Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(2): 1989-1991
Received: 07-01-2019
Accepted: 10-02-2019

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Effect of potassium and sulphur on yield and nutrient uptake of pigeonpea

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Abstract
The present investigation entitled "Effect of potassium and sulphur on yield and nutrient uptake of pigeonpea" was conducted on EAD Farm, College of Agriculture, Nagpur during kharif season of 2017-2018. The field experiment was laid out in Factorial Randomized Block Design (FRBD) with four levels of potassium (0, 15, 30 and 45 kg ha^{-1}) and four levels of sulphur (0, 10, 20 and 30 kg ha^{-1}). Results indicated that grain and straw yield; content and uptake of N, P, K and S increased with increased in rate of application of K and S. The result of present experiment indicate that application of 30 kg K_2O ha^{-1} resulted improvement in grain (11.59 q ha^{-1}) and straw (45.14 q ha^{-1}) yield of pigeonpea. The highest uptake of N (110 kg ha^{-1}), P (21.35 kg ha^{-1}), K (90.15 kg ha^{-1}) and S (12.50 kg ha^{-1}) was recorded with the application of 20 kg sulphur ha^{-1}. The uptake of N and K increased due to application of 30 kg K_2O and P and S due to 45 kg K_2O ha^{-1}.

Keywords: Potassium, sulphur, pigeopea, yield

Introduction
Pigeonpea is one of the important pulse crop of India and rank second after chickpea in area and production. It is commonly known as Red gram or Arhar and grown in kharif as well as semi rabi. In India area under pigeonpea crop is 3.75 m ha^{-1} with production of 3.12 million tones which occupies the area (36.70 %) and production (22.62 %) among the pulses. However, the area under this crop in Maharashtra is 11.75 lakh ha^{-1} with production of 27.6lakh tones, Productivity of pigeonpea in India is 760 kg ha^{-1}, in Maharashtra is 921.75 kg $ha^{-1}$and that of Vidarbha is 712 kg ha^{-1} (Agropedia, 2012) [1].
The pigeonpea is consumed as split dhal, but is also consumed as green vegetable in India. Seeds are rich in protein, iron, iodine, and essential amino-acids like lycine, cystine and arginine. It is good source of dietary minerals such as calcium, magnesium, iron, sulphur and potassium (Sinha, 1977) [9] and soluble vitamins especially thiamine, riboflavin and niacin (Salunkhe *et al.*, 1986) [7]. The declined soil fertility is the main cause of low productivity on the cultivated lands resulting in wide spread nutrient deficiencies especially N, P, K and S. So, the emphasis has been given to supplement the soil with source of nutrients viz. N, P,

Material and methods
An experiment was conduct at experimental field at Exta Assistant Director (EAD) Farm of Agronomy section, College of Agriculture, Nagpur. The field selected for conducting the experiment was fairly uniform and leveled. The soil under study was medium black, moderately alkaline in reaction, clayey in texture, medium in organic carbon, low in available N, medium in available P, high available K and low in available S. In order to study the chemical characteristics, a composite soil sample was prepared for the whole field by collecting soil samples up to 0-15 cm depth from randomly selected spots over the experimental field before sowing. This composite soil sample was analyzed for various chemical properties in order to assess the initial fertility status of soil.

Results and discussion
a) Grain and Stover Yield
The result obtained in respect of grain yield of pigeonpea as influenced by potassium and sulphur application are presented in table 1. The result clearly indicated that, the grain yield of pigeonpea was significantly influenced due to application of levels of potassium and sulphur along with the application of RDF (25:50:00 kg NPK ha^{-1}). The highest grain yield of pigeonpea (11.59 q ha^{-1}) was obtained with the application of 30 kg K_2O ha^{-1} along with RDF (25 kg N 50 kg P_2O_5 ha^{-1}) which was found at par with the level of 45 kg K_2O ha^{-1} indicating

the response of potassium to pigeonpea. Among sulphur levels highest grain yield of pigeon pea was obtained in treatment of 30 kg S ha^{-1}. This treatment was significantly superior over 10 kg S ha^{-1} and at par with 20 kg S ha^{-1}. The interaction effect of potassium and sulphur found to be significant for grain yield of pigeon pea. Highest grain yield (11.56 q ha^{-1}) of pigeon pea was observed due to application of 30 kg K_2O ha^{-1} in combination of 30 kg S ha^{-1} ($K_{30}S_{30}$). Deshbharat *et al.* (2010) [2] also noted that, significant increase in grain yield (14.81 q ha^{-1}) of pigeonpea after 20 kg sulphur and 20 kg P_2O_5 ha^{-1} with common dose of nitrogen@ 30 kg ha^{-1}.

The highest stover yield of pigeonpea (45.14q ha^{-1}) was recorded in the application of 30 kg K_2O ha^{-1} which was superior over 0 and 15 kg K_2O and at par 45 kg K_2O ha^{-1}. Sulphur at the rate of 30 kg ha^{-1} (45.10 q ha^{-1}) brought the highest stover yield which was at par with 20 kg S ha^{-1} (43.91). The interaction effect of potassium and sulphur revealed that, the highest stover yield of pigeon pea (46.60 q ha^{-1}) was recorded with the application of 30 kg K_2O ha^{-1} + 30 kg S ha^{-1} which was found significantly superior over K_0S_{10}, K_0S_{20}, $K_{15}S_{10}$, $K_{15}S_{20}$, $K_{45}S_{10}$ treatment combination and at par with other treatments. Umesh *et al.* (2013) [10] also reported that, application of graded level of NPK fertilizer along with sulphur and zinc has significantly influence stover yield of pigeonpea.

b) Nutrient uptake

The total uptake of N, P, K and S by pigeonpea is presented in table 2. Data in respect to total uptake of nitrogen by pigeonpea as affected by different level of potassium and sulphur was found to be significant with respect to total uptake of nitrogen. From the result, it revealed that, highest total uptake of N (105.9 kg ha^{-1}) was observed with 45 kg K_2O ha^{-1} along with RDF which found at par with 30 kg K_2O ha^{-1}. Umesh *et al.* (2013) [10] recorded total uptake of nitrogen 102.5 kg ha^{-1}, with the use of N-37, P-75, K-25, S-10 and zinc-12.5 kg ha^{-1}. Highest total uptake of P (21.47 kg ha^{-1}) was observed with 45 kg K_2O ha^{-1} along with RDF which found at par with 30 kg K_2O ha^{-1}. The highest total uptake of phosphorus was observed under 20 kg S ha^{-1} (21.35 kg ha^{-1}) which found at par with 30 kg S ha^{-1}. Similarly, Singh and Alhawat (2005) [8], reported that, total uptake of phosphorus (21 to 26.7 kg ha^{-1}) was obtained under different levels of phosphorus. The maximum value of total uptake of potassium (86.23 kg ha^{-1}) was observed with 30 kg K_2O ha^{-1} along with RDF which found at par with 45 kg K_2O ha^{-1}. The highest total uptake of potassium was observed under 20 kg S ha^{-1} (90.15 kg ha^{-1}) which found at par with 30kg S ha^{-1}. The application of S @20 kg ha^{-1} enhance the total uptake of K. Singh and Singh (2012) [6] reported that, the application of potassium @ 40 kg along with N-30, P-50, S-30 recorded total potassium uptake (96.9 kg ha^{-1}) by pigeonpea. This found superior over 25 kg P_2O_5 and control.

The highest total uptake of sulphur was found with the application of 45 kg of K_2O ha^{-1} (12.74 kg) and with the sulphur level 30 kg ha^{-1} S was 12.50 kg. Palsaniya and Ahlawat (2009) [4] reported that, the sulphur application to pigeonpea (rest of treatments i.e. mean of 30 and 60 kg Sha^{-1}) recorded 41.7% higher pigeonpea grain yield over no sulphur. The interaction effect of potassium and sulphur revealed that, the highest uptake of S of pigeonpea (14.25kg ha^{-1}) was recorded with the application of $K_{45}S_{20}$.

Table 1: Effect of potassium and sulphur on grain and stover yield of pigeonpea

Treatment	Grain Yield (q ha^{-1})				Straw Yield (q ha^{-1})			
Levels of potassium kg ha^{-1}								
K_0	9.81				40.00			
K_{15}	10.72				42.89			
K_{30}	11.59				45.14			
K_{45}	11.20				43.66			
SE (m)±	0.351				1.01			
CD at 5 %	1.018				2.91			
Levels of Sulphur kg ha^{-1}								
S_0	10.15				40.49			
S_{10}	10.81				42.21			
S_{20}	11.08				43.91			
S_{30}	11.20				45.10			
SE (m)±	0.351				1.01			
CD at 5 %	1.018				2.91			
Interaction (potassium x sulphur)								
	K_0	K_{15}	K_{30}	K_{45}	K_0	K_{15}	K_{30}	K_{45}
S_0	9.23	9.89	10.96	10.49	36.98	39.59	43.95	41.47
S_{10}	9.87	10.37	11.37	11.31	39.44	41.47	45.03	42.87
S_{20}	9.87	11.09	11.09	11.48	40.44	44.07	44.98	46.13
S_{30}	10.28	11.56	11.56	11.20	43.15	46.46	46.60	44.17
SE (m)±	0.702				2.90			
CD at 5 %	2.026				7.11			

Table 2: Effect of potassium and sulphur on total uptake of N, P, K and S of pigeonpea.

Treatments	N uptake kg ha^{-1}				P uptake kg ha^{-1}				K uptake kg ha^{-1}				S uptake kg ha^{-1}			
Levels of potassium kg ha^{-1}																
K_0	90.9				18.32				77.85				9.26			
K_{15}	98.1				19.46				78.58				11.30			
K_{30}	106.7				19.46				86.23				12.65			
K_{45}	105.9				21.47				82.05				12.70			
SE (m)±	2.34				0.40				1.76				0.356			
CD at 5 %	6.76				1.18				5.10				1.028			
Levels of Sulphur kg ha^{-1}																
S_0	89.3				17.43				70.40				10.17			
S_{10}	97.9				19.69				81.69				11.10			
S_{20}	110.0				21.35				90.15				12.08			
S_{30}	104.4				20.23				82.47				12.50			
SE (m)±	2.34				0.40				1.76				0.356			
CD at 5 %	6.76				1.18				5.10				1.028			
Interaction (potassium x sulphur)	K_0	K_{15}	K_{30}	K_{45}	K_0	K_{15}	K_{30}	K_{45}	K_0	K_{15}	K_{30}	K_{45}	K_0	K_{15}	K_{30}	K_{45}
S_0	80.34	88.49	103.4	91.49	16.20	17.29	20.01	19.77	71.08	71.78	85.69	82.84	8.02	10.38	11.28	10.98
S_{10}	86.44	87.15	115.8	103.0	17.48	18.19	21.74	20.43	69.10	75.74	92.61	76.86	9.26	10.43	12.12	12.82
S_{20}	98.63	101.8	107.9	118.4	17.27	19.50	20.57	20.50	72.44	95.35	89.18	87.94	9.69	11.86	12.87	13.90
S_{30}	91.85	114.2	112.9	104.8	18.79	23.79	23.07	20.23	68.98	83.88	93.12	82.25	10.09	12.53	14.21	13.17
SE (m)±	5.73				1.003				4.33				0.872			
CD at 5 %	16.56				2.89				12.51				2.512			

Conclusion

From the result it can be concluded that, application of potassium 30kg ha^{-1} and sulphur 30 kg ha^{-1} along with recommended dose of 25 kg N and 50 kg P_2O_5 are more sutaible for yield, content and total uptake which significantly increased the grain and stover yield of pigeonpea. Application of potassium 30 kg ha^{-1} and sulphur 30 kg ha^{-1} significantly increased the content of N, P, K and S. Application of balanced nutrient (25: 50: 30: 30 NPKS kg ha^{-1}) helps to increase the productivity of pigeon pea and improves the soil fertility status of Vertisol.

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