



Figure 4. Relative change of the red shift FLM upon temperature. 1- palm (*Cocos nucifera*), 2- mulberry black (*Morus nigra*), 3- crabtree (*Malus*), 4- oak (*Quercus robur*), 5- sour cherry (*Prunus cerasus*), 6- willow (*Salix alba*), 7- birch (*Betula pendula*).

It is well known that any change over usual grown condition (298 K ± 5 K) cause dramatic change photosynthetic apparatus efficiency through change in lipid membrane composition, activation oxygen scavenging enzymes, water loss and altered growth morphology [12-14]. As the measure for temperature sensitivity was used the slope of linear regression obtained drawing $\Delta\lambda [\%] = f(\Delta T)$ (Figures 3 and

4). Obtained slope was presented in Table 1. One can see that different plant species shown different temperature sensitivity. In the other words different plant species will “answer” at different way on environment temperature which depends of its adaptation on climate condition. This is an agreement with literature data [6,12,13]. Some of them are excellent adapted on low temperature [15].

Table 1. Relative change of the red shift $\Delta\lambda$ and in photosynthetic apparatus efficiency $\Delta\epsilon$ in temperature range (263 K-328 K).

Objects	$\Delta\lambda$ [nm]	$\Delta\lambda/\Delta T$ [nm/K]	$\Delta\epsilon$ [%] Eq.(1)	$\Delta\epsilon/\Delta T$ [%][K ⁻¹]
Plum	44.8	0.692	62.38	0.959
Locust tree	15.94	0.245	31.77	0.489
Linden tree	18.26	0.281	34.75	0.535
Birch silver	16.06	0.241	31.92	0.489
Poplar	6.69	0.103	18.02	0.277
Walnut	27.51	0.423	45.37	0.698
Chestnut	3.80	0.058	12.47	0.192
Palm tree	44.48	0.699	62.36	0.959
Mulberry black	6.65	0.102	17.95	0.276
Crabtree	5.21	0.081	15.31	0.236
Oak tree	5.92	0.054	16.64	0.259
Sour cherry	27.53	0.424	45.36	0.698
Willow	18.17	0.279	34.60	0.532
Carb	16.37	0.252	35.32	0.543

Other one being excellent adapted to high temperature [13]. On the other words, it is well known that: a) heat damage is reflected in drastic changes of the light-induced fluorescence spectra (fluorescence intensity) which is correlated with inhibition to Photosystem II [16] and b) chilling also cause dramatic change in light-induced fluorescence spectra which is correlated with in cells morphology [6].

Also, using Eq. (1) relative change in photosynthetic apparatus efficiency $\Delta\varepsilon$ was calculated. The rate of the relative change of photosynthetic apparatus efficiency $\Delta\varepsilon/\Delta T$ was obtained as the slope of the line $\Delta\varepsilon [\%] = f(\Delta T)$ and are given in **Table 1**. One can see that for all species $\Delta\varepsilon/\Delta T$ is close to each other except for Poplar, Chestnuts and Oak. This mean that photosynthetic apparatus efficiency ε for all species, except three mentioned, are very sensitive to temperature change. Also, small temperature sensitivity $\Delta\varepsilon/\Delta T$ may be result of the excellent acclimation to the climate condition and great resistivity of photosynthetic apparatus on temperature fluctuation. Also, it mean that photosynthetic apparatus and its function as well as the chlorophyll content of the leaf will good and fast adjust to new environment temperature. This can be explained with in different change in plant morphology and physiology caused by temperature. For example, temperatures which induce irreversible damage in lipid membrane of plant leaves are different for different plant species [10]. Plants may be differ in heat tolerance, and studied have shown that some plants are capable of physiological acclimation to increase both their heat tolerance and their temperature optimum for net photosynthesis [10]. Therefore one can say that temperature tolerance is specific and determinate with plants genetically.

Obtained difference in for different plant species in not unexpected. Namely, in literature data one can find that the high temperature effects depend on species and genotype [17-20]. Some experimental data have shown that in poplar photosynthesis significantly decreased after heat stress so after 24 h exposing to the 315 K photochemical quenching is about 45.2% [21].

In literature data one can find lot of examples that change of temperature, outside the optimum condition can cause change in damage of the photosynthetic apparatus [3,22,23].

Taking account mentioned discussions and results from literature date for 73 trees species [1] we assumed that if the change of the photosynthesis apparatus is change less that 40% due the temperature change mentioned plants have great ability to survive in given environmental conditions.

Preliminary discussions indicate the possibility of practical application of the examination of optic properties of the green plant leaf. Namely, mmentioned above discussion lead to say two thinks. First, that the plants with smaller $\Delta\varepsilon/\Delta T$ have greater ability for adapted (greater possibility) to environment temperature conditions. Second, measuring the $\Delta\varepsilon/\Delta T$ can it would be an indicator, for young or by crossing

obtained the new plant species that indicates how much the plant is able to overcome the resulting temperamental changes in the environment.

CONCLUSION

The temperature has great effect on red shift of the first fluorescence maximum in fluorescence spectra of the plant leaves. The shift rate $\Delta\lambda/\Delta T$ induced with temperature is different for different plant species. Direct correlation between red shift and change in photo system apparatus efficiency $\Delta\varepsilon$ exist, greater change in $\Delta\lambda$ was connected with greater change in $\Delta\varepsilon$. $\Delta\varepsilon/\Delta T$ can be used as indicator of plant adaptivity on environment temperature changing.

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