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INFLUENCE OF NATURAL COMPLEX ORGANIC FERTILIZERS OF BORON, BASED ON ORGANIC FERTILIZATION, ON SOME QUALITATIVE PARAMETERS OF WATERMELONS ON PSAMOSOLS

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ABSTRACT – Boron fertilization is an efficient technological work, especially when boron is applied on organic background. The obtained results pointed out the role of boron in plant metabolism: it stimulated the accumulation of some biochemical components in leaves (chlorophyll and carotene), intensified the activity of some enzymes (catalase) and improved fruit quality. In the variants where boron compounds were applied, greater chlorophyll content, 4.31-4.46 mg/g fresh matter, was recorded, compared to 2.14 mg/g fresh matter in the unfertilized variant and 4.00 mg/g fresh matter in the variant where only manure was used. The carotene content of leaves was of 0.73-0.79 mg/g fresh matter, compared to 0.49 mg/g fresh matter in the unfertilized variant and 0.63 mg/g fresh matter in the variant where only manure was used, in 2005. The quantity of total DM from fruits has increased from 9.35% in the unfertilized variant to 10.20-10.35% in the variants fertilized with manure + Folibor 5 l/ha - two treatments. On the organic background of 30 t/ha manure, by the leaf application of Folibor, yield increase was of 10.7 t/ha.

Key words: boron, fertilization, watermelons, quality, psamosol

REZUMAT - Influența fertilizanților organici naturali complecşi ai borului, pe fondul fertilizării organice asupra unor parametri calitativi la pepenii verzi, pe psamosoluri. Fertilizarea cu bor este o lucrare tehnologică eficientă, în special atunci când borul se aplică plantelor pe agrofond organic. Rezultatele obținute evidențiază rolul borului în metabolismul plantelor: stimulează acumularea unor componente biochimice în frunze (clorofilă, caroten), intensifică activitatea unor enzime (catalază) şi îmbunătățeşte calitatea fructelor. La variantele la care s-au aplicat compuşi pe bază de bor, s-a înregistrat un conținut mai mare de clorofilă, 4,31-4,46 mg/g substanță proaspătă, comparativ cu 2,14 mg/g substanță proaspătă, la varianta nefertilizată, şi 4,00 mg/g substanță proaspătă la varianta la care s-a folosit doar gunoi de grajd, şi un conținut de caroten în

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frunze de 0,73-0,79 mg/g substanță proaspătă, comparativ cu 0,49 mg/g substanță proaspătă la varianta nefertilizată și 0,63 mg/g substanță proaspătă la varianta la care s-a folosit doar gunoi de grajd, în anul 2005. Cantitatea de substanță uscată totală din fructe a sporit de la 9,35%, la varianta nefertilizată, la 10,20-10,35%, la variantele fertilizate cu gunoi de grajd + Folibor 5 l/ha - două tratamente. Pe agrofoundul organic de 30 t/ha gunoi de grajd, prin aplicarea foliară de Folibor, sporul de producție a fost de 10,7 t/ha.

Cuvinte cheie: bor, fertilizare, pepeni verzi, calitate, psamosol

INTRODUCTION

The continuous degradation of organic matter from soil, by mineralization, results in a great diminution of the qualitative and quantitative yield in cultivated plants (Toma *et al.*, 2008). The organic fertilization contributes to improving and maintaining soil fertility characteristics, generally, and sandy soils, especially, providing the plant with the nutrients it needs. The organic fertilization determines the mobilization of the microbiological complex from soil, releasing gradually, the nutritive elements, in order to be available for plants during the entire vegetation period (Stoian, 2005). By using the organic fertilization, besides the contribution of nutrients, humus content and soil structure and texture are improved (Badea *et al.*, 2005).

If the organic fertilization is supplemented with leaf fertilization, there are real opportunities of plant yield increase and constant maintenance, especially in less favourable areas for agriculture. Davidescu,1974 and Lascu *et al.*, 2005 assess that boron is an important element in the life of plants, having a role in root growth, flower fecundation, intensification of the activity of some enzymes and synthesis of aromatic compounds. The boron absence or insufficient amounts in plants may cause severe nourishing troubles, with negative repercussions on yield quantity and quality (Gartel, 1974).

Psamosols from southern Oltenia have total boron content, comprised between 12-18.3 ppm and a content of soluble boron, which varies between 0.05 and 0.26 ppm (Băjescu and Chiriac, 1984; Băjescu *et al.,* 1977). For achieving high yields, watermelons extract from soil great quantities of nutritive substances. The leaf application of complex natural organic fertilizers of boron, on the background of the fertilization with organic fertilizers, leads to high yields and intensifies plant metabolism and some physiological indices, enriching fruit quality.

The goal of the authors was to determine the role of boron in a soil belonging to this category and cultivated with watermelons.

MATERIALS AND METHODS

For establishing the role of complex natural organic fertilizers of boron, based on the organic fertilization, on watermelons, an experiment was set up

with four variants: V1-Unfertilized control; V 2- Manure, 30 t/ha; V 3- Manure, 30 t/ha + Folibor standard, 5 l/ha, two treatments; V 4- Manure, 15 t/ha + Folibor standard 5 l/ha, two treatments.

The experiment was set up in randomized blocks design, with four replicates: the area of the experimental area: 18 m^2 and the area of the experiment: 288 m^2. Times ofapplying leaf fertilizers: treatment I, at the beginning of stalk formation; treatment II, 10 days after the first treatment; The solution quantity for one treatment: 300 l/ha.

Testing was carried out in 2005, using Dulce de Dăbuleni Variety, cultivated by direct sowing in the field and, in 2006, Audry F1, cultivated by seedling. The other technological works were recommended in the cultivation technology elaborated by the Research and Development Station for Plant Growing on Sands, Dăbuleni, Dolj County.

During the trial, the following observations and determinations were carried out:

- a+b chlorophyll content (mg/g fresh matter), by the colorimetric method;
- carotene content (mg/g fresh matter), by the colorimetric method;
- activity of the catalase enzyme, by the permanganate method ;
- chemical content of watermelons in the following substances: water and total DM (%) by the gravimetric method; soluble DM (%), by the refractometric method; glucoses (%), by the Fehling Soxleth method; titrable acidity (g malic acid /100g f.m.); vitamin C (mg/100g f.m.) by the iodometric method and nitrate content (mg/kg product) by the Bremner method.
- NPK content of watermelon leaves: total nitrogen (%) – Kjeldahl method, total phosphorus (%) - colorimetric method, total potassium (%) – flame photometric method.
- Watermelon yield.

Watermelons like warm, fertile and rich in organic matter soils and, first, well aired and drained. The experiment was conducted on a soil with reduced total nitrogen (0.08-0.10%), well supplied with extractable phosphorus (47-74 ppm), mean supplied with potassium (56-120 ppm) and with a reduced content of organic matter (0.81-0.91%), according to data from *Table 1*.

Soil Ph had neuter values (6.90-6.97), while boron content was of 0.20-0.25 ppm (mean supply).

Table 1 – Soil supply with main chemical components in watermelons

Depth (cm)	Nt (%)	P-AL (ppm)	K-AL (ppm)	Organic carbon (%)	Ph in H_2O	Boron in H_2O (ppm)
0-20	0.10	74	120	0.81	6.97	0.25
21-40	0.08	47	56	0.91	6.90	0.20

RESULTS AND DISCUSSION

For achieving a high yield, watermelons extract from soil great nutrient amounts. The leaf application of complex natural organic fertilizers of boron, based on the organic fertilization, leads not only to yield increases but also increases plant metabolism and some physiological indices, enriching fruit quality.

The content of chlorophyll and carotene from leaves was determined at the intense growth stage of the vegetative mass (*Table 2*). The obtained results pointed out differences between variants and during the two years. In all the fertilized variants, we have determined a greater content compared to the unfertilized control. In case of the culture set up by sowing (2005), the chlorophyll content was comprised between 2.14 mg/g fresh matter in the unfertilized variant and 4.46 mg/g fresh matter in the variant fertilized with 30 t/ha manure + Folibor, 5 l/ha, two treatments. If culture was set up by seedling, the chlorophyll content has also recorded the highest values in the variants where boron products were used, on a manure background, that is 3.82 mg/g in the variant fertilized with 15 t/ha manure + Folibor, 5 l/ha, two treatments and 3.74 mg/g fresh matter in the variant fertilized with 30 t/ha manure + Folibor, 5 l/ha, two treatments.

The boron fertilization has also influenced the carotene content, which had high values in the fertilized variants, compared to the variants where boron was not used. The highest values were obtained in the variants fertilized with 15 t/ha manure + Folibor, 5 l/ha, two treatments, that is 0.79 mg/g fresh matter in 2005 and 0.68 mg/g fresh matter in 2006.

The activity of catalase was more intense in 2005, inclusively at the control. That year, determinations were carried out in Dulce de Dăbuleni Variety and culture was set up by sowing (culture with longer vegetation period). In all the fertilized variants, values were higher than the values of the unfertilized control, but by the application of boron, we did not obtain higher values compared to the organically fertilized variant.

The NPK content of leaves has recorded higher values than the unfertilized control in all the variants where fertilizers were applied (*Table 3*). Higher values were recorded in the variants supplemented with boron products, which showed that the additional fertilization has improved watermelon supply with nutrients.

Fruit quality, expressed by the biochemical composition, (TDM, SDM, glucose, vitamin C, acidity and content of nitrates), was also influenced by the application boron fertilizers, in complex with organic fertilizers (*Table 4*). The obtained results differentiated according to the rates of applied fertilizers and to the studied variety under the climatic conditions of the respective year.

Table 2 – Influence of complex natural organic fertilizers of boron, based on the organic fertilization, on the content of chlorophyll, carotene and on the activity of catalase enzyme in leaves of watermelons, at the stage of shoot intense growth

Variant	Chlorophyll a+b mg / g f.m.*		Carotene mg/ g f.m.		Catalase ml $KMnO_4$	
	2005	2006	2005	2006	2005	2006
Unfertilized control	2.14	3.09	0.49	0.39	19.2	12.4
Manure, 30 t/ha	4.00	3.61	0.63	0.47	25.6	13.6
Manure, 30 t/ha + Folibor, 5 l/ha, two treatments	4.46	3.74	0.73	0.62	23.7	13.8
Manure, 15 t/ha + Folibor, 5 l/ha, two treatments	4.31	3.82	0.79	0.68	25.0	13.8

* fresh matter

Table 3 – Influence of complex natural organic fertilizers, based on the organic fertilization, on the NPK content of the watermelon leaves (2005-2006)

Variant	Nt (%)	Pt (%)	Kt (%)
Unfertilized control	3.12-2.80	0.14-0.17	0.97-1.24
Manure, 30 t/ha	3.88-3.92	0.23-0.30	1.45-1.57
Manure, 30 t/ha + Folibor, 5 l/ha, two treatments	4.32-4.40	0.30-0.37	2.07-2.17
Manure, 15 t/ha + Folibor, 5 l/ha, two treatments	4.52-4.38	0.28-0.34	1.84-2.07

Table 4 - Influence of complex natural organic fertilizers of boron, based on the organic fertilization, on the biochemical composition of watermelons

Variant	TDM (%)	Water (%)	SDM (%)	Titrable acidity (g malic acid at 100 g fresh matter)	Vitamin C (mg/100 g fresh matter)	Nitrates NO_3^- (mg/Kg fruit)	Glucose (%)
Unfertilized control	9.35	90.65	9.10	0.13	6.71	12.85	8.39
Manure, 30 t/ha	10.10	89.90	9.98	0.12	9.90	30.71	9.02
Manure, 30 t/ha + Folibor, 5 l/ha, two treatments	10.20	89.80	10.00	0.09	11.22	23.20	8.87
Manure, 15 t/ha + Folibor, 5 l/ha, two treatments	10.35	89.65	10.10	0.09	14.41	24.80	9.08

TDM= total dry matter
SDM = soluble dry matter

The quantity of total dry matter has increased from 9.35% in the unfertilized variant to 10.20-10.35% in the variants fertilized with manure and Folibor 5 l/ha, two treatments. In both variants fertilized with manure and Folibor, we have obtained higher values of total dry matter. The content of soluble dry matter has also increased in all the fertilized variants, compared to the unfertilized control. Better results were obtained in the variants where boron products were used for the additional fertilization.

Organic fertilizers, applied in complex with boron fertilizers, have resulted in a greater accumulation of vitamin C in fruits. These stimulated the metabolic processes, inducing a high output of photosynthesis and other biosynthesis reactions, related to the assimilation of different nutrients by plant and by fruits.

The quantity of Vitamin C in fruits had greater values in all the fertilized variants (9.90-1441 mg/100 g fresh matter), compared to the unfertilized control (6.71 mg/100 g fresh matter).

In the variants where boron was used, based on organic fertilization, the nitrate content from fruits recorded reduced values, compared to the variant where only manure was used (23.20-24.80 mg/kg fruit).

Next to the fertilization, the climatic factors and especially, light intensity had a special influence on the nitrate content from plant, the activity of nitratereductase being the highest under conditions of great temperatures. High nebulosity, moisture excess and low air temperature have contributed to the accumulation of nitrates in plant and fruit.

The glucose content from fruits was favourably influenced by the application of organic fertilizers in complex with boron fertilizers. It was comprised between 8.39% in the unfertilized variant and 9.08% in the variant fertilized with 15t/ha manure + Folibor. Both the application of boron and organic fertilizers stimulated the photosynthesis process and glucoses were the product of this process.

On the average of the two testing years, the fertilization of watermelon culture on Psamosols has resulted in getting high yield increases for the investigated variants, being comprised between 8.1 t/ha and10.7 t/ha (*Table 5*).

The use of complex natural organic fertilizers of boron in organically fertilized crops has resulted in a better use of fertilizers, so that the diminution at half of manure, from 30 t/ha to 15 t/ha, has determined an insignificant yield loss of 1.1 t/ha. In watermelons cultivated on Psamosols, the efficiency of complex natural fertilizers of boron was high and allowed the decrease at half of the fertilizer quantity, in case of the organic fertilization.

Yield increases achieved in case of the application of boron leaf fertilizers, based on organic fertilizers, were significant.

Table 5 – Influence of complex natural organic fertilizers of boron, based on the organic fertilization, on the watermelon yield (average on 2005-2006)

Variant	Year		Average on 2005-2006			
	2005	2006	t/ha	%	Diff. t/ha	Signific.
Unfertilized control	27.0	47.9	37.5	100	Control	Control
Manure, 30 t/ha	37.6	53.6	45.6	122	+8.1	-
Manure, 30 t/ha + Folibor, 5 l/ha, two treatments	39.5	56.4	48.2	126	+10.7	x
Manure, 15 t/ha + Folibor, 5 l/ha, two treatments	38.2	56.0	47.1	126	+9.6	x

LSD 5% - 8.9 ; LSD 1% - 12.3; LSD 0.1% - 16.9

CONCLUSIONS

Boron fertilization is an efficient technological work, especially when boron is applied on crops that are fertilized organically.

The obtained results pointed out the role of boron in plant metabolism by stimulating the accumulation of some biochemical components in leaves (chlorophyll and carotene), improving fruit quality.

Indifferently of the studied variety or hybrid or the growing method, in the variants where boron products were applied, a great content of chlorophyll and carotene was recorded in leaves. The activity of catalase enzyme also improved in these variants.

Fruit quality was favourably influenced by boron application. Fruits had a greater content of DM, glucose, vitamin C and a lower content of nitrates.

With the organic fertilization of 30 t/ha manure, the leaf application of Folibor has resulted in a yield increase of 10.7 t/ha. Therefore, the fertilization with moderate rates of organic fertilizers, combined with boron leaf application, coming from complex natural organic fertilizers, may be an important technological measure of obtaining biological watermelons and of making this culture efficient on sandy soils.

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