THE EFFECT OF THE MICROELEMENT COMPLEX MICROCOM ON GRAPE AND SUGAR BEET PRODUCING CAPACITY AND RESISTANCE

EFECTUL COMPLEXULUI DE MICROELEMENTE MICROCOM ASUPRA PRODUCTIVITĂȚII ŞI REZISTENȚEI PLANTELOR DE VIȚĂ DE VIE ŞI A SFECLEI DE ZAHĂR

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Abstract. *The complex of trace elements Microcom was elaborated in the Institute of Genetics and Plant Physiology ASM. It includes the necessary micronutrients in such relations and contents, which allow maintaining the metabolic processes in plants in dependence of corresponding culture and stressing factors with aim to mitigate the negative impact of the unfavorable conditions of environment. The test in conditions of green house and production showed that under the low temperature and drought foliar treatment of vine and sugar beet by that complex can serve as an effective procedure for mitigation of consequence of such stress-factors. Increase of plant resistance and productivity was marked.*

Key words: Microcom, stressing factors, productivity, resistance

Rezumat*. Preparatul Microcom include microelementele necesare în combinații şi raporturi care să corespundă menținerii proceselor metabolice din plantă la nivel înalt în dependență de cultura respectivă şi de factorul stresogen concret în scopul diminuării la maximum a impactului factorilor nefavorabili. În condiții nefavorabile de mediu microelementele din complex determină utilizarea mai eficientă a metaboliților din plante şi realizarea mai deplină a potențialului adaptiv şi productiv al acestora. În condiții de producție acest complex poate servi ca un procedeu efectiv de atenuare a consecințelor factorilor nefavorabili şi de majorare a rezistenței şi productivității plantelor, manifestată prin sporirea productivității lor cu 10-15%.*

Cuvinte cheie: Microcom, factori nefavorabili, productivitate, rezistență.

INTRODUCTION

The plant capability to tolerate water or temperature stress increases while plants utilize water and nutrients in organic synthesis more efficiently and until the protoplasm is not exposed to significant destructive processes (1, 2). The respond of different plant varieties and species to the action of these factors depends on the ecological resistance. Plant resistance enhancement in these conditions is one of the predominant chains in solving the general problem of deriving stable yields with required qualities. Significant deviations in the intensity of absorption processes and involvement of nutritive elements into metabolism occur, in the first place, in

conditions of unfavorable soil humidity. These deviations can be reduced through exogenic regulation of macro- and microelement doses and ratios. Vegetative mass accumulation, yield volume and quality depend on the degree of macro- and microelement incorporation in metabolism (1, 3). The necessity of microelements for plants and human's health, deficit of these elements in different countries are well presented in the recent literature (1, 4-6). During the last years, a tendency has been well pronounced to develop and employ new nutritive substances that are complex, more efficient and can be integrated into new agricultural technologies.

The aim of these studies has been to disclose the impact of the trace element complex Microcom on formation and realization of the producing capacity potential and resistance of the crops that are important for Moldova agriculture – grape and sugar beet.

MATERIALS AND METHODS

The studies were carried out during the years 2005 to 2008 on grape (industrial cvs Aligote and Traminer). Grape plants were foliar treated with the complex of trace elements Microcom-V in three dates (1 – before flowering, 2 and 3 at the stage of intensive shoot growth with an interval of 12-14 days). Water treated plants were used as control. The shoot growth and ripening were determined according to the methods of Lazarevskii M.A. (1963) and Alexandrescu I. et al. (1998). The grape resistance to wintering was assessed in field conditions after their wintering according to the method developed by Cernomoreț M. V. specifically for the grape crop (1985, 2000). The productivity and yield quality were determined according to the recommendations worked out by Amirdjanov A.G., Suleimanov D.S. (1986) and Alexandrescu I. et al. (1998). The effect of the Microcom-T action on sugar beet was evaluated in the monitored conditions of temporary water stress (35% FWC, 10 days) in green house (soil – carbonated cernozem) and in production conditions. The studies in the monitored conditions of temporary water stress were performed on the autochthonous varieties Moldovenesc 41 and Victoria, in production conditions on the German cultivars Lenora, Georgina, and Merak in 2005 to 2008. The solution concentration was 0.25% …0.30%. The nitrate reductase activity in leaves was determined in vivo after Mulder, the monosaccharide and saccharose content after Bertran.

RESULTS AND DISCUSSIONS

The content of photosynthetic pigments in leaves is one of the important indices that characterizes plant physiological condition during the vegetation period. The determination of these indices in plant leaves demonstrated a positive influence of trace element complex treatment on the plant photosynthetic activity. The chlorophyll *a+b* sum increased after the foliar15,7% – 19,3% treatment in comparison with the control. The relationship between the chlorophyll types showed no significant change. The total carotenoids content increased significantly after the treatment with the trace element complex. A tendency of the carotenoids content decrease in leaves was observed after the treatment with the Fe chelate type present in the Microcom-V. The effect of Microcom was corroborated in the year 2007 characterized by an unusual drought. As the drought advanced (08.10.2007), the effect of the foliar treatment on the

pigment accumulation reduced but the content of photosynthetic pigments maintained at a higher level in comparison with that in the control plants.

The microelement content in leaves is one of the basic indices, which is indicative of the nutrition regime state and conditions a more complete realization of producing capacity potential and ecological resistance in plants. In the monitored conditions of the vegetative house, an increase of Fe, Mn, and Zn content was observed following the treatment in comparison with the control plants. The Cu content dropped in comparison with the witness. An antagonistic effect between the microelements of Fe and Cu is well pronounced and must be taken in consideration while utilizing the complex.

The importance of phosphorus in synthesis, activation, energy exchange, transport, as well as its impact on the reactions of formation and manifestation of the degree of frost and wintering resistance suggested an idea regarding quantitative studies on phosphoric compounds in grape plants in relation to foliar treatment with the complex of trace elements Microcom-V. The studies conducted on the Aligote cultivar revealed evident modifications in the content of acid-soluble phosphorus, as well as in its components: the fraction of inorganic phosphorus and that of organic one.

The determination of carbohydrate content in the tissues of grape leaves and shoots during the vegetation period demonstrated that the treatment with the Microcom-V product had a positive influence on the content of soluble saccharides. Simultaneously, the process of starch synthesis in shoots intensified, which indicated their higher resistance (fig. 1 and 2).

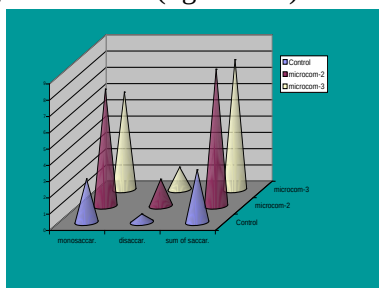

Fig. 1. The Microcom-V effect on the carbohydrate content in grape leaves, %

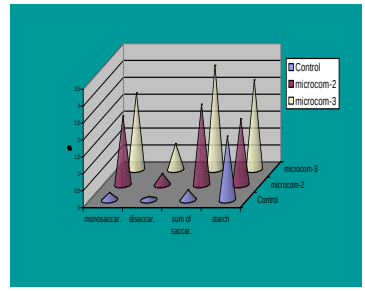

Fig. 2. The Microcom-V effect on the carbohydrate content in grape shoots, %

The foliar treatment of grape plants during the vegetation period with the Microcom-V product induced increase of mean shoot length and the degree of their ripening, which resulted in the enhancement of plant resistance to frost during the rest period. The foliar treatment during the vegetation period with Microcom-V has been found to enhance the degree of wintering resistance by 2.5% to 5.1%. In this treatment, 83.8% -9 1.9% of viable wintering eyes were found that also included injured ones in which the main bud died but at least one secondary bud developed. The evident increase in the degree of annual wood tissues in the treated plants is associated with the intensification of accumulation of reserve substances, especially protective ones. The foliar plant nutrition with Microcom-V increased grape

productivity. A beneficial action of the specific microelement complex on the yield volume and grape fruit quality has been detected. A mean weight of grape bunches increased in comparison with the control, the mean yields per bush grew. It is important that the production quality was higher (table 1).

Table 1

The influence of the microelement complex on the grape producing capacity, cv. Aligote, the district of Criuleni

Treatments	August 10, 2007		August 29, 2007		Yields per bush, kg
	sugar content, %	acid content, proml	sugar content, %	acid content, proml	
Witness	12.7	10.5	18.67	6.8	6.7
Microcom-V	13.2	10.6	19.30	6.0	8.2

The studies performed on sugar beet have demonstrated that in the monitored conditions of temporary water stress, the primary process of nitrate reduction in leaves decreased significantly. The foliar treatment with the trace element complex Microcom-T in such conditions results in the maintenance of the nitrate reductase (NR) activity in leaves at a higher level. Since the process of nitrate reduction is in a total direct dependence on the intensity of nitrogen metabolism, it may be concluded that the diminution of the nitrogen metabolism occurs in the unfavorable conditions of soil humidity followed by the decrease of organic mass accumulation by plants. It is also known that many nutritive elements, especially trace one, become partially inaccessible for plants in drought conditions. The Microcom-T product contains microelements which enter directly into the composition of NR enzyme (Mo) or are cofactors in activating it (Mn, Co). Probably, in the monitored conditions of temporary water stress, the plant foliar treatment with the Microcom-T product contributed to the increase of microelement accessibility and, consequently, to the maintenance of the NR activity at a higher level in comparison with the plants from the control-35% FWC. The product effect is also well pronounced in the optimal conditions of soil humidity. The maintenance of NR activity at a higher level is also followed by modifications in monosaccharide and saccharose content. As a rule, the content of monosaccharides and saccharose drops in leaves under the influence of the microelement complex. A tendency of monosaccharide and saccharose content diminution is also observed in optimal soil humidity conditions, but it is pronounced more weakly. It was found that after 10-day water stress, the plant treatment with the Microcom-T complex led to an increase in organic mass accumulation in comparison with the control -35% FWC by 14.1%, and in comparison with the combination of the BMnMo by 9.3% (the plant weight in the control -35% is 130.7 g).

The application of the microelement complex, as well as the BMnMo combination at the end of vegetation increased the root weight not only in comparison with that in the control -35% FWC but in the control -70% FWC. It is worthy to mention a more significant effect of the Microcom-T complex in comparison with the BMnMo combination. Simultaneously, the sugar content also

grew in roots. Thus, practically, if the duration of the water stress is relatively short (10-15 days), the foliar treatment with the microelements contributes, on the one hand, to a more efficient utilization of water in organic synthesis during the unfavorable factor action, and on the other hand, to an ulterior stimulation of the metabolic processes that improve the plant physiological condition manifested through diminution of the negative drought impact on the yield volume and production quality. It is noteworthy that at the end of vegetation, the root weight per plant in optimal conditions of soil humidity upon the plant treatment with the Microcom-T complex was higher in comparison with their weight in conditions of the monitored water stress.

The results of the NR activity evaluation in leaves in production conditions at the stages of intensive growth and sugar accumulation (as in the case of the experiments carried out in the monitored conditions of soil humidity in the vegetation house) demonstrated the same regularity – the maintenance of the enzyme activity at a higher level upon the plant treatment with the Microcom-T product and the BMnMo combination especially during the years with sufficient atmospheric precipitations for plant growth and development (2005 and 2006). During vegetation, the content of monosaccharides in leaves and roots and that of saccharose in leaves reduced insignificantly in the plants treated with the Microcom-T product and the BMnMo combination. The increase of the NR activity in leaves and the diminution of the monosaccharide and saccharide content in leaves was followed by an increase in root yields and sugar content.

The studies performed in production conditions allows us to compare the efficacy of the product in different growing conditions. In the year 2005, the Microcom-T product increased the root yields by 6.4% (cvs. Georgina, Germany) and the sugar content by 0.9% (71.3 M.T./ha and 15.6% in the control, respectively). In the year 2006, on the background of the root yields of 62.0 M.T./ha and sugar content of 19.2% in the control, the Microcom-T product contributed to an increase of root yields by 7.2 M.T./ha or by 11.6% and sugar content by 0.5%. The efficiency of the treatment with the microelement combination (BMnMo) was evident but less significant: in the year 2005, the root yields increased by 4.5% while the sugar content by 0.7%, and in the year 2006, the effect of the microelement combination application was pronounced even weaker – the root yields increased by 3.7% and the sugar content by 0.4%. The two-year experimental data of trials of the Microcom-T product and the BMnMo combination in production conditions confirmed a more significant efficiency of the complex as compared with the BMnMo combination for both root yields and sugar content. Therefore, in the following years (2007 and 2008) the microelement combination (BMnMo) was ruled out from the experiment.

The year 2007 was characterized by an acute, long and disastrous drought for plant growth and development. Due to the long-duration drought (from the second half of May to August), acute visual symptoms of soil humidity insufficiency were manifested in plants (a sharp drop of metabolic processes, vegetative mass accumulation, basal leaf drying) already at the stage of leaf unification in a row.

After atmospheric precipitation fell in the second half of August, nitrogen and carbohydrate metabolism (reduction of monosaccharide and saccharose content in leaves) intensified, mass and sugar content in roots increased in the plants, especially those treated with the complex microelements. The root yield records showed the degree of the negative environmental impact on the producing capacity of sugar beet. In 2007, the root yields made only 12.9 M.T./ha or 18.1% of the 2005 yields and 20.8% of the year 2006. Against this background, the Microcom-T microelement complex increased the root yields by 19.9% or 2.6 M.T./ha. It is noteworthy that the more intensive accumulation of root weight under the influence of the microelement complex was followed by increase of sugar content. In the year 2008, against the background of the root yields making 51.3 M.T. per hectare, the foliar treatment with the Microcom-T microelement complex resulted in the yield increase by 4.9 M.T./ha (56.2 M.T./ha in the control) or by 9.5% and an increase of sugar content by 0.5% (19.2% in the control). Thus, the production conditions have shown that the product effect depends on the duration of the unfavorable humidity factor. The effect of the complex application is even more significant if the drought is relatively short (10-15 days). Long-duration drought reduces the efficiency of the employment of the microelement complex Microcom-T significantly.

CONCLUSIONS

In conditions of natural calamities (short-duration drought, low negative temperatures), the employment of grape and sugar beet foliar treatment with the specific microelement complex may serve as an effective procedure to mitigate the consequences of stress factors and to enhance plant resistance and producing capacity. The utilization of the microelement complex Microcom improves the nitrogen and carbohydrate metabolism in plants in both optimal and unfavorable environmental growing conditions, increases plant producing capacity by 10-15%. The procedure developed is included in the grape and sugar beet cultivation techniques.

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