

Nutrient Management in Seed Crop of Pea (*Pisum sativum* L.) through Organic, Inorganic and Integrated Approaches

V UIKEY, SS KUSHWAH*, OP SINGH AND KS VERMA

College of Horticulture, Mandsaur 458 001, Madhya Pradesh

*kushwahhort@rediffmail.com

ABSTRACT: A field experiment was conducted with pea cv. Arkel at Research farm, College of Horticulture, Mandsaur, Madhya Pradesh during *Rabi* season of 2007-08. Sixteen treatment combinations of organic, inorganic and integrated approaches including control (No NPK and Bioinoculants), were tested in randomized block design with three replications. The results revealed that organic, inorganic and integrated nutrient management had significant effect on growth, yield and quality of pea seed. Application of 10t/ha FYM +45:75:60 kg/ha NPK + Rz+PSB culture recorded maximum values of growth attributes, yield attributes, yield and seed quality followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture. Maximum gross income and net income was received with application of 10t FYM/ha +45:75:60 kg/ha NPK + Rz+PSB culture.

Key words: Pea, Nutrients, Seed yield, Quality, Economics

INTRODUCTION

Pea (*Pisum sativum* L.) is an important vegetable crop grown throughout the world. It is utilized mainly as a vegetable. The green peas can easily be canned, frozen and dehydrated. The nutritive value (per 100g of edible portion) with regard to moisture (g), protein (g), fibre (g), carbohydrates (g), energy (K cal), calcium (mg), phosphorus (mg), iron (mg), carotene (μ g) of dry pea is 16.0, 19.7, 4.5, 56.5, 315, 75, 298, 7.05, 39 [1]. India is the largest producer of pea in the world followed by China. Green pea occupies an area of 1.19 million ha with a production of 8.925 million tonnes in the world, while in India it occupies an area of 0.348 million ha with a production of 2.916 million tonnes. The average yield of green pea in India is 8.4 tonnes/ha, which is quite below than 10.3 t/ha in China and 11.0 t/ha in USA [2].

There are several factors which influence the yield of the crop. Out of these, seed is one very important input. The availability of good seed in sufficient quantity is very important for its

successful production. Therefore, increase in quality seed production of pea is the need of the time to boost up the production of crop. The management practices for growing of crop are of prime importance and among the various agronomical factors, the optimum plant nutrient management need due attention for improving the quantity and quality of seeds. Improper use of fertilizers is one of the major causes of poor yield of the crop. The available agro-techniques, which amalgamate organic, inorganic and biofertilisers for higher productivity and quality of vegetable pea seed are meager. The use of organic manures like FYM and vermicompost, based on rural waste may also be considered for sustainable production and better quality produce [3]. Therefore, an attempt has been made to evaluate the influence of organic, inorganic and integrated nutrient management on yield and quality of pea seed.

MATERIALS AND METHODS

A field experiment was conducted with pea cv.

Arkel at research farm, College of Horticulture, Mandasaur, Madhya Pradesh during *Rabi* season of 2007-08. Sixteen treatment combinations viz., F₁ - control (No NPK and Bioinoculants), organic [F₂ - Rz (*Rhizobium*) + PSB culture, F₃ - 10 t/ha vermicompost + Rz + PSB culture, F₄ - 20 t/ha FYM + Rz + PSB culture], inorganic [F₅ - 30:60:40 kg/ha NPK + Rz + PSB culture, F₆ - 30:75:40 kg/ha NPK + Rz + PSB culture, F₇ - 45:60:40 kg/ha NPK + Rz + PSB culture, F₈ - 45:75:60 kg/ha NPK + Rz + PSB culture, F₉ - 45:90:60 kg/ha NPK + Rz + PSB culture, F₁₀ - 55:75:60 kg/ha NPK + Rz + PSB culture, F₁₁ - 55:90:60 kg/ha NPK + Rz + PSB culture] and integrated approaches [F₁₂ - 20t/ha FYM +30:60:40 kg/ha NPK + Rz + PSB culture, F₁₃ - 20t/ha FYM +30:75:40 kg/ha NPK + Rz + PSB culture, F₁₄ - 10 t/ha FYM +45:60:40 kg/ha NPK + Rz + PSB culture, F₁₅ - 10 t/ha FYM +45:75:60 kg/ha NPK + Rz + PSB culture and F₁₆ - 10 t/ha FYM +45:90:60 kg/ha NPK + Rz + PSB culture] were tested in randomized block design with three replications. The soil samples were collected prior to sowing of seeds. The analysis of samples revealed the soil pH 7.20, available nitrogen 200 kg/ha, available phosphorus 20.10 kg/ha and available potassium 347.20 kg/ha. Rz + PSB (Phosphorus Solubilizing Bacteria) cultures were used as seed inoculants at the time of sowing. FYM and Vermicompost were applied at the time of field preparation in respective plots as per treatment. The complete dose of nitrogen, phosphorus and potash was applied at the time of sowing. Nutrients viz., nitrogen, phosphorus and potassium were applied in the form of DAP, SSP and Muriate of Potash. The pure and healthy seed of pea variety Arkel were used for sowing. Seeds were sown at a spacing of 30 cm between rows and 10 cm within rows at 4-5 cm depth. Thereafter, recommended package of practices was followed for raising the crop. Well-matured pods were harvested and dried. Seeds were extracted, cleaned and weighed. The observations on plant height, number of leaves per plant, dry weight of plant, days to 50% flowering, number of pods per plant, number of seed per pod, seed yield per hectare were recorded and analysed statistically as per standard procedure. Germination percentage (with paper towel method) and test weight (weight of 100 seed)

were determined as suggested by Agrawal (4). Economics of different treatments was worked out on the basis of prevailing prices of inputs and produce. The prices of inputs and produce were DAP @ Rs. 980/q, Urea @ Rs. 504/q, MOP @ Rs. 550/q, Bioinoculants (*Rhizobium* culture @ Rs. 50 kg and PSB culture @ Rs. 40/kg and pea seed @ Rs. 60/kg.

RESULTS AND DISCUSSION

Growth parameters

Growth parameters viz., plant height, number of leaves and dry weight per plant reflected the significant effect of different nutritional doses in pea. Different nutritional treatments had significant influence on plant height of pea. Maximum plant height was recorded under application of 10t/ha FYM + 45:75:60 kg /ha NPK + Rz+PSB culture which was significantly superior over other treatments. It was followed by application of 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture, 10t/ha FYM +45:60:40 kg/ha NPK + Rz+PSB culture, 20t/ha FYM +30:60:40 kg/ha NPK+ Rz+PSB culture and 10t/ha FYM +45:90:60 kg/ha NPK + Rz+PSB culture. Minimum plant height was observed under control, which was significantly lower to other treatments. In general, application of chemical fertilizers with organic manures viz., either 20t FYM or 10t vermicompost enhanced the plant height as compared to their application without organic manures. Application of organic manure along with higher doses of chemical fertilizer might have increased the availability of nutrients to the plant, which resulted in more plant height. Mandal and Maiti [5] in fenugreek and Singh and Singh [6] in pea have also reported the increase in plant height with higher doses of nutrients.

Number of leaves exhibited significant differences under various treatments. Application of 10t/ha FYM +45:75:60 kg/ha NPK + Rz+PSB culture showed maximum number of leaves followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture, 10t/ha FYM +45:60:40 kg/ha NPK + Rz+PSB culture and 10t/ha FYM +45:90:60 kg/ha NPK + Rz+PSB culture. Minimum number of leaves were observed under control. The difference between control and application of

Rz+PSB culture was non significant.

Dry weight of shoot showed significant effect of different nutritional doses. Application of 10t/ha FYM +45:75:60 kg/ha NPK + Rz+PSB culture recorded maximum dry weight of shoot per plant followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture, 10t/ha FYM +45:60:40 kg/ha NPK + Rz+PSB culture, 20t/ha FYM +30:60:40 kg/ha NPK+ Rz+PSB culture and 10t/ha FYM +45:90:60 kg/ha NPK + Rz+PSB culture. Minimum dry weight of shoot per plant was found with control. Application of 20t/ha FYM + Rz+PSB culture was at par to 10t/ha vermicompost + Rz+PSB culture and surpassed to application of Rz+PSB culture alone and control. Sole application of Rz+PSB culture showed superiority over control. Seed inoculation with Rz and PSB culture enhances the nodulation in roots of pea as well as phosphorus solubilisation in soil, thereby increasing the growth in terms of plant height and dry weight. Similarly, application of higher nutritional doses along with FYM might have enhanced the availability of nutrients, which resulted in more photosynthesis and accumulation of food materials and ultimately in more dry weight of shoot. These findings are in line with those of Mandal and Maiti [5] in fenugreek and Rabbani *et al.* [7] in pea.

Days to 50 per cent flowering in pea showed significant influence of nutritional doses. Maximum days to 50 percent flowering were taken with application of 55:75:40 kg/ha NPK + Rz+PSB culture followed by 55:90:40 kg/ha NPK + Rz+PSB culture. However, the difference were non significant. Minimum days to 50 per cent flowering were noted under control which stands at par with application of Rz + PSB culture, 10t/ha Vermicompost +Rz+PSB culture and 20t/ha FYM + Rz+PSB culture. Higher dose of nitrogen delayed flowering whereas application of phosphorus showed early flowering. Singh and Singh [6] also observed delay in 50 per cent flowering with increasing dose of nitrogen. Yadav and Luthra [8] reported marginal increase in days to 50 per cent flowering due to FYM, over vermicompost. They found decrease in days to 50 per cent flowering with phosphorus

application.

Yield parameters and yield

Nutritional doses caused significant differences in number of pods per plant. Highest number of pod per plant were observed with application of 10t/ha FYM +45:75:60 kg/ha NPK + Rz+PSB culture followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture, 10t/ha FYM +45:60:40 kg/ha NPK + Rz+PSB culture, 20t/ha FYM +30:60:40 kg/ha NPK+ Rz+PSB culture and 10t/ha FYM +45:90:60 kg/ha NPK + Rz+PSB culture in the descending order. The differences between 10t/ha FYM +45:75:60 kg/ha NPK + Rz+PSB culture and 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture were non significant. The crop grown without NPK and Rz+PSB culture recorded minimum number of pods, which was significantly lower than other treatments. All the combinations of NPK + Rz+PSB culture were significantly lower than their application with 20t or 10t FYM. Amongst Vermicompost and FYM, application of 20t/ha FYM along with Rz+PSB culture was found significantly superior over 10t/ha vermicompost + Rz + PSB culture.

Different treatments had significant effect on number of seeds per pod. Maximum numbers of seeds per pod were recorded with application of 10t/ha FYM +45:75:60 kg/ha NPK + Rz+PSB culture followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture, 45:60:40 kg/ha NPK + Rz+PSB culture, 20t/ha FYM + Rz+PSB culture, 30:60:40 kg/ha NPK+ Rz+PSB culture, 45:75:40 kg/ha NPK + Rz+PSB culture, 55:75:40 kg/ha NPK + Rz+PSB culture, 55:90:40 kg/ha NPK + Rz+PSB culture in the descending order. All the treatments except Control and Rz + PSB culture were statistically at par. Bhattarai *et al.* [9] reported increase in pods per plant and seeds per pod with the use of organic manure and bioinoculants. Negi *et al.* [10] also reported increase in these parameters with combined application of FYM and NPK. Singh *et al.* [11] observed significant improvement in number of pod and number of seeds per pod with higher nutrient doses.

Seed yield of pea exhibited significant effect of different nutritional combinations. At same

level of P and K, increase in nitrogen up to 45 kg/ha showed increase in yield, which further increased with combination of FYM at both levels i.e. 10t and 20t per hectare. Similarly, application of phosphorus showed linear increase in yield up to 75 kg/ha. Soil incorporation of 10t/ha FYM +45:75:60 kg/ha NPK + Rz+PSB culture recorded maximum seed yield which was significantly superior over other treatments. It was followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture. Among the organic manures, application of 20t FYM along with Rz+PSB culture stands numerically better than 10t/ha vermicompost

+Rz+PSB culture application. Lowest seed yield was recorded under control. Enhanced availability of nutrients with application of higher doses of NPK in conjunction with bioinoculant and organic manures resulted in increased growth parameters, yield parameters and ultimately in higher seed yield. Bhattarai *et al.* [9], Negi *et al.* [10], Singh *et al.* [11] and Singh *et al.* [12] also reported significant increase in seed yield with application of organic manure, chemical fertilizer and bioinoculants. Sundara *et al.* [13] reported increase in seed yield with increase in phosphorus level.

Table 1. Effect of organic, inorganic and integrated nutrient management on growth, flowering, yield and seed quality in pea

Treatments	Plant height (cm)	No. of leaves/plant	Dry wt. of shoot/plant (g)	Days to 50% flowering	No. of pods/plant	No. of seed/pod	Seed yield (q/ha)	Germination (%)	Test weight (g)
F ₁	47.43	91.46	8.77	48.66	14.27	5.89	8.28	72.79	18.49
F ₂	51.08	98.60	11.63	50.47	16.20	5.95	10.07	77.22	19.56
F ₃	54.73	117.46	12.83	50.55	16.47	6.19	12.44	79.25	19.75
F ₄	54.77	118.60	13.00	51.13	17.60	6.49	13.03	84.16	19.81
F ₅	55.80	118.26	13.83	52.76	17.67	6.47	16.17	84.17	19.96
F ₆	56.60	118.90	14.00	52.71	18.60	6.28	16.83	84.25	20.16
F ₇	57.13	130.13	14.33	54.82	19.07	6.53	18.10	86.29	20.19
F ₈	57.13	120.20	14.83	54.78	19.13	6.43	18.93	88.49	20.22
F ₉	57.73	120.30	15.67	54.80	21.73	6.28	20.40	91.73	20.75
F ₁₀	57.60	121.50	15.50	55.52	20.13	6.41	20.19	89.77	20.75
F ₁₁	57.37	131.40	14.90	55.50	19.33	6.33	19.29	88.96	20.28
F ₁₂	58.73	119.70	16.72	55.43	23.60	6.10	20.47	92.30	20.87
F ₁₃	61.07	140.40	19.00	55.46	25.53	6.80	22.70	96.89	21.00
F ₁₄	58.87	135.10	18.33	55.22	24.13	6.29	20.58	95.79	20.98
F ₁₅	65.87	157.90	22.67	55.11	26.40	7.01	26.54	98.67	21.30
F ₁₆	58.47	130.20	16.43	54.96	23.20	6.27	20.42	91.88	20.81
SEm ±	1.28	8.99	0.29	0.87	0.36	0.30	0.56	1.52	0.29
CD at 5%	3.98	25.94	0.85	2.51	1.03	0.85	1.62	4.38	0.82

Seed quality parameters

Germination percentage revealed significant effect of different nutrient treatments. Highest germination percentage was noted under 10t/ha FYM + 45:75:60 kg/ha NPK + Rz+PSB culture followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture, 10t/ha FYM +45:60:40 kg/ha NPK + Rz+PSB culture with at par performance. Lowest germination was recorded under control. Application of Rz+PSB culture showed significant increase in seed germination. Among the organic manures, crop raised with 20t/ha FYM + Rz+PSB culture showed more germination percentage as compared to the crop raised with 10t/ha vermicompost + Rz+PSB culture. Sundara *et al.* [13] also reported increase in seed germination with increase in phosphorus level.

Test weight of seed exhibited significant influence of nutrient doses. Maximum test weight was recorded with application of 10t FYM/ha +45:75:60 kg/ha NPK + Rz+PSB culture followed by 20t/ha FYM +30:75:40 kg/ha NPK + Rz+PSB culture, 10t/ha FYM +45:60:40 kg/ha NPK + Rz+PSB culture, 20t/ha FYM +30:60:40 kg/ha NPK+ Rz+PSB culture, 10t/ha FYM +45:90:60 kg/ha NPK + Rz+PSB culture, 45:90:40 kg/ha NPK + Rz+PSB culture, 55:75:40 kg/ha NPK + Rz+PSB culture with at par performance. Minimum test weight was recorded in case of the crop raised without application of NPK and Rz+PSB culture. Singh and Singh [6]) and Sundara *et al.* [13]) also reported enhanced seed test weight with higher nutritional doses.

Table 2. Economics of different treatments

Treatments	Common expenditure (Rs./ha)	Extra expenditure (Rs./ha)	Total cost of cultivation	Yield (q/ha) (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	C : B ratio
F1	18500	0.0	18500.0	8.28	49680	31180.0	1:2.69
F2	18500	350.0	18850.0	10.07	60420	41570.0	1:3.21
F3	18500	6350.0	24850.0	12.44	74640	49790.0	1:3.00
F4	18500	4350.0	22850.0	13.03	78180	30480.0	1:3.42
F5	18500	2287.2	20787.2	16.17	97020	76232.8	1:4.67
F6	18500	2540.9	21040.9	16.83	100980	79939.1	1:4.80
F7	18500	2561.1	21061.1	18.10	108600	87538.9	1:5.16
F8	18500	2999.0	42560.1	18.93	113580	71019.9	1:2.67
F9	18500	3168.7	21668.7	20.40	122400	100731.4	1:5.65
F10	18500	3181.4	21681.4	20.19	121400	99718.6	1:5.60
F11	18500	3529.5	22029.5	19.29	115740	93710.5	1:5.25
F12	18500	6287.2	24787.2	20.47	122820	98032.8	1:4.95
F13	18500	6541.0	25041.0	22.70	136200	111159.0	1:5.44
F14	18500	4561.0	23061.0	20.58	123480	100419.0	1:5.35
F15	18500	4998.3	23498.3	26.54	159240	135741.7	1:6.78
F16	18500	5256.3	23756.3	20.42	122520	98763.7	1:5.16

Economics of different treatments

The data pertaining to economics of different treatments has been presented in Table 2. Maximum cost of cultivation was recorded with application of 10t FYM/ha +45:90:60 kg/ha NPK+Rz+PSB culture whereas maximum gross income was received with application of 10t FYM/ha +45:75:60 kg/ha NPK + Rz+PSB culture. The data pertaining to net income showed maximum return with application of 10t FYM/ha +45:75:60 kg/ha NPK + Rz+PSB culture followed by 20t FYM/ha +30:75:40 kg/ha NPK + Rz+PSB culture and 45:90:40 kg/ha NPK + Rz+PSB culture. Cost : benefit ratio calculated on the basis of gross income and total cost of cultivation revealed maximum return per rupee investment with application of 10t FYM/ha +45:75:60 kg/ha NPK + Rz+PSB culture followed by 45:90:40 kg/ha NPK + Rz+PSB culture, 55:75:40 kg/ha NPK + Rz+PSB culture and 20t FYM/ha +30:75:40 kg/ha NPK + Rz+PSB culture. Yadav and Luthra [8] noted that net return and B : C ratio were higher in treatment having FYM as compared to vermicompost. Bhattarai *et al.* [8] also found higher net return with combined application of recommended dose of NPK and bioinoculants.

Therefore, from the findings of present experiment it may be concluded that application of 10t FYM/ha +45:90:60 kg/ha NPK+Rz+PSB culture is most suitable nutrient combination with respect to growth, yield and quality of pea seed.

REFERENCES

1. FAGERIA MS, BR CHOUDHARY AND RS DHAKA (2003) *Vegetable Crops Production Technology*. Vol. II, Kalyani Publishers, Ludhiana. p 127
2. NHB (2010) Indian Horticulture Database 2009. National Horticulture Board, Gurgaon, Govt of India. www.nhb.gov.in
3. DATT N, RP SHARMA AND GD SHARMA (2003) Effect of supplementary use of farmyard manure along with chemical fertilizers on productivity and nutrient uptake by vegetable pea (*Pisum sativum* L.) and build up of soil fertility in Lahaul valley of Himachal Pradesh. *Indian Journal of Agricultural Sciences*, **73**: 266-268
4. AGRAWAL RL (2003) *Seed Technology*. Second edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
5. MANDAL AR AND RG MAITI (1992) Effect of nitrogen and phosphorus on growth, flowering and seed yield of fenugreek. *Indian Agriculturist* **36**: 169-175
6. SINGH RAKESH AND SS SINGH (2003) Response of seed yield of garden pea (*Pisum sativum* var. Hortense) to various seed rate and fertility. *Veg. Sci.*, **30**: 71-73
7. RABBANI MG, ARM SOLAIMAN, KM HOSSAIN AND T HOSSAIN (2005) Effect of *Rhizobium* inoculant, nitrogen, phosphorus and molybdenum on nodulation, yield and seed protein in pea. *Korean Journal of Crop Science*, **50**: 112-119
8. YADAV VS AND JP LUTHRA (2005) Effect of organic manures at different levels of phosphorus on yield and economics of vegetable pea. *Udyanika*, **11**: 119-121
9. BHATTARAI RK, LN SINGH AND RKK SINGH (2003) Effect of integrated nutrient management on yield attributes and economics of pea (*Pisum sativum*). *Indian Journal of Agricultural Sciences*, **73**: 219-220
10. NEGI SUSHEELA, RV SINGH AND GK DWIVEDI (2004) Effect of biofertilizers, FYM, NPK and lime on pea in acidic soil of Uttaranchal hills. *Veg. Sci.*, **31**: 193-195
11. SINGH RAJIV KUMAR, JAGDISH SINGH, DE NIRMAL AND MATHURA RAI (2006). Effect of nutrient on yield and root parameters in vegetable pea. *Veg. Sci.*, **33**: 88-90
12. SINGH RAJIV KUMAR, JAGDISH SINGH, DE NIRMAL AND MATHURA RAI (2005). Integrated nutrient management influences yield and nodulation of pea. *Veg. Sci.*, **32**: 59-61
13. SUNDARA TH, BS VYAKARANAHAL, M SHEKHARGUDA, SD SHASHIDHARA AND RM HOSAMANI (2004) Influence of phosphorus and micronutrients on seed yield and quality of pea (*Pisum sativum* L.). *Seed Research.*, **32**: 214-216.