Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
ISSN Online 2286-1580, ISSN-L 2285-5653

EFFECTS OF *GLOMUS MOSSEAE* ON LETTUCE

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Abstract

The aim of study is to access the influence of arbuscular mycorrhizal fungi Glomus mosseae (BEG isolate) on the growth, yield and its quality of lettuce. Tree cultivars of lettuce cv. 'Arktika', 'Lollo Bionda' and 'Crimson' were grown from seeds. Fungus preparation was added under seeds during sowing. Control - without fungus. At the 3rd true leaf stage seedlings were planted in 1 L vegetation pots with peat substratum. Fresh weight of seedlings before transplantation, fresh and dry weight was detected. Results showed that Glomus mosseae stimulated seedling growth. Plant fresh and dry weight increased as result of fungi treatment. Glomus mosseae effect on the yield of lettuce depended on cultivar.

Key words**:** arbuscular mycorrhiza*, Glomus mosseae,* lettuce

INTRODUCTION

Mycorrhizae is the mutually beneficial relationship between the plant and root fungus. These specialized fungi colonize plant roots and extend far into the soil. Mycorrhizal fungal filaments in the soil are truly extensions of root systems and are more effective in nutrient and water absorption than the roots themselves. Arbuscular-mycorrhizal (AM) fungi are important in agriculture because they improve plant water relations, increase mineral uptake, which reduces the use of fertilizers, increase the drought resistance of host plants and improve disease control. Endomycorrhizal associations often result in greater yields of crop plants such as rice tomato and onion and bell pepper [10, 11].

Vesicular-arbuscular mycorrhizal (VAM) fungi are beneficial plant symbionts that form a mutualistic relationship with the roots of most crop plants. VAM fungi enhance the uptake of nutrients of low mobility in the soil solution such as P, Zn, and Cu, but they have many other impacts on crop productivity. Mycorrhizal associations play important roles in this nutrient cycling through their microbial activity and their involvement in plant nutrient acquisition [4, 12]. VAM fungi can also reduce the impact of environmental stresses such as drought [13] and salinity [11, 6]. Inoculated plants under salt stress reach levels of photosynthetic capacity (estimated by the chlorophyll content) even superior to those of non-stressed plants, showing that in this respect mycorrhization is capable to fully counterbalance salt stress [14, 7, 11].

It is known that the development of mycorrhizal colonization and its effectiveness on plant growth is enhanced in poor soils AM root colonization is increased at low and medium nutrient levels but reduced at high levels [8].

The concept of effectiveness is defined as the ability of an AM inoculum to increase plant nutrient uptake and plant growth. Thus, the effective use of AM inocula and resulting colonization would results in similar plant growth. However, in order to optimize management of AM fungi/host plants under field conditions, more knowledge on the effect of agricultural practices is required [1, 2, 3, 5].

The aim of study is to clarify the influence of arbuscular mycorrhizal fungi *Glomus mosseae* (BEG isolate) on the growth, yield and quality of lettuce.

MATERIAL AND METHOD

Investigations were carried out at the Latvia University of Agriculture, Institute of Soil and Plant Sciences.

Three cultivars of lettuce cv. 'Lollo Bionda' 'Crimson' and iceberg lettuce 'Arktika' was grown from seeds. Arbuscular mycorrhizal fungi *Glomus mosseae* (BEG isolate) preparation was added under seeds during sowing. Control - without fungus.

Seedlings were grown in 2 L pots with peat substratum (content of mineral elements in 1M HCl, mg L^{-1}: N 17, P 76, K 415, Ca 3410, Mg 415, S 4.4, Fe 285, Mn 26, Zn 33, Cu 35, Mo 0.14, B 0.8, pH 5.2) in the heated polycarbonate greenhouse without artificial illumination. Temperature in green house was maintained between 8 ºC (min at night) and 30 ºC (max at day time). Lettuce was sown at January 26, transplanted at the stage of 3rd true leaf (February 23) and finished month transplantation (March 23).

At the 3rd true leaf stage seedlings were planted in 1 L pots with the same peat substratum. Fresh weight of seedlings before transplantation, fresh and dry weight, and leaf pigment content after vegetation was detected. Content of chlorophylls and carotenoides was determined spectrophotometrically in the ethanol extract of crushed fresh plant leaves. [9]. Experiments were done in 10 replicas and obtained data was elaborated by ANOVA.

RESULTS AND DISCUSSIONS

Obtained results showed that even at the early stages of lettuce development mycorrhizae had a positive effect on the plant growth. In average the seedling shoot weight increased by 12.4% in comparison with control. The largest increase was observed for cv. 'Crimson'. In this variant statistically significant difference was detected in comparison with control. (Fig.1). Similar results were obtained with root of lettuce seedlings. Ratio between lettuce shoot and root was close to 1. The largest differences as result of arbuscular mycorrhizal fungi treatment was observed for cv. 'Crimson', but data statistical elaboration didn't approve the significance of these data. (Fig.2.)

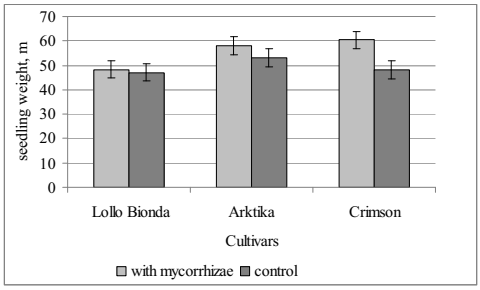

Fig.1.Lettuce seedling shoot weight (mg) at the age of 3rd true leaf.

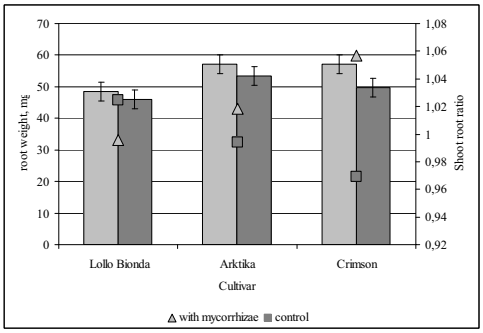

Fig. 2. Lettuce seedling root weight (mg) and shoot and root ratio (%) at the age of 3rd true leaf.

Almost the same fresh matter weight increase (in average 13.1%) was obtained after month of lettuce cultivation as result of AM fungi tratment. All cultivars showed stimulation effect of *Glomus mosseae,* but the largest effect was observed for cv. 'Lollo Bionda' where the fresh weight of lettuce increased by 35.1%, and it was significantly higher than control. For other two cultivars the significance of effect was not statistically approved. (Fig.3). Plant weight depended on cultivar. Naturally that the highest plant weight was observed for iceberg lettuce 'Arktika' in comparison with curly varieties 'Lollo Bionda' and red curly variety 'Crimson'.

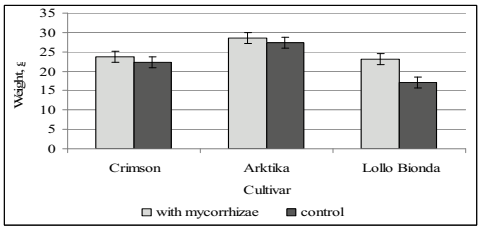

Fig. 3. Weight of lettuce (g) at the end of experiment.

During plant growth the ratio between lettuce shoot and root increases. In average shoot is 1.67 times larger in comparison with root. The differences between cultivars were found. In average proportion of leaves in whole plant is larger for iceberg lettuce. The use of arbuscular fungi decreases the ratio in comparison with control. Reverse regularity was founded for curly varieties. There plant treatment with *Glomus mosseae* increased shoot proportion. (Fig.4). Data statistical elaboration approves significance of ratio for cultivar 'Lollo Bionda'.

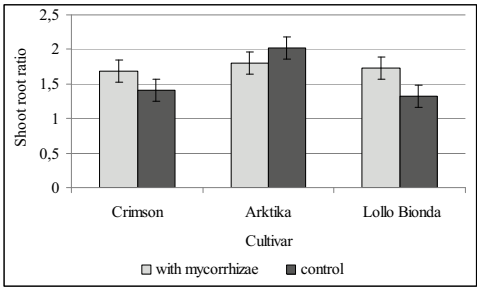

Fig. 4. Lettuce plant shoot and root ratio (%) at the end of experiment

Significant differences were found also in dry matter content between cultivars. Iceberg lettuce ,Arktika' contained the lowest dry matter content from tested varieties. No effect of mycorrhizal fungi was found. Both curly varieties were responsive to *Glomus mosseae* treatment and in average the increase of dry mater content by 24% was observed. Cultivar 'Crimson' was more sensitive and differences between variants with fungi and control is statistically significant (Fig. 5).

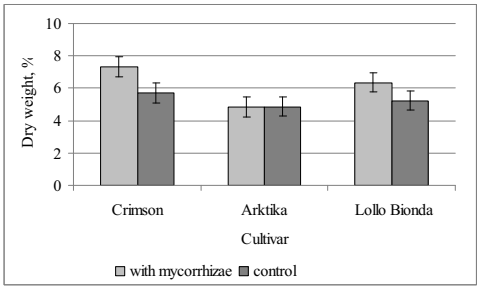

Fig.5 .Dry matter content (%) of lettuce plant at the end of experiment

Content of lettuce leaf pigments depended on cultivar. (Data not shown). In average leaves of cv. 'Arktika' contained 34.7% more chlorophyll and 31.6% more carotenoides in comparison with curly varieties. No significant effect of arbuscular micorhizae fungi treatment was observed. It is opposite literature data, were effect was found [14]. Differences should be explained with different growing conditions. Amelioration of chlorophyll content was found under salinity stress.

Obtained data reaffirm literature data that arbuscular mycorrhizae is beneficial for plants and *Glomus mosseae* (BEG isolate) should be used for improvement of lettuce growth.

CONCLUSIONS

1.The increase of fresh weight by 12-13 % during vegetative cultivation of lettuce as result of *Glomus mosseae* (BEG isolate) presowing treatment was found.

2.Presowing treatment with *Glomus mosseae* increased shoot proportion in the lettuce shoot root ratio for curly varieties.

3.Arbuscular mycorrhizae stimulate accumulation of dry matter in the leaves of curly lettuce varieties.

4.Content of leaf pigments depended on cultivar. No significant effect of arbuscular micorhizae fungi treatment on the content of chlorophylls and carotenoides in the lettuce leaves was found.

5.Glomus mosseae (BEG isolate) should be recommended for improvement of lettuce growth.

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