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Effect of sulphur and phosphorus on yield and quality of pearl millet (*Pennisetum glaucum)*

MAMTA PANDEY, A.B.ABIDI AND R.P.SINGH

Department of Biochemistry, N.D.University of Agriculture & Technology, Kumargang, Faizabad (U.P.)

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ABSTRACT

A field experiment was conducted during kharif season to asses the effect of sulphur (0,20,30 and 40 kg^{-1}) and phosphorus levels (0,30,40 and 50 kg P_20_5 ha^{-1}) on productivity and bio-chemical constituents of pearl millet (Pennisetum glaucum L.). The experiment was laid out in randomized block design with 16 treatment combinations and three replications. The results revealed that the pearl millet crop responded significantly up to 50 kg P_2O_5 ha^{-1} and increased the grain yield by 16.3 per cent over control. Application of 40 kg S ha^{-1} proved significantly superior to control with respect to grain yield and increased the yield by 38.1%. The protein quality and quantity both improved with increasing levels of P and S and maximum value (12.64%) was recorded under S_4P_{50} treatment. The mineral content in pearl millet grain also increased with P and S levels over control. Amino acid composition and was also significantly improved with S and P application over control. However, the amount of tryptophan in pearl millet grain was not affected significantly with P and S application. The interactions (PXS) had also significant effect on yield and quality of pearl millet.

Keywords: Sulphur, phosphorus, yield, quality, pearl millet

INTRODUCTION

Pearl millet is an indispensible cereal crop of dry arid and semiarid region. Being a staple food, it has also value for its dry fodder in livestock based farming system. The nutritious cereals as a group are represented by sorghum, pear millet, fingermillet and maize. These nutritious cereals are cultivated in harsh environment with poor soil and water condition. Owing to their severe drought tolerance, their cultivation in dought prone area is effectively providing food and fodder security through risk oversion on sustainable basis. In providing nutrition, this group of cereal is not less than fine cereals like rice and even superior than these in certain constituents. Pearl millet grain contains 63-71% starch and its protein content is comparable with that of wheat (*Abdalla et al., 1998*). Pearl millet is also rich in fat. Lysine is an important amino acid present in sorghum and pearl millet in 159-380 mg/100g of protein (*Abdalla et al. 1998*). Pearl millet is also rich in threonine, methionine and cysteine. Thus, this nutritious cereal is comparable even superior than the fine cereals and therefore the inclusion of these cereals would definitely ensure the fulfillment of dietry requirement.Phosphorus is an important nutrient needed for normal growth and development of the plants. It plays an important role in energy transformation and metabolic processes in plants. It is known to be associated with cell division and transfer of heredity. Sulphur plays an important role in formation of S-containing amino-acids, which act as building blocks in the synthesis of proteins. It has to role to play in increasing chlorophyll formation and aiding photosynthesis. Considering the above mentioned fact, the present study was conducted to determine the effect of sulphur and phosphorus levels on yield and nutritional parameters of pearl millet.

MATERIALS AND METHODS

A field experiment was conducted at the students instructional farm of N.D. University of Agriculture & Technology, Kumarganj Faizabad (U.P.) during kharif season to study the effect of sulphur and phosphorus levels on nutritional parameters of pearl millet Variety NHB 2123. The experiment was laid out in randomized block design with three replications. Healthy seeds of hybrid variety NHB2123 were used to asses their performance as influenced by four doses of sulphur (0, 20, 30 and 40 kg ha^{-1}) and four levels of phosphorus (0, 30, 40 and 50 kg P_2O_5 ha^{-1}). The crop was sown in second week of July and all necessary packages of practices were adopted for obtaining good yield of the crop.The available S content in the soil sample was estimated by extraction with 0.15 per cent $CaCl_2$ solution and determined turbidimetrically. Available P in soil was exyracted with 0.5M NaH

CO_3 and determined colorimetric method. The crop was harvest at maturity and grain was recorded. After harvesting and threshing, healty grain were obtained and utilized for biochemical analysis. The protein content in defatted meal was determined by Lowry's methods (1951) using crystalline bovine serum albumin as standard protein. The amino acids were analysed by the methods namely Lysine (Cancon, 1975), Tryptophan (Spies and Chamber, 1949) Methionine Horn *et al.* (1946). Total mineral content was determined by method given by Hart and Fisher (1971). The data recorded on above characters were subjected to statistical analysis as described by Fisher and Yates (1949).

RESULTS AND DISCUSSION

Yield

Data on grain yield as affected by S and P levels are presented in Table 1. Application of 50 kg P_2O_5 ha^{-1} recorded significantly higher yield of grain of pearl millet over control. The increase in yield with 50 kg P_2O_5 ha^{-1} was 16.3 % over control. The increase in yield may be attributed to the effective metabolic activities coupled with increased rate of photosynthesis leading to better translocation of photosynthates to sink. Similar results were reported by Singh *et al.* (2017). Grain yield of pearl millet also increased significantly with S application over control. The highest yields of grain (27.42 q ha^{-1}) was recorded with 40 kg S ha^{-1}. Similar results were reported by Chauhan *et al.* (2017). The biochemical examination of the grain sample revealed that sulphur and phosphorus both affected the quality of produce in pearl millet (Table 1). Protein content in grain was affected due to various doses of phosphorus. Maximum (11.71%) protein content was recorded with 50 kg P_2O_5 ha^{-1} followed by treatments 40 and 30 kg P_2O_5 ha^{-1}. Minimum protein content was observed (10.88%) in control plot. Sulphur (40 kg ha^{-1}) gave maximum value of protein (11.97%) content in pearl millet grain. Sulphur has direct role in protein synthesis and is also a structural component in protein structure. Our findings are in accordance with Rao and Bharti (1996) who emphasized that the degree of gluten strength and bread volume varied upon the rate of fertilizers applied. Higher fertilizer levels lead to high protein content. Interaction data reveals that sulphur and phosphorus both had positive effects on the protein content of pearl millet (Table 1). Maximum (12.64 %) protein was observed in the treatment $S_{40}P_{50}$ (Table 1) indicating a beneficial effect on protein content.

Table 1: Effect of sulphur and phosphorus on yield, protein and mineral content in pearl millet grain

Phosphorus (kg ha^{-1})	Sulphur (kg ha^{-1})				Mean
	0	20	30	40	
			Grain Yield (q ha^{-1})		
0	18.59	23.03	23.45	26.09	22.79
30	19.62	25.01	25.86	27.15	24.41
40	20.47	27.36	28.31	27.79	25.98
50	20.72	28.43	28.16	28.69	26.50
Mean	19.85	25.96	26.45	27.42	
CD (P=0.05)	P = 1.06	S = 1.06		P X S = 2.09	
			Total minerals (%)		
0	2.11	2.14	2.17	2.21	2.16
30	2.17	2.21	2.26	2.30	2.23
40	2.31	2.34	2.36	2.40	2.34
50	2.36	2.38	2.38	2.45	2.38
Mean	2.24	2.26	2.29	2.32	
CD (P=0.05)	P = 0.07	S = 0.07		P X S = 0.13	
			Protein (%)		
0	10.56	10.64	10.85	11.00	10.76
30	10.81	10.88	10.90	12.00	11.19
40	11.08	11.14	11.25	12.26	11.43
50	11.10	11.50	11.60	12.64	11.71
Mean	10.88	11.04	11.15	11.97	
CD (P=0.05)	P =	S =		P X S =	

Minimum protein content was observed in control plot. Our findings are in accordance with Yakadri and Gautam (2001). Phosphorus levels did not affect the lysine content but sulphur level had positive effects on the lysine content. Maximum lysine (2.49 g/16 N) in pearl millet grain was observed in the treatment S, where sulphur was applied @ 40 kg ha^{-1}. Interaction of sulphur and phosphorus did not vary significantly. Phosphorus levels had beneficial effect on tryptophan content in grain. Data revealed that maximum tryptophan (0.94 g/16 g N) was recorded when phosphorus was applied @ 50 kg ha^{-1}. Maximum tryptophan content was noticed when sulphur was applied @ 40 kg ha^{-1}. The interaction due to sulphur and phosphorus did not vary significantly. Phosphorus level did not show any effect on methionine content. Sulphur levels affected the quality of sulphur containing amino acids and maximum (2.12 g/16 N) methionine content was recorded where sulphur was applied @ 40 kg ha^{-1} in pearl millet (Table 1). All the values were found significantly superior to control while interaction of sulphur phosphorus did not vary significantly. Maximum total mineral content i.e. 2.40% was noticed in grain in the treatment P_3 where phosphorus was applied @ kg ha^{-1}. Maximum (2.45%) total mineral content was noticed in treatment $S_{40}P_{50}$ in grain (Table 1). All minerals came from the soil and translocated into stem finally reaches to the seed of plant as amount of total mineral of the seed. The result was well supported by the findings of Chauhan *et al.*(2017).

Table 2: Effect of sulphur and phosphorus on content of amino acids in pearls millet grain

Phosphorus (kg ha^{-1})	Sulphur (kg ha^{-1})				Mean
	0	20	30	40	
			Try to phan (g/16 g N)		
0	0.84	0.86	0.87	0.86	0.86
30	0.87	0.90	0.91	0.89	0.89
40	0.90	0.93	0.94	0.90	0.92
50	0.92	0.94	0.96	0.95	0.94
Mean	0.88	0.90	0.92	0.90	
CD (P=0.05)	P = NS	S = NS		P X S = NS	
			Lysine (g/ 16 g N)		
0	2.33	2.36	2.40	2.42	2.37
30	2.35	2.38	2.44	2.48	2.41
40	2.40	2.42	2.48	2.52	2.45
50	2.46	2.48	2.52	2.56	2.50
Mean	2.38	2.41	2.46	2.49	
CD (P=0.05)	P = 0.24	S = 0.24		P X S = 0.49	
			Methionine (g/ 16 g N)		
0	1.89	1.92	1.96	2.00	1.94
30	1.94	1.97	1.98	2.04	1.98
40	2.00	2.03	2.08	2.06	2.04
50	2.04	2.08	2.12	2.12	2.09
Mean	1.96	2.00	2.03	2.05	
CD (P=0.05)	P = NS	S = 0.26		P X S = 0.53	

Considering the role of minerals in human diet, the status of total mineral will helpful in improving better nutritional quality. Total mineral content increased with increasing dose of sulphur. This may be due to this reason that it required information of chlorophyll and many other components that are involved in nitrogen fixation and photosynthesis (Singh *et al.* 2014). Interaction of sulphur and phosphorus did not vary significantly,

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