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Growth and Effect on Pea (Pisum Sativum l.) of Fertilizers – A Review

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Abstract – Modern agriculture is getting more and more dependent upon the supply of synthetic inputs such as chemical fertilizers, pesticides etc. which are inevitable to meet food demand for growing population in the world. However, excessive, imprudent and imbalanced use of these inputs may throw devastating impacts on the water, air and soil environments. Probably the soil environment is the most vulnerable to the direct effects of these practices in modern agriculture. They could destroy the fertility of the soil in a long run which compels the scientific community to look for the alternatives like organic farming. Biofertilizers are one of the most important tools in organic Agriculture. Biofertilizers are prepared from live or latent cells of different microorganisms and applied to seed, soil or composting areas to augment the availability of nutrients and to improve fertility status of soil. The role and importance of bio-fertilizers in sustainable crop production has been reviewed by several authors and found that application of NPK as a source of chemical fertilizer integrated with vermicompost and biofertilizers were found to be superior with regards to yield and yield-attributing characters over control and sole application of 100% recommended dose of chemical fertilizers. The pea plant can readily absorb and utilize the nutrients and express the highest value in all characters and finally the pod yield under combined application of organics and inorganics.

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INTRODUCTION

Pea (*Pisum sativum* L .) is one of the important vegetables in the world and ranks among the top 10 vegetable crops (Ref./ in the world?). Pea is commonly used in human diet throughout the world and it is rich in protein (21-25 %), carbohydrates, vitamin A and C, Ca, phosphorous and has high levels of amino acids lysin and trypophan (Bhat *et al*., 2013). Its cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus play a vital role in fostering sustainable agriculture (Negi *et al.* 2006). Therefore, apart from meeting its own requirement of nitrogen, peas are known to leave behind residual nitrogen in soil 50-60 kg/ha (Kanwar *et al*., 1990).

Chemical fertilizers are needed to get good crop yields but their abuse and overuse can be harmful for the environment and their cost cannot make economic and profitable agricultural products (Bobade *et al.,* 1992). The increased use of chemicals under intensive cultivation has not only contaminated the ground and surface water but has also distributed the harmony existing among the soil, plant and microbial population (Bahadur *et al*., 2006). Biofertilizers on the other hand are cost-effective and renewable source of plant nutrients to supplement the parts of chemical fertilizers. Biofertilizers are known to play an important role in increasing availability of nitrogen and phosphorus besides improving biological fixation of atmospheric nitrogen and enhance phosphorus availability to crop (Bhat *et al.*, 2013). Therefore, introduction of efficient strains of rhizobium in soils with low nitrogen may help augment nitrogen fixation and thereby boost production of crops.. Phosphorus is known to play an important role in growth and development of the crop and have direct relation with root proliferations, straw strength, grain formation, crop maturation (Bhat *et al*., 2013). Enhancing P availability to crop through phosphate-soubilizing bacteria (PSB) holds promise in the present scenario of escalating prices of phosphatic fertilizers and a general deficiency of p in Indian soils (Alaguwadi and Gaur, 1988). A judicious use of organic manures and biofertilizers may be effective not only sustaining crop productivity and in soil health, but also in supplementing chemical fertilizers of crop (Jaipal *et al.* , 2011).

Growth of Pea Effect of inorganics application

Minimum number of days were taken to complete 50% germination by the seed harvested from plants received 69 kg P2O5/ ha, while maximum days were

taken by the seeds procured from plants received no phosphorus. Mean values for "K" levels revealed that minimum number of days to complete 50% germination was required by the seed taken from plants received 100 kg K2O/ ha, closely followed by those harvested from the plants received 50 kg K2O/ha (Amjad *et al.,* 2004). Phosphorus and potassium application had significant effect on vine length while their interaction indicated nonsignificant differences among the treatment means. The result indicates that the vine length significantly increased with the increasing rate of phosphorus and potassium up to 69kg P2O5 and 100 kg K2O ha-1 respectively (Akhtar *et al*., 2003).

Effect of bio-fertilization

Pea (Pisum sativum) belongs to family leguminous is a well-known vegetable of the world. Pea is commonly used in human diet throughout the world and it is rich in protein (21-25 %), carbohydrates, vitamin A and C, Ca, phosphorous and has high levels of amino acids lysine and tryptophan (Bhat et al., 2013). Its cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus plays a vital role in fostering sustainable agriculture (Negi et al., 2006). Application of excessive chemical fertilizers may affect soil health and sustainable productivity. They have not only left soils degraded, polluted and less productive but have also posed severe health and environmental hazards. Organic farming methods (such as the use of biofertilizers and vermicompost) would solve these issues and make the ecosystem healthier. Biofertilizers on the other hand are cost-effective and renewable source of plant nutrients to supplement chemical fertilizers. Biofertilizers are known to play an important role in increasing biological fixation of atmospheric nitrogen and enhance phosphorus availability to crop (Bhat et al., 2013). Similarly humus derived from vermicompost is most commonly used for sustainable production (Premsekhar and Rajashree 2009) due to its beneficial effects on nutrient uptake and retention, pest control and productivity (Barrios et al., 2011). Use of vermicompost in horticulture at large scale can solve the management and disposal problem associated with macrophytes and also resolves the deficiency of organic matter in such soils in addition to nutrient depletion.

El-Beheidi *et al*. (1985) found that the growth of pea cultivar Progress No. 9; i.e., stem length, number of both branches and leaves / plant were not significantly affected by nodulation treatments while, nodules number / plant was significantly increased by inoculation treatments. Also, Zaghloul *et al*. (1988) reported that plant height of pea, cultivar Little Marvel, was not affected by seed inoculation with *Rhizobium*, but number of leaves plant was significantly increased. In addition, Abdel-Ghaffar and Mohamed (1992) found that plant height of pea, cv. Vctory Frezer, was significantly increased by seed inoculation. They found also that nodule number / plant was significantly affected by *Rhizobium* inoculation. Prasad and Maurya (1992) reported that growth and nodulation of pea plants during winter season significantly increased by Rhizobium inoculation of seeds.

Serdyuk *et al*. (1992) stated that increase in seed germination and root and shoot lengths of pea seedling could be due to the action of one or more of the growth promoting substances especially auxin and gibberellins.

Also, Gheeth (1993) found that plant height, number of both branches and nodules /plant were increased markedly with *Rhizobium* inoculation treatment compared with uninoculation of pea plants. Moreover, Hassan *et al*. (1993) indicated that plant height and number of branches/plant significantly increased by *Rhizobium* inoculation of pea seeds of cultivar *Little Marvel*. They added that number of effective nodules / plant markedly increased by *Rhizobium* inoculation treatments.

Srivastava and Ahlawat (1995) reported that inoculation of pea seeds with mixture of *Rhizobium* and phosphorein gave the highest values of plant height and nodules number compared with inoculation with a single of *Rhizobium* or phosphorein. Ramadan (1997) indicated that seed inoculation with *Rhizobium*, revealed significant effect on all studied morphological characters; i.e. stem length (cm), number of branches, number of leaves and number of nodules/plant compared to untreated one(control). In addition, Ahmed (1999), under sandy soil conditions on pea plants, indicated that inoculation with *Rhizobium* significantly increased number of nodules /plant. Similarly, El-Mansi *et al*. (2000) indicated that total root length of pea, branches and leaves number, nodules number/plant and stem length were significantly increased with *Rhizobium* inoculation compared with control. Sarg and Hassan (2003) reported, on pea plant, that plant height, both leaves and branches number /plant and number of nodules were significantly increased with *Rhizobium* inoculation compared with the uninoculated one. Solieman *et al*. (2003) reported, on pea plant, that inoculation of pea seeds with *Rhizobium* significantly increased plant height, number of branches/plant compared to the uninoculated one.

Rather *et al.* (2010) find out the effect of biofertilizers (*Rhizobium*, *Azotobacter* and phosphate solubilizing bacteria (PSB)) application on growth, yield and economics of field pea (*Pisum sativum* L.). The Coinoculation of all the three bio-fertilizers *i.e. Rhizobium*, Azotobacter and PSB produced significantly higher growth characters as compared to absolute control and when inoculated them individually. The treatment T8 comprising *Rhizobium* +*Azotobacter* + PSB gave highest growth in terms of

plant height (45.26 cm), number of branches/ plant (4.20), number of leaves/ plant.

Effect of combined application of inorganics and bio-fertilizer application

Negi *et al.* (2006) recorded that number of nodes significantly increased with biofertilizers, FYM, NPK and their combined application and lime further increased the number of nodes per plant. El-Shaikh *et al*. (2010) conducted a field experiment to investigate the efficiency of VA-mycorrhizal inoculants as an effective alternative for phosphorus chemical fertilizer on the productivity of some garden pea cultivars (Master B, Early perfection and progress no.9). They reported that early perfection cultivar gave the highest number of branches/plant (3.56 and 3.23) as compared to other cultivars with application of phosphorus and inoculation with VA-mycorrhiza. Jaipaul *et al.* (2011) were study the effect of different organic manures in comparison to inorganic inputs on growth, yield, and quality attributes of garden pea (*Pisum sativum* L.). Poultry manure + biofertilizer resulted in plant height of garden pea *at par* with integrated nutrient management. Sharma and chauhan *(*2011) reported that 100% NPK +Vermicompost + Biofertilizers gave the maximum plant height of 72.83 cm which was statistically significant over all other treatments. Sharma *et al. (*2011) reported that 100% NPK +Vermicompost + Biofertilizers gave the maximum plant height of 72.83 cm which was statistically significant over all other treatments. Concluding these facts it can be said that growth parameters like plant height, number of branches, and number of leaves are increased with biofertilizers. So combined application of NPK as chemical fertilizers along with organics like FYM, vermicompost as well as biofertilizers can increase the growth significantly than control (no-inoculation). This might be due to the fact that N-fixer and P-solubilizing microorganism they secrete certain organic acids and some biochemical, which are growth promoting on nature.

Yield Attributing Characters of Pea Effect of inorganics application

Chandra *et al.* (1989) reported that application of phosphorus to Pea cvs. Pea-116 and T-163 resulted in increased 1000 seed weight. Akhtar *et al*. (2003) studied that the highest rate of phosphorus application (69 kg P2O5/ha) produced maximum number of pods per plant and number of grains per pod, pod length were obtained from the plants received K2O @ 150 kg/ha. Minimum numbers of pod was recorded in those plants, which received no potassium. Amjad *et al*. (2004) reported that the highest weight of 1000 seeds was recorded from the plants received 69 kg/ha P and lowest from those plant received no phpsphorus Potash application also recorded to improve the seed weight in pea in that study. Achakzai and Bangulzai (2006) revealed that maximum number of fresh pod plant-1, pod length was recorded with fertilizer dose of 100 + 60+ 40 kg NPKha-1.

Effect of bio-fertilization

Zaghloul *et al*. (1988) stated that seed inoculation with *Rhizobium* did not significantly increase the average number of seeds / pod in pea cv. *Little Marvel*. Abdel-Ghaffar and Mohamed (1992) demonstrated that inoculation with Rhizobium significantly increased 100 green seeds weight of pea cv. *Victory Freezer*. Karaine *et al*. (2009) conducted a field experiment to know the effect of Rhizobial inoculation on growth, yield, nodulation and biochemical characters of vegetable pea (Pisum sativum). Inoculation with *Rhizobium leguminosarum* @ 20 g kg-1 of seed and enhanced biomass production through branching but delayed maturity. It resulted in more pods, higher test weight, increased nodulation and enhanced harvest index. Rather *et al.* (2010) conducted a field experiment to find the out the effect of biofertilizers (*Rhizobium*, *Azotobacter* and PSB application on growth, yield and economics of field pea (*Pisum sativum* L.) and found that number of pods/ plant, number of seeds/ pod, pod length and1000 grain weight (g) of pea increased by co-inoculation of bio-fertilizers and were highest for the treatment in which *Rhizobium*, *Azotobacter* and PSB were coinoculated. Moreover, the co-inoculation of *Rhizobium* and PSB also gave beneficial results in respect to other treatments. Jaipaul *et al*. (2011) conducted field experiments in 2006–08 to study the effect of different organic manures in comparison to inorganic inputs on growth, yield, and quality attributes of garden pea (*Pisum sativum* L.). Poultry manure + biofertilizer resulted in number of pods/plant, number of seeds/pod, pod length of garden pea at par with integrated nutrient management.

Effect of combined application of inorganics and biofertilizer application

Negi *et al*. (2006) reported that number of pods per plant was increased by biofertilizers, FYM, NPK and lime application. The combined effect of NPK +FYM was far superior to individual one. They also reported that pod length is significantly increased under the influence of biofertilizers by 20.27 % weight of 100 seeds significantly increased biofertilizers viz, *Rhizobium leguminosarum* + *Pseudomonas striata* by 17.4% over no inoculation. Mishra *et al.* conducted a field experiment during two consecutive Rabi seasons of 2007 and 2008 to study the effect of biofertilizers in conjunction with inorganic fertilizers on growth and yield of dwarf field pea (cv. Jai) and found that number of pods plant-1, number of seeds pods-1 at maturity attributed significantly increasing with the application of 100% DRF and seed inoculation of *Rhizobium* + PSB + PGPR. El-Shaikh *et al*. (2010)

conducted a field experiment to investigate the efficiency of VA- mycorrhizal inoculants as an effective alternative for phosphorus chemical fertilizer on the productivity of some garden pea cultivars (Master B, Early perfection and progress no.9). They reported that early perfection cultivar gave the highest number of pods/plant (31.93 and 32.46) as compared to other cultivars with application of phosphorus and inoculation with VAmycorrhiza.

The most interesting result was found with interaction among VA-mycorrhizal inoculants with early perfection cultivar. Sharma and Chauhan (2011) found maximum number of grains per pod of 8.04, pod length of 8.49 cm in 100% NPK +FYM + biofertilizers application and maximum pod weight with 100% NPK +FYM + biofertilizers application which was at par with100%NPK +vermicompost application.

The organic source applied to the soil through biofertilizers have influenced the soil nutrient availability through better microbial activity by *Azotobacter, Azospirillum and PSB* in fixing atmospheric N and releasing the nutrients from the soil and helped in the processes of absorption of ample nutrients and its utilization by the plants due to influence on.

Yield of Pea Effect of inorganics application

Reddy *et al.* (1998) obtained the highest yield of pea crop with 10 t ha-1 vermicompost + 100 % recommended dose of N:P:K (37.5 : 60:50). Achakzai and Bangulzai (2006) revealed that maximum pod yield plant-1, fresh pod yield ha- 1, were recorded with fertilizer in pea.

Effect of bio fertilization

El-Neklawy *et al.* (1985) reported that inoculation of pea seeds cv. *Little Marvel* with a local inoculum (okadin) or an introduced inoculum (TAL) significantly increased green pods yield. In addition, Zhagloul *et al*. (1988) indicated that total yield / feddan of inoculated pea plants cv. Little Marvel recorder significant increase (13.8%) above the untreated ones. Peres *et al*. (1990) found that inoculation of pea seeds with specific efficient strain of *Rhizobium* significantly increased seed yield.Abdel-Ghaffar and Mohamed (1992) indicated that *Rhizobium* inoculation of pea seeds, cv. victory Frezer, significantly increased average pod green weight compared with uninoculated one. In addition, Prasad and Maurya (1992) found that inoculation of pea seeds with *Rhizobium* significantly increased the total yield / feddan. Also, Gheeth (1993) found that *Rhizobium* inoculation markedly increased yield of the fresh pods/*fed* compared with uninoculated pea plants while, Farrag *et al*. (1993) mentioned that dry pod and seed yield of pea, cv. Little Marvel, were significantly increased by *Rhizobium* inoculation. Hassan *et al.* (1993) concluded that inoculation of pea seeds with Rhizobium was most effective in enhancing the total yield / feddan. Abdel-Ghaffar *et al*. (1994) demonstrated that seed inoculation with *Rhizobium* significantly increased the total green pods of pea plants. Srivastava and Ahlawat (1995) reported that inoculation of pea seeds with dual *Rhizobium* and phosphorein gave the highest yield and its components than inoculation with *Rhizobium* or phosphorein alone.

CONCLUSION

The above results showed that the pure chemical or pure organic treatments could not result in highest yield and quality. The integration of biofertilizers along with chemicals and FYM not only has a positive effect on the yield attributes of pea and gives highest net returns but also Increasing soil fertility status and ecofriendly as well (Bhattarai *et al*. 2003).

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