



Studies on Integrated Nutrient Management of Cowpea (*Vigna unguiculata* L.): A Review

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

There are many management methods for nutrient which can be specifically applied in farming systems. Integrated nutrient management (INM) generally denotes the combined use of organic and chemical fertilizers for producing crops in a sustainable manner and to maintain soil fertility as well as to supply nutrient in appropriate amount which consider social, ecological and economic impacts. This paper shows the importance and need of INM in agriculture production. Also, the relation of INM and yield attributes are analyzed and evaluated including growth and physical attributes of cowpea. The status of nutrient uptake by plant is also described along with other physical and chemical properties of soil. Finally, this paper also describes about the biofertilizer and its relation, impact and effect on crop production which can be used as a improved technology with the combination of other nutrient management practices.

Keywords: INM; organic fertilizer; inorganic fertilizer; Biofertilizer; Cowpea.

ABBREVIATION

1. INM : Integrated Nutrient Management

2. PSM : Phosphate Solubilizing Microorganism

3. AMF : Arbuscular Mycorrhizal Fungi

4. VAM : Vesicular Arbuscular Mycorrhizal

5. PSB : Phosphate Solubilizing Bacteria

6. FYM : Farm Yard Manure

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7. NPK : Nitrogen Phosphorous Potassium

8. RDF : Recommended Dose of Fertilizer

9. VC : Vermi Compost

1. INTRODUCTION

Pulses are the most important source of dietary protein and also can maintain or restore soil fertility through fixing nitrogen biologically as well as by adding considerable amount of residue to the soil [1]. Among various legumes cowpea (*Vigna unguiculata* L.) is a very important pulse crop in our country specially for household consumption [2]. It is an annual herbaceous legume crop from the genus *Vigna* and family "Fabaceae" or Leguminosae [3]. It can fix atmospheric nitrogen and also can supply it to the soil at the rate of 56 kg ha⁻¹ in association with symbiotic bacteria (rhizobium) under suitable conditions [4,5,6]. INM is basically combination of chemical fertilizers and organic manures simultaneously for sustainable crop production and maintenance of soil fertility. Considering this it can be said that INM is ecologically, socially and economically viable and going to play an important role in future agriculture. Increase in production potential can be achieved by applying organic, inorganic and bio-fertilizers in a suitable proportion. Under the topic of INM practices, many sub-topics can be introduced, including the use of biofertilizers, farmyard manures, natural and mineral fertilizers, soil amendments, crop residues, and farm waste recycling, agroforestry, green manures, and compost. Biofertilizers, when added as a component of INM is considered to be most cost effective, eco-friendly and renewable source of non-bulky, low cost of plant nutrient which can replace chemical fertilizers in sustainable agriculture system in India. Integrated management of fertilizers reduces the high costs of chemical fertilizers and also improves the soil sustainability for making it more productive [7]. According to Mohandas [8], bio-fertilizers cannot replace for inorganic fertilizers but they are very much useful in increasing yield, quality and production of crops when they are used together i.e. organic manures and inorganic fertilizers in a balanced proportion. Hence, emphasis must be given on bio-fertilizers as it is a supplementary, renewable and non-polluting sources of nutrients to the plants.

This particular article contains the need of INM, relation of INM with growth and yield of cowpea along with the soil physical chemical properties,

impact of INM on nutrient uptake and effect of biofertilizer use in cowpea.

2. IMPORTANCE OF INTEGRATED NUTRIENT MANAGEMENT

As the world population is increasing rapidly and expected to be double within 3-5 decades, it is very difficult to feed the growing population without increasing the productivity [9]. To feed the huge growing population use of chemical fertilizers and stimulants are increasing rapidly which will definitely create some short of environmental problem in near future. Therefore, a sustainable agriculture system is extremely necessary to maintain the soil health in future. The above concerns require a permanent solution which can be achieved by adapting the integrated nutrient management system by which soil health and fertility can be maintained sustainably.

Integrated nutrient management (INM) is the integrated use of fertilizers with organic resources like urban/rural wastes, crop residues, composts, cattle manures, green manures and biofertilizers [10]. The combination of organic and inorganic sources increases the production and profitability of field crops, and also helps in maintaining the fertility of soil [11].

The major benefit of using organic and inorganic nutrient source ;in combination; in integrated nutrient management has showed to be superior to the use of each component individually [12].

The major goal of the INM is to achieve homogeneous as well as effective combination that could lead to effective use and target of the fertilizers and also through the sufficient and balanced use of their quantity and quality, easily uptake by plants for higher productivity and yield without damaging the soil nutrients or jeopardizing the environment. To achieve such goals the use of Integrated nutrient management, which is known as a balanced mixture of organic, inorganic, and bio-organic microorganisms in combinations with different practices is viable [13]. It can enhance molecule absorption of macronutrients (NPK) and micronutrient. Also, it can match the crop nutrient requirements and removes the difficulties of nutrient deficiency without any detrimental influence in the environment and goods we produce [14].

Soil fertility management is a growing concern in global context. New challenges are coming

forward for maintaining better status of the soil. The extensive uses of chemicals are degrading the quality of soil. The sharp downfall of soil quality and fertility is leading to less production of food and increasing cost for maintaining soil fertility. These scenarios are leading us to develop a sustainable idea and technology to solve the soil degradation problem. Several ideas and concepts are put forward, and recommended for use. Integrated nutrient management is one of the sustainable techniques to maintain soil fertility and helps to manage soil in a better way. Therefore, INM is needed for the sustainable agriculture promoting the health and fertility of the soil.

3. INM AND GROWTH/YIELD OF COWPEA

INM signifies combined use of mineral fertilizers with organic resources like urban/rural wastes, crop residues, composts, cattle manures, green manures and biofertilizers in a suitable proportion [10]. Such combined use of organic as well as inorganic sources of plant nutrients not only increases the production and profitability of field crops, but also have a huge importance in maintaining stable fertility status of the soil [11].

Mathew and Hameed [15] conducted an field experiment reported where they showed that application of inoculation Phosphorus solubilizing microorganisms (PSM) along with Arbuscular micoriza @ 30 kg ha⁻¹ given higher green pod yield compared to synthetic chemical fertilization. Similar results were reported by Singh et al. [16] where they observed that 75% recommended dose of NPK along with Rhizobium, VAM and PSB resulted in significantly higher yield in pea.

Negi et al. [17] also studied the effect of microbial inoculants (*Rhizobium leguminosarum* and *Pseudomonas striata*) @ 250 gm per 10 kg seed, nutrient sources in the combination of FYM @ 20 t ha⁻¹ and NPK @ 25:25:25 kg ha⁻¹ and lime (@ 4 t ha⁻¹ shows more yield of garden pea. Furthermore, Choudhary and Yadav [18] did a field study reporting that use of 20 kg nitrogen and 40 kg P₂O₅ ha⁻¹ to cowpea produced higher dry matter and yield of cowpea over lower doses of nitrogen and phosphorus.

Yadav [19] reported that application of 20 kg N ha⁻¹ by applying vermicompost increased the number of pods per plant, seeds per pod, yield if

seed and straw of cowpea over the same dose of N given through urea or FYM. Also, Das et al. [20] concluded that application of vermicompost showed a positive influence on dry matter yield, number of pods and pod yield of green gram over the use of manures or chemical fertilizers. Similar experiment conducted by Kumari and Kumari [21] also reported that an application of phosphorus enriched vermicompost added in the yield ;contributing characters like number of pods per plant, number of seeds per pod and 100-seed weight of cowpea over control.

Netwal [22] reported significantly more plant height and number of branches per plant of cowpea because of the use of vermicompost at 5 t ha⁻¹. Bhattarai et al. [23] also conducted a similar experiment in which application of full recommended nutrient and 5 t ha⁻¹ poultry manure showed the highest plant height and dry matter accumulation per plant in field pea. Kumar et al. [24] found that application of vermicompost @ 5 t ha⁻¹ over helped to improve the plant height and dry matter accumulation per plant of moong bean significantly.

Panda et al. [2] concluded that application of 75% RDF along with either vermicompost or with FYM and application of lime in cowpea produced the highest yield of 18.21 q ha⁻¹. Also, Meena [1] found out higher number of pods per plant, number of seed per pod, seed, straw and biological yield with the application of 75% RDF and vermicompost @ 2t ha⁻¹. A recent experiment carried out by Dorjee et al. [3] found out that use of 75% RDF, 25% vermicompost and 24% neem cake showed maximum number of plants per bed in cowpea (66.15 plants/bed).

4. INM AND NUTRIENT UPTAKE

Several research studies showed that integrated management of nutrients and incorporation of biofertilizers can improve the nutrients uptake specially for Nitrogen.

According to Kormata et al. [25] cowpea can fix up to 88 kg N ha⁻¹ in normal condition while in an effective cowpea Rhizobium symbiosis system have the ability to fix more than 150 kg N ha⁻¹ which can supply upto 80-90% of plants total N requirement. Similar experiment was conducted by Giller [26] who showed that cowpea can fix up to 200 kg N ha⁻¹ under field conditions when rhizobium is supplied externally. Vedram et al. [27] also observed that application of nitrogen

with rhizobium and azotobacter, Sulphur and zinc in moong bean gives significantly higher nutrient uptake as compared to their respective control which was recommended dose of NPK.

A experiment conducted by Kahlon and Sharanappa [28] reported that use of 50 kg P₂O₅, 20 kg sulphur, 10 kg ZnSO₄ ha⁻¹ along with PSB (*Bacillus megaterium*) and VAM (*Glomus mosseae*) in cowpea resulted in a greater uptake of nitrogen (155 kg ha⁻¹), phosphorus (33.6 kg ha⁻¹), potassium (57.4 kg ha⁻¹), sulphur (11.5 kg ha⁻¹), zinc (135 g ha⁻¹), iron (255 g ha⁻¹) and copper (88.6 g ha⁻¹).

Tiwari et al. [29] observed that with successive soil treatment with organic matter and NPK + organic matter, the growth attributes of cowpea was highly active and stimulated. The organic manures also influenced the different soil properties and crop yield. Farm yard manure combined with chemical fertilizer management also showed increment in organic carbon, available Nitrogen and available Phosphorus [30].

Choudhary et al. [31] observed that use of 25 kg N ha⁻¹ and 50 kg P₂O₅ ha⁻¹ and 40 kg K₂O ha⁻¹ along with Rhizobium, VAM and PSB showed higher available nitrogen and available phosphorous in groundnut. Meena [1] found out that application of 75% RDF+VC @ 2t ha⁻¹ increased the organic carbon, available Nitrogen, P₂O₅ and K₂O content in soil. Balaji and Thirunavukkarasu [32] revealed that pressmud application @ 5 t ha⁻¹ along with 50 % RDF in okra observed highest available calcium of 0.14 % and magnesium content of 0.28% in the soil.

5. INM AND SOIL PROPERTIES

The integrated use of organic manures and chemical fertilizers improves the physical condition as well as soil health of soil more effectively than continuous addition of chemical fertilizers alone. [33].

Badanur et al. [33] showed that integrated approach of plant nutrient management, without affecting the yield of crops, improves soil fertility and maintains soil health.

Pareek and Yadav [34] performed an experiment that found out the application of organic manure significantly increased the saturated hydraulic

conductivity, moisture retention, available water and organic carbon content of soil compared to sole application of chemical fertilizers which was done to demonstrate the effect of organic manures on soil physico-chemical properties in a loamy sand soil.

Panda et al. [35] observed that the use of beneficial bacteria and organic amendments not only improves the growth, yield, nodulation and profitability of cowpea but also restores soil health. They also concluded that organic amendments were at least as good as the control (recommended RDF) in respect to yield and profitability.

Chesti et al. [36] have also reported that application of organic manures significantly increased the available Nitrogen, Phosphorus and potassium in soil after harvesting green gram. Another experiment conducted by Singh et al. [37] found that combination of inorganic and organic sources of nutrients improved the soil organic carbon (SOC) content, availability of soil nutrient status, microbial biomass carbon (MBC) and dehydrogenase activity (DHA) in soil.

6. CONCLUSION

The sustainability concept of INM is better needed in this era, which provides environmental benefits along with increase in crop production. Also, INM does not jeopardize soil native nutrients. The beneficial organisms also find a safe environment and grow well providing benefits to the soil and as a result soil fertility increase. As the concept suggests, INM can match the nutrient uptake and also helps to balance macro as well as micronutrients. Beside this, the uses of different organic resources have also increase in crop productivity which is cited by various scientists time to time. The different biofertilizer provides better nutrient significantly increasing in crop yield. Being a legume crop, symbiosis with rhizobium helps cowpea to fix atmospheric nitrogen in adequate amount. Different researches have also shown the nutrient uptake in cowpea has increased by the use of different INM approaches. Numerous experiments are held globally which shown that INM also improves the physical and chemical properties of soil. Organic amendments have helped cowpea to improve in nodulation which have led to better nitrogen fixation. Some experiments have also concluded which ultimately showed that combination of inorganic and organic source of nutrient helps to improve

soil organic carbon plant metabolism. Finally, this review portrays the scope of using the organic and inorganic sources of nutrients along with the use of beneficial microorganisms.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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