TO STUDY THE EFFECT OF INTEGRATED NUTRIENT ON YIELD AND NUTRIENT UPTAKE BY PEA (*PISUM SATIVUM* L.) CV.ARKEL

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ABSTRACT

A field experiment was conducted to study the effect of integrated nutrient on yield and nutrient uptake by pea (*Pisum sativum* L.) Cv. Arkel during rabi 2013-2014 at the research farm of Department of Soil Science, Sam Higginbottom University of Agriculture, Technology And Sciences, Allahabad. The experiment was laid out in 3x2x2 factorial with randomized block design with three level of NPK @ $N_0P_0k_0$kg ha^{-1}, @ $N_{15}P_{30}k_{20}$ kg ha^{-1} @ $N_{30}P_{60}K_{40}$kg ha^{-1}, two level of FYM @ 0 tha^{-1},@15tha^{-1} and two level of *Rhizobium* @ 0 and 200g/10Kg seed. The treatments were replicated three times and were allocated at random in each replication. The treatment combination of T_{11} [@$N_{30}P_{60}K_{40}$ kg ha^{-1} + @ $FYM_{15}tha^{-1}$ + *Rhizobium* @ 200g/10kg of seed], shows the best result with respect to plant height 79.33cm, number of leaves per plant 54.00, number of pods/plant 17.10, number of seeds/pod 8.55 and nutrient uptake in plant. It gave highest yield 103.70qha^{-1}. The same treatment combination resulted a slight change in pH 7.56 and EC 0.21dsm^{-1} increase in OC% 0.58%. From the economical point of view, the same treatment combination gave the maximum profit of 57299 Rs ha^{-1} with B: C ratio of 1:2.23.

Key Words: *Pea (Pisum sativum L.), NPK, FYM, Rhizobium, soil pH, organic carbon, yield, nutrient uptake.*

INTRODUCTION

Pea (*Pisum sativum* L.) belong to Leguminaceae family it is believed to be native to the Mediterranean region of Southern Europe and to Western Asia comprising Italy and South-Western Asia and India. Later its cultivation was taken up by many countries like France, Japan Spain, Pakistan etc **(Mithen, 2003)** In India it is cultivated mainly in Uttar Pradesh, Bihar, Punjab, Delhi etc. where it is grown for both vegetable (table purpose) and pulse purpose.

Pea is a cool-season legume crop. The plants of pea are 35-60 cm tall. The plant is short leaved, herbaceous annual, which climbs by leaf let tendrils. The stem is slender, circular and weak. The root system is not strongly developed except taproot. The flowers are arranged in the form of an axillary receme. The flowers may be reddish, purple or white. Pods are 5-9cm long, it containing 8 to10 seeds in them. The seeds may be round, angular or wrinkled depending upon type and variety. Pea is highly nutritive and contains high proportion of protein, carbohydrates, minerals and vitamins. A 100g of dried pea contains protein 22.5g, carbohydrate 62.1g, fat 1.8g.

Nitrogen plays an important role in plants. Nitrogen is an essential element for proper plant growth and development. It imparts green colour to leaves and stems and enables them for efficient photosynthesis. Pea, like other grain crops needs great supply of nitrogen. Due to leguminous nature, major part of nitrogen requirement can be met through inbuilt mechanism of atmospheric nitrogen fixation.

Besides nitrogen, phosphorus is the second most important plant nutrient and classed as a major plant nutrient. Phosphorus is a key element in the process involving conversion of solar energy into the plant food. The P compounds like ADP (Adenosine diphosphate) and ATP (Adenosine Triphosphne) infect act as energy currency within the plants. Thus, phosphorus influences the vigour of plant, root growth and improves the quality of crop yield. It also counteracts the harmful effect of excess nitrogen in the plants. Phosphorus not only enhances the root growth but also promotes early plant maturity **(Mullins *et al.*, 1996)**.

Potassium is often referred as the quality element for crop production due to its positive interaction with other nutrients (especially with nitrogen) and production practices **(Usherwood, 1985)**. It promotes synthesis of photo-synthates and transport to fruits and grains, and enhances their conversion into starch, protein, vitamins, oil etc. Application of NPK to pea crop usually promotes vegetative growth and nodulation, and improves green pod yield.

Being a legume crop and has the inherent ability to obtain much of its nitrogen requirement from the atmosphere by forming a symbiotic relationship with Rhizobium bacteria in the soil. Pulse crops ability to use the atmospheric nitrogen through Biological Nitrogen Fixation (BNF) is economically sound and environmentally acceptable **(Saikia and Jain, 2007)** Biofertilizers are organic products containing living cells of different types of microorganisms, which have the ability to convert nutritionally important elements from unavailable to available form through biological processes **(Vessey, 2003)**.

The *Rhizobium* as fertilizer in pulses could fix 50-200 kg of N/ ha/season and is able to meet 80-90% of the crop requirement for nitrogen. Inoculation in these crops was found to increase the crop yield by about 10-15% under on farm conditions

The use of organic manures holds prestigious position with the farmers since long back. The organic manures play an important role in crop production. It acts on the soil physically, chemically and biologically in many beneficial ways. Physically, organic matter promotes, formation of soil crumbs that make the soil friable and thereby facilitate the proper movement of air and

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water and absorption of rainwater. Chemically, organic manures add nutrients and organic compounds to the soil while going under decomposition. Biologically,organic manures provide food for the beneficial soil microorganisms.

Biofertilizers can only add nitrogen and increase native phosphorus availability to some extent. Chemical fertilizers are main suppliers of major plant nutrients (N, P and K). The imbalance and continuous use of chemical fertilizers has adverse effect on soil physical, chemical and biological properties there by affecting the sustainability of crop production, besides causing environmental pollution. Therefore, there is an urgent need to reduce the usage of chemical fertilizers and in turn increase in the usage of organics which needed to check the yield and quality levels. Use of organics alone does not result in spectacular increase in crop yields, due to their low nutrient status. Hence an integrated approach which involves the combined use and exploitation of all the sources of plant nutrients offers a great promise in this direction. Therefore, the rational and practical means to maintain soil fertility and to supply plant nutrient in balanced proportion, is to practice integrated plant nutrients supply through the combined use of organic, chemical and biofertilizers.

REVIEW OF LITERATURE

Patel Pushkar Singh *et al.* (2013) reported that application of recommended doses of NPK and biofertilizer were superior in terms of number of flowers per plant, number of pods per plant, number of seeds per pod, length of leaf (cm), shelling percentage, weight of 10-pods (g), seed weight (g),and yield per plot.

Vishal Sharma (2013) Studied that application of FYM 2.5 t ha^{-1} + Rhizobium in integration with 150% of recommended NPK resulted in significant improvement in growth, yield, nutrient uptake of garden pea and improved the fertility of the soil. Pea cropping in conjunction with integrated use of FYM 2.5 t ha^{-1} + Rhizobium along with 150% of recommended NPK was found to be the best. However, organic carbon content was significantly higher with FYM 5 t ha^{-1} in integration with 150% of recommended NPK. In terms of net returns, FYM 2.5 t ha^{-1} + Rhizobium in integration with 100% of recommended NPK was as good as in combination with 150% of recommended NPK.

Singh *et al.* (2012) reported that application of vermi-compost @ 1 t ha^{-1} + rest PK (50:25 kg ha^{-1}) through chemical fertilizers with variety Azad Pea-3 resulted maximum height of plant (59.40 cm), number of pods plant-1 (8.46), weight of pods plant-1 (41.22g), shelling percentage (50.66%) and yield of green pod (126.54 qha^{-1}). On the basis of cost of cultivation, maximum net return of Rs. 44392/ ha and C.B. ratio (1:2.93) was recorded under Azad Pea-3 with the application of vermi-compost @ 1 t ha^{-1} + rest PK (50:25 kg ha^{-1}) and next best treatment was FYM @3 t ha^{-1} + rest PK (48:10 kg ha^{-1}) in the same variety which gave Rs. 41796/ ha with C:B ratio 1:2.57.

Uday Sharma and Jitender Kumar Chauhan (2011) The experiment conducted on pea, taking two levels of chemical fertilizers, farm yard manure and vermicompost, and dual inoculation with biofertilizers in different combinations, revealed that the integrated nutrient management was the best option for the maximum yield and quality produce. The biofertilizers, both Azotobacter and PSB, played a major role in increasing the nutrient availability to the plants, which in turn was reflected through the quality of the produce and yield maximization. The biofertilizers, however, showed better responses when applied in conjunction with the organic manures, since the manures provided a favorable environment for the activity of these micro organisms. Amongst the organic manures tried, the vermicompost proved to be a suitable alternative to the FYM owing to its higher nutrient content and other associated properties.

Anupma Kumari *et al.* (2010) reported that various combinations of inorganic (IN) and organic nutrition (ON) to pea (*Pisum sativum* L.), superimposition of 50% nitrogen (equivalent to 20 kg N) through vermi-compost over the recommended dose i.e 40-17-16-20kg N-P- K-S ha^{-1} (100% IN + 50% ON) resulted in significantly higher values for yield, harvest index, B: C ratio, protein and nutrient content. Seed inoculation with bio-fertilizer (Rhizobium + PSB + PGPR) in combination with application of Zn was also conducive for these parameters. Moreover, the interaction between the 100% IN + 5O% ON fertility level with bio-fertilizer + Zn gave significantly higher grain yield.

Mishra *et al.* (2010) reported that combined application of 100% RDF and seed inoculation with Rhizobium + PSB + PGPR improved all the growth, yield attributes and yield of pea. Plant height, fresh and dry weight plant, nodules number and dry weight plant were found significantly maximum. Number of grains pod, number and weight of pods plant at maturity attributed significantly in incresing the grain yield of pea upto 31.00q ha^{-1} and net return upto Rs. 26187 ha^{-1} with the application of 100% RDF and seed inoculation of Rhizobium + PSB + PGPR, yield was 10.96 and 11.93% higher over co-inoculation of Rhizobium + PSB + PGPR (27.60qha^{-1}) and 100% RDF (27.30q ha^{-1}) application. Thus it can be recommended that to obtain the maximum grain yield and net profit from dwarf field pea,seed should be inoculated with rhizobium + PSB + PGPR and crop should be fertilized with 100% recommended dose of fertilizer.

Rajput and Kushwah (2005, 2010, 2012, 2013) reported that the application of recommended doses of fertilizer followed by soil application of bio-fertilizers mixed 25 kg FYM along with 50% recommended dose of fertilizers and were at par statistically. So the use of bio-fertilizer with 50% recommended dose of fertilizer saved 50% N, P (10 kg N. 25 kg P_2O_5). It also saved the financial resources as well as FYM.

MATERIALS AND METHODS

Field study was conducted at the research farm of Department of Soil Science, Sam Higginbottom University of Agriculture, Technology And Sciences Allahabad during the rabi seasons (2013-2014) with Pea (Cv. Arkel) as the test crop. The experimental soil having a pH (1:2) 7.8, EC 0.38 dSm^{-1}, organic carbon 0.46%, available nitrogen 201kg/ha, available phosphorus 28.85 kg/ha, available potassium 165kg/ha. The 100% NPK recommended dose of fertilizer for pea was 30 Kg N, 60Kg P_2O_5 and 40Kg K_2O ha^{-1}, respectively. The experiment consisted of twelve treatments replicated three times in a randomized block design viz., control, $N_0P_0K_0$ + FYM_0 + *Rhizobium* @ 200g / 10 kg of Seed, $N_0P_0K_0$ + FYM @15 t ha^{-1} + $Rhizobium_0$, $N_0P_0K_0$ + FYM @ 15 t ha^{-1} + *Rhizobium* @ 200g/10 kg of seed, $N_{15}P_{30}K_{20}$ + FYM_0 + $Rhizobium_0$, $N_{15}P_{30}K_{20}$ + FYM_0 + *Rhizobium* @ 200g / 10 kg of Seed, $N_{15}P_{30}K_{20}$ + FYM @ 15 t ha^{-1} + $Rhizobium_0$, $N_{15}P_{30}K_{20}$ + FYM @ 15 t ha^{-1} + *Rhizobium* @ 200g/10 kg of Seed, $N_{30}P_{60}K_{40}$ + FYM_0 + $Rhizobium_0$, $N_{30}P_{60}K_{40}$ + FYM_0 + *Rhizobium* @ 200g/10 kg of

seed, $N_{30}P_{60}K_{40}$ + FYM @15 t ha^{-1} + *Rhizobium*$_0$ and $N_{30}P_{60}K_{40}$ + FYM @15 t ha^{-1} + *Rhizobium* @ 200g/10kg of Seed. Total N,P and K contents of FYM were 0.50%, 0.20% and 0.50% respectively. After the third pickings of pea crop, the composite surface (0-15cm) soil samples from each plot of the experimental field were analyzed for physical and chemicals properties by standard procedures.

RESULTS AND DISCUSSION

The general results of the investigation are summarized below:

The experiment was conducted at the Research Farm of Soil Science, Sam Higginbottam Institute of Agriculture, Technology and Sciences, Allahabad (Deemed to be University), Allahabad during Rabi season 2013-14 "To study the effect of Integrated Nutrient on Yield and Nutrient Uptake by Pea (*Pisum sativum* L.) Cv. Arkel" in Allahabad soil.

The treatments were allocated in 3 x 2 x 2 factorial Randomized Block Design (RBD) with three replications. The treatment considered of all combination, 3 levels of NPK fertilizer (i.e L_0- $N_0P_0K_0$ kg ha^{-1}, L_1 - $N_{15}P_{30}K_{20}$ kg ha^{-1}, L_2 - $N_{30}P_{60}K_{40}$ kg ha^{-1}), 2 levels of FYM (i.e F_0- 0t ha^{-1}, F_1 15t ha^{-1}) and 2 levels of *Rhizobium* (i.e B_0 - 0g *Rhizobium* 0kg seed ha^{-1}, B_1 - 200g *Rhizobium* 10 kg seed ha^{-1}) with twelve treatment combinations. The application of Farm Yard Manure @15 t ha^{-1} resulted in higher yield of pea and application of *rhizobium* @200g/10 kg seed there was significant increase in number of nodules and yield. The interaction between NPK Fertilizer in conjunction with FYM and *rhizobium* increase all the growth parameters, yield and nutrient uptake in plant. The treatment T_{11} (i.e 100% NPK kg ha^{-1} + 15t FYM ha^{-1} + 200 g *rhizobium*/kg seed) increased more than any other treatment combinations but there was a slight decrease in soil pH and EC(dSm^{-1}). The same treatment combination T_{11} (i.e 100% NP & K kg ha^{-1} + 15 t FYM ha^{-1} + 200 g *rhizobium* /kg seed) was the best combination. Highest Net Returns and Benefit / Cost Ratio was also recorded in this treatment combination (1:2.23).

Table No. 1. Interaction effect of different levels of Integrated Nutrient on soil properties by Pea (Pisum sativum L.)

Treatment Combination	pH (1:2)w/v	EC (dSm^{-1})	organic carbon	Particle density	Bulk density
T_0	7.78	0.25	0.33	2.68	1.69
T_1	7.65	0.23	0.35	2.67	1.70
T_2	7.73	0.26	0.37	2.61	1.67
T_3	7.62	0.21	0.45	2.61	1.66
T_4	7.71	0.20	0.40	2.66	1.68
T_5	7.66	0.26	0.36	2.68	1.69
T_6	7.56	0.25	0.47	2.63	1.66
T_7	7.77	0.24	0.55	2.62	1.65
T_8	7.65	0.23	0.49	2.65	1.69
T_9	7.58	0.21	0.52	2.66	1.68
T_{10}	7.57	0.23	0.51	2.59	1.65
T_{11}	7.56	0.21	0.58	2.60	1.64
Interaction (Lx F x B)	S	S	S	NS	NS
C.D at 5%	0.00	0.00	0.00	0.205	0.1822
	0.015	0.015	0.011	-	-

Table No. 2: Interaction effect of different levels of Integrated Nutrient on Nutrient uptake and yield by Pea (Pisum sativum L.)

Treatment combination	Nitrogen content	Phosphorus content	Potassium content	Yield q/ha
T_0	46.36	8.50	26.97	51.84
T_1	54.36	12.40	34.73	53.33
T_2	55.46	10.26	38.53	66.66
T_3	60.30	11.93	36.53	71.11
T_4	64.26	10.90	37.66	59.25
T_5	68.13	13.83	40.83	62.22
T_6	76.30	14.60	44.16	81.48
T_7	81.90	18.63	50.20	97.77
T_8	70.70	15.56	46.36	63.70
T_9	76.83	15.86	45.43	66.66
T_{10}	78.73	16.13	47.00	88.88
T_{11}	88.26	22.83	52.86	103.70
Interaction	S	S	S	S
(Lx F x B)	0.00	0.00	0.00	0.01
C.D. at 5%	0.91	1.17	3.64	0.69

CONCLUSION

On the basis of findings it is concluded that the treatment combination @ $N_{30}P_{60}K_{40}$ + FYM @ 15 t ha^{-1} + *Rhizobium* @ 200g/ 10kg of Seed i.e, Treatment T_{11} shows best result on Yield and Nutrient Uptake by Pea (*Pisum sativum* L.) in comparison to other treatment combinations. From the economical point of view, the same treatment combination gave maximum profit of 57299 Rs ha^{-1} with B:C ratio of 1:2.23. Since the findings are based on the research done in one season further experiments with more than one season will help in better to study the effect of integrated nutrient on yield and nutrient uptake by Pea (*Pisum sativum* L.) Cv. Arkel.

REFRENCES

Kumari, A., Singh, O.N., Kumar, R., Singh, A.K. and Singh, R. (2010) Effect of integrated nutrient management on yield and quality of dwarf pea (*Pisum sativum* L.) Home > Vol 37, No. 2 (2010) > Kumari

Mishra, A., Prasad,K. and Rai,G. (2010) Effect of bio-fertilizer inoculations on growth and yield of dwarf field pea (*pisum sativum* L.) in conjunction with different doses of chemical fertilizer. *Journal of Agronommy* 9(4): 163-168,2010.

Mithen, S. (2003) After the Ice: A Global Human History 20,000 - 5,000 BC. Weidenfield and Nicholson, London.

Mullins, G.L., B.F. Hajek and C.W. Wood. (1996) Phosphorus in agriculture. Bull. No. 2. Dept. of Agronomy and Soils, Auburn, USA.

Rajput, R.L. and Kushwah, S.S. (2005) Effect of integrated nutrient management on yield of pea (*Pisum sativum*) Legume Research - *An International Journal* Vol : 28, Issue : 3.

Saikia, S.P. and V. Jain, (2007) Biological nitrogen fixation with non-legumes: An achievable target or a dogma. *Curr. Sci.,* 92: 317-322.

Singh, P.P., Ram, R.B., Prakash,J. and Meena,M.L(2013) Effect of Biofertilzers on Growth and Yield Attributes of Pea (*Pisum sativum* L.) Trends in Biosciences Volume : 6, Issue : 2, First page : (174) Last page : (176)

Singh, S.S., Verma, R.S., Singh, P.K. and Dubey, K.D. (2012) Effect of integrated nutrient management in garden pea (Pisum sativum var. hortense) *Hort Flora Research Spectrum* 08/2012; 1 (3) : 244 - 247.

Sharma,V. (2013) Effect of integrated nutrient management inm in garden pea under dry temperate high hill conditions

Sharma, U and Chauhan, K.J (2011) Influence of integrated use of inorganic and organic sources of nutrients on growth and production of pea. *Journal of Farm Sciences* 1(1) : 14 - 18, 2011

Usherwood, N.R (1985) The role of potassium in crop quality. In: Munson, RS. (Ed.). Potassium in Agriculture. ASA-CSSA-SSSA, Madison, WI, USA,pp.489-513.

Vessey, J.K., (2003) Plant growth promoting rhizobacteria as biofertilizers. *Plant Soil*, 255: 571-586.