in terms of yield increase, N and P use efficiencies. They came out with the following result: (1) The superiority of biofertilizer performance in dry climate over other climatic regions (ii) meta regression analysis reveal that yield response due to Biofertilizer application was small at low soil P level; efficacy increased along higher soil P levels in the order Arbuscular mycorrhiza fungi (AMF), P Solublizers, and N fixers;(iii) meta regression showed that the success of inoculation with AMF was great at low organic matter content and neutral pH. They conclude that their findings provide a basis and a guide when choosing and applying biofertilizers. Dolfode (2017) studied the effect of biofertilizers on soils and reported that *Azotobacter* and phosphate solubilising bacteria(PSB) alone and in different combinations with recommended dose of chemical fertilizer (NPK) produce various result when tested on brinjal soils. The results obtained shows that the water holding capacity in soils treated with chemical fertilizers decreases while the pH increases. In biofertilizer treated soils there is an increase in water holding capacity while the pH decreases. The EC in soils treated with chemical fertilizer increases while the organic carbon decreases and it increases in biofertilizer treated soils. The available P and N increases in both biofertilizer treated soils and chemical fertilizer soils. The research also recorded a significant increased in PSB and *Azotobacte* in soils that was treated with biofertilizers, Preeti *et al*., (2017) reported that biological fertilization is an efficient method to supply plant with their necessary nutrients. They noted that it is economically and environmentally recommendable, because it results in sustainability. Sun *et al*., (2017) reported that nutrients imbalance in soils can be corrected by microbial fertilizer containing phosphorous dissolving strain *pseudomonas plecoglossicida* and potassium dissolving strain *Bacillus aryabhattai* to stimulate the growth of plant and increase nutrients in soil. They discovered that microbial fertilizer is effective in increasing the contents of total N P and K in soil and the activities of soli sucrose and urease. They also found out that microbial fertilizers significantly promoted the growth of reed in addition to increasing soil nutrients and enzyme activities. Anusha *et al*.,(2017) conducted a research to improve the uptake of NPK with different biofertilizer species,*Azotobacter Chroccocum* for N fixation, *Pseudomonas* for P solubolisation and *Fronteria aurantia* for K mobilization. The result revealed that biofertilizers along with half RDF of NPK has shown better uptake of fertilizers by the plants. The lowest uptake was recorded in control followed by the treatments were only biofertilizer were used. They concluded by saying that application dosage of fertilizer can be minimized to half by using Biofertilizer at frequent interval and at optimum level which are eco friendly and reduce cultivation cost. Barna *et al*., (2016) report that application of organic substrate and use of bio-mulching materials are effective in retaining soil moisture content, reducing soil erosion, suppressing weed growth and thereby improving soil health. They went further to states that combine application of organic and biofertilizer have a significant effect on growth, leaf yield and quality of mulberry plant. Saha *et al*.,(2016) reported that the interaction between microbes whether mutualistic, symbiotic or suppressive that coexist in soil ecosystem or within the plant is the most important process which regulate soil health. They noted that the important interaction between microbes and plants is in the rhizosphere where complex process takes place. They observed that microorganism are excellent indicators of soil health as they respond quickly to changes in soil ecosystem. They suggested that the useful microbes can be harnessed to improved soil health since they participate in many dynamic activities in the soil. Ge *et al*., (2016) investigated the effect of applying vermicompost, Nitroxin and cow manure on the growth characteristics of *Aspergillus officinalis L*. They observed a significant difference in germination percentage between the treatments. Vermicompost was more efficient at low concentration and in non combined treatments but highest effect were recorded from the mixture of cow manure with Nitroxin. According to this research maximum mean germination time and rate were related to the treatment of 15% and 30% vermicompost and cow manure mixed with Nitroxin. Significant difference was obtained also on root and shoot length, fresh and dry weight of root and shoot. Rocheli *et al*., (2015) states that the interaction between microbes in the root zones are the determinants of plant health, productivity and soil fertility. They reported that several bacterial characteristics such as nitrogen fixation, phosphate solubiliztion, ACC deaminal activity, and production of siderophores and phythohomones can be assesse as plant growth promotion traits. Goeta *et al*., (2015)

investigated the effect of organic biofertilizer and crop residues application on soils microbial activity in rice. The outcome of their investigation reveal that the organic practices which involves the use of vermicompost, crop residue and biofertilizer improves soil microbial characteristics and organic carbon in rice – wheat system. Newton *et al*.,(2015) conducted an experiment to evaluate the effectiveness of phosphate and potassic sources (rock biofertilzer and soluble fertilizer) base on several sugarcane characteristics and soil attribute. The outcome of the research reveal that biofertilizer has the potential to increase sugarcane characteristics. Aislabie and Julie (2013) discuss the roles of microbes in the ecosystem services. They stated that the diversity of microbes in soils is enormous and they control many soil activities including cycling of major biological elements (C N P), in the recycling of waste and the detoxification of environmental pollutants. Microbes play an important role in cycling nitrogen and mediate in nitrogen fixation, denitrification and nitrification. Their finding has shown how microbes contribute immensely in ecosystem process Meena *et al*., (2013) observed that the combined application of graded Nitrogen with and with out *Azotobacter* inoculation on yield and nutrient uptake by maize crop. The result reveals that grain yield increased with increasing levels of nitrogen and maximum yield was recorded with 150kgN/ha with FYM at 5t/ha and *Azotobzcter* inoculation. According to this result NPK was also significant with application of 150kgN/ha. Application of organic manure and biofertilizer significantly increase the protein content of maize with each level of N application. Arshad (2011) investigated the effect of combined application of two commercial biofertilizers namely Biopower and Effective micro organism (EM) on rice in soil amended with farm yard manure (FYM), Green manure (GM) and NPK fertilizers. Biopower is a product of nuclear institute for biotechnology and genetic engineering, which contain species of associative and endophytic diazotroph, while EM consist of co existing beneficial microorganism mainly species of photosynthetic and lactic acid bacteria, as well as yeast. According to this finding biopower adversely affected plant growth and yield in NPK amendment, while biofertilizers markedly promote plant growth and yield in green manure amended soils, while its effect is not significant in green manure amendment, applying EM enhances yield by 46%, while co-inoculation of biopower and EM improved root and shoot growth in FYM amended soils. It was concluded that the use of the two bio fertilizers enhanced shoot bio mass and green yield in green manure amended soils.Aly and Naggar (2010) investigated the effect of biofertilizers, organic compost and mineral fertilizers on the growth, flowering and bulb production of (*Narcissus Tazetta.L.*). The outcome of their research shows that the interaction effect of applying biofertilizer with mineral fertilizer resulted in significant increase in all the parameters studied . Rajeshwar and Arif (2010) investigated the effect of biofertilizers on soil fertility and yield of rice and maize crop in an alfisol. The result shows that in rice field the highest yield was obtained with RDF + application of biofertilizers (6600kgha^{-1})' In maize crop highest yield was recorded with RDF + biofertilizers (6500 kgha^{-1}) followed by 6150 kgha^{-1}) in 25% low RDF + biofertilizers. They reported that there was no difference in pH when compared with initial soil status but there is slight decrease in EC. They also observed that the change in organic carbon status was more in rice treatments than maize, the organic carbon content decrease in all the treatments when compared to initial status. The result also shows that the increase in nitrogen availability was more in RDF + Biofertilizer followed by farmers practice in kharif rice and decrease in 25% low RDF +Biofertilizer and RDF. Whereas in rabi maize the availability of N content decrease. The P availability increase in all the treatments in kharif rice whereas in maize there was no much difference, while K availability decrease more in RDF followed by 25% low RDF + application of biofertilizer in both rice and maize. Ramalakshm *et al*.,(2008) conducted a field experiment to determine the influence of biofertilizers on soil physical, chemical and biological properties. They reported that biofertilizer inoculation produce a shift in the pH reducing the alkalinity slightly and an increased in the organic carbon content was observed in all the treatments inoculated with biofertilizer. The available nitrogen content was higher in treatment with *Azospirillum*. Almost all the nutrients recorded a significant increased as a result of the activities of the microorganism. Mycorrhiza and phosphobacteria increases the activities of soil phosphorous. Plots inoculated with biofertilizer produce a high population of total bacteria, fungi and actinomycetes. Domergues *et al*.,(1980) observed that microorganism affect plant productivity favorably or unfavorably either indirectly by acting upon soil physical or chemical properties, or directly by interaction with plant roots. According to them the direct effect on soils properties concern coating of particles with water repellant compounds, redox potential, soil nitrogen status (fixation) and denitrification process, availability of nutrients especially N and P and accumulation or elimination of phytotoxic inorganic compounds. They also noted that soil microorganism affect plant growth by reducing or improving nutrients or water uptake, or may produce growth regulating substance or protect plant against certain and pathogens. Prasanna *et al*.,(2008) investigated the role of blue alga (BGA) in conjunction with other organic amendment and came out with a promising result. The result of their findings shows that application of vermicompost with BGA and chemical fertilizer brought about a significant increase in nitrogenase activity, while Azotobacter plus BGA treatment gave highest value of chlorophyll. They also describe that the addition of vermicompost and farmyard manure plus inorganic fertilizer (NPK) 40:30:30 enhanced cyanobacterial abundance and cyanaobacterial genera. They conclude by advocating the use of organic amendment, chemical fertilizers and biofertilizers on wheat crop to improve soil fertility.

Conclusion

The use of Biofertilizers with chemical fertilizers should be encourage to improved Agricultural productivity and to maintain the soil physical and chemical properties since the microorganism in the biofertilizer are capable of modifying the status of the soils to make it favorable for growth of plants and in addition to that they are also eco-friendly they are capable of purifying the enviroments.

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