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Effect of Principal and Inadvertently Applied Nutrients Through Different Fertilizer Carriers on the Yield and Nutrient Uptake by Groundnut

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ABSTRACT

A field experiment was conducted on a medium black calcareous soil during summer, 1981 to study the effect of principal (N & P) and inadvertently (S &Ca) applied nutriets on the yield and nutrients uptake by groundnut (*Arachis hypogaea* Linn.). The results revealed that individual application of urea (U), Triple superphosphate (TSP), elemental sulphar (ES) and ammonium sulphate (A S) did not affect the yield and nutrient uptake. Single superphosphate (SSP) applied alone significantly outyielded other carriers of P indicating beneficial effect mainly of S and to some extent of Ca. On equal N P basis, U+SSP, U+diammonium phosphate (DAP) + gysum (G), U+DAP+ES considerably increased yield, oil content and nutrient uptake over U+DAP. However, U+SSP produced better effect than U+DAP+G and U+DAP+ES. Of the latter two, the former was better than latter. Incorporation of Ca as calcium chloride with U+DAP did not produce significant effect on yield and nutrient uptake.

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INTRODUCTION

Nitrogen is applied to groundnut mainly through urea (U) and to some extent ammonium sulphate (AS), whereas P both through single superphosphate (SSP) and diammonium phosphate (DAP) in groundnut growing region of Saurashtra in Gujarat. But some times the farmers and extension workers of the region , based on their experience, point out the superiority of the AS over U and of U+SSP over DAP. This superiority of AS can be attributed to S and of SSP to S and Ca. This paper reports the results on the effect of principal inadvertenlty applied nutrients through different fertilizers on the yield, quality and nutrient uptake by groundnut (*Arachis hypogaea* Linn.).

MATERIALS AND METHODS

A field experiment in a randomised block design with four replications was conducted on a calcareous medium black clay soil (Table 1) of the farm of the Gujarat Agricultuaral University, Junagath during summer 1981. Taxonomically, these soils are classified as Ustochrepts. Treatments consisted of 25 kg N/ha and 50 kg P_2O_5/ha applied in various combinations with 30 and 38 kg S/ha and 56 and 76 kg ca/ha through different fertilizer carriers (Table 2). The treatments were based on the recommended dose of 25 kg N and 50 kg P_2O_5/ha. The dose for S for treatment covering this nutrient except those of AS was based on its equivalent quantity of 38 kg/ha derived from SSP used to supply 50 kg P_2O_5/ha while in case of AS treatment, it was 30 kg S/ha

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derived from this fertilizer. Similary incase of Ca, 76 kg derived from SSP and 56 kg from gypsum were considered as such but Ca from calacium chloride was applied equivalent to that obtained from gypsum.

The entire dose of each nutrient as per treatments was drilled at 10 -12 cm depth in rows 45 cm a part followed by drilling of groundnut seeds of variety 'GAUG 1' in the same row. After covering the row with soil, the plots were uniformly irrigated. A week after germination, thinning was carried out to maintain 10 cm space between plants. In all 13 irrigations each of 50 mm depth were applied, besides 30 mm of water received through rainfall on May 9, 1981.

At maturity, samples for pod and haulm were collected separately. Shelling percentage was worked out from 500 g sample and oil content from kernels was determined by soxhlet ether extraction procedure. Total nitrogen from the powdered samples of pod and haulm was determined separately by Kjeldahl's method and other nutrients from the diacid extract by the standard methods. Phosphorous was estimated by vana-domolybdophosphoric yellow color method, K by flame photometrically and Ca and Mg by EDTA (Jackson, 1973) and S by tubidometric method (Chaudhary and Cornfield, 1966). Micronutrient cations from the acid extract were estimated by Shimadzu atomic absorption spectrophotometer model AA-640-13.

RESULTS AND DISCUSSION

Effect of N, P and S

The results have clearlyshown that, despite deficiency of available N, P and S in the soil, individual application of these nutrients (U, TSP & ES) over control (C) was ineffective in significantly increasing pod and haulm yield, oil content (Table 2) and nutrient uptake (Table 4). However, individual application each of these nutrients significantly increased the concentration of P in both haulm and pod, of N in haulm and of S in pod. So also the application of N significantly increased its concentration in pod and that of S its concentration in haulm (Table 3). The ineffectiveness of the individual application of N, P and S in increasing yield, oil content and nutrient uptake could be due to inadequate supply of the other nutrients in the soil. The possibility of S deficiency for the reported poor response groundnut to N and P fertilization (Patel and Kanzaria, 1985) in soils of this region , even those deficient in these nutrients (Ghosh and Hasan, 1979, 1980) can not be ruled out. Marsonia (1980) reported about 20% soil samples deficient in heat soluble S in Junagath district. This contention is well supported by the fact that the combined application of any two (U+DAP, AS) or more (SSP, U+SSP, AS+TSP, U+DAP+Ca, U+DAP+ES) of these nutrients not only significantly out yielded the control (C) but also to their individual application (U, TAP & ES). Thus, the results clearly demonstrate the need of balance fertilization.

Effect of inadvertenlty applied sulphur

A comparison of AS over U on equal N basis, of SSP over TSP on equal P basis, AS+TSP over U+DAP on equal NP basis and U+SSP and U+DAP+G over U+DAP+Ca on equal NPCa basis isolates the effect of inadvertently applied sulphur. A perusal of the data (Tables 2, 3 & 4) reveals that the magnitude of the effect of different S treatments over those devoid of S in the respective comparative group is varied on the yield, quality and concentration and total uptake of nutrients. However, in most of the cases except AS+TSP, the former have shown their superiority over the latter in respect of these parameters. Thus, it can be inferred that on equal nutrient basis, this superiority of the former treatments is due to inadvertently applied S through the carriers covered in these treatments. The noted positive effect of U+DAP+ES over U+DAP supports the above inference. The better yield response and nutrient utilization to fertilizer carrieres incorporated with ES or those containly S are

expected in the S deficient (7.2 ppm heat soluble) soil (Table 1). The results also showed that, in general, the treatments with S improved the oil content but failed to effect the shelling percentage. Similar observations were also made by Chopra and Kanwar (1966), Yadav and Singh (1970) and Walker *et al.* (1976) on yield , oil content and nutrient utilization by groundnut. However, the poor performance of AS+TSP over U+DAP+ES especially in respect of pod and haulm yield remains upexplained.

Comparison of S containing treatments on NP or NPCa basis revealed that SSP has undoubtedly established its superiority over elemental S and gypsum in that order. The

TABLE 1

Physical and chemical properties of the soil of the experimental plot.

Soil characteristic	*Value*	
	0-15 cm	*15-30 cm*
Mechanical Composition		
Sand (%)	14.3	11.9
Slit (%)	22.1	23.3
Clay (%)	63.6	64.8
Textural Class	Clay	Clay
Chemical Composition		
pH (1:2.5)	7.9	7.6
E.C. (1:2.5) (mmhos/cm)	0.31	0.27
$CaCo_3$ (%)	30.8	32.6
C.E.C. (me/100 g soil)	42.4	40.8
Exch. Ca. (me/100 g soil)	29.4	26.1
Exch.mg. (me/100 g soil)	10.3	12.4
Organic Carbon (%)	0.63	0.58
Total N (%)	0.06	0.05
Available P (P_2O_5 kg/ha)	18.9	17.5
Available K (K_2O kg/ha)	378	324
Heat soluble sulphur (ppm)	7.6	6.8

TABLE 2

Effect of fertilizer treatments on yield and quality of groundnut.

Treatment	*Yield (Q/ha)*		*Shelling*	*Oil*
	Halum	*Pod*	*(%)*	*content (%)*
Control (C) (0-0-0-0)	29.5	19.4	71.8	47.5
Urea (U) (25-0-0-0)	30.1	19.6	73.5	47.7
Triple super-(0-50-0-0) Phosphate (TSP)	30.7	20.3	73.3	47.8
Elemental (0-0-38-0) Sulphur (ES)	30.5	19.9	73.7	48.2

1	2	3	4	5
Urea + Diammonium Phosphate (U+DAP) (25-50-0-0)	33.0	22.9	74.1	48.5
Ammonium sulphate (AS) (25-0-30-0)	31.3	20.9	73.7	48.4
Single superphosphate (SSP) (0-50-38-76)	35.2	25.3	74.6	49.2
Urea + Single superphosphate (U+SSP) (25-50-38-76)	35.5	25.4	74.7	49.7
Ammonium sulphate + Triple superphosphate (AS+TSP) (25-50-30-0)	32.7	21.4	74.5	49.1
Urea + Diammonium phosphate + Gypsum (U+DAP+G) (25-50-38-56)	34.7	24.7	74.6	49.3
Urea + Diammonium phosphate + Calcium chloride (U+DAP+Ca) (25-50-0-56)	33.4	23.3	73.7	47.5
Urea + Diammonium phosphate + Elemental sulphur (U+DAP+ES) (25-50-38-0)	34.2	23.7	74.6	49.1
C.D. (5%)	2.33	2.69	NS	0.95

Note: Figures in brackets indicate nutrients applied in kg/ha as N-P_2O_5-S-Ca.

TABLE 4

Effect of different fertilizer treatments on total uptake of nutrients by groundnut.

Treatments	*Total uptake*									
	kg/ha						*g/ha*			
	N	*P*	*K*	*Ca*	*Mg*	*S*	*Fe*	*Cu*	*Mn*	*Zn*
C	120.6	10.7	68.2	37.3	22.2	7.3	2033.0	93.9	326.7	369.8
U	126.7	11.3	70.0	38.4	22.8	7.8	2086.3	106.2	343.9	373.5
TSP	127.0	12.0	72.0	39.6	23.4	7.8	2167.2	113.0	358.5	307.6
ES	126.6	11.6	72.8	38.9	23.4	8.1	2125.2	118.3	370.3	345.6
U+DAP	145.3	13.5	85.3	44.3	25.8	8.8	2385.6	124.6	435.3	358.6
AS	136.5	12.1	78.1	41.0	24.5	8.7	2250.4	122.4	399.0	359.8
SSP	159.4	14.9	92.3	48.6	28.6	10.0	2663.7	144.3	483.7	418.4
U+SSP	161.3	15.3	95.2	50.0	28.7	10.2	2661.6	145.8	476.9	424.1
AS+TSP	145.2	13.2	85.7	44.2	25.9	8.9	2334.4	126.9	409.1	352.4
U+DAP+G	156.8	14.9	93.0	49.8	28.3	10.2	2576.4	144.1	468.2	389.2
U+DAP+Ca	147.5	13.6	86.2	45.8	26.1	8.8	2446.5	122.8	409.1	364.9
U+DAP+ES	152.4	14.3	91.0	46.5	27.3	9.7	2514.5	133.5	449.6	407.4
CD (5%)	9.6	0.7	4.7	2.9	1.0	0.6	157.5	5.2	69.8	37.8

TABLE 3

Effect of different treatments on concentration of nutrients in haulm and pod.

Treatment	Haulm										Pod									
	N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu
	(%)						(ppm)				(%)						(ppm)			
C	2.11	0.198	1.91	1.17	0.61	0.158	450	97	73	14	3.01	0.253	0.64	0.14	0.21	0.138	364	21	79	28
U	2.20	0.207	1.92	1.18	0.62	0.162	454	98	73	16	3.07	0.258	0.63	0.15	0.22	0.146	366	24	80	29
TSP	2.25	0.213	1.93	1.19	0.62	0.159	461	102	63	17	3.01	0.269	0.63	0.15	0.22	0.144	371	22	71	30
ES	2.17	0.210	1.98	1.18	0.62	0.168	454	106	66	17	3.03	0.260	0.63	0.15	0.22	0.149	369	24	73	33
U+DAP	2.25	0.220	2.13	1.23	0.63	0.164	464	115	61	16	3.09	0.272	0.66	0.16	0.23	0.147	374	25	68	32
AS	2.28	0.210	2.08	1.21	0.63	0.176	469	112	66	17	3.12	0.262	0.63	0.15	0.23	0.155	375	24	74	33
SSP	2.27	0.224	2.16	1.26	0.65	0.174	483	120	66	18	3.11	0.275	0.64	0.17	0.23	0.152	382	24	73	32
U+SSP	2.29	0.230	2.20	1.28	0.64	0.179	478	117	67	18	3.15	0.281	0.67	0.18	0.24	0.153	380	25	74	33
AS+TSP	2.28	0.224	2.19	1.24	0.64	0.178	470	111	63	17	3.14	0.273	0.67	0.17	0.24	0.155	374	22	69	34
U+DAP+G	2.28	0.229	2.20	1.30	0.65	0.180	475	118	63	17	3.14	0.280	0.67	0.19	0.23	0.161	375	23	68	34
U+DAP+Ca	2.26	0.220	2.13	1.26	0.63	0.162	468	106	62	16	3.10	0.270	0.66	0.16	0.22	0.146	380	23	68	30
U+DAP+ES	2.29	0.228	2.20	1.24	0.63	0.176	475	115	67	16	3.15	0.273	0.67	0.17	0.24	0.155	375	23	76	33
C.D. (5%)	0.03	0.004	0.07	0.02	0.01	0.007	NS	NS	NS	NS	0.04	0.005	0.02	0.02	0.01	0.004	NS	1.3	NS	3.2

poor performance of ES may be attributed to its nonavailability as sulphate in early growth period of the crop as it requires 3-4 weeks period for oxidation to sulphate (Kittams, 1963). Although the differences in yield and nutrient uptake between U+SSP and U+DAP+G were nonsignificant, the edge of the former over the latter may be due to variation in physical and chemical composition of S containing carriers in these treatment, in addition to a little higher amount of Ca added in the former treatment than in the latter one (Table 2).

Effect of inadvertently applied calcium

With a few exceptions, the effect of inadvertent supply of Ca through different fertilizer carriers, namely U+SSP and U+DAP+G over U+DAP+ES and U+DAP+G over U+DAP was almost nonsignificant. However, treatments carrying Ca have edge over those without Ca. As such beneficial effect of Ca either as calcium chloride or its inadvertant supply through different fertilizers is not expected in the soil under study , for it is highly calcareous and its exchange complex is predominantly occupied by Ca^{++}.

From the foregoing results, it may be concluded that groundnut did not respond to individual application each of N, P and S, when the soil is deficient in N or P or S or any two or all three of these nutrients. However, combinations, especially of N, P and S increase not only yield but also improve quality and nutrient utilization by the crop. The significantly better effect of AS, SSP and gypsum is mainly due to their S content. Therefore, the results of this study definitely stress the need for S fertilization to the groundnut crop, where (i) soils are deficient in available S, (ii) fertilizer devoid of S are in vogue and (iii) intensive cropping is a normal practice especially where two crops (Kharif and Summer) of groundnut are included in the cropping as found in Saurashtra.

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