Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(6): 935-938
Received: 12-09-2020
Accepted: 15-10-2020

Harsukhmaan Singh
PG Department of Agriculture
GSSDGS Khalsa College,
Patiala, Punjab, India

Mohinder Lal
PG, Department of Agriculture,
GSSDGS Khalsa College,
Patiala, Punjab, India

Sandeep Singh
PG, Department of Agriculture
GSSDGS Khalsa College,
Patiala, Punjab, India

Talwinder Singh
PG, Department of Agriculture,
GSSDGS Khalsa College,
Patiala, Punjab, India

Corresponding Author:
Harsukhmaan Singh
PG Department of Agriculture
GSSDGS Khalsa College,
Patiala, Punjab, India

Response of sowing time and fertilization on the growth parameters and yield of field pea (*Pisum sativum* L.) under irrigated conditions of Punjab

Harsukhmaan Singh, Mohinder Lal, Sandeep Singh and Talwinder Singh

DOI: https://doi.org/10.22271/phyto.2020.v9.i6n.13066

Abstract
A field experiment was conducted during Rabi season 2017- 18 at the Campus for Research and Advanced Studies Dhablan of G.S.S.D.GS. Khalsa college Patiala with twelve treatment combinations of three sowing time D_1 (2nd fortnight of October), D_2 (1st fortnight of November), D_3 (2nd fortnight of November) in main plots and fertilization levels F_1 (25 kg ha^{-1} P_2O_5), F_2 (45 kg ha^{-1} P_2O_5), F_3 (25 kg ha^{-1} P_2O_5 + Rhizobium inoculation) & F_4 (45 kg ha^{-1} P_2O_5 + Rhizobium inoculation) in sub plots were tested in split plot design with three replications. Plant growth parameters like emergence count (m^{-2}), plant height (cm), number of branches plant^{-1}, number of leaves plant^{-1}, dry weight (g) plant^{-1} and yield were recorded significantly superior with crop sown on D_2 (1st fortnight of November) with F_4 (45 kg ha^{-1} P_2O_5 + Rhizobium inoculation). D_2 (1st fortnight of November) sown crop with F_4 (45 kg ha^{-1} P_2O_5 + Rhizobium inoculation) produced significantly higher grain yield (q ha^{-1}) and straw yield (q ha^{-1}) as compared to others treatments.

Keywords: Sowing time, phosphorus, rhizobium inoculation

Introduction
Field Pea (*Pisum sativum* L.) is one of the most important pulse crops. Pea is usually a leguminous vegetable crop cultivated throughout the world. The major pea leading countries are Russia, China, Canada, Europe, U.S and India. In India, field pea is cultivated in an area of 0.7 million hectares with the production of 0.6 million tonnes. Main pea cultivation states in India are Rajasthan, Uttar Pradesh, Orissa, Haryana, Bihar, Maharashtra, Madhya Pradesh and Punjab. In Punjab field pea is cultivated in 2.2 thousand hectares area during 2014-15 with production of 2.56 thousand tonnes. The average yield of field pea was 11.62 q ha^{-1} (Anonymous, 2016) [2].

In India and other countries pea is consumed in a different ways, such as food source like vegetable or soup or canned, frozen or dehydrated and pea straw is a nutritious fodder (Aykroyd, 1963) [3]. It is widely grown as a cool season vegetable crop. The suitable temperature for proper germination of seeds 22 °C. At the same time, it can germinate up to 5 °C but germinate at slow rate. For pea cultivation optimum temperature is 15- 30 °C. It can tolerate frost condition at initial stage of growth but at later stage, the flower, pods are affected and problem of wilt and stem fly complex created, which result in loss in yield. So optimum temperature should be important for better yield and variation in temperature is slow from low to high. Time of sowing plays an essential role in increasing the pea yield. Sowing at optimum time allows sufficient growth and development of a crop to obtain a satisfactory yield because high temperature is one of the major environmental stresses that affect plant growth and development (Boyer, 1982) [5]. Phosphorus is one of the chief nutrients for plant growth and development. Phosphorus helps in protein synthesis in plants as it is a component of the complex nucleic acid structure. Phosphorus is one of the chief nutrients for plant growth and development. Seed inoculation is the most widely used methods of inoculants application. Rhizobium culture is undoubtedly the best known and popular bio-fertilizer used in leguminous crop like pea. Rhizobium inoculation helps in increasing the yield of field pea. Pea properly inoculated with the appropriate strain of Rhizobium bacteria is able to fix a large amount of its nitrogen requirement from air in the soil. Field peas can be met their nitrogen needs between 30-80% through biological fixation (Ali-Khan and Zimmer, 1989) [1].

Material and Methods

The experiment was carried out at Campus for Research and Advanced Studies, Dhablan of PG Dept. of Agriculture G.S.S.D.G.S. Khalsa College, Patiala Punjab at about 30° 19′ North Latitude and 76° 24′ East Longitude at an altitude of about 250 m above the mean sea level. The soil of the experiment site had a clay texture with pH = 7.3, organic carbon (0.56%), available nitrogen (262 kg ha^{-1}), available phosphorus (22.6 kg ha^{-1}) and available potassium (129 kg ha^{-1}). The experiment was carried out as a split plot three replications. The treatments included three sowing time (2nd fortnight of October, 1st fortnight and 2nd fortnight of November) in the main plots and four phosphorus levels *viz*; 25 kg ha^{-1}, 45 kg ha^{-1} and with and without Rhizobium inoculation in the sub plots. Land preparing operations included the land irrigation before plowing, plowing the land to the depth of 30 cm, disking to the depth of 15 cm and trowel. Each replication included 12 plots and the whole plan included 36 experimental units. Nitrogen 30 kg ha^{-1} and potassium 10 kg ha^{-1} was applied at time of sowing. Nitrogen was applied in the form of urea, phosphorus was applied in the form of single super phosphate (as per treatment) and potassium was applied in form of murate of potash. The seed was drilled with the help of plough keeping distance of 30 cm between the rows. The seed rate of crop was 75 kg ha^{-1}.The seeds were covered with soil thoroughly to avoid the damages from birds etc. The crop harvesting was done when all plants have tan pods at the bottom and yellow to tan pods in the middle, the grains became hard and dry. For recording biometric observations at regular interval of 30 days i.e. 30, 60, 90 and 120 DAS and five plants in the net plot area were randomly selected and tagged. However, for dry matter accumulation, five plants were randomly selected from the sample rows (border plot area) at regular interval. Yield was studied after harvesting of the crop. The observation recorded during the course of investigation were tabulated and analyzed statistically to draw a valid conclusion. The data analyzed as per the standard procedure for analysis of variance (ANOVA) as described by Gomez and Gomez, 1984. The significance of the treatment was test by F test. The standard error of the treatment was calculated in all cases. The differences in the treatment mean were tested by using Critical difference (CD) at 5% level of probability.

Result and Discussion

Emergence count (m^{-2})

The data on the effect of various treatments on emergence count of field pea crop have been presented in table 1, revealed that a significantly higher emergence count (12.08 m^2) was recorded when crop was sown on D_2 (1st fortnight of November) significantly superior than crop sown on D_1 (2nd fortnight of October) and D_3 (2nd fortnight of November). Lowest of emergence count of D_3 (2nd fortnight of November) sown crop might be due to delaying the sowing date decreased the emergence rate and increased the time from germination to initial and final emergence. Similar findings were obtained by (Chaudhary and Ghildyal, 1970) [7]. There was non-significant effect of phosphorus levels and Rhizobium inoculation on emergence count.

Table 1: Response of sowing time, and fertilization on emergence count (m^{-2})

Treatment	Emergence count (m^2)
Date of sowing	
D_1	10.79
D_2	12.08
D_3	9.29
SEm+	0.36
CD 5%	1.01
Fertilization	
P_1	10.33
P_2	10.94
P_3	10.72
P_4	10.89
SEm+	0.25
CD 5%	NS

Growth attributes

The data given in table no. 2 that sowing time and fertilization levels had significant effect on all growth parameters like plant height (cm), no. of leaves $plant^{-1}$, no. of branches $plant^{-1}$ and dry weight (g) $plant^{-1}$. Significantly higher plant height (cm), no. of leaves $plant^{-1}$, no. of branches $plant^{-1}$ and dry weight (g) $plant^{-1}$ was found with crop sown on D_2 (1st fortnight of November) then other lower treatment D1 (2nd fortnight of October) & D_3 2nd fortnight of November). This is due to the fact that favorable temperature and longer time available for the growth and development under earlier sowing could have promoted the growth of the plants and development of the new leaves as against too late sowing crop. Crop obtained maximum length of growing period, favorable temperature and other climatological parameters for the growth characters which helps in promoting better cell division and cell elongation. Similar results were reported by Bozoglu *et al.*, (2007) [6] and Singh and Singh (2011) [14, 15, 17]. Similarly fertilization level had significant effect on all growth parameters like plant height (cm), no. of leaves $plant^{-1}$, no. of branches $plant^{-1}$ and dry weight (g) $plant^{-1}$. Significantly higher plant height (cm), no. of leaves $plant^{-1}$, no. of branches $plant^{-1}$ and dry weight (g) $plant^{-1}$ was found with F_4 (45 kg P_2O_5 ha^{-1} with inoculation of Rhizobium) then rest of treatments F_1, F_2 & F_3 (25 kg ha^{-1} P_2O_5, 45 kg ha^{-1} and without Rhizobium inoculation). This is might be due to Inoculation of seeds with symbiotic nitrogen fixers might have increased the concentration of an efficient and healthy strain of Rhizobium in rhizosphere, which in turn resulted in greater fixation of atmospheric nitrogen in soil and consequently for use by the plants resulting in higher plant height, number of branches $plant^{-1}$and root development of plant. Similar results were also observed by Tyagi *et al.*, (2003) [17], Biswas and Patra (2007) [4], Kumar (2011) [10] and Jakobsen (1985) [9]. Rhizobium increase the nodulation, nitrogen fixation and synthesis of growth substances might have increase vegetative

growth like plant height, number of leaves and branches and by increasing these characters dry matter accumulation also increased. Similar results were also reported by Prasad and Prasad (1993) [12].

Table 2: Response of sowing time and fertilization on the growth parameters of field pea (*Pisum sativum* L.)

Treatment	Plant height (cm)				No. of leaves per plant				No. of branches per plant				Dry weight per plant (g)			
Time of sowing	60 DAS	90 DAS	120 DAS	At harvest	60 DAS	90 DAS	120 DAS	At harvest	60 DAS	90 DAS	120 DAS	At harvest	60 DAS	90 DAS	120 DAS	At harvest
D1	42.99	66.73	71.92	72.56	57.04	105.85	107.43	106.3	16.35	17.87	18.51	18.28	2.46	4.89	5.2	5.8
D2	47.37	72.4	77.57	78.15	59.79	109.82	111.73	110.65	17.55	19.39	20.06	19.86	2.97	6	6.24	6.78
D3	38.47	56.79	64.8	65.55	54.38	99.8	101.97	100.67	14.21	15.83	17.16	16.88	1.6	3.56	4.38	4.71
SE	1.16	1.3	1.35	1.39	0.96	0.99	1.15	1.26	0.33	0.22	0.34	0.35	0.14	0.18	0.07	0.26
CD	3.21	3.62	3.76	3.87	2.65	2.74	3.19	3.5	0.92	0.62	0.94	0.96	0.39	0.49	0.18	0.73
F1	38.52	58.26	64.92	65.14	52.99	101.11	102.67	101	14.92	16.14	17.26	16.94	1.94	4.14	4.67	4.93
F2	43.22	66.12	72.46	73.23	57.33	105.38	107.49	106.16	16.11	17.7	18.81	18.58	2.4	4.91	5.38	5.88
F3	42.77	65.88	71.68	72.2	56.81	104.2	106.53	105.53	15.88	17.54	18.32	18.12	2.24	4.69	5.22	5.6
F4	47.26	71.21	76.66	77.77	61.14	109.93	111.49	110.47	17.23	19.39	19.91	19.71	2.78	5.52	5.83	6.64
SE	1.29	0.99	1.43	1.33	1	1.11	1.27	1.34	0.29	0.49	0.34	0.35	0.09	0.16	0.15	0.22
CD	3.72	2.86	4.14	3.84	2.87	3.21	3.67	3.88	0.85	1.42	0.97	1.02	0.27	0.47	0.42	0.64

Grain yield (q ha^{-1}) and straw yield (q ha^{-1})

A perusal of data given in table… shows that significantly higher grain and straw yield was recorded when crop sown on D_2 (1st fortnight of November as) compared to crop sown on D_1 (2nd fortnight of October) and D_3 (2nd fortnight of November). Lowest grain and straw yield was recorded when sowing was done on D_3 (2nd fortnight of November). D_2 (1st fortnight of November) sown crop produce superior grain yield and straw yield due to favourable effect of earlier sowings on growth and development of pea plants encouraged higher growth and yield attributes which ultimately resulted in higher grain and straw yield. These findings are corroborated with those reported by Shaukat *et al.*, (2012) [13], Tiwari *et al.*, (2014) [16] and Singh *et al.*, (1991) [14, 15, 17].

Fertilization has significant effect on grain and straw yield. Maximum grain and straw yield was produced with application of F_4 (phosphorus @ 45 kg ha^{-1} along with Rhizobium inoculation) and minimum grain and straw yield was recorded with F_1 (application of phosphorus @ 25 kg ha^{-1} with no application of Rhizobium inoculation). Increased grain and straw yield with phosphorus application may be attributed to favourable effects of phosphorus on dry matter production of field pea through its favourable effect on various parameters such as plant height, number of leaves, number of branches, pods plants^{-1}. Inoculation of Rhizobium as bio-fertilizer was very significant in production of number of nodules, root/shoot weight and vigorous growth of plant which are related to straw yield. The result was in agreement with the findings of Nadeem *et al.*, (2003) [11] and Uniyal and Mishra (2009) [18].

Table 3: Response of sowing time and fertilization on yield attributes of field pea

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
Date of sowing		
D_1	18.36	21.01
D_2	22.88	24.26
D_3	14.74	17.01
SEm+	0.49	0.23
CD 5 %	1.37	0.63
Fertilization		
F_1	16.72	19.01
F_2	19.02	21.21
F_3	18.22	20.47
F_4	20.68	22.34
SEm+	0.33	0.38
CD 5 %	0.95	1.10

Conclusion

In conclusion, significantly higher growth attributes was observed with respect to plant height (cm), number of leaves plant^{-1}, number of branches plant^{-1}, dry weight (g plant^{-1}) by crop sown on D_1 (2nd fortnight of October) with F_4 (45 kg ha^{-1} P_2O_5 + Rhizobium inoculation). Grain yield and Stover yield harvest index was significantly higher with when crop sown on D_1 (2nd fortnight of October) with F_4 (45 kg ha^{-1} P_2O_5 + Rhizobium inoculation).

Reference

1. Ali-Khan ST, Zimmer RC. Production of field peas in Canada Agric Canada Pub 1710/E. Communications Branch, Agriculture, Ottawa, Canada 1989, P21.
2. Anonymous. Area and production of pulse crop by Package and practices for crops of Punjab in Rabi season 2016, P30-35.
3. Aykroyd WR. Indian Council of Medical Research, New Delhi, Special Rept, Ser No 42 1963.
4. Biswas A, Patra AP. Study on the effect of phosphorus, Vesicular Arbuscular Mychorryzae (VAM) and Phosphate Solubilizing Bacteria (PSB) on the performance of summer green gram. (In) National Symposium on Legumes for Ecological Sustainability: Emerging Challenges and Opportunities. Indian Institute of Pulses research Kanpur 2007.
5. Boyer JS. Plant productivity and environmental, Science 1982;218:443-448.

6. Bozoglu H, Peksen E, Peksen A, Gulumser A. Determination of the yield performance and harvesting periods of fifteen pea (*Pisum sativum* L.) cultivars sown in autumn and spring. Pakistan Journal Botany 2007;39(6):2017-2025.
7. Chaudhary TH, Ghildyal BP. Effect of temperature associated with levels of bulk density on rice seedling emergence. Plant and Soil 1970;33:87-91.
8. Gomez KA, Gomez AA. Statistical procedures for agricultural research. John wiley and sons, New York 1984, P680.
9. Jakobsen I. The rate of phosphorus in nitrogen fixation by young plant (*Pisum sativum* L.) Physiological Plantarum 1985;64(2):190-196.
10. Kumar J. Effect of phosphorus and Rhizobium inoculation on the growth, nodulation and yield of garden pea. Indian Journal of Legume Resistance 2011;34(1): 20-25.
11. Nadeem A, Muhammad A, Anjum MA. Growth and yield response of pea (*Pisum sativum* L.) crop to phosphorus and potassium application. Pakistan Journal of Agricultural Sciences 2003;40(4):217-222.
12. Prasad RN, Prasad A. Effect of Rhizobium inoculation, phosphorus and gibberellic acid on growth and nodulation of pea. Haryana Journal of Horticultural Science 1993;22(3):244-246.
13. Shaukat SA, Ahmad Z, Choudry YA, Shaukat SK. Effect of different sowing dates and row spacing on the growth, seed yield and quality of off- season pea (*Pisum sativum* L.) under temperate conditions of Rawalakot Azad Jammu and Kashmir. Scientific Journal of Agricultural Research 2012;1(5):117- 125.
14. Singh R, Singh PM. Effect of sowing dates and varieties on yield and quality of garden pea. Vegetable Science 2011;38(2):184-187.
15. Singh RC, Singh M, Faroda AS. Response of tall and dwarf pea genotypes to sowing dates and row spacing's. Haryana Agriculture University Journal Research 1991;21:64-68.
16. Tiwari R, Bhatt L, Dev R. Effect of date of sowing on growth and yield of vegetable pea genotypes under rain-fed mid-hill conditions of Uttarakhand. Indian Journal of Horticulture 2014;71(2):288-291.
17. Tyagi MK, Singh CP, Bhattacharya P, Sharma NL. Dual inoculation effect of Rhizobium and phosphate solublizing bacteria (PSB) on pea (*Pisum sativum* L.). Indian Journal of Agricultural Research 2003;37(1): 1-8.
18. Uniyal SP, Mishra AC. Effect of different levels of nitrogen and phosphorus on performance of vegetable pea in rain fed hills. Pantnagar Journal of Natural Resources 2009;7(2):184-186.