STUDIES ON BEHAVIOUR OF SOME MICROELEMENTS IN SOIL AND PLANT

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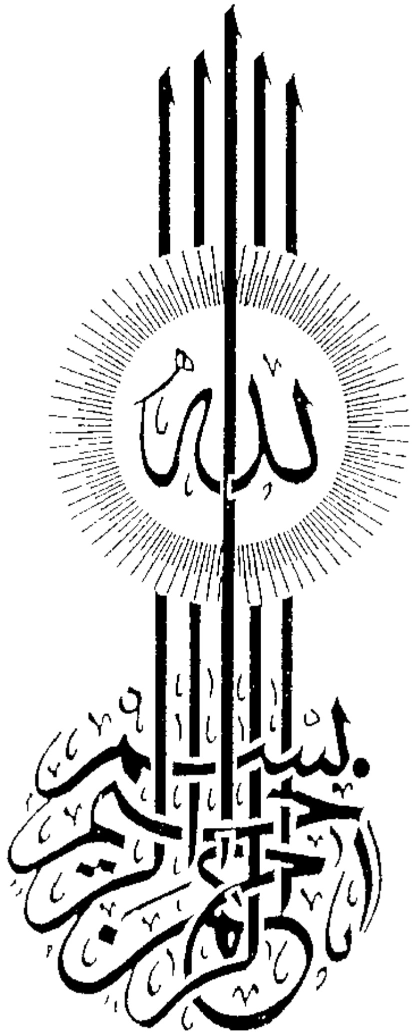
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INTRODUCTION

Soybean, one of the oldest cultured crop in the world,, is one of the most famous legume crops used for multiple purposes. It is frequently economical especially for its relatively high contents of protein, oil and fats. Both Calland and Clark cultivars are recommended for their early maturity; besides, it has recently proved to be commercially suitable in Egypt.

Nutritional conditions are one of the main factors which affect soybean production. Mn has several functions in plant particularly what concerning essentiality in photosynthesis and catalytic agency in nitrate reduction. It is also a constituent of some respiratory enzymes and some enzymes responsible for protein synthesis and carbohydrate metabolism. Zn plays an apparent role in protein synthesis, growth regulators as well as energy production in plants.

In fact, deficiency symptoms of both Mn and Zn in soybeans are apparent if the above ground parts of plant contain less than 15 ppm Mn or about 20 ppm Zn in the mature leaves. For correcting their deficiencies in the field, the most common practice is the addition of inorganic salts, such as sulphates, or chelated froms, foliar sprays being effective.

The aim of the current work is to study the effect of fertilization with Mn and Zn on behaviour of some macro and micronutrients in soybean plants grown under conditions of an alluvial soil, investigation being proposed to be later performed taking in consideration the availability of nutrients in soil .

2. REVIEW OF LITERATURE

Deficiency of both zinc and manganese is frequently observed with soybean plants; their availability and correction of their depression have been the interest of several investigations. One of the practices performed is the application of certain materials either through soil treatment or foliar spray techniques. Literature have manipulated such phase of study through several approaches one of which is the evaluation of plant behaviour under indicated practices.

2.1. Effect of manganese application on soybean behaviour:

2.1.1. Plant growth :

Manganese is an important micronutrient in soybean nutrition and subsequently for plant growth.

Steckel et al. (1948) found that dry matter yield of soybean is not significantly influenced by different rates (O to 20 lb $MnSO_4$/ acre) of applied manganese . Chu et al. (1963) added that application of Mn, B, Mo and Zn is not effective on growth of either vegetative or generative organs of soybeans. This is relatively different from results reported by Kumar et al. (1977) who reported that addition of 15-45 kg $MnSO_4$/ha to soil significantly increases both growth and dry matter accumulation, rate of application being not effective. Still an almost opposite trend has been obtained by Singh and Banerjee (1984), through pot trials, with soybean plants supplied with O- 40 ppm Mn for 10 weeks. Dry matter accumulation in the above ground plant parts has been significantly decreased at higher Mn rates.

Shuman et al. (1976) studied the effect of different sources of Mn, applied at various levels, on dry matter yield of soybean udner greenhouse trials . No responses have been obtained, whether Mn-EDTA or $MnSO_4$ is used, in spite of the high correlation encountered for Mn status in both plant and soil.

2.1.2. Nutritional status :

Several studies have been introduced for evaluating responses of nutritional status of soybean plants to Mn application .

2.1.2.1. Macroelements :

Haroun et al. (1978) , in pot trials, used microelements mixture containing O, 2, 4, 8 and 12 ppm Mn as foliar spray or 3 times these rates applied to the soil. They found that such practices are favorable for both nodulation and N content, increases being 73.6 % for the first and 95- 128 % for the latter with spray technique being superior to soil application. Opposite results have been,however, obtained by Kabi and Poi (1980) who found that both nodulation and N fixation by soybean decrease with application of both Mn and Cu.

Baza (1985) reported that organic form of Mn, foliary applied, at a rate of 0.03 % Mn EDTA significantly increases the total N content of different plant parts of soybean plants, such increase being expected due to favorable effect on growth expressed as dry matter content.

For soybean plant, Rizk _et al_. (1986) found that, in pot experiment, the phosphorus percentages (Calland cv.) are not affected by soil application of Mn (25 kg/ fed.)in both clay and loam soils.

2.1.2.2. Microelements :

Concerning responses of iron, Heenan and Campbell (1983) reported that its uptake is independent of solution Mn concentration although being increased with increasing its level; more iron is retained by the roots at high Mn level. Baza (1985) added that Fe content of different organs namely, leaves, stems and pods, increases significantly by foliar application of Mn- EDTA at the different stages of plant growth.

With respect to Mn responses, Steckel et al. (1948) reported that higher rates of $MnSO_4$ increase the Mn concentration from 15 to 109 ppm in the soybean plants. Similar results have been obtained by Saxena et al.(1971) who stated that application of different micronutrients either to the soil or as foliar spray, at flowering, increases their respective contents in all organs of plants, values being 11 - 11.2 mg/ kg in the above ground parts, 25- 90 mg/ kg in roots and 13- 17 mg/ kg in seeds with highest accumulation in the leaves. Parker et al. (1981) reported that concentrations of Mn in recently matured leaves vary among cultivars in untreated plots from 10 to 17 ppm and in Mn treated ones (22.4 kg Mn/ ha) from 20 to 28 ppm. They added that Mn treatments do not influence the concentration of nutrients (Cu, Fe and Zn) but not Mn in leaves and seeds of soybean cultivars. Wilson et al. (1983) found that Mn leaf concentration in both Mn treated (11 kg Mn/ ha) and untreated plots increases with increasing the time while, at a rate of 22 kg Mn/ha, the relative Mn concentration in the treated and untreated plots are nearly the same for all growth stages. More recently, Singh and Banerjee (1984) again reported that accumulation of Mn in plant greatly depends on its content in the growth medium.

The organic Mn form (Mn- EDTA) has been found by Baza (1985) to significantly increase the Mn content of both leaves and stems 100 days from application, the effect of (0.03 %) being more conspicuous than that of (0.06 %).

With respect to the effect of pH values on plant Mn levels, Shuman et al. (1976) reported that the higher soil pH results in much lower plant Mn. They added that the concentration of Mn in plants grown on pH 6.31 (Alapaha soil) responds to Mn sulphate at a lower rate (10 µg/ g) than with the pH 7.02 (Leefield soil, 50 ug/g).

Mn uptake by soybean plants has been studied by Heenan and Carter (1976) who found that it increases with each increment of solution containing 0 to 12 ppm Mn and being always markedly higher in roots than in shoots. The authors added that variations in both Mn uptake and distribution among cultivars and between roots and shoots are small.

Reddy et al. (1978) found that Mn is not favorable for absorption of Zn by roots as well as translocation to shoots of soybean seedlings, effects being of high magnitude at high level of Mn (5.0 ppm). This agrees with results of Gettier et al. (1985 b) who stated that foliar Mn application is depressive for Zn status in blades, petioles and seeds, depression being attributed to dilution obtained from increased plant growth due to foliar Mn application.

2.1.3. Yield and yield quality :

2.1.3.1. Seed yield :

Several investigations have been performed to evaluate responses of soybean yield to manganese application.

Randall et al. (1975 a and b) reported that Mn rates from 5 to 22 kg Mn/ha as $MnSO_4$ with the starter row fertilizer at planting time,appears to be most effective in increasing seed yield with no significancy for rate of application. This agrees with results obtained by Kumar et al. (1977) who found that soybean seed yields increase by application of 15- 45 kg $MnSO_4$ / ha to the soil, differences among used rates being not significant. Further studies have been performed by Parker et al. (1981) and Wilson et al. (1983) who added that seed yields of soybean increase from 1.99 t /ha without Mn to 3.12 t/ha with application of 22 kg Mn/ ha, 25 kg/ feddan being reported by Rizk et al. (1986) to be favorable for Calland variety .

Shuman et al. (1976) found that Mn sulphate,manganese oxide and fritted Mn, applied at rates variable between 5.6 to 22.4 kg/ ha are satisfactory sources and produced relatively high yields, Mn chelate being not effective except at the highest rate.

With respect of foliar practice of application , several investigations such as those of Rumple _et al_. (1967), Rebertson and Thompson (1970) and Randall and Schulte (1971) showed that multiple spraying of Mn (two times or more) is superior to single applications particularly if compared with soil addition (up to 40 lb/acre), almost one pound of sprayed Mn per acre being more suitable than 40 lb/ ac. $MnSO_4$ applied to soil. Feasibility of foliar application of manganese is reported to be related to soil conditions, regularity of spray program and time of discovery for deficiency symptoms. Kumar _et al_.(1977) and Kamel _et al_. (1983) added that 1.5- 4.5 kg Mn/ha or 150 ppm Mn spray is enough for a good production of soybean. Relatively different results have been obtained by Krishuarajan _et al_. (1973), Kroetz _et al_. (1973) and Jones (1977) who pointed out that foliar spray by $MnSO_4$ is either not favorable or even not effective, highest soybean yields being associated with lower leaf Mn concentration.

Finally,Axinte (1973) and Randall _et al_. (1975 a) reported that, foliar applications of Mn are most effective when applied at either flowering or early pod set stages or in multiple applications at both of these stages, single application of 2.24 and 4.48 kg Mn/ ha as $MnSO_4$or 0.51 kg Mn/ha as Mn- EDTA being a reason for burning of foliage.