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Effects of phosphorus levels and varieties on growth and yield of peas (*Pisum sativum* L.)

Bhuneshwar Singh, Dr. RS Sidar, Kamal Kant and Cheteshawar Kumar Sahu

Abstract
An experiment conducted at Research Chums Instructional Farm, Rajmohani Devi College of Agricultural and Research Station Ambikapur Surguja (C.G.) during *Rabi* season of 2020-21. The treatment consisting of two factors first factor *viz.* V_1 (IPFD-1011) and V_2 (IPFD-1202) as second factor *viz.* P_1 (0 kg ha^{-1}), P_2 (30 kg ha^{-1}) and P_3 (60 kg ha^{-1}) were laid out in factorial randomized blocks design (FRBD) with four replications. The result revealed that the maximum plant population and growth characters *viz.*, plant height (cm), total number of branches, dry matters accumulation g $plant^{-1}$ and crops growth rate (g $plant^{-1}$ day^{-1}), were recorded on IPFD-1202 and minimum values was recorded with IPFD-1011. The yields attributing characters *viz.*, number of pods plant-1, number seed pod^{-1} and 100 seed weight (g) were also recorded higher under variety of IPFD-1202 closely followed by IPFD-1011. The variety of field pea i.e. IPFD-1202 was gave significantly highest biological, grain and straw yield, harvest index and B:C ratio as compared to IPFD-1011. Among the Phosphorus levels 60 kg ha^{-1} P_2O_5 was found superior in case all growth and yield parameters which was followed by 30 and 0 kg ha^{-1} P_2O_5. Interaction effect was found significant in respect to biological, grain, yield, gross returns, nets returns and B:C ratio. Variety IPFD-1202 sown under 60 kg ha^{-1} P_2O_5 gave significantly higher values.

Keywords: Varieties and phosphorus levels (P_2O_5), on field pea

Introduction
Field Peas (*Pisum sativum* L.) is one of the most important pulse crop of India, grown in winter season. It is highly nutritive, containing high percentages of digestible protein, carbohydrate, vitamins and very rich in minerals. Its fresh pod contains 19.8 per cent carbohydrate, 7.2 per cent protein, and 0.8 per cent mineral matter, while dried peas grain contains, 56.6 per cent carbohydrate, 19.7 per cent protein, and 4.4 per cent iron, besides being a rich sources of vitamins A, BD and C. In India average field pea production was recorded 21.99 lakh tones and area of 10.59 lakh ha, with an averages productivity of 993 kg ha^{-1} (Anonymous, 2020-21). Total field pea production in Chhattisgarh 0.044 lakh tones with area 0.119 lakh ha and average productivity is 375 kg ha^{-1} which is, far below to national productivity 993 kg ha^{-1}. Maximum field pea producing district is Dhamtari (530 tons) followed by Balrampur (420 tones) and Surguja (400 tones), (Anonymous, 2020-21).
The selection of suitable variety and nutrient management are the play vital role to optimum production among the various agronomical factors, the optimum plant nutrient, managements mainly ad equates Phosphorus fertilization (Kanaujia *et al.*, 1997) [5]. Phosphorus not sonly enhances, the roots growth buts also promotes early plant maturity (Mullins *et al.*, 1996) [7]. Phosphorus is often referred as the quality element for crops production due to its positive interactions with others nutrients (especially with nitrogen), (Usherwood, 1985) [17]. It promotes synthesis of photo-synthates and strand sport to fruits and grains and enhances their conversion into protein, starch, vitamins, etc. (Mengel, and Kirkby, 1997) [6].

Materials and Methods
The present experiments was conducted during *Rabi* seasons 2020-21 at Research -cum-Instructional Farms of Raj Mohini Devi College of agriculture and Research Stations Ambikapur (Surguja) Chhattisgarh. The climates of Surguja regions is of sub-humid with hot and dry summer, and cold winters. The treatment consisting of two varieties as first factor *viz.* V_1 (IPFD-1011) and V_2 (IPFD-1202) with three Phosphorous level as second factor *viz.* P_1 (0 kg ha^{-1}), P_2 (30 kg ha^{-1}) and pP_3 (60 kg ha^{-1}) the experimental deign was laid outs in factorial randomized blocks design with four replications.

Results and Discussion

Growth parameters

The data pertaining to varietals performances with Phosphorus on growth parameters are 'presented in table 1. Maximum plant height, number of branches, dry smatter accumulation/plant^{-1}, crop growths rate (g plant^{-1} day^{-1}) was recorded with variety IPFD-1202 (14.4, 43.6 and 55.1cm) as compared to variety IPFD-1011. It might be due to the varietal differences due to genetics characters. These findings were supported with the findings of Singh *et al.* (1997) [12] and Tripathi *et al.* (2020) [16]. Among different Phosphorus levels, 60 kg ha^{-1} Phosphorous application produce significantly tallest plant height, number of branches, dry smatter accumulation (g plant^{-1}) and crops growth rate (g plant^{-1} day^{-1}). On other hand lowest growth parameters recorded with control plot or o kg ha^{-1} Phosphorous application. Phosphorus is important in root developments and translocation of photosynthatesd and being constituent of nuclicsacid, phyton and phospholipids its application increases different growths parameters, (Srivastava and Ahlawat 1995) [15]. Plant in this experiment also reacted positively to higher level of Phosphorus these finding are close conformity of Singh *et al.* (1981) [11]. Almost similar result was founds by Singh *et al.* (2017) [13]. Their interaction, effects was found to be non-significant.

Yields parameters and yields

The data regarding on yields attributes are significantly influenced by variety and Phosphorus level. The maximum values for no. of pods plant^{-1}, no. of seeds pod^{-1} and 100 seed weight, highest biological yield, grain yield, Stover yield and harvests index were found with IPFD-1202 followed by IPFD-1011. Among the Phosphorus levels no. of pods plant^{-1}, no. of seeds pod^{-1} and 100 seed weight, seed yields and harvest index significantly affected by various level of Phosphorous. However, in case of Phosphorus level, the biological, grain and Stover yield increased successively with increase in doses of Phosphorus, the higher biological, grain, Stover yield and harvest index were, found under 60 kg ha^{-1} of Phosphorous level (values 59.8, 16.4, 43.4 q ha^{-1} and 27.9%) followed by 30 and 0 kg ha^{-1} P_2O_5. Lower yields was obtained under without application of Phosphorous their values were biological, grain, Stover yield and harvest index 43.1, 10.7, 32.4 q ha^{-1} and 24.1%, respectively. Same trends of results were also reported by Gupta *et al.*, (1994) [4] and Shukla *et al.*, (2006) [10]. The trend of increases din grains yield obtained due to these treatments was exactly in accordance with the similar increases in the yield components. These results, are in the line with those of Singh, *et al.* (2013) [14], Shukla, *et al.* (2013) [9], Saket, *et al.* (2014) [8] and Singh *et al.* (2017) [13].

Economics

The data pertaining to cost of cultivation, gross/returns, net/returns and B:C ratio shave been presented in Table 3. The result of the present study showed that gross return (₹ 75563), net return (₹ 53156), and B:C (2.37) ratio were markedly higher in variety IPFD-1202 and lower values (₹ 66443, ₹ 44036 and B:C 1.97) were recorded in IPFD-1011 at same cost of cultivation (₹ 22407). Among different phosphorus levels, 60 kg ha^{-1} of Phosphorus dose gave highest gross returns (₹ 85054) and net returns (₹ 59872) which resulted in highest benefit-cost ratio (2.38), followed by under 30 kg ha^{-1} (P_2O_5). Whereas, control (0 kg P_2O_5) gave lowest net returns (₹ 33749) and benefit-cost ratio (1.51) under lowest cost of cultivation (₹ 22407). This might be due to higher growths and yields attributes resulting in more seed and Stover yield with 60 kg ha^{-1} P_2O_5. Similar reported by Bhat *et al.*, (2013) [3].

Conclusion

It is concluded from the study that variety IPFD-1202 was found higher growth parameters, yield attributing characters and yields under 60 kg ha^{-1} P_2O_5 in northern hill region of Chhattisgarh and Maximum nets returns and B:C ratio were obtained under 60 kg ha^{-1} P_2O_5 with IPFD-1202 variety of field pea.

Table 1: Effects of varieties and phosphorous levels on plants population m^{-2}, plant heights (cm), No. of branches plant^{-1}, DMA and CGR

Treatments	Plant population m^{-2}	Plant height (cm)	No. of branches plant^{-1},	Dry smatter accumulation g plant^{-1}	Crops growth rate, g plant^{-1} day^{-1},
Varieties					
V_1: IPFD-1011	34.0	53.1	4.6	9.7	0.25
V_2: IPFD-1202	34.5	55.1	5.0	10.1	0.26
S.Em±	0.60	0.74	0.16	0.11	0.01
C.D. (P=0.05)	NS	2.24	0.48	0.34	0.02
Phosphorus levels					
P_1: 0 kg ha^{-1}	33.9	51.5	4.3	9.2	0.24
P_2: 30 kg ha^{-1}	34.8	54.6	4.9	10.0	0.25
P_3: 60 kg ha^{-1}	34.1	56.1	5.2	10.5	0.28
S.Em±	0.49	0.61	0.13	0.09	0.00
C.D. (P=0.05)	NS	1.83	0.39	0.28	0.01
Interaction effect					
S.Em±	0.84	1.04	0.22	0.16	0.007
C.D. (P=0.05)	NS	NS	NS	NS	NS

Table 2: Effect of varieties and phosphorous levels on No. of podssplant^{-1}, No. seed plant^{-1}, 100 seed weight (g), Biological yield, Seed yield, Stover yield and Harvest index

Treatments	No. of pods plant^{-14}	No. seed plant$^{-1/}$	100sseed weight (g)	Biologically yield (Q ha^{-1})	Seeds yield (Q ha^{-1})	Stover yield (Q ha^{-1})	Harvest Index (%)
Varieties							
V_1: IPFD-1011	14.28	4.9	23.4	49.3	12.7	36.6	25.2
V_2: IPFD-1202	15.0	5.0	23.9	54.3	14.5	39.8	26.7
S.Em±	0.24	0.06	0.31	0.57	0.32	0.53	0.47
C.D. (P=0.05)	0.72	NS	0.93	1.72	0.97	1.59	1.41
Phosphorus levels							
P_1: 0 kg ha^{-1}	12.8	4.7	22.4	43.1	10.7	32.4	24.1
P_2: 30 kg ha^{-1}	14.9	5.0	23.8	52.4	13.8	38.7	26.1
P_3: 60 kg ha^{-1}	16.1	5.2	24.8	59.8	16.4	43.4	27.9
SEm±	0.20	0.05	0.25	0.47	0.26	0.43	0.38
C.D.(P=0.05)	0.59	0.16	0.76	1.40	0.79	1.30	1.15
Interaction effect							
SEm±	0.33	0.09	0.43	0.81	0.46	0.74	0.66
C.D. (P=0.05)	NS	NS	NS	2.43	1.38	2.24	1.99

Table 3: Effect of Varieties and Phosphorous levels on costs of cultivation, gross returns, nets returns and B:C ratio

Treatments	Cost of cultivation (₹ ha^{-1}),	Gross returns (₹ ha^{-1}),	Nets returns (₹ ha^{-1}),	B:Csratio
Varieties				
V_1: IPFD-1011	22407	66443	44036	1.97
V_2: IPFD-1202	22407	75563	53156	2.37
Phosphorus levels				
P_1: 0 kg ha^{-1}	22407	56156	33749	1.51
P_2: 30 kg ha^{-1}	23794	71798	48003	2.02
P_3: 60 kg ha^{-1}	25182	85054	59872	2.38

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