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Yield and Yield Attributes of Garden Pea (*Pisum sativum* var. *hortense* L.) as Influenced by Nutrient Management Practices under Agroclimatic Conditions of Meghalaya

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A B S T R A C T

The present investigation was undertaken with the main objective of studying the influence of nutrient management practices on yield and yield attributes of garden pea varieties *viz.*, Vivek Matar-11 and VivekMatar-12 during *rabi* season, 2017. The experiment consisted of seven nutrient management practices replicated thrice in factorial RBD. The results revealed that the tallest plant (99.74 cm), significantly early flowering (89.83 days), maximum number of pods per plant (16.67), number of seeds per pod (7.33) and pod yield (9.63 t/ha) was recorded in Vivek Matar-12 with 50% recommended dose of N through urea + 50% recommended dose of N through FYM + recommended dose of PK through single super phosphate (SSP) and muriate of potash (MOP) + 0.2% B. The same treatment combination also recorded second highest B: C ratio in both the evaluated varieties.

Introduction

Garden Pea (*Pisum sativum* var. *hortense* L.) is one of the most important vegetable crops belonging to the family Leguminaceae.

It is the second most important legume crop of the world (Pawar *et al.*, 2017). The green and dry foliage are used as cattle feed and green pods being highly nutritious are preferred for culinary purpose. 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) and phosphorus (139 mg) per 100 g of edible portion (Gopalan, 2007).

Garden pea has long been recognized as a restorer of soil fertility due to their unique ability of symbiotic nitrogen fixation (Rana *et al.*, 1998). This ability has made the crop as one of the most important and useful component of existing cropping system in the present context of soil fertility degradation. Improving the yield of garden pea depends on proper nutrient management and genetic makeup of the variety. Fertilizers play an important role on growth and productivity of garden pea. Nitrogen is essential for synthesis of chlorophyll, enzymes and protein. Phosphorus is essential for root growth, nodulation, energy storage and transfer necessary for metabolic processes. Potassium plays an important role in the promotion of enzyme activity and enhancing the translocation of assimilates and protein synthesis (Zaghlou *et al.*, 2015). But the imbalance and improper use of chemical fertilizers has adverse effect on soil health thereby affecting the yield and sustainability of production, besides causing environmental pollution. Therefore, there is a need for judicious use of fertilizers for sustainable production and better soil health. This will help to sustain crop yield, improve the physical, chemical and biological properties of soil, and increase the efficiency of applied fertilizers (Singh and Biswas, 2000).

Super phosphate fertilizers have been widely used to improve crop production. Due to high cost of superphosphate, focus is now on rock phosphate as a source of natural phosphorus (P) because of its relatively low cost and soil of the region being acidic, makes the P from rock phosphate also available. In respect of using micronutrients, Sarkar *et al.,* (2007) reported that the use of micronutrients in garden pea significantly increased the yield of agricultural crops. Boron (B) is one of the essential micronutrient required for normal growth of the plants and plays a vital role in promoting growth, yield and nodulation in garden pea. So, the current study includes rock phosphate and B as source of nutrients to evaluate its influence on growth, yield attributes and yield of garden pea.

Materials and Methods

The experiment was conducted at the Horticulture Experimental Farm, ICAR Research Complex for NEH Region, Umiam, Meghalaya. The experiment was laid out in Factorial Randomized Block Design with 14 treatment combinations replicated thrice during *rabi* season, 2017. The experimental site is situated at an elevation of 950 m above the mean sea level (MSL) with 25°41’N latitude and 91°54’E longitude. The location is characterized by subtropical climate and received an average annual rainfall of 150-250 cm with 80% of the rainfall occurring during the period from April to September. The available NPK and B of the experimental farm is 134 mg; 9.8 mg; 69.2 mg and 0.26 mg per Kg soil, respectively. The treatment detail is as follows:

Variety

V_1 – Vivek Matar-11
V_2 – Vivek Matar-12

Nutrient management

T_1 – Control

T_2 – RDF (20:60:40 kg/ha NPK through urea, SSP and MOP)

T_3–RDF of N through FYM

T_4 - 50% RDF of N through urea + 50% recommended dose of N through FYM + recommended dose of PK through SSP and MOP + 0.2% B

T_5 - RDF of NPK through urea, rock phosphate and muriate of potash

T_6 - RDF of NK through urea and MOP + double the dose of recommended P from SSP

T_7–RDF of N and K through urea and MOP + double the dose of recommended P from rock phosphate

0.2% B was sprayed as per the treatment detail at the time of flower initiation by using knapsack sprayer. To raise the crop recommended package of practices were followed. The treatments were evaluated on the basis of growth, flowering and yield performance. The mean data were subjected to statistical analysis following analysis of variance technique (Gomez and Gomez, 1984).

Results and Discussion

Different nutrient management practices influenced growth parameters *viz.,* plant height, number of primary branches per plant, days taken to 50% flowering as well as 1stpicking. Amongst the two varieties evaluated, Vivek Matar-12 showed significantly taller plant (99.74 cm), maximum number of primary branches per plant (2.21) and minimum days taken to 50% flowering (89.83 days) and 1st picking (129 days). Application of 50% recommended dose of N through urea + 50% recommended dose of N through FYM + recommended dose of PK through SSP and MOP + 0.2% B showed significantly taller plant, maximum number of primary branches per plant and minimum days taken to 50% flowering and 1st picking in both the varieties under study. While minimum plant height, lowest number of primary branches per plant and maximum days to 50% flowering and 1st picking was recorded in control. The increase in growth parameters under this treatment might be due to adequate availability of macro and micro nutrients and improved soil health due to incorporation of organic manure. The application of organic manure also facilitates greater availability and continuous supply of plant nutrients for longer period and thus provides a better environment for root growth and proliferation.

Besides, application of boron enhanced the photosynthetic activity, resulting in increased production and accumulation of carbohydrates which in turn favorably affect the plant growth. These findings are in consonant with the findings of Jaipaul *et al.,* (2011), Sharma *et al.,* (2011), Sharma and Chauhan (2011), Dubey *et al.,* (2012) and Kumari *et al.,* (2012) in garden pea.

Amongst the genotypes, Vivek Matar-12 recorded significantly higher number of pods per plant (16.67), higher pod length (7.22 cm), higher number of seeds per pod (7.33) and higher pod yield (9.63 t/ha) over Vivek Matar-11. The increase in growth components and pod yield of Vivek Matar-12 may be attributed to genetic makeup of the variety. Afreen *et al.,* (2017) also reported varietal differences for growth components and pod yield in garden pea.

The interaction effect of nutrient management practices and varieties was found to be significant for all the traits under study except for pod length, number of pods per plant and number of primary branches per plant. This indicates that interaction between fertilizers and varieties significantly affected most of the traits under study.

The increase in pod yield with application of 50% recommended dose of N through urea + 50% recommended dose of N through FYM + recommended dose of PK through SSP and MOP + 0.2% B may be attributed to better growth in terms of plant height and number of primary branches, which reflected into improved yield components *viz.,* number of pods per plant, pod length and pod yield per plant as compared to other treatments.

In the early growth phase, the immediate requirements of nutrients were fulfilled through nutrients released from fertilizers while in later stage of plant development, the required nutrients are provided through decomposition of organic manures. Boron as micronutrient supplement in the treatment combination might have also increased the plant's use efficiency of macronutrients (NPK) due to their improved recovery efficiency by plant (Manoj *et al.,* 2016). The findings are in close conformity with those of Sepehya *et al.,* (2012), Singh *et al.,* (2014) and Pawar *et al.,* (2017) in garden pea (Table 1–5).

Table.1 Effect of nutrient management on 50% flowering and 1st picking

Treatment	Days to 50 % Flowering			Days to First Picking		
	V_1	V_2	Mean	V_1	V_2	Mean
T_1	109.00	106.08	107.54	145.20	145.30	145.25
T_2	103.87	102.00	102.93	141.51	144.41	142.96
T_3	111.00	93.13	102.07	140.67	138.50	139.59
T_4	102.31	89.83	96.07	139.00	129.00	134.00
T_5	106.67	96.00	101.33	141.00	137.67	138.33
T_6	103.74	93.20	98.47	142.08	139.00	140.54
T_7	106.33	104.00	105.17	142.81	144.00	143.41
	106.13	97.75		141.75	139.70	
	S.Em±	CD at 5%		S.Em±	CD at 5%	
Variety (V)	0.54	1.57		0.35	1.01	
Treatment (T)	1.00	2.93		0.65	1.89	
Interaction (V × T)	1.42	4.15		0.91	2.67	

Table.2 Effect of nutrient management on pod length and no. of seeds per pod

Treatment	Pod length (cm)			No. of seeds per pod		
	V_1	V_2	Mean	V_1	V_2	Mean
T_1	5.69	6.02	5.86	5.10	4.24	4.67
T_2	6.40	6.58	6.49	5.74	5.89	5.81
T_3	6.00	6.90	6.45	5.18	6.41	5.80
T_4	6.77	7.22	7.00	6.39	7.33	6.86
T_5	6.15	7.19	6.67	6.37	7.21	6.79
T_6	6.71	6.95	6.83	6.07	6.67	6.37
T_7	6.72	7.14	6.93	6.37	7.05	6.71
	6.35	6.86		5.89	6.40	
	S.Em±	CD at 5%		S.Em±	CD at 5%	
Variety (V)	0.11	0.30		0.05	0.16	
Treatment (T)	0.19	0.57		0.10	0.29	
Interaction (V × T)	0.27	NS		0.14	0.42	

Table.3 Effect of nutrient management on no. of pods per plant and pod yield

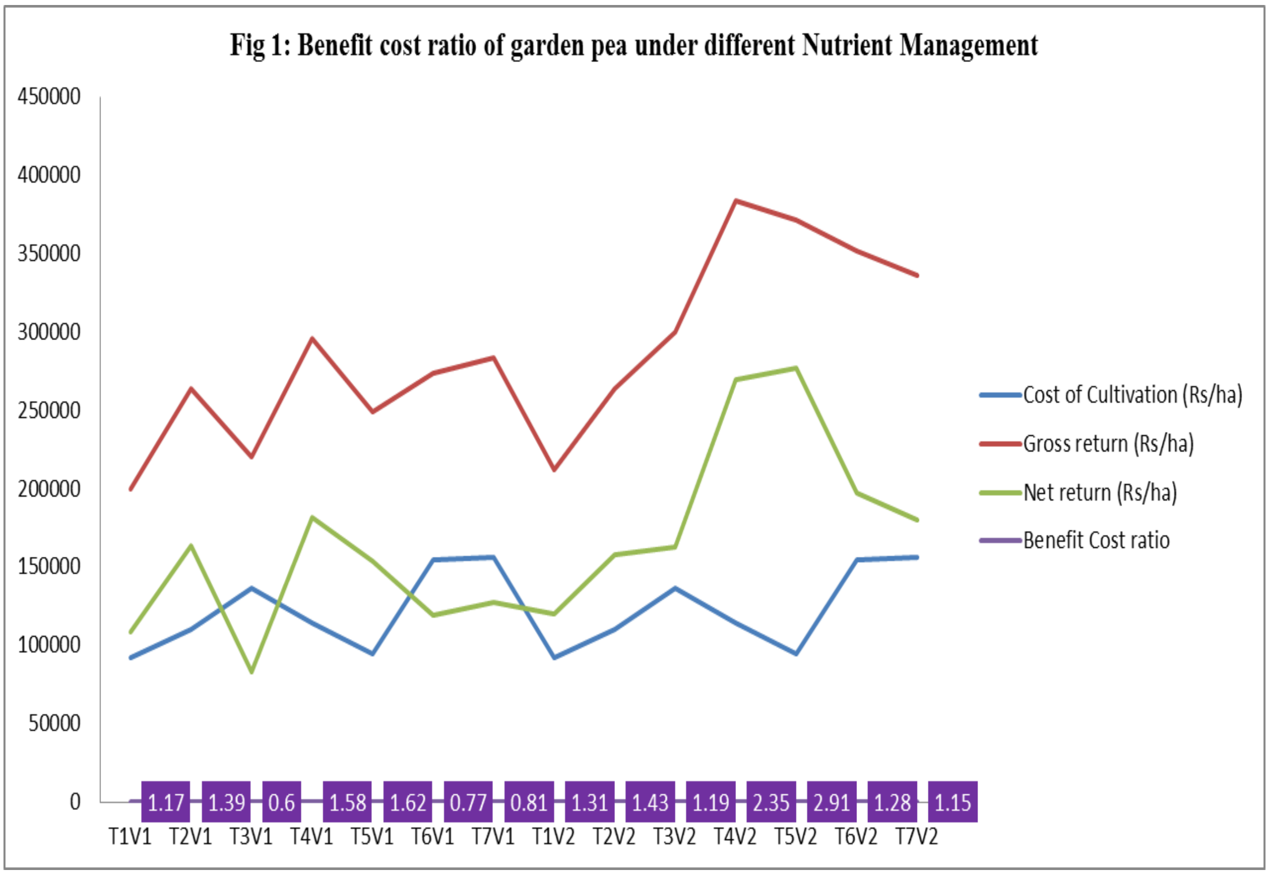
Treatment	No. of pods per plant			Yield (q/ha)		
	V_1	V_2	Mean	V_1	V_2	Mean
T_1	11.67	11.00	11.33	50.39	53.52	51.96
T_2	13.33	13.33	13.33	66.08	66.53	66.31
T_3	12.00	15.00	13.50	55.03	75.67	65.35
T_4	14.67	16.07	15.67	74.53	96.29	85.41
T_5	12.67	16.67	14.67	61.05	93.57	77.31
T_6	13.33	15.00	14.17	68.01	88.55	75.78
T_7	14.33	15.33	14.83	71.56	84.06	77.81
	13.14	14.71		63.81	79.03	
	S.Em±	CD at 5%		S.Em±	CD at 5%	
Variety (V)	0.43	1.25		0.75	2.18	
Treatment (T)	0.80	2.34		1.39	4.07	
Interaction (V × T)	1.13	NS		1.97	5.76	

Table.4 Effect of nutrient management on shelling % and plant height

Treatment	Shelling %			Plant Height (cm)		
	V_1	V_2	Mean	V_1	V_2	Mean
T_1	44.83	44.22	44.53	44.79	40.24	42.52
T_2	65.43	46.13	55.78	48.30	51.85	50.08
T_3	58.22	55.66	56.94	47.69	41.24	44.47
T_4	50.68	41.62	46.15	89.39	99.74	94.57
T_5	50.46	40.89	45.68	52.56	49.22	50.89
T_6	53.91	40.80	47.40	61.58	50.66	56.12
T_7	38.09	58.05	48.07	76.16	48.85	62.51
	51.66	46.78		60.07	54.54	
	S.Em±	CD at 5%		S.Em±	CD at 5%	
Variety (V)	0.71	2.06		0.63	1.84	
Treatment (T)	1.32	3.86		1.18	3.45	
Interaction (V × T)	1.87	5.45		1.67	4.87	

Table.5 Effect of nutrient management on primary branch per plant and TSS

Treatment	Primary branch per plant			TSS (^{0} Brix)		
	V_1	V_2	Mean	V_1	V_2	Mean
T_1	1.56	1.50	1.53	11.51	11.31	11.31
T_2	2.13	1.77	1.95	19.72	19.95	19.84
T_3	1.77	1.70	1.74	10.51	12.49	11.50
T_4	2.00	2.21	2.11	11.78	17.33	14.56
T_5	1.83	1.65	1.74	16.08	11.95	14.02
T_6	1.82	1.62	1.72	16.57	16.80	16.69
T_7	1.57	1.82	1.70	11.02	11.63	11.32
	1.81	1.75		13.88	14.47	
	S.Em±	CD at 5%		S.Em±	CD at 5%	
Variety (V)	0.13	NS		0.50	NS	
Treatment (T)	0.24	NS		0.94	2.74	
Interaction (V × T)	0.33	NS		1.33	3.87	



From the present study it is observed that higher dose of rock phosphate when applied along with the recommended dose of N and K gave good performance in terms of growth parameters and pod yield in both the evaluated varieties. This might have resulted from the higher availability of P due to better mineralization of nutrients. This better availability and uptake of P increased growth parameters and hence pod yield. These results are inconformity with the findings of Shaktawat *et al.,* (2006) who also reported that, higher phosphorus dose through rock phosphate either alone or in combination with acidulants give better result than the lower one.

Benefit cost ratio

The B: C ratio was observed to be greater than 1 (one) in all the treatment combinations for V_2 (VivekMatar 12), implying that all the treatments were economically viable.

In case of V_1 (VivekMatar 11), the B: C ratio was higher than 1 (one) in all treatment combinations except for treatments, T_3, T_6 and T_7. This observation was due to higher cost of productions in the treatment combinations incurred due to high dose of FYM in T_3 and double doses of P in T_6 and T_7. Maximum B: C ratio in both the varieties was observed in case of nutrient management practice comprising of recommended dose of NPK through urea, rock phosphate and muriate of potash (Fig. 1). This was due to the lower cost of production owing to cheaper rate of rock phosphate as compared to SSP used in other treatment combinations. The second highest B: C ratio in both the varieties was observed in the nutrient management practice comprising of 50% recommended dose of N through urea + 50% recommended dose of N through FYM + recommended dose of PK through SSP and MOP + 0.2% B which also recorded highest pod yield per hectare.

The treatments that combined 50% recommended dose of N through urea + 50% recommended dose of N through FYM + recommended dose of PK through SSP and MOP + 0.2% B gave the best results in terms of all growth parameters measured as well as the pod yield, while the control showed the lowest values. This indicates that provided that the problem of affordability and procurement of chemical fertilizer by resource poor farmers persists, the use of this chemical fertilizer with organic source of nutrient (less expensive and affordable) would serve as a viable alternative. Considering both the fresh pod yield and B: C ratio, it can be concluded that reduced dose of chemical fertilizers upto50% with incorporation of organic and micronutrient (Boron) gave highest yield and higher B: C ratio as compared to sole use of inorganic fertilizers. Further the conjoint application of rock phosphate as a source of phosphorus along with recommended dose of N and K can potentially benefit the farmers as it was economically more viable and also gave reasonably high yield. The efficacy of rock phosphate as an organic source of fertilizer needs to be further evaluated and studied.

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