UNDER PEER REVIEW

Studies of Spacing on Growth and Yield of Different Varieties of Field Pea (*Pisum sativum* L.)

ABSTRACT

A field experiment entitled " **Studies of spacing on growth and yield of different varieties of field pea (*Pisum sativum* L.)"** was undertaken during the *rabi* season of 2023 - 2024 at Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences, Utlou, Bishnupur District, Manipur, India. The treatment comprised of three different spacing (S_1- 20×10 cm, S_2- 30×10 cm, and S_3- 40×10 cm,) and three varieties V_1- Rachna, V_2 –Aman and V_3- Prakash with a total of nine treatment combinations. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications. The results revealed that the individual effect of spacing S_3 - 40×10 cm (S_3) and variety S_3V_2 (V_2) significantly enhanced the growth attributes i.e. plant height, number of branches, fresh and dry weight, number of nodules, dry weight of nodules for all the growth stages recorded. The treatment combination S_3V_2 (40 × 10 cm + Aman) recorded maximum plant height, number of branches, fresh and dry weight, number of nodules and dry weight of nodules for all the growth stages recorded. The different planting spaces and varieties significantly enhanced the yield attributes of pea. The spacing(S_3) and varieties (V_2) significantly increased the number of pods per plant, seeds per pod, pod length, test weight, seed yield, stover yield of pea. The treatment combination S_3V_2 (40 × 10 cm + Aman) gave the maximum seed yield (20.69 kg/ha) and stover yield (25.19 kg/ha). The highest gross return, net return and highest benefit-cost ratio were obtained from the treatment S_3V_2 (40 × 10 cm + Aman). Thus, from the experiment it can be concluded that the application of S_3V_2 (40 × 10 cm + Aman) is more favorable for attaining sustainable higher profits and productivity in the cultivation of during Rabi season of Manipur.

Keywords: Pea, spacing, varieties, growth, yield.

1. INTRODUCTION

(*Pisum sativum* L.) is a very common leguminous crop grown in the rabi season oughout the world. Pea crop own a strategic position in Indian agriculture as it is an excellent source of dietary protein and a mini-nitrogen plant having ameliorative effect on soil. It helps in improving physical, chemical and biological properties of soil and also utilize natural resources in a better way (Kolb *et al*., 2017). Less inputs particularly the irrigation and fertilizer are needed in cultivation of pea. It improves soil fertility due to fixation of nitrogen by rhizobium bacteria. Nutritionally, pea contains, 7.2 g, fats 0.1 g, minerals 0.8 g, carbohydrates 15.8 g, calcium 20 mg, magnesium 34 mg, copper 0.23 mg, iron 1.5 mg and vitamin C 9.0 mg/100 g of edible portion (Sepehya *et al*., 2015).

Spacing is also one of the important parameters, which ultimately affected nutrients uptake, growth and yield of plant. Increase in spacing, the total population decrease, but with more nutrition the individual plant grows better and get more yield and vice-versa. The increase or decrease of row spacing's and plant population has definite pattern in relation to the yield. Among various agronomic yield limiting factors, planting pattern is considered of great importance. Lone *et al*. (2009) stated that the optimum plant density with proper geometry of planting is dependent on variety, its growth habit and agroclimatic conditions. Optimum spacing is necessary to obtain maximum yield in any crop by reducing the competition among the plants for light, nutrient, moisture, etc. Optimum spacing for any crop varies considerably due to environment under which it is grown and different variety.

In agriculture, varieties are essential for enhancing productivity and are chosen based on their ability to grow in specific environments and maximize yield potential. The growth and yield of a crop are influenced by several factors, and selecting the right variety plays a crucial role in improving both. Each variety has a genetic potential for growth, which defines its maximum size, growth rate, and the ability to produce leaves, flowers, and roots. This potential is determined by genes that regulate cell division, elongation, and differentiation. Varieties with superior genetic growth potential can achieve better vegetative growth, which supports higher yield outcomes. Keeping these points in s, the present investigation entitled “Studies of Spacing on Growth and Yield of Differ arieties of Field Pea (*Pisum sativum* L.) was conducted during *rabi* 2023-24 at the farm of Pandit Deen Dayal Upadhyay Institute of Agriculture Science, Utlou, Bishnupur, Manipur.

2. MATERIAL AND METHODS

The field experiment was conducted at the experimental site of the Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences situated in Utlou, Bishnupur District, Manipur, during the Rabi season of 2023–2024 which is at 24°43'23"N latitude & 93°51'33"E longitude and at an altitude of 790 above mean sea level (MLS). The soil of the experimental site was clayey, the soil pH was acidic in reaction (5.2) with high organic carbon content (1.9%). The available nitrogen (188 kg/ha) is low and phosphorus (20.0 kg/ha) is medium and potassium (324.0 kg/ha) is high in range according to TNAU soil rating chart. During the period of experimentation, the monthly maximum and minimum temperature were between 22.3^0 C - 28.9^0C and 4.6^0C - 8.8^0C, and the maximum and minimum relative humidity were recorded between 93% - 94% and 32% - 57%, respectively. There are nine treatments and three replications laid out in a Factorial Randomized Complete Block Design (FRBD). The treatments were: T_1 S_1V_1 20×10 cm + Rachna T_2 S_1V_2 20×10 cm + Aman T_3 S_1V_3 20×10 cm + Prakash T_4 S_2V_1 30×10 cm + Rachna T_5 S_2V_2 30×10 cm + Aman T_6 S_2V_3 30×10 cm + Prakash T_7 S_3V_1 40×10 cm + Rachna T_8 S_3V_2 40×10 cm + Aman T_9 S_3V_3 40×10 cm + Prakash. A uniform dose of 20 kg nitrogen (as urea), 60 kg phosphorus (SSP) and 40 kg potash (MOP) were applied to all the treatments during the time of sowing. The biometric observation on different growth and yield attributes were recorded at various crop growth period

3. RESULTS AND DISCUSSION

3.1 Effect of spacing and varieties on plant height (cm)

The data on plant height as influenced by spacing and varieties recorded during 30, 60, 90 DAS and at harvest are presented in Table 1. The individual effect of spacing on plant height of field pea has been found to be significant for all the growth stages. In general, the spacing, S_3 (40×10 cm) recorded the maximum plant height i.e. 11.69 cm, 30.13 cm, 41.62 cm and 42.84 cm respectively during 30, 60, 90 DAS and at harvest, and S_1 (20×10 cm) recorded minimum plant height i.e. 10.89 cm, 28.88 cm, 39.31 cm and 46.29 cm. Again, the varieties, V_2 (Aman) recorded maximum plant height i.e. 12.98 cm, 30.68 cm, 46.29 cm and 47.22 cm, respectively during 30, 60, 90 DAS and at harvest and V_1 (Rachna) recorded minimum plant height i.e. 9.77 cm. 27.92 cm, 35.61 cm, and 36.62 cm respectively during 30, 60, 90 DAS and at harvest. The combined effect of spacing and varieties on plant height of field pea has been found to be non-significant for all the growth stages. Significant enhancement in plant height under different spacing and varieties seems to be due to increase in cell division which results in rapid growth of plants obtained by Yadav (2003) in cowpea and Sen *et.al.* (2005) in dwarf field pea. These findings are in good lines with those obtained by Khan *et al.* (2021), reported that increased row spacing increase the plant height.

Table 1. Effect of spacing and varieties on plant height (cm)

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
Spacing				
S_1: 20×10 cm	10.89	28.88	39.31	40.98
S_2: 30×10 cm	11.24	29.51	40.53	42.04
S_3: 40×10 cm	11.69	30.13	41.62	42.84
S.Ed (±)	0.10	0.36	0.42	0.32
C.D. (P = 0.05)	0.21	0.77	0.88	0.67
Varieties				
V_1: Rachna	9.77	27.92	35.61	36.62
V_2: Aman	12.98	30.68	46.29	47.22
V_3: Prakash	11.07	29.92	39.55	42.03
S.Ed (±)	0.10	0.36	0.42	0.32
C.D. (P = 0.05)	0.21	0.77	0.88	0.67

3.2 Effect of spacing and varieties on number of branches per plant of field pea.

The data on number of branches per plant as influenced by spacing and varieties recorded during 30, 60, 90 DAS and at harvest are presented in Table 2. The individual effect of spacing on number of branches per plant of field pea has been found to be significant for all the growth stages. In general, the spacing, S_3 (40×10 cm) recorded the maximum number of branches per plant i.e. 1.30, 2.53, 2.95 and 3.93 which was at par with S_2 again S_2 was also at par with S_1 during 30 DAS and 60 DAS but superior at 90 DAS and at harvest. Minimum number of branches per plant was recorded in S_1 (20×10 cm) i.e.1.19, 2.42, 2.74 and 3.7. Again, the varieties, V_2 (Aman) recorded maximum number of branches per plant i.e. 1.37, 3.12, 3.52 and 4.62, respectively during 30, 60, 90 DAS and at harvest and V_1 (Rachna) recorded minimum number of branches per plant i.e. 1.12, 1.94, 2.31, and 3.20 respectively during 30, 60, 90 DAS and at harvest. The combined effect of spacing and varieties on number of branches per plant of field pea has been found to be non-significant for all the growth stages. Significant enhancement in number of branches per plant might be due to

different row spacing which had sufficient space, nutrients, moisture and sunlight for better overall development of individual plant. The variation in production of branches per plant in varieties may be due to genetically makeup of individual varieties. This result is also obtained by *et al.* (2012) and Kumari *et al*. (2021) in pea.

Table 2. Effect of spacing and varieties on number of branches per plant of field pea.

Treatments	Number of branches per plants			
	30 DAS	60 DAS	90 DAS	At harvest
Spacing				
S_1: 20×10 cm	1.19	2.42	2.74	3.71
S_2: 30×10 cm	1.27	2.48	2.89	3.84
S_3: 40×10 cm	1.30	2.53	2.95	3.93
S.Ed (±)	0.04	0.03	0.02	0.02
C.D. (P = 0.05)	0.08	0.07	0.03	0.03
Varieties				
V_1: Rachna	1.12	1.94	2.31	3.20
V_2: Aman	1.37	3.12	3.52	4.62
V_3: Prakash	1.27	2.37	2.74	3.65
S.Ed (±)	0.04	0.03	0.02	0.02
C.D. (P = 0.05)	0.08	0.07	0.03	0.03

3.3 Effect of spacing and varieties on number of pods per plant

The data on number of pods per plants as influenced by spacing and varieties are presented in Table 3. The individual effect of spacing and varieties on number of pods per plants of field pea has been found to be significant. Among the different spacing S_3 (40×10 cm) recorded the maximum number of pods per plants i.e. 13.01 and S_1 (20×10 cm) recorded minimum pods length per plant i.e. 10.87. Among the different variety, V_2 (Aman) recorded maximum number of pods per plants i.e. 13.53 and V_1 (Rachna) recorded minimum number of pods per plants i.e. (10.46). The combined effect of spacing and varieties on number of pods per plant of field pea has been found to be non-significant for all the growth stages. This might be due to wider row spacing which give the sufficient space of individual plant for better reproductive growth and increase the pod bearing ability because easily provide essential plant nutrients in this row spacing. Significant variation in pods per plant may be correlated with the number of branches. Significant interaction between row spacing on number of pods plants was also reported by Sajid *et al*. (2012) and Shaukat *et al*. (2012) in field pea.

3.4 Pods length (cm)

The data on pods length of plants as influenced by spacing and varieties are presented in Table 3. The individual effect of spacing and varieties on number of pods length of plants of field pea has been found to be significant. Among the different spacing S_3 (40×10 cm) recorded the maximum number of pods length i.e. 6.01 cm and S_1 (20×10 cm) recorded minimum pods length per plant i.e. 4.71 cm. Among the different variety, V_2 (Aman) recorded maximum number of pods length i.e. 5.65 cm and V_1 (Rachna) recorded minimum number of pods length i.e. (4.98 cm). The interaction of spacing and varieties on number of pods length of field pea was found to be significant for all the growth stages of field pea. The maximum number of pods length per plants was found to be for the treatment S_3V_2 (40×10 cm + Aman), i.e. (6.11). The treatments combination of (S_2V_2, S_3V_1, S_3V_2 and S_3V_3) and (S_1V_2, S_1V_3, S_2V_1 and S_2V_3) was recorded to be at par with each other. The lowest number of pods

length was for the treatment S_1V_1(20×10 cm + Rachna), i.e. (4.23 cm). Enhancement in number of pod length under different spacing and varieties seems to be due to the variation in pod length among varieties which accounted for varietals inheritance. Significant interaction between row spacing on pod length was also observed by Alizai *et al.* (2005) in pea. Significant effect on variety were also reported by Bhutia *et al.* (2017) in pea.

3.5 Seed yield (q/ha)

The data on seed yield as influenced by spacing and varieties are presented in Table 3. The individual effect of spacing and varieties on seed yield of field pea has been found to be significant. Among the different spacing S_3 (40×10 cm) recorded the maximum seed yield i.e. 17.60 q/ha and S_1 (20×10 cm) recorded minimum seed yield i.e.13.81 q/ha. Among the different variety, V_2 (Aman) recorded maximum seed yield i.e.18.46 q/ha and V_1 (Rachna) recorded minimum seed yield i.e. (13.06 q/ha). The interaction of spacing and varieties on seed yield of field pea was found to be significant for all the growth stages of field pea. The seed yield ranged from 11.21 q/ha to 21.11 q/ha. The maximum seed yield was found to be for the treatment S_3V_2 (40×10 cm + Aman), i.e. (20.69 q/ha) followed by treatment S_2V_2 (30×10 cm + Aman) i.e. 18.34 q/ha. The lowest seed yield was for the treatment S_1V_1 (20×10 cm + Rachna) i.e. (11.21 q/ha). The variation in seed yield in varieties may be due to maximum number of nodules per plant, pods per plant, seed yield per plant and better seed index. This favorable phenomenon resulted in higher yield. Significant interaction between row spacing on seed yield was observed by Hussain *et al.* (2017) in pea. Significant effect on variety were also reported by Kumar *et al.* (2018) in field pea. Significant interaction between row spacing and variety on seed yield/plant was also reported by Malek *et al.* (2012) and Mondal *et al.* (2014).

Table 3. Effect of spacing and varieties on number of pods, pod length (cm) and seed yield (q/ha) of field pea.

Treatments	Number of pods	Pod length (cm)	Seed yield (q/ha)
Spacing			
S_1	10.19	4.71	11.26
S_2	10.50	5.25	12.33
S_3	10.72	6.01	12.86
S.Ed(±)	0.01	0.11	0.04
C.D	0.03	0.23	0.08
Varieties			
V_1	9.74	4.98	10.60
V_2	11.08	5.65	13.56
V_3	10.58	5.34	12.29
S.Ed(±)	0.01	0.11	0.04
C.D	0.03	0.23	0.08
Spacing x varieties			
S_1V_1	9.60	4.23	9.41
S_1V_2	12.50	5.03	10.86
S_1V_3	11.01	4.87	10.30
S_2V_1	10.45	4.81	9.81
S_2V_2	13.66	5.82	11.05
S_2V_3	12.24	5.12	10.64
S_3V_1	11.32	5.90	10.01
S_3V_2	14.43	6.11	11.34
S_3V_3	13.27	6.04	10.81
S.Ed(±)	0.11	0.18	0.03
C.D	0.22	0.39	0.05

4. CONCLUSION

Based on the results from the experiment it can be concluded that the effect of spacing and varieties on growth and yield of field pea (*Pisum sativum* L.) significantly increases the growth attributes, yield and yield attributes of field pea. The spacing (40×10 cm) and variety (Aman) was found best for field pea cultivation. The treatment combination S_3V_2 (40×10 cm + Aman) was found most effective from all the other treatment. From this research outputs we can conclude that the spacing i.e. 40×10 cm and variety i.e. S_3V_2 (70,810) leads to better net returns.

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