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

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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 (S₁- 20×10 cm, S₂- 30×10 cm, and S₃- 40×10 cm,) and three varieties V₁- Rachna, V₂ –Aman and V₃- 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 S₃ - 40×10 cm (S₃) and variety S₃V₂ (V₂) 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 S₃V₂ (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(S₃) and varieties (V₂) significantly increased the number of pods per plant, seeds per pod, pod length, test weight, seed yield, stover yield of pea. The treatment combination S₃V₂ (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 S₃V₂ (40 × 10 cm + Aman). Thus, from the experiment it can be concluded that the application of S₃V₂ (40 × 10 cm + Aman) is more favorable for attaining sustainable higher profits and productivity in the cultivation of pea during Rabi season of Manipur.

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

26 1. INTRODUCTION

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

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

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

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59 2. MATERIAL AND METHODS

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61 The field experiment was conducted at the experimental site of the Pandit Deen Dayal
62 Upadhyay Institute of Agricultural Sciences situated in Utlou, Bishnupur District, Manipur,
63 during the Rabi season of 2023–2024 which is at 24°43'23"N latitude & 93°51'33"E longitude
64 and at an altitude of 790 above mean sea level (MLS). The soil of the experimental site was
65 clayey, the soil pH was acidic in reaction (5.2) with high organic carbon content (1.9%). The
66 available nitrogen (188 kg/ha) is low and phosphorus (20.0 kg/ha) is medium and potassium
67 (324.0 kg/ha) is high in range according to TNAU soil rating chart. During the period of
68 experimentation, the monthly maximum and minimum temperature were between 22.3° C -
69 28.9°C and 4.6°C - 8.8°C, and the maximum and minimum relative humidity were recorded
70 between 93% - 94% and 32% - 57%, respectively. There are nine treatments and three
71 replications laid out in a Factorial Randomized Complete Block Design (FRBD). The
72 treatments were: T₁ S₁V₁ 20×10 cm + Rachna T₂ S₁V₂ 20×10 cm + Aman T₃ S₁V₃ 20×10 cm
73 + Prakash T₄ S₂V₁ 30×10 cm + Rachna T₅ S₂V₂ 30×10 cm + Aman T₆ S₂V₃ 30×10 cm +
74 Prakash T₇ S₃V₁ 40×10 cm + Rachna T₈ S₃V₂ 40×10 cm + Aman T₉ S₃V₃ 40×10 cm +
75 Prakash. A uniform dose of 20 kg nitrogen (as urea), 60 kg phosphorus (SSP) and 40 kg
76 potash (MOP) were applied to all the treatments during the time of sowing. The biometric
77 observation on different growth and yield attributes were recorded at various crop growth
78 period

79 **3. RESULTS AND DISCUSSION**

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81 **3.1 Effect of spacing and varieties on plant height (cm)**

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83 The data on plant height as influenced by spacing and varieties recorded during 30, 60, 90
 84 DAS and at harvest are presented in Table 1. The individual effect of spacing on plant height
 85 of field pea has been found to be significant for all the growth stages. In general, the
 86 spacing, S₃ (40×10 cm) recorded the maximum plant height i.e. 11.69 cm, 30.13 cm, 41.62
 87 cm and 42.84 cm respectively during 30, 60, 90 DAS and at harvest, and S₁ (20×10 cm)
 88 recorded minimum plant height i.e. 10.89 cm, 28.88 cm, 39.31 cm and 46.29 cm. Again, the
 89 varieties, V₂ (Aman) recorded maximum plant height i.e. 12.98 cm, 30.68 cm, 46.29 cm and
 90 47.22 cm, respectively during 30, 60, 90 DAS and at harvest and V₁ (Rachna) recorded
 91 minimum plant height i.e. 9.77 cm, 27.92 cm, 35.61 cm, and 36.62 cm respectively during
 92 30, 60, 90 DAS and at harvest. The combined effect of spacing and varieties on plant height
 93 of field pea has been found to be non-significant for all the growth stages. Significant
 94 enhancement in plant height under different spacing and varieties seems to be due to
 95 increase in cell division which results in rapid growth of plants obtained by Yadav (2003) in
 96 cowpea and Sen *et al.* (2005) in dwarf field pea. These findings are in good lines with those
 97 obtained by Khan *et al.* (2021), reported that increased row spacing increase the plant
 98 height.

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

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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

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103 **3.2 Effect of spacing and varieties on number of branches per plant of field pea.**

104 The data on number of branches per plant as influenced by spacing and varieties recorded
 105 during 30, 60, 90 DAS and at harvest are presented in Table 2. The individual effect of
 106 spacing on number of branches per plant of field pea has been found to be significant for all
 107 the growth stages. In general, the spacing, S₃ (40×10 cm) recorded the maximum number of
 108 branches per plant i.e. 1.30, 2.53, 2.95 and 3.93 which was at par with S₂ again S₂ was also
 109 at par with S₁ during 30 DAS and 60 DAS but superior at 90 DAS and at harvest. Minimum
 110 number of branches per plant was recorded in S₁ (20×10 cm) i.e. 1.19, 2.42, 2.74 and 3.7.
 111 Again, the varieties, V₂ (Aman) recorded maximum number of branches per plant i.e. 1.37,
 112 3.12, 3.52 and 4.62, respectively during 30, 60, 90 DAS and at harvest and V₁ (Rachna)
 113 recorded minimum number of branches per plant i.e. 1.12, 1.94, 2.31, and 3.20 respectively
 114 during 30, 60, 90 DAS and at harvest. The combined effect of spacing and varieties on
 115 number of branches per plant of field pea has been found to be non-significant for all the
 116 growth stages. Significant enhancement in number of branches per plant might be due to

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

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

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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

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126 **3.3 Effect of spacing and varieties on number of pods per plant**

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128 The data on number of pods per plants as influenced by spacing and varieties are presented
 129 in Table 3. The individual effect of spacing and varieties on number of pods per plants of
 130 field pea has been found to be significant. Among the different spacing S₃ (40×10 cm)
 131 recorded the maximum number of pods per plants i.e. 13.01 and S₁ (20×10 cm) recorded
 132 minimum pods length per plant i.e. 10.87. Among the different variety, V₂ (Aman) recorded
 133 maximum number of pods per plants i.e. 13.53 and V₁ (Rachna) recorded minimum number
 134 of pods per plants i.e. (10.46). The combined effect of spacing and varieties on number of
 135 pods per plant of field pea has been found to be non-significant for all the growth stages.
 136 This might be due to wider row spacing which give the sufficient space of individual plant for
 137 better reproductive growth and increase the pod bearing ability because easily provide
 138 essential plant nutrients in this row spacing. Significant variation in pods per plant may be
 139 correlated with the number of branches. Significant interaction between row spacing on
 140 number of pods plants was also reported by Sajid *et al.* (2012) and Shaukat *et al.* (2012) in
 141 field pea.

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143 **3.4 Pods length (cm)**

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145 The data on pods length of plants as influenced by spacing and varieties are presented in
 146 Table 3. The individual effect of spacing and varieties on number of pods length of plants of
 147 field pea has been found to be significant. Among the different spacing S₃ (40×10 cm)
 148 recorded the maximum number of pods length i.e. 6.01 cm and S₁ (20×10 cm) recorded
 149 minimum pods length per plant i.e. 4.71 cm. Among the different variety, V₂ (Aman) recorded
 150 maximum number of pods length i.e. 5.65 cm and V₁ (Rachna) recorded minimum number of
 151 pods length i.e. (4.98 cm). The interaction of spacing and varieties on number of pods length
 152 of field pea was found to be significant for all the growth stages of field pea. The maximum
 153 number of pods length per plants was found to be for the treatment S₃V₂ (40×10 cm +
 154 Aman), i.e. (6.11). The treatments combination of (S₂V₂, S₃V₁, S₃V₂ and S₃V₃) and (S₁V₂,
 155 S₁V₃, S₂V₁ and S₂V₃) was recorded to be at par with each other. The lowest number of pods

156 length was for the treatment S₁V₁(20×10 cm + Rachna), i.e. (4.23 cm). Enhancement in
157 number of pod length under different spacing and varieties seems to be due to the variation
158 in pod length among varieties which accounted for varieties inheritance. Significant
159 interaction between row spacing on pod length was also observed by Alizai *et al.* (2005) in
160 pea. Significant effect on variety were also reported by Bhutia *et al.* (2017) in pea.

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162 **3.5 Seed yield (q/ha)**

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164 The data on seed yield as influenced by spacing and varieties are presented in Table 3. The
165 individual effect of spacing and varieties on seed yield of field pea has been found to be
166 significant. Among the different spacing S₃ (40×10 cm) recorded the maximum seed yield i.e.
167 17.60 q/ha and S₁ (20×10 cm) recorded minimum seed yield i.e.13.81 q/ha. Among the
168 different variety, V₂ (Aman) recorded maximum seed yield i.e.18.46 q/ha and V₁ (Rachna)
169 recorded minimum seed yield i.e. (13.06 q/ha). The interaction of spacing and varieties on
170 seed yield of field pea was found to be significant for all the growth stages of field pea. The
171 seed yield ranged from 11.21 q/ha to 21.11 q/ha. The maximum seed yield was found to be
172 for the treatment S₃V₂ (40×10 cm + Aman), i.e. (20.69 q/ha) followed by treatment S₂V₂
173 (30×10 cm + Aman) i.e. 18.34 q/ha. The lowest seed yield was for the treatment S₁V₁ (20×10
174 cm + Rachna) i.e. (11.21 q/ha). The variation in seed yield in varieties may be due to
175 maximum number of nodules per plant, pods per plant, seed yield per plant and better seed
176 index. This favorable phenomenon resulted in higher yield. Significant interaction between
177 row spacing on seed yield was observed by Hussain *et al.* (2017) in pea. Significant effect
178 on variety were also reported by Kumar *et al.* (2018) in field pea. Significant interaction
179 between row spacing and variety on seed yield/plant was also reported by Malek *et al.*
180 (2012) and Mondal *et al.* (2014).

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208 **Table 3.** Effect of spacing and varieties on number of pods, pod length (cm) and seed yield
 209 (q/ha) of field pea.
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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 ₁ V ₁	9.60	4.23	9.41
S ₁ V ₂	12.50	5.03	10.86
S ₁ V ₃	11.01	4.87	10.30
S ₂ V ₁	10.45	4.81	9.81
S ₂ V ₂	13.66	5.82	11.05
S ₂ V ₃	12.24	5.12	10.64
S ₃ V ₁	11.32	5.90	10.01
S ₃ V ₂	14.43	6.11	11.34
S ₃ V ₃	13.27	6.04	10.81
S.Ed(±)	0.11	0.18	0.03
C.D	0.22	0.39	0.05

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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 S₃V₂ (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. S₃V₂ (70,810) leads to better net returns.

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