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CALCIUM - BORON INTERACTION IN THE SOILS AND THE GROUNDNUT

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ABSTRACT

This study explains calcium-boron interactions in groundnut plants grown on the soil treated with 0, 10, 20 and 30 per cent CaCO3 and 0, 0.5, 1.0 and 2.0 ppm boron. The calcium-boron interaction of the soil were also explained by post harvest soil analysis and boron adsorption studies in the laboratory.

Calcareous soils are known for the low boron availability to economical crop production (Fox, 1968). The problem becomes more acute when the crop like groundnut which needs high amount of calcium and boron is grown in these soils. The calcareous soils pose some nutritional problems with respect to boron availability due to Ca-B antagonism (Patel and Golakiya, 1986). The present study was therefore undertaken to investigate the effect of Ca-B interactions on the yield attributes of groundnut, boron uptake by this crop and boron availability in the soil.

MATERIALS AND METHODS

A pot experiment was conducted on a medium black, calcareous clay soils with four levels, of $CaCO_3$ namely, 0, 10, 20, 30 per cent and four levels of boron namely, 0.0, 0.50, 1.00, 2.00 ppm with three replications in a completely randomized design. The soil has average values of pH (1:2.5) 7.4, EC (1:2.5) o.16 mmhos/cm, $CaCO_3$ 3.5 per cent, CEC 53.0 me/100g with exchangeable Ca 41.5 and Mg 6.4 me/100g. Organic carbon was 0.59 per cent, Olsen's P 2.0 ppm P_2O_5, available K 180 ppm K_2O and hot water soluble boron 0.66 ppm. Calcium carbonate (3 mm size with 92% purity) and borax ($Na_2B_4O_7.10H_2O$) were used as sources of $CaCo_3$ and boron, respectively. Required quantities of N @ 25 ppm and P @ 50 ppm P_2O_5 as a basal dose through urea and DAP were mixed with the soil. Then each of the polyethylene lined earthen pots (37.5 cm x 37.5 cm x 25 cm) was filled with 13 kg of the treated soil. Seven bold seeds of groundnut cv GAUG-1 were sown which were thinned to three plants, a week after germination. The pots were irrigated uniformly with demineralized water throughout the crop season. The plant samples were digested in a tri-acid mixture as described by Jackson (1967). The calcium was determined from the acid extract by versanate method and boron was determined from the dry ash of plants using curcumin (Jackson, 1967).

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After harvest, the soil was analysed for available calcium (versanate) and hot water soluble boron (hws-B) concentration.

To know the effect of $CaCo_3$ on boron adsorption, duplicate air-dried soils samples (3g) from four treatments of $CaCo_3$ were equilibriated by shaking for 18 hours with 20 ml solution of boric acid at several concentrations between 0 to 80 ug B/ml in 50 ml of polypropylene centrifuged tubes. After centrifugation, the aliquotes of clean solutions were analysed for boron. The difference in boron concentrations before and after equilibrium represented the amount of boron adsorbed by the soil. The adsorption data were fitted to Langmuir adsorption isotherm and boron adsorption capacity (b) was calculated from equation :

$$\frac{c}{X/m} = \frac{1}{Kb} + \frac{C}{b}$$

Where C = equilibrium boron concentration

X/m = adsorbed B (µg/g soil)

b = adsorption capacity (µg B/g soil)

K = constant related to bonding energy (m1/mg)

RESULTS AND DISCUSSION

Yield attributes :

Interaction effect of calcium and boron becomes evident from Fig. 1. Flower number per pot decreased from 192 to 166 as $CaCO_3$ levels increased from 0 to 30 per cent under boron control. On the contrary flower counts increased from 192 to 206 as boron level increased from 0 to 2.0 ppm, respectively. However, when each $CaCO_3$ level superimposed by varying levels of boron, the adverse effect of $CaCO_3$ was curtailed, as evidenced by 166 flower counts under 30 per cent $CaCO_3$ without boron; and 182, 189 and 192 flowers per pot under 0.5, 1.0 and 2.0 ppm boron, respectively under the same level of $CaCO_3$. This is because of the involvement of boron in pollen viability and flower fertility (Garg et al., 1979). Similar effect was transmitted to the total number of pegs whereby adverse effect of $CaCO_3$ was mitigated by increasing levels of boron. Number of pods is a pivotal yield attribute as it determines the yield, grade and price of marketable groundnut. The number of pods almost doubled as $CaCO_3$ level increased from 0 to 30 per cent. This could be because of the lime induced starvation of the other nutrients espeacially of boron as evinced by sharp decline in the number of pods under different levels of $CaCO_3$ with advancing levels of boron. This also affected the number of pods per pot in the similar fashion. Numerous evidences are available (Cox and Reid, 1964; Yadahalli et al., 1970; Hill and Morrill, 1975) in which improvement of the groundnut grade and yield were reported by boron fertilization under different degree of calcareousness. It is also true that positive effect of boron on yield attributes was decreased with increasing levels of $CaCO_3$. This could be because of Ca/B

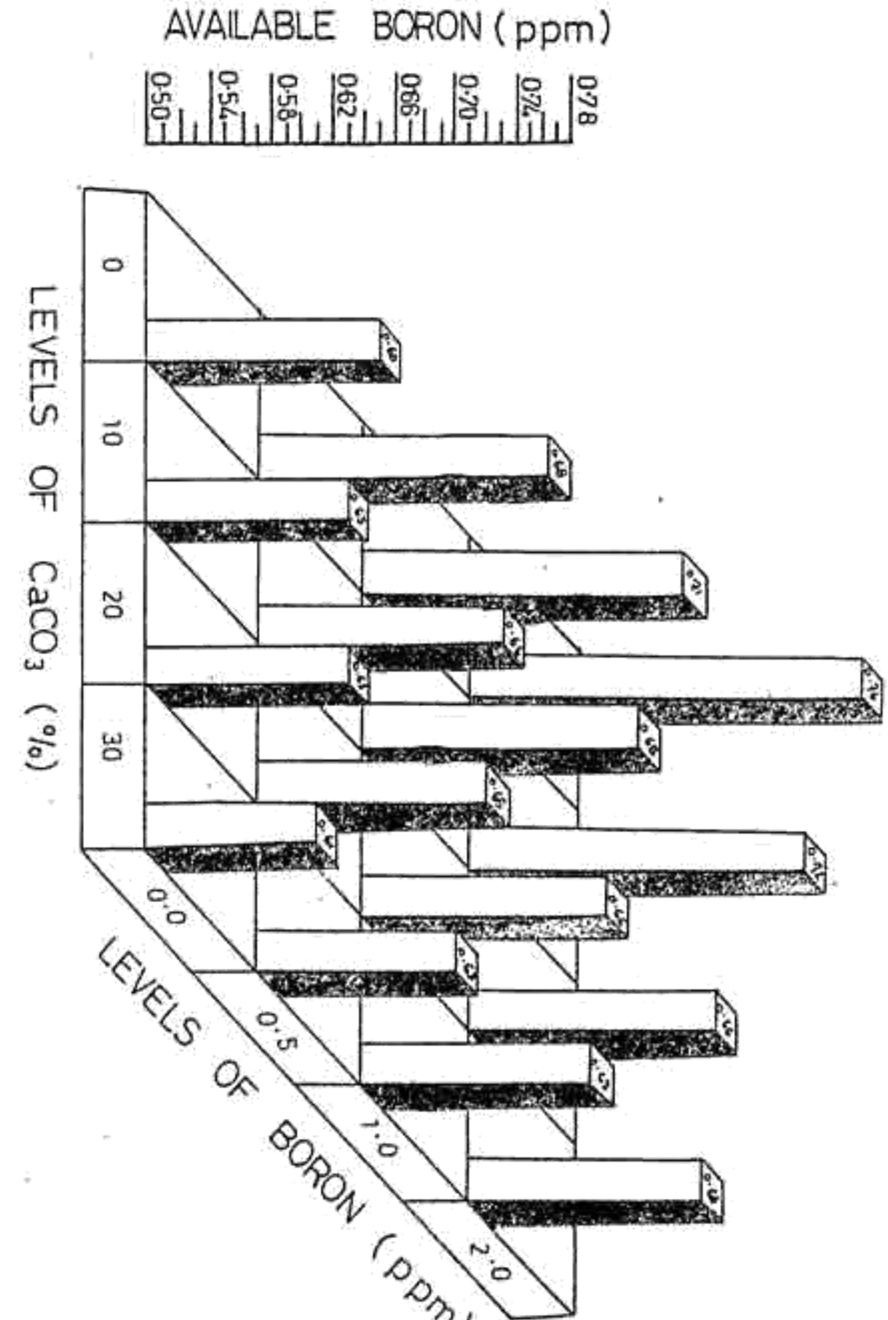

FIG. - 3 AVAILABLE BORON (ppm) AS A FUNCTION OF $CaCO_3$ AND BORON LEVELS.

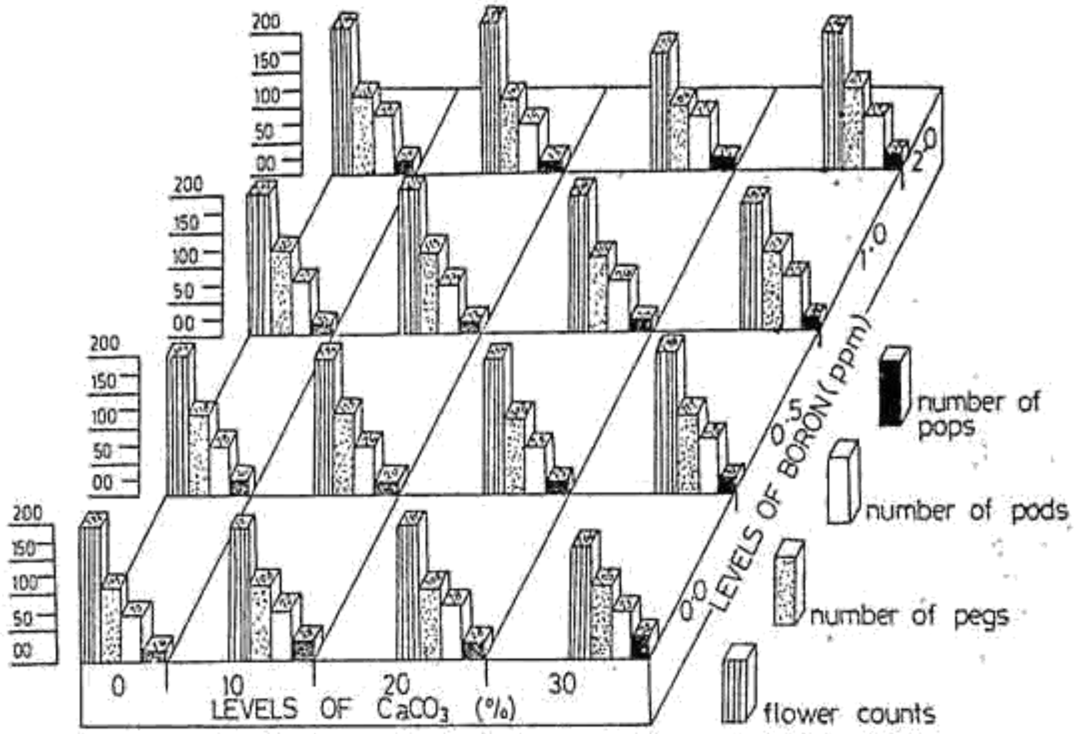

FIG. 1 INTERACTION EFFECT OF $CaCO_3$ AND BORON ON YIELD ATTRIBUTES OF GROUNDNUT POT^{-1}

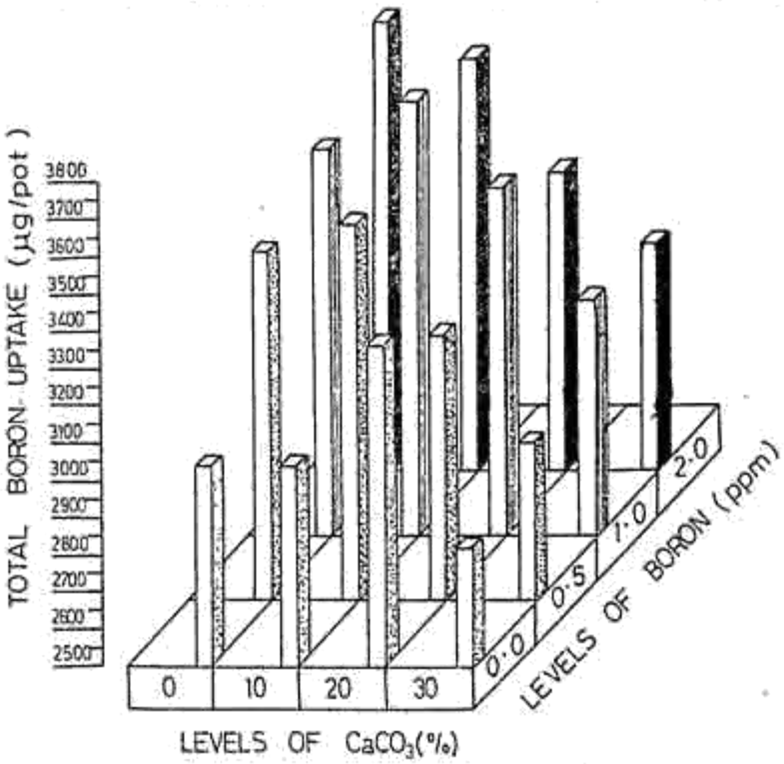

FIG. 2 TOTAL BORON UPTAKE (µg/pot) AS A FUNCTION OF $CaCO_3$ AND BORON LEVELS.

antagonism as revealed by boron uptake under different levels of $CaCO_3$.

BORON UPTAKE

The uptake of boron gradually increased as the level of a fertilization advanced. However, it was sharply curtailed when each boron level was superimposed with the $CaCO_3$ levels except 10 per cent $CaCO_3$. This is because of the higher dry matter yield under this level. The uptake of boron at different levels of B was reduced to almost half of the initial when $CaCO_3$ increased from 0 to 30 per cent. The reduction of functional boron status of plant due to the calcicole nature of groundnut could be one of the reason (Gopal, 1970). Further, Ca/B interaction in soil could illuminate this point.

BORON AVAILABILITY :

Available boron diminished from 0.76 ppm at native CaCO3(3.5%) to 0.65 ppm at 30 per cent $CaCO_3$ under 2.0 ppm boron levels. The possible reasons to this effect are : (i) conversion of soluble sodium borate in to sparingly soluble calcium borates (Gupta and Chandra, 1972) and (ii) adsorption of boron on the crystaline $CaCO_3$; (Keran and Gast, 1981). The later explanation can be evidenced by the data of adsorption study (Table 1). Boron adsorption capacity of soil having 0, 10, 20 and 30 per cent $CaCO_3$ was 24, 38, 57 and 78 µg B/g soil, respectively. The adsorption capacity of boron almost doubled in 30 per cent $CaCO_3$ level over that of control. These results are in conformity with the findings of many workers (Mezuman and Keren, 1981.)

Calcareous soils limit the yields of calcicole-legumes especially of groundnut on account of lime induced boron deficiency. Therefore boron fertilization according to the degree of calcareousness can solve the problem of boron starvation.

TABLE 1 : Boron adsorption capacity (b) of soils as a function of its $CaCO_3$ content.

$CaCO_3$ contents of soil(%)	Boron adsorption capacity (µgB/g soil)
0	24
10	38
20	57
30	78

(r = + 0.8619**)

REFERENCES

COX, F.R. and REID. 1964. Calcium-boron nutrition in relation to concealed damage in peanuts. J. Am. Soc. Agron., 56 : 173-76.

FOX, R.H. 1968. The effect of calcium and pH on boron uptake from high concentration of boron by cotton and alfalfa. Soil Sci. 106 : (6) : 435-49.

GARG, O.K., A.N. SHARMA and G.R. KONA. 1979. Effect of boron on the pollen viability and yield of rice plant. Plant and Soil 52 : 591-94.

GOPAL, N.H. 1970. Uptake and accumulation of boron by groundnut and sorghum plants. J. Indian Soc. Soil Sci. 18 : 335-40.

GUPTA. I.C. and H. CHANDRA. 1972. Effect of gypsum in relation to boron hazard of saline water and soil. **Ann. Arid zone.** 11 : 228-30.

HILL, W.E. and L.G. MORRILL. 1975. Boron, calcium and potassium interactions in peanut. **Proc. Soil Sci. Am.** 39 : 80-84.

JACKSON, M.L. 1967. Soil Chemical Analysis, Printice, Hall, India, pp 496.

KERAN, R. and R.G. GAST. 1981. Effect of wetting and drying and of exchangeable cations on boron adsorption and release by montmorillonite. **Soil Sci. Soc. Am. J.** 45 : 45-48.

MEZUMZN, U and R. KEREN. 1981. Boron adsorption by soils using a phonomenological adsorption equation. **Soil Sc. Soc. Am. J.** 45 : 722-26.

PATEL, M.J. and B.A. GOLAKIYA. 1986. Effect of calcium carbonate and boron on the yield and nutrient uptake by groundnut. **J. Indian Soc. Soil Sc.** 34: 815-20.

SESHADRI, C.R. 1962. "Groundnut", Monograph. Indian Central Oilseeds Committee, Hydrabad, pp. 87-88.

YADAHALLI, Y.H., G.D. RADDER and S.V. PATEL. 1970. Response of groundnut to major and minor elements in red sandy soils of Baduni. **Mysore J. Agric. Sci.** 4 : 208-9.

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EFFECT OF TRICYCLAZOLE AND MANCOZEB ON RICE PATHOGENS

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ABSTRACT

Tricyclazole and mancozeb effectively inhibited four vital functions viz., spore germination, germ tube elongation, mycelial growth and sporulation of four rice pathogens tested at different concentrations of the fungicides. Tricyclazole at 500 ppm was highly effective against **Pyricularia oryzae** and **Thanatephorus cucumeris** whereas a concentration of 1000 to 1500 ppm was required to inhibit **Helminthosporium oryzae** and **Sarocladium oryzae.** Mancozeb around 500 ppm was highly inhibitory to **P. oryzae,** at 1000 to 1500 ppm to **H. oryzae** and at 1000 to 2000 ppm to **T. cucumeris,** whereas even at 200 ppm it was inhibitory to mycelial growth of **S. oryzae.**

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