VARIATIONS OF FOLIAR PIGMENTS CONTENT AT *ABIES ALBA* AND *NEPETA PANNONICA* SPECIES FROM THREE DIFFERENT AREAS OF BUKOVINA, IN GROWING AND FLOWERING PHENOPHASES

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Abstract

Leaf pigments serve as indicators for photosynthetic activity of plants. Also, pigments content can provide valuable information concerning physiological status of plants and some biochemical processes. The present study had as starting point the hypothesis that pigments are quantitatively influenced by phenophase and location. The studied species are *Abies alba* and *Nepeta pannonica*, identified in local wild populations near bukovinian localities named Cacica, Gura Humorului and Câmpulung Moldovenesc, which have specific climatic, orographic and edaphic characteristics. For collecting of biological material, from *Abies alba* species, there was selected mature exemplars, about same age. From them, there were harvested annual growings, from the first level of branches, during growing and flowering phenophases, in 2017. Probes of *Nepeta pannonica* leaves have been picked up from the third foliar node, in the same phenophase, during the same year. Researches were performed on plants, using CCM - 900 PLUS device, and in laboratory, with Shimandzu UV - 1800 spectrophotometer. After data centralization, there has been observed that *Abies alba* from all these three areas cotains a greater amount of chlorophyll and flavonoids during flowering phenophase than during growing phenophase. Also, the pigments content is inversely proportional with altitude. *Nepeta pannonica* presents different variations concerning amount of these pigments. This thing is caused by senescence of leaves, unusual meteorological conditions and reduced light. Thus, it can be concluded that the connection between amount of foliar pigments and phenophase, respectively location, is more obvious at *Abies alba* than *Nepeta pannonica*.

Keywords: pigments, chlorophyll, photosynthesis, plant, phenophase

Photosynthetic pigments have a great importance in photosynthesis process, which determine growing and development of plants (Ashraf M. *et al*, 2013; Li Q. *et al*, 2011). The main photoreceptors from this process are chlorophylls, which absorb solar energy as electromagnetic radiation, synthesizing carbohydrates and O_2 from water and CO_2 (Mall L.P. *et al*, 1973; Mishra S.S. *et al*, 2013). In plants, there are two types of chlorophyll, which acts like photoreceptors, namely chlorophyll *a* and chlorophyll *b* (Khaleghi E. *et al*, 2012). From the structural point of view, chlorophyll molecule has the porphyrin nucleus, which has a Mg^{2+} atom in center. It gives to chlorophyll fluorescence and green color. This nucleus has two acid functions – COOH, as chlorophyllin acid, esterificated with methanol, respectively with phytol. Chlorophyll a contains chlorophyllin acid *a* and chlorophyll b contains chlorophyllin acid *b*. Molecule of chlorophyll has a hydrophylic pole, represented by the porphyrin nucleus, and a hydrophobic pole, represented by phytol (Jităreanu D.C. *et al*, 2007). The amount of chlorophyll offers clues about photosynthetic activity which takes place at the level of plant, also about some physiological processes, like growing and development. Also, it reflects physiological state of plant and happening of some biochemical processes (Sims D.A. *et al*, 2002; Steele M. *et al*, 2008). Simultaneously, it is influenced by season and external factors: temperature, light and precipitations (Jităreanu D.C. *et al*, 2007).

MATERIAL AND METHOD

Materials of researching were represented by vegetal probes from *Abies alba* and *Nepeta pannonica* species, harvested in growing and flowering phenophases, during year 2017, from three different areas, with specific orographic characteristics: Cacica, Gura Humorului and Câmpulung Moldovenesc. Samples from *Abies alba* species was collected from annual growths, from the first level of branches. From *Nepeta pannonica* species, samples have been taken under form of leaves, from the third foliar node.

The determination of chlorophyll content index was realized on terrain, directly on plant, with

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the CCM-200 PLUS device. Afterwards, leaves was collected for extraction of pigments in the sight of absorbance determination. These was performed in laboratory, using acetone extracts of pigments, of 1% concentration, which were used for determination at spectrophotometer. The pigments content from leaves was appreciated reading values from visible spectrum (400-700 nm) and from near-UV (320 mn), corresponding to chlorophyll a, chlorophyll b and flavonoids.

RESULTS AND DISCUSIONS

Calculation of chlorophyll content index (CCI) at studied species offer us informations about photosynthesis intensity. At *Abies alba* species (*figure 1*) it was observed a growing of this during transition to flowering phenophase.

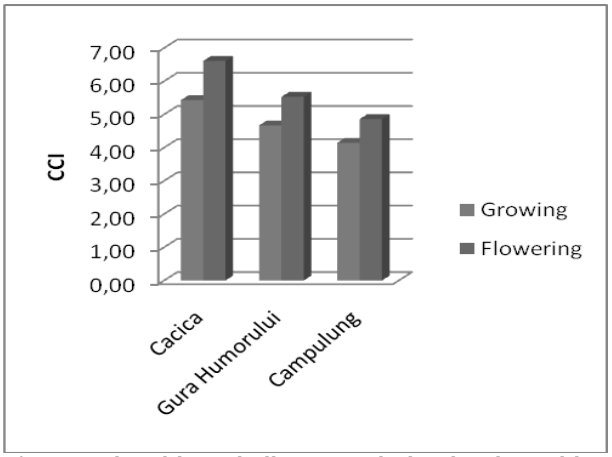

Figure 1 **The chlorophyll content index (CCI) at *Abies alba* species**

At *Nepeta pannonica* species (*figure 2*) it can be observed a descrease of chlorophyll content index, in flowering phenophase, in case of exemplars from Cacica and Gura Humorului. The main reason of chlorophyll content decreasing is the lack of light, caused by shading given by surrounding plants. Leaves from the third foliar node lose the photosynthesis capacity gradually, entering in a degradation state, followed by necrosis.

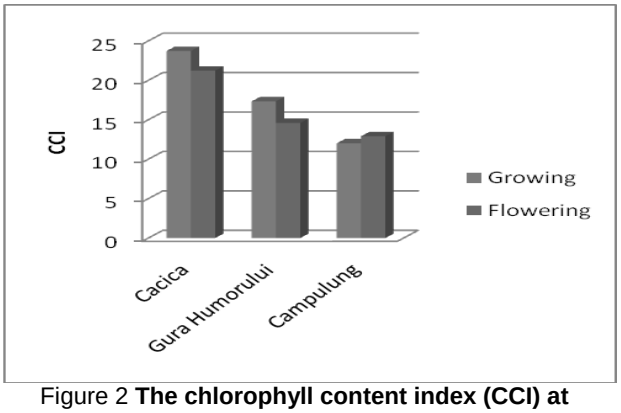

Figure 2 **The chlorophyll content index (CCI) at *Nepeta pannonica* species**

The capacity of light absorbtion by photosynthetic pigments extract from studied species

The analysis of foliar pigments emphasizes the fact that, in flowering phenophase, exemplars of *Abies alba* from Cacica area have the highest chlorophyll content, while the ones from Câmpulung area have the lowest content. In flowering phenophase, the amount of photosynthetic pigments knows a visible growing at the plants from all three areas (*figure 3, 4, 5*). It can be said that at *Abies alba*, the amount of chlorophyll from annual growths is inversely proportional with altitude.

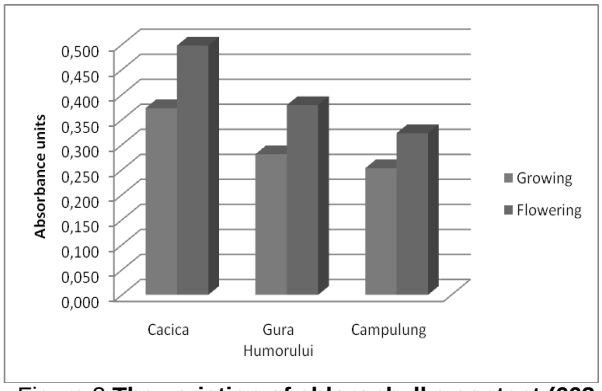

Figure 3 **The variation of chlorophyll a content (663 nm) at *Abies alba* species according to phenophase and location**

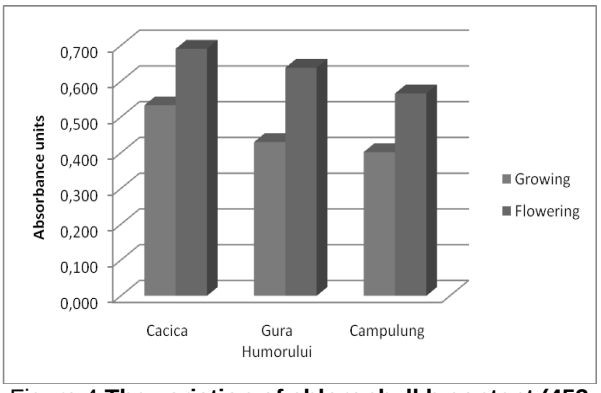

Figure 4 **The variation of chlorophyll b content (453 nm) at *Abies alba* species according to phenophase and location**

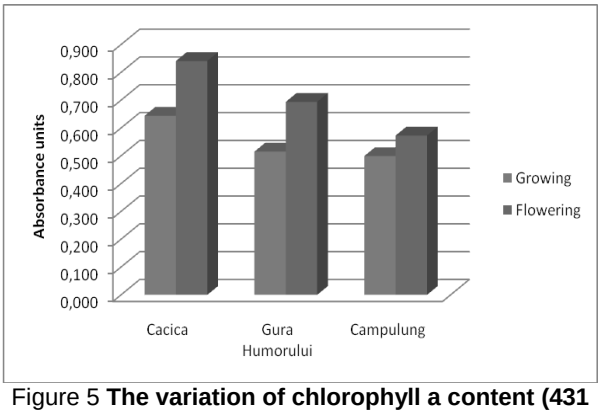

Figure 5 **The variation of chlorophyll a content (431 nm) at *Abies alba* species according to phenophase and location**

At *Nepeta pannonica* species, in growing phenophase, it can be observed that plants from Câmpulung area have the lowest chlorophyll content in leaves from the third foliar node, while the ones from Cacica area have the highest. On intermediate position are situated the plants from Gura Humorului area. In the flowering phenophase, leaves from the target node begind to lose the photosynthetic capacity against of lack of light, caused by competition of surrounding plants. This aspect is reflected by chlorophyll content, which begin to low. An exception makes only plants from Câmpulung area, which know a slight growing of chlorophyll amount in this period (*figure 6, 7, 8*).

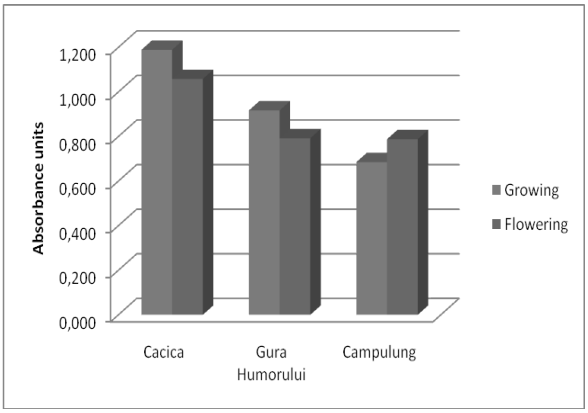

Figure 6 **The variation of chlorophyll a content (663 nm) at *Nepeta pannonica* species according to phenophase and location**

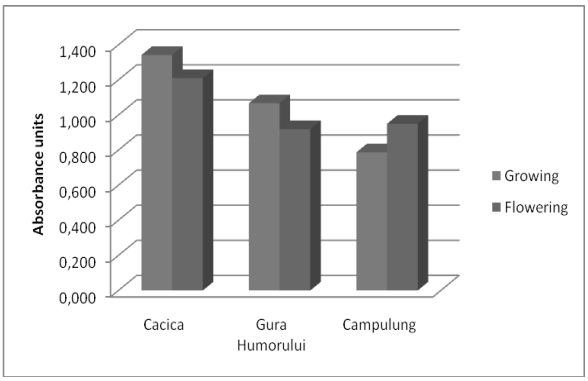

Figure 7 **The variation of chlorophyll b content (453 nm) at *Nepeta pannonica* species according to phenophase and location**

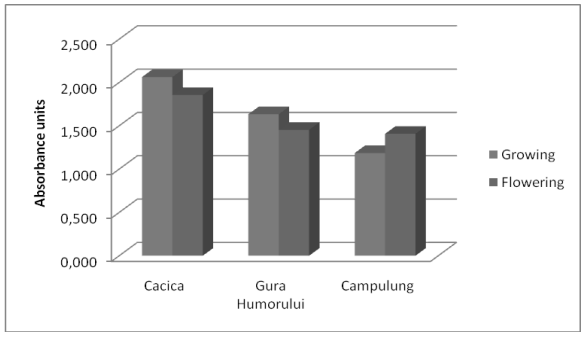

Figure 8 **The variation of chlorophyll a content (431 nm) at *Nepeta pannonica* species according to phenophase and location**

With study of absorbtion capacity by foliar pigments extracts it was found if there exists a dynamics of flavonoids content acording to species and area. Thus, it was observed that at *Abies alba* species, the amount of flavonoids content of annual growths is directly proportional with altitude and inversely proportional with content of chlorophyll *a* and *b*, being greater in flowering phenophase than in growing phenophase (*figure 9*).

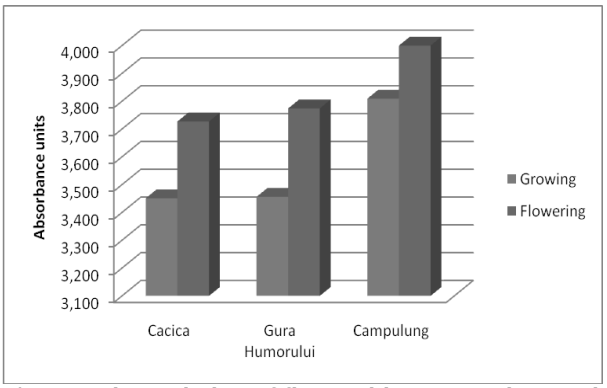

Figure 9 **The variation of flavonoids content (332 nm) at *Abies alba* species according to phenophase and location**

At *Nepeta pannonica*, the flavonoids content grows visibly with altitude and it is greater in flowering phenophase. At this species it can't be observed a clear connection with chlorophyll amount (*figure 10*).

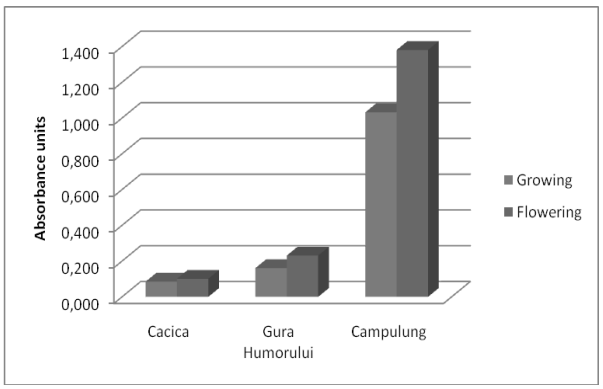

Figura 10 **The variation of flavonoids content (332 nm) at *Nepeta pannonica* species according to phenophase and location**

CONCLUSIONS

Researchings undertook on *Abies alba* and *Nepeta pannonica* species conducted to next conclusions:

- During growing phenophase, in the case of both species, the content of chlorophyll is inversely proportional with altitude;

- In flowering phenophase, *Abies alba* species knows a growing of chlorophyll amount in all the three target areas;
- At *Nepeta pannonica* species, during the flowering, the content of photosynthetic pigments can't be put in direct connection with geographic position of areas;
- The flavonoids amount grows with amount of chlorophyll *a* and *b*, at both species.

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