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Yield and quality parameters of groundnut (*Arachis hypogaea*) under sulphur and phosphorus nutrition

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ABSTRACT

A field trial was conducted at N.D. University of Agriculture & Technology Faizabad (U.P.) to assess the effect of different sulphur and phosphorus levels on yield oil content and fatty acid composition of groundnut (Arachis hypogaea). The experiment was laid out in randomized block design with 16 treatment combinations and three replications. Results revealed that the pod yield of groundnut crop increased significantly up to 50 kg P_20_5 ha^{-1} and increased in yield was to the tune of 14.7 per cent over control. Application of 40 kg S ha^{-1} proved significantly superior to control with respect to pod yield and in increased the yield by 38.7 per cent. Protein content in groundnut Kernels increased significantly with P and S and maximum value of protein (27.09%) content was recorded with $P_{50}S_{40}$ treatment. A significant increase in oil content was recorded with an increase in sulphur and phosphorus levels from 0 to 40 kg ha^{-1} and 0 to 50 kg ha^{-1} over control. Significant variation in fatty acid profile was also observed with different sulphur and phosphorus levels.

Key words: Yiels, quality, groundnut, sulphur, phosphorus

INTRODUCTION

India's per capita consumption of oils and fat is continuously increasing. India has witnessed a dramatic increase in its middle class and upper middle class both in numbers and per capita income. This has lead to an increase in demand of quality vegetable oil so that it fulfill both the palatability of traditional Indian diet and also has less effect on health matters. Several approaches are being developed by scientists to boost good quality of edible oil. Groundnut (*Arachis hypogaea* L.) is an important oilseed crop of India and its oil is mainly used for edible purpose. One of these approaches is balanced fertilizer application with special emphasis on sulphur and phosphorus application because oilseeds are very sensitive to sulphur fertilization. Groundnut seed contain about 20-25 per cent protein and 40-50 per cent oil. It is highly concentrated form of feed, rich in protein and fat apart from having good amount of minerals and vitamins (Pathak and Pathak,1992). Phosphorus is essential for photosynthesis, respiration, nitrogen metabolism, carbohydrate metabolism and fatty acid biosynthesis. Sulphur is constituent of sulphur contain+ning amino acids. Oil seed crops in generally have high sulphur requirement because of oil storage organs are quite rich in proteins. Sulphur can improve crop quality in several ways such as increasing the oil content and synthesis of sulphur containing amino acids and protein percentage. Considering the importance of sulphur and phosphorus, an attempt made to study its influence on oil conteOnt and fatty acid profile of groundnut.

MATERIALS AND METHODS

The experiment was conducted at the students' instructional farm of N.D. University of Agriculture & Technology, Kumarganj Faizabad (U.P.). Four levels of sulphur (0,20,30 and 40 kg ha^{-1}) and four levels of phosphorus (0,30.40 and 50 kg ha^{-1}) were tested in randomized block design with three replications. Recommended doses of N and K were applied at the time of sowing. Groundnut variety G 201 was sown with a spacing of 30 cm x 10 cm. All other cultural operations were carried out as per recommendations. Plant protection measures were taken as and when require. Bold and healthy seeds of G 201 (Kausal) weighted 10g were kept is an oven at 70^0 C for removal of moisture. The moisture free seeds were used for oil extraction according to the conventional soxhlet method (AOAC, 1970). Fatty acid composition of groundnut oil was determined by ''Gas liquid chromatography'' after preparing methyl esters at Central Drug Research Institute, Lucknow (U.P.).

RESULTS AND DISCUSSION

The data obtained for yield, protein and oil content of groundnut as influenced by phosphorus and sulphur fertilization has been presented in Table 1. Effect of phosphorus application on the pod yield of groundnut irrespective of S levels revealed that application of 50 kg P_2O_5 ha^{-1} recorded the highest mean groundnut pod yield, which was at par with application of 40 kg P_2O_5 ha^{-1}. Similar results were reported by Gadi *et al.* (2018). Application of 40 kg S ha^{-1} recorded highest pod yield, which was significantly superior to lower levels of S and control. This might be due to its multiple roles in metabolism as an essential constituent of amino acids (Prasad, 2004, Dash *et al.* 2013). The protein content of Kernels showed an increasing trend with increase in phosphorus levels from 0 to 50 kg P_2O_5 ha^{-1}. Similar results were reported by Gadi *et al.* (2018). The mean protein content in groundnut Kernels was the highest with 40 kg S ha^{-1} and the increase was per cent over the control. It might be due to availability of more sulphur for production of amino acids. This corroborates the results of Dash *et al.* (2013). A significant increase was noticed in oil content with increase in sulphur and phosphorus doses. Maximum oil content (49.72%) was observed when sulphur was applied @ 42 kg ha^{-1} and phosphorus was applied @ 50 kg ha^{-1} and it was statistically superior over all the treatments, The mnimum oil content (40.17%) was recorded under controlled treatment. The increase in oil content with sulphur application was due to conversion of carbohydrate into fat (Singh and Abidi, 1991, Dash *et al.* 2013). Nitrogen and sulphur both are vital structural elements and specially needed for protein and fat synthesis. Due to sulphur nitrogen, a favourable was created for production of metabolites responsible for oil biosynthesis in plants. Enhancement of oil content with increasing level of sulphur may be due utilization of sulphur in electron transport system (Ramnathan and Ramnathan, 1982). Richnold (1973) reported that sulphur affects the quantity and quality of groundnut oil. Palmitic acid content ranged from 11.86 to 13.37 per cent. Maximum palmitic acid content (13.37%) was observed in the treatment where sulphur and phosphorus were applied @ 40 kg + 50 kg ha^{-1}. Minimum palmitic acid (11.86%) was observed in control plot. Fatty acid composition of groundnut oil was also affected by location as reported by Mathur and Sharma (1989).

Table 1: Effect of sulphur and phosphorus on pod yield, protein and oil content in groundnut Kernels

Phosphorus (kg ha^{-1})	Sulphur (kg ha^{-1})				Mean
	0	20	30	40	
			Pod Yield (q ha^{-1})		
0	12.44	13.29	14.029	17.80	14.26
30	12.51	13.86	16.27	18.27	15.23
40	13.51	14.47	17.82	18.56	16.09
50	13.86	14.68	17.94	18.96	16.36
Mean	13.08	14.07	16.58	18.40	
CD (P=0.05)	P = 0.46		S = 0.46	P X S = 0.91	
			Protein (%)		
0	19.25	21.16	21.09	24.08	20.40
30	20.28	22.52	23.34	24.06	22.55
40	21.02	23.67	24.42	26.09	23.80
50	21.63	24.35	25.74	27.09	24.63
Mean	20.55	22.93	23.65	25.35	
CD (P=0.05)	P = 0.57		S = 0.57	P X S = 1.14	
			Oil content (%)		
0	40.17	40.60	42.08	42.81	41.41
30	40.20	41.05	42.21	43.06	41.63
40	40.49	41.58	42.29	43.68	42.10
50	40.99	41.80	42.41	43.72	42.23
Mean	40.46	41.25	42.24	43.19	
CD (P=0.05)		P0=0.94	S 0.94	P X S	1.88

Stearic acid content ranged from 2.65-2.86 per cent. Maximum stearic acid (2.86%) was observed in the treatment S3P3 where both fertilizers were applied at the highest rate (sulphur 40 kg ha^{-1}, phosphorus 50 kg ha^{-1}). Fertilizer affects the quality of oil. Das *et al.* (2013) reported that maximum oil was synthesized under the influence of sulphur treatment. Arachidic acid, which is mainly found in groundnut seed also get affected due to fertilizer doses. Arachidic acid ranged from 1.23-1.37 per cent. Maximum arachidic acid content (1.37%) was observed in the treatment S_3P_3. The results are inconformity with findings of Nagra j(1990).

Table 2: Fatty acid profile of groundnut oil as influenced bu S and P application

Phosphorus (kg ha^{-1})	Sulphur (kg ha^{-1})				Mean
	0	20	30	40	
			Palmitic acid (%)		
0	11.86	12.17	12.46	12.60	12.27
30	12.27	12.57	12.84	12.70	12.59
40	12.65	12.93	13.20	12.78	12.89
50	12.83	13.14	13.17	12.85	13.00
Mean	12.40	12.70	12.91	12.73	
CD (P=0.05)	P = 0.37	S = 0.37		P X S =0.74	
			Stearic acid (%)		
0	2.65	2.68	2.71	2.72	2.69
30	2.70	2.73	2.77	2.75	2.74
40	2.76	2.78	2.83	2.78	2.79
50	2.78	2.80	2.86	2.79	2.81
Mean	2.72	2.75	2.79	2.76	
CD (P=0.05)	P = 0.21	S = 0.21		P X S = 0.42	
			Arachidic acid (%)		
0	1.23	1.25	1.27	1.29	1.26
30	1.26	1.28	1.30	1.31	1.29
40	1.29	1.31	1.33	1.33	1.31
50	1.29	1.32	1.35	1.37	1.32
Mean	1.27	1.29	1.31	1.32	
CD (P=0.05)	P = 0.15	S = 0.15		P X S = 0.30	
			Olric acid (%)		
0	46.06	46.36	46.68	46.87	46.49
30	46.16	46.87	47.19	46.98	46.80
40	46.57	47.38	47.68	47.10	47.18
50	47.10	47.57	47.89	47.18	47.42
Mean	46.47	47.04	47.36	47.03	
CD (P=0.05)	P = 0.31	S = 0.31		P X S = 0.62	
			Linoleic acid (%)		
0	33.72	33.99	34.21	34.42	34.08
30	34.13	34.48	34.62	34.60	34.46
40	34.51	34.87	34.98	34.80	34.79
50	34.70	35.06	35.17	34.92	34.96
Mean	34.26	34.60	34.74	34.68	
CD (P=0.05)	P = 0.42	S =0.42		P X S = 0.84	

Oleic acid content ranged from 46.06 to 47.89 percent. Highest oleic acid was observed (47.89%) in the treatment S2 P_3 followed by S_3P_3 and S_3P_0. Maximum oleic acid was noticed (46.06%) in control plot. This may be due to the fact that acetate available in seeds get converted

into fatty acids having 18 carbon atom in protoplast of oilseedendosperm leading to increase in oleic, linoleic acid content and decrease in palmitic acid. Linoleic acid content ranged from 33.72-35.17 per cent. Maximum value (35.17%) was noticed in the treatment S_3P_3 followed by other treatment. Linoleic acid which is also known as vitamin F has got its importance in nutrition of human beings. Sulphur and phosphorus interaction affects the yield and quality of produce in oil seeds and specially its fatty acid profile. Our results were inconfirmation to Nagraj (1990) and Singh and Abidi (1991).

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