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Effect of different levels of N P K and Zn on physico-chemical properties of soil growth parameters and yield by pea (*Pisum sativum* L.) Cv. Rachana

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Abstract
A study was conducted on the "Effect of N P K and Zn on Physico-chemical Properties of Soil, Growth Parameters and Yield by Pea (*Pisum sativum* L.) Cv. Rachna", at the Soil Science Research Farm, Sam Higginbottom University of Agriculture & Technology Sciences. Allahabad during Rabi season 2017-2018. The number of pods plant^{-1} (19.53), number of seeds pod^{-1} (6.20) and pod yield (77.67qha^{-1}) were significantly increased with the application of 50% recommended dose of N P K fertilizers and 100% Zinc fertilizer. The maximum yield was obtained in T_5 – [N@ 20kg + P@ 40kg + K@ 20kg and Zn@ 20kg ha^{-1}]. Growth parameters, soil properties, increased significantly with the application of 100% recommended dose of fertilizers *i.e.* T_8 – [N@ 40kg + P@ 80kg + K@ 40kg and Zn@ 20kg ha^{-1}], pH, EC (dSm^{-1}) and bulk density (gcm^{-3}) were they decreased with increase in fertilizer levels. The lowest values related to all parameters were obtained in control treatment. Cost benefit ratio (C:B) 1: 2.29 was highest in T_5 - (*i.e.* N@ 20kg + P@ 40kg + K@ 20kg and Zn@ 20kg ha^{-1}) 50% recommended dose of NPK and 100% Zinc was more profitable Rs. 59234.00 than any other treatments and recommendations.

Keywords: N P K, Zn, soil, yield, cost benefit ratio, Pea

Introduction
Pea (*Pisum sativum* L.) is a valuable vegetable as well as pulse crop all over the world, is also known as 'Matar'. It belongs to the family *Leguminosae*, self-pollinated crop (Anonymous, 2004) [2].

Globally, pea is grown in an area of 1.1 million ha with total production of 9.2 million tonnes and the productivity is 8.35 t ha^{-1} (Anonymous, 2004) [2]. In India, it is cultivated mainly in Uttar Pradesh, Madhya Pradesh, Jharkhand, Punjab, West Bengal, Haryana, Andra Pradesh, Bihar, Uttarkhand and Himachal Pradesh, where it is grown for both vegetable and pulse purposes and is a highly remunerative crop (Singh *et al*, 2005) [20]. In India, field pea occupies an area of 475.89 hectare with an annual production and productivity of 4651.53 tonnes and 9.5 tonnes/ ha respectively (Indian Horticulture Database-2014-15).

India has a major world's crop area 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 soil in the form of their roots left after harvesting of the crops, on an average, one hectare crop adds 15 to 30 kg nitrogen in readily available form (Singh, 2001) [20]. 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) [16]. Legumes have been recognized as an important component of any cropping system and as a low input approach towards improvement of soil fertility. Peas (*Pisum sativum* L.) a grain legume and a member of the leguminosae family grown throughout the world it is a native of central or Southeast Asia. It grows well in cool weather in the presence of ample moisture. Peas are recognized as one of the earliest agricultural crops domesticated by human beings. It is most important cultivated legume next to soybean, groundnut and beans (Hules, 1994) [13]. It appears to have originated many thousands of years ago in central Asia and the Middle East. They were originally dried and stored for long periods, providing nutrition during the non-growing seasons. Peas are now grown throughout the world and are consumed in both fresh and dried conditions. It is widely cultivated in temperate regions for its fresh green seed.

Peas are an excellent human food (Kakar *et al*. 2002) [7], either eaten as a vegetable or used in preparation of soup. The peas are full of nutrition because its grain is rich in protein, complex carbohydrates, vitamins, minerals, dietary fibers and antioxidant compounds (Bhatt *et al*. 2013). 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 soybean, groundnut and French beans and is grown on an area of 528.71 thousand hectares in the world (WWW. FAO stat, 2009) [28].

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 states are Utter Pradesh, Bihar, Haryana, Punjab, H.P, Orissa, and Karnataka. Uttarakhand is also emerging as vegetable pea growing state as farmers are taking three crops 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. The major pea producing belts in different states are as Karnataka (Belgum, Bangalore, Kolar, Chikmagalur). Madhya Pradesh (Ujjain, Durg). Rajasthan (Jaipur, Alwar, Jodhpur, Udaipur). West Bengal (Nadia, Hooghly, 24 parganas.). Punjab (Jalandhar, Amritsar, Hoshiarpur). Haryana (Sonepat, Jhajjar, Rohtak, Karnal, Panipat, Hisar). Assam (Darrang, Kamrup, Nagao). (WWW.FAO stat, 2012) [27]. Uttar Pradesh is the major field pea growing state. Uttar Pradesh alone produces about 60 per cent of total pea produced in India. Besides, Uttar Pradesh, Madhya Pradesh and Jharkhand are the major field pea producing states. (Singh *et al.*, 2005) [20]. In Uttar Pradesh it is grown over 216.39 ha, with production and productivity of 2454.07 t ha^{-1} and 9.6 t ha^{-1} (Indian Horticulture Database- 2014-15).

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Materials and Methods

The present study entitled "Effect of different levels of NPK and Zn on physico-chemical properties of soil, Growth Parameters and Yield by Pea (*Pisum sativum* L.) Cv. Rachana" comprise of a field experiment which was carried out at the Soil Science Research Farm, Sam Higginbottom University of Agriculture & Technology Sciences. Allahabad during Rabi season 2017-2018, which is located at 25^0. 27^1 N latitude, 81^0. 56^1 E longitude and 98m 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 Allahabad district comes under subtropical belt in the South east Uttar Pradesh, which experience extremely hot summer and fairly winter. The maximum temperature of the location reaches up to 46^0 C-48^0 C 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 1100mm annually. It comes under subtropical climate receiving the mean annual rainfall of about 1100mm, 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 5.9 ^{0}c and the maximum is to be 29.04 ^{0}C. The minimum humidity was to be 42.72.0% and maximum was to be 93.28%.

Table 1: The treatments consisted of nine combination of NPK and Zn source of fertilizer

Treatment	Description		Symbol
T0	Control No treatment		(L_0Z_0)
T1	NPK 0%, Zn 50%	10kg Zn ha^{-1}	(L_0Z_1)
T2	NPK 0%, Zn 100%	20kg Zn ha^{-1}	(L_0Z_2)
T3	NPK 50%, Zn 0%	20:40:20 Kg NPK ha^{-1}	(L_1Z_0)
T4	NPK 50%, Zn 50%	20:40:20 Kg NPK+10kg Zn ha^{-1}	(L_1Z_1)
T5	NPK 50%, Zn 100%	20:40:20 Kg NPK+20kg Zn ha^{-1}	(L_1Z_2)
T6	NPK 100%, Zn 0%	40:80:40 Kg NPK ha^{-1}	(L_2Z_0)
T7	NPK 100%, Zn 50%	40:80:40 Kg NPK+10kg Zn ha^{-1}	(L_2Z_1)
T8	NPK 100%, Zn 100%	40:80:40 Kg NPK+20kg Zn ha^{-1}	(L_2Z_2)

Experiment will be laid out in 2x2 factorial randomized block design with three levels of N P K and Zn plot size was 2x2 m^2 for crop seed rate is 80-100 kg ha^{-1} (*Pisum sativum* L.) Cv. Rachna. Pea grows in 9th November 2017 and the source of Nitrogen, Phosphorus, Potassium and Zinc were Urea, SSP, MOP, and $ZnSo_4$ respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation uni furrows opened by about 5 cm. All the agronomic practices were carried out uniformly to raise the crop. The crop was harvested on 10th March. Soil samples were collected from the soil 0-15 cm depth, air dried kept in an oven at 105^0C for 48 hrs for drying, pass through 2 mm sieve, soils were analysis by using standard procedures as described

for pH 1:2 (w/v) (Jakson 1958), EC (dSm^{-1}) (Wilcox 1950) [26], organic carban (%) (Walkley and Black 1947), available nitrogen kg ha^{-1} (Subbiah and Asija 1956) [22], phosphorus kg ha^{-1} (Olsen *et al*., 1954) [19] and potassium kg ha^{-1} (Toth and Price 1949). The physical and chemical properties at start of experiment are presented in Tables 2 and 3, respectively.

Results and Discussion

Table 2: Physical properties of soil (pre- sowing)

Particulars	Results	Methods
Sand (%)	65.14	Bouyoucos Hydrometer method (1952)
Silt (%)	21.12	
Clay (%)	13.74	
Textural class	Sandy loam	
Soil Color	-	Munshell Color Chart (1915)
Dry Soil	10YR 6/4 light yellowish brown	
Wet Soil	10YR 4/3 brown	
Bulk density(mg m^{-3})	1.26	Graduated measuring cylinder (Black 1965)
Particle density (mg m^{-3})	2.60	Graduated measuring cylinder (Black 1965)
Pore Space (%)	47.2	Graduated measuring cylinder (Black 1965)

Table 3: Chemical properties of soil (pre- sowing)

Particulars	Results	Methods employed
Soil pH (1:2 w/v)	7.6	Glass electrode, pH meter (Jackson)
Soil EC (dSm^{-1})	0.16	EC meter (Wilcox 1950) [26]
Organic Carbon (%)	0.70 to 0.74	Walkey and Black's (1934)
Available Nitrogen (kg ha^{-1})	288.99	(Subbaih and Asija 1956). Kjeldhal Method
Available Phosphorus (kg ha^{-1})	23.19	(Olsen *et al*. 1954) [19]
Available Potassium (kg ha^{-1})	107.20	(Toth and Price 1949)
Available Zinc (ppm)	0.50	DTPA extratable Atomic absorption method

Table 4: Effect of different levels of NPK and Zn on Physico-Chemical properties of soil after harvest of pea crop.

Treatment combination	Bd (Mg m^{-3})	Pd (Mg m^{-3})	Porespace (%)	pH 1:2 (w/v)	EC (dSm^{-1})	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	Zn (ppm)	Organic carbon (%)
T0=(L_0Z_0)	1.26	2.57	47.33	7.73	0.16	275.33	21.50	106.20	0.52	0.65
T1=(L_0Z_1)	1.23	2.47	46.67	7.55	0.16	295.33	23.03	124.50	0.54	0.70
T2=(L_0Z_2)	1.24	2.68	47.33	7.54	0.15	299.33	26.00	133.80	0.58	0.73
T3=(L_1Z_0)	1.21	2.59	48.00	7.46	0.15	295.67	24.83	152.13	0.62	0.72
T4=(L_1Z_1)	1.22	2.51	48.67	7.37	0.14	299.33	27.33	161.97	0.65	0.74
T5=(L_1Z_2)	1.23	2.63	49.67	7.34	0.12	305.67	26.17	170.67	0.71	0.75
T6=(L_2Z_0)	1.22	2.48	48.33	7.31	0.12	302.33	28.00	187.40	0.75	0.73
T7=(L_2Z_1)	1.20	2.58	50.00	7.30	0.11	311.67	28.87	214.27	0.80	0.76
T8=(L_2Z_2)	1.21	2.50	49.67	7.05	0.11	315.33	28.90	225.27	0.91	0.76
MEAN	1.22	2.55	48.40	7.40	0.13	299.99	26.07	164.02	0.67	0.72
CD at 5%	NS	NS	NS	0.29	0.02	5.80	0.689	0.873	0.02	0.02

Physical properties of soil (post-harvest)

The results in given Table 4 indicate some of the important parameter on physical and chemical properties on Pea crop. NPK and Zn fertilizers conjunction on bulk density, particle density and pore space to be non-significant. The bulk density (Mgm^{-3}), particle density (Mgm^{-3}) and pore space (%) of post-harvest soil was recorded 1.21, 2.50 and 49.67 with the treatment T_8 respectively. The slight decreased in bulk density, particle density and pore space may be due to tillage operation and increase in plant growth

Chemical properties of soil (post-harvest)

The results in given Table 4 indicate some of the important parameter on physical properties on Pea crop. NPK and Zn fertilizers in conjunction on BD, PD, and pore space was found non-significant and pH, EC (dSm^{-1}), Organic carbon (%), available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}), available potassium (kg ha^{-1}) and Zn (ppm) was found significant. pH, EC (dSm^{-1}), Organic carban (%), available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}), available potassium (kg ha^{-1}) and available Zinc (ppm) was recorded 7.05,0.11, 0.76,315.33, 28.90, 225.27 and 0.91 respectively in the treatment T_8 that was significantly higher as compared to other treatment combination.

pH was recorded 7.05 in the treatment T_8 that were significantly lower as compared to other treatment combination. The slight decreased in soil pH and soil EC (dSm^{-1}) and increased in Organic carbon (%), available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}), available potassium (kg ha^{-1}) and available Zinc (ppm) may be due to increase in levels of NPK and Zn fertilizer and plant growth, which is increased the plant residues into soil. It may be concluded from trial that the various level of NPK, and Zinc used from different sources in the experiment, the treatment combination T_8 ($N_{40}P_{80}$ K_{40} Kg ha^{-1}+ Zn $_{20}$ kg ha^{-1}) was found to be the best, for improvement in physical and chemical properties of soil.

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