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Integration of organic and inorganic nutrient sources for enhancing field pea productivity: A review

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Abstract
Pulses on account of their significant contribution in balancing the nutrition and strategic position in the bio-spectrum of the earth cannot be overlooked. These are only the richest source of proteins in the agricultural crop galaxy. Pulses are not only providing proteins to vegetarian community but also sustain the edaphic resources by virtue of their dynamic roots. The pulses constitute an association with Rhizobium bacteria living in their roots symbiotically. The field pea (*Pisum sativum* L.) crop is a high yielding, input responsive and relatively stable pulse crop of Rabi season that contributes significantly to the total pulses production of the country. It has high level of amino acids, especially lysine and tryptophan. Field pea inoculated with the appropriate strain of bacteria is able to fix a large portion of its nitrogen requirement from air in the soil through biological nitrogen fixation. Biological nitrogen fixation is an important nitrogen source due to the fact that it requires less energy and causes less environmental pollution. On the other hand inorganic fertilizers play a special role in crop production and are main suppliers of major plant nutrients (N, P and K). Intensive agricultural practices have resulted in numerous problems like micro nutrient deficiencies, nutrients imbalances, and deterioration of soil health and decline crop yield, Therefore, the rational and practical means to maintain soil fertility and to supply plant nutrient in balanced proportion, is to practice combined use of organic and inorganic sources of plant nutrients.

Keywords: Biofertilizers, organic and inorganic sources, field pea

Introduction

Intensive agricultural practices have resulted in numerous problems like micro nutrient deficiencies, nutrients imbalances, and deterioration of soil health and decline crop yield. Chemical fertilizers are main suppliers of major plant nutrients (N, P and K). The involvement of bacteria mediated nitrogen fixation in plant has been recognized as an unquestionable natural input for legumes. Seed inoculation with suitable strain of bioinoculants can increase the yield of pulses by enhancing nodulation and response for this practice depends upon the soil conditions and native form of the soil. No single source of nutrient is capable of supplying plant nutrients in adequate amount and in balanced proportion. Therefore, the current trend is to explore the possibility of supplementing chemical fertilizers with biofertilizers and organic fertilizers. Biofertilizers may add nitrogen and increase native phosphorus availability to some extent. Therefore, the rational and practical means to maintain soil fertility and to supply plant nutrient in balanced proportion, is to practice combined use of organic and inorganic sources of plant nutrients.

Effect of organic and inorganic sources on growth, yield attributes and yield of field pea:
Inoculation of field pea seeds with specific strain of *R. leguminosarum* led to the fixation of nitrogen 55 to 77 kg ha^{-1} by field pea crop (Nutman, 1976; Pandey *et al.* 2002; Shayed *et al.* 2002) [1, 2, 3]. Chahal (1991) [4] observed increase in dry matter production and grain yield with the increase in nodulation in legumes sown after inoculation with *Rhizobium* due to significant increase in the activity of enzyme nitrogenase, which improved nitrogen fixation as well as the grain yield in field pea. Inoculation of field pea with *Rhizobium* enhance all symbiotic parameters and produced a significant increase in nitrogenase activity which resulted in increased plant dry weight and nitrogen content (Buttery and Gibson,1990; Ryderberg, 1990) [5, 6]. Fixation of atmospheric nitrogen by field pea plants was found to increase up to grain filling stage and then decreased rapidly. Shabir *et al.* (2010) [7] observed that the rate of nitrogen fixation declined with the onset of pod filling stage in small determinate cultivars of field pea. But in large indeterminate cultivars, nitrogen fixation rate did not reach its peak until

several weeks in the pod filling period. Phosphorus application significantly improved the number of pods plant^{-1} over the control in field pea crop. The grain yield was significantly augmented with the use of phosphorus over the control (Yadav *et al*. 1992) [8]. Phosphorus application caused significant increase in grain yield over no phosphorus in a soil analyzing medium in available phosphorus. However, significant differences did not exist among the variable doses ranging from phosphorus 25 to 75 kg ha^{-1} (Yadav *et al*. 1990) [9]. Yadav *et al*. (1993) [10] reported that the application of phosphorus to field pea significantly improved the leaf area plant^{-1}, leaf area index and leaf area ratio over the control due to increased number of leaves and branches, while relative growth rate reduced with phosphorus application as compared to the control**.** Dass *et al.* (2005) [11] reported that the application of phosphorus 75 kg ha^{-1} to October sown vegetable pea resulted in significantly higher growth, yield attributes and yield compared to November sown crop. Rajput and Kushwah (2005) [12] concluded that the highest yield of field pea crop was recorded with the application of recommended dose of fertilizer followed by soil application of bio-fertilizers mixed with FYM 25 kg ha^{-1} along with 50 per cent recommended dose of fertilizers and were statistically at par. Mishra *et al.* (2010) [13] reported that the application of 100 per cent RDF and seed inoculation with *Rhizobium* + PSB + PGPR improved fresh and dry weight plant^{-1}, nodules number, yield attributes and yield in field pea. Kumari *et al*. (2012) [14] reported that application of inorganic nutrients, bio-fertilizers and zinc to field pea produced the highest seed yield over the recommended inorganic nutrients. Erman *et al*. (2009) [15] concluded that seed inoculation and phosphorus application (60 kg ha^{-1}) to field pea had significant effect on yield attributing characters. Bhat *et al.* (2013) [16] found that recommended dose of phosphorus and dual inoculation of seed with *Rhizobium* and PSB produced significantly higher seed and stover yield of field pea. Kumari *et al*. (2010) [17] reported that superimposition of 50 per cent nitrogen through vermicompost over the recommended dose, along with the seed inoculation with bio-fertilizer (*Rhizobium* + PSB + PGPR) and application of Zn resulted in significantly higher yield, harvest index, B: C, protein and nutrient content in dwarf field pea. Erman *et al.* (2009) [18] concluded that the application of nitrogen 20 kg ha^{-1} + *Rhizobium* inoculation in field pea gave significant increase in yield and yield attributing characters. Negi *et al.* (2007) [19] concluded that combine application of FYM + RDF and bio-fertilizers in vegetable pea recorded the significant values of yield and yield attributing characters, nitrogen, phosphorus, potassium uptake and harvest index. Mishra *et al.* (2010) [20] reported that the application of 100 per cent recommended dose of fertilizer (RDF) and seed inoculation with *Rhizobium* + PSB + PGPR improved fresh and dry weight plant^{-1} and nodules number in field pea. (Bhat *et al.* 2013; Sharma *et al.* 2002) [21, 22] found that recommended dose of phosphorus and dual inoculation of seed with *Rhizobium* and PSB produced significantly higher NPK content in field pea crop and protein content in seed.

Naik *et al*. (1991) [23] observed a significant increase in phosphorus uptake at maturity by phosphorus application over no phosphorus to field pea on a sandy loam soil.

Conclusion

An overall improvement in the growth, yield attributes and yield of field pea crop due to application of organic and inorganic nutrient sources particularly through seed inoculation and was possibly due to increase in nodulation as this parameter contributes greatly towards atmospheric nitrogen fixation which is an essential nutrient for plant growth and development.

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