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EFFECT OF DIFFERENT LEVELS OF NPK ZN AND *Rhizobium* ON PHYSICO-CHEMICAL PROPERTIES OF SOIL, GROWTH PARAMETERS, YIELD AND NUTRIENT UPTAKE BY PEA (*Pisum Sativum* L.) CV. ARKEL

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ABSTRACT

A study was conducted at the Soil Science Research Farm, Sam Higginbottom Institute of Agriculture and Technology Sciences-Deemed-to-be-University. Allahabad during Rabi season 2013-14. The number of pods/plant (18.22), number of seeds/pod (7.64), pod yield (78.60 q/ha) and number of nodules (14.33) were significantly increased with the application of 50% recommended dose of N P K, Zn fertilizers and with *Rhizobium* inoculation. The maximum yield was obtained in T_5 – [N@ 20kg + P@ 40kg + K@ 20kg + Zn@ 10 kg/ha + *Rhizobium@* 200g 10/kg seeds]. Growth parameters, soil properties, nutrient uptake NPK and Zn [86.16, 18.02, 49.15 kg/ha and 35.77 g/ha] and protein content 30.99% in seeds increased significantly with the application of 100% recommended dose of fertilizers and with *Rhizobium* inoculation *i.e.* T_8 – [N@ 40kg + P@ 80kg + K@ 40kg + Zn@ 20kg/ha + *Rhizobium@* 200g 10/kg seeds] except nodule growth, pH, EC (dS/m) and bulk density (gc/m) decreased with increase in fertilizer levels. The lowest values related to all parameters were obtained in control treatment. Soil chemical properties, growth parameters, yield and nutrient uptake decreased from its initial status under absolute control. Cost benefit ratio (C:B) 1: 2.48 was highest in T_5 - (N @ 20kg + P @ 40kg + K @ 20kg + Zn @ 10 kg/ha + *Rhizobium@* 200g 10/kg seeds) 50% recommended dose of fertilizers with *Rhizobium* inoculation was more profitable ₹ 51671.25 than any other treatments and recommendations.

Key words : *NPK, Zn, rhizobium, soil, nutrients, protein, yield, cost benefit ratio, and pea.*

The agriculture sector is a prominent part of the Indian economy. 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" (1). 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. 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 leguminoseae 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 soyabean, groundnut and beans. Peas are an excellent human food (2), 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 (3). Nutrition value of green peas per 100g contain Eenergy 339 KL, Dietary Fiber 5.1g, Protein 5.42, Carbohydrates 14.45g, Sugars 5.67g, Fat 0.4g, Vitamin C 40mg, folic acid 50.7µg, Iron 1.47mg, potassium 217mg, magnesium 33mg, phosphorus 108mg. (4). The center of production of peas has moved from the traditional Middle East locale to Canada, which is now the largest single producer. Peas ranks 4th in the world on a production basis 441.53 thousand tonnes among grain legumes after soybean, groundnut and French bean and is grown on an area of 528.71 thousand hectares in the world (5). Uttar Pradesh is the largest producer of pea growing state in India *i.e.* 1,805.01 tonnes. Total production of pulse, reported 2012-13 (April/ May) was at 17.3 million tonnes. In which from them pea was covered in production 3744.84 tonnes. Nitrogen is an important nutrient for all crops. It increases yield nutrition and economics of pulses also increases the protein content. Deficient plants may have stunted

growth and develop yellow-green colour. It accelerates photosynthetic behaviour of green plants as well as growth and development of living tissues specially tiller count in cereals. Phosphorus plays a vital role in photosynthesis, respiration, energy storage, cell elongation and improves the quality of crops. Deficient plants may have thin, erect and spindly stems and leaves turn into bluish-green colour. Potassium enhances the ability of plants to resist diseases, insect-pest attack, cold, drought and other adversities. Potassium is known to play a vital role in photosynthesis, translocation of photosynthates, regulation of plant pores, activation of plant catalysts and many other processes. Zinc is involved in various host plant metabolic processes, nodule growth and N_2 fixation processes. In Zn deficient plants, protein synthesis and protein levels are markedly reduced but amino acids and amides are accumulated as Zn is the structural component of the protein synthesizing polymerase enzyme; hence, in Zn deficient plants ,the protein synthesis of Ribonucleic Acid (RNA) is impaired. *Rhizobia* are soil bacteria that fix nitrogen after becoming established inside root nodules of legumes. Amongst the soil bacteria there is a unique group called rhizobia that have a beneficial effect on the growth of legumes. *Rhizobium* inoculated seeds increases the number of nodules of plant and increases seed yield and protein content of legume. *Rhizobium* inoculation increases the number of nodules upto 53%.

MATERIALS AND METHODS

Field experiment was conducted on the Soil Science research field of Allahabad school of Agriculture, SHIATS-DU-Allahabad (U.P) during Rabi season of 2013-14. The surface soil samples (0-15 cm) collected from the experiment site were analyzed for Physico-chemical characteristics as suggested by Jackson 1958 and results are summarized in table.1 Indian Pea (*Pisum sativum* L.) Cv. Arkel was tested with three levels of N @ 0, 20 and 40 kg/ha, P @ 0, 40 and 80 kg/ha, K @ 0, 20 and 40, Zn @ 0, 20 and 40 kg/ha and *Rhizobium* @ 0, 100g/10 kg seed and 200g/10 kg seed. Irrigation scheduling, fertilizers application and intercultural operation are followed as per normal agronomic practices. The experiment was laid out in 1.5 x 1.5 m 3^2 factorial R.B.D with 9 treatments and three replications. Pod yield was recorded at harvest for all the treatments. At harvest of crop analysis for soil textural classes, pH, EC performed as per standard laboratory methods.

Soil sampling and analysis : Soil samples from each plot at 0-15cm depth were collected at different stages were air-dried, grind and passed through 2 mm sieve and finally stored in polythene bags for analysis of different Physico- chemical parameters and changes in available N, P, K and Zn content. The soil sample was analyzed for Bulk density, Particle density, % Pore-space, pH, EC, Organic carbon, Available N, P, K and Zn.

Plant sampling and analysis : Pea plant leaf samples and whole plants at harvest were collected as per treatment. Five plant leaves were collected from each net plot, washed thoroughly with distilled water and dried under shade. Then, they were dried in hot air oven at 65°C till a constant weight was obtained. Dried plant samples were powdered in a willey grind mill and stored in polythene covers for further chemical analysis. Digestion of plant and leaf samples powdered plant samples were digested using concentrated sulphuric acid at 300°C for nitrogen estimation. For potassium and phosphorus estimation, powdered sample was predigested with 5 ml of concentrated nitric acid over night and digested with 10 ml of triacid mixture consisting of concentrated nitric acid, sulphuric acid and perchloric acid. The digestion was continued till solution turned clear. The content was cooled and the digested material was diluted with 6N HCl. The contents were made up to 50 ml with distilled water. A known aliquot was taken for estimation of P and K in the digested plant samples.

Nutrient determination in plant samples : The nitrogen in plant sample was estimated by micro-kjeldahl method as described by (6). Plant sample was digested with conc. H_2SO_4 and a pinch of digestion mixture comprising of salicylic acid, K_2SO_4 and $CuSO_4$. $2H_2O$ and digested sample was distilled with excess of 40 per cent sodium hydroxide. Whereas, ammonia released was trapped in 2 % of boric acid and ammonium tetra borate thus formed was titrated against 0.05N H_2SO_4. Phosphorus content in the triacid digest was determined by vanado-molybdate yellow color method. The intensity of yellow color was read in spectrophotometer at 420 nm and phosphorus content was determined. The triacid digested sample used for phosphorus estimation was also used for determination of potassium. A known aliquot was taken and diluted suitably in a volumetric flask and fed to flame

Table-1: Pre sowing Physical and Chemical analysis of Soil Properties at 0-15 cm depth of Soil.

Particulars	Rating	Method
Soil pH, (1:2) W/V	7.61	Digital pH meter – (Jackson M.L. 1958)
EC (d/Sm)	0.25	Digital EC meter – (Wilcox (1950)
Bulk density (g cm^{-3})	1.07	Graduated measuring cylinder (Black 1965)
Particle density (g cm^{-3})	2.47	Graduated measuring cylinder (Black 1965)
Pore space (%)	53.60	Graduated measuring cylinder (Black 1965)
Organic carbon (%)	0.35	Walkley and Black (1947)
Available N (Kg/ha)	258.5	Alkaline Permanganate Method (Subbiah and Asija 1956)
Available P (Kg/ha)	24.16	Calorimetric Method (Olsen et al. 1954)
Available K (Kg/ha) Available Zn (ppm)	102.70 0. 50	Flame photometric Method (Toth and Price, 1949) Atomic absorption method (di-acidic method)

photometer selecting K filter. The di-acid digested sample used for Zinc estimation. Digested samples were prepared by using HNO_3 and H_2O_2 and diluted with water, zinc content in the digestion sample is determined by using Atomic Abosorption Spectrophotometer.

Protein content (%) : The nitrogen in pea seed was estimated by micro-kjeldahl method as described by (6). Plant sample was digested with conc. H_2SO_4 and a pinch of digestion mixture comprising of salicylic acid, K_2SO_4 and $CuSO_4$. $2H_2O$ and digested sample was distilled with excess of 40 per cent sodium hydroxide. Whereas, ammonia released was trapped in 2 % of boric acid and ammonium tetra borate thus formed was titrated against 0.05N H_2SO_4, and the final values of nitrogen content are noted and multiplied with the standard value 6.25 to get the protein content in seeds.

RESULTS AND DISCUSSION

The results given in table-3 indicate some of the important parameters like plant height (cm), No. of leaves/plant/, No. of branches/plant, No. of nodules/ plant, No. of pods/plant, No. of seed/pod, Green pod yield of Pea. No. of leaves, No. of branches of pea increased significantly and progressively with the increasing level of N P K, Zinc and *Rhizobium* at 65 DAS in $T_8 – L_2\ Zn_2\ R_2$ (N@ 40kg + P @ 80kg + K @ 40 kg + Zn @ 20 kg/ha + *Rhizobium @* 200 g for 100 kg seeds/ha) was recorded 83.68, 59.86, 14.96 respectively Maximum No. of Nodules/plant, No. of pods/plant, and yield (q/ha), No. of seed/pod was found in T_5 with significant increase recorded as 14.33, 18.22, 7.64 and 78.60. Maximum Green pod yield was found in T_5 with non-significant difference. No. of nodules decreased at 65 DAS. The combined effect of 50% N P K, Zn fertilizer and 100% *Rhizobium* inoculation played very important role due to their synergistic effect. Application of Zinc and *Rhizobium* increased the supply of easily assimilated major as well as micro nutrient to plants, besides mobilizing, unavailable nutrients in available form moreover, *Rhizobium* also performed better when soil is well supplied with nutrients. Related results were also reported by (7).

Table-2 : Particular of the treatments.

Treatments	Levels of NPK, Zn/ ha	Symbol used
Levels of N, P, K, & Zn	@ 0% N P K, Zn @ 50% N P K, Zn	L_0Zn_0 L_1Zn_1
	@100% N P K, Zn	L_2Zn_2
Levels of Rhizobium	@0% Rhizobium @50% Rhizobium @100% Rhizobium	R_0 R_1 R_2

In table 4 Soil bulk density after crop harvest was non-significant. The minimum bulk density of post harvest soil was 1.02 g cm^{-3} in $T_8 – L_2\ Zn_2\ R_2$ (N @ 40kg + P @ 80kg + K @ 40kg + Zn @ 20 kg/ha + *Rhizobium @* 200g for 100kg seeds/ha). Maximum bulk density of post harvest soil was 1.33 gcm^{-3} in $T_6 – L_2\ Zn_2\ R_0$ (N @ 40kg + P @ 80kg + K @ 40kg + Zn @ 20kg ha^{-1} + *Rhizobium @* 200g 10/kg seeds) was greater than all other treatment combinations, similar findings were recorded by (8). Soil particle density after crop harvest was non-significant. The maximum particle density of post harvest soil was 2.70 g cm^{-3} in $T_8 – L_2\ Zn_2\ R_2$ (N @ 40kg + P @ 80kg + K @ 40kg + Zn @ 20kg ha^{-1} + *Rhizobium @* 200g for 10/kg seeds). The minimum particle density of post harvest soil was 2.50 gcm^{-3} in $T_1 – L_0\ Zn_0\ R_1$ (N @ 00kg + P @ 00kg + K @ 00 kg + Zn @ 00 kg/ha + *Rhizobium @* 200g 10/kg

Table-3: Effect of different levels of N P K, Zn and Rhizobium on growth parameters and yield of pea (*Pisum sativum* L.) Cv. Arkel" at 45 and 65 days after sowing.

Treatment Combination	Plant height(cm)	No. of leaves	No. of branches	No. of Nodules		No. of Pod/ plant	No. of seed/pod	Yield of Pea (q/ha)
				45 DAS	65 DAS			
$T_0 = L_0Z_0R_0$	71.33	43.50	9.30	8.27	6.36	8.73	4.83	52.73
$T_1 = L_0Z_0R_1$	73.44	49.36	9.86	8.83	7.06	10.06	5.21	59.18
$T_2 = L_0Z_0R_2$	77.99	51.66	11.22	10.46	8.78	10.53	5.31	61.24
$T_3 = L_1Z_1R_0$	81.44	53.16	12.20	11.36	7.90	11.50	5.43	67.96
$T_4 = L_1Z_1R_1$	78.06	56.58	14.63	13.28	8.13	14.42	5.87	71.66
$T_5 = L_1Z_1R_2$	88.30	68.88	18.07	14.33	8.28	18.22	7.64	78.60
$T_6 = L_2Z_2R_0$	89.06	68.20	18.20	12.77	7.56	17.99	7.11	76.52
$T_7 = L_2Z_2R_1$	96.20	73.77	19.99	12.17	7.77	15.57	7.30	73.42
$T_8 = L_2Z_2R_2$	97.30	73.66	21.22	11.35	6.92	15.25	6.88	72.13
Mean	83.68	59.86	14.96	11.42	7.64	13.58	6.17	68.16
F-test	NS	S	S	S	S	S	S	NS
S. Em (±)	2.16	1.29	0.46	0.75	0.26	0.34	0.23	5.10
C. D. at 5%	-	3.87	1.40	1.59	0.80	1.03	0.69	-

seeds) was greater than all other treatment combinations, similar findings were reported by (9). Soil pore space (%) after crop harvest was non-significant. The minimum pore space of post harvest soil was 32.85 in $T_4 - L_1 Zn_1 R_1$ (N @ 20 kg + P @ 40 kg + K @ 20 kg + Zn @ 10 kg/ha + *Rhizobium* @ 100g 10/kg seeds). The maximum % pore space of post harvest soil was 50.58 in $T_7 - L_2 Zn_2 R_1$ (N @ 40 kg + P @ 80 kg + K @ 40 kg + Zn @ 20 kg/ha + *Rhizobium* @ 200 g 100/kg seeds) which was greater than all other treatment combinations, similar findings were recorded by (10). The minimum pH of post harvest soil was 7.00 found in $T_8 - L_2 Zn_2 R_2$ (N @ 40kg + P @ 80kg + K @ 40 kg + Zn @ 20 kg/ha + *Rhizobium* @ 200 g 10/kg seed). The maximum pH of post harvest soil was 7.66 found in the $T_0 - L_0 Zn_0 R_0$ (control) which was greater than all other treatment combinations. The interaction between N, P, K, Zn *Rhizobium* the soil pH after crop harvest was non-significant, similar findings were recorded by (11). The minimum EC of post harvest soil was 0.11 in $T_8 - L_2 Zn_2 R_2$ (N @ 40 kg + P @ 80kg + K @ 40 kg + Zn @

Table-4: Effect of different levels of N P K, Zn and Rhizobium on post-harvest properties of soil.

Treatment combination	Bd (gcm^{-3})	Pd (gcm^{-3})	Pore space(%)	pH (1:2 w/v)	EC (dS/m)	N (kg/ ha)	P_2O_5 (kg/ ha)	K_2O (kg/ ha)	Organic Carbon (%)	Zinc (ppm)
$T_0 = L_0Z_0R_0$	1.27	2.53	45.80	7.66	0.16	278.73	22.79	107.77	0.67	0.50
$T_1 = L_0Z_0R_1$	1.25	2.50	46.12	7.56	0.16	298.00	23.13	125.74	0.70	0.54
$T_2 = L_0Z_0R_2$	1.25	2.61	47.01	7.50	0.16	290.25	23.64	134.72	0.73	0.57
$T_3 = L_1Z_1R_0$	1.20	2.65	46.26	7.50	0.15	290.25	24.33	152.68	0.71	0.63
$T_4 = L_1Z_1R_1$	1.19	2.68	32.85	7.36	0.14	298.64	24.66	161.66	0.74	0.67
$T_5 = L_1Z_1R_2$	1.15	2.63	50.43	7.30	0.14	307.02	26.03	170.65	0.75	0.70
$T_6 = L_2Z_2R_0$	1.33	2.58	49.97	7.26	0.13	303.57	26.04	188.61	0.73	0.83
$T_7 = L_2Z_2R_1$	1.09	2.69	50.58	7.13	0.13	314.36	27.78	215.55	0.76	0.88
$T_8 = L_2Z_2R_2$	1.02	2.70	50.36	7.00	0.11	319.60	28.67	226.54	0.78	0.90
Mean	1.19	2.61	46.59	7.36	0.14	300.04	25.23	164.88	0.73	0.69
F-test	-	-	-	-	-	-	-	-	-	-
S.Em (±)	0.09	0.07	5.02	0.07	0.007	4.32	0.42	13.47	0.012	0.013
C.D. at 5%	-	-	-	-	-	-	-	-	-	-

Table-5: Effect of different levels of N, P, K, Zn and Rhizobium on Nutrient uptake and protein content of Pea (*Pisum sativum* L.) Cv. Arkel

Treatment Combination	N (g/kg)	P (g/kg)	K (g/ha)	Zn (mg/kg)	Protein (%)
$T_0 = L_0Z_0R_0$	48.03	9.31	27.22	18.11	20.60
$T_1 = L_0Z_0R_1$	50.62	11.39	37.57	19.15	22.78
$T_2 = L_0Z_0R_2$	54.61	12.04	43.45	20.37	22.81
$T_3 = L_1Z_1R_0$	64.09	13.05	30.56	22.72	23.64
$T_4 = L_1Z_1R_1$	66.11	14.97	38.25	23.16	24.20
$T_5 = L_1Z_1R_2$	73.85	16.51	46.30	27.30	25.97
$T_6 = L_2Z_2R_0$	74.45	16.66	36.50	32.62	29.49
$T_7 = L_2Z_2R_1$	79.84	17.04	40.92	33.23	30.66
$T_8 = L_2Z_2R_2$	86.16	18.02	49.15	35.77	30.99
Mean	66.41	14.33	38.88	25.82	25.68
F-test	NS	S	NS	NS	NS
S.Em (±)	2.36	0.17	0.87	0.50	1.06
C.D. at 5%	-	0.51	-	-	-

20 kg/ha + *Rhizobium* @ 200g 10/kg seeds). The maximum EC of post harvest soil was 0.16 dS/m in $T_0 - L_0\ Zn_0\ R_0$ (control), T_1 and T_2 which was greater than all other treatment combinations, similar findings were recorded by (8).

The maximum available nitrogen 319.60 kg/ha, available phosphorus 28.67 kg/ha, available potassium 226.54 kg/ha, available Zinc 0.90 ppm and organic carbon 0.78% was found in $T_8 - L_2\ Zn_2\ R_2$ (N @ 40 kg + P @ 80 kg + K @ 40 kg + Zn @ 20 kg/ha + *Rhizobium* @ 200g 10/kg seeds) showed non significant difference and was greater than all other treatment combinations. Legumes have potential to improve soil nutrients status through biological nitrogen fixation and incorporation of biomass in to the soil as green manure. *Rhizobium* inoculation helped in increasing the nitrogen content especially in the form of NH_2 in the soil which is preferred by the plants. P-solubilizing organisms help in solubilizing the native as well as applied phosphates, Legumes have potential to improve soil nutrients status through biological nitrogen fixation and incorporation of biomass in to the soil as green manure, similar findings were recorded by (12).

In table-5 depicted the maximum Nitrogen 86.16 kg/ha, Phosphorus 18.02 kg/ha, Potassium 49.15 kg/ha and Zinc 30.99 g/ha uptake (N P K and Zn) in plants was in $T_8 - L_2\ Zn_2\ R_2$ (N @ 40 kg + P @ 80kg + K @ 40 kg + Zn @ 20 kg/ha + *Rhizobium* @ 200g 10/kg seeds) was greater than all other treatment combinations. The minimum N P K and Zn uptake in plants was in $T_0 - L_0\ Zn_0\ R_0$ (control). Increases in elemental constituents of pea seeds may be due to the effect of micronutrients on stimulating biological activities, *i.e.* enzyme activity, chlorophyll synthesis, rate of translocation of photosynthetic products and increased nutrient uptake through roots, similar results have also been recorded by (3). The treatment T_8 (N@ 40 kg + P@ 80 kg + K@ 40 kg + Zn@ 20 kg/ha + *Rhizobium*@ 20

Table-6: Effect of different levels of N P K Zn and *Rhizobium* on cost benefit ratio (C: B) of different Treatment Combination with Pea crop.

Treatment	Yield (q/ha)	Yield @ ₹/q	Gross return (₹/ha)	Total cost of cultivation (₹/ha)	Net profit (₹/ha)	Cost benefit ratio (C : B)
T_0	52.73	1100.00	58003.00	32450.00	25553.00	1:1.78
T_1	59.16	1100.00	65076.00	32550.00	32526.00	1:1.99
T_2	61.24	1100.00	67364.00	32650.00	34714.00	1:2.06
T_3	67.96	1100.00	74756.00	34594.75	40161.25	1:2.16
T_4	71.66	1100.00	78826.00	34694.75	44131.25	1:2.27
T_5	78.60	1100.00	86466.00	34794.75	51671.25	1:2.48
T_6	76.52	1100.00	84172.00	36539.50	47632.50	1:2.30
T_7	73.44	1100.00	80784.00	36639.50	44144.50	1:2.20
T_8	72.13	1100.00	79343.00	36739.50	42603.50	1:2.15

Selling price of pea (Green pods) = ₹ 1100.00/q

g/ha) shows maximum protein content of 30.99 % with non significant difference. It is clear from the data that increase in protein content is directly proportional to increase in NPK, Zn and *Rhizobium* application, similar findings were recorded by (3).

Economics of cultivation of pea (*Pisum sativum* L.) : Maximum gross return (₹ 86466.00/ha) which was recorded with the treatment of T_5 -L_1 Zn_1 +R_2 (@ 20kg N + @ 40 kg P+ @ 20kg K + @ 10kg Zn/ ha and @ 200g *Rhizobium* 10/kg seed/ha) fallowed by T_6- L_2 Zn_2 +R_0 (@ 40 kg N + @ 80 kg P + @ 40 kg K + @ 20 kg Zn/ha + @ 00g *Rhizobium* 10/kg seed/ha). The treatment T_5 -L_1 Zn_1 +R_2 (@ 20 kg N + @ 40 kg P+ @ 20kg K + @ 10kg Zn/ha and @ 200g *Rhizobium* 10/kg seed/ha) provided highest net profit of 51671.25 with benefit cost ratio of (1:2.48) and the minimum net profit of 25553 was recorded in the treatment T_0 - L_0 Zn_0+R_0 (control) with benefit cost ratio of (1:1.17) respectively.

CONCLUSION

It is concluded that the treatment T_5- L_1Zn_1 R_2 - [N @ 20 kg + P @ 40kg + K @ 20kg + Zn @ 10 kg/ha and *Rhizobium* @ 200g 10/kg seeds] was best in terms of yield and cost benefit ratio, number of pods/plant, number of seeds/pod and total yield was highest (78.60 q/ha) and net profit was (₹` 51671.25) with cost benefit ratio (C:B) 1:2.48 which was par of any other treatment. However T_5 showed average results for growth parameters of soil properties nutrient uptake and protein content. Hence T_5 - L_1Zn_1 R_2 - [N @ 20 kg + P @ 40 kg + K @ 20kg + Zn @ 10 kg/ha and *Rhizobium* @ 200g 10/kg seeds] was best and suitable treatment in all aspects. Therefore, application of @ 50% N P, K, Zn along with 100% *Rhizobium* inoculation can be recommended for Pea (*Pisum sativum* L.) Cv. Arkel for Allahabad region.

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