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Effect of phosphatic fertilizers, gypsum and their mode of application on yield, oil and protein content of groundnut (*Arachis hypogaea*)

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ABSTRACT

A field experiment was conducted on cultivator's field during the rainy seasons of 1986 and 1987 to find out the effect of single superphosphate, diammonium phosphate, gypsum and their mode of application (full basal, full top-dressing on foliage and half basal + half top-dressing on foliage) on yield, oil and protein content of 'M 13' groundnut (*Arachis hypogaea* L.). Application of 60 kg P_2O_5/ha through single superphosphate with 50 kg S/ha through gypsum as full basal gave the maximum yield, oil and protein contents, which was on a par with single superphosphate @ 60 kg P_2O_5/ha full basal. Full top-dressing of phosphatic fertilizer and gypsum 60 days after sowing gave significantly lower yield than its conventional basal application. Single superphosphate was superior source of P to diammonium phosphate.

Legumes and oilseed crop respond to sulphur application and its utilization is also related to phosphorus uptake to meet P requirement of crop. The availability of P and S and their uptake by plant are also fairly proportionate. Single superphosphate and diammonium phosphate are water-soluble P sources and extensively used. Single superphosphate supplies S to the crop, as it contains calcium sulphate ($CaSO_4 . 2H_2O$) about 50% weight of fertilizer. Groundnut (*Arachis hypogaea* L.) has relatively high requirement of P and S. Information on yield and qualities of 'M 13' groundnut as influenced by P fertilizer, gypsum and their mode of application is meagre. Therefore, present investigation was undertaken to know the effect of phosphatic fertilizers, gypsum and their mode of application on yield and chemical composition of groundnut.

MATERIALS AND METHODS

The experiment was conducted during the rainy seasons of 1986 and 1987 on farmer's field at Neendar and Tankarda villages of Jaipur district. The experimental soils were Typic Ustipssament and their physico-chemical characteristics are given in Table 1. Fertilizer treatments comprised single superphosphate, diammonium phosphate, gypsum and their mode of application, i.e. full basal, full top-dressing and half basal + half top-dressing; gypsum along with non-S-containing P fertilizer diammonium phosphate and the control. Eleven treatments were laid out in randomized block design with 3 replications in plot of 5 m × 4 m.

Table 1. Physico-chemical characterisitics of the soils

Characteristics	Experimental site	
	Needar	Tankarda
Texture	Loamy sand	Loamy sand
Electrical conductivity (dS/m)	0.12	0.15
pH	8.1	8.0
$CaCO_3$ (%)	1.0	1.0
Available N (kg/ha)	180.2	170.6
Available P_2O_5 (kg/ha)	14.2	14.2
Available K_2O (kg/ha)	280.4	286.2
Available S (ppm)	6.0	4.0

Phosphatic fertilizers and gypsum were applied @ 60 kg P_2O_5 and 50 kg S/ha respectively. Basal application of gypsum was done 21 days before sowing and top-dressing of phosphatic fertilizers and gypsum was done 60 days after sowing of crop. Groundnut 'M 13' was used. After harvesting of crop yield data were recorded. Plant and soil samples were also collected for chemical determinations. Nitrogen in kernel was estimated by Kjeldahl's method (Jackson, 1967) and protein content was calculated by multiplying N content with factor 6.25. Oil content in kernel was determined by Soxhlet's method and available P_2O_5 by Olsen's method (Jackson, 1967).

RESULTS AND DISCUSSION

Application of 50 kg S/ha through gypsum with 60 kg P_2O_5/ha through diammonium phosphate as full basal gave significantly highest pod yield, oil and protein contents of groundnut, which was on a par with 60 kg P_2O_5/ha through single superphosphate as full basal (Table 2). Increase in pod yield, oil and protein contents of groundnut due to gypsum application along with P may be attributed to the fact that groundnut requires P for proper root development which was not fully supplied, as experimental soils were deficient in available P (Table 1). Gypsum supplied Ca and S to experimental soils deficient in both the nutrients. Presence of Ca in adequate quantities in the fruiting zone is necessary for proper filling of pods, because the xylem vessels in the gynophores of groundnut are too narrow to permit the movement of calcium ions in quantities needed to meet the growing demands of the rapidly developing kernel and shell of the pod. Role of S in increasing the yield of groundnut has been well documented, as it is required for the synthesis of the S-containing amino-acids, proteins, chlorophyll and oil. It also promotes nodulation (Pasricha and Aulakh, 1986). These nutrients might have encourged total biomass production and kernel development in groundnut which finally reflected in pod yield. Similar results were reported by Yadav *et al.* (1991) in groundnut on calcareous soil.

Single superphosphate gave significantly higher pod yield, oil and protein contents (Table 2) and lower residual available P than diammonium phosphate. The better performance of single superphosphate than diammonium phosphate may be attributed to presence of nearly 50% $CaSO_4 . 2H_2O$, which supplies Ca and S to the crop during the growth period. Ca and S are essential nutrients for better yield and qualities of groundnut. Besides increasing P availability, S also increases the assimilation rate (Sacchidanand *et al.*, 1980). Aulakh *et al.* (1980) also reported an increase in yield with application of single superphosphate over diammonium phosphate in groundnut.

Table 2. Effect of P fertilizers, gypsum and their mode of application on available P_2O_5, pod yield, oil and protein contents of groundnut

Treatment	Pod yield (q/ha)			Available P_2O_5 (kg/ha)			Oil content (%)			Protein content (%)		
	1986	1987	Pooled	1986	1987	Pooled	1986	1987	Pooled	1986	1987	Pooled
SSP full basal	29.82	24.17	27.00	14.67	16.00	15.34	48.07	47.20	47.64	24.33	24.46	24.37
SSP full top-dressing	27.32	22.30	24.81	21.33	22.00	21.67	45.40	45.53	45.47	23.77	23.47	23.62
SSP ½ basal + ½ top-dressing	28.07	23.17	25.62	18.67	19.33	19.00	46.13	46.07	46.10	24.00	24.00	24.00
DAP full basal	26.66	22.00	24.33	17.33	18.00	17.67	44.07	44.07	44.07	23.10	22.93	23.02
DAP full top-dressing	24.41	20.83	22.62	22.67	22.66	22.67	42.53	42.47	42.50	21.95	21.67	21.81
DAP ½ basal + ½ top-dressing	25.57	21.50	23.54	22.00	23.33	22.67	43.60	43.13	43.37	23.20	23.00	23.10
Gypsum full basal	22.07	19.17	20.62	13.33	14.00	13.67	47.13	47.27	47.20	23.80	23.67	23.74
Gypsum full top-dressing	20.41	18.33	19.37	14.67	14.66	14.67	45.93	45.73	45.83	22.70	22.40	22.55
Gypsum ½ basal + ½ top-dressing	21.41	18.67	20.40	13.33	13.33	13.33	46.93	46.47	46.70	23.07	22.87	22.97
DAP + gypsum full basal	31.65	25.33	28.49	23.33	24.00	23.67	48.53	47.93	48.23	25.00	24.67	24.84
Control	17.33	15.33	16.33	14.00	13.33	13.67	42.30	42.40	42.35	21.20	21.20	21.20
CD (P = 0.05)	0.83	3.60	2.28	5.01	1.15	5.00	1.34	1.18	1.35	1.52	NS	2.00

SSP, Single superphosphate; DAP, diammonium phosphate

Full top-dressing of phosphatic fertilizer and gypsum 60 days after sowing gave significantly lower yield and higher residual available P_2O_5 than its conventional basal application. It may be attributed that in half soil + half top-dressing and full top-dressing methods, plant seemed to have suffered due to lack of sufficient P, Ca and S availability during early period of crop growth. Top-dressing failed to supply P when it was needed in larger amounts by the crop and hence it caused leaf injury. Parker and Boswell (1980) reported that the translocation of foliar top-dressing of P to the site of action is too low which increases concentration of P ions in the leaf-tissues leading to leaf injury, and poor growth. However, application of full dose at the time of sowing resulted in adequate supply of P to the plant during early growth stage at which it was needed in larger quantities (Harper 1975).

It was concluded that basal application of 60 kg P_2O_5/ha either through single superphosphate or through diammonium phosphate with gypsum may be applied in P- and S-deficient soils for getting increased crop yield, oil and protein contents of groundnut.

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