Impact of Inorganic Fertilizer and Organic manure on Physico-chemical properties of soil in field Pea (*Pisum sativum*.L)

Abstract

The field experiment was carried out at central research farm of department of soil science and agricultural chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Rabi season 2023-24. The texture of the soil in the experimental region was sandy loam. The design was set up using randomized block design, with three levels of FYM (0:50:100), and NPK (0:50:100) at different levels. The treatment T_9 (@100% NPKS + 100% FYM) gave the best results in terms of plant height, number of siliqua plant^{-1}, and total Field Pea yield. It also showed a slight decrease in pH, bulk density, and particle density; however, there was a significant increase in pore space, water holding capacity, EC, organic carbon, available nitrogen, phosphorus, and potassium, as well as plant growth and yield attributes. There was no discernible difference in the growth and production of Field Pea under control. The use of NPK and FYM, significantly increases the characteristics of growth and total yield attributes of Field Pea.

Keywords: Field Pea, NPK, FYM, Growth and Yield, etc.

INTRODUCTION

Pea is a nutritional vegetable crop, it has a significant amount of digestible carbohydrates, protein, lipids, minerals, and vitamins. It also has a high level of antioxidant activity, it contains 2% fat, 60-65% carbohydrates, 25–28% protein, and other minerals. Lysine and tryptophan are two amino acids found in pea in large quantities like cereal grains. The seeds are free of cholesterol, abundant in fiber, and low in fat. It can be cultivated for hay, pasturage, green manure, and as a forage crop. Compared to soybean, it has 5 to 20 % fewer trypsin inhibitors. As a result, it can be fed to animals without undergoing the extrusion heating process. Pea plays a key role in promoting sustainable agriculture by maintaining soil fertility through biological nitrogen fixation in conjunction with symbiotic rhizobium present in its root nodules **(Negi et al., 2004).**

According to **Pawar et al. (2017),** it is the second most valuable legume crop in the world. The dry, green foliage is fed to cattle, and the exceptionally nutrientdense green pods are preferred for food. According to **Gopinath et al. (2007),** this legume has a high concentration of nutrients per 100 g of edible part, including digestible protein (7.2 g), carbs (15.8 g), vitamin A (139 I.U.), vitamin C (9 mg), magnesium (34 mg), and phosphorus (139 mg). The availability of nutrients is directly related to food production. The need for chemical fertilizers has increased as a result of the need to produce more and more food for the growing population. Despite the best use of high yielding varieties and higher volumes of chemical fertilizers, the rise of food production has slowed over the past three decades (Sharma et al., 2006).

Soil is fundamental to crop production. Without soil, no food could be produced on a large scale, nor would livestock be fed. Because it is finite and fragile, soil is a precious resource that requires special care from its users. Many of today's soil and crop management systems are unsustainable. A sound knowledge of soil health/quality is essential to a large extent for agricultural sustainability**.** The concept of soil quality emerged in the literature in the early 1990s **(Doran and Safely, 1997; Wienhold *et al.*, 2004)**, and the first official application of the term was approved by the Soil Science Society of America Ad Hoc Committee on Soil Quality (S- 581) and discussed by **Karlen *et al.* (1997)**. Soil quality was been defined as ''the capacity of a reference soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation''. Subsequently the two terms are used interchangeably **(Karlen *et al.*, 2001)** although it is important to distinguish that, soil quality is related to soil function **(Karlen *et al.*, 2003),** whereas soil health presents the soil as a finite non-renewable and dynamic living resource **(Doran and Zeiss, 2000)**. **Doran and Parkin** define soil quality as "the capacity of soil to function, within ecosystem and land use boundaries, to sustain biological productivity, maintain environmental quality, and promote plant and animal health". It is worth noting here that "soil health" and "soil quality: are synonymous terms. The soil health can be asses to sustain plant and animal productivity and diversity; maintain or enhance water and air quality; support human health and habitation **(Doran *et al.*, 1994)**.

Inorganic fertilizer as like (nitrogen) is important for all crops. It increases growth and development of all living tissues and increases protein content in the pulses. It also increases utilization of phosphorus and potassium to an appreciable extent. Inorganic fertilizer (i.e. P) not only improves the growth, seed yield, nodulation and quality of legumes, but also increases the organic matter, nitrogen and P content in soils, have reported that yield of grains increases with the increasing levels of phosphorus. Phosphorus is the second most important plant nutrient that must be added to the soil to maintain plant growth and sustain crop yield. Potassium enables crops to tolerate water stress, and bringing about improvement in crop yield and quality. Organic manure like FYM or compost is applied to enrich the soil fertility and provide plants with many macro and micro nutrients. Farm yard or compost manure seems to act directly for increasing the crop yields either by acceleration of respiratory process with increasing cell permeability and hormonal growth action or by combination of all these processes. It improves physicalchemical properties of soil such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients, increase in cation exchange capacity, stimulation of soil flora and fauna etc.

Materials and Methods

During the Rabi Season of 2023–2024, the research was conducted at the Soil Science Research Farm, Department of Soil Science and Agricultural Chemistry Sam Higginbottom University of Agriculture, Technology and Sciences, Naini Agricultural Institute, Prayagraj. Prayagraj district, with its exceptionally hot summers and relatively chilly winters, embodies the subtropical belt of South East Uttar Pradesh in terms of agroclimatology. The location's highest temperature is between 46°C and 48°C, with rare dips below 4°C or 5°C. There was a 20–94% variation in the relative humidity. This location receives around 1100 mm of rain on average each year.Three levels of inorganic fertilizer (N, P, and K; 0, 50, and 100%) and one level of FYM (0, 50, and 100%) were used in the experiment, which was conducted using a Randomized Block Design (RBD). Each treatment was duplicated three times. T1 [ABSOLUTE CONTROL], T2 [NPK @0% +FYM @50%], T3 [NPK @ 0%+FYM @100%], T4 [NPK @ 50%+ FYM @0%], T5 [NPK @ 50% +FYM@50%], T6 [NPK @50%+FYM@100%], T7 [NPK @ 100%+ FYM @0%], T8 [NPK @ 100%+ FYM @50%], and T9 [NPK @ 100%+ FYM @ 100%] were the treatments. Characteristics of growth and yield were noted during the trial. The inorganic nutrients came from rhizobium, urea, SSP, MOP, and micronutrients, in that order.

Results and Discussions

After harvesting the shows that soil bulk density was found to be non significant by organic and inorganic. The maximum soil bulk density at 0-15 to 15-30 cm soil depth was recorded in T1 [NPK@0% +FYM @0%] which was 1.37 and1.42 Mg m-3 and minimum soil bulk density was recorded in T9 NPK @100% +FYM@100%] which was 1.25 and 1.36 Mg m-3. These results indicated that the soil pH was decreased by N application at different stages. N application could increase the N contents of leaf and stem **Heng et al. (2014).** Similar findings were recorded by **Verma and Baigh, (2012), Muthuval, et al. (1992) . Similar results were also reported by Tadesse, et al. (2013) and Abou El-Magd et al. (2006).** The maximum soil particle density at 0-15 to 15-30 cm soil depth was recorded in T_1[NPK@0% +FYM @0%] which was 2.66and 2.70Mg m-3 and minimum soil particle density was recorded in T_9 NPK @100% +FYM@100%] which was 2.61 and 2.66 Mg m-3. As the production of total biomass was higher in these treatments, moreamountofresiduemight haveaddedinthesoil informofleavefallandrootswhichwill buildup the organic matter level in soil that might be the reason in lower bulk density. Similarfindingswererecordedby**Kumar*etal.*(2008),Reddy*etal.*(2005).**AlsoSimilarresultswere alsoreportedby**SudarsoandPontianak(2010),Githinji*etal.*(2013)and Mukherjee*etal.*(2014).** The maximum soil %porespace at 0-15 to 15-30 cm soil depth was recorded in T9NPK@100%+FYM@100%], which was 49.31and 45.33%and minimum soil %porespace was recorded in T_1[NPK@0% +FYM @0%], which was 45.31 and 42.13%. Similar results were also reported by **Sudarso and Pontianak (2010), Githinji *et al.*(2013)andMukherjee*et al.*(2014).** ThemaximumsoilpH at 0-15 to 15-30 cm soil depth was recorded in T1 [NPK@0% +FYM @0%], which was 7.73 and 7.77 and minimum soil pH was recorded in T9 NPK@100%+FYM@100%], which was 7.62 and 7.60. Similar results werealsoreported by**Tadesse, etal.(2013) andAbou El-Magdetal.(2006).** The maximum soil EC (dS m^{-1}) at 0-15cm soil depth was recorded in T9NPK@100%+FYM@100%] which was 0.48 Mg m^{-1} andminimum was recorded inT1[NPK@0%+FYM@0%] which was 0.33 Mg m^{-1}.At15-30cmsoildepthwasrecordedinT9NPK@100%+FYM@100%]whichwas0.40Mgm^{-1}andminimumwasrecordedinT1[NPK@0% +FYM @0%]with 0.31 Mg m^{-1}. Similar findings were recorded by **Muthuval, et al. (1992) , Kumar, (2008)Gupta*et al.* (2000).**

Table 1: Physical properties of soil sample after harvesting of Pea (Pisum sativum L.)

Treatments combination		**Bulk density (Mg m-3)**		**Particle density (Mg m- 3)**		**% pore space**		**pH(1:2)**		**EC (dS m-1)**	
		0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
T_1	ABSOLUTE CONTROL	1.37	1.42	2.66	2.7	45.31	42.13	7.73	7.77	0.33	0.31
T_2	[NPK@0% +FYM @50%]	1.33	1.41	2.65	2.69	45.5	42.32	7.7	7.72	0.35	0.32
T_3	[NPK@0%+FYM @100%]	1.31	1.4	2.63	2.68	47.86	43.38	7.68	7.7	0.37	0.34
T_4	[NPK@50%+FYM@0%]	1.34	1.41	2.65	2.69	46.71	43.53	7.69	7.71	0.38	0.38
T_5	[NPK@50%+FYM@50%]	1.31	1.39	2.64	2.68	47.82	43.64	7.65	7.67	0.41	0.36
T_6	[NPK@50%+FYM@100%]	1.30	1.39	2.63	2.67	48.46	44.28	7.61	7.64	0.42	0.37
T_7	[NPK@100%+FYM@0%]	1.31	1.39	2.64	2.69	46.38	44.2	7.67	7.69	0.46	0.38
T_8	[NPK@100%+FYM@50%]	1.30	1.38	2.63	2.68	48.6	44.42	7.63	7.65	0.47	0.39
T_9	[NPK@100%+FYM@100%]	1.25	1.36	2.61	2.66	49.31	45.33	7.62	7.6	0.48	0.40
F- test		NS	NS	S	S	S	S	NS	NS	S	S
S. Ed. (±)		0.166	0.315	0.078	0.08	0.539	0.436	0.24	0.233	0.075	0.073
C. D. (P = 0.05)		0.349	0.662	0.164	0.168	1.132	0.916	0.504	0.489	0.158	0.153

The data recorded on % organic carbonwasrecorded at0-15and 15-30cmsoildepth.Theresultofthedatashowsthatsoil %organiccarbon was found to be significant by organic and inorganic. The maximum soil % organiccarbon at 0-15 cm soil depth was recorded in T_9 NPK@100%+FYM@100%] which was 0.46and minimum was recorded in T_1 [NPK@0% +FYM @0%] which was 0.36. At 15-30 cm soil depth was recorded in T_9 NPK@100%+FYM@100%]whichwas 0.45 and minimum wasrecorded in T_1[NPK@0% +FYM @0%]with0.35%. Itwasalsoobservedtheorganiccarbonofsoilweregraduallyincreasewithanincreaseindoseof NPK **Selvi *et al.* (2002)**. Themaximumsoilavailablenitrogen(kgha^{-1})at0-15cmsoildepthwasrecordedinT_9NPK@100%+FYM@100%] whichwas276.32andminimumwas recordedinT_1[NPK@0% +FYM @0%] which was 256.29.At 15-30 cmsoil depth was recorded in T_9NPK@100%+FYM@100%] which was

267.87 and minimumwasrecorded in T1[NPK@0% +FYM @0%] with 247.22. Similar results were also reported by **Bhende, et al., (2015) and Vimera*et al*. (2012)** whoreported that application of 100 % NPK fertilizers recorded maximum available NPK in soilafter harvesting of respective crops. Themaximumsoilavailablephosphorus(kgha^{-1})at0-15cmsoildepthwasrecordedinT9NPK@100%+FYM@100%]whichwas21.45andminimumwasrecordedinT1[NPK@0% +FYM @0%] which was 18.33.The maximum soil available phosphorus (kg ha^{-1})at15-30cmsoildepthwasrecordedinT9NPK@100%+FYM@100%]whichwas19.21andminimumwasrecorded in T1[NPK@0% +FYM@0%] with16.45.The organic acidsandhydroxylacidsliberatedduringthedecompositionoforganicmattermayformcomplexorchelate Fe, Al, Mg and Ca and prevented them from reacting with phosphate (**Sharma *et al*.,2001**). Themaximumsoilavailablepotassium(kgha^{-1})at0-15cmsoildepthwasrecordedinT9NPK@100%+FYM@100%]whichwas226.74andminimum wasrecordedinT1[NPK@0%+FYM@0%]whichwas199.94.Themaximumsoilavailablepotassium(kgha^{-1})at15-30cmsoil depthwasrecordedinT9NPK@100%+FYM@100%]whichwas221.67andminimumwasrecorded in T1[NPK@0%+FYM@0%] with195.31. Similar findings were recorded by **Kumar *et al.* (2008) and Reddy *et al.* (2005)** also theintegrated use of organic along with inorganic amendments increased the mineralization oforganic manures and during the decomposition of organic manures, many organic acids arereleased that makes complexes with the clay preventing the fixation of potassium in the soilandalsofacilitatingit'sreleaseinthesoil**(Walia*etal*.,2010).**

Table 2: Chemical properties of soil sample after harvesting of Pea (Pisum sativum L.)

Treatments combination		**% Organic Carbon**		**Available N (kg ha-1)**		**Available P (kg ha-1)**		**Available K (kg ha-1)**	
		0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
T_1	ABSOLUTE CONTROL	0.36	0.35	256.29	247.22	18.33	16.45	199.94	195.31
T_2	[NPK@0% +FYM @50%]	0.41	0.38	258.26	253.19	18.98	16.76	206.59	202.52
T_3	[NPK@0%+FYM @100%]	0.44	0.40	263.29	255.22	19.56	17.20	210.61	206.54
T_4	[NPK@50%+FYM@0%]	0.42	0.39	259.80	253.73	19.67	17.56	208.51	204.76
T_5	[NPK@50%+FYM@50%]	0.43	0.41	266.74	257.67	20.11	18.05	214.00	210.93
T_6	[NPK@50%+FYM@100%]	0.45	0.42	269.04	258.97	20.33	18.29	220.72	215.09
T_7	[NPK@100%+FYM@0%]	0.4	0.38	271.91	262.84	20.46	18.66	218.78	213.71
T_8	[NPK@100%+FYM@50%]	0.43	0.40	274.59	257.52	21.20	18.98	222.72	216.89

T_9	[NPK@100%+FYM@100%]	0.46	0.45	276.32	267.87	21.45	19.21	226.74	221.67
F- test		S	S	S	S	S	S	S	S
S. Ed. (±)		0.075	0.074	0.687	1.183	0.141	0.115	0.66	0.714
C. D. (P = 0.05)		0.158	0.155	1.443	2.484	0.296	0.242	1.38	1.499

Conclusion

From trial it was concluded that T9 (NPK@ 100% + FYM@ 100%) was found to be best forsoil health, obtaining more productivity and also economically feasible. The result of theexperiment concluded as the application NPK and FYM in treatment T9 was found mosteffective in improving Physico- Chemical properties of soil as it decreases bulk density,particledensityandpHandincreasesporespace,waterholdingcapacity,EC,Organiccarbon ,availablenitrogen,phosphorusand potassium.

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