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SHORT COMMUNICATION

EFFECT OF SULPHURIC ACID ON CONTROL OF LIME INDUCED IRON CHLOROSIS IN GROUNDNUT

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To investigate the effect of sulphuric acid on control of lime induced iron chlorosis in groundnut, cv. TCGS-37 was grown in calcareous soil with different levels of sulphuric acid (0.0, 1.0%, 1.5%, 2.0% and 2.5%). Application of H_2SO_4 to soil decreased iron chlorosis and significantly increased chlorophyll content and active iron in leaves. Acid application increased the total dry matter and pod yield. H_2SO_4 at 2.5% concentration recorded higher dry matter compared to other treatments. The increase in pod yield can be attributed to increased availability of Fe, P and chlorophyll contents. Acid application of above 2.0% raised the DTPA-Fe level of the soil above the critical limit of 4.5 ppm by decreasing soil pH, $CaCO_3$ content and HCO^-_3 concentration. The results indicated that soil application of 2.5% H_2SO_4 was an effective means of controlling lime induced iron chlorosis in groundnut.

Key words : **Groundnut, iron chlorosis, sulphuric acid.**

Iron chlorosis of plants appears to be related to many soil factors. Besides soil pH, other factors such as bicarbonates has been shown to inhibit some of the mechanisms of response induced by iron deficiency, such as the root reducing capacity of Fe absorption and translocation to the leaves (Fleming *et al.* 1984). Acid application increases soil acidity, available Fe, P and crop yield (Khorsandi 1994). Wallace and Mueller (1978) showed that spot acidification of soil corrected iron chlorosis in soybeans. The purpose of this experiment was to study the effect of acid application on Fe availability and plant yield.

Green house experiment was conducted using the soil collected from the fields surrounding Tirupati, Andhra Pradesh, where lime induced iron chlorosis was observed in the previous crop. Soil was collected in bulk from the top 0-15 cm depth for study. Fifty kg of soil was placed in 50 kg capacity pots with a basal drainage hole at the bottom. Sulphuric acid at different rates (0.0, 1.0%, 1.5%, 2.0% and 2.5%) was applied to soil upto full saturation by plugging the drainage hole. After twelve hours of soaking, the drainage hole was opened and excess acid was removed by application of good quality tap water. The seeds of (6 seeds/pot) ground nut cultivar, TCGS-37 were planted. All pots were irrigated sufficiently to minimise water stress. Five acid treatments were replicated four times for a total of twenty pots.

The pH, free $CaCO_3$, HCO_3, and DTPA extractable iron in the soil was estimated as per the methods given by Richards (1954), Jackson (1973) and Lindsay and Norval (1978) respectively. For estimation of chlorophyll content and active iron (Fe^{2+}), third fully opened leaf from top was collected and estimated as per the methods described by Arnon (1949) and Katyal and Sharma (1980), respectively.

Application of H_2SO_4 to soil decreased iron chlorosis and significantly increased the chlorophyll content and active iron in leaves (Table 1). Kalbasi *et al.* (1986) observed similar results of increased chlorophyll and Fe^{2+} contents due to soil acidification. Total dry matter and pod yield increased with increasing levels of H_2SO_4 (Table 1). The increase in pod yield can be attributed to indirect effect on availability of Fe, P and chlorophyll content. In the present study, acid application increased the DTPA extractable Fe and active iron (Fe^{2+}) in leaves, P (data not given) and chlorophyll content. All these parameters might have contributed for optimum growth and finally the increased yield.

The soil pH decreased with the increase in acid concentration at both 30 and 60 DAS. The low pH levels were accompanied by large increase in DTPA extractable Fe at both the stages of crop growth (Table 2). Acid application of above 2.0% raised the DTPA-Fe level of the soil above the critical limit of 4.5 ppm. The change in soil pH may likely resulted in the change in Fe level because availability of Fe is pH dependent. The results suggest that the use of H_2SO_4 as a soil amendment would increase the availability of iron and evoke plant response. Ryan et al. (1975) showed that surface applied acid significantly increased DTPA extractable iron in calcareous soils from deficient levels to adequate levels which produced optimum plant growth.

Application of acid to soils increased available Fe to plants by decreasing pH, $CaCO_3$ and HCO^-_3. Higher concentrations of $CaCO_3$ and HCO^-_3 were mainly responsible for iron chlorosis in calcareous soils. Iron chlorosis was noticed in plants of untreated soils which contain high concentration of $CaCO_3$ and HCO_3 content at both the stages of crop growth (Table 2). The results were in agreement with the findings of Kalbasi *et al.* (1986) who reported that the reduction in $CaCO_3$ content from 22.0 to 0.5 per cent after acid application. High content of HCO_3 also inhibit the iron absorption or iron availability. Reduction of Fe^{3+} was inhibited more by bicarbonate than by high pH (Romera *et al.* 1992). Kalbasi *et al.* *(1986)* reported decrease in HCO_3 content from 6.5 to 1.8 mmol/l after acid application.

Table 1. Effect of different levels of acid application on total chlorophyll (mg g^{-1} f. wt), active iron (ppm), total drymatter and pod yield in groundnut.

Treatment	Total chlorophyll (mg g^{-1} f. wt.) 30 DAS	60 DAS	Active iron (ppm) 30 DAS	60 DAS	Total dry matter (g $plant^{-1}$) 30 DAS	60 DAS	Pod yield (g $plant^{-1}$)
Control	0.13	0.93	23.00	22.50	1.79	5.52	5.75
H_2SO_4, 1.0%	0.24	1.49	24.75	28.25	1.91	7.37	7.15
H_2SO_4, 1.5%	0.43	1.53	26.25	28.75	2.19	7.69	8.88
H_2SO_4, 2.0%	0.87	1.68	28.75	29.75	2.50	10.59	10.11
H_2SO_4, 2.5%	0.94	1.75	32.25	33.75	3.59	11.42	10.83
CD at 5%	0.05	0.07	1.19	0.98	0.30	0.52	0.66

Table 2. Effect of acid application on pH, $CaCO_3$, HCO^-_3 and DTPA-Fe in soil

Treatment	30 DAS				60 DAS			
	pH	$CaCO_3$ (%)	HCO^-_3 (ppm)	DTPA-FE (ppm)	pH	$CaCO_3$ (%)	HCO^-_3 (ppm)	DTPA Fe (ppm)
Control	8.23	5.43	520.0	1.60	8.40	5.66	532.7	1.81
H_2SO_4, 1.0%	7.50	4.80	324.0	2.79	7.43	5.10	300.3	2.82
H_2SO_4, 1.5%	7.33	4.46	297.7	2.85	7.06	4.50	289.0	2.98
H_2SO_4, 2.0%	6.80	3.53	185.0	4.55	6.73	3.70	184.0	4.61
H_2SO_4, 2.5%	6.53	2.66	170.7	4.79	6.26	3.46	171.3	4.85
CD at 5%	0.28	0.88	3.7	0.09	0.10	0.19	9.3	0.12

H_2SO_4 which is relatively inexpensive and an abundant byproduct of the battery industry, coal burning power plant and copper smelting industry could be used to increase p and Fe availability levels and minimize the use of commercial fertilizers. However, there is a need to conduct studies in the field to find out the doses of H_2SO_4 in ameliorating the lime induced iron chlorosis.

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