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## Effects of organic nutrients in combination with bio-fertilizers on yield and economics parameters of garden pea (*Pisum sativum* L.) CV. Bonneville

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### Abstract

The results revealed that, the significantly maximum weight of pod (6.10 g, 6.29 g and 6.19 g), highest yield of pods per plot (1.98 kg, 2.22 kg and 2.10 kg) and yield of pods per hectare (101.35 q, 113.70 q and 107.52 q) was recorded with treatment F<sub>5</sub> (Recommended dose of N as neem cake) and treatment T<sub>1</sub> [Seed treatment with PSB (200ml/ha)] was found significantly highest number of pods harvested per plant (6.34, 6.16 and 6.25), weight of pod (6.22 g, 6.26 g and 6.24 g), yield of pods per plot (1.93 kg, 2.19 kg and 2.06 kg) and yield of pods per hectare (98.73 q, 112.28 q and 105.50 q) during the year 2013, 2014 and in pooled analysis, respectively. The significantly highest number of pods harvested per plant (5.89) was observed with treatment F<sub>5</sub> (Recommended dose of N as neem cake) in pooled.

**Keywords:** Bonneville, garden pea, economics, yield

### Introduction

The growing of vegetable is the most intensive and remunerative business. Garden pea (*Pisum sativum* L. var. hortense) is a second important food legume of the world. The green and dry foliage are used as cattle fodder and green pods of vegetable pea are highly nutritive so, preferred for culinary purpose. The 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 (Gopalkrishnan, 2007) [8]. The food legumes restorer of soil fertility has long been recognized due to their unique ability of symbiotic nitrogen fixation. This also makes them the most important and useful component of a cropping system in the present context of energy crisis (Rana *et al.* 1998) [14]. To eradicate the low yield of pea, success of Indian agriculture depends heavily on use of fertilizers. To sustain soil health and benign environment there is a need for standardization the conjunctive use of organic sources and bio-fertilizers in order to increase the productivity and alternately improving the soil health (Sharma and Chauhan, 2011; Bahadur *et al.* 2006; Rajput and Kushwah, 2005) [19, 1, 13]. The concept of organic nutrients with bio-fertilizers are gaining considerable momentum today but negligible study has been conducted so, the present investigation was planned on garden pea.

### Materials and Methods

The investigation was conducted at Department of Vegetable Science, College of Horticulture, S. D. Agricultural University, Sardarkrushinagar. Five levels of organic nutrients including recommended dose of N as chemical fertilizer and six levels of bio-fertilizers were applied individually and with in combination. So, the total numbers of treatment combinations were thirty were tested during the *rabi* season of the year 2013 and 2014. The experiment was laid out in a Randomized Block Design (with factorial concept) with thirty treatments were employed and replicated thrice.

The details of treatments, their combinations and notations are furnished here in order to have their clear understanding.

### ✓ Factors:

#### A) Organic Fertilizers (Five levels):

- Control (Recommended dose of N as Urea)
- Recommended dose of N as Farm Yard Manure
- Recommended dose of N as Vermicompost

### Notation

- F<sub>1</sub>
- F<sub>2</sub>
- F<sub>3</sub>

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- Recommended dose of N as Poultry Manure F<sub>4</sub>
- Recommended dose of N as Neem cake F<sub>5</sub>

### B) Bio-fertilizers (Six levels):

- Seed treatment with PSB (200 ml/ha) T<sub>1</sub>
- Seed treatment with KMB (200 ml/ha) T<sub>2</sub>
- Seed treatment with *Azospirillum* (200 ml/ha) T<sub>3</sub>
- Soil treatment with PSB (500 ml/acre) T<sub>4</sub>
- Soil treatment with KMB (500 ml/acre) T<sub>5</sub>
- Soil treatment with *Azospirillum* (500 ml/acre) T<sub>6</sub>

To raise the crop recommended package of practices were followed. The treatments were evaluated on the basis of growth, flowering and yield performance from ten randomly selected tagged plants at different stages. The mean data were subjected to statistical analysis following analysis of variance technique (Gomez and Gomez, 1984) [7].

## Results and Discussion

### Yield and Yield Attributes

**Organic manures:** A perusal of data from Table 1 revealed that the numerically maximum numbers of pickings were recorded with treatment F<sub>5</sub> (3.44 and 3.83) during the both year (2013 and 2014) and treatment F<sub>5</sub> (3.61) in pooled analysis. Significantly maximum number of pods harvested per plant was found under treatment F<sub>5</sub> (5.89) in pooled. Significantly highest weight of pod was recorded with treatment F<sub>5</sub> (6.10 g and 6.29 g) during both the years of experimentation (2013 and 2014) and treatment F<sub>5</sub> (6.19 g) in pooled. Significantly maximum yield of green pods per plot was recorded with treatment F<sub>5</sub> (1.98 kg and 2.22 kg) during both the years of experimentation (2013 and 2014) and treatment F<sub>5</sub> (2.10 kg) in pooled. Significantly maximum yield of green pods per hectare recorded with treatment F<sub>5</sub> (101.35 q and 113.70 q) during both the years of experimentation (2013 and 2014) and treatment F<sub>5</sub> (107.52 q) in pooled.

**Bio-fertilizers:** A perusal of data from Table 1 revealed that the maximum numbers of pickings were observed with treatment T<sub>1</sub> (3.40 and 4.13) during the both year (2013 and 2014) and treatment T<sub>1</sub> (3.77) in pooled. Significantly maximum number of pods harvested per plant was observed with treatment T<sub>1</sub> (6.34 and 6.16) during the both year (2013 and 2014) and treatment T<sub>1</sub> (6.25) in pooled. Significantly highest weight of pod was observed with treatment T<sub>1</sub> (6.22 g and 6.26 g) during both the years of experimentation (2013 and 2014) and treatment T<sub>1</sub> (6.24 g) in pooled. Significantly maximum yield of green pods per plot was recorded with treatment T<sub>1</sub> (1.93 kg and 2.19 kg) during both the years of experimentation (2013 and 2014) and treatment T<sub>1</sub> (2.06 kg) in pooled. Significantly maximum yield of green pods per hectare was observed with treatment T<sub>1</sub> (98.73 q and 112.28 q) during both the years of experimentation (2013 and 2014) and treatment T<sub>1</sub> (105.50 q) in pooled.

The effect of organic manures *viz.*, FYM, vermicompost, poultry manure, neem cake and bio-fertilizers in balanced proportion played a vital role in decomposition and easy release of different plant nutrients throughout the plant life. Initially, the bio-fertilizers provided rapidly better nutrition with all essential nutrients and their uptake by the plant which leads to better plant growth. In latter stage, the required plant nutrient provided through decomposed organic manures for the good development of the plant which in turn resulted into higher yield of the crop. It is fact that PSB produce organic

acids like gluconic, guccinic, lactic, oxalic, citric and  $\alpha$ -ketogluconic acid which convert the insoluble phosphate to soluble one and synthesis growth promoting substances which augment plant growth. The overall development of plant in terms of root and shoot which might have absorbed more nutrient and enhanced photosynthesis and production of assimilates, which in turn increased the yield of pea. The results obtained in present investigation are in line with the findings of Tarafdar and Rao (2001) [20], Yadav *et al.* (2005) [21], Meena *et al.* (2007) [10], Chopra *et al.* (2008) [3], Shivkumar *et al.* (2008) [17], Selvakumar *et al.* (2009) [18], Bahadur *et al.* (2006) [11], El-Desuki *et al.* (2010) [6], Ramana *et al.* (2010) [15], Rather *et al.* (2010) [16], Sharma and Chauhan (2011) [19], Dubey *et al.* (2012) [4], Indires *et al.* (2012) [9] in vegetable crops and Deshmukh *et al.* (2014) [5] in garden pea.

### Economics Parameters

The details of total cost of cultivation, gross and net realization, BCR on pooled data basis for different organic nutrients and bio-fertilizers treatments have been calculated and presented in Table 2. Economics influenced due to various organic nutrients, the treatment F<sub>5</sub> accrued the highest gross realization (₹2,15,040/ha) and net realization (₹1,78,210/ha). The highest benefit cost ratio (6.34) was recorded in treatment F<sub>1</sub>. The lowest gross realization (₹1,85,820/ha) and net realization (₹1,47,073/ha) with the benefit cost ratio (4.80) was recorded in treatment F<sub>3</sub>. The treatment F<sub>5</sub> gave highest gross and net realization but not in BCR; the reason might be due to higher unit cost of neem cake (₹13.66/kg).

Economics influenced due to different bio-fertilizers, the treatment T<sub>1</sub> accrued the highest gross realization (₹2,11,000/ha), net realization (₹1,80,301/ha) and highest benefit cost ratio (6.87). The lowest gross realization (₹1,90,420/ha), net realization (₹1,60,098/ha) and benefit cost ratio (6.28) was recorded with treatment T<sub>6</sub>.

The results of interaction effect between different organic nutrients and bio-fertilizers are summarized in Table 3 indicated that maximum gross realization (₹2,29,162/ha) and net realization (₹1,92,370/ha) were obtained with treatment combination F<sub>5</sub>T<sub>1</sub> and the maximum BCR (7.09) was recorded with treatment combination F<sub>1</sub>T<sub>2</sub>. The treatment combination F<sub>5</sub>T<sub>1</sub> gave highest gross and net realization but not in BCR; the reason might be due to higher unit cost of neem cake (₹13.66/kg). The minimum gross realization (₹1,52,714/ha) and lowest net realization (₹1,21,877/ha) were obtained with treatment combination F<sub>1</sub>T<sub>5</sub>. Whereas, the minimum BCR (4.31) was obtained with treatment combinations F<sub>3</sub>T<sub>1</sub> and F<sub>3</sub>T<sub>4</sub>. Further, the present investigation also revealed that the application of organic nutrients with bio-fertilizers increase yield as well as economic returns. Chattoo *et al.* (2010) [2], El-Desuki *et al.* (2010) [6], Mishra *et al.* (2010) [11], Dubey *et al.* (2012) [4], Patra and Sinha (2012) [12] in green gram recorded similar results in terms of the economic returns from the combined application of organic nutrients with bio-fertilizers in garden pea.

### Summary and Conclusion

Significantly maximum number of pods harvested per plant were recorded with treatment F<sub>5</sub> (Recommended dose of N as neem cake) in pooled and treatment T<sub>1</sub> [Seed treatment with PSB (200ml/ha)] during the both years (2013 and 2014) and in pooled. The treatment combination F<sub>5</sub>T<sub>1</sub> [Recommended dose of N as neem cake + Seed treatment with PSB (200 ml/ha)] was observed maximum number of pods harvested

per plant during the year 2013 and in pooled. Significantly maximum weight of pod, yield of green pods per plot, yield of green pod per hectare were found with treatment F<sub>5</sub> (Recommended dose of N as neem cake), treatment T<sub>1</sub> [Seed treatment with PSB (200ml/ha)] and in treatment combination F<sub>5</sub>T<sub>1</sub> [Recommended dose of N as Neem cake + Seed treatment with PSB (200 ml/ha)] during the both years (2013 and 2014) and in pooled.

Economics of different treatments (pooled mean), the treatment F<sub>5</sub> (Recommended dose of N as neem cake) recorded the highest gross and net realization. The highest benefit cost ratio was recorded in treatment F<sub>1</sub> [Control, Recommended dose of N as urea]. The treatment T<sub>1</sub> [Seed treatment with PSB (200 ml/ha)] exhibited the highest gross and net realization and the highest benefit cost ratio. In

combination of organic nutrients and bio-fertilizers treatments, maximum gross realization and net realization were obtained with treatment combination F<sub>5</sub>T<sub>1</sub> [Recommended dose of N as neem cake + seed treatment with PSB (200 ml/ha)] and the maximum benefit cost ratio was recorded with treatment combination F<sub>1</sub>T<sub>2</sub> [Control + seed treatment with KMB (200 ml/ha)]. The experimental evidences warrant the following specific conclusion which may be adopted for profitable organic production of garden pea under North Gujarat conditions. It may be concluded that the application of nitrogen through neem cake in combination with PSB achieved better growth, reasonably comparable yield and yield attributes with maximum net return under North Gujarat condition, as this treatment combination proved to be the best among all the treatments.

**Table 1:** Influences of organic nutrients and bio-fertilizers on yield and yield attributes of garden pea

Treatments	Total number of pickings			No. of pods harvested plant <sup>-1</sup>			Weight of pod (g)			Yield of green pod plot <sup>-1</sup> (kg)			Yield of green pod hectare <sup>-1</sup> (q)		
	Year 2013	Year 2014	Pooled	Year 2013	Year 2014	Pooled	Year 2013	Year 2014	Pooled	Year 2013	Year 2014	Pooled	Year 2013	Year 2014	Pooled
<b>Organic manures</b>															
F <sub>1</sub>	3.17	3.72	3.44	5.52	5.14	5.33	5.62	5.90	5.76	1.82	1.93	1.87	93.38	98.82	96.10
F <sub>2</sub>	3.28	3.72	3.50	5.56	5.05	5.31	5.91	5.99	5.95	1.86	2.10	1.98	95.30	107.76	101.53
F <sub>3</sub>	3.11	3.83	3.47	5.32	5.03	5.17	6.02	5.99	6.00	1.65	1.97	1.81	84.67	101.14	92.91
F <sub>4</sub>	3.28	3.78	3.56	5.58	5.16	5.37	5.84	6.05	5.95	1.76	2.11	1.94	90.11	108.28	99.20
F <sub>5</sub>	3.44	3.83	3.61	5.96	5.82	5.89	6.10	6.29	6.19	1.98	2.22	2.10	101.35	113.70	107.52
S. Em.±	0.11	0.19	0.11	0.17	0.27	0.16	0.09	0.09	0.06	0.06	0.05	0.04	3.11	1.95	2.06
C.D. at 5%	NS	NS	NS	NS	NS	0.44	0.26	0.24	0.18	0.20	0.10	0.10	8.80	5.38	5.80
<b>Bio-fertilizers</b>															
T <sub>1</sub>	3.40	4.13	3.77	6.34	6.16	6.25	6.22	6.26	6.24	1.93	2.19	2.06	98.73	112.28	105.50
T <sub>2</sub>	3.27	3.80	3.53	5.99	5.94	5.96	5.83	6.14	5.99	1.81	1.98	1.90	92.91	101.61	97.26
T <sub>3</sub>	3.20	3.73	3.47	5.30	4.70	5.00	5.90	6.20	6.05	1.83	2.03	1.93	93.80	104.27	99.03
T <sub>4</sub>	3.27	3.67	3.47	6.06	4.03	5.05	5.69	5.64	5.66	1.88	1.94	1.91	96.49	99.47	97.98
T <sub>5</sub>	3.13	3.53	3.47	4.02	5.69	4.86	5.98	6.03	6.00	1.85	2.11	1.98	95.06	108.35	101.70
T <sub>6</sub>	3.27	3.80	3.54	5.83	4.93	5.38	5.76	6.00	5.88	1.58	2.14	1.86	80.78	109.65	95.21
S. Em.±	0.12	0.21	0.12	0.18	0.29	0.17	0.10	0.09	0.07	0.06	0.06	0.04	3.41	2.96	2.26
C.D. at 5%	NS	NS	NS	0.51	0.83	0.48	0.29	0.27	0.19	0.20	0.20	0.10	9.60	8.40	6.30
CV %	13.88	21.33	18.57	12.53	21.66	17.42	6.64	6.04	6.34	14.20	10.82	12.43	14.20	10.82	12.43

**Table 2:** Gross realization, cost of cultivation, net realization and benefit cost ratio (BCR) as influenced by various organic nutrients and bio-fertilizers treatments (pooled basis)

Treatments	Green pod Yield (q/ha)	Gross realization (₹/ha)	Total Cost of cultivation (₹/ha)	Net realization (₹/ha)	Benefit Cost Ratio (BCR)
<b>Organic Manures</b>					
F <sub>1</sub> : Control (Recommended dose of N as urea)	96.10	192200	30306	161894	6.34
F <sub>2</sub> : Recommended dose of N as farmyard manure	101.53	203060	33972	169088	5.98
F <sub>3</sub> : Recommended dose of N as vermicompost	92.91	185820	38747	147073	4.80
F <sub>4</sub> : Recommended dose of N as poultry manure	99.20	198400	32324	166076	6.14
F <sub>5</sub> : Recommended dose of N as neem cake	107.52	215040	36830	178210	5.84
<b>Bio-fertilizers</b>					
T <sub>1</sub> : Seed treatment with PSB (200 ml/ha)	105.50	211000	30699	180301	6.87
T <sub>2</sub> : Seed treatment with KMB (200 ml/ha)	97.26	194520	30267	164253	6.43
T <sub>3</sub> : Seed treatment with <i>Azospirillum</i> (200 ml/ha)	99.03	198060	30159	167901	6.57
T <sub>4</sub> : Soil treatment with PSB (1.25 l/ha)	97.98	195960	30196	165764	6.49
T <sub>5</sub> : Soil treatment with KMB (1.25 l/ha)	101.70	203400	30196	173204	6.74
T <sub>6</sub> : Soil treatment with <i>Azospirillum</i> (1.25 l/ha)	95.21	190420	30322	160098	6.28

Foregoing discussion highlights the importance of judicious use of organic nutrients in combination with bio-fertilizers in modifying the vegetative growth, yield, quality of garden pea and soil nutrients status.

**Table 3:** Influences of organic nutrients in combination with bio-fertilizers on economics of different treatments (pooled basis)

Treatment combination	Green pod yield (q/ha)	Gross realization (₹/ha)	Total Cost of cultivation (₹/ha)	Net realization (₹/ha)	Benefit Cost Ratio (BCR)
F <sub>1</sub> T <sub>1</sub>	87.48	174969	29974	144996	5.84
F <sub>1</sub> T <sub>2</sub>	106.19	212374	29974	182400	7.09
F <sub>1</sub> T <sub>3</sub>	90.63	181259	30274	150985	5.99
F <sub>1</sub> T <sub>4</sub>	95.31	190618	30537	160081	6.24
F <sub>1</sub> T <sub>5</sub>	76.36	152714	30837	121877	4.95
F <sub>1</sub> T <sub>6</sub>	100.75	201500	30537	170963	6.60
F <sub>2</sub> T <sub>1</sub>	106.96	213922	34132	179790	6.27
F <sub>2</sub> T <sub>2</sub>	101.58	203152	34432	168720	5.90
F <sub>2</sub> T <sub>3</sub>	95.94	191887	34432	157455	5.57
F <sub>2</sub> T <sub>4</sub>	107.76	215514	33795	181719	6.38
F <sub>2</sub> T <sub>5</sub>	100.32	200639	33795	166844	5.94
F <sub>2</sub> T <sub>6</sub>	95.17	190336	34395	155941	5.53
F <sub>3</sub> T <sub>1</sub>	85.89	171779	39861	131918	4.31
F <sub>3</sub> T <sub>2</sub>	108.28	216568	39261	177307	5.52
F <sub>3</sub> T <sub>3</sub>	105.50	211001	38361	172640	5.50
F <sub>3</sub> T <sub>4</sub>	82.54	165081	38324	126757	4.31
F <sub>3</sub> T <sub>5</sub>	103.47	206948	38924	168024	5.32
F <sub>3</sub> T <sub>6</sub>	88.22	176441	39224	137217	4.50
F <sub>4</sub> T <sub>1</sub>	110.56	221117	32376	188741	6.83
F <sub>4</sub> T <sub>2</sub>	105.13	210255	32376	177879	6.49
F <sub>4</sub> T <sub>3</sub>	93.34	186672	32676	153996	5.71
F <sub>4</sub> T <sub>4</sub>	109.18	218370	32039	186331	6.82
F <sub>4</sub> T <sub>5</sub>	90.68	181369	32639	148730	5.56
F <sub>4</sub> T <sub>6</sub>	100.74	201489	31739	169750	6.35
F <sub>5</sub> T <sub>1</sub>	114.58	229162	36792	192370	6.23
F <sub>5</sub> T <sub>2</sub>	112.16	224316	37392	186924	6.00
F <sub>5</sub> T <sub>3</sub>	106.34	212685	37392	175293	5.69
F <sub>5</sub> T <sub>4</sub>	100.44	200890	36755	164135	5.47
F <sub>5</sub> T <sub>5</sub>	100.59	201175	37355	163820	5.39
F <sub>5</sub> T <sub>6</sub>	101.40	202793	36755	166038	5.52

\*Selling price of green pod: ₹ 20.00 per kilogram

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