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Effect of organic and inorganic sources of nutrients on physico-chemical properties of soil in garden pea (*Pisum sativum* L.) var. gk-10

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Abstract
An experiment was conducted during *Rabi* season (Nov. 2021 – Feb. 2022) to study the "Effect of Organic and Inorganic Sources of Nutrients on Physico-Chemical Properties of Soil in Garden Pea (*Pisum sativum* L.) Var. GK-10*"*. On central research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment was laid out in randomized block design with three levels of NPK (0% NPK, 50% NPK and 100% NPK), and three level of FYM (0% FYM, 50% FYM and 100% FYM). The excavated soil sample from experimental site before conducting research operation, mentioned that, soil is of sandy loam texture with neutral to alkaline in reaction and significantly highest in treatment. The treatment combinations were replicated three times and were allocated at random in each replication. The result shows that application of different levels combination of inorganic fertilizers increased growth, yield of garden pea and improved soil chemical properties. It was recorded from the application of NPK and FYM fertilizers in treatment T_9 [NPK @ 100% + FYM @ 100%] maximum bulk density 1.265 Mg m^{-3} at 0-15 cm and 1.267 Mg m^{-3} at 15-30 cm, particle density 2.522 Mg m^{-3} at 0-15 cm and 1.527 Mg m^{-3} at 15-30 cm,% pore space 54.78% at 0-15 cm and 52.68% at 15-30 cm, water holding capacity 44.75% at 0-15 cm and 43.82% at 15-30 cm, pH 6.85 at 0-15 cm and 7.08 at 15-30 cm, EC 0.469 dSm^{-1} at 0-15 cm and 0.476 dSm^{-1} at 15-30 cm, organic carbon 0.564% at 0-15 cm and 0.568% at 15-30 cm, available nitrogen 311.56 kg ha^{-1} at 0-15 cm and 304.55 kg ha^{-1} at 15-30 cm, available phosphorus 37.70 kg ha^{-1} at 0-15 cm and 34.28 kg ha^{-1} at 15-30 cm, available potassium 221.42 kg ha^{-1} at 0-15 cm and 211.67 kg ha^{-1} at 15-30 cm with cost benefit ratio is 1: 2.27 best from T_1 [(control) NPK @ 0% + FYM @ 0%].

Keywords: Garden pea, FYM, NPK and Physico-chemical, etc

Introduction
India has a major world's cup era under pulses and one fourth of the total production. Pulse crops offer stable source of protein in vegetarian diet of masses. Besides their well-recognized role in restoring fertility and its physical conditions, pulse crops provide succulent and nutritious to our cattle, therefore, have been described as "Unique jewels of Indian crop husbandry". Pulses add 0.8 to 1.5 tonnes of organic matter to the sol in the form of their roots left after harvesting of the crops, on an average, one hectare adds 15 to 30 kg nitrogen in readily available form (Singh, 2001) [15]. The population of our country is at an alarming rate, which would be expected to reach 1280 million in 2020 and at this rate of population increase, India will need at least 30 million tonnes of pulses by 2020 (Kumar *et al*., 2004) [8].
The Center of production of peas has moved from the traditional Middle East locale to Canada, which is now the largest single producer. Pea production in Western Canada has been increasing since 1997. France, China and India are also large producers next to Canada. Peas ranks 4th in the world on a production basis (441.53 thousand tonnes) among grain legumes after soyabean, groundnut and French beans and is grown on an area of 528.71 thousand hectares in the world (Anonymous, 2012) [1]. The most pea growing states are U.P, M.P, Bihar and Maharashtra. Uttar Pradesh is the largest producer pea growing state in India *i.e.*, 1,805.01 tonnes. Pea is grown as vegetable in various states of India. Major pea growing is also emerging as vegetable pea growing state as farmers are taking three cops in a year. Total production of pulse reported 2012-2013 (April/May) was at 17.3 million tonnes. In which from them pea was covered in production 3744.84 tonnes.

Materials and Methods

The present study entitled "Effect of Organic and Inorganic Sources of Nutrients on Physico-Chemical Properties of Soil in Garden Pea (*Pisum sativum* L.) Var. GK-10" comprise of a field experiment which was carried out at the Soil Science & Agricultural Chemistry Research Farm, Sam Higginbottom University of Agriculture Technology and Sciences Prayagraj during *Rabi* season 2021, which is located at $25^0 24' 30''$ N latitude, $81^0 51' 10''$ E longitude and 98 m above the mean sea level. The detail of the experimental site, soil and climate is described in this chapter together with the experimental design, layout plan, cultural practice and techniques employed for the parameters. The area of Prayagraj district comes under subtropical belt in the Southeast Uttar Pradesh, which experience extremely hot summer and fairly winter. The maximum temperature of the location reaches up to 46^0C-48^0C and seldom falls as 4^0C – 5^0C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually. It comes under subtropical climate receiving the mean annual rainfall of about 1100 mm, major rainfall from July to end of September. However, occasional precipitation was also not uncommon during winter. The winter months were cold while summer months were very hot and dry. The minimum temperature during the crop season was to be 27.1 ^{0}C and the maximum is to be 39.94 ^{0}C. The minimum humidity was 57.70% and maximum was to be 75.37%.

Experiment was laid out in randomized block design with three levels of NPK, and Three level of FYM. Plot size was 2 x 2 m^2 for crop seed rate is 75-80 kg ha^{-1} (*Pisum sativum* L.) Var. GK-10. Basal dose of fertilizer was applied in respective plots according to treatment allocation uniform furrows opened by about 5 cm. All the agronomic practices were carried out uniformly to raise the crop. The crop was harvested in February. Treatment combination for Garden pea crop were taken T_1[Control (NPK @ 0% + FYM @ 0%)], T_2[NPK @ 0% + FYM @ 50%], T_3[NPK @ 0% + FYM @ 100%], T_4[NPK @ 50% + FYM @ 0%], T_5[NPK @ 50% + FYM @ 50%], T_6[NPK @ 50% + FYM @ 100%], T_7[NPK @ 100% + FYM @ 0%], T_8[NPK @ 100% + FYM @ 50%], T_9[NPK @ 100% + FYM @ 100%].

Results and Discussion

Physical properties of soil

The result of data depicted in Table 1 showed that maximum bulk density(Mg m^{-3}) of soil was recorded 1.265 Mg m^{-3} at 0-15 cm and 1.270 Mg m^{-3} at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 1.261 Mg m^{-3} at 0-15 cm and 1.267 Mg m^{-3} at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum bulk density of soil was recorded 1.246 Mg m^{-3} at 0-15 cm and 1.250 Mg m^{-3} at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The maximum particle density of soil was recorded 2.522 Mg m^{-3} at 0-15 cm and 1.527 Mg m^{-3} at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 2.518 Mg m^{-3} at 0-15 cm and 1.524 Mg m^{-3} at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum particle density of soil was recorded 2.498 Mg m^{-3} at 0-15 cm and 1.502 Mg m^{-3} at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The maximum pore space of soil was recorded 54.78% at 0-15 cm and 52.68% at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 51.82% at 0-15 cm and 50.32% at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum pore space of soil was recorded 40.25% at 015 cm and 37.50% at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The maximum water holding capacity of soil was recorded 44.75% at 0-15 cm and 43.82% at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 42.87% at 0-15 cm and 41.26% at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum water holding capacity of soil was recorded 31.56% at 0-15 cm and 29.45% at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively.

Table 1: Effect of different levels of organic and inorganic source of nutrients on bulk density (Mg m^{-3}), Particle density (Mg m^{-3}), Pore space (%) and Wate holding capacity (%) of soil

Treatments	Bulk density (Mg m^{-3})		Particle density (Mg m^{-3})		Pore space (%)		Water holding capacity (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	1.246	1.250	2.498	2.502	40.25	37.50	31.56	29.45
T_2	1.249	1.252	2.502	2.506	41.87	39.85	32.97	30.85
T_3	1.251	1.254	2.505	2.509	43.65	41.10	34.09	32.08
T_4	1.252	1.257	2.506	2.511	44.34	42.65	35.41	33.67
T_5	1.254	1.260	2.509	2.514	46.21	44.72	37.23	35.90
T_6	1.257	1.262	2.513	2.517	48.45	46.54	39.78	37.56
T_7	1.258	1.265	2.514	2.520	49.67	48.90	40.21	39.40
T_8	1.261	1.267	2.518	2.524	51.82	50.32	42.87	41.26
T_9	1.265	1.270	2.522	2.527	54.78	52.68	44.75	43.82
F-Test	NS	NS	NS	NS	S	S	S	S
S.Ed. (±)	-	-	-	-	0.40	0.32	0.42	0.30
C.D. at 0.5%	-	-	-	-	0.78	0.72	0.80	0.65

Chemical properties of soil

The result of data depicted in Table 2 showed that maximum pH of soil was recorded 6.85 at 0-15 cm and 7.08 at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed 6.78 at 0-15 cm and 7.02 at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum pH of soil was recorded 6.42 at 0-15 cm and 6.55 at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The maximum EC of soil was recorded 0.469 dSm^{-1} at 0-15 cm and 0.476 dSm^{-1} at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 0.463 dSm^{-1} at 0-15 cm and 0.471 dSm^{-1} at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum EC of soil was recorded 0.429 dSm^{-1} at 0-15 cm and 0.435 dSm^{-1} at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The maximum organic carbon of soil was recorded 0.564% at 0-15 cm and 0.568% at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 0.560% at 0-15 cm and 0.563% at 15-30 cm in

treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum organic carbon of soil was recorded 0.535% at 0-15 cm and 0.530% at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The maximum available nitrogen of soil was recorded 311.56 kg ha^{-1} at 0-15 cm and 304.55 kg ha^{-1} at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 308.25 kg ha^{-1} at 0-15 cm and 299.38 kg ha^{-1} at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum available nitrogen of soil was recorded 289.75 kg ha^{-1} at 0-15 cm and 282.32 kg ha^{-1} at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The result of data depicted in Table 3 showed that the available phosphorus (kg ha^{-1}) of soil as influenced by organic and inorganic source of nutrients. phosphorus of soil was recorded 37.70 kg ha^{-1} at 0-15 cm and 34.28 kg ha^{-1} at 15-30 cm in treatment T_9 (NPK @ 100% + FYM @ 100%) followed by 34.17 kg ha^{-1} at 0-15 cm and 31.20 kg ha^{-1} at 15-30 cm in treatment T_8 (NPK @ 100% + FYM @ 50%) and minimum available phosphorus of soil was recorded 20.48 kg ha^{-1} at 0-15 cm and 18.32 kg ha^{-1} at 15-30 cm in treatment T_1 [control (NPK @ 0% + FYM @ 0%)] respectively. The mean value of available phosphorus (kg ha^{-1}) of soil was found significant.

Table 2: Effect of different levels of organic and inorganic source of nutrients on pH, EC (dSm^{-1}), and Organic carbon (%) of soil.

Treatments	pH		EC (dSm^{-1})		Organic carbon (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	6.42	6.55	0.429	0.435	0.535	0.530
T_2	6.45	6.60	0.432	0.439	0.538	0.534
T_3	6.48	6.66	0.436	0.445	0.542	0.539
T_4	6.52	6.72	0.440	0.449	0.544	0.545
T_5	6.58	6.78	0.446	0.454	0.547	0.549
T_6	6.64	6.85	0.451	0.460	0.552	0.553
T_7	6.71	6.91	0.457	0.465	0.556	0.557
T_8	6.78	7.02	0.463	0.471	0.560	0.563
T_9	6.85	7.08	0.469	0.476	0.564	0.568
F-Test	NS	NS	NS	NS	NS	NS
S.Ed. (±)	-	-	-	-	-	-
C.D. at 0.5%	-	-	-	-	-	-

Table 3: Effect of different levels of organic and inorganic source of nutrients on Available nitrogen (kg ha^{-1}), Available phosphorus (kg ha^{-1}), and Available potassium (kg ha^{-1}) of soil.

Treatments	Available nitrogen (kg ha^{-1})		Available phosphorus (kg ha^{-1})		Available potassium (kg ha^{-1})	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	289.75	282.32	20.48	18.32	190.23	187.55
T_2	291.54	284.65	21.62	19.78	193.41	189.82
T_3	293.32	287.90	23.78	21.90	196.58	191.56
T_4	295.70	289.65	24.05	22.06	199.08	194.72
T_5	298.62	291.72	26.42	24.82	203.56	197.80
T_6	302.80	294.35	29.61	27.45	208.78	201.45
T_7	305.08	296.62	31.54	29.72	213.81	203.72
T_8	308.25	299.38	34.17	31.20	217.95	208.65
T_9	311.56	304.55	37.70	34.28	221.42	211.67
F-Test	S	S	S	S	S	S
S.Ed. (±)	1.80	1.45	1.85	1.32	6.93	1.72
C.D. at 0.5%	3.74	3.02	3.65	2.80	14.06	3.85

Conclusion

In the present investigation, it was apparent that application of NPK and FYM fertilizer in treatment T_9 (NPK @ 100% + FYM @ 100%) was found on physical and chemical parameters of soil such as bulk density, particle density,% pore space, water holding capacity, EC, pH, organic carbon, available N, P and K than other treatment combinations. Thus it can be concluded that different levels of NPK and FYM fertilizer improved soil available nutrient, increased soil available nitrogen, phosphorus, potassium and electrical conductivity. However, pH of soil increased and also among the treatments T_9 recorded the best treatment which increased the availability of nutrient and influenced on physical and chemical properties of soil as well.

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