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Consequence of Optimum Levels of Fertilizer on Enlargement and Yield of Vegetable Pea Cv. VI Ageti Matar-7 under Uttarakhand Hills Condition

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Abstract: Pea (*Pisum sativum* L.) is an important cash crop and protein source for farmers in many parts of India and other countries. Just about 80% of the nitrogen necessity of pea comes from nitrogen fixation by *Rhizobia*, be relevant one-half pound of nitrogen per 1000 square foot area at seeding if the soil test shows the N-NO₃ level below 5 ppm. This will help ensure nitrogen deficiency does not occur before nitrogen fixation occurs. *Rhizobia* immunization is muscularly recommended. It is used as foodstuff and the green unripe pods are cooked or conserved as vegetable. Therefore, field experiment was conducted under the field conditions at Institute of Medicinal and Aromatic Plants, Gairsain Campus, Uttarakhand University of Horticulture and Forestry during the winter season on 2013-2014 to find out the optimum levels of fertilizer on growth and yield attributes of vegetable pea, consisting two levels of nitrogen (20 and 40), three levels of phosphorus (30, 60 and 90) and three levels of potash (30, 60 and 90) along with control on vegetable pea in Randomized Block Design with three replications. The seeds were sown at a distance of 30×10 cm in plot size of 3.0×2.5 m in last week of November 2013. Full dose of phosphorus and potash and half dose of nitrogen were applied to each plot at the time of sowing on November 25, 2013. Days taken to germination, numbers of nodules per plant, fresh weight of nodules per plant, dry weight of nodules per plant, plant height (cm), days taken to first flowering, days taken to pod setting, number of pods per plant, number of grains per pod, fresh weight of 100 grains and yield ha⁻¹ were significantly affected by the application of nitrogen phosphorus and potash. It was worth noting that 20 kg N ha⁻¹, 90 kg P₂O₅ ha⁻¹ and 60 kg K₂O ha⁻¹ yielded good result in number of grain per pod. Peas are highly nutritive and contain high content of digestible protein (7.2 g/100 g), carbohydrate (15.8 g), vitamin-C (9 mg), phosphorus (139 mg) and minerals.

Key words: Fertilizer, enlargement, yield, vegetable pea, VL-Ageti Matar-7

INTRODUCTION

Pea (*Pisum sativum* L.) is an essential vegetable in India. The crop is usually cultivated for its green pods and it is one of the most important hilly vegetable cash crops and grown as an off-season vegetable during summer in high hills and in Rabi season in mid hills. It is highly nutritive and is rich in protein. It is used as a vegetable or in soup, canned frozen or dehydrate. It is cooked as a vegetable along or with potatoes. Split grains of pea are widely used for dal. Pea straw is a nutritious fodder. VL-Ageti Matar-7 (VL-7) developed at Almora through advanced generation selection from the cross Pant Uphar x Arkel. Plants are dwarf with dark green foliage and white flowers. Pods are light green, attractive, slightly incurved towards suture at the distal end and medium in size containing 6-7 seeds. Early season dwarf variety is obtained in first picking in 90-95 days after sowing, pods 8 cm long, light green, slightly curved,

seeds wrinkled, yield 23-25 t ha⁻¹ and very sweet with high TSS (16.8%). Average yield 10 t ha⁻¹ with 42% shelling, maturity time 120-125 days (seeding to first picking) during November sowing in mid hills. Maximum cultivation of pea is in Uttar Pradesh. It occupies good place among nutritious vegetables as being rich source of protein, carbohydrates and vitamin A. Pea being a leguminous crop has low nitrogen requirement. Higher dose of nitrogen has adverse effect on nodulation and nitrogen fixation (Choudhury, 1967). The crop gives good response to phosphorus application. It favors nitrogen fixation by increasing nodule formation. Phosphate increases yield and quality of pea. An investigation was carried out to observe consequence of optimum levels of fertilizer on enlargement and yield of Pea (*Pisum sativum* L.) is a cool season crop and performs best at 10-18°C. The flower and young pods are badly affected by frost. The germination of seeds takes place at 3.3°C soil temperature. Boswell (1926) reported that as the

temperature increases during the growing season, the yield decline sharply. The optimum mean monthly temperature for pea is 12.8-18°C. They found that crop yield of pea was most affected with the combined application of organic and mineral fertilizers.

MATERIALS AND METHODS

The present investigation was conducted under the field conditions at Uttarakhand University of Horticulture and Forestry, Institute of Medicinal and Aromatic Plants, Gairsain Campus, Uttarakhand during the year 2013-2014. It has an altitude 345 m above sea level latitude 30.05° N and longitude 79.28° E. The experiment consisting of eighteen treatments of optimum labels of fertilizer (two levels of nitrogen (20 and 40), three levels of phosphorus (30, 60 and 90) and three levels of potash (30, 60 and 90)) along with control was laid out in Randomized Block Design (RBD) with three replications. The seeds were sown at a distance of 30×10 cm in plot size of 3.0×2.5 m in last week of November 2013. Two seeds per gap were sown at the suggested planting depth of 5 cm with spacing of 10 cm between plants and 30 cm between rows. Reduction of one seedling per hole was carried out after 12 days from seed sowing. Full quantity of phosphorus (single super phosphate), potash (murat of potash) and half dose of nitrogen (urea) according to treatments were applied to each plot at the time of sowing on 25 November 2013. Equally, other agronomic practice was reserved homogeneous for all treatments as suggested and adopted for the site.

Recommended cultural practices and plant protection measures were followed. Healthy crop raised observations were recorded in the year. Days taken to germination, numbers of nodules per plant, fresh weight of nodules per plant, dry weight of nodules per plant, plant height (cm), days taken to first flowering, days taken to pod setting, numbers of pods per plant, numbers of grains per pod, fresh weight of 100 grains and yield per hectare were recorded. Data on days taken to germination, numbers of nodules per plant, fresh weight of nodules per plant, dry weight of nodules per plant, plant height (cm), days taken to first flowering, days taken to pod setting, numbers of pods per plant, numbers of grains per pod, fresh weight of 100 grains and yield per hectare were statically analyzed according to procedure of analysis for Randomized Block Design (RBD) and compared using LSD at a probability level of 5 and 1%.

RESULTS AND DISCUSSION

The days taken to germination, numbers of nodules per plant, fresh weight of nodules per plant, dry weight of

nodules per plant, plant height (cm) are shown in Table 1 and days taken to first flowering, days taken to pod setting, numbers of pod per plant, numbers of grains per pod, fresh weight of 100 grains and yield per hectare increased significantly with the increasing levels of nitrogen, phosphorus and potash application are shown in Table 2. Plant height in nitrogen, phosphorus and potash levels T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) showed the maximum height of the plants (66.81 cm). Plant height varied from 58.80-66.81 cm (Table 1). While observing the effects of phosphorus levels on pea, Kulkarni *et al.* (2000) reported the maximum plant height at 90 kg phosphorus ha⁻¹ with the fact that phosphorus with phosphate soubizers attributed to higher translocation of carbohydrates to respective parts during maturity due to better phosphate dose. In French bean, Rana and Singh (1998) and Chandra *et al.* (1987) recorded maximum height with 100 and 80 kg phosphorus ha⁻¹, respectively. The treatment, T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) that flowered in 23.33 days, was the earliest first flowering treatment. The days taken to germination period of the treatment showed that T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) was the earliest seed germination (12.33 days). Days taken to first flowering ranged from 23.33-28.33 (Table 2) and days taken to germination duration varied from 12.33-17.67 (Table 1), however, earliest first flowering and days taken to germination was recorded for T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) treatment.

A nitrogen, phosphorus and potash level also influences the number of pods per plant (Table 2). The highest pod number (195.33) was obtained with T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) under the present study and numbers of pod per plant ranged from 138.33-195.33. Rana and Singh (1998) also found an increase in pod increasing per plant with increasing levels of phosphorus and the maximum number being at 100 kg P₂O₅ ha⁻¹ in French bean. Present findings also followed the results reported by Chandra *et al.* (1987) with regards the pod number in French bean.

An increasing trend in number of grains per pod was observed in pea with increasing levels of nitrogen, phosphorus and potash and the maximum seeds (8.21) being under T₈ (nitrogen: phosphorus: potash 20:30:60 kg ha⁻¹) level, whereas, number of grains per pod varied from 6.52-8.21 per pod and low to moderate variation was observed for test weight ranged from 63.00-68.00 g measured as the weight of 100 seeds showed considerable variation (Table 2). Similar trends have also been reported by Srinivas and Rao (1984) and Ghakravarti *et al.* (1990) in French bean with the

Table 1: Consequence of optimum levels of fertilizer on enlargement and yield of Pea (*Pisum sativum* L.) Cv. VL-Ageti Matar-7 germination and subsequent seed growth

Treatment (kg ha ⁻¹)	Days taken to germination	No. of nodules plant ⁻¹	Fresh weight of nodules plant ⁻¹	Dry weight of nodules plant ⁻¹ (g) (h)										At harvesting
				24	48	72	20	40	60	80	100			
T ₁ (Control)	17.67	44.00	0.128	0.040	0.037	0.035	7.81	19.42	30.33	42.07	54.63	58.80		
T ₂ (N:P:K20:30:30)	14.00	77.00	0.160	0.049	0.045	0.043	9.33	20.39	32.39	43.03	55.01	62.52		
T ₃ (N:P:K20:60:30)	13.33	78.67	0.163	0.048	0.046	0.046	9.91	21.29	33.03	43.39	55.87	62.77		
T ₄ (N:P:K20:90:30)	12.67	88.00	0.172	0.051	0.048	0.047	9.87	21.05	32.77	43.32	56.37	63.36		
T ₅ (N:P:K40:30:30)	13.00	57.67	0.131	0.044	0.039	0.039	9.40	21.54	32.77	43.01	55.32	62.77		
T ₆ (N:P:K40:60:30)	13.67	60.00	0.133	0.045	0.041	0.039	9.18	21.39	32.32	46.31	55.78	62.97		
T ₇ (N:P:K40:90:30)	13.00	67.00	0.141	0.048	0.046	0.046	9.37	21.75	33.07	44.05	55.02	60.07		
T ₈ (N:P:K20:30:60)	12.67	92.33	0.205	0.060	0.058	0.056	10.15	22.02	33.36	45.73	56.60	63.59		
T ₉ (N:P:K20:60:60)	13.00	91.67	0.208	0.061	0.058	0.056	10.74	22.10	33.38	46.63	56.76	64.87		
T ₁₀ (N:P:K20:90:60)	12.33	98.67	0.225	0.065	0.061	0.059	10.93	22.97	34.00	47.74	57.90	66.81		
T ₁₁ (N:P:K40:30:60)	14.67	68.00	0.151	0.053	0.050	0.049	9.73	21.04	32.79	45.07	53.39	61.93		
T ₁₂ (N:P:K40:60:60)	13.33	77.33	0.169	0.047	0.046	0.046	9.94	21.73	32.33	45.35	55.03	62.22		
T ₁₃ (N:P:K40:90:60)	13.67	71.67	0.162	0.055	0.051	0.050	8.40	21.36	32.32	45.52	55.29	59.99		
T ₁₄ (N:P:K20:30:90)	14.67	91.00	0.204	0.059	0.055	0.054	9.03	22.62	33.22	46.24	56.91	62.44		
T ₁₅ (N:P:K20:60:90)	13.00	97.67	0.222	0.064	0.058	0.058	10.29	23.25	34.21	47.41	57.18	65.87		
T ₁₆ (N:P:K20:90:90)	14.67	96.33	0.219	0.062	0.058	0.057	10.91	23.51	34.11	47.13	57.80	66.34		
T ₁₇ (N:P:K40:30:90)	14.67	57.00	0.141	0.048	0.045	0.043	9.18	22.14	33.13	46.30	56.07	61.33		
T ₁₈ (N:P:K40:60:90)	15.00	62.00	0.148	0.050	0.047	0.045	9.80	22.40	33.30	46.02	56.69	62.98		
T ₁₉ (N:P:K40:90:90)	13.33	51.33	0.139	0.047	0.044	0.043	9.07	21.03	32.09	45.19	55.95	61.40		
CD (1%)	4.88	31.66	0.02	0.015	0.007	0.007	0.45	1.64	1.61	1.34	1.19	0.91		
CD (5%)	3.64	23.61	0.01	0.011	0.005	0.005	0.33	1.22	1.20	1.00	0.89	0.68		
CV	15.95	18.98	5.72	12.840	6.841	6.657	2.10	3.40	2.20	1.34	0.96	0.65		
Sem	1.27	8.23	0.01	0.003	0.001	0.001	0.11	0.42	0.41	0.35	0.31	0.23		
GM	13.78	75.12	0.16	0.052	0.059	0.048	9.63	21.73	32.89	45.23	55.97	62.79		

CD: Critical difference, CV: Critical variance, Sem: Stander mean error, GM: Grant mean

Table 2: Consequence of optimum levels of fertilizer on enlargement and yield of Pea (*Pisum sativum* L.) cv. VL-Ageti Matar-7 subsequent yield attributes

Treatment (kg ha ⁻¹)	Days taken to		No. of pod per plant	No. of grains per pod	Fresh weight	
	first flowering	Days taken to pod setting			of 100 grains	Yield hectare ⁻¹
T ₁ (Control)	28.33	39.33	138.13	6.52	63.00	111.77
T ₂ (N:P:K 20:30:30)	26.67	36.67	173.13	7.01	64.67	155.40
T ₃ (N:P:K 20:60:30)	25.00	35.67	175.33	7.13	64.33	163.02
T ₄ (N:P:K 20:90:30)	24.33	36.33	178.27	8.17	67.00	166.76
T ₅ (N:P:K 40:30:30)	25.67	35.67	160.07	7.09	64.00	127.77
T ₆ (N:P:K 40:60:30)	25.67	36.33	168.27	7.27	64.67	138.65
T ₇ (N:P:K 40:90:30)	25.33	35.67	170.27	7.35	65.00	136.75
T ₈ (N:P:K 20:30:60)	24.00	35.33	190.80	8.21	67.67	161.36
T ₉ (N:P:K 20:60:60)	25.00	36.33	185.20	7.38	64.33	177.80
T ₁₀ (N:P:K 20:90:60)	23.33	34.67	195.33	8.20	68.00	179.00
T ₁₁ (N:P:K 40:30:60)	26.67	35.00	169.67	7.03	64.00	133.79
T ₁₂ (N:P:K 40:60:60)	25.67	35.67	173.27	7.34	64.33	137.80
T ₁₃ (N:P:K 40:90:60)	25.67	36.67	178.38	7.40	64.67	141.19
T ₁₄ (N:P:K 20:30:90)	26.33	35.00	179.10	7.11	64.33	148.88
T ₁₅ (N:P:K 20:60:90)	25.33	35.67	185.60	7.23	64.67	161.68
T ₁₆ (N:P:K 20:90:90)	26.33	35.33	188.41	7.02	64.67	166.59
T ₁₇ (N:P:K 40:30:90)	26.00	35.33	145.55	6.98	63.33	121.78
T ₁₈ (N:P:K 40:60:90)	27.67	36.67	148.13	6.72	64.00	125.58
T ₁₉ (N:P:K 40:90:90)	25.00	35.00	152.23	7.27	65.33	129.88
CD (1%)	1.62	1.31	0.87	0.70	1.26	0.92
CD (5%)	1.21	0.98	0.65	0.52	0.94	0.69
CV	2.84	1.64	0.23	4.34	0.87	2.84
Sem	0.42	0.34	0.22	0.18	0.32	0.24
GM	25.68	35.91	171.32	7.28	64.84	146.60

CD: Critical difference, CV: Critical variance, Sem: Stander mean error, GM: Grant mean

maximum number of grains per pod under 100 kg ha⁻¹ and 75 kg P₂O₅ ha⁻¹, respectively. The best response of nitrogen, phosphorus and potash application was observed with nitrogen 20 kg ha⁻¹, phosphorus 90 kg ha⁻¹ and potash 60 kg ha⁻¹ T₁₀ treatment. These findings are in conformity with these of Baboo *et al.* (1998), Singh and Singh (1999), Jasrotia and Sharma (1998), Rana and Singh (1998), Haldavanekar *et al.* (1992), Kanaujia *et al.* (1999) and Tomar (2001) in French bean. These results are in agreement with the findings of Tewari and Singh (2000) in French bean who found the maximum fresh weight of 100 grains at 60 kg P₂O₅ ha⁻¹ the highest dose of phosphorus under study. However, green pod yield per hacter for the level varied widely from 111.77-179.00 kg ha⁻¹ the T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) treatment (179.00 kg ha⁻¹) was the maximum yielding Treatment, followed by T₉ (nitrogen: phosphorus: potash 20:60:60 kg ha⁻¹) (177.80 kg ha⁻¹), the control treatment was yielded the lowest (111.77 kg ha⁻¹) (Table 2). Days taken to pod setting showed extreme variation ranging from 34.67-39.33 days, the treatment, T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) being the earliest pod setting level (34.67 days). Numbers of nodules per plant ranged from 44.00-98.67 showed considerable variation (Table 1). As the levels of fertilizer increased the fresh and dry (24 to 72 h), weight were also increased on doses of fertilizer and the significantly maximum fresh and dry weight of nodules per plant

(0.225 and 0.059 g) were found for T₁₀ (nitrogen: phosphorus: potash 20:90:60 kg ha⁻¹) while, minimum value (0.128 and 0.035 g) were observed in control (Bahuguna, 2007).

CONCLUSION

Application of the correct level of fertilizer is necessary to achieve maximum yield of vegetable pea and the present study, growth and yield correctors of vegetable pea as days taken to germination, numbers of nodules per plant, fresh weight of nodules per plant, dry weight of nodules per plant, plant height (cm), days taken to first flowering, days taken to pod setting, numbers of pods per plant, numbers of grains per pod, fresh weight of 100 grains and yield per hectare were significantly affected by the application of nitrogen, phosphorus and potash 20 kg N ha⁻¹ 30 kg P₂O₅ ha⁻¹ and 60 kg K₂O ha⁻¹ obtained the top rank. While, it was worth noting that 20 kg N ha⁻¹ 30 kg P₂O₅ ha⁻¹ and 60 kg K₂O ha⁻¹ yielded good results in number of grain per pod. In universal it suggested with the purpose of investigate the similar study in different localities to have genuine information for the optimum level of fertilizer to produce vegetable pea.

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