REACTIONS OF GINKGO BILOBA L. SEEDLINGS ON WATER SCARCITY

Raček M., Lichtnerová H., Dragúňová M.

Department of Green´s Biotechnics, Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture in Nitra, tel.: +421376415433, E-mail: marcel.racek@uniag.sk

Abstract. The goal of the experiments was to define chosen reactions of *Ginkgo biloba* L. seedlings to differentiated irrigation regime. Seedlings growing in one litre plastic containers were used in experiments. Two experimental variants were established. The saturation of substratum of the control variant was 70 %. The saturation of substratum of stressed seedlings was 40 %. We found out that *Ginkgo biloba* L. seedlings responded to water scarcity by decrease of chlorophyll content in the leaves, decrease of specific leaf area and increase of dry mass of leaves. Remarkable results were obtained after root characters analyses. The amount of roots of stressed seedlings was for one third reduced.

Introduction. Global climatic change causes modifications of plant living conditions. Reduction in the quality and stability of the environment is caused, because many species are not viable in drought conditions. The indicators of adaptability to water scarcity may be due to various professional look problematic to define From an ecological point of view is the subject of adaptability the ability to populate the extreme sites.Botany perceives morphological differences and phenotypic expression, resulting in the emergence of new taxonomic units. There are several indicators from a physiological point of view.As stated Filová et al [1] large numbers of secondary metabolites in plants are result of plants response to biotic or abiotic stress. According to Jureková et al. [4] is in particular an adaptation mechanism the process of osmotic adjustment which is characterized by the presence of osmotically active substances, amino acids and simple sugars. This osmotically active substances change concentration of cell solutions and act osmotically in favor of cells. Due to exposure of osmoprotectants plant cells are able to provide its functions. According to Olšovská et al [8] the ability to control the flow of water in the cells and tissues have some proteins which are synthesised in plants under conditions of dehydration. Their presence may indicate a positive response of the plant to water stress. Another plant responses to water scarcity is the change of size and arrangement of stomata. According to Larcher [5] the smaller and more densely arranged stomata react more sensitively. The result of reaction like this is more precise control of transpiration. Water scarcity may also lead to reduction of leaf area. That reaction can caused creation of a thicker layer of mesophyll with more chlorophyll per unit of the leaf area [9]. Expected benefit for the plant is offset of photosynthetic activity compared with photosynthetic activity in optimal conditions. On the other hand according to Slováková and Mistrík [10] may strong water deficit to cause the degradation of chloroplast membranes and chlorophyll. Such reaction causes inhibition of photosynthesis. The leaves of more sensitive species used to be loss and damaged. Vitality and aesthetic value of these plants are remarkable reduced. These reactions are particularly specific for certain groups of perennials [2, 3]. Unlike leaves which prevent the growth in conditions of gradual drying of the soil substratum roots used to elongate. Due to transport of assimilates to the root system there are formed so-called compensatory roots. Their task is to penetrate into the deeper layers of soil substratum in order to get enough water [7]. Changes of the root system, thicker cuticle, more stomata, the reduction of leaf area and chlorophyll content in leaves, may be in certain circumstances regarded as indicators of plant responses to water scarcity. Plants ability to adapt decides of their existence and possible application.The subject of research became *Ginkgo biloba* L. one of the phylogenetically oldest species, which originates from Southeast Asia. Its natural habitat is the Sichuan province in China. Since 1730 is growing in Europe [11]. The public knows him primarily as part of various pharmaceutical products. It is characterized by slower growth and is relatively resistant to the pollutants and de-icing salts. *Ginkgo biloba* L. is generally considered one of the most adaptable species in our climatic conditions [11]. The goal of the experiments was to define chosen reactions of *Ginkgo biloba* L. seedlings in conditions of differentiated irrigation regime.

Material and Methods. Plant material was produced from seeds from parent plants growing in the park of Topoľčianky. It were one-year old seedlings grown in plastic one-liter containers in a substrate TS 3 Standard (pH 5,5 to 6,0 + fertilizer 1 kg / m ^{3}) enriched by clay fraction (0–25 mm / m clay 20 kg /

m ^{3}). At the beginning of June in the phenological stage of rapid shoot growth different irrigation regimes were induced. The level of soil substratum saturation was 40 % for stressed plants and 70 % for controlled plants. Substratum was irrigated three times a week.Differentiated irrigation regime was maintained for eighty five days. There were measured development of dry mass of leaves (%) and specific leaf area of turgescent leaves SLAt ($cm^2.g^{-1}$) in experiments, which were calculated by Larcher [6]. The sampling was made six times per growing season. The first collection took place immediately after the induction of differentiated irrigation regime. The last sampling took place at the beginning of September after eighty five days of differentiated irrigation regime. Ten seedlings were analysed (five for each variant) per one analysis. Initial analysis was common for both variants. Development of chlorophyll in the leaves was measured too. It was measured for all growing season at twenty plants (ten for each variant – saturation of the soil substratum 40 % for stressed plants and 70 % for controlled plant). Three the same leaves were measured twice per each plant in one data collection. The amount of chlorophyll was measured by chlorophyll meter Opti-Science. Unit measured was chlorophyll content index (CCI). At the end of growing season was analysed water content of the stem, water content of the roots and volume of the roots. There were analysed relationships between reactions of the seedlings in stress and control variants.

Results and Discussion. The results obtained suggest that *Ginkgo biloba* L. seedlings exposed to water scarcity reacted by different ontogenetic evolution of the chlorophyll content in the leaves. Chlorophyll content in leaves of stressed plants decreased rapidly after exposure to differentiated irrigation regime (Fig. 1). Decrease stopped after one month and the curve of chlorophyll showed similar continuance as chlorophyll content in control Decrease in chlorophyll content in leaves could be caused by limited nutrition which was induced by water scarcity in the soil substratum.

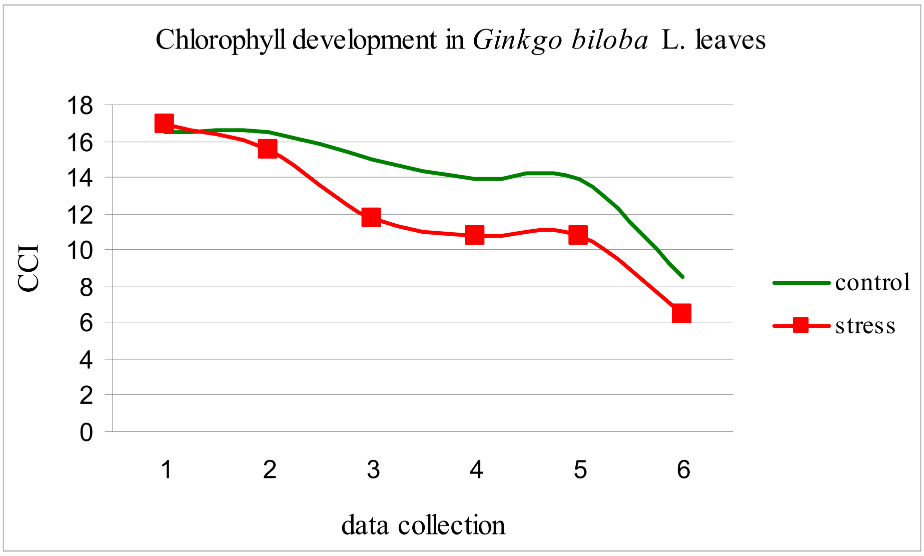

Figure 1. The curves of the chlorophyll content in the leaves of stressed and controlled Ginkgo biloba L. seedlings under different irrigation regimes expressed in CCI.

The analyses showed, that water scarcity increased dry mass of *Ginkgo biloba* L. leaves (Fig. 2) and caused differences in specific leaf area of turgescent leaves (SLAt) of stressed and controlled seedlings (Fig. 3). SLAt of *Ginkgo biloba* L. stressed seedlingsincreased in average for 2,7 $mg.cm^{-2}$.tion of SLAt indicates the response to water scarcity, which could be creation of thicker leaves. Similar reactions recorded Paganová et al [9] on seedlings of *Pyrus pyraster* L.

At the end of growing season was analysed water content of the stem, water content of the roots and volume of the roots. As is shown in the Table the most differences influenced by water scarcity were measured on growth character of the roots. The major changes were measured in the amount of *Ginkgo biloba* L. roots.

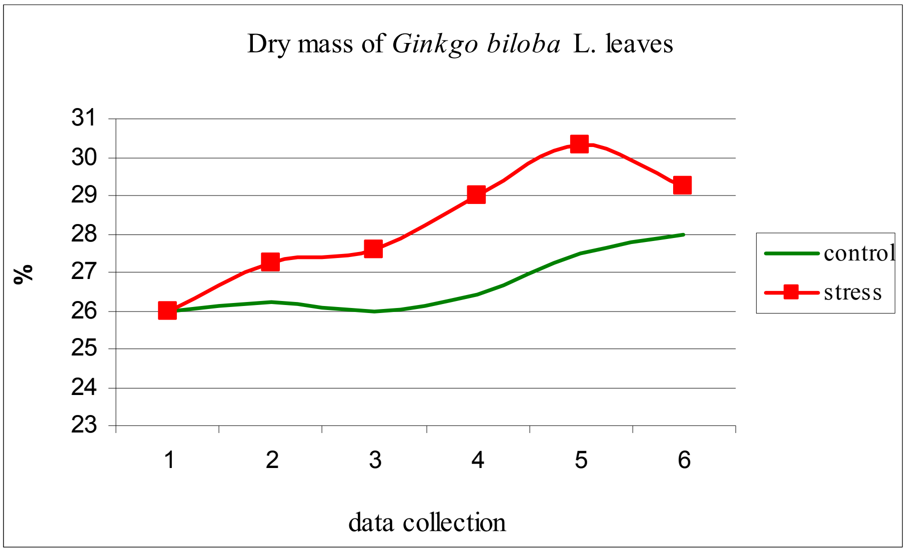

Figure 2. Increase of dry mass of *Ginkgo biloba* L. leaves under differentiated irrigation regime.

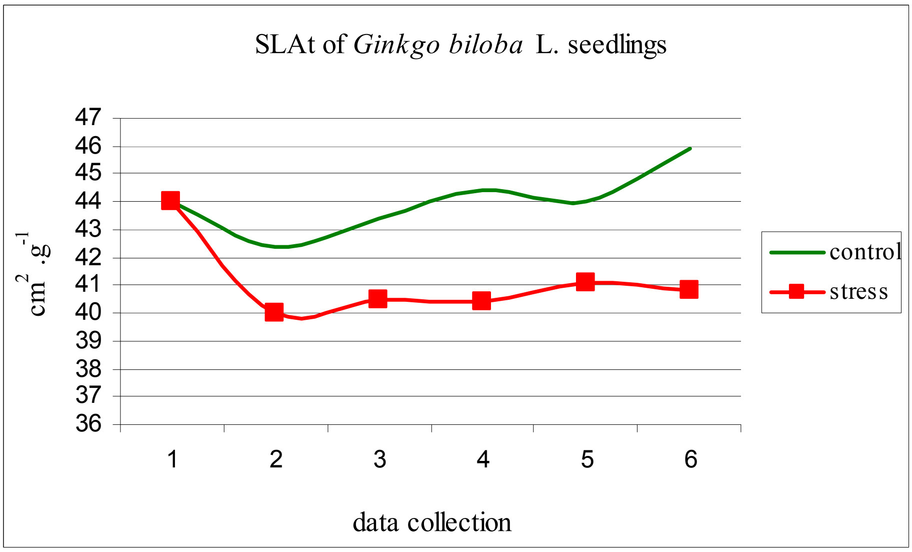

Figure 3. Development of SLAt of *Ginkgo biloba* L. seedlings under differentiated irigation regime.

Table. **Physiological reactions of *Ginkgo biloba* L. seedlings influenced by water scarcity**

	Stem		Roots		
	Dry mass, %	Water content, %	Dry mass, %	Water content, %	Amount, cm^3
Control	43,2	56,8	23,2	76,8	15,25
Stress	43,8	56,2	26,3	73,7	10,5

Conclusion. *Ginkgo biloba* L. seedlings responded to water scarcity by decrease of chlorophyll content in the leaves, decrease of specific leaf area and increase of dry mass of leaves. Decrease of specific leaf area of turgescent leaves could indicate creation of thicker leaves as the respond to water scarcity. That assumption is necessary to confirm by another experiments. Remarkable results were obtained after root characters analyses. The amount of roots of stressed seedlings was for one third reduced.

Acknowledgements. Research was realised with the financial support of the grant project VEGA 1/0426/09 «Plant adaptability and vitality as criteria of their utilization in urban environment and in the landscape».