J. Soils and Crops 33 (1) 73-77, June 2023

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

INTEGRATED NUTRIENT MANAGEMENT STUDIES IN PEA (*Pisum sativum* L.) UNDER SUB-MONTANE AND LOW HILLS SUBTROPICAL ZONE OF HIMACHAL PRADESH

Anil Kumar[1], Manisha Kumari[2] and Swapana Sepehya[3]

ABSTRACT

A field experiment was carried out during *rabi* season of 2019-2020 to study the effect of integrated nutrient management in pea (*Pisum sativum* L.) under sub-montane and low hills subtropical zone of Himachal Pradesh at the experimental farm of the College of Horticulture and Forestry, Neri, Hamirpur, (HP) in a randomized block design with eleven treatments replicated thrice. The results revealed that the combined application of fertilizers and manures significantly influenced all the yield attributes (plant height, No. of pods plant^{-1}, No. of grains pod^{-1} and shelling percentage), yield (pod yield, stover yield and seed yield), quality (TSS and protein content) and nutrient uptake (N, P, K, S, Ca, Mg, Fe, Cu, Zn and Mn) by pea. The treatment comprising of 100 per cent RDF + poultry manure @ 10 t ha^{-1} (T_8) recorded the highest pod (79.82 q ha^{-1}), stover (20.45 q ha^{-1}) and seed yield (14.45 q ha^{-1}), quality parameters *viz.*, TSS (15.50^{o}B) and protein content (11.47 %) and nutrient uptake. However, this treatment was closely followed by the treatment receiving 75 per cent recommended dose of fertilizer + poultry manure (T_7).

(Key words : Pea, integrated nutrient management, yield attributes, yield, uptake and quality)

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the important vegetable crop in the world and ranks among the top 10 vegetable crops. It belongs to family *Fabaceae* and is a nitrogen fixing leguminous plant. It is very common nutritious vegetable grown which is consumed either fresh, canned, as pulse in frozen form or in dehydrated forms. It is a nutritious vegetable and 100 g of edible portion of pea contains 72.9 per cent moisture, 7.2 g protein, 0.1g fat, 4.0 g fibre, 15.9 g carbohydrates, 93 Kcal energy, 20 mg calcium, 139 mg phosphorus, 1.5 mg iron, 83 µg carotene, 0.25 mg thiamine, 0.01 mg riboflavin, 9 mg vitamin C and 0.8 mg niacin (Choudhary *et al.,* 2009).

Fertilizer is an important input for pea production as it has quite high fertilizer requirements due to its high yielding potential unit^{-1} area. Use of chemical fertilizers played a crucial role in the fulfillment of nutrient needs of the crop but had a damaging effect on the soil health (Anitha *et al*., 2015). Moreover, the continued use of high levels of chemical fertilizers decreases plant nutrients intake and induces either stagnation or decrease in yields and environmental pollution.

Organic manures contain plant nutrients though in small quantities, in comparison to the chemical fertilizers, the presence of growth hormones and enzymes make them essential for the improvement of soil fertility and productivity. In addition to this, the organic manures help in improving the use efficiency of inorganic fertilizers (Singh and Biswas, 2000). In addition, it plays a major role in supplementing the crop nutrients through their direct addition and improvement in soil conditions (Rajiv *et al*., 2016).

But presently in the country the organic sources available could meet nearly 1/3rd of total nutrients required to achieve the target of agricultural production. Given, the organic resources constraint, the use of organic is supplementary rather complimentary. Therefore, to sustain high productivity and quality of crop, judicious nutrient management is vital. Neither organic manures nor chemical fertilizer alone can achieve the yield sustainability. Their integrated use may help in improving crop productivity and quality of the produce. Keeping the above points in view, the present investigation was carried out to study the effect of integrated nutrient management on pea (*Pisum sativum* L.) under sub-montane and low hills subtropical zone of Himachal Pradesh.

1. Sr. Scientist, Dept. of Soil Science and Water Management, College of Horticulture and Forestry, Neri (Dr. YSP UHF,Nauni), Hamirpur, 177001, H. P. (India)
2. P. G. Student, Dept. of Soil Science and Water Management, College of Horticulture and Forestry, Neri (Dr. YSP UHF,Nauni), Hamirpur, 177001, H. P. (India)
3. Asstt. Professor, Dept. of Soil Science and Water Management, College of Horticulture and Forestry, Neri (Dr. YSP UHF,Nauni), Hamirpur, 177001, H. P. (India)

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm of the College of Horticulture and Forestry, Neri, Hamirpur, (H. P.) during *rabi* season of 2019-2020. The soil of experimental farm was sandy loam in texture, neutral in reaction (pH 6.72), low in organic carbon (4.50 g kg^{-1}) with 198.61, 16.16 and 146.67 kg ha^{-1} of available N, P and K, respectively. Eleven treatments *viz*.,Control (T_1), 100 % RDF (T_2), VC @ 10 t ha^{-1} (T_3), 75 % RDF + VC (T_4), 100 % RDF + VC (T_5), PM @ 10 t ha^{-1} (T_6), 75 % RDF + PM (T_7), 100 % RDF + PM (T_8), FYM @ 10 t ha^{-1} (T_9), 75 % RDF + FYM (T_{10}) and 100 % RDF + FYM (T_{11}) were tested and replicated thrice in randomized block design (RBD). Observations related to yield attributes{*viz*., plant height (at the time of final harvest), No. of pods $plant^{-1}$, No. of grains pod^{-1} and shelling percentage} and yield (*viz*., pod yield, stover yield and seed yield) were recorded. Plant samples were collected and analysed for nutrient contents. Nitrogen content was estimated by Micro Kjeldahl method (Jackson, 1973), P by Vanado-molybdo-phosphoric acid method (Jackson, 1973), K by Flame photometer method (Black, 1965), S by Turbidimetric method (Chesnin and Yein, 1950), Ca by Flame photometer method (Jackson, 1973), Mg, Fe, Zn, Cu, Mn by AAS method (Jackson, 1973) and uptake was determined by multiplying the respective nutrient content in per cent with the obtained dry matter yield of seed and stover (q ha^{-1}). The uptake of nutrients by the seed and stover was summed up to obtain total amount of nutrients removed by pea. Quality parameters like protein content in pea seed was estimated by multiplying the nitrogen content in pea seed by factor 6.25 by the method given by Jones (1941) and TSS was also determined with the help of Hand-Held Refractometer under room temperature conditions by the method given by Anonymous (1970).

The shelling percentage was worked out as under:

$$\text{Shelling percentage} = \frac{\text{Weight of shelled peas (g)}}{\text{Weight of unshelled pods (g)}} \times 100$$

The nutrient uptake was determined as per standard methods by using the following formula.

Nutrient uptake (kg ha^{-1}) = Nutrient content (%) x yield (q ha^{-1})

Total uptake (kg ha^{-1}) = uptake by seed + uptake by stover

The data so generated was statistically analysed using analysis of variance (ANOVA) for randomized block design. The treatments mean were tested for significant level at P=0.05.

RESULTS AND DISCUSSION

Yield attributes

The data depicted in Table 1 revealed that the treatment combination of 100 per cent recommended dose of fertilizer + poultry manure @ 10 t ha^{-1} (T_8) recorded maximum values of plant height (59.13cm), no. of pods $plant^{-1}$ (39.10), no. of grains pod^{-1} (7.63) and shelling percentage (60.33%).Among the sole organic manure application, poultry manure application proved better followed by vermicompost and farmyard manure in terms of growth and yield attributes. Application of 100 per cent recommended dose of fertilizers along with manures recorded higher values of growth and yield parameters as compared to application of 75 per cent recommended dose of fertilizers along with respective manures. The superiority of poultry manure over vermicompost and farmyard manure might be due to its nutritional richness, rapid mineralization and increased plant nutrient translocation. The increase in yield attributes of pea due to integrated nutrient management may be ascribed to the higher nutrient availability in the soil *rhizosphere* through the integration of organic and inorganics which might have resulted in higher nutrient uptake thereby increasing plant height. Similar beneficial effect of integrated nutrient management on different yield attributes of pea are in conformity with Singh *et al*. (2016),who reported that plant height, no. of pods $plant^{-1}$ and no. of grains pod^{-1} were recorded maximum in treatment receiving 50 per cent NPK +FYM @ 5.0 tha^{-1}+ VC @ 1.5 tha^{-1}+ PM @ 1.5 t ha^{-1}.

Yield

Among different treatments, treatment T_8 (100% RDF + poultry manure @ 10 t ha^{-1}) gave highest pod yield (79.82 q ha^{-1}), stover yield (20.45 q ha^{-1}) and seed yield (14.45 q ha^{-1}). However, lowest pod yield (35.19 q ha^{-1}), stover yield (8.41q ha^{-1}) and seed yield (5.02q ha^{-1})was recorded in T_1 (Control). A significant response of organics over control (T_1) was observed and the per cent increase in pod yield, stover yield and seed yield with the application of poultry manure @ 10 t ha^{-1}(T_6) was 69.59, 68.37 and 91.63 per cent, respectively. On comparing the treatments receiving 75 and 100 per cent RDF with different organics *viz.,* vermicompost, poultry manure and FYM, it was found that application of 100 per cent RDF with manures gave higher yield and was at par with the treatments receiving 75 per cent RDF coupled with respective manure but was superior over sole application of organics (Table 1).

The substantial increase in pea yield with the integrated use of chemical fertilizers alone or in combination with organic manures could be due to the contribution of organic manure containing mainly macro and micro nutrients as well as growth-promoting substances that have led to better plant growth. Initially, chemical fertilizers provided all essential nutrients and their absorption by the plant which rapidly improved nutrition, leading to better plant growth. In the latter stage, decomposed organic manures provided the necessary plant nutrients for the good growth of the plant, which in turn resulted in higher crop yields. These results are in conformity with Lal *et al.* (2022), who reported that treatment receiving 75 per cent RDF +FYM @ 5 t ha^{-1}+ Vermicompost @ 2.5 t ha^{-1} +*Rhizobium* recorded highest grain yield, stover yield and biological yield.

Quality parameters

The data presented in Table 1 indicates that the highest TSS (15.50°B) and protein content (11.47 %) of pea

Table 1. Effect of integrated nutrient management on yield attributes, yield, total soluble solids (TSS) and protein content in pea

Treatments		Plant height (cm)	Number of pods plant^{-1}	Number of grains pod^{-1}	Shelling percentage (%)	Pod yield (q ha^{-1})	Stover yield (q ha^{-1})	Seed yield (q ha^{-1})	TSS (^{o}Brix)
T_1	Control	41.73	23.20	5.67	47.20	35.19	8.41	5.02	13.83
T_2	100 % RDF	51.73	30.30	6.50	56.80	63.63	15.03	10.83	14.97
T_3	Vermicompost @ 10 t ha^{-1}	50.73	27.80	6.13	53.03	54.70	13.28	8.70	14.57
T_4	75 % RDF + Vermicompost @ 10 t ha^{-1}	54.67	32.47	6.67	58.80	72.68	17.43	12.82	15.00
T_5	100 % RDF + Vermicompost @ 10 t ha^{-1}	56.73	36.20	7.37	59.06	76.18	19.33	13.50	15.33
T_6	Poultry manure @ 10 t ha^{-1}	50.93	31.80	6.37	53.76	59.68	14.16	9.62	14.80
T_7	75 % RDF + Poultry manure @ 10 t ha^{-1}	56.07	37.60	6.83	59.16	75.55	18.46	13.39	15.10
T_8	100 % RDF + Poultry manure @ 10 t ha^{-1}	59.13	39.10	7.63	60.33	79.82	20.45	14.45	15.50
T_9	Farmyard manure @ 20 t ha^{-1}	49.73	26.20	6.03	52.82	52.20	12.19	8.25	14.43
T_{10}	75 % RDF + Farmyard manure @ 20 t ha^{-1}	55.20	31.40	6.53	57.46	71.46	16.52	12.30	14.90
T_{11}	100 % RDF + Farmyard manure @ 20 t ha^{-1}	58.13	33.80	6.93	58.83	73.54	17.60	13.00	14.70
	SE (d) ±	4.01	1.07	0.09	2.16	3.67	1.56	0.68	0.40
	CD at 5%	8.07	2.13	0.19	4.36	7.70	3.28	1.43	0.81

Table 2. Effect of integrated nutrient management on the total uptake of nutrients in pea

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	S (kg ha^{-1})	Ca (kg ha^{-1})	Mg (kg ha^{-1})	Fe (g ha^{-1})	Cu (g ha^{-1})	Zn (g ha^{-1})
T_1	14.04	5.02	22.70	6.33	13.34	3.58	503.15	67.60	509.87
T_2	34.16	10.43	47.46	13.39	28.51	7.78	1134.03	227.27	1266.24
T_3	27.47	8.61	38.33	10.93	23.16	5.62	983.95	156.74	1029.52
T_4	40.10	11.84	54.45	15.07	34.36	8.39	1362.93	247.54	1274.08
T_5	46.32	13.33	62.36	17.29	37.25	9.40	1594.00	298.97	1658.43
T_6	31.54	9.39	43.63	11.96	25.21	6.23	1083.85	192.39	1102.82
T_7	43.56	13.00	57.53	17.08	35.63	9.06	1547.27	283.11	1210.42
T_8	50.44	14.69	70.32	19.31	41.89	10.81	1778.04	342.46	2035.87
T_9	25.10	7.94	35.22	9.96	21.56	5.30	866.44	146.41	633.82
T_{10}	38.01	11.51	51.29	14.74	31.66	7.75	1281.32	244.52	1383.78
T_{11}	41.80	12.46	57.22	15.95	35.15	9.03	1474.93	284.36	1579.01
SE (d)±	5.07	0.74	3.63	1.03	2.98	0.85	100.64	24.62	234.95
CD at 5%	10.14	1.50	7.30	2.08	6.00	1.70	202.30	49.24	472.71

was recorded under T_8 (100 per cent RDF + poultry manure @ 10 t ha^{-1}) whereas lowest TSS (13.83°B) and protein content (7.47 %) was observed in control plots (T_1). Chemical fertilizer application (T_2) significantly improved the TSS and protein content over control (T_1). Vermicompost, poultry manure and farmyard manure when applied alone or in combination with the recommended doses of fertilizers resulted in significantly higher TSS and protein content over control (T_1).Application of manures and fertilizers either alone or in combination significantly influenced the total soluble solids of pea which might be due to the higher availability of phosphorus which is a important constituent of ADP, ATP and other high energy compounds. Tisdale *et al.* (1995) observed the improvement in protein content of pea with the addition of chemical fertilizers and organics; it might be due to the effect of N supplied to the crop. On the other hand, added organics play an important role in synthesis of protein by enhancing the availability of N and S through mineralization, which help in formation of sulphur containing amino acids. The findings are in accordance with studies carried out bySarkar and Ibotui (2017), who observed the highest TSS (7.5 °B) in treatment receiving VC @ 8 t ha^{-1} + Azotobacter and protein content of 19.94 per cent was recorded maximum with the application of vermicompost (Sepehya *et al.*, 2015).

Nutrient uptake

The total uptake of nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, iron, copper, zinc and manganese was significantly influenced by combined application of organic and inorganic manure. The data given in Table 2 shows that highest total uptake of nutrients by pea was observed under treatment T_8 (100 per cent RDF + poultry manure @ 10 t ha^{-1}) and lowest of was observed in control (T_1). The use of chemical fertilizers alone (T_2) or in combination with organic manures resulted in a significant increase in total uptake of nutrients by pea over control (T_1).Amongst treatments receiving 75 and 100 per cent RDF with different organic manures, application of 100 per cent RDF with organics was found superior in terms of total nutrient uptake by pea. On comparing different organic manures, poultry manure was found superior over vermicompost and farmyard manure.

The integration of organic and inorganic fertilizers resulted in higher uptake as compared to sole use of organic or inorganic ones and control. This may be due to the fact that the balanced and combined use of various plant nutrient sources results in proper absorption, translocation and assimilation of those nutrients, ultimately increasing the dry-matter accumulation and nutrient contents of plant and thus showing more uptake of elemental nutrients. Increased uptake of the nutrients under balanced nutrient supply was due to many intricate factors enabling better root and shoot growth facilitating in better absorption of water and nutrient from soil.Similar findings were reported by Karhale *et al.* (2021), who also recorded highest total uptake of nitrogen (123.95 kg ha^{-1}), phosphorus (22.93 kg ha^{-1}) and potassium (87.33 kg ha^{-1}) in treatment receiving FYM @ 5.0 t ha^{-1} + 30 kg N ha^{-1} + biofertilizer.

Thus, it is inferred from the above study that integrated use of fertilizers and organic manures was beneficial in improving yield attributes, yield, uptake and quality of pea. The treatment comprising of 100 per cent RDF + poultry manure @ 10 t ha^{-1} (T_8) was optimum under sub-montane and low hills subtropical zone of Himachal Pradesh. However, this treatment was closely followed by the treatment receiving 75 per cent recommended dose of fertilizer + poultry manure @ 10 t ha^{-1}(T_7).

REFERENCES

Anonymous, 1970.Official and tentative methods of analysis.11th ed. Association of Official Analytical Chemists.William Star Wetglad, Washington DC.

Anitha, M., D. V. Swami and Suneetha, D. R. Salomi, 2015. Seed yield and quality of fenugreek (*Trigonella foenum-graecum*L.) cv. Lam methi-2 as influenced by integrated nutrient management. The Bioscan.**10**:103-106.

Black, C. A. 1965. Methods of Soil Analysis.*Part II.*America Society of Agronomy, Madison, Wisconsin, USA.pp.572.

Chesnin, L. and C. H. Yien, 1950.Turbidimetric determination of available sulphates. *Soil* Sci. Soc. Am. Proc.**15**:149-151.

Choudhary, B. R., M. S. Fageria and R. S. Dhaka, 2009. A Text Book on Production Technology of Vegetables.Kalyani Publishers, New Delhi.pp.318.

Jackson, M. L. 1973. Soil Chemical Analysis.Prentice Hall of India Pvt. Ltd., New Delhi.

Jones, D. B. 1941. Factors for converting percentages of nitrogen in foods and feeds into percentage of proteins. Circular No. 183 (slightly revised). Washington, D.C.: United States Department of Agriculture. pp 22.

Karhale, A. R., N. D. Parlawar, M. R. Deshmukh, D. J. Jiotode and A. P. Karunakar, 2021.Effect of nutrient management on nutrient uptake, yield and economics of Soybean. J. Soils and Crops. **31 (1):** 116-120.

Lal, M., S. Gupta and S. Singh, 2022.Effect of integrated nutrient management on growth and yield of green gram (*Vigna radiata* L.). J. Soils and Crops. **32 (2):** 330-334.

Rajiv, D. P. Singh and K. P. Singh, 2016. Yield and economics of garden pea (*Pisum sativum* var. hortense) grown with integrated nutrient management . (In) Proceeding of Natural Science on Vegetable Legumes for Soil and Human Health.Indian Institute of Vegetable Research, Varanasi. February, 12-14, pp. 343-344.

Sarkar, A. and Ibotui, 2017.Efficacy of vermicompost and azotobacter on growth, yield and quality of strawberry cv. Festival. J. Soils and Crops. **27 (2):** 1-5.

Sepehya, S., S. K. Bhardwaj and S. Dhiman, 2015. Quality attributes of garden pea (*Pisum sativum* L.) as influenced by integrated nutrient management under mid hill conditions. J. KrishiVigyan. **3**:78-83.

Singh, G. B. and P. P. Biswas, 2000.Balanced and integrated nutrient management for sustainable crop production.Limitations and future strategies. J. Fertil. **45**:55-60.

Singh, M., Deokaran and B. P. Bhatt, 2016.Effect of integrated nutrient management on soil fertility status, productivity and profitability of garden pea. J. KrishiVigyan.**5**:29-33.

Tisdale, S. L., W. L. Nelson, J. D. Beaton and J. L. Haulin, 1995.Soil Fertility and Fertilizers.Prentice Hall of India Private Limited, New Delhi.pp.430.

Rec. on 23.11.2022 & Acc. on 08.12.2022