CONTENT OF MANGANESE IN PLANT MATERIAL IN DIFFERENT KINDS OF FERTILIZATION

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Abstract

A new rapid, selective, simple and sensitive extractive-spectrophotometric method for the determination of trace amounts of manganese with Methylene Blue in plant material was used.

The influence of fertilization has been studied upon the content of manganese in eggplant samples. A certain research has been carried out for the content of manganese under the influence of soil fertilization, leaf fertilization and mixed fertilization (soil and leaf). In connection with this aspect some leaf fertilizers have been tested, such as: Kristalon, Agroleaf, Fitona, Hortigrow.

The content of manganese is higher in eggplant samples in the treatment of plants with the leaf fertilizer Kristalon - 24.05 mg kg^{-1} Mn. By all means this is due to the fact that the leaf fertilizer Kristalon comprises in its composition 0.04 % Mn. The experimental data show that the highest is the content of Mn 27.30 mg kg^{-1} in soil fertilization $N_{12}P_6K_6$ and leaf fertilizer Kristalon.

Key words: manganese, methylene blue, plants, fertilization

INTRODUCTION

Manganese is important for the synthesis of the organic substance in plants and the metabolism of a number of nutrient elements in a plant organism. Manganese takes part in a number of important physiological and biological processes [1, 2]. Manganese insufficiency leads to a considerable accumulation of nitrates, disturbance in the protein synthesis in plants and illness to some plants [3, 4].

The objective of this study is to determine the manganese content using a new extraction – spectrophotometric method with Methylene Blue [5] in eggplant samples. To explore the influence of leaf fertilization and mixed fertilization (soil and leaf) upon the assimilation of manganese in the fruit of eggplant.

MATERIAL AND METHODS

The experiment was carried out in eggplant samples in ten variants: non frtilized, soil fertilization, leaf fertilization and mixed fertilization (soil with leaf).

Variants of the experiment:

1. Control - non fertilized
2. Soil fertilization $N_{12}P_6K_6$
3. Leaf fertilization Fitona
4. Leaf fertilization Hortigrow
5. Leaf fertilization Agroleaf
6. Leaf fertilization Kristalon
7. $N_{12}P_6K_6$ + Fitona
8. $N_{12}P_6K_6$ + Hortigrow
9. $N_{12}P_6K_6$ + Agroleaf
10. $N_{12}P_6K_6$ + Kristalon

An analysis for manganese content by variants in leaf mass of eggplant were carried out using a new extraction-spectrophotometric method with Methylene Blue (MB) [5]. Manganese(VII) forms an ion-pair with thiazine dyestuff Methylene Blue (MB). The molar absorptivity of the complex is (3.86 ± 0.06) x 10^4 L/mol cm and the system obeys Beer's law in the range 0.1 – 0.99 μg/mL Mn(VII). The detection limit (DL) and quantitation limit (QL) of Mn(VII) determination were found to be 0.0146 and 0.049 μg/mL, respectivly. A new rapid, selective, simple and sensitive extractive-spectrophotometric method for the determination of trace amounts of manganese in plants was developed.

Apparatus — Spectrophotometer UV- VIS with 1-cm light path quartz cells.

Determination of manganese in plants

A wet burning of the plant sample was carried out in which a mixture of sulphuric and nitric acids was used for the oxidation of the organic substance. A portion of 2 g of air-dry plant material was placed into a Kjeldal flask and moistened with 4 mL distilled water. Add 5 mL conc. sulphuric acid and 10 mL conc. nitric acid. If the oxidation of the organic substance is not completed, some more HNO_3 is added and heated again. When all the organic material is oxidized, the solution is heated at a higher temperature for 10 min. After cooling the solution is diluted with water and filtered. Portions of 3 mL conc. H_2SO_4, 2 mL conc. H_3PO_4 and 0.01 g potassium periodate were added for oxidation Mn(II) to Mn(VII). It was heated to boiling point and the temperature was maintained for 10 min. Then the solution was cooled. It was transfered into a volumetric flask of 50 mL and diluted up to the mark with distilled water. Aliquots parts of this solution were taken for analysis.

Procedure — In separatory funnel of 100 mL are introduced the solutions: 1 mL of nitric acid 15.5 M, 1 mL of Methylene Blue $1x10^{-5}$ M aliquote of the prepared solution of plant sample. It is diluted up to a volume of the aqueous phase of 10 mL with distilled water and extracted with 3 mL of 1,2-dichloroethane for 20 s. The organic phase is filtered through a dry paper into a 1 cm cuvette and the absorbance measured at 290 nm. A blank is run in parallel in the absence of plant sample. A calibration graph is constructed with standards similarly treated.

RESULTS AND DISCUSSION

The developed method with Methylene Blue has been used for determination of microquantities of manganese in eggplant samples (Table 1).

The experimental data show that the content of Mn 21.53 mg kg^{-1} in the control - nonfertilized is lower than that in soil fertilization with $N_{12}P_6K_6$ (background) 22.57 mg kg^{-1}. Besides the soil fertilization, fertilization with leaf fertilizers is included in the experiment in order to make a comparison between the two ways of feeding-up in plants.

The content of manganese in eggplant samples is presented on Fig.1 in different leaf fertilization. The content of Mn is lowest 14.85 mg kg^{-1} in leaf fertilization with Agroleaf. The content of Mn is approximately two times higher 27.3 mg kg^{-1} in the use of the leaf fertilizer Kristalon. Probably this can be ascribed to the fact that the leaf fertilizer Kristalon contains 0.04% Mn in its composition. The content of manganese 22.57 mg kg^{-1} in background is presented on the same figure. The content of manganese in background in comparison with the one in leaf fertilization with Agroleaf; Hortigrow; Fitona; Kristalon it can be seen that the accumulation of manganese is higher in the fruit of eggplant in leaf fetilization with Kristalon.

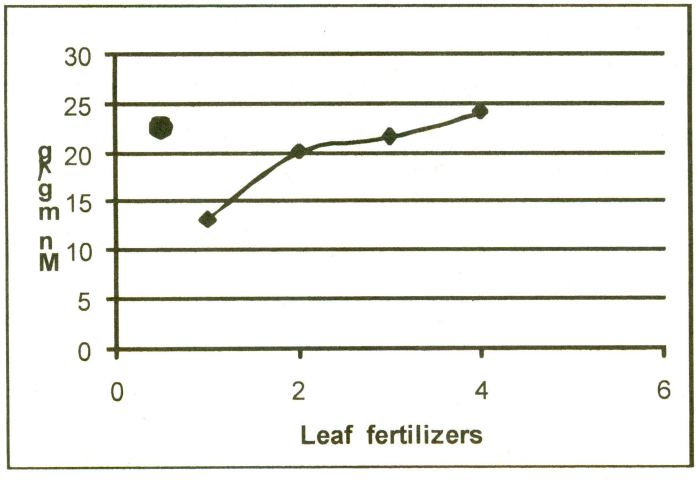

Fig.1 Content of Mn in eggplant samples in different leaf fertilization:

● – Background; 1– Agroleaf; 2– Hortigrow; 3– Fitona; 4– Kristalon

An experiment has been carried out (Fig. 2) with mixed fertilization (soil with leaf). In these variants with mixed fertilization, the content of Mn is highest 27.3 mg kg^{-1} in fertilization with $N_{12}P_6K_6$ + Kristalon. This can be explained with the content of manganese in the leaf fertilizer Kristalon. In mixed fertilization (soil with leaf) the opportunity for plants to accumulate more manganese is more. This can be seen when we compare the experimental data (variants 1, 3, 4) from the two kinds of fertilization - leaf fertilization (Fig.1) and mixed fertilization soil with leaf (Fig. 2). The only exception is the leaf fertilizer Hortigrow.

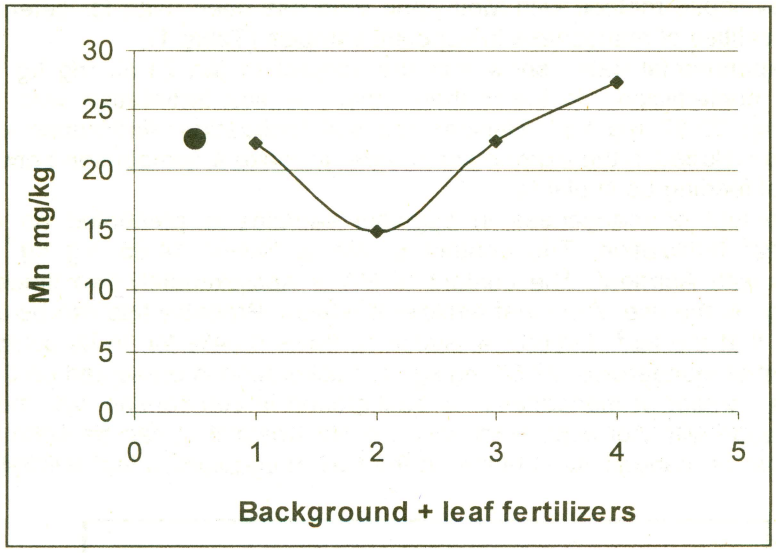

Fig. 2 Content of Mn in eggplant samples in different fertilization:

● – Background; 1– $N_{12}P_6K_6$ + Agroleaf; 2– $N_{12}P_6K_6$ + Hortigrow; 3– $N_{12}P_6K_6$ +Fitona; 4– $N_{12}P_6K_6$ +Kristalon

Table 1 Content of manganese in eggplant samples in mineral fertilization and leaf treating

№	Variants	Mn mg kg^{-1} MB method	RSD* %	Mn mg kg^{-1} TV method
1	Control - nonfertilized	21.53	1.9	21.90
2	$N_{12}P_6K_6$ - background	22.57	1.4	22.30
3	Fitona	21.54	2.0	21.40
4	Hortigrow	20.00	1.2	20.25
5	Agroleaf	13.05	1.7	13.20
6	Kristalon	24.05	1.4	24.30
7	$N_{12}P_6K_6$ + Fitona	22.50	1.8	22.35
8	$N_{12}P_6K_6$ + Hortigrow	14.85	1.5	15.00
9	$N_{12}P_6K_6$ + Agroleaf	22.30	1.9	22.10
10	$N_{12}P_6K_6$ + Kristalon	27.30	1.6	27.00

*Relative Standard Deviation (n = 3)

The data obtained (Table 1) were checked up by the method with Tetrazolium Violet (TV). The good agreement of the results obtained by both methods shows that Methylene Blue (MB) can be used as a reagent for determination of microquantities of manganese in plants. The method we developed has a high sensitivity and selectivity. Preisolation of manganese or most other ions is not necessary.

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