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BRIEF COMMUNICATION

Long-Term Effect of Irradiance on Growth, Water Relations and Epidermal Conductance of Two *Cyclamen* Cultivars

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Abstract. Decrease in leaf irradiance to 50 % due to shading of plants in glasshouse only during clear summer days did not induce significant changes in growth parameters, characteristics of water relations and epidermal conductance of two cyclamen cultivars. Thus the possibility of acclimation of plants to non-stable changes in environmental conditions was not proved.

Plants which grow in a sunny or a shaded locality are adapted and acclimated to it and, consequently, they differ in many anatomical and physiological characteristics. Acclimation of plants to growing irradiance was proved by many experiments in air-conditioned chambers where plants were grown under different irradiances (but constant for every daylight hours and usually very low) : in addition to growth mainly photosynthesis and stomata were significantly affected (for review see *e.g.* Patterson 1980, Björkman 1981, Solárová and Pospíšilová 1987). However, irradiance of leaves in nature is usually much higher and varies spatially, diurnally and seasonally. Therefore the following experiments were done in glasshouse under sufficient irradiance and their aim was to determine whether also nonstable changes in irradiance can induce acclimation of plants.

Two cultivars of *Cyclamen persicum* Mill. 'Harting Rot' and 'Rosa von Zehlen-

The term acclimation is used here for nonheritable modifications of character caused by exposure of an organism to certain climatic conditions in contradistinction to the term, adaptation, which is used for heritable modifications in the structure and function.

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dorf' were grown in plastic pots (diameter 12 cm, mixture of bark, peat and clay 2 : 2 : 1, sufficiently ebb/flood irrigated by 0.05 % nutrient solution, 16 pots per m^2) in glasshouse during spring and summer 1989. Irradiance of half of plants was decreased to 50 % in clear days (about 60 % of days in the summer 1989) by shading of plants from 10.30 to 17 h. The optimum temperature for growing of cyclamens is 18 to 20 °C (Hendriks and Scharff 1988). The negative effect of high temperature in glasshouse during summer days was diminished by periodical misting of leaves whenever air temperature was higher than 25 °C (misting for 15 s, time of breaks was automatically directed). As cyclamens have nonwettable leaves it is possible to suppose that misting does not produce a coherent film of water covering whole leaf

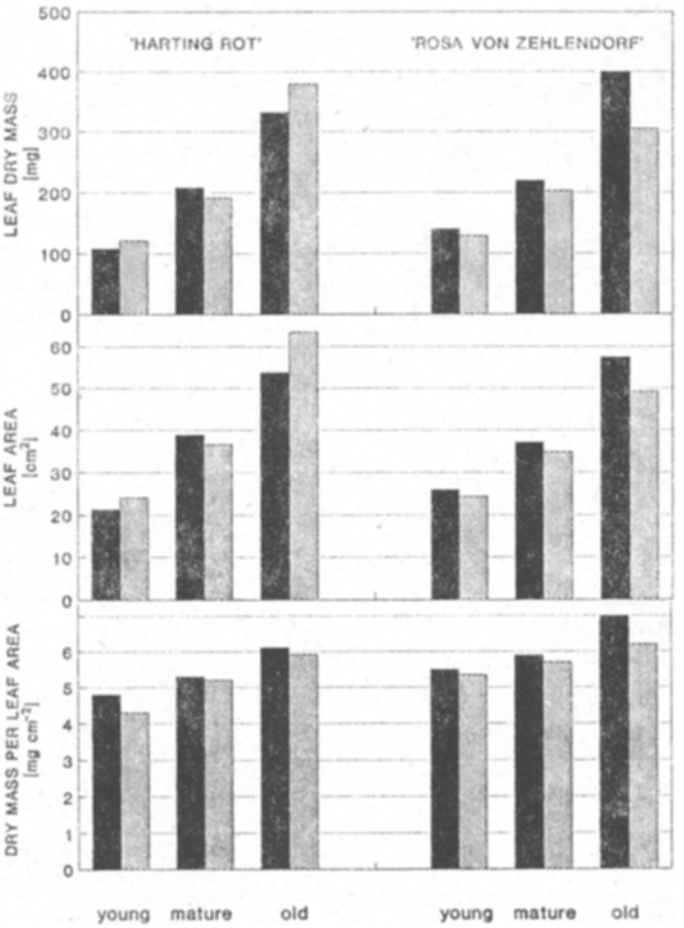

Fig. 1. Effect of decrease in leaf irradiance to 50 % during clear summer days on growth characteristics of young, mature and old leaves of two cyclamen cultivars 'Harting Rot' and 'Rosa von Zehlendorf' (Black columns unshaded plants, hatcted columns shaded plants)

Table 1

Water relation parameters

Cultivar	Treatment	Water Potential	Osmotic Potential	Pressure Potential
'Harting Rot'	shaded	− 0.64	− 0.76	0.12
	$s_{\bar{x}}$	0.09	0.08	0.04
	unshaded	− 0.70	− 0.83	0.13
	$s_{\bar{x}}$	0.12	0.10	0.04
'Rosa von Zehlendorf'	shaded	− 0.71	− 0.79	0.08
	$s_{\bar{x}}$	0.14	0.12	0.04
	unshaded	− 0.73	− 0.85	0.12
	$s_{\bar{x}}$	0.11	0.10	0.02

surface which might decrease the CO_2 transport (Smith and McClean 1989). These treatments lasted from 15th June to the end of September. At the end of September the size of 60 plants in each variant, number of flower buds etc. were evaluated and no important effects of shading were found. The growth parameters were determined in more detail in six plants of each cultivar and treatment. Similarly, no statistically significant effects of shading on dry mass, area and thickness of young, mature and even old leaves (grown under these treatments for the longest period) were found (Fig. 1). Leaf water and osmotic potentials were measured by a droplet thermocouple psychrometer joined with a Keithley Microvolt Ammeter 150 B at a temperature 25 + 0.002 °C. Water potential was determined on a living leaf section and osmotic potential was determined after the same section had been frozen

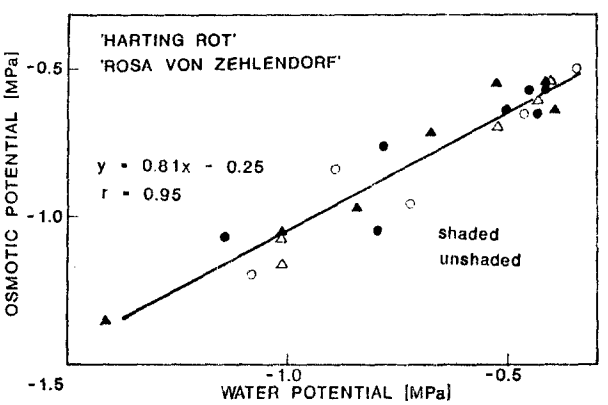

Fig. 2. Relationship between the water and the osmotic potentials in two cyclamen cultivars 'Harting Rot' (circles) and 'Rosa von Zehlendorf' (triangles) grown under shaded (full points) or unshaded (empty points) conditions

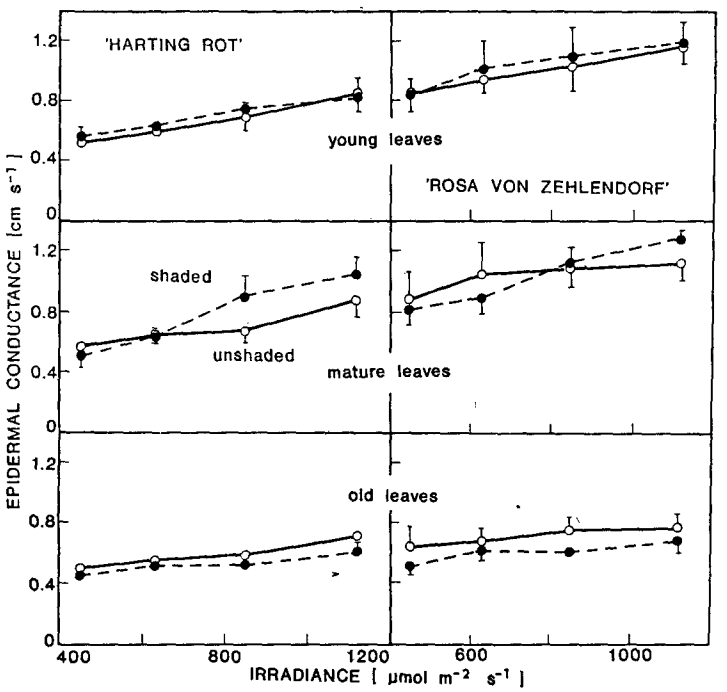

Fig. 3. Diffusive conductance of abaxial epidermis in young, mature and old leaves of two cyclamen cultivars 'Harting Rot' and 'Rosa von Zehlendorf' grown under shaded (full points) or unshaded (empty points) conditions. Actual irradiance 400 to 1200 µmol m^{-2} s^{-1} PAR, temperature 25 °C, air humidity 60–70 %.

(−18 °C, 16 h) and thawed. Pressure potential was calculated as the difference between water and osmotic potentials. Water, osmotic and pressure potentials of leaves detached from plants in the morning were also similar in both cultivars and both treatments (Table 1). As osmotic adjustment caused by this treatment was not observed (Fig. 2) it is possible to suppose that misting of leaves was sufficient to prevent development of water stress also in unshaded variant.

Stomatal conductance of abaxial epidermis (cyclamen has hypostomatous leaves) and its dependence on actual irradiance (from 400 to 1200 µmol m^{-2} s^{-1} PAR; four photolamps immersed in cooled distilled water) was measured by the diffusion porometer Delta-T (type Mk3) at a temperature 25 °C and a relative humidity 60–70 %. Diffusive conductance of abaxial epidermis (g_{ab}) was always higher in mature than in young and old leaves (Fig. 3) similarly as in many other plant species (for review see e.g. Solárová and Pospíšilová 1983, Čatský *et al.* 1985, Field 1987). The values of g_{ab} in young and mature leaves of cv. 'Rosa von Zehlendorf' were higher than those of cv. 'Harting Rot'. Shading of plants did not significantly affect g_{ab} in young, mature and old leaves of both cultivars and also dependence of g_{ab} on actual irradiance (measured in the range of irradiances which roughly corresponded to

shaded and unshaded conditions in glasshouse). As growth of shaded and unshaded plants was similar and the both treatments did not result in water stress, it is not possible to suppose that the negative effect of other environmental factors, counterbalanced the eventual positive effect of higher irradiance on epidermal conductance under unshaded conditions.

Thus the non-stable changes in irradiance (even if the difference in irradiance was high and treatment lasted for several months) did not evoke acclimation of cyclamen plants.

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