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The correlated study of manganese content in seeds of wheat, wheat plants and agricol soil

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Abstract

Among the trace elements required for a normal growth of the plants, Manganese is important, playing a definitive role in the metabolism. Manganese is considered essential for the life of plants and animals. It could be called "bioessential" element. The aim of the paper is to present a study of total manganese in soil, wheat grain and wheat plants. The quantification of Manganese was done by the spectrophotometric method. A kinetic of Manganese concentration in the growing of wheat plants, in the soil with known Manganese content, for one month period was done. The total Manganese from the soil, from the initial wheat grain and wheat plants grown only in distillated water was established too. The concentration of NO3 – in the agricol soil has measured.

The total manganese (II) of wheat grain has been 330.696 ppm. After 10 days of grown it was noticed the manganese (II) content of wheat plants was approximately constant for two both situations: wheat plants in normal soil and wheat plants in distillated water.

This fact allows us to presume that the wheat plants in the first two-three lives weeks grown supported by wheat grain manganese (II) content. A very strong correlation between pH of soil and content of Manganese has been found. At the 7.24 pH-value of soil although the soil has high manganese content (478.903 ppm) still the content of manganese from the wheat plants is about 125 -140 ppm during the experimented growing period of plants. After one month of wheat plants growing, the NO3 – concentration of the soil is increasing from 21 ppm initial value up to 28.5 ppm and pH values of soil slowly decreased the values being 6.7 in the end of experiments..

Keywords: Manganese, spectrophotometric method, wheat grain, soil, plants wheat.

1. Introduction

Manganese plays a crucial role in plants growth and development. The physiological functions of Mn^{2+} in plants are strongly related to redox potential (0,8V) and manganese (II) ions feature to turn easily into manganese (III) ions (reversible process).

Manganese as well as Fe, Cu, Zn, is involved into the process of chlorophyll synthesis. It is important for CO2 assimilation and photosynthesis process. The presence of manganese ions (Mn^{2+}) in plants is important for amino acids and proteins synthesis also.

Manganese ions are involved in membrane stability and as bio-catalytic cofactor for a range of anti-oxidant enzymes [1]. The possible transformations of manganese in soil could be as following:

$$Mn^{2+} \rightleftharpoons MnO_2 \cdot nH_2O \ (Mn^{4+})$$

$$MnO_2 \cdot nH_2O(Mn^{4+}) \rightleftharpoons Mn_2O_3 \cdot n\ H_2O(Mn^{3+})$$

$$Mn_2O_3 \cdot n\ H_2O\ (Mn^{3+}) \rightleftharpoons Mn^{2+}$$

Among these forms, only manganese (II) is available by plants. The manganese (III) and manganese (IV) from soil are unavailable and therefore can determine Mn^{2+} deficiencies in plants. The biological transformations of soil manganese are favoured by some mushrooms and

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autotrophic manganese oxidizing bacteria. Autotrophic bacteria oxidizing both NH^{4+} and NO_2^- to NO_3^- stimulate also the reduction of MnO_2 to Mn^{2+} [2].

2. Materials and Method

The studied seeds of wheat was purchased from the Department of Treatment of Grain Cereals, Galati. The soil was taken out from Covurlui plain. The used chemicals had an analitical purity.

The humidity of soil, wheat grain and wheat plants were determined with a drying stove. The measurements of pH and E (redox potential) of soil were made with pH-meter Tolledo Switzerland. The absorbance measurements were made using a SECOMAN Spectrophotometter S750I France.

Growing conditions.
Seeds of wheat *(Triticum aestivum* L.,) were soaked for 30 min in 0.35% $CaCl_2$/, thoroughly rinsed with distilled water and germinated in the greenhouse on vermiculite watered with distilled H_2O. After 4 days, seedlings with the same first-leaf size were transferred to the soil.

Preparation of standard solutions
A manganese (II) solution of known concentration was prepared. Peroxydisulfate, together with silver(I) as a catalyst, was added to oxidize manganese (II) to manganese (VII). The oxidation was carried out at the boiling point. The purple colour of permanganate develops as the oxidation proceeds. A nitrat solution of known concentration was prepared from a soluble salt in order to determine the calibration curve.

Preparation of vegetal and soil solutions
The vegetal materials and soil were disintegrated with the method described by D. Davidescu[3].

3. Results and Discussions

Experiments were repeated two times. The values are the average of the two or three individual results. The NO^{3-} concentration of agricol soil was determined by the colorimetric method [4].

The total content of managanese (II) from wheat grain, soil and wheat plants grown in distilled water, in normal soil and in soil enriched with manganese (II) was determined. The standard curve of manganese (II) has a linear equation: $y = 0.0474x - 0.0097$ and $r^2 = 0.9752$.

On the basis of the linear equation there was determined the content of total manganese from vegetal materials and soil. Results are presented in the fig. 1.

The total content of manganese (II) from wheat grain was 330.696 ppm. After 10 days of grown it was noticed that the manganese (II) content of wheat plants is approximately constant for two both situations: wheat plants in normal soil and wheat plants in distillated water.

The conclusion is that, in their early period of life, the wheat plants use only a little part of the available manganese contained by the wheat grain (a constant amount). In the case of the wheat plants growing in the soil enriched with manganese (II) the total content of manganese (II) is greater after 10 days of life (about 256 ppm) than at the wheat plants grown in the normal soil (151 ppm) or distilled water (140 ppm). The results are different from literature [5].

Soil pH-value was 7.24. In these conditions although the soil has a high manganese content (478.903 ppm) still the content of manganese from the wheat is decreasing during the first 17 days of plants growing.

Table 1. The pH-values and the NO_3^- concentration of agricol soil

Soil sample	**pH**	**NO_3^- (ppm)**
At the beginning of the experiments	7.24 ± 0.11	2 1± 0.2
After one month of the plants growing	6.7 ± 0.5	28.5 ± 0.04

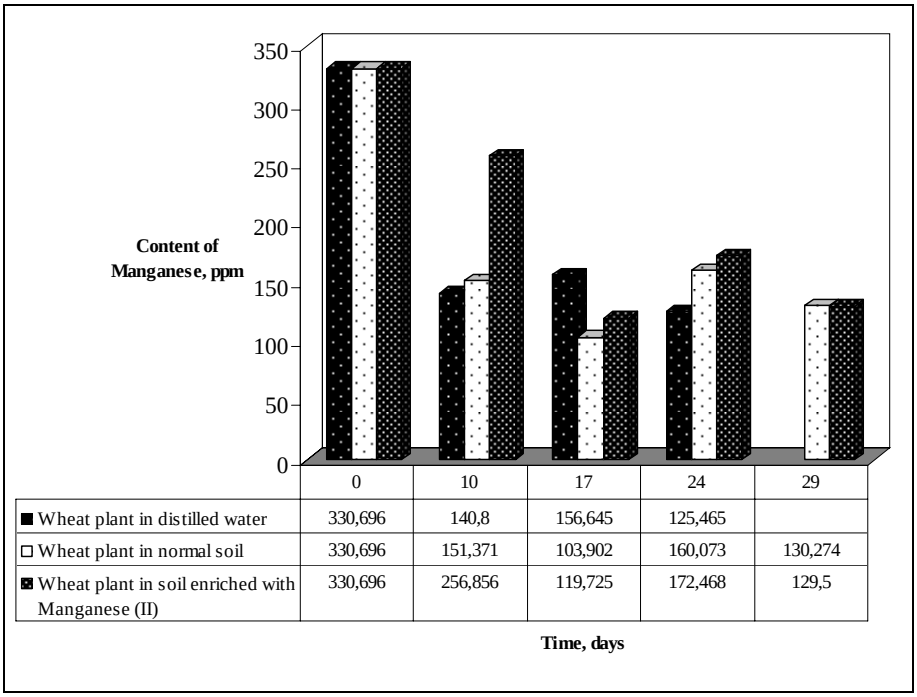

Figure 1. The content of total manganese from of vegetal materials and soil in various conditions

This observation allows us to assert that wheat plants in the first two-three lives weeks grown supported by wheat grain manganese (II). At 24 days of life the content of manganese is greater than at 17 days of life. We can affirm that the plants use other parts of manganese (II) from soil, for their physiological requests.

In the case of wheat plants from water distilled the content in manganese is increasing till 17 days of growing plants after that it was noticed a slowly decreasing in the concentration of manganese. Only the distilled water is not sufficiently to develop the normal wheat plants. An explanation of increasing of manganese availability could be found in the concentration of nitrate ion in the soil. After 3 – 4 weeks the concentration oh nitrate in soil is about 28 ppm. It was noticed a strong correlation between NH^{4+}, NO_2^-, NO_3^- and Mn^{2+} content of soil. The reduction of MnO_2 to Mn^{2+} was found when NO_2^- accumulated and pH of soil was slightly decreased [6].

These quantitative differences are due to the pH of soil, the oxidation-reduction potential of soil, the effect of soil's organic matter on micronutrients [7].

4. Conclusion

The variations of the manganese (II) amount from the studied plants are determined by a series of factors as: soil temperature, soil humidity, redox processes etc. The content of manganese is strongly related to the soil -pH soil –rH, redox potential and the soil texture.

The bacteria transformation of the ammonium, nitrite and nitrate ions favorize the reducing character of soil and the decreasing of pH-value corresponding to a slowly acidic character. The available manganese is strongly correlated to the acidic character of the soil.

It should be stressed that the results of the laboratory experiments, though they prove the presence of manganese-oxidizing microflora, do not provide clear evidence that these organisms take part in the process of manganese oxidizing [8].

Another factor which influences the quantity of manganese in wheat plants is the effect of salt and carbonate soil content on micronutrients solubility and micronutrients absorbtion by plants.

The available water capacity of soil is related to soil texture which affects plant growth by water and with it the nutrient supply.

It was noticed that the wheat plants have grown slowly in distillated water, for ten days but the growth became even slower afterwards. The conclusion is that the manganese content of the soil is significant for the growth wheat plants.

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