Response of short-duration pigeonpea (*Cajanus cajan* L.) genotypes to levels of phosphorus and sulphur

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ABSTRACT

A field experiment was carried out during cropping seasons 2021-22 and 2022-23 at the Private Agriculture-cum-Research Farm, Beenda Semaria road, Rewa (M.P.) to study the response of short-duration pigeonpea genotypes to levels of phosphorus and sulphur. Amongst the genotypes, TJT-501 performed the best with respect to plant height (150.4 cm), branches (72.3/plant), leaves (243/plant), and dry matter 35.93 g/plant, yield attributes viz. 199.5 pods/plant, 3.97 seeds/pod, 2.07 pod length and 11.90 g and 1000-seed weight. Consequently seed yield (12.15 q/ha), straw yield (45.59 q/ha), and seed protein (21.46 %) and net income (Rs. 69412/ha), were found be significantly highest. In case of fertility levels, P_{60} S_{45} brought about significantly highest seed yield (12.90 q/ha), straw yield (57.70 q/ha and seed protein 22.09 %), but harvest index was found lowest (18.33 %) as against highest (20.20 %) in case of $P_{30}S_{0}$. The economical gain was eventually highest under both these best (TJT-501 and P_{60} S_{45})treatments.

Key words: Short-duration, genotypes, pigeonpea, phosphorus, sulphur

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INTRODUCTION

Due to continuous cropping with high-yielding genotypes, use of imbalanced and sulphur-free chemical fertilizers, non-addition of organic manures, sulphur and zinc, the soil fertility and soil health are deteriorating and crop productivity becoming unstable. Therefore it is essential to recoup nutrient deficiencies as per soil test and crop response. The requirement of phosphorus in is higher than other crops for their root development and metabolic activities. It is the vital component of DNA, RNA, ATP and photosynthetic system and catalyses a number of biochemical reactions (Saket *et al.* 2017 and Gadi *et al.* 2018). Sulphur is considered to be the forth important essential nutrient after N,P and K for plant growth. Sulphur performs many physiological functions like synthesis of chlorophyll, vitamins, metabolism of carbohydrates and proteins.

Sulphur also plays a role in the activation of enzymes, nucleic acids and forms a part of biotin and thiamine. (Sandeep Singh, 2018). Genotypes play an important role in determining the yield the crop, the potential yield of genotypes within its genetic limit is set by its environment. The performance of short-duration pigeonpea genotypes in this region may be the major breakthrough in achieving increased production under double cropping system in a year. With these facts, the present research was taken up.

MATERIALS AND MATHODS

A field experiment was conducted during cropping seasons 2021-22 and 2022-23 at the Private Agriculture-cum-Research Fram, Beenda-Semaria Road, Rewa (M.P.). The soil of the experimental field was silty clay-loam having ph *7.1-7.3,* electric conductivity 0.26-0.33 d S/m, organic carbon 6.35-6.53 g/kg, available N 230-238 kg/ha, available P_2O_5 22.4-25.3 kg/ha, available K_2O 330-349 kg/ha and available 13.0-13.8 kg/ha. The rainfall received during cropping period was 760 mm 2021-22. The treatments comprised four pigeonpea genotypes (ICPL-87, ICPL-157, IJPAS-120 and TJT-501) in the main-plots and six P x S levels in the sub-plots (Table 1). The experiment was laid out in split-plot design with three replications. The pigeonpea genotypes, inoculated with *Rhizobium*, were sown during 3rd week of July in both the years @ 20 kg seed/ha at 30 cm row spacing. The P and S levels were applied as basal through diammonium phosphate, urea and single superphosphate. An uniform dose of 20 kg K_2O/ha was applied as basal through muriate of potash in all the treatments. The crop was grown as per recommended package of practices. The crop was harvested during last week of December to first week of January in both the years. The protein content in grain was determined by multiplying the percent N content in grain with 6.25 (A.O.A.C,1997).

RESULTS AND DISCUSSION

Amongst the pigeonpea genotypes, TJT-501 resulted in significantly higher plant height (150.4 cm) total branches (72.3/plant), trifoliate leaves (243/plant), dry matter (35.9 g/plant), pods (199.5/plant), seeds (3.97/pod), pod length (2.07 cm) and 1000-seed weight (11.90 g) as compared to other genotypes (Table 1). The maximum seed yield (12.15 qha^{-1}), straw yield (45.49 qha^{-1}), and seed protein (21.46 %) and net income (Rs. 69412/ha) with 2.50 B:C ratio were obtained from TJT-501, followed by UPAS-120 and then ICPL-157. The best performance of TJT-501 over others might be ascribed to its better physiological role in synthesis and partitioning of the biomass. Secondly, due to its genetic build up towards the desirable characters.

The performance of pigeonpea genotypes varies from place to place due to the varied agro-climatic conditions and thus the growth and yield of a genotype does not remain the same for all the regions. The variations in yield components among the pigeonpea genotypes were also reported (Phom *et al*., 2014, Raj *et al*.,2014, Singh *et al*., 2015, Singh *et al*.,2013, Bhutia *et al*.,2017).

The highest fertility level of P_{60} S_{45} increased the significantly highest plant height (154.4 cm), total branches (75.3/plant), trifoliate leaves (244/plant),dry matter (37.4 g/plant), pods (224.5/plant), seeds (4.54/pod), pod length (2.21 cm) and 1000-seed weight (13.25 g) over the lower fertility levels. The fertility levels enhanced all these parameters significantly over P_0S_0 (control). Consequently, the seed yield (12.94 qha^{-1}), straw yield (57.70 qha^{-1}) and net income of Rs. 78500/ha with 2.63 B:C ratio and seed protein (22.09 %) of pigeonpea were found to increase significantly with the increased fertility level up to P_{60} S_{45}. The protein content in grain was found to increase significantly with the increasing levels of phosphorus and sulphur up to $P_{60}S_{45}$. The probable reason may be ascribed as $P_{60}S_{45}$ resulted in greater chlorophyll synthesis, energy transformation, accumulation of carbohydrates, proteins and their translocation to the reproductive organs (Solanki and Sharma, 2016, Saket *et al*., 2017). This was due to maximum N-content in grain under $P_{60}S_{45}$ fertility level. The response of P and S in improving seed quality may be attributed to its significant role in regulating the photosynthesis, root enlargement and better microbial activities (Saket *et al*., 2017).

CONCLUSION

Sulphur is constituent of amino acids and thus vital for protein production (Gokhale *et al*., 2005). These results are in agreement with those of several researchers (Saket *et al*. 2017; Masu *et al*. 2019; Singh and Singh, 2017, Singh *et al*., 2017; Das, 2017).The findings concluded that the best treatment combination was TJT-501 genotype with highest P60 S45 fertility level to achieve the maximum yield and quality of pigeonpea for this region.

Conflict of interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Table 1 Growth, yield attributes, yield and quality and economics of pigenonpea under genotypes and fertility levels

Treatments	Plant height (cm) (90 DAS)	Total braches /plant (90 DAS)	Trifoliate leaves/ plant (90 DAS)	Dry matter / plant (g) (90 DAS)	Pods /plant	Seeds /pod	Length of pod (cm)	1000-seed weight (g)	Seed yield (q/ha)	Straw yield (q/ha)	Seed protein (%)	Net income (Rs./ha)	B:C ratio
Genotypes													
ICPL-87	147.3	64.3	227	30.56	181.6	3.58	1.96	11.33	9.48	47.50	20.87	48842	2.05
ICPL-157	148.8	66.4	238	32.92	191.6	3.76	2.01	11.63	10.49	46.82	21.09	56625	2.22
UPAS-120	149.6	71.3	241	34.72	194.4	3.88	2.04	11.76	11.54	45.66	21.31	64560	2.40
TJT-501	150.4	72.3	243	35.93	199.5	3.97	2.07	11.93	12.15	45.49	21.46	69412	2.50
CD(P=0.05)	0.57	0.81	0.91	0.19	1.54	0.11	0.05	0.26	0.28	0.38	0.09	-	-
Fertility levels(kg/ha)													
$P_0 S_0$	143.6	61.9	231	29.70	163.4	3.17	1.85	10.21	9.21	37.43	20.27	44670	2.01
$P_{30} S_0$	145.1	64.6	234	31.32	172.9	3.45	1.92	10.53	9.78	39.05	20.61	49080	2.10
$P_{60} S_0$	147.3	67.2	236	32.54	183.4	3.57	1.97	11.53	10.62	43.81	20.89	56963	2.25
$P_{60} S_{15}$	150.9	69.8	239	34.30	195.1	3.83	2.05	12.00	11.05	47.85	21.48	61180	2.32
$P_{60} S_{30}$	152.9	72.6	241	35.96	207.1	4.24	2.13	12.44	11.89	52.36	21.76	68766	2.46
$P_{60} S_{45}$	154.4	75.3	244	37.40	224.5	4.54	2.21	13.25	12.94	57.70	22.09	78500	2.63
CD (P=0.05)	0.37	0.54	0.60	0.12	0.85	0.070	0.033	0.17	0.19	0.25	0.094	-	-
Interaction	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	-	-

Sig. = Significant