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Research Paper

Effect of Variable Seed Rates on Crop Growth Rate (CGR) and Seed Yield of different Field Pea (*Pisum sativum* L.) Genotypes at New Alluvial Zone of West Bengal

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ABSTRACT

The field experiment was conducted at District Seed Farm, 'A-B' block, of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India, during two subsequent *rabi* (winter) seasons (November – March) of 2018-19 and 2019-20, to evaluate the growth rate and seed yield of field pea genotypes under varying seed rates at New Alluvial Zone of West Bengal. The experiment was laid out in a split plot design with two different seed rates (80 kg ha^{-1} & 100 kg ha^{-1}) and five different genotypes (HUDP 15, SKNP 04-09, IPF 16-13, VL 42, TRCP 8) as primary and subplot factors respectively. Based on pooled data of two-year investigations, higher seed rate treatment (seed rate 100 kg/ha) always recorded a superior growth rate compared to lower seed rate treatment (seed rate 80 kg/ha). Still, contradictorily, lower seed rate recorded higher seed yields. This implies optimum plant population is a crucial practice to obtaining higher seed yield. In the case of variable genotypes, the highest CGR has been observed in SKNP 04-09 genotype during the interval of 60-90 DAS, and the highest seed yield was recorded in the case of IPF 16-13 genotype. The combination of genotype IPF 16-13 and HUDP 15 along with a seed rate of 80 kg/ha are economically profitable options for better production in terms of quality and quantity for cultivation in the New Alluvial Zone of West Bengal.

HIGHLIGHTS

- Optimum seed rate of field pea is 80 kg/ha for higher yield in a new alluvial zone (NAZ).
- Seed rate >80 kg/ha did not assure higher CGR vis-à-vis yield of field pea.
- Genotypes, IPF 16-13 and HUDP 15 might be preferred as a suitable variety in NAZ, West Bengal.

Keywords: CGR, Yield, Field pea genotypes, New alluvial zones

Field pea (*Pisum sativum* L.) is an excellent season food legume and cultivated in *rabi* season in our country. The crop is considered a a rich source of protein (21-25%); hence it plays a vital role in human nutrition (Bhat *et al.*, 2013). Field pea is highly nutritive and contains digestible protein (7.2 g), carbohydrate (15.8 g), vitamin-C (9 mg), and phosphorus (139 mg) per 100 (g) an edible portion (Gopalkrishnan, 2007). Peas are widely grown for hay, pasturage, or silage production alone or mixed with cereals as relay and inter or mixed crop (McKenzie and Sponer, 1999). The crop is cultivated in a wide range of soil types, from light sandy loams to heavy clays, but it does not tolerate saline and waterlogged soil conditions (FAO, 2012). In the new alluvial zone of West Bengal, local

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farmers often apply seeds at varying rates which proved to affect the crop growth rate as well as the seed yield of field pea. In field pea production, plant population is a yield limiting factor that is mainly determined by seed rate. If a higher seed rate is given, the plant population will increase, and plants compete for water, nutrients, and sunlight, resulting in poor quality and yield. If less seed rate is used, the yield will be less due to fewer plants in unit area^{-1} (Attarde and Khuspe, 1989; Pramanick *et al*. 2018; Dey *et al.* 2021). Thus, identifying the optimum plant population as governed by seed rate is most necessary to harness the desired yield from the crop. According to previous research by Kibe and Kamithi (2007), Dahmardeh *et al.* (2010), and Dey *et al.* (2021a), seeding rate and cultivar are key factors influencing the production and quality of grain legumes. Based on previous research on a similar topic, our research aims to optimize seed rate and find superior field pea genotypes suitable for the new alluvial zone of West Bengal.

MATERIALS AND METHODS

The field experiment was conducted at District Seed Farm, 'A-B' block, (22°93' N latitude, 88°53' E longitude, and 9.75 m above mean sea level) of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India during two subsequent *rabi* (winter) seasons (November – March) of 2018-19 and 2019-20. The experiment was laid out in Split Plot Design which was replicated thrice. Two different seed rates S_1 (80 kg/ha) and S_2 (100 kg/ha) were taken as main plot factors, and five genotypes, namely HUDP 15 (F_1), SKNP 04-09 (F_2), IPF 16-13 (F_3), VL 42 (F_4), TRCP 8 (F_5) were taken in subplots. The climate of the new alluvial zone of West Bengal is sub-tropical, with high summer temperature, erratic rainfall, high humidity, and short-mild winter. The experiment was conducted on a medium land, well-drained Gangetic alluvial soil (order: Inceptisol), which belonged to the class of clayey loam with medium fertility having and almost neutral in reaction. Furrows were made 30 cm apart by using tools, and seeds were placed in the furrows and then covered with soil. Seeds were sown at 3-5 cm soil depth in 4 m × 3.6 m plots. Two hand-weeding were given 30 and 45 days after sowing (DAS), respectively. A uniform fertilizer dose of 20:40:40 kg ha^{-1} of N: P_2O_5: K_2O was applied to all the experimental units through urea, single super phosphate, and muriate of potash. To measure the variation of growth in different genotypes as affected by varying seed rates, crop growth rate (CGR) was measured in three intervals i.e., 0-30 DAS, 30-60 DAS, and 60-90 DAS. The seed yield of field pea genotypes significantly varied due to varying seed rates. The data obtained in the study were analyzed by the analysis of variance (ANOVA) suitable for split plot design, and the significance of different sources of variations was tested by 'F' test (Gomez and Gomez, 1984) for appropriate degrees of freedom.

RESULTS AND DISCUSSION

All the crop genotypes showed a progressive growth rate throughout its growing period from emergence to 90 DAS during both years (2018-19 and 2019-20). CGR was calculated by using the formula given by Watson in 1952, where an increase in aerial dry matter per unit is per unit time was formulated. From Table 1, it can be observed that higher seed rate treatment S_2 (seed rate 100 kg/ha) always recorded a superior growth rate compared to S_1 (seed rate 80 kg/ha) irrespective of the genotypes during the respective crop growing years. As per the two-year pooled values, S_2 treatment attained a higher growth rate (1.08, 18.85, 23.30 g m^{-2} day^{-1}) during the time interval of 0-30, 30-60, and 60-90 DAS. The crop growth rate was significant during all growth periods in both years. A similar result was found by Pramanick *et al.* (2014), Garai *et al.* (2019), and Ali *et al.* (2018), who found higher seed rate resulted in higher dry matter production per unit area in field pea, cultivated under relay cropping with Aman rice. Among the five genotypes treatments, the CGR of field pea ranged between 0.74 to 1.11 and 0.75 to 1.27 g m^{-2} day^{-1} at 0-30 DAS, 12.16 to 21.23 and 9.57 to 19.81 g m^{-2} day^{-1} at 30-60 DAS and 12.66 to 25.89 and 14.66 to 29.07 g m^{-2} day^{-1} at 60-90 DAS during 2018-19 and 2019-20 respectively. The CGR of field pea in five different genotypes significantly varied between all the stages of growth up to 90 DAS during the consecutive years of experimentation. The pooled over two years value revealed that the highest CGR value (1.18 g m^{-2} day^{-1}) was observed in V_5 (TRCP 8) treatment between 0-30 DAS. However, between 30-60 DAS and 60-90 DAS, the V_3 (IPF 16-13) and V2 (SKNP

Table 1: Crop growth rate (CGR) of field pea at different growth stages as influenced by seed rates and different genotypes during 2018-19 and 2019-20

Treatment	0 – 30 DAS			30 – 60 DAS			60 – 90 DAS		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
A. Seed rate (S)									
S_1	0.68	0.78	0.73	10.69	12.14	11.42	18.80	19.65	19.22
S_2	1.11	1.05	1.08	20.32	17.34	18.85	20.88	23.72	23.30
S.Em (±)	0.026	0.017	0.021	0.056	0.080	0.030	0.338	0.456	0.199
CD (p=0.05)	0.169	0.111	0.136	0.369	0.526	0.197	2.21	2.98	1.30
B. Genotypes (V)									
V_1	0.74	0.75	0.74	12.16	10.45	11.31	15.03	15.39	15.21
V_2	0.81	0.78	0.79	12.94	9.57	11.26	25.89	32.25	29.07
V_3	0.80	0.76	0.78	21.23	19.02	20.12	12.66	16.65	14.66
V_4	1.03	1.03	1.03	17.45	19.81	18.63	22.77	21.85	22.31
V_5	1.11	1.27	1.18	13.76	14.86	14.30	22.87	22.26	22.57
S.Em (±)	0.067	0.054	0.043	0.145	0.495	0.273	0.727	0.875	0.603
CD (p=0.05)	0.203	0.163	0.129	0.438	1.49	0.827	2.19	2.64	1.82

04-09) achieved the highest CGR (20.12 g m^{-2} day^{-1} and 29.07 g m^{-2} $day^{-1,}$ respectively) followed by V_4 (VL 42) (18.63 g m^{-2} day^{-1}) and V_5 (TRCP 8) (22.57 g $m^{-2}day^{-1}$) respectively (Table 1).

Seed yield of field pea significantly varied during 2018-19 but showed a non-significant effect in 2019-20 (Table 2). Seed rate 80 kg/ha showed a notable role in the upliftment of the seed yield, which led to a higher yield level in S_1 treatment (Seed rate 80 kg/ha) (1245.36 kg/ha) as compared to S_2 treatment (seed rate 100 kg/ha) during 2018-19. Pooled data of two-year investigations also exhibited a significantly superior seed yield level in S_1 treatment (1030.55 kg/ha) over S_2 (928.23 kg/ha). Similarly, Kumar *et al.* in 2006 observed that a seed rate of 100 kg/ha in the case of Chickpea significantly increased seed yield/ha (1012.3 kg/ha over 75 kg/ha (909.5 kg/ha) and a further increase in seed rate recorded lower seed yield (995.2 kg/ha) due to relatively inferior yield attributes with an increase in seed rate. However, the seed yield of field pea was significantly influenced by different genotypes. V_3 (IPF 16-13) (1626.15 kg/ha) and V_1 (HUDP 15) (1493.05 kg/ha) showed the highest yield during the subsequent growing seasons. Under pooled analysis V_1 (HUDP 15) (1249.99 kg/ha) showed the highest yield, followed by V_3 (IPF 16-13) (1160.30 kg/ha) which were statistically significant over the others. Significant differences for all the characters along with grain yield among the genotypes of field pea were observed at Hissar, India (Chetia and Yadav, 2002). Kumar *et al.* (2021) also found similar results.

Table 2: Seed yield of field pea as influenced by seed rates and different genotypes during 2018-19 and 2019-20

Treatment	Seed yield (kg/ha)		
	2018-19	2019-20	Pooled
(A) Seed rate (S)			
S_1	1245.36	815.74	1030.55
S_2	993.05	863.42	928.23
S.Em(±)	6.72	17.56	12.13
C.D. (P=0.05)	44.05	NS	79.51
(B) Genotypes (V)			
V_1	1006.93	1493.05	1249.99
V_2	1307.87	960.64	1134.25
V_3	1626.15	694.46	1160.30
V_4	1116.89	335.64	726.27
V_5	538.19	714.12	626.15
S.Em(±)	21.11	19.13	14.36
C.D. (P=0.05)	63.86	57.86	43.42

CONCLUSION

To meet the future demandfor nutrients for growing populations, the increasing area under field pea or maximizing yield $unit^{-1}$ area by adopting appropriate production technology with the use of optimum seed rate and proper management practices is the need of the hour. Based on the above observations found in the experiment, it can be concluded that field pea might be sown at 80 kg/ha for better seed yield. At the same time, genotypes like IPF 16-13 and HUDP 15 might be preferred as a suitable variety in the New Alluvial Zone of West Bengal.

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