Indian Journal of Agricultural Sciences **91** (4): 577–81, April 2021/Article
https://doi.org/10.56093/ijas.v91i4.112679

Productivity and profitability of garden pea (*Pisum sativum*) as influenced by integrated nutrient management

RAJIV[1], D P SINGH[1] and SAURABH TOMAR[1]*

Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208 002, India

Received: 16 September 2020; Accepted: 01 December 2020

ABSTRACT

The field experiment was conducted at Vegetable Research Farm, Kalyanpur, Kanpur (UP) during *rabi* 2014–15 and 2015–16, to study the effect of integrated nutrient managementon garden pea. The experiment was laid out in randomized block design with thirteen treatments of inorganic fertilizers (NPK50:60:40 kg/ha) and integration with organic sources combinations (FYM 10.0 and 20.0 t/ha, neem cake 2.5 and 5.0 q/ha, vermicompost 2.5 and 5.0 t/ha, press mud 5.0 and 10.0 t/ha, sewage sludge 10.0 and 20.0 t/ha and poultry manure 2.5 and 5.0 t/ha) were tested against the control. Based on 2 years pooled data, application of vermicompost @ 2.5 t/ha+ half NPK through chemical fertilizers produced significantly highest green pod yield of 8.31 t/ha and net return of ₹ 100470/ha. The treatment of full recommended dose of NPK through chemical fertilizers (50:60:40 kg/ha) produced green pod yield of 7.29 t/ha with net return ₹ 86195/ha. Return per rupee invested (₹ 3.46) was also higher under the treatment of application of vermicompost @ 2.5 t/ha+ half NPK through chemical fertilizers. Vermicompost and half NPK through chemical fertilizers proved to be the best treatments for enhancing productivity and profitability of garden pea under Upper Gangetic Plains of Uttar Pradesh. Therefore, the practice of vermicompost integration with half dose of chemical fertilizers may serve as alternative of NPK inorganic fertilizers and fear of pollution hazards and may also be recommended to exploit the better eco-friendly economic pod yield of garden pea.

Keywords: Garden pea, Integrated nutrient management, Organic manures, Productivity, Profitability

Garden pea (*Pisum sativum* var. hortense L.) is one of the most important vegetable crop. It is the second most important legume crop of the world (Pawar *et al.* 2017). Uttar Pradesh is the highest garden pea producing state and it alone produces about half of total production (Dubey *et al*. 2012). This legume contain high percentage of digestible protein (7.2 g), carbohydrates (15.8 g), vitamin A (139 I.U.), vitamin C (9 mg), magnesium (34 mg), phosphorus (139 mg) and essential amino acids per 100 g of edible portion (Gopalan *et al.* 2007). Continuous use of chemical fertilizers has resulted in nutritional imbalance, depletion of soil organic matter, contamination of food and water, adverse effect on biodiversity as well as on human health. Thus, the importance of organic manure in present agriculture is increasing day by day, because of its utility not only improving the physical, chemical and biological properties of soil but also maintaining the soil health without pollution (Naidu *et al.* 2009).

Present address: [1]Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh. *Corresponding author e-mail: rajiv.agro69@gmail.com.

Supplying of nutrients through integrated use of chemical fertilizers and organic sources can be opted for avoiding the hazardous effect of fertilizers and maintaining sustainability. Organic manures like FYM, neem cake, vermicompost, pressmud, sewage sludge, poultry manure and bio-fertilizers may play a major role in supplementing the crop nutrients through their direct addition, improvement in soil condition, nitrogen fixation and solubilisation of fixed forms of phosphorus in soil (Rajiv *et al*. 2016). Application of organic manures also improves the availability of micronutrients like zinc, iron, manganese and copper. Chauhan *et al.* (2010) reported that vermicompost has gained impetus in organic farming to boost agricultural production to its important multifarious features such as being rich in nutrients, vitamins, growth regulators, free from pathogen and containing immobilized micro flora. Supplementary and complementary use of organic manures and inorganic chemical fertilizers augment the efficiency both the substances to maintain a high level of soil productivity. So, the current study includes integrated nutrient management to evaluate its influence on yield attributes, productivity and profitability of garden pea under Upper Gangetic Plains.

MATERIALS AND METHODS

The field experiment was conducted for two consecutive winters (*rabi*) during 2014–15 and 2015–16 at vegetable

research farm, Kalyanpur of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur. Initial soil sample at the start of the study was sandy loam in texture, low in soil organic carbon (0.38%), low in available nitrogen (156.0 kg/ha), medium in available phosphorus (14.8 kg/ha) and low in available potassium (184.0 kg/ha) with neutral *p*H (7.7).

The experiment was laid out in randomized block design with three replications. The fourteen treatments consisted, viz. recommended dose of NPK through chemical fertilizers @ 50:60:40 kg/ha, farmyard manure @ 20 t/ha, farmyard manure @ 10 t/ha + half NPK through chemical fertilizers, neem cake @ 5 q/ha, neem cake @ 2.5 q/ha + half NPK through chemical fertilizers, vermicompost @ 5 t/ha, vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers, pressmud @ 10 t/ha, pressmud @ 5 t/ha + half NPK through chemical fertilizers, sewage sludge @ 20 t/ha, sewage sludge @ 10 t/ha + half NPK through chemical fertilizers, poultry manure @ 5 t/ha, poultry manure @ 2.5 t/ha+ half NPK through chemical fertilizers and farmyard manure @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha + bio-fertilizers, were applied to the same plots ever year. The available N, P and K contents in FYM, vermicompost, neem cake, press mud, sewage sludge and poultry manure were 0.47, 0.26 & 0.54%, 1.48, 0.47 & 1.40 %, 4.62, 0.72 & 1.32%, 0.62, 1.86 & 1.98%, 1.16, 0.40 & 0.28% and 1.44, 1.26 & 1.12%, respectively. Garden pea genotypes Azad Pea-3 was sown with recommended seed rate of 75 to 80 kg/ha with row to row and plant to plant spacing 30x10 cm on 20 and 23 October in 2014-15 and 2015-16, respectively. Recommended cultural practices of growing garden pea were followed and the plant samples of one-meter row were taken at random from the middle rows of each plot from the three replications to measure pod length (cm), pod thickness (mm), numbers of pods/plant, number of grains/pod, pod weight (g), pod weight/plant (g) and green pod yield (t/ha) at the harvest of crop. On the basis of total variable cost and gross return, net return and return per rupee invested were calculated as per methods suggested by Devasenapathy *et al*. (2008). The data of two years were pooled and statistically analyzed using analysis of variance (ANOVA) for randomized block design. The treatment means were tested for significance at P=0.05.

RESULTS AND DISCUSSION

Effect of integrated nutrient management on yield attributes: Different treatment combinations influenced yield attributes of garden pea significantly (Table 1). Based on two consecutive years pooled data, application of vermicompost

Table 1 Effect of integrated nutrient management treatments on yield attributes of garden pea

Treatment	Pod length (cm)	Pod thickness (mm)	No. of pods/plant	No. of grains/pod	Pod wt.* (g)	Pod wt.*/ plant (g)
Recommended dose of NPK through chemical fertilizers (@ 50:60:40 kg/ha	8.02	13.87	7.33	5.58	3.39	24.66
Farm yardmanure @ 20 t/ha	7.68	13.43	6.27	4.67	3.38	21.28
Farmyard manure @ 10 t/ha + half NPK through chemical fertilizers	8.64	14.13	7.37	5.66	3.40	24.90
Neem cake @ 5 q/ha	7.52	13.10	5.33	3.61	3.12	17.31
Neem cake @ 2.5 q/ha + half NPK through chemical fertilizers	7.98	13.30	6.06	4.58	3.45	20.91
Vermicompost @ 5 t/ha	7.92	13.77	6.83	5.26	3.47	23.49
Vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers	8.91	14.72	8.28	6.12	3.62	27.88
Pressmud @ 10 t/ha	7.62	13.57	6.35	4.82	3.44	21.76
Pressmud @ 5 t/ha+ half NPK through chemical fertilizers	8.66	14.17	7.48	5.44	3.42	25.42
Sewage sludge @ 20 t/ha	7.86	13.63	6.61	5.09	3.48	22.83
Sewage sludge @ 10 t/ha + half NPK through chemical fertilizers	8.80	14.43	7.87	6.08	3.41	26.60
Poultry manure @ 5 t/ha	7.72	13.73	6.47	4.93	3.47	22.23
Poultry manure @ 2.5 t/ha + half NPK through chemical fertilizers	8.75	14.37	7.62	5.88	3.39	25.86
Farmyard manure @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha + bio-fertilizers	8.83	14.53	8.02	6.09	3.49	26.69
SEm±	0.37	0.55	0.26	0.20	0.12	0.86
CD (P=0.05)	1.08	1.59	0.77	0.57	0.34	2.50

*wt. = weight

@ 2.5 t/ha + half NPK through chemical fertilizers produced significantly highest yield attributes like pod length (8.91 cm), pod thickness (14.72 mm), number of pods/plant (8.28), number of grains/pod (6.12), single pod weight (3.62 g) and pod weight/plant (27.88 g). It was followed by FYM @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha+ bio-fertilizers. The treatment of recommended dose of NPK through chemical fertilizers @ 50:60:40 kg/ha produced pod length of 8.02 cm, pod thickness of 13.87 mm, number of pods/plant of 7.33, number of grains/pod of 5.58, single pod weight of 3.39 g and pod weight/plant of 24.66 g. As compared to recommended dose of NPK through chemical fertilizers @ 50:60:40 kg/ha, garden pea yield attributes reduced in all sole organic treatments significantly except the treatment of FYM @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha + bio-fertilizers. It might be attributed to the availability of nutrients for crop use. Sole organics could not meet the nutrition need of crop. The combination of organic and inorganic nutrients is more effective in yield attributes due to the reason of better uptake of nutrients as evidenced in treatment FYM @ 10 t/ha + half NPK through chemical fertilizers, neem cake @ 2.5 q/ha + half NPK

Table 2 Effect of integrated nutrient management practices on green pod yield and economics of garden pea

Treatment	Green pod yield (t/ha)			Increase/decrease in yield over full recommended dose of NPK through chemical fertilizers		Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Return/ rupee invested (₹)
	2014-15	2015-16	Pooled	t/ha	%				
Recommended dose of NPK through chemical fertilizers (@ 50:60:40 kg/ha	7.21	7.36	7.29	-	-	37633	123828	86195	3.29
Farmyard manure @ 20 t/ha	6.03	6.21	6.12	(-) 1.17	(-) 16.05	39000	104091	65091	2.67
Farmyard manure @ 10 t/ ha + half NPK through chemical fertilizers	7.31	7.49	7.40	(+) 0.11	(+) 1.51	37817	125766	87949	3.32
Neem cake @ 5 q/ha	4.66	4.81	4.74	(-) 2.55	(-) 34.98	40500	80529	40029	1.99
Neem cake @ 2.5 q/ha + half NPK through chemical fertilizers	5.92	6.07	6.00	(-) 1.29	(-) 17.69	39067	101932	62865	2.61
Vermicompost @ 5 t/ha	6.79	6.90	6.84	(-) 0.45	(-) 6.17	43500	116348	72848	2.67
Vermicompost @ 2.5 t/ ha + half NPK through chemical fertilizers	8.26	8.36	8.31	(+) 1.02	(+) 13.99	40817	141287	100470	3.46
Press mud @ 10 t/ha	6.23	6.37	6.30	(-) 0.99	(-) 13.58	47850	107066	59216	2.24
Press mud @ 5 t/ha+ half NPK through chemical fertilizers	7.46	7.62	7.54	(+) 0.25	(+) 3.43	42817	128180	85363	2.99
Sewage sludge @ 20 t/ha	6.58	6.63	6.61	(-) 0.68	(-) 9.33	48625	112336	63711	2.31
Sewage sludge @ 10 t/ ha + half NPK through chemical fertilizers	7.86	7.93	7.90	(+) 0.61	(+) 8.37	43567	134147	90580	3.08
Poultry manure @ 5 t/ha	6.37	6.41	6.39	(-) 0.90	(-) 12.34	48125	108613	60488	2.26
Poultry manure @ 2.5 t/ ha + half NPK through chemical fertilizers	7.59	7.63	7.61	(+) 0.32	(+) 4.39	43130	129370	86240	3.00
Farmyard manure @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ ha + press mud @ 5 t/ha + sewage sludge @ 10 t/ ha + bio-fertilizers	7.99	8.01	8.00	(+) 0.71	(+) 9.74	53265	136034	82769	2.55
SEm±	0.26	0.28	0.27	-	-	1805.84	4635.20	2869.18	0.13
CD(P=0.05)	0.77	0.82	0.79	-	-	5249.50	13474.34	8340.59	0.38

through chemical fertilizers, vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers, pressmud @ 5 t/ha + half NPK through chemical fertilizers, sewage sludge @ 10 t/ha + half NPK through chemical fertilizers and poultry manure @ 2.5 t/ha + half NPK through chemical fertilizers. The results are in confirmation with the findings of Singh *et al*. (2005) and Dubey *et al*. (2012) in garden pea.

Effect of integrated nutrient management on productivity: Garden pea green pod yield was influenced significantly by different treatments during both years and also in pooled analysis (Table 2). Based on two consecutive years pooled data, application of vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers produced significantly highest of 8.31 t/ha green pod yield of garden pea. It was followed by FYM @ 5 t/ha+ neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha + bio-fertilizers (8.00 t/ha) and sewage sludge @ 10 t/ha+ half NPK through chemical fertilizers (7.90 t/ha). The recommended dose of NPK through chemical fertilizers @ 50:60:40 kg/ha produced green pod yield of 7.29 t/ha.

As compared to recommended dose of NPK through chemical fertilizers, green pod yield of garden pea increased in all treatment combinations of organic and inorganic except the treatment of neem cake @ 2.5 q/ha + half NPK through chemical fertilizers. Whereas, green pod yield reduced in all sole organic treatments significantly except the treatment of FYM @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha + bio-fertilizers but margin of appreciation or reduction varied in different treatments. The margin of appreciation was highest of 1.02 t/ha or 13.99% in vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers and lowest of 0.11 t/ha or 1.51% in FYM @ 10 t/ha + half NPK through chemical fertilizers whereas, the margin of reduction was lowest of 0.45 t/ha or 6.17% in vermicompost @ 5 t/ha and highest of 2.55 t/ha or 34.98% in neem cake @ 5 q/ha. It might be attributed to the availability of nutrients for crop use.

In treatment of vermicompost @ 2.5 t/ha+ half NPK through chemical fertilizers, the higher values of yield attributing parameters were observed which are directly associated with green pod yield enhancement. Application of vermicompost integration with chemical fertilizers might have improved the availability of nutrients for crop use thus yielded higher to NPK fertilizers treatment. The results are similar to findings documented by Singh *et al*. (2005), Meena *et al*. (2006), Dubey *et al*. (2012), Meena *et al*. (2013) and Bilashini Devi *et al*. (2018).

Effect of integrated nutrient management on economics: The economics of crop was affected by different treatments (Table 2). Application of FYM @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha + bio-fertilizers required highest cultivation cost followed by sewage sludge @ 20 t/ha, poultry manure @ 5 t/ha and pressmud @ 10 t/ha. It might be attributed to higher cost of organic manures like pressmud, sewage sludge, poultry manure, vermicompost etc. Gross returns were worked out highest of ₹ 141287/ha in vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers followed by FYM @ 5 t/ha + neem cake @ 2.5 q/ha + vermicompost @ 2.5 t/ha + pressmud @ 5 t/ha + sewage sludge @ 10 t/ha + bio-fertilizers with ₹ 136034/ha and sewage sludge @ 10 t/ha + half NPK through chemical fertilizers with ₹ 134147/ha income. Application of neem cake @ 5 q/ha recorded lowest gross income. The results of the study revealed that the combination of organic and inorganic nutrients increased gross income.

Net returns were significantly affected by different treatments. The highest net returns were recorded of ₹ 100470/ha in treatment of vermicompost @ 2.5 t/ha+ half NPK through chemical fertilizers followed by sewage sludge @ 10 t/ha + half NPK through chemical fertilizers with ₹ 90580/ha and FYM @ 10 t/ha + half NPK through chemical fertilizers with ₹ 87949/ha (Table 2). Application of vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers gave higher return than other treatment combinations of organic and inorganic nutrients. Net return is the resultant of gross income and cost of cultivation where gross income dominated over cultivation cost in present study. Return per rupee invested of ₹ 3.46 was also significantly higher in vermicompost @ 2.5 t/ha + half NPK through chemical fertilizers. It might be due to higher gross income under this treatment. Sarkar *et al*. (2011) and Bilashini Devi *et al*. (2018) also reported similar findings.

From the above said findings, it can be concluded that application of vermicompost (@ 2.5 t/ha) integration with half recommended dose of inorganic fertilizers is profitable alternative of recommended dose of inorganic fertilizers in garden pea under Kanpur condition. It will ensure the sustainability in production and soil health along with pollution free environment.

REFERENCES

Bilashini Devi M, Thoithoi Devi M, Jha A K, Yumnam A, Balusamy A, Verma V K, Talang H D, Deshmukh N A, Rymbai H and Assumi S R. 2018. Yield and yield attributes of garden pea (*Pisum sativum* var. hortense L.) as influenced by nutrient management practices under agroclimatic conditions of Meghalaya. *International Journal of Current Microbiology and Applied Sciences* **7**(9): 3447–54.

Chauhan H S, Joshi S C and Rana D K. 2010. Response of vermicompost on growth and yield of pea (*Pisum sativum* L.) cv. Arkel. *Nature and Science* **8**(4): 18–21.

Devasenapathy P, Ramesh T and Gangwar B. 2008. *Efficiency indices for agriculture management research*. New India Publishing Agency, New Delhi. p. 136.

Dubey D K, Singh S S, Verma R S and Singh P K. 2012. Integrated nutrient management in garden pea (*Pisum sativum var. hortense*). *HortFlora Research Spectrum* **1**(3): 244–47.

Gopalan C, Rama S B V and Balasubramanian S C. 2007. *Nutritive Value of Indian Foods*. Revised edition. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India. p. 50.

Meena B P, Kumar A, Meena S R, Dhar S, Rana D S and Rana K S. 2013. Effect of sources and levels of nutrients on

growth and yield behavior of pop corn (*Zea mays*) and potato (*Solanum tuberosum*) sequence. *Indian Journal of Agronomy* **58**(4): 474–79.

Meena R N, Singh Y, Singh S P, Singh J P and Singh K. 2006. Effect of sources and level of organic manures on yield, quality and economics of garden pea (*Pisum sativum* L.) in Eastern Uttar Pradesh. *Vegetable Science* **31**(1): 60–63.

Naidu D K, Radder B M, Patil P L, Hebsur N S and Alagundagi S C. 2009. Effect of integrated nutrient management on nutrient uptake and residual fertility of chilli (cv. byadgidabbi) in a vertisol. *Karnataka Journal of Agricultural Sciences* **22**(2): 306–09.

Pawar Y, Verma L R, Verma P, Joshi H N, More S G and Dabhi J S. 2017. Influences of integrated use of organic and inorganic sources of nutrients on growth, flowering and yield of garden pea (*Pisum sativum* L.) cv. Bonneville. *Legume Research* **40**(1): 117–24.

Rajiv, Singh D P and Singh K P. 2016. Yield and economics of garden pea (*Pisum sativum var. hortense*) grown with integrated nutrient management. *(In) Proceeding of National Seminar on Vegetable Legumes for Soil and Human Health.* Indian Institute of Vegetable Research, Varanasi. February 12-14, pp. 343–44.

Sarkar A, Sarkar S, Jaman A and Devi W P. 2011. Productivity and profitability of different cultivars of potato (*Solanum tuberosum)* as affected by organic and inorganic sources of nutrients. *Indian Journal of Agronomy* **56**(2): 159–63.

Singh R K, Singh J, De Nirmal and Rai M. 2005. Integrated nutrient management influences yield and nodulation of pea. *Vegetable Science* **32**(1): 59–61.