REVIEW ARTICLE

NUTRIENTS REQUIREMENT IN FENUGREEK FOR THEIR GROWTH AND YIELD

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Abstract: Fenugreek (*Trigonella foenum-graecum* L.) belongs to sub family papilionaceae of leguminous family. It is an important multipurpose crop commonly used as spice, condiment, food, fodder, soil renovator and medicine for a wide range of disease. It is a source of raw material for pharmaceutical and perfume industries. Increase in growth and quality throw suitable management of farm practices could contribute to income of farm land industries. Plant growth depends upon metabolic process, which is governed by genetic makeup, climatic and edephic factors. Therefore, appropriate farming practice involving optimum level of nutrients through different sources under different growth condition can help in widespread and economical cultivation of the crop. Studies indicate that the uses of appropriate fertilizers at right time are necessary to maximize overall performance of crop. To achieve the objective of sustainable crop production, the study undertaken by different workers on the effect of organic and inorganic nutrients on growth and yield of fenugreek is needs to be reviewed.

Keywords: Fenugreek, Nitrogen, Phosphorus, Vermicompost, Biofertilizer, Yield

INTRODUCTION

Fenugreek belongs to *Trigonella* genus of leguminous family.The two important species are *Trigonella foenum-graecum* (common methi) and *Trigonella corniculata* (kasurimethi). It is an annual, self pollinating dry land crop widely cultivated in India and other part of world (Acharya *et al*., 2006). It was cultivated in part of Europe, Northern Africa, West and South Asia, North and South America, Australia and India (Mehrafarin *et al*., 2011). In India, fenugreek is mainly grown in Rajasthan, Gujarat, Madhya Pradesh, Maharastra and Haryana (Godara *et al*.,2012).

Fenugreek has been grown over 2500 years for its medicinal properties (Nehra *et al*., 2006). It is used in folk medicine for a wide range of disease including diabetes (Tuncturk, 2011). Fenugreek seed contain volatile oil, protein, sugar, mucilage and alkaloid. It is effective in dysentery, diarrhea, dyspepsia, loss of appetite, chronic cough, enlargement of spleen and diabetes. It is a vegetable for human and forage for cattle (Ahmed *et al*., 2010). Seeds of fenugreek are used as a spice, condiment, artificial flavoring of maple syrup and production of hormone (Jorgensen, 1988). Its leaves and seeds are used as anti-diabetic, lowering blood pressure & cholesterol, anticancer, roasted grain as coffee substitute, insect control in stored grain and perfume industry (Mehrafarin *et al*., 2011). As it is a multipurpose crop, so, it should be cultivated on large scale.

Cultivation of crop needs information about its response to nutrient sand farm practices. Proper use of nutrients play important role in increasing yield, quality and quantity of product (Sehatoleslami *et al*., 2013).Nitrogen and phosphorus are major plant nutrients. Nitrogen is essential constituent of amino acid, protein, nucleic acid, flavin, pyridine, enzyme and coenzyme which contribute to growth of plant (Mehta *et al*., 2011). Nitrogen promotes increased growth, good leaves, developed stem and dark green colour plant (Zandi *et al*., 2011). Phosphorus is a structural component of nucleic acid, coenzyme, phosphoprotein and phospholipid. It play important role in cellular energy transfer, respiration and photosynthesis (Tuncturk, 2011).It also enhances symbiotic nitrogen fixation (Mehta *et al*., 2011). Potassium and zinc have important role in plant protection under stress condition. Potassium is required for maintenance of Co_2 fixation, high pH in stomata and oxidative damage to chloroplast. Zn helps in root growth and drought tolerance by increasing Auxin production (Sehatoleslami *et al*., 2013). Sulphur play important role in plant metabolism and has positive effect on root growth in plant (Basu *et al*., 2008). An adequate supply of nitrogen, phosphorus, organic manure and proper seed rate will leads to higher productivity in fenugreek (Deora *et al*., 2009).Heavy use of chemical fertilizer has adverse effect, whereas biofertilizers are eco-friendly (Mishra *et al*.,2011).

There is a gap between nutrient supply and removal from soil. It can be bridged by combined use of chemical fertilizers and biofertilizers (Mehta *et al*.,2011). Combined use of organic and inorganic nutrients supplies most of the nutrients to plant and sustain soil health (Godara *et al*., 2011). Agricultural waste are good source of organic nutrients which can be converted into compost, vermicompost , farmyard manure and dry leaf manure (Ghadge and Jadhar,

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2013). Plant growth depends on metabolic processes which are governed by genetic makeup, climatic and edephic factors. Therefore, growth and yield can be regulated by improving environment through agronomic treatments (Ahmed *et al*., 2010). Although fenugreek is a multipurpose crop but it has not obtained due importance in our cropping pattern (Mehrafarin *et al*.,2011), therefore, present study conducted with the objective of investigating the cultivation aspect of fenugreek and to standardize optimum nutrients management on growth and yield parameters of fenugreek.

Effect on growth parameters:

Nitrogen and phosphorus-Application of 20 kg nitrogen $ha^{-1}$and 40 kg P_2O_5 ha^{-1} significantly enhanced plant height, dry matter and number of branches per plant (Deora *et al*.,2009), whereas, increased growth parameters were also reported with application of 40 kg nitrogen $ha^{-1}$and 45 kg P_2O_5 ha^{-1}in fenugreek (Godara *et al*.,2012). These results are in conformity with the other workers who reported significant increase in growth character of fenugreek with application of 46.5kg P_2O_5 ha^{-1}(Ahmed *et al*., 2010). Mehta *et al.*(2010) have also reported higher plant height, dry matter accumulation and leaf area with application of 20kg nitrogen ha^{-1}. Significant increase in growth parameter was observed with application of nitrogen 40 kg ha^{-1}along withvermicompost5 t ha^{-1} (Dubey *et al*.,2011).

Khiriya *et al*.(2001) also reported increase in growth parameter of fenugreek with increasing level of phosphorus up to 40 kg ha^{-1}.Mehta *et al.* (2010) and Bhunia *et al.*(2006) were also in agreement with the results of the other researchers who observed increase in growth parameter *i.e.*, plant height, dry matter accumulation and leaf area, with the application of 40 kg P_2O_5 ha^{-1}. But, according to Gour *et al.* (2009) these growth parameters were recorded maximum with application of 60 kg P_2O_5 ha^{-1}. Higher plant height in fenugreek were also reported from 30 kg P_2O_5 ha^{-1} (Tuncturk, 2011), whereas from 90kg P_2O_5 ha^{-1} by Mavai *et al.*(2000) observed enhanced growth parameter from 60 kg P_2O_5 ha^{-1}. Increasing level of phosphorus significantly increase number of branches in fenugreek (Khan *et al*., 2005). Number of branches per plant significantly increased with increasing level of phosphorus up to 60 kg ha^{-1}(Gour *et al*., 2009 and Kumar *et al*., 2013). Most of the researchers were not confirm the findings of Khan *et al.* (2005), they reported that phosphorus application showed no significant effect on growth parameter of fenugreek. Majority of studies suggested that application of approximately 40kg P_2O_5 $ha^{-1}$was sufficient for fenugreek growth. The differences in result might be due to differentials in environmental condition under which these studies were carried out.

Vermicompost-Application of vermicompost had significantly effect on growth parameters of fenugreek (Jat *et al*., 2006). Application of 4 t ha^{-1}vermicompostsignificantly enhanced plant height and number of branches per plant in fenugreek (Deora *et al*., 2009). Growth parameters enhanced with application of 5 t ha^{-1}vermicompost along with 40kg nitrogen per hectare (Dubey *et al*., 2011), whereas, Karmegam (1999) reported that growth of green gram increase with application of 3 t vermicompost per hectare. Number of branches per plant, number of pod per plant and pod length was recorded maximum with the application of vermicompost4 t ha^{-1} (Jat *et al*., 2006 and Kumar *et al*., 2013).Integration of 50% RDF through poultry manure + 50% RDF through inorganic source to fenugreek recorded higher number of branches per plant and biological yield in fenugreek (Chaudhary *et al*., 2011).

Biofertilizers- Phosphorene dissolves the bound form of phosphate and makes it available to plant which leads to increase in plant growth and dry matter (Ahmed *et al*., 2010). Application of *Rhizobium* or PSB resulted in higher plant height but dry matter and leaf area was significantly higher with combination of *Rhizobium* spp. and PSB (Mehta *et al*., 2010). These results are in harmony with findings of Bhunia *et al.* (2006) in fenugreek, whereas, Rammurti (1996) has not confirm the above findings. He observed that before sowing if seed inoculated with *Rhizobium* had no effect on different growth parameters in fenugreek, but Panghal *et al.* (2014)reported that plant height, number of branches per plant, number of pod per plant and pod length was increased significantly if seeds of fenugreek treated with *Rhizobium* + PSB solution before sowing when compared to without inoculation.

Effect on yield attributes and yield:

Nitrogen and phosphorus–Application of nitrogen has significant effect on yield and yield attributes in fenugreek. Application of 25 kg N ha^{-1} produced highest number of pod per plant but maximum seed yield and biological yield was obtained from 75 kg N ha^{-1} (Zandi *et al*., 2011). Mehta *et al.* (2011) reported that number of seed per pod, number of seed per plant, 1000 seed weight, seed and biological yield increased with 20 kg N $ha^{-1}$and these findings were also confirmed by Tuncturk *et al.* (2011) and Gowda *et al.* (2006). Application of 40 kg N ha^{-1}+45 kg P_2O_5 ha^{1}recorded higher pod length, pod per plant ,seed per pod and 1000 seed weight (Godara *et al*., 2012 and Mavai, 1997) Whereas Bhunia *et al.* (2006) recorded significantly higher seed and straw yield with20 kg N ha^{-1}+40 kg P_2O_5 ha^{-1}. The difference in results might be due to difference in environmental and soil conditions under which these studies were carried out. Adequate supply of nitrogen may increase photosynthesis and translocation of photosynthate, which increases yield by increasing flowering and fruiting.

Many researcher reported higher seed yield in fenugreek with application of phosphorus (Chaudhary, 1999; Khan *et al*., 200519 and Mavai *et*

al., 2000). Maximum seed yield was obtained when 40 kg ha^{-1} phosphorus was applied (Basu *et al*., 2008 and Bhunia *et al*., 2006). Whereas, other researchers are in agreement that mineral fertilizer applied at a rate of 60 kg P_2O_5 ha^{-1} resulted in maximum number of seed per pod,1000 seed weight, number of seed per plant, seed yield, biological yield and harvest index (Gour *et al*., 2009 and Khan *et al*., 2005). Application of 60 kg P_2O_5 ha^{-1} resulted in higher number of pod $plant^{-1}$,1000seed weight, whereas, highest seed yield was obtained with the application of 60 and 90 kg $P_2O_5ha^{-1}$(Tuncturk ,2011).Whereas, Khan *et al.* (2005) reported that number of pod per plant was not affected by phosphorus application but phosphorus application improved performance in term of 1000 seed weight. Some researchers reported that application of 60 kg P ha^{-1} significantly increased number of pod per plant, but 40 kg P ha^{-1} significantly increased number of seed per pod and seed yield (Basu *et al*., 2008; Bhunia *et al*., 2006; Kumar *et al*., 2013; Mehta, Kumar *et al*., 2011 and Mehta *et al*., 2010). Applied phosphorus might have enhanced nitrogenase activity which increase root nodulation and various physiological process in plant .It increase translocation of photosynthate which results in increased seed yield.

Vermicompost **-** Number of pod per plant, seed yield and straw yield significantly increased with application of $4tha^{-1}$vermicompost in fenugreek (Kumar, 2013). Whereas, other researchers suggested that application of 5t ha^{-1}vermicompostand 40 kg N ha^{-1}along with *Rhizobium*gave maximum seed and straw yield (Bhunia, 2006). Significantly higher number of pod per plant, seed and straw yield recorded with combined application of FYM 10t ha^{-1} +vermicompost5t ha^{-1} + *Rhizobium*+PSB[Kumawat *et al*., 2013 and Fathi *et al*., 2012). Combined application of 50% RDF through vermicompost + 50% through inorganic source increased seed yield, straw yield and biological yield (Godara *et al*., 2012). Integration of 50% RDF through poultry manure + 50% RDF through inorganic source to fenugreek recorded higher numberof pod per plant, seed per pod, seed yield and biological yield (Chaudhary *et al*., 2011).Vermicompost supply additional nutrients and increase solubility of soil nutrientsit increase yield by increasing flowering and fruiting.

Biofertilizers**-** Inoculation of seed with PSB and *Rhizobium* increased seed and straw yield in fenugreek (Kumar *et al*., 2000 and Mehta *et al*., 2011).These results are in accordance with findings of Bhunia *at el.*(2006), Chaudhary (1999) and Panghal *et al.* (2014). Application of bio-phosphate fertilizer significantly increase pod per plant, weight of pod $plant^{-1,}$,seed and straw yield (Ahmed *et al*., 2010).Application of *Rhizobium* increase root growth and PSB increase phosphate solubilizaion it increase growth and yield.

CONCLUSION

Fenugreek is a commercial and multipurpose crop. It is used as medicine for wide range of disease, spices, condiments, food, forage, soil renovator, insect control in stored grain. It is a dryland legume crop which responds to application of irrigation. Studies related to agronomic practices which could produce high growth of fenugreek under different environmental conditions are uncommon. Efficient agronomic practice for Indian growing conditions needs to be developed. There is a need to standardize the optimum level of nutrient under different growth conditions for assured and high quality as well as quantity of fenugreek. Appropriate farming for wide range of growth condition can help in widespread cultivation to meet increasing demand of this crop.It can be inferred from the present review that higher growth, development and yield of fenugreek can be obtained with application of 20 kg N and 40kg P_2O_5 ha^{-1} with inoculation of seed by PSB and *Rhizobium*. The differences in result might be due to different environmental conditions under which these studies were conducted. Researcher conducted their experiment under different condition and did not combine the level of nutrient with different spatial arrangements. Wide range of environmental conditions prevails in India and world which affect plant growth. Requirements of plant change with change in climatic and edephic factors. Standardization of optimum nutrient level needs verification by more studies under different conditions. Therefore, confirmation of trends seen in studies needs to be obtained before providing more specific recommendation of nutrients level can be made.

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