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Response of groundnut to phosphatic fertilizers with ferrous sulphate in calcareous soils

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Abstract

A field experiment was conducted on calcareous soil to assess the effect of single super phosphate and diammonium phosphate, the common phosphatic fertilizers with and without ferrous sulphate on yield, quality, uptake of nutrients by groundnut and residual fertility status of soil. The results indicated that the application of 60 kg P_2O_5 through single super phosphate with 25 kg ha^{-1} ferrous sulphate resulted in increasing significantly the pod and haulm yield, protein and oil content, uptake of nutrients (N, P, K, Ca, Fe), and improving the residual fertility status of soil. The increase of pod yield due to phosphorus application was 21.9 per cent higher over the control.

Additional keywords: Yield and quality of groundnut, nutrients uptake, soil fertility status.

Introduction

Groundnut is one of the most important oilseed crops grown in India and accounts for 45 per cent (8.4 m ha) of the total area under oilseeds contributing to 40 per cent of the oil requirement of the country. However, its yield level remained stagnant at around 800 kg ha^{-1} during the last decade (Anonymous, 1993). Amongst the different constraints in groundnut production, the deficiency of phosphorus and iron was found to be major one in calcareous shrink-swell soils of Vidarbha region when water soluble phosphate applied gets immobilized into slightly soluble to insoluble phosphate compounds. Iron compounds are also not soluble due to alkaline soil reaction and it causes chlorosis, adversely affecting yield of groundnut (Patel *et al.* 1993). In view of the above, the experiment was conducted to study the response of groundnut to different levels of phosphatic fertilizers with and without ferrous sulphate in calcareous shrink-swell soils.

Materials and methods

The field experiment was conducted during kharif 1995 at Agricultural College Farm, Nagpur. The experiment had fourteen treatments replicated thrice (Table 1) and the design was RBD. Basal dose of 25 kg N ha^{-1} was applied to all the treatments except absolute control (T0). The phosphatic fertilizers viz. single super phosphate and diammonium phosphate were applied at the rates of 40, 50 and 60 kg P_2O_5 ha^{-1}, with and without 25 kg ha^{-1} ferrous sulphate.

The soil of the experimental site belongs to Haplusterts great group (Soil Taxonomy). The soil was moderately alkaline (pH 8.2) in reaction and low in salt content (EC <0.4 dS m^{-1}). The level of free calcium carbonate was 7.2 per cent. The available N and P_2O_5 were 270 kg ha^{-1} and 21 kg ha^{-1}, respectively. The available Fe in the soil was 5 mg kg^{-1}.

At maturity of the crop, the pod and haulm yields were recorded separately. The seed and haulm samples were analysed for N by Kjeldahl's method (Piper, 1966) and digested in diacid mixture (9:4 HNO_3-$HClO_4$) for phosphorus analysis. Phosphorus was determined by vanadomolybdate-nitric acid yellow colour method (Jackson, 1967). Iron was determined by ortho-phenanthroline method by using colorimeter. The protein content was obtained by multiplying total N with a factor 6.25 and oil content by using NMR Minispec P-201 model.

Table 1. Influence of sources and levels of phosphorus with and without ferrous sulphate on yield, quality and uptake of N, P and Fe by groundnut

Treat No.	Treatments	Pod yield (q/ha)	Haulm yield (q/ha)	Protein content (%)	Oil content (%)	Uptake (kg/ha)				
						N	P	Fe	K	Ca
T_0	Absolute control	20.23	36.04	21.21	48.30	108.94	25.64	1.30	46.12	37.10
T_1	P0	21.01	36.08	21.43	48.36	115.38	26.70	1.37	47.75	38.00
T_2	P40 (SSP)	22.20	39.93	21.66	48.46	127.63	32.81	1.64	52.72	44.55
T_3	P50 (SSP)	23.75	42.23	21.83	49.20	141.49	37.08	1.65	54.97	46.10
T_4	P60 (SSP)	24.22	42.89	21.95	49.60	143.24	38.75	1.64	57.58	47.25
T_5	P40 (DAP)	21.44	40.43	21.61	48.41	136.30	29.78	1.74	50.70	40.33
T_6	P50 (DAP)	23.22	41.37	21.78	48.70	139.94	32.54	1.78	54.44	41.20
T_7	P60 (DAP)	23.99	41.80	22.81	48.86	149.22	34.85	1.71	56.35	42.40
T_8	P40 (SSP) with 25 kg ha^{-1} $FeSO_4$	24.00	42.11	23.37	49.80	156.34	31.61	2.66	57.42	42.95
T_9	P50 (SSP) with 25 kg ha^{-1} $FeSO_4$	25.53	43.72	23.49	50.00	165.88	35.67	2.32	60.61	45.70
T_{10}	P60 (SSP) with 25 kg ha^{-1} $FeSO_4$	25.61	43.84	23.50	50.03	168.77	37.31	2.32	61.33	46.34
T_{11}	P40 (DAP) with 25 kg ha^{-1} $FeSO_4$	22.69	40.47	22.66	48.70	140.02	29.78	2.51	54.25	38.57
T_{12}	P50 (DAP) with 25 kg ha^{-1} $FeSO_4$	23.66	42.60	22.75	49.20	150.86	33.02	2.75	55.75	40.30
T_{13}	P60 (DAP) with 25 kg ha^{-1} $FeSO_4$	24.02	42.82	23.26	49.30	154.81	34.82	2.33	58.68	41.25
F test		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE±		0.596	1.343	0.40	0.34	4.95	0.65	0.14	1.62	1.46
CD at 5%		1.73	3.90	1.18	1.00	14.39	1.90	0.37	4.71	4.25

Results and discussion

Data (Table 1) indicated that the application of phosphorus through single super phosphate and diammonium phosphate with and without ferrous sulphate had significant effect on yield, quality, uptake of nutrients (NPK, Ca and Fe) by groundnut and residual fertility status of soil . Significantly higher pod yield (25.61 q ha^{-1}), haulm yield (43.84 q ha^{-1}), oil content (50.03%), protein content (25.50%) and uptake of N (168.77 kg ha^{-1}), P (37.31 kg ha^{-1}), K (61.33 kg ha^{-1}) and Ca (46.34 kg ha^{-1}) were recorded with application of 60 kg P_2O_5 ha^{-1} in the form of single super phosphate alongwith 25 kg ha^{-1} ferrous sulphate over the other treatments. Kulkarni *et al.* (1989) and Naphade *et al.* (1991) also reported

significant increase in groundnut yield due to the application of 60 kg P_2O_5 ha^{-1} through single super phosphate alongwith 15 kg ha^{-1} ferrous sulphate. The increase in pod yield was 26.59 per cent higher over absolute control, and 21.89 per cent higher over non application of phosphatic fertilizers.

Application of ferrous sulphate increased the protein and oil content of groundnut (Table 1). Krishnappa *et al.* (1992) also observed that the increase in levels of iron application increases the protein content of groundnut.

Table 2. Residual fertility status of soil as influenced by levels of P_2O_5 through SSP and DAP with and without Fe

Treatment No.	Treatment	Total N (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})	Exch. Ca^{++} (cmol(p+)kg^{-1})	Available Fe (mg kg^{-1})
T_0	Absolute control	0.0695	262.11	20.75	263.86	34.06	4.026
T_1	P0	0.0729	276.26	21.62	265.06	34.40	4.046
T_2	P40 (SSP)	0.0758	280.00	24.49	269.73	36.40	4.053
T_3	P50 (SSP)	0.0796	283.73	26.58	271.60	38.00	4.193
T_4	P60 (SSP)	0.0829	287.39	28.72	272.53	39.13	4.286
T_5	P40 (DAP)	0.0739	277.74	23.89	285.60	35.80	4.013
T_6	P50 (DAP)	0.0743	281.49	25.68	291.20	36.13	4.093
T_7	P60 (DAP)	0.0762	282.24	27.17	296.80	36.86	4.160
T_8	P40 (SSP) with 25 kg ha^{-1} $FeSO_4$	0.0781	284.48	25.56	279.86	37.33	6.726
T_9	P50 (SSP) with 25 kg ha^{-1} $FeSO_4$	0.0805	287.46	27.03	284.66	38.33	6.827
T_{10}	P60 (SSP) with 25 kg ha^{-1} $FeSO_4$	0.0834	294.93	29.96	288.40	39.53	6.786
T_{11}	P40 (DAP) with 25 kg ha^{-1} $FeSO_4$	0.0744	279.25	25.98	285.13	35.73	6.073
T_{12}	P50 (DAP) with 25 kg ha^{-1} $FeSO_4$	0.0758	282.98	27.77	288.40	36.43	6.460
T_{13}	P60 (DAP) with 25 kg ha^{-1} $FeSO_4$	0.0781	286.72	29.86	299.60	36.60	6.463
SE±		0.008	13.73	1.64	9.87	1.12	0.201
CD at 5%		—	—	4.76	—	—	0.58

The residual fertility status (Table 2) of soil indicated that the sources of phosphorus viz. SSP and DAP with or without ferrous sulphate did not differ in their effects on the contents of total and available nitrogen as well as available K_2O and exchangeable calcium in the soil after harvest of the crop. However, it was observed that the total and available

nitrogen as well as available K_2O and exchangeable calcium increased in the soil with the increasing levels of P applied irrespective of P sources. The contents of available P_2O_5 and available Fe were found to be significantly affected by the levels of P. There was an increase in content of available P_2O_5 in soil with the increase in P levels, whether added alone or alongwith $FeSO_4$. Application of $FeSO_4$ @ 25 kg ha^{-1} increased available Fe content in the soils by one and half times than the treatments which received no Fe_2SO_4. P levels as well as P sources did not differ significantly in their effects on available Fe contents in soil.

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