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Effect of foliar application of potassium nitrate and calcium nitrate on groundnut (*Arachis hypogaea*)

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ABSTRACT

A field experiment conducted during the spring season of 1996 and 1997 at Baruipur in gangetic alluvial soil showed that foliar application of potassium nitrate (0.25%) and calcium nitrate (0.203%) to groundnut (*Arachis hypogaea* L.) during 50% flowering stage increased the growth parameters and yield attributes which ultimately resulted in higher pod yield than foliar spray of KNO_3 @ 0.50 and 1.00% and $Ca(NO_3)_2$ @ 0.406 and 0.812%, water spray and the control. There was 71% yield increase over the control.

***Key words*:** Groundnut, Potassium nitrate, Calcium nitrate, Foliar application

Groundnut is a recent introduction in spring season after wet-season rice in gangetic alluvial land of West Bengal. However, the productivity is remarkably low due to poor management of fertilizers. In certain plant species, such as legumes, drop of flowers and developing pods is a major yield-limiting factor. Nitrogen deficiency during the flowering period enhances flower drop and depresses seed yield correspondingly (Streeter, 1978).

Since late application of N delays the synthesis of abscisic acid, promotes cytokinin activity and causes higher chlorophyll retention (Brevedan and Hodges, 1973) and thereby higher photosynthetic activity in effective leaves for the supply of current photosynthates to the grains (Yoshida 1972) for higher yield. Foliar fertilization with N during appropriate period of crop need may increase crop productivity by enhanced uptake and assimilation of nutrients. Legumes, in general, require high amount of K (Romaine, 1957). Calcium is an important nutrient in groundnut (Brady, 1947). Hence the present study was initiated to investigate the effect of foliar application of potassium nitrate and calcium nitrate on groundnut in gangetic

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alluvial soil.

MATERIALS AND METHODS

The field experiment was conducted during the spring season of 1999 and 1997 at the experimental farm, Baruipur, in gangentic alluvial soil having 0.72% organic carbon, 30 kg available P_2O_5/ha and 260 kg available K_2O/ha with pH 6.0. The treatments consisted of foliar spray of potassium nitrate, calcium nitrate and their combination, water spray and control (Table 1). Foliar spray of KNO_3 and $Ca(NO_3)_2$ at 2 concentrations, supplied equal amount of NO_3-N as per concentration of respective treatment (Table 1). Total 7 treatments were tried in randomized block design with 4 replications. A basal dose of 20 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha was applied in all the treatments. 'AK 12-24' groundnut was sown on 16 January 1996 and 18 January 1987 with a spacing of 30 cm × 10 cm, giving 333,000 plants/ha. Dilute solutions of nutrient salts as per treatment were applied @ 800 litres water/ha as foliar spray during 50% flowering stage of the crop. Teapol, a surfactant, was also mixed @ 0.5 ml/litre water to make the spray retention more effective. Total 3 irrigations were applied at critical stages of the crop. The observations for growth and yield-attributing parameters were recorded from 10 random plants in each plot. Two plant samples were randomly removed from the border rows for data collection on physiological parameters. The crop was harvested 132 days after sowing. Pod and haulm yields were recorded on net plot size.

RESULTS AND DISCUSSION

Growth attributes

The various growth and physiological characters of groundnut were significantly influenced by different foliar spray treatments (Table 1). The sprays of KNO_3,

Table 1. Effect on foliar spray of potassium nitrate and calcium nitrate on growth of groundnut (pooled data of 2 years)

Treatment	Rate (kg/ha)	Plant height (cm)	Leaf-area index at 60 days*	Dry-matter production (g/plant)	Crop growth rate (g/plant/day) at 60-80 days*
Control		37.6	2.14	10.6	0.203
Water spray		39.2	2.34	11.3	0.251
KNO_3, 0.50%	4.0	45.2	2.96	12.8	0.263
KNO_3, 1.00%	8.0	43.9	2.89	12.5	0.261
$Ca(NO_3)_2$, 0.406%	3.2	46.8	3.01	13.87	0.265
$Ca(NO_3)_2$, 0.812	6.4	45.7	2.99	13.79	0.264
KNO_3, 0.25% +	2.0+	48.6	3.11	14.60	0.285
Ca $(NO_3)_2$, 0.203%	1.6				
CD ($P = 0.05$)		3.42	NS	1.51	0.018

*Days after sowing

$Ca(NO_3)_2$ and their mixture were found superior to water spray and unsprayed control for growth and physiological parameters (Table 1). Spray of moisture of KNO_3 @ 0.25% + Ca $(NO_3)_2$ @ 0.203% appreciably improved growth parameters like plant height, leaf-area index and crop-growth rate and consequently the overall crop growth in terms of dry-matter accumulation. The mixed spray of KNO_3+ $Ca(NO_3)_2$ influenced the vigour of the plant through effective absorption of nutrients at critical stage, resulting in enhanced physiological activity and increased dry-matter production. Increase in growth and physiological attributes due to application of such mixed spray at critical stage could be ascribed to the overall improvement in plant growth, vigour and production of photosynthates owing to increased availability, absorption and translocation of nutrients in plants.

Yield attributes

Foliar application significantly affected the yield attributes of groundnut (Table 1). Mixed spray of KNO_3 @ 0.25% + $Ca(NO_3)_2$ @ 0.203% during 50% flowering stage resulted in significantly more number pods/ plant, pod weight/plant, length of pod and kernel/pod than foliar spray of KNO_3 @ 0.50% and 1.00% Ca $(NO_3)_2$ @ 0.406 and 0.812%, water spray and unsprayed control. However, 100-kernel weight did not show significant variation. Beneficial effect might be attributed to the fact that foliar application met the N requirement of the crop during flowering and post-flowering periods resulting in greater availability, absorption, and assimilations

Table 2. Effect of foliar spray of potassium nitrate and calcium nitrate on yield characters and yield of groundnut (pooled data of 2 years)

Treatment	Rate (kg/ha)	Pods/ plant	Length of pod (cm)	Pod weight/ plant	100-kernel weight (g)	Pod yield (q/ha)			Haulm yield (q/ha)	Harvest index	Shelling (%)
						1996	1997	Pooled			
Control		8	2.0	6.5	34.0	13.8	14.2	14.0	43.0	0.246	66.0
Water spray		10	2.5	7.3	34.4	16.7	16.3	16.5	43.7	0.274	66.9
KNO_3, 0.5%	4.0	14	3.0	9.8	34.8	20.8	21.8	21.2	51.5	0.292	70.1
KNO_3, 1.00%	8.0	15	3.2	10.7	34.7	20.4	19.6	20.0	54.3	0.262	67.0
Ca $(NO_3)_2$, 0.406%	3.2	12	4.5	9.6	34.9	22.3	22.7	22.5	52.2	0.301	65.0
Ca $(NO_3)_2$, 0.812%	6.4	17	3.8	10.9	35.0	19.0	18.6	18.8	48.5	0.278	60.0
KNO_3, 0.25% + Ca $(NO_3)_2$, 0.203%	2.0+ 1.6	18	4.8	13.8	34.5	23.7	24.3	24.0	43.5	0.354	73.0
CD (P = 0.05)		4.5	1.5	1.56	NS	2.25	1.28	1.94	3.7		

of nutrients and efficient translocation of assimilates to reproductive parts which eventually contributed to the high yield attributes.

Yield

Potassium nitrate (KNO_3, 0.25%) + calcium nitrate [$Ca(NO_3)_2$, 0.202%] when sprayed during 50% flowering gave significantly higher pod yield than sole spray of KNO_3 @ 0.50 and 1.00% and Ca $(NO_3)_2$ @ 0.406 and 0.812%, water spray and unsprayed control in both the years and also in pooled data (Table 2). This treatment resulted in 45.0 and 71.0% higher pod yield than water spray and unsprayed control treatment respectively, on pooled basis. It appears that nutrient salts like N, K and Ca supplied through foliar application of KNO_3 and $Ca(NO_3)_2$ at critical growth stage are effectively absorbed as cation and anion by the plants; assimilated and translocated more efficiently to the developing pods for proper filling which reflected in higher values of yield attributes and resulted in higher pod yield. Spray of mixture salts during flowering supplied N which might have delayed the synthesis of abscisic acid and promoted cytokinin activity (Brevendan and Hodges, 1973), causing higher chlorophyll retention which secured higher photosynthetic activity in effective leaves and in turn supplied the developing pods with current photosynthates and resulted in higher yield. Besides the beneficial functions of nitrate-nitrogen, the prevalence of K^+ and Ca^+ + in mixture salts might have improved growth of the crop with favourable effect on utilization of soil N and assimilation of NO_3^- in roots and leaves, and also enhanced photosythetic activity and facilitated partitioning of photosynthates (Barta, 1982), resulting in higher pod yield. Spray of either of the nutrients in lower concentration proved more beneficial. The mixed spray treatment gave higher shelling (%) and harvest index but lower haulm yield than KNO_3 and Ca $(NO_3)_2$ sole sprays. Increased harvest index under mixed spray was due to the increased physiological capacity of the crop to metabolize the photosynthates towards economic yield.

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