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A review on integrated nutrient management an approach to sustainability

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Abstract

Organic manures are used traditionally to supply plant nutrients. The volume of organic fertilizers is high they are bulky in nature so, there are many problems in application of these fertilizers which forces farmers to use synthetic fertilizers. Using organic fertilizers helps to recycle the organic waste. The end product which is obtained from organic waste can provide nutrients in an efficient manner and also improves conditions of the soil. Because synthetic fertilizers which are currently in use may not fulfill or maintain the quality of soil needs for sustainable agriculture. By applying all essential nutrients through synthetic fertilizers can degrade the quality and health of the soil which is directly responsible for unsustainable yields. So, to improve the nutrient supply in an integrated nutrient management system chemical fertilizers and organic manures should be combined together for best outputs. To maintain the soil fertility and proper soil health balanced application of organic and inorganic nutrients is required. Through integrated management sustainability in agricultural productivity should be achieved. By using integrated nutrient management on yield components of crops is very important for guarantee of food security. Integrated nutrient management or supply focus at maintaining the fertility of soil and nutrient supply for plants to an optimum level in relation to sustain the desired crop productivity by optimizing all sources of plant nutrients with the help of integrated nutrient management which can also include other aspects like; maintenance or enhancement of soil productivity by using chemical fertilizers and organic fertilizers in a balanced manner. Different types of organic materials such as bio compost, FYM, green manures, vermicompost, crop residues, industrial wastes, composts, animal manures.

Keywords: Organic waste, synthetic fertilizers, INM, organic manures

Introduction

The organic manures are used to improve the health of soil and supply nutrients to plants since times. Different types and organic sources are utilized in agricultural practices but most of the remaining materials are unutilized. Organic materials are bulky and available in city waste, farmyard manure, poultry manure and industrial wastes. If these materials are not recycled they may become a cause for air, water and land pollution. Large amounts of organic wastes are available in the forms of city waste, farm waste, poultry litter, sewage sludge and agro industrial wastes (Lal, 2005; Kolay, 2000) [9, 10]. The different types of organic manures are used in the fields by farmers for sustainable yield of crop. But due to variation in composition, level of water they consist and bulky nature, application and transportation of organic manures is a big problem in this world where people are conscious for fuel. The application of these bulky manures also increases labour requirements to a certain extent, which is also responsible for high input cost and that is not an economical option for an average or poor farmer. Composting is a very effective and eco-friendly approach for the disposal of organic waste (Millner *et al.*, 1998) because it is cost effective and eco-friendly. It also helps in conservation of natural resources and also improves the cycling of non-renewable resources. Keeping present energy crises in view it is a very good option for conservation of energy because a large amount of energy is utilized in the fertilizer sector. This process converts organic waste into stable humus forms, which are stored and applied in agricultural practices without causing any harmful effects to the environment (Gallardo-Larva & Nogales, 1987) [8]. The organic compost and manures play a very important role in sustaining farming by providing an efficient supply of nutrients (Korsaeth *et al.*, 2002). The production of compost for agriculture has got attention due to the sudden increase in prices of fertilizers and lowering in quality of soil. This may be due to the increment in costs of waste management and also awareness for waste recycling in people.

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Composting is a process which is a very good way to manage large volumes of organic wastes in a good manner (Stetiford, & Lasaridi, 1999). Organic matter is available in different forms and different stages of organic matter decomposition at various stages is used in soil application at high quantity in tons/ha for improvement in productivity of crop (Terrance *et al.*, 2004). The application of synthetic chemical fertilizers is very important for the proper nutrition of crop which helps in increasing productivity of crop. The yields of cereal crop like wheat are not increasing from last couple of years. The application of natural organic manures and organic materials composted along with synthetic chemical fertilizers can help to increase in yield of crop further. The poor fertilizer management has a major reason for low productivity of crop yields, so for the achievement of optimum crop yield productivity nutrients have to be managed through integrated nutrient management of organic and inorganic sources which are required. The management of fertilizer is a very important factor to increase the yield and growth of any crop (Ghaffari, *et al.*, 2011) [2]. Integrated nutrient management (INM) is a system in which inorganic and organic nutrient sources are combined for the maintenance of soil health and to enhance crop yield. The application of appropriate and efficient supply of required nutrients through both inorganic and organic provides the solutions for the different problems like increment in prices of synthetic fertilizers, deterioration in quality of soil and productivity of the soil. Hence, combined application of these combinations helps in sustaining fertility of soil and productivity of soil.

Concept of Integrated nutrient management (INM)

Integrated nutrient management (INM) is an approach in which complete application of synthetic fertilizer and organic resources is a better, effective integrated method (Janssen, 1993). It also helps to improve the health of the soil by improving physio-chemical properties, reduces the degradation of soil and boost productivity of farm (Janssen, 1993, Esilaba *et al.*, 2004). INM is not just only help to increase growth of crop but also it preserves the resources of soil. It mainly stresses on the application of farm wastes, farm yard manure (FYM), organic fertilizers, soil amendments, green manures, crop residues, crop rotations, cover crops, intercropping, conservation tillage, drainage and irrigation for the preservation of stable reserved water and for enhancement of the nutrients of plant (Janssen, 1993). INM requires the proper amount of nutrient and timing of nutrient application to be in relation with the nutrient uptake capacity of crop, which directly implements to maximize the yield and also helps to improve the nutrient-use efficiency of crop (Cassman *et al.*, 2002).

Components of Integrated nutrient management (INM)

Generally INM is an effective use of both organic and synthetic fertilizers integrated together. Where synthetic or chemical fertilizers consist components which have all essential macro nutrients like, NPK in the forms like Urea, SSP, MOP, DAP, Urea etc for the enhancement of the growth factors in an eminent manner. But excessive or overuse of these chemicals can deteriorate the fertility of soil so Integrated Nutrient Management comes into attention. There are different components of INM which include improvement in health of soil, helps to restore the crops like leguminous crops, green leaf manures, etc; recycling of residues which remain from the crop; application of organic manures like

biogas slurry, FYM, vermicompost, poultry manure, biological composts, oil cakes, by utilization of biological agents; proper and application of nutrients through a proper manner in an integrated way fertilizers as per the requirements of crop to improve the yields of crop.

Effect of N- fertilizers in INM

N fertilizer have leaching problems of nitrates into ground water due to improper use of N fertilizer which can result in more discharge losses to environment. Integrated nutrient management helps to reduce the nitrogen losses, reduce injurious environmental effects and also results in crop growth and high productivity in crops (Gruhn *et al.*, 2000). The leaching of nitrogen is influenced by various aspects, like pattern of nitrogen application, soil properties, crop characteristics, administration practices and climatic situations. So, INM helps to enhance the Nitrogen-use efficiency which minimize the volatilisation losses of -NH_3 and reduce leaching of nitrate (Sharma and Bali, 2018) [33].

Effect of Organic fertilizer

The organic fertilizer which supply nutrients to plants include budding of legumes in the farming system, organic manures, green manures, crop leftover, (FYM, compost, vermicompost, biogas slurry, phosphorus-compost, bio-compost, oil cakes, green manure, biofertilizers etc. According to information which is available till now shows that organic manures as compared to fertilizers are more preferred to sustain the high yields of crops over longer periods, in comparison to single use of synthetic fertilizers. In various researches it is found in results that The results of various researches the possibility for stand in for more than 25% of RDF with organic sources in the intensive cropping systems. When legumes and green manures applied into harvesting system under perfect conditions it has the capability to meet more than 50% requirement of nitrogen in the rice crop. The soil is a basic need/requirement for the production of crop because it provides water, nutrients and support to the plants. An stable supply of organic and inorganic sources of nutrient is available in soils, but these nutrients are often completed with the help of external application of fertilizer for better performance of plant (Smaling, 1993). Natural or organic fertilizers are the final product of animal waste, plant residues, organic manures and even other wastes which are recyclable and bio-fertilizers, like fishery wastes, municipal wastes, etc. Application of organic fertilizers has number of advantages like improvement in soil structure physically and capacity of soil to hold water are enhanced drastically, organic fertilizers help to increase the soil capacity to buffer changes in the pH, also increases the cation exchange capacity, fixation of diminish phosphate, and it is a reservoir for all types of nutrients essential for crop plants. Organic matter results to more soil microorganisms and soil fauna, which are the important to operate the decomposition of organic matter and which results in releasing of mineral nutrients in the ecosystem of soil (Janssen, 1993). By Integrating all of fertilizers which contain NPK with organic manure, like vermicompost, which helps in building the fertility of the soil according to soil nutrient availability and supply of C and N in the soil formed by microorganisms (Anwar, 2005). The goat manure and poultry manure has ability to quick supply of nutrients than FYM and they help in conversion of non-available form of nitrogen to available form of nitrogen (Thavaprakash, 2005) [35].

Green manuring

Organic farming is totally dependent on soil health and recycling of nutrients by using natural processes in the soil. Green manures perform a vital role in fertilization, in concert with the addition of animal manures if those are used. It is quite promising application of green manures has helps to enhance crop yield and fertilizer saving (Dixit, 2007) [11]. Green manuring application is done with plowing under or soil incorporation of any green manuring crops when they are green or soon after flowering. Green manures are leguminous crops or forage crops which are grown for their leafy material used in the soil conservation losses. Results of some studies shows that 18 grain legume species are very important for green manuring in different farming situations of rice in Asia.

Effect of bio-fertilizers

Bio-fertilizers are the fertilizers which are formed from organic or natural substances mainly they are of nitrogen fixing type and p - solubilising type; these both type of bio-fertilizers are generally acts on the rhizosphere of plant and also improve growth of plant by providing them essential nutrients.

Different types of bio fertilizer and their effect on plant

- **Nitrogen fixing type:** Rhizobium inoculation used as nitrogen fixing of legume crop is an important practices which are adopted in the different parts of different countries. It shows its major effect of growth on formation of nodule, leaf growth, yield of grains and content of protein in peas (Mckenzie *et al.*, 2001) azospirillum and azotobacter also helps in enhancement of the nitrogen effect in plant.
- **Phosphate solubilising type:** Phosphate solubilising microorganism (PSM) helps mainly to enhance the effect of phosphorus in the plant and also in the soil. *Penicillium bilaiae* inoculation could helps to enhance percentage of available phosphorus in the soil and improves the quality of dry matter, grain yield, and uptake of phosphorus in wheat (Kucey, 1987). It is also used for consistent improvement of total organic crops.

Strategy for INM improvement

INM is integration of synthetic and natural fertilizers. So, this system of fertilizer application can implemented by farmers because the it has many environmental benefits and also helps to sustain the agricultural methods/techniques. By studying and go through different reports of research, by concluding recent methods which can be undertaken by the farmers and further can be boosted by some modifications and adjustments into them the implementation of site-specific INM practices. INM is an futuristic approach to improve environmental conditions, mechanization due to serious labour shortage, conservation tillage and rain water-harvesting methods, recycling of organic nutrient flow, new technological innovations, are some of the issues which could be given importance to promote INM.

Conclusion

Integrated nutrient management system is growing faster in the agricultural farming system throughout the whole world due to its efficiency and effectiveness in both quality as well as in productive factor. In this system we can use both organic and synthetic fertilizer has a judicial and plays effective role in the enhancement of the yield of crops and also helps to increase the economic condition of the farmers different

countries of world. Some different agencies of government and department of agriculture should have to look forward in improving the condition of farmers to adopt integrated method of farming because single use of synthetic fertilizers deteriorates the quality and productivity of the soil and also have adverse effect on the environment. Organic farming cannot fulfil the food requirement of the world so integrated farming is most effective to tackle this problem.

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