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Effect of Meteorological Parameter on Growth and Yield of Different Varieties of Field Pea (*Pisum sativum* L.) in the Bundi District, Rajasthan, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

A field experiment was conducted in a farmer field of Bundi district, Rajasthan, Department of Environmental Science and Natural Resources Management College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj, during Rabi 2020-2021. The experiment used a factorial randomized block design with three different planting dates: D115 October, D2–5 November, and D3– 25 November, as well as three different varieties: V1-Annapurna, V2-Azad -111, and V3- SS- 10. The findings discovered The maximum germination percentage (78.51%) and lowest germination percentage (66.78%) of seeds per plot were found in plots D1 and V1 (15th October + Annapurna). The maximum number of branches (4.00) were found in D1 and V3 (15th October + SS-10), while the lowest number of branches were found in D3 and V1 (25th November + Annapurna) (2.33). D1 and V1 (15th November + Annapurna) reported the highest plant height of 26.00, 91.38, and 124.15cm at 30, 60, and 90 DAS, whereas D3 and V3

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(25th November + SS-10) recorded the minimum plant height of 19.00, 25.54, and 67.95cm at 30, 60, and 90 DAS. D3 and V3 (05th November + SS-10) had the highest blooming percentage (50.41), whereas D3 and V2 (25th November + Aazad-111) had the lowest flowering percentage (46.18). D1 and V3 (15th October + SS-10) had the highest seeds/pods (7.0), whereas D3 had the fewest (4.0).D2 and V3 (05th November + SS-10) had the highest grain yield (12.68), whereas D3 and V1 (25th November + Annapurna) had the lowest grain yield (11.01). Variety-1 plant height was shown to have a substantial positive relationship (Annapurna).

Keywords: Field pea; pods; seeds; grain yield; meteorological parameters and correlation.

1. INTRODUCTION

India is the greatest producer of pulses in the world, accounting for one-fourth of worldwide production. In a vegetarian diet, pulse crops offer a stable supply of protein. Pulses, in addition to their well-known role in restoring fertility and physical conditions, provide luscious and nutritious food for our cattle, giving them the title "Unique jewels of Indian crop husbandry." Pulses contribute 0.8 to 1.5 tonnes of organic matter to the soil in the form of roots left behind after harvesting, while a one-hectare crop adds 15 to 30 kg nitrogen in easily accessible form on average [1].

Peas (*Pisum sativum* L.) are one of the most important Rabi season pulse crops in Uttar Pradesh. With 1,805.01 tonnes produced, Uttar Pradesh produces the most peas in India. In numerous Indian states, peas are grown as a vegetable. The largest pea-growing states are Uttar Pradesh, Bihar, Haryana, Punjab, Himachal Pradesh, Orissa, and Karnataka. Vegetable peas are also growing popular in Uttarakhand, with farmers collecting three crops each year. Pulse production in 2012-2013 (April/May) is predicted to exceed 17.3 million tonnes. This will result in a total of 3744.84 tonnes of pea output.) (Source: FAO, 2012).

Pea farming is more common in areas with a pleasant and warm climate since relatively high or low temperatures are the most important parameters regulating pea growing. A dry atmosphere is also detrimental to the plant, particularly in terms of flowering and pod development. Dry periods have a huge impact on agriculture. Planting early and utilising seeds from early flowering and ripening cultivars can help Vild thrive [2].

The most essential criterion limiting pea production is high or low temperatures, and a nice and warm atmosphere is optimal. A dry atmosphere is also detrimental to the plant, particularly in terms of flowering and pod development. Planting early and utilising seeds from early flowering types can help Vild thrive [2].

Peas are sown in the northern plains during the rabi season, which spans from the beginning of October to the end of November, since the cool climate is ideal for pea production for four months. Peas grow best in temperatures ranging from chilly to warm. Seed germination is best when the temperature is approximately 22 degrees Celsius. However, it may sprout at temperatures as low as 5°C, albeit slowly. Peas grow best in temperatures ranging from 13 to 180 degrees Celsius. Peas are resistant to the cold in their early stages of growth, but their blooms and pods are damaged later. Seeded wrinkled varieties are the most popular.

2. MATERIALS AND METHODS

The Field experiment was conducted during 2020-21 at farmer field of Bundi district, Rajasthan under guidance Department of Environmental Science and Natural Resources Management College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj, during rabi. The field experiment was laid out in Factorial Randomized Block Design which consist three different sowing dates viz. D115th October, D2-5th November and D3- 25th November along with three varieties like V1- Annapurna, V2-Azad-111 and V3- SS-10. The Net Cultivated Area was 27x4=108 m^2, total cultivated Area was 196.24 $m^2$and Net Plot Size was 2m x 2m, respectively. A spacing of 45x10 cm was adopted by using 75-80 kg ha-1 seed ha^{-1}. A recommended dose of fertilizer (80:40:40 kg N, P, K ha-1) was applied uniformly to all the treatments.

The periodical observations on growth, micrometeorological parameters and yield contributing characters were recorded at regular interval of 14 days and at harvest. To assess the treatment effects and correlation amongst

weather parameters and plant characters of pea varieties under extended sowing times were worked out. Data of weather parameters growing period of pea trial during 2021.

3. RESULTS AND DISCUSSION

Table 1 showed that the interaction of date of sowing and varieties/ genotypes had shown a significant impact on different characters of vegetable pea.

3.1 Pre Harvest Observation

The interaction of date of sowing and varieties/genotypes had shown a significant impact on differentcharacters of vegetable pea. The interaction of date of sowing and varieties/genotypes had shown a significant impact on differentcharacters of vegetable pea. The interaction of date of sowing and varieties/The interaction of date of sowing and varieties/The interaction of date of sowing and varieties/characters of vegetable pea.

3.2 Germination Percentage

The interaction effect of sowing dates and varieties was found significant. The maximum germination percentage (78.51%) of seeds per plot was found in D1 and V1 (15th October + Annapurna) and the minimum germination percentage (66.78%) of seeds per plot was found in D3 and V3 (25th November + SS-10). Similarly, the effect of dates of sowing on percentage germination of seeds per plot was found significant. The maximum germination percentage of seeds per plot was recorded D1 V3 (78.33%) and the minimum was in D2V1 (72.33%) [3,4].

3.3 Plant Height (cm)

The interaction effect of sowing dates and varieties was found significant. The maximum plant height 124.15cm at 90 DAS were recorded in D1 and V1 (15th November + Annapurna) and the minimum plant height 67.95cm at 90 DAS were recorded in D3 and V3 (25th November + SS-10). At later stage the growth increase was may be due to the more suitable environment condition and availability of temperature, humidity, Sun-shine hours, Similar reports have been reported by Pani et al. [5] Peksen et al. [6], Ranalli et al. [7]

3.4 Number of Branches

The interaction effect of sowing dates and varieties was found significant the maximum number of branches (10.44) was recorded in D1 and V3 (15th October + SS-10) and the minimum number of branches (5.33) was found in D3 and V1 (25th November + Annapurna). At later stage the growth increase was may be due to the more suitable environment condition andavailable of temperature, humidity, sun-shine hours.

3.5 Day Taken Flowering (%)

The interaction effect sowing dates and varieties was found significant. The maximum flowering % (50.41) was found in D3 and V3 (05th November + SS-10) and the minimum flowering (%) (46.18) was found in D3 and V2 (25th November + Aazad-111).At later stage the growth may be due to the more suitable environment condition and availability of temperature, rainfall, humidity, sun-shine hours and GDD. Similar reports have reported by Baginsky, C.et al. [8], Mishra et al. [3].

3.6 Post-harvest Observation

3.6.1 Seeds (per pod)

The interaction effect of sowing dates and varieties was found significant. The maximum (8.55) seeds were found D1 and V3 (15th October + SS-10) and the minimum (5.0) was found in D3 and V1 (25th November + Annapurna).At later stage the growth may be due to the more suitable environment condition and availability of temperature, rainfall, humidity, sun-shine hours and GDD. Similar reports have reported by Ahmad et al. (2005), Wadan et al. [9], Khichi,P. et al. [10].

3.6.2 Test weight (gm)

The interaction effect of sowing dates and varieties was found significant. The maximum (100) seeds test weight (27.55) were found D1 and V3 (15th October + SS-10) and the minimum (100) seed test weight (24.27) was found in D3 and V2 (25th November + Aazad-111).At later stage the growth may be due to the more suitable environment condition and availability of temperature, rainfall, humidity, sun-shine hours and GDD. Similar reports have reported by Amjad et al. [11], Wadan et al. [9].

Table 1. Effect of different sowing date on pre-and post-harvest observation of different Varieties of Field Pea (*Pisum sativum* L.) at Bundi, Rajasthan

D/V	Germination percentage (%)				Plant height(cm)				Number of branches				Day Taken Flowering (%)			
	V1	V2	V3	Mean	V1	V2	V3	Mean	V1	V2	V3	Mean	V1	V2	V3	Mean
D1	78.51	74.84	74.95	76.10	91.38	82.55	75.15	83.02	10.67	10.22	10.44	10.44	50.75	47.63	50.48	49.62
D2	73.72	70.50	69.99	71.40	86.40	76.88	70.01	77.76	6.55	6.11	6.11	6.25	48.35	46.35	51.41	48.7
D3	76.02	71.17	66.78	71.32	86.91	74.98	67.95	76.61	5.33	5.99	6.11	5.81	47.28	46.18	50.78	48.08
Mean	76.08	72.17	70.57		88.23	78.14	71.03		7.51	7.44	7.55		48.79	46.72	50.89	
	F-Test	CD at 5%	SED (±)		F-Test	CD at 5%	SED (±)		F-Test	CD at 5%	SED (±)		F-Test	CD at 5%	SED (±)	
Date	S	0.966	0.452		S	1.507	0.705		NS	NA	1.231		S	0.727	0.34	
Variety	S	0.966	0.452		S	1.507	0.705		S	NA	1.231		S	0.727	0.34	
Interaction	NS	1.674	0.783		NS	N/A	1.22		NS	NA	2.23		S	1.259	0.589	
D/V	**Seeds (per pod)**				**Test weight (gm)**				**Grain yield (qh-1)**				**Straw Yield (qh^{-1})**			
	V1	V2	V3	Mean	V1	V2	V3	Mean	V1	V2	V3	Mean	V1	V2	V3	Mean
D1	6.11	8.00	8.55	7.55	27.03	25.35	27.55	26.64	14.34	14.44	15.58	14.79	18.06	16.48	19.90	18.15
D2	5.89	6.44	5.55	5.96	26.64	25.78	26.63	26.35	15.11	15.78	16.11	15.67	16.65	18.08	19.98	18.23
D3	5.00	5.22	6.77	5.66	25.3	24.27	26.35	25.44	3.11	3.56	4.22	3.63	15.18	15.18	16.57	15.64
Mean	5.66	6.55	6.96		26.32	25.27	26.84		10.85	11.26	11.97		16.63	16.58	18.81	
	F-Test	CD at 5%	SED (±)		F-Test	CD at 5%	SED (±)		F-Test	CD at 5%	SED (±)		F-Test	CD at 5%	SED (±)	
Date	S	NA	1.712		S	0.955	0.446		S	0.673	0.144		S	0.583	0.273	
Variety	S	NA	1.712		S	0.955	0.446		S	0.673	0.144		S	0.583	0.273	
Interaction	NS	NA	2.965		NS	NA	0.773		NS	0.952	0.204		NS	1.009	0.472	

3.6.3 Grain yield (qh^{-1})

The interaction effect of sowing dates and varieties was found significant. The maximum Grain yield (16.11) were found D2 and V3 (05th November + SS-10) and the minimum Grain yield (3.11) was found in D3 and V1 (25th November + Annapurna).

At later stage the growth may be due to the more suitable environment condition and availability of temperature, rainfall, humidity, sun-shine hours and GDD. Similar reports have reported by Baginsky, C. et al. [8], Wadan et al. [9].

3.6.4 Straw Yield (qh^{-1})

The interaction effect of sowing dates and varieties was found significant. The maximum Straw Yield (19.98) were found D2 and V3 (05th November + SS-10) and the minimum Straw Yield (15.18) was found in D3 and V1 (25th November +Annapurna) [12].

3.6.5 Correlation matrix between growth attributes and climatic factors for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10

Correlation coefficients were worked out between plant height and various maximum temperature, minimum temperature, humidity morning, humidity, evening, sunshine hours and rainfall. The values calculated are presented in Table 2.

The results of correlation coefficients revealed that plant height was significantly and positively and negative correlated with maximum temperature (r = 0.707*,-0.730*and -0.725*), minimum temperature (r = 0.797*, -0.779* and0.721*), humidity morning (r = 0.583, -0.581 and -0.762*), humidity evening (r = 0.711*, -0.722* and -0.592), sunshine hours (r = 0.795*,-0.804** and-0.718*) and rainfall (r=0.695*, -0.335 and-0.290) was obtained for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10, respectively.

The results of correlation coefficients revealed that maximum temperature was significantly and positively and negative correlated with plant height (r = 0.707*,-0.730* and-0.725*), minimum temperature (r = 0.982**, 0.982** and0.982**), humidity morning (r = 0.959**,0.997** and0.959**), humidity evening (r = 0.997**, 0.977** and 0.997**), sunshine hours (r = 0.670*,0.670* and0.670*) and rainfall (r = 0.260, 0.260 and-0.260) was obtained for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10, respectively.

The results of correlation coefficients revealed that minimum temperature was significantly and positively and negative correlated with plant height (r = 0.797*,-0.779* and -0.762*), maximum temperature (r = 0.982**, 0.982** and 0.982**), humidity morning (r = 0.906**, 0.906**and0.906**), humidity evening (r = 0.977**, 0.977** and0.977**), sunshine hours (r = 0.753*, 0.753* and0.753*) and rainfall (r= 0.402, 0.402 and0.402) was obtained for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10, respectively.

The results of correlation coefficients revealed that humidity morning was significantly and positively and negative correlated with plant height (r = 0.583, 0.980**and-0.592), maximum temperature (r = 0.959**, 0.959**and 0.959**), minimum temperature (r = 0.906**, 0.906** and 0.906**), humidity evening (r = 0.950**, 0.950**and0.950**), sunshine hours (r = 0.455, 0.455and 0.455) and rainfall (r= 0.198, 0.198 and 0.198) was obtained for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10, respectively.

The results of correlation coefficients revealed that humidity, evening was significantly and positively and negative correlated with plant height (r = 0.711*, 0.997**and-0.718*), maximum temperature (r = 0.997**,0.972**and 0.997**), minimum temperature (r = 0.977**, 0.950**and 0.977**), humidity morning, (r = 0.950**, 0.692*and 0.950**), sunshine hours (r = 0.692*, 0.246 and= 0.692*) and rainfall (r= 0.246, 0.753* and0.692*) was obtained for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10, respectively.

The results of correlation coefficients revealed that sunshine hours were significantly and positively and negative correlated with plant height (r = 0.795*, 0.670*and -0.758*), maximum temperature (r = 0.670*, 0.753* and0.670*), minimum temperature (r = 0.753*, 0.455and0.753*), humidity morning, (r = 0.455, 0.692*and 0.455), humidity evening (r = 0.692*, 0.465 and0.692*) and rainfall (r= 0.465, 0.695*and 0.465) was obtained for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10, respectively.

The results of correlation coefficients revealed that rainfall was significantly and positively and negative correlated with plant height (r = 0.695*,

Table 2. Correlation matrix between growth attributes and climatic factors for varieties

Variety		Plant height	T max	T min	RH max (%)	RH min (%)	BSS (hrs)	Rain (mm)
1 Annapurna	Plant height	1	0.707*	0.797*	0.583	0.711*	0.795*	0.695*
	T max	0.707*	1	0.982**	0.959**	0.997**	0.670*	0.260
	T min	0.797*	0.982**	1	0.906**	0.977**	0.753*	0.402
	RH max (%)	0.583	0.959**	0.906**	1	0.950**	0.455	0.198
	RH min (%)	0.711*	0.997**	0.977**	0.950**	1	0.692*	0.246
	BSS (hrs)	0.795*	0.670*	0.753*	0.455	0.692*	1	0.465
	Rain(mm)	0.695*	0.260	0.402	0.198	0.246	0.465	1
2-Azad-111	Plant height	1	-0.730*	0.779*	-0.581	-0.722*	-0.804**	-0.335
	T max	0.730*	1	0.982**	0.959**	0.997**	0.670*	0.260
	T min	0.779*	0.982**	1	0.906**	0.977**	0.753*	0.402
	RH max (%)	0.581	0.959**	0.906**	1	0.950**	0.455	0.198
	RH min (%)	0.722*	0.997**	0.977**	0.950**	1	0.692*	0.246
	BSS (hrs)	0.804**	0.670*	0.753*	0.455	0.692*	1	0.465
	Rain(mm)	0.335	0.260	0.402	0.198	0.246	0.465	1
3 SS-10	Plant height	1	-0.725*	-0.762*	-0.592	-0.718*	-0.758*	-0.290
	T max	-0.725*	1	0.982**	0.959**	0.997**	0.670*	0.260
	T min	-0.762*	0.982**	1	0.906**	0.977**	0.753*	0.402
	RH max (%)	-0.592	0.959**	0.906**	1	0.950**	0.455	0.198
	RH min (%)	-0.718*	0.997**	0.977**	0.950**	1	0.692*	0.246
	BSS (hrs)	-0.758*	0.670*	0.753*	0.455	0.692*	1	0.465
	Rain(mm)	-0.290	0.260	0.402	0.198	0.246	0.465	1

0.260 and-0.290), maximum temperature (r = 0.260, 0.402and 0.260), minimum temperature (r = 0.402, 0.198and 0.402), humidity morning (r = 0.198, 0.246 and0.198), humidity evening (r = 0.246, 0.465and 0.246) and sunshine hours (r= 0.465, 0.453 and 0.465) was obtained for varieties-1 Annapurna. 2-Azad-111 and 3 SS-10, respectively.

4. CONCLUSION

The findings of the experiment demonstrate a considerable impact on sowing dates and variety germination. The SS-10 variety produced the highest grain yield of 15.60 q/ha. Under agro-climatic conditions for plant height and yield, Annapurna can be sown by early November.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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