RELATIONSHIPS BETWEEN SLUDGE DOSES AND CALCIUM CONTENT FROM AGRICULTURAL CROPS

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ABSTRACT

By applying sewage sludge has been a complete Ca concentrations in soil and therefore were induced and observed some positive influences in nutrition and plant physiology. This improved environment like maize, wheat and soybeans have absorbed and used in specific quantities to ensure their normal physiology. Increases were evident in maize and moderate in wheat and soybean. The functions indicated concentrations of 0.4 to 0.5 % Ca in field maize, and 0.1-0.3 % in the maize from vessels, and then between 0.2 and 0.3 % Ca in wheat(2) and 0.3-0.34 % Ca in wheat(4), and between 1.0-1.2 % Ca in soybean. As the mature seeds was uncertain relations with negative trends in relation to levels of harvest obtained. In absolute values grains contained as in: 0.048-0.020 % maize both in the field and in dishes, 0.10-0.07 % for wheat (2 and 4) and about 0.04 % for soybeans.

INTRODUCTION

Of all the elements of fertilizers in the soil, calcium (Ca) has a special status, specific. As natural reserves originate in many minerals and rocks, whose decomposition takes relatively complex characters (Lăcătuşu et al, 1974). This is where aragonite, calcite, dolomite, beritocalcite- of carbonates, apatite in the phosphate-arsenate-vanadates class and of silicates; chabazite (a zeo-silicate), labrador (a semi-precious tecto-silicate), Johannsenite (an ino-silicate), with some plagioclase feldspats (e.g. anortite). If white luvicsoil there is a dymanic equilibrium between the forms of Ca, equilibrium is shifted toward a constant adsorption by clay particles (Woodruff, 1955), or for consumption by plants and leaching (Epstein, 1972; Borlan et al, 1982; Mengel & Kirkby, 1987). However, the absolute amounts of luvicsoil Ca is insufficient for plant growth. Calcium here is unable to contribute and maintain the right of the base saturation of soil colloids (Tisdale & Nelson, 1975). Under these conditions ions exchangeable Al^{3+} dominate the clay exchange places, contributing to excessive soil acidity, and soluble Al^{3+} becames toxic to most plants (Marshall, 1953; Fleming & Foy, 1968; Thorup, 1969). The best way to correct the absence of Ca (deficiency) is the application of calcite amendments (dolomite). By limesting place of business or reducing the solubility of aluminium (Al) and manganese (Mn) (White, 1970), they are removed from the soil solution (SSol). However, in these circumstances, the fate of Ca release in soil solution (SSol) is considered less complex, quite simple. Thus, if the activity of nutrient decreases in SSol as possible washing od absorption, it trends to be replaced in the adsorption phase (Clarkson, 1985). If the Ca activity in SSol increases quickly unexpected (e.g. through limesting with calcite), it tends to follow the path of adsorption. As of Ca regime from SSol under these conditions becomes a status of inconsistency, either by weaker competition with other cations or by concentration fluctuation due to the contribution of amendments, and also by climatic factors. In addition, it was found that Ca^{2+} ions existing at some point in cultivated soil, it is particularly imporant in plant uptake (Black, 1968; Nemeth et al, 1970). Thus, it goes into the plant in a predominantly passive (Clarkson, 1985, with the flow of water through the apical area of the root with less *suberus*. Its movement occurs through xylem (wood vessels) with flows evapotranspiration (ET) and the pressure caused by root. As the plant circulation occurs acropetal and also accumulates in tissues and organs that passively sweat more, as observed for wate elimination by gutation. Redistribution through the phloem between organs and tissues is an-marked (Mengel & Kirkby, 1984), as well as between old vegetative organs (basal) and young (apical). It can be said that the Ca in plant has a weak body mobility. In plant tissue it is contained in vacuolar fluid in the form of salts of organic acids (oxalic acid, malic acid) and membrane structures as salts of pectic acids and phospholipids. In the enzyme system forms the structure of the polypeptide *calmodulin*, consisting of a chain of amino- acids containing 4 carbon atoms of Ca (Cheung, 1980). It is involved in the phosphorylation and transfer of chemical metabolism energy. Given the state of this chemical element necessary for plants, it required completing concentrations in the soil at all times (Davidescu & davidescu, 1981; Borlan et al, 1994). As found lime amendments apply as rock processed, it is very beneficial (Borlan et al, 1973; Thurston et al, 1976; Tropea, 1976). At the same time the use of organic fertilizers of any king, should be done carefully, as it may accelerate soil acidification. As is known, humus and organic matter (OM) containing reactive groups of type carboxyl-, phenolic-, and amino-, capable of binding the hydrogen ions (H^+). However, in larger quantities being in dynamic equilibrium with those SSol, creates acid that fund, undesirable for the the plants food (Tisdale & nelson, 1975). From this point of view, sewage sludge, an organic fertilizer latest taken in agricultural research, on the one hand can lead to a possible soil acidification as well as in addition it has a reserve of calcium (Ca), which have the composition of this nutrient in important concentrations i.e. between 3.1-4.2 % Ca in processed sludge (by anaerobic digestion) and between 2.1 and 2.5 % Ca in sludge compost. The paper presents the results obtained with different doses of sludge processed and composted with chemical fertilizers (such as NP) needed to ensure specific concentrations of Ca at the main plant of the agricultural field.

MATERIAL AND METHODS

Calcium in the agricultural regime was ensured by setting up complex agricultural experiments with stationary nature. These included a combination of rotation of 4 years with doses of sludge and chemical fertilizers. Plants were grown as maize, wheat and soybean slurry due doses: 0,5,10,25 and 50 t.ha^{-1} and of type NP fertilizers doses: o, half of the dose and 1/1 in normal doses resort conditions (Davidescu & Şuteu, 1971; Cottenie, 1978). Sewage sludge was applied to maize in the first year and to confirm its purpose were once applied doses of sludge to wheat second year, and sobeans and wheat in the past year to benefit from the effect of residual sludge. The experimental variants were surface of 100 m^2 in three replications. Another line of research consisted of maize cultivation in the same doses, but composted sludge. The experimental variants were obtained from the growth vessel such as buckets, and weighting 18-20 kg soil, the top surface of 700 cm^2, in five repetitions. Type experiment was similar with two factors and sub-divided parcels, with factors in combination of 5 doses of sludge and 3 doses of chemical fertilizers, a total of 15 (5 x 3) complex doses. The chemical analyses were made of concentrations of Ca from leaves and grains, according to SR EN ISO 14911-06. Plant samples were collected in two stages: at the plants blooming by analysis of leaves and in mature plant periods by analysis of seeds (Olson, 1971; Claassen & Wilcox, 1974). Data processing was performed using analysis of variance, Anova test, and Excel program to obtain correlations and regressions. Harnessing sludge being processed or composted in these agroecosystems has been a revival of this chemical element concentrations necessary for plant, calcium (Ca).

RESULTS OBTAINED

Evolution of Ca concentrations from maize plants (field conditions)

Applying complex with processed sludge doses with doses of chemical fertilizers, maize plants produced total biomass steadily increasing. Under these conditions, the concentrations of Ca in plants have been positively corelated with the biomass of maize- fig. 1.

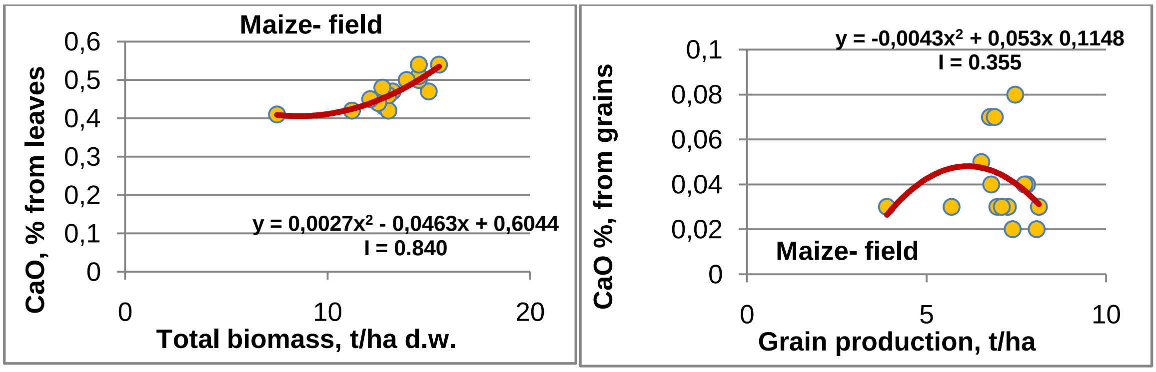

Fig. 1. Correlations between total biomass and grains with Ca contents from leaves and grains of maize from field fertilized organic and mineral

Thus, in the first versions of Ca content ranged around 0.4 % in the low doses of sludge, and in fertilized with higher doses of sludge Ca increased steadly to about 0.54 %. Values show a good group around the office (function). The correlation obtained with the Ca content in maize grains shows a relatively small increase in dose, a maximum followed by a decrease at dose levels (combinations(higher. The absolute position varied between 0.02 and 0.05 % Ca. Data were wide enough unevenness to function.

Evolution of Ca concentrations from wheat plants (2)

The climate enjoyed by wheat this year has been very favorable. In these conditions the plants produced higher plant biomass, of course, the difference between variations depending on the dose administered complex. Ca concentrations in leaves of wheat have evolved slightly increased in relation to the total dry matter produced- fig. 2.

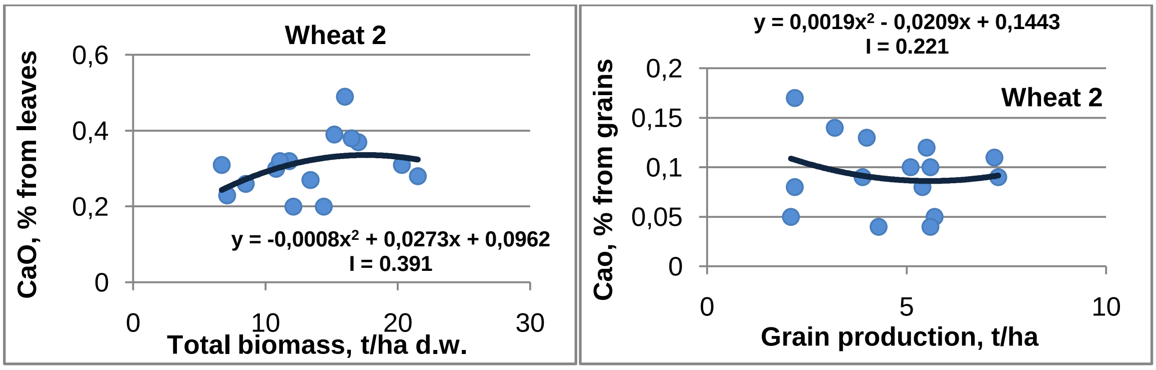

Fig. 2. Correlations between total biomass and grains with Ca contents from leaves and grains of wheat (second year) fertilized organic and mineral

The developments show calcium (% CaO) between 0.24 % the first options and 0.33 % during in higher doses. The correlation obtained between grain production and Ca concentrations show a relative decrease. The oscillated around 0.110 and 0.087 %, with a scattering of the data.

Evolution of Ca concentrations from soybean plants

In the first year od residual effect of sludge processed soybean contained Ca in leaves as in between 1.0 and 1.2 % with a group of poor data- fig. 3.

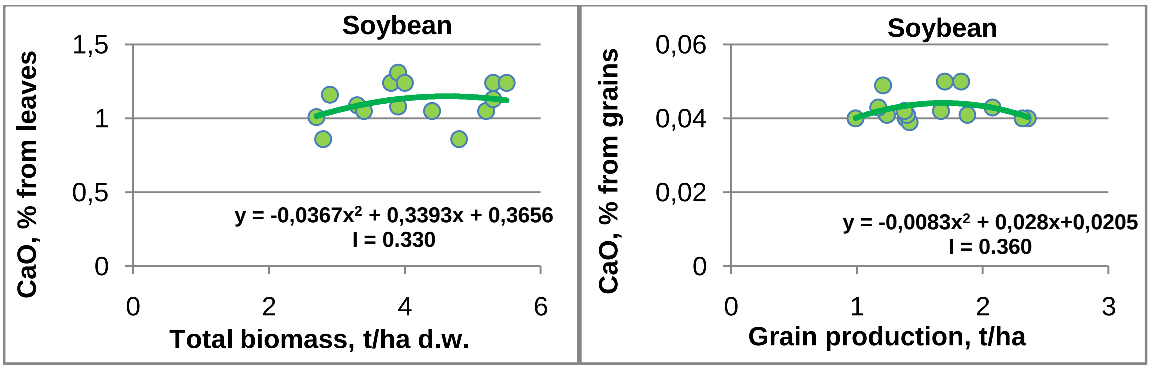

Fig. 3. Correlations between total biomass and grains with Ca contents from leaves and grains of soybean fertilized organic and mineral

In comparison to maize and wheat(2) soybean leaves contained Ca 2-3 times more. Mature soybean beans correlated positive to the first complex doses and negative variations in the case of the latter variant. As a function of the values showing the range of 0.04 and 0.045 %, based on the production of grain obtained.

Evolution of Ca concentrations from wheat plants (4)

Wheat this year benefited from the dry climate fund. In these conditions the concentration of ca leaves moved positively in the conjunction with total biomass formed- fig. 4. The data had a relatively tight group (I = 0.428).

Grain yield very poorly correlated with the concentrations of Ca in grains show a relative decrease function around 0.07 %.

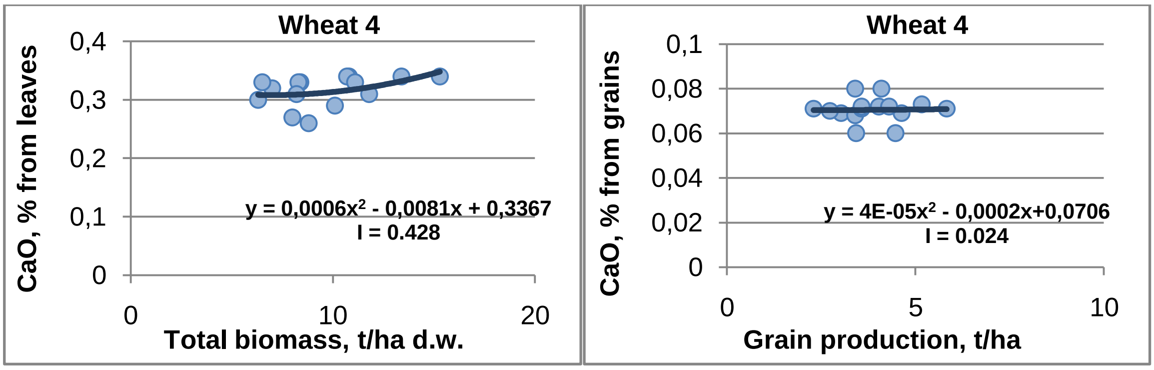

Fig. 4. Correlations between total biomass and grains with Ca contents from leaves and grains of wheat(4) fertilized organic and mineral

Evolution of Ca concentrations from maize plants (vessel condition)

Having a controlled environment like maize absorbed Ca in a direct, positive total plant biomass- fig. 5. Ca intake was made with sludge compost. The values show a fairly good group around the office, between 0.1-0.3 %.

As maize grains contained Ca had a predominantly negative relationship. If the first variable as having 0.04 %, in the following amounts this dropped into 0.02 %.

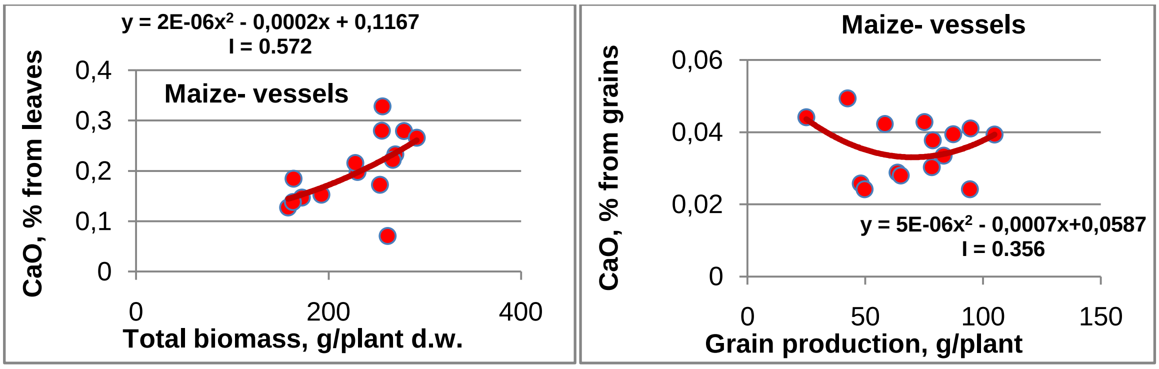

Fig. 5. Correlations between total biomass and grains with Ca contents from leaves and grains of maize from vessels fertilized organic and mineral

CONCLUSIONS

The sludge can be considered with the role of amendments, because average concentrations of Ca: 3.5 % on average in processed form (anaerobic digestion) and 2.5 % in the form of compost (with additional aerobic fermentation).

The field crops: maize, wheat and soybeans, total plant biomass produced in a positive relationship, increasing with complex doses of sludge and chemical fertilizers. Against this background plants absorbed and used more Ca.

Correlations of the total biomass and concentrations of Ca from leaves were positive in all cases. Values that ranged between 0.4 % of 7.5 $t.ha^{-1}$ maize plants and 0.52 % of 15.5 $t.ha^{-1}$ biomass produced in the field and 0.15-0.25 % in total biomass produced in vessels. Wheat since 2 content as between 0.23 % of 7.0 $t.ha^{-1}$ biomass and 0.33 % of 16-20 $t.ha^{-1}$ total biomass. Wheat from 4 year had 0.3 % of 7.0 $t.ha^{-1}$ biomass and 0.35 % of 15.3 $t.ha^{-1}$ total plant biomass. Soybean leaves have concentrations of Ca between 1.0 % of 2.8 $t.ha^{-1}$ biomass ans 1.3 % of 5.2-5.5 $t.ha^{-1}$ total plant biomass.

Ca was filed in matute grains. Concentrations of grains were negatively correlated with production capacity achieved. The limit values were between 0.03 and 0.48 % for maize from field and 0.044 to 0.04 % for maize from dishes. Content of wheat grains between were 0.11 and 0.075 % in the second year and 0.07 % in year four. Soybean kernels contain as the mature between 0.04 and 0.045 % Ca.

Concentrations of Ca determined by the dose of sludge and chemical fertilizers in this arrangements demonstrates special statements. Ca contents in plants increased with increasing doses of sludge. As the grain was negatively correlated with grain production, because at this stage of maturity Ca as chemical element was’n no longer necessary.

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