Himachal Journal of Agricultural Research 36 (1): 101-104, 2010

Short Note

Effect of conjoint use of enriched compost and chemical fertilizers on the yield and nutrient uptake in pea (*Pisum sativum* L.) under mid-hill conditions

S.K. Bhardwaj, R. Kaushal and Yoginder Sharma
Department of Environmental Science
Dr. Y.S. Parmar University of Horticulture and Forestry, Solan-173 230, India.

Abstract

Conjoint use of 100% NPK and enriched compost resulted in 15.40 % increase in green pod yield over 100% NPK alone. Application of enriched compost along with 50% NPK produced yield, pod length and plant height statistically at par with 100% NPK alone fertilizers. Combined application of enriched compost and chemical fertilizers significantly increased the uptake of macronutrients in pea plants as compared to their sole applications. Enriched compost along with 100% NPK fertilizers resulted in maximum soil available NPK contents after crop harvest. Whereas, enriched compost alone resulted in the highest organic carbon content (10.12 g kg^{-1} soil) and total microbial counts $5.70x10^7$ cfu per gram of soil.

Key words: Organic carbon, NPK, available macronutrients, microbial counts.

Pea (*Pisum sativum* L.) is an important winter vegetable in the north western Himalayas of India (Pandey *et al.* 2006). Reports are available on performance of pea under inorganic conditions. However, continuous sole and imbalance use of costly chemical fertilizers as a source of nutrients and scarce availability of FYM in mid hill vegetable farming has led to decrease in plant nutrient use efficiency and ultimately resulted in either yield stagnation or decrease in yield. Whereas, information on conjoint use of enriched compost and chemical fertilizers in pea crop is lacking in the region. Therefore, conjoint effect of enriched compost with chemical fertilizers was studied in commercial pea crop grown under mid-hill conditions.

Field experiments were conducted on commercial pea crop variety Lincoln during the year 2003 to 2004 on Eutrocrept soil under mid hill condition of Himachal Pradesh. The soil was gravely loam, having bulk density 1.19 Mg m^{-3}, porosity 48.60%, pH 6.9, organic carbon 9.8 g kg^{-1} , microbial counts were 4.88 x 10^7cfu per gram of soil and available NPK content was 321, 38 and 245 kg ha^{-1}, respectively. The investigations were undertaken by taking eight treatments composed of various combinations of chemical fertilizer levels i.e. recommended (100%), 75% of recommended, 50% of recommended, alone or with enriched compost @ 5tha^{-1} (Table 1). The recommended N, P_2O_5 and K_2O levels applied for pea crop were 25, 65 and 65 kg ha^{-1}, respectively. On dry weight basis the enriched compost was neutral (pH 6.93) in reaction and had 0.27 dSm^{-1}electrical conductivity, 2.21 g kg^{-1} organic carbon, 21.67 C/N ratio, 258 x 10^6 cfu / gram compost, 1.02% total N and 0.71% total P contents . Treatments were replicated thrice in a randomized block design. Pods were picked weekly and yield was noted from 20 plant samples. For estimating pod length 20 pods from each plot were taken. At the end of each experiment the plants were separated into tops, roots and pods dried at 65^0C, weighed and analyzed separately for total NPK contents by using standard procedures (Jacksons, 1973). The total N content in plant sample was determined by micro-kjeldahl method. Total P was determined by vanadomolybdophosphoric yellow colour method. K was estimated by using flame photometer. The total quantity of each element estimated in roots, tops and pods was calculated by multiplying by the respective dry weights. These were combined to show the total plant content and uptake was converted to kg ha^{-1} .To draw better inference pooled analysis of the two years data with respect to various growth parameters was done.

Soil samples were collected after the harvest of last crop during 2004 from the surface layer (0-15 cm) and were analyzed for available NPK contents using standard procedures as described by Jackson (1973). Soil microbial biomass was determined by soil fumigation-extraction method detailed by Vance *et al.* (1987).

Growth parameters and nutrient uptake

Conjoint application of 100% NPK + enriched compost resulted in the highest green pod yield (26.67 q ha^{-1}), plant height (66.17cm) and pod length (9.12 cm) in pea crop (Table 1).

Table 1. Effect of conjoint use of enriched compost and chemical fertilizers on yield and quality parameters of pea

Treatments	Plant height (cm)	Pod length (cm)	Green pod yield (q ha^{-1})	% increase /decrease in yield over 100% NPK	Nutrient uptake (kg ha^{-1})		
					N	P	K
T_1 (control)	45.41	7.52	14.11	-38.94	92.15	9.35	51.55
T_2 (100 % NPK)	62.05	8.68	23.11	-	107.85	15.45	58.30
T_3 (75 % NPK)	57.80	8.66	21.00	-9.13	100.15	13.75	56.05
T_4 (50 % NPK)	55.96	8.33	19.56	-15.36	98.15	11.35	53.45
T_5 (Enriched compost)	53.75	7.95	17.56	-24.00	96.1	11.00	52.05
T_6 (T_5 + T_2)	66.17	9.12	26.67	+15.40	116.7	20.05	65.10
T_7 (T_5 + T_3)	64.71	8.99	22.34	-3.33	112.65	17.45	62.60
T_8 (T_5 + T_4)	63.83	8.63	21.50	-7.00	109.65	15.25	59.10
CD (P=0.05)	3.42	0.13	0.70	-	1.31	0.61	0.86

This combination was followed by 75% NPK + enriched compost and 50% NPK + enriched compost, respectively. Conjoint use of 100% NPK and enriched compost resulted in 15.40 % increase in green pod yield over alone 100% NPK. The higher yields might be due to better physico - chemical environment and more availability of nutrients under this combination. Similar effects of various levels of compost and fertilizers on growth and yield of pea were also reported by Aga *et al.* (2004) and Gopinath *et al.* (2009). Whereas, enriched compost along with 50% NPK produced yield, pod length and plant height statistically at par with alone 100% NPK fertilizers. Similarly, 100% NPK + enriched compost also resulted in maximum uptake of macro nutrients in pea crop (Table 1). The NPK uptake under this combination was 116.7, 20.1 and 65.1 kg ha^{-1}, respectively. This combination was followed by 75% NPK + enriched compost and 50% NPK + enriched compost. The increased uptake of macronutrients due to conjoint application of enriched compost and chemical fertilizers was due improved environment of the rhyzosphere and added supply of nutrients and proliferous root system developed resulting in better absorption of water and nutrients. Parmar *et al*, (1998) have also reported significant improvement in the uptake of nutrients under conjoint application of chemical fertilizers and manures in pea crop.

Soil Fertility

Highest organic carbon content (10.12 g/kg) was observed with the sole application of enriched compost followed by the treatments wherein enriched compost and chemical fertilizers were applied in combination, whereas, minimum content (9.60 g kg^{-1}) was recorded under control where no chemical fertilizers and enriched compost was applied (Table 2). Conjoint application of enriched compost and chemical fertilizers (T_6-T_8) resulted significantly higher organic carbon content over their corresponding alone fertilizer treatments (T_2-T_4). Higher organic carbon may be ascribed to the addition of organic materials under enriched compost based treatments. Application of enriched compost alone, interestingly, resulted in the highest total microbial counts (5.70×10^7 cfu g^{-1}) in the soil followed by 100% NPK + enriched compost and 75% NPK + enriched compost treatments. Gopinath *et al*, (2009) also reported higher organic carbon and microbial biomass under pea crop grown in Himalayan region under organics as compared to INM treatments. Conjoint application of enriched compost along with 100% NPK fertilizers resulted in maximum build up of available NPK contents viz; 354.20, 48.00 and 280.12 Kg ha^{-1}, respectively in the soils. The increase in available NPK contents in the soil with 100% NPK + enriched compost, 75% NPK + enriched compost and 50% NPK + enriched compost was to the tune of 11.1, 29.9 and 14.9%, respectively over 100% NPK alone. Combinations of enriched compost and various levels of NPK fertilizers, similar to their effects on plant growth parameters, increased the availability of NPK in the soil over their respective alone applications. Enriched compost + 50% NPK

resulted in buildup of available NPK equal to alone 100% NPK fertilizer. The increase in available N due to application of organics could also be attributed to the greater multiplication of microbes which could convert organically bound N to inorganic form; by reducing the phosphorus fixing capacity of the soil it increases the available P in the soil solution. Whereas, increase in available K due to application of enriched compost might be attributed to the direct addition of K to the available K pool of the soils besides the reduction of K fixation and release of K due to interaction of organic matter with clay (Bhardwaj and Omanwar, 1994). The increase in available P content of soil could be also be attributed to the influence of organics which enhanced the labile P in the soil by complexing Ca, Mg and Al (Subramanian and Kumaraswamy 1989).

Table 2. Changes in available macronutrients and microbial counts of soil after pea harvest

Treatments	Organic carbon (g kg^{-1})	Microbial counts (cfu g^{-1})	Available macronutrients (kg ha^{-1})		
			N	P	K
T_1 (control)	9.60	4.90×10^7	318.80	36.96	243.80
T_2 (100 % NPK)	9.73	5.07×10^7	334.90	42.80	265.56
T_3 (75 % NPK)	9.75	5.47×10^7	331.50	41.32	262.20
T_4 (50 % NPK)	9.68	4.97×10^7	330.21	39.56	260.15
T_5 (Enriched compost)	10.12	5.70×10^7	326.51	36.98	252.18
T_6 ($T_5 + T_2$)	10.10	5.50×10^7	354.20	48.00	280.12
T_7 ($T_5 + T_3$)	10.09	5.53×10^7	333.60	42.50	264.20
T_8 ($T_5 + T_4$)	10.05	5.13×10^7	332.88	41.72	263.60
C.D (P=.0.05)	0.11	0.24	2.13	1.32	2.58
Basic Status	9.80	4.88×10^7	321.00	38.00	245.00

The study indicated that the conjoint application enriched compost with recommended NPK fertilizers is essential to increase quality green pod yield and nutrient uptake in pea crop and in maintaining soil fertility.

Acknowledgement

Grateful thanks are expressed to ICAR for providing financial assistance under CGP mode of NATP scheme for taking up this study.

References

Aga FA, Singh JK, Singh, DK and Peer FA 2004. Effect of different levels of compost and phosphorus on growth and yield of pea (*Pisum sativum* L.) under rain fed condition. Environ. and Eco. **22** (2): 353-56.

Bhardwaj V and Omanwar PK 1994. Long- term effects of continuous rotational cropping and fertilization on crop yields and soil properties-II. Effects on EC, pH, organic matter and available nutrients of soil. J. Indian Soc. Soil Sci. **42**: 387-92.

Gopinath KA, Supradeep Saha, Mina BL, Harit Pande Narender Kumar, Srivastva AK and Gupta HS 2009. Yield potential of garden pea (*Pisum sativum* L.) varieties and soil properties under organic and integrated nutrient management systems. Archives Agron. Soil Sci. **55** (2): 157-67.

Jackson ML 1973. *Soil Chemical Analysis*. Prentice Hall, India, Pvt. Ltd. New Delhi.

Pandey AK, Gopinath KA, Bhattacharya R, Hooda KS, Sushil SN, Kundu S, Selvakumar G, Gupta HS 2006. Effect of source and rate of organic manures on yield attributes, pod yield and economics of garden pea grown under organic farming system. Indian J. Agric Sci. **76:** 230–34.

Parmar DK, Sharma PK and Sharma TR 1998. Integrated nutrient supply system for 'DPP 68' vegetable pea (*Pisum sativum* var. *arvense*) in dry temperate zone of Himachal Pradesh. Indian J. Agric. Sci. **68** (2): 84-86.

Subramanian KS and Kumaraswamy K 1989. Effect of continuous cropping and fertilization on chemical properties of soil. J. Indian Soc. Soil Sci. **37**: 171-73.

Vance ED, Brookes PC and Jenkinson DS 1987. An extraction method of measuring soil microbial biomass carbon. Soil Biol. and Biochem. 19: 703-07.

VIR SOFTECH