Effects Of Organic And Inorganic Fertilizers On The Growth, Yield And Soil Properties Of Field Pea (*Pisum Sativum* L.)

Roshan Kshetrimayum[1], Raja Joshi[2*], Mansi Nautiyal[3], Jayanti Ballabh[4], Sunil Prakash[5], Diksha Nautiyal[6] and Gaurav Jain[7]

[1]M.Sc. Ag. (Agronomy) Student, SOA, Uttaranchal University, Dehradun 248007, Uttarakhand;
Email id: roshankshetrimayum46@gmail.com
[2*]Assistant Professor, SOA, Uttaranchal University, Dehradun 248007, Uttarakhand;
Email id: rajajoshi63262@gmail.com
[3]Assistant Professor, SOA, Uttaranchal University, Dehradun 248007, Uttarakhand;
Email id: mansinautiyal94@gmail.com
[4]Assistant Professor, SOA, Uttaranchal University, Dehradun 248007, Uttarakhand;
Email id: jayantiballabh1987@gmail,.com
[5]Assistant Professor, SOA, Uttaranchal University, Dehradun 248007, Uttarakhand;
Email id: sonymt099@gmail.com
[6]Assistant Professor, SOA, Uttaranchal University, Dehradun 248007, Uttarakhand;
Email id: dikshanautiyal72@gmail.com
[7]Assistant Professor, SOA, Uttaranchal University, Dehradun 248007, Uttarakhand;
Email id: gauravj888@gmail.com

***Corresponding Author:** Raja Joshi
*Email id: rajajoshi63262@gmail.com

Abstract:
The experiment entitled **"Effects of organic and inorganic fertilizers on the growth, yield and soil properties of field pea (*Pisum sativum* L.)"** was conducted at research's field and laboratories of Uttaranchal University, Department of Agriculture, Dehradun (Uttarakhand). The experiment is carried out during the rabi season of December 2022 to March 2023. The present research investigates at the effects of organic and inorganic fertilizers on the growth, yield and soil properties of field pea (*Pisum sativum* L.). The study's goal is to give useful information about the usage of organic and inorganic fertilizers optimization to improve pea crop performance. The study used a randomized block design (RBD) with three replications. Data on growth characteristics, quality traits, and yield components were gathered and examined statistically. The results demonstrated significant differences in plant growth, quality, and yield variables between treatments. The results indicate that the use of VC (Vermicompost), RH (Rhizobium), FYM (Farm Yard Manure) and NPK, influenced the growth, quality, and yield of the plants. The experiment was carried out in Randomized block design (RBD) with 7 treatments and 3 replications included VC (Vermicompost), RH (Rhizobium), FYM (Farm Yard Manure) and NPK). The variety of pea used was Arkel. Experimental observation on crop growth parameters, yield attributes and quality parameters were recorded and analyzed statistically.

Key words: Vermicompost, FYM, Rhizobium, NPK, Pea

1. Introduction

A pea, also known as (*Pisum sativum* L.), is an herbaceous yearly crop that is farmed for food. Around the world, it is a crop that is planted during the cool seasons. There are two categories that it falls under. For canning and preserving vegetables, use (*Pisum sativum L. var. Hortense*) is a type of garden or table pea. On the other hand, the field pea (*Pisum sativum* L. *var. arenes*), which is cultivated to produce dry peas similar to the split pea and is sold fresh, frozen, or canned, is eaten as a vegetable. "Dal" is also made from mature seeds of this kind. Given its high content of fiber, protein, starch, trace minerals, and a variety of phytochemicals, which have long played a significant role in human health.

Worldwide, 2.74 million hectares of land are used to produce 21.22 million tonnes of peas (FAO, 2018). One of the most significant pulse crops worldwide is the pea, with an estimated 76.26 lakh hectares under cultivation. China, Russia, India, Ethiopia, and the United States are the main producers of field peas. Canada is the world leader in both production and area, with 46.11 lakh tonnes (32%) and 16.97 lakh ha (22%) of field pea area, respectively. With 10.59 lakh acres (13.89%), India is second in terms of area after Russia (13.64%). India finishes in fourth with a production of 21.99 lakh tonnes (7.04%). Ukraine has the highest productivity, with 3126 kg produced per hectare, followed by Canada (2717 kg) and Lithuania (2676 kg).

On a 0.011million hectare farm in Uttarakhand, it produces 0.055 million metric tonnes of green pods each year. Due to lack of knowledge on proper planting times, spacing requirements, and other management practices, the productivity of

this crop is only 48.74 q ha^{-1} (Anonymous, 2002). The crop has a very great potential in the Uttarakhand hills because of its off-season production and the strong demand for green pods during the lean season, particularly in the major cities of the Northern Plains.

Poultry manure as an organic material is particularly important since it conditions and improves soil fertility and contains all macronutrients and most of the micro-nutrients a addition of organic manure (FYM) (Al-Taey *et al.,*2018 b). Farhan (2012) showed that a significant differences among organic residue levels the addition with 5 t. ha-1 was significantly the best on plant height, number of branches, dry weight of plant, leaves chlorophyll content and total yield of broad bean plants.

The fertilization with FYM (Cattle manure) at 48 m 3 .ha-1on pea plants significantly increased pod length, pod weight, number of green seeds per pod (Hameda et al., 2012). Al-Taey (2018) achieved elevation in pepper growth and yield parameters with organic a fertilization under salinity stress, the poultry and cattle manure were superior increasing plant height, branches number, pods number per plant and pod weight of broad bean plants (Jassim and Al-Dulaimi, 2014). Soil fertilization with chemical or organic fertilizer led to a significant increase in the number of pods per plant, pod length and seed yield of broad bean plants (Jasem et al., 2015).

Abo-Basha (2016) found that addition 238 kg N.ha-1 as chicken manure increased plant length, dry weight of vegetative growth, pod length, pod weight, seeds number per pod and total yield compared with NPK fertilizer (control). Using organic fertilizer (Tea waste) increased plant height and number of grains per plant, used egg shell powder increased number of branches per plant, used egg shell powder, banana peel and tea waste showed positive effect on pod yield (Wazir *et al.,*2018)

Poultry manure as an organic material is particularly important since it conditions and improves soil fertility and contains all macronutrients and most of the micro-nutrients a addition of organic manure (FYM) (Al-Taey*et al.,*2018 b). Farhan (2012) showed that a significant differences among organic residue levels the addition with 5 t. ha-1 was significantly the best on plant height, number of branches, dry weight of plant, leaves chlorophyll content and total yield of broad bean plants.

The fertilization with FYM (Cattle manure) at 48 m 3.ha -1on pea plants significantly increased pod length, pod weight, number of green seeds per pod (Hameda et al., 2012). Al-Taey (2018) achieved elevation in pepper growth and yield parameters with organic a fertilization under salinity stress, the poultry and cattle manure were superior increasing plant height, branches number, pods number per plant and pod weight of broad bean plants (Jassim and Al-Dulaimi, 2014). Soil fertilization with chemical or organic fertilizer led to a significant increase in the number of pods per plant, pod length and seed yield of broad bean plants (Jasem et al., 2015).

Abo-Basha (2016) found that addition 238 kg N.ha-1 as chicken manure increased plant length, dry weight of vegetative growth, pod length, pod weight, seeds number per pod and total yield compared with NPK fertilizer (control). Using organic fertilizer (Tea waste) increased plant height and number of grains per plant, used egg shell powder increased number of branches per plant, used egg shell powder, banana peel and tea waste showed positive effect on pod yield (Wazir *et al.,*2018)

According to Al-Taey *et al.*, (2018 b), poultry manure is a particularly significant organic substance since it promotes soil fertility and conditions the soil while also containing all macronutrients and the majority of the micronutrients. According to research by Farhan (2012). Taey (2018) improved the broad bean plants' plant height, branch count, pod count per plant, and pod weight by using organic fertilizer under salinity stress. Jassim and Al-Dulaimi (2014) found that chicken and cattle manure were preferable in this regard. Broad bean plants produced significantly more pods, longer pods, and seeds when the soil was fertilized with chemical or organic fertilizer. (2015) Jasem *et al.*, In comparison to NPK fertilizer (control), Abo-Basha (2016) discovered adding 238 kg N ha^{-1} as chicken manure boosted height of plant, vegetative dry weight development, pod length, pod weight, seeds per pod, and total yield.

Poultry manure as an organic material is particularly important since it conditions and improves soil fertility and contains all macronutrients and most of the micro-nutrients a addition of organic manure (FYM) (Al-Taey*et al.,*2018 b). Farhan (2012) showed that a significant differences among organic residue levels the addition with 5 t. ha-1 was significantly the best on plant height, number of branches, dry weight of plant, leaves chlorophyll content and total yield of broad bean plants.

The fertilization with FYM (Cattle manure) at 48 m3.ha-1 on pea plants significantly increased pod length, pod weight, number of green seeds per pod (Hameda et al., 2012). Al-Taey (2018) achieved elevation in pepper growth and yield parameters with organic a fertilization under salinity stress, the poultry and cattle manure were superior increasing plant height, branches number, pods number per plant and pod weight of broad bean plants (Jassim and Al-Dulaimi, 2014). Soil fertilization with chemical or organic fertilizer led to a significant increase in the number of pods per plant, pod length and seed yield of broad bean plants (Jasem et al., 2015).

Abo-Basha (2016) found that addition 238 kg N.ha-1 as chicken manure increased plant length, dry weight of vegetative growth, pod length, pod weight, seeds number per pod and total yield compared with NPK fertilizer (control). Using organic fertilizer (Tea waste) increased plant height and number of grains per plant, used egg shell powder increased number of branches per plant, used egg shell powder, banana peel and tea waste showed positive effect on pod yield (Wazir *et al.,*2018)

Poultry manure as an organic material is particularly important since it conditions and improves soil fertility and contains all macronutrients and most of the micro-nutrients a addition of organic manure (FYM) (Al-Taey*et al.,*2018 b). Farhan (2012) showed that a significant differences among organic residue levels the addition with 5 t. ha-1 was significantly the best on plant height, number of branches, dry weight of plant, leaves chlorophyll content and total yield of broad bean plants.

The fertilization with FYM (Cattle manure) at 48 m3.ha-1 on pea plants significantly increased pod length, pod weight, number of green seeds per pod (Hameda et al., 2012). Al-Taey (2018) achieved elevation in pepper growth and yield parameters with organic a fertilization under salinity stress, the poultry and cattle manure were superior increasing plant height, branches number, pods number per plant and pod weight of broad bean plants (Jassim and Al-Dulaimi, 2014). Soil fertilization with chemical or organic fertilizer led to a significant increase in the number of pods per plant, pod length and seed yield of broad bean plants (Jasem et al., 2015).

Abo-Basha (2016) found that addition 238 kg N.ha-1 as chicken manure increased plant length, dry weight of vegetative growth, pod length, pod weight, seeds number per pod and total yield compared with NPK fertilizer (control). Using organic fertilizer (Tea waste) increased plant height and number of grains per plant, used egg shell powder increased number of branches per plant, used egg shell powder, banana peel and tea waste showed positive effect on pod yield (Wazir *et al.,*2018)plant, utilisedegg shell powder, banana peel, and tea waste had a favourable impact on pod output. 2018 Wazir *et al.*

Peas can be grown in a variety of soil types, including light sand and clay. Due to excessive vegetative growth and poor pod development, highly organic soils are not suitable for producing peas. The ideal temperature range is 15 to 18 degrees Celsius. During the blooming season, high temperatures are harmful and have a negative impact on productivity. In the arid, temperate highlands, pea is a vital income crop. Peas grown on hills have a unique flavor, sweetness, and freshness. Several high-yielding cultivars are planted, despite the low (6 MT/ha) average pea output. By standardizing the field production procedure, the output of the pea crop can be boosted, providing under field conditions the highest possible ideal plant population per unit area as well as a supply of acceptable and balanced nutrients maximum yield may be attained.

Al-Saleem (2017) found that Mezza Rama cultivar outperformed Little Marvel cultivar in terms of length of plant, number of branches/plants, leaves chlorophyll, vegetative percentage of dry matter development, length of pod, organic production, and seeds yield/plant and hectare. The local cultivar outperformed the Holland Ian cultivar in terms of branch count, pods/plant, seeds/pod, and seed production. Al-Badawi and Dhary, 2017.

When seed crops were grown in crops like peas at the most ideal plant density per unit area, blooming dates, higher grain yields, and the number of days until the first harvest. The life cycle of the pea crop uses about 50–70 kilograms of nitrogen, 20–30 kilograms of phosphorus, and 40–60 kilos of potash. Because nitrogen enhances functional photosynthetic area and, thus, the generation of dry matter, it is essential for pea's early vegetative growth.

Fertilizer is crucial for agricultural productivity and growth. When opposed to artificial fertilizers, which worsen environmental issues, cow dung is one sort of organic fertilizer that comes from cows. It's easy to use and environmentally beneficial. Organic fertilizers are more affordable than chemical fertilizers and are simply made from locally sourced goods and livestock manure. The harmonies of the interdependent systems of soil organisms, plants, animals, and people is its main objective. Regarding their influence on the plant's crop growth, local, natural circumstances, and differences in soil and climate, determine the best fertilizer options suitability for crops cultivation. Farm yard manure is a perfect fertilizer for crop growth, according to several tests and experiences, thanks to its nutrients that have a long track record of effectiveness. Crop plants need a lot of the element's nitrogen, phosphorus, and potassium to sustain the cell's appropriate physiological function. The supply of potassium is particularly crucial because insufficient levels of potassium are a common cause of inferior quality, much to how phosphorus deficiency makes crop plants grow abnormally slowly and turn abnormally dark green. Excess phosphorus also shortens leaves and increases the risk of burns. While a lack of nitrogen can also result in sluggish growth and low yield, an excess of nitrogen lowers leaf quality and delays maturity. Since soil that has been combined with cow dung is an excellent source of various plant nutrients, especially N.P.K. research on maize crop plants is still ongoing. However, these plants lack potassium.

2. Materials and methods

The investigation *"Effects of organic and inorganic fertilizers on the growth, yield and soil properties of field pea (Pisum sativum L.)"* was conducted at research's field and laboratories of Uttaranchal University, Department of Agriculture, Dehradun (Uttarakhand). The experiment was carried out during the rabi season of December 2022 to March 2023. This chapter provides a detailed account of the materials and the methods used during experimentation.

2.1 Treatment details

Treatment	Details
T1 -	NPK+RDF
T2 -	30x15cm RDF+RH
T3 -	30×15 cm RDF+ Vermi Compost (VC)
T4 -	30×15 cm + RDF+ RH+ Vermi Compost (VC)
T5 -	30×15 cm + RDF +FYM
T6 -	30×15 cm + RDF +VC + RH + FYM
T7 -	Control

2.2 Statistical analysis

The observations were statistically analyzed utilizing the Cochran and Cox technique's Two Factorial Randomized Block Design, (1992). At a 5% level of significance (LOS), mean differences will be analyzed using the "F" test. The critical difference (CD) was used to compare treatments with a 5% level of probability. The results will be presented in tables and graphs.

3. Result and Discussion

Effect on growth

The growth characteristics alter slightly during the later growth stages, which are 45 DAS, 60 DAS, and 75 DAS. For example, for 30 DAS, T5 measured 15.86 cm, whereas T_2 measured 15.20 cm, T_4 measured 34.22 cm, and T_7 measured 30.00 cm. For 60 DAS, T_2 measured 49.41 cm, T_5 measured 42.23 cm, and for 75 DAS, T_4 measured 64.80 cm, T_7 measured 53.54 cm. The number of branches/plants at 30 DAS, maximum T_2 (3.9 cm), and lowest T_4 (2.5 cm), there was no discernible difference. At the later growth stages of 45, 60, and 75 DAS, changes were seen. The treatments T_4 (5.15cm), T_5 (8.96cm), and T_5 (12.32cm) had the highest and lowest branch counts, respectively, while T_3 (4.1cm), T_6 (5.9cm), and T_3 (8.9cm) had the lowest. The numbers of leaves/plants is visible at 30 DAS, 45 DAS, 60 DAS, and 75 DAS. T_4 (13.7 cm), T_5, 24.8 cm, T_4, and T_2 (56.9 cm) had the highest values, while T_6 (10.3 cm), T_7 (20.1 cm), T_1 (40.25 cm), and T_7 (50.57 cm) had the lowest values.

Effect on yield attributes

With the control treatment, the grain yield was higher (5,208kg/ha^{-1}). T_1 treatment has the lowest documented minimum (2,477kg/ha^{-1}). The crop of straw remained found maximum in control treatment, (7,812kg/ha^{-1}) and minimum was recorded in treatment, T_1 (3,715kg/ha^{-1}). the biological yield maximum in control treatment, (130.20q/ha^{-1}). Minimum was recorded in treatment, T_1 (61.92q/ha^{-1}). Length of the pods was found to vary depending on whether they received organic or inorganic fertilizer. Maximum pod length of 9.4 cm was seen in the T_7 treatment group. T_5 (7.5 cm), nevertheless, was observed with the short. The control T_7 had the lowest pod yield (49.1q/ha), while treatment T_2 had the highest (82.21q/ha). The yield of the pod also affects the diversity and proper management techniques. Fertilizers, both organic and inorganic, had a significant effect on the weight of the fresh and dry pod. Treatment T_2 had the highest fresh weight and dry weight (25.28gm and 5.056gm, respectively). The lowest fresh weight and dry weight of the treatment controls were T_7 (5.94gm) and T_7 (1.88gm), respectively.

Effect on quality

The T_4 treatment occasioned in a advanced protein gratified in the pit (24.74%), whereas the T_1 treatment resulted in a lower protein content (20.23%). TSS data demonstrated that varied amounts of spacing had a substantial effect on total soluble solids. The treatment having wider treatment, T_6 (7.46^o) have higher Total soluble solids level. In contrast, treatment having small treatment, T_5 (3.30^o) have less Total soluble solids level. Information on how both organic and inorganic fertilizers have an impact on total nitrogen concentration. The treatment with the highest nitrogen level was T_6 (1.26%). The lowest levels of total nitrogen were seen in the control treatments, T_1 and T_5 (0.42% and 0.5%). The information on how both organic and inorganic fertilizers affect the total phosphorus content. The overall phosphorus concentration varied significantly between the treatments. The highest level of phosphorus was found in T7 (0.61%), which was greater than previous treatments. On all potassium-containing treatments, the maximum was discovered in T6(0.81%), though. The control T1 treatment's minimum potassium content (0.20%) was much lower than that of the other treatments.

Table 1. Effect on growth parameters by organic and inorganic fertilizers

Treatments	Plant height @ 60 DAS	No. of branches @ 60 DAS	No. of leaves @ 60 DAS
T_1	47.90	6.54	40.25
T_2	49.41	8.13	46.3
T_3	45.43	6.93	43.2
T_4	46.32	7.36	49.8
T_5	42.23	8.96	48.6
T_6	46.22	5.9	42.64
T_7	43.24	7.26	41.92

Table 2. Effect on yield attributes by organic and inorganic fertilizers

Treatment	Pod length (cm)	Pod yield/hectare (q)	Number of nodules	Nodules weight/plant (mg)
T_1	8.8	66.3	29.56	104.98
T_2	7.9	82.1	45.98	300.32
T_3	8.3	51.3	26.93	207.39
T_4	8.2	75.6	32.56	214.47
T_5	7.5	69.8	40.403	228.59
T_6	8.6	68.6	36.543	176.25
T_7	9.4	49.1	27.15	81.28

Table 3. Effect on quality parameters by organic and in organic fertilizers

Treatment	Protein content (%)	Total soluble solids (°Brix)	Nitrogen (%)	Phosphorous (%)	Potassium (%)
T_1	20.23	3.46	0.42	0.21	0.20
T_2	21.19	3.60	0.50	0.31	0.28
T_3	23.13	5.20	1.11	0.42	0.51
T_4	24.73	5.50	1.13	0.55	0.72
T_5	20.66	3.30	0.51	0.33	0.31
T_6	22.50	7.46	1.26	0.60	0.81
T_7	24.26	6.70	1.24	0.61	0.75

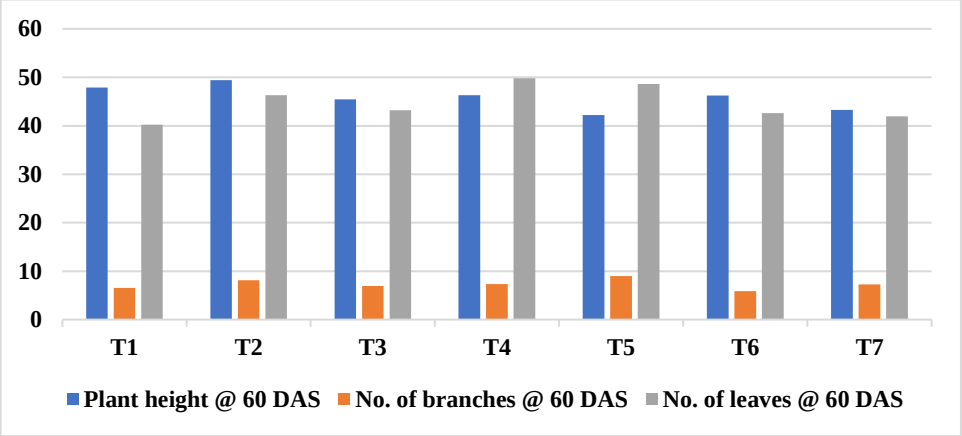

Fig 1. Effect on growth parameters by organic and inorganic fertilizers

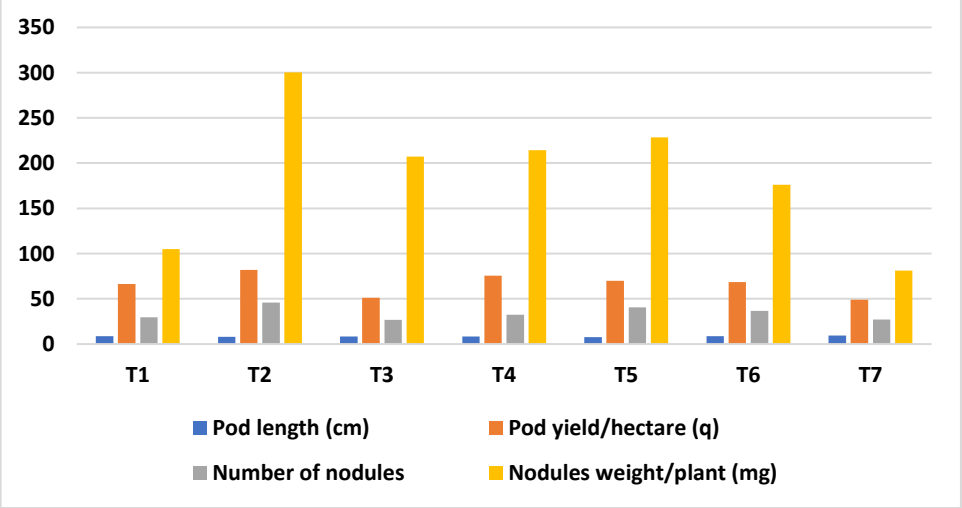

Fig 2. Effect on yield attributes by organic and inorganic fertilizers

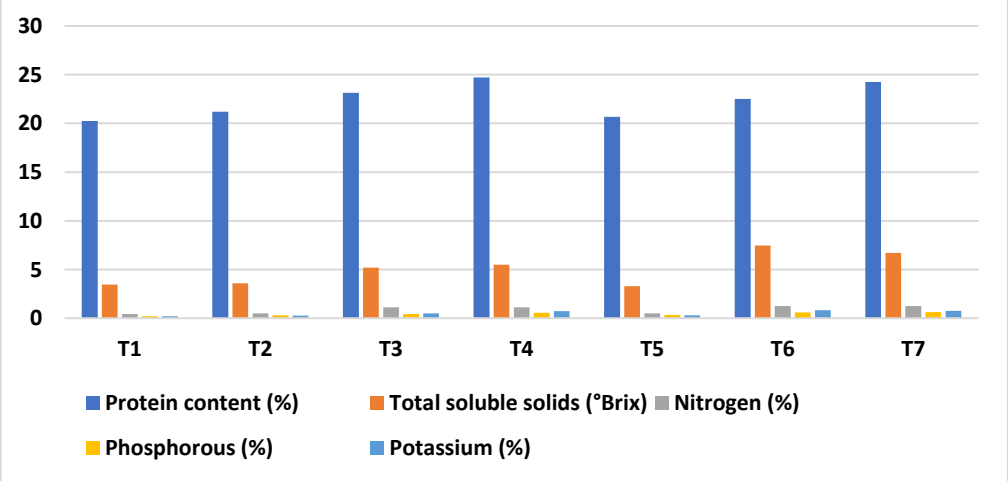

Fig 3. Effect on quality parameters by organic and in organic fertilizers

Conclusion

According to the results of the experiment, it can be said that applying both organic and inorganic fertilizers improve plant development in general. Fertilizers, both organic and artificial, enhance crop growth, yield, and pea quality. Rhizobium (Rh) aids in the soil's nitrogen fixation. Vermi Compost (VC) improves soil nutrient content, influences soil microbial activity, increases oxygen availability, maintains normal soil temperature, promotes soil porosity and water infiltration, and boosts pea growth, yield, and quality. FYM is used to enhance and restore the soil's natural properties.

4. Reference

1. FAO, (2018). Food and Agriculture Organization of the United Nations (2018). The future of food and agriculture. Alternative pathways to 2050, FAO.
2. Al-Taey *et al.*, (2018). Effect of saline water, NPK and organic fertilizers on soil properties and growth, antioxidant enzymes in leaves and yield of lettuce (*Lactuca sativa var. Parris Island*).
3. Al- Taey., (2018). AL-Taey, D.K.A., S.S.M. AL-Azawi, M.J.H. AL-Shareefi and A.R. AL-Tawaha. 2018. Effect of saline water, NPK and organic fertilizers on soil properties and growth, antioxidant enzymes in leaves and yield of lettuce (*Lactuca sativa var. Parris Island*). Res. Crops .19(3):441-449.
4. Farhan (2012). The Effect of Organic Matter and Potassium Fertilizers on Growth and Yield of Broad Bean (*Visia faba L.*). Diyala Journal of Agriculture Science, 4(1): 50-61.
5. Jasem *et al.*, (2015). Effect of organic and chemical fertilizers and their interaction with foliar fertilizers on yield of broad bean (*Viciafaba L.*).
6. Abo-Basha (2016). Abo-Basha, O.M.R. (2016). Impact of interaction between organic nitrogen and Biofertilizers on quality and productivity of Pea (*Pisum sativu L.*) plants. International Journal of Pharm Tech Research, 9(12):949-956.
7. Al-Saleem M.S.S.D (2017). Effect of Application Some Mineral and Organic Nutrients on Growth and Yield of Two Pea (*Pisum sativum L.*) Cultivars. Ph.D. Thesis, College of Agriculture and Forestry, University of Mosul, Iraq.
8. Al-Badawi and Dhary, 2017. Response of Different Varieties of Faba Bean to Plant Source Organic Fertilizers. The Iraqi Journal of Agricultural Science, 48(4): 1141- 1147.Appavu *et al.,* (2000). Effect of organics and irrigation levels on soil physical properties and yield of crops under sorghum-soybean cropping system. Parasuraman *et al.*, (2000). Effect of organic, inorganic and biofertilizers on soil fertility under double cropping system in rainfed red soils. Indian journal of Agronomy 45: 242-247.
9. Sharma KC (2000). Influence of integrated nutrient management on yield and economics in broccoli (*Brassica oleracea L. var Italica*) plenck under cold temperate conditions. Veg. Sci., 27(1): 62-63
10. Singh, P. and H.K, (2012). Effect of nitrogen on yield, economics and quality of fodder sorghum genotypes. Annals of Plant and Soil Research 14(2): 133-135.
11. Kushwaha, S.S. (2001). Integrated nutrient management for kharif sorghum. Indian Journal of Dryland Agricultural Research & Development.16: 83-85.
12. Shanwad *et al.,* (2010). Integrated nutrient management (INM) in maize- bengal gram cropping system in Northern Karnataka. Research Journal of Agriculture Science, 1(3): 252-254.
13. Bahadur *et al*., (2003). Effect of organic manures and biofertilizers on growth, yield an quality attributes of broccoli (*Brassica oleracea L. var. italica Plenck*). Vegetable Science 30: 192–4.
14. Bhattarai (2003). Effect of integrated nutrient management on yield attributes and economics of pea (*Pisum sativum*) Indian J. Agric. Sci., 73 (4) (2003), pp. 219-220.
15. Datt *et al.,* (2003). Effect of supplementary use of farmyard manure along with chemical fertilizers on productivity and nutrient uptake by vegetable pea (*Pisum sativum var Arvense*) and build-up of soil fertility in Lahaul valley of Himachal Pradesh. Indian Journal of Agricultural Sciences. 2003; 73:266-268.
16. Gautam *et al.*, (2020). Responses of soil microbial community structure and enzymatic activities to long-term application of mineral fertilizer and beef manure. In: Environmental Sustainability Indicator. p. 100073.
17. Bahadur *et al*., (2004). Response to cabbage to organic manures and biofertilizers. Indian Journal of Horticulture 61 (3): 278–9.
18. Lakpale *et al.,* (2003). Response of gram (*Cicer arietinum*) to integrated nutrient management in Vertisols of Chhattisgarh plains. Indian J. Agric. Sci.73(3):162-163.