J. Plant Develop.
18(2011): 41-45

COMPARATIVE BIOCHEMICAL AND PHYSIOLOGICAL RESEARCH ON TAXA OF *MENTHA* L. GENUS

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Abstract: The *Mentha* L. genus has many aromatic and medicinal taxa with a large area in our country. These taxa prefer flooded, swampy areas and wetlands, but they can also grow in moderate dry areas. Biochemical characteristics were obtained for 7 taxa from *Mentha* L. genus, wild or cultivated plants. The studies concerning the assimilative pigments, the hydric content, and the dry matter were determined for each vegetation stage. We used the gravimetric method for the hydric content and dry matter and the spectrophotometric method for estimation of the assimilative pigments. The results of the experiments are not the same for each taxon because of different harvesting periods and the ecological conditions of each taxon area.

Key words: *Mentha*, assimilative pigments, dry matter, water

Introduction

Mentha genus includes herbaceous plants, perennial, aromatic, with a pungent odor characteristic, due to the volatile oil they contain. The Genus *Mentha* L. has a complex taxonomy, which makes it difficult to identify the species because of its phenotypic plasticity, genetic variability and because most species are able to produce hybrids by crossing. For example, the delimitation of the species *Mentha spicata* L. is problematic due to hybridization and doubling the number of chromosomes, especially when introgressive hybridization appears between some species in certain areas [HARLEY, 1972].

Due to their properties, these plants are used in pharmaceutical cosmetic and food industries. Photosynthetic pigments are known for their physiological role of protection against physical agents, such as blue and ultraviolet radiation, but also against biological agents [HOPKINS, 1985].

Water provides an environment for vital biochemical reactions. In metabolic processes it makes the enzyme activity and is involved in both biosynthesis and anabolic processes to catabolic processes of degradation [TOMA & JITĂREANU, 2000].

Materials and methods

The material used in this paper is represented by seven taxa of the genus *Mentha*, cultivated or from spontaneous vegetation, collected in three phenophases: vegetative, flowering and senescence, during the vegetation period of 2010. The culticated taxa are: *Mentha spicata* L., *Mentha piperita* var. *black* Mitcham. and *Mentha* x *piperita* var. *columna* L. The spontaneous taxa were collected from the following locations: Caraorman,

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Tulcea County (*Mentha aquatica* L. and *Mentha pulegium* L.), Negreşti and Cioatele, Vaslui County (*Mentha longifolia* (L.) Huds.).

For determination of foliar assimilatory pigments we used the spectrophotometric method and for determining the content water and dry matter the gravimetric method was used [BOLDOR & al. 1983].

Research has been conducted in the Laboratory of Plant Physiology of the Faculty of Biology, "Alexandru Ioan Cuza", Iaşi.

Results and discussions

The research conducted on the biosynthesis and accumulation of assimilatory pigments in the studied taxa, reveals the following results (Tab. 1):

Tab. 1. Assimilatory pigment content in species of the genus *Mentha* during vegetative stage in 2010

Taxon	Vegetative stage	Chlorophyll *a* (mg/g fresh matter)	Chlorophyll *b* (mg/g fresh matter)	Carotenoidic pigments (mg/g fresh matter)	Chlorophyll *a* / Chlorophyll *b*
Mentha longifolia (L.) Huds. (Negreşti)	Vegetative	1.130	0.404	0.0003	2.797
	Flowering	1.353	0.451	0.0004	3.000
	Senescence	1.012	0.283	0.0003	3.575
Mentha longifolia (L.) Huds. (Cioatele)	Vegetative	0.961	0.311	0.0002	3.090
	Flowering	0.909	0.339	0.0002	2.681
	Senescence	1.252	0.360	0.0003	3.477
Mentha aquatica L.(Caraorman)	Vegetative	0.455	0.198	0.0001	2.297
	Flowering	0.495	0.178	0.0001	2.780
	Senescence	0.641	0.315	0.0002	2.034
Mentha pulegium L. (Caraorman)	Vegetative	0.779	0.237	0.0001	3.286
	Flowering	0.905	0.365	0.0002	2.479
	Senescence	1.127	0.401	0.0003	2.810
Mentha x *piperita* var. *columna* L.(Vaslui)	Vegetative	1.841	0.590	0.0005	3.120
	Flowering	1.532	0.450	0.0004	3.404
	Senescence	1.340	0.452	0.0004	2.964
Mentha piperita var. *black* Mitcham. (Piatra Neamţ)	Vegetative	1.510	0.558	0.0004	2.706
	Flowering	2.081	0.739	0.0001	2.815
	Senescence	1.898	0.675	0.0002	2.811
Mentha spicata L. (Piatra Neamţ)	Vegetative	1.101	0.387	0.0003	2.844
	Flowering	2.294	0.755	0.0006	3.038
	Senescence	2.178	0.643	0.0003	3.387

On the taxa taken into study one may note an upward trend of assimilatory pigments in plant during the growing season. From the quantitative point of view there are significant differences throughout the growing season: the content of assimilatory pigments in cultivated taxa (*M*. x *piperita* var. *columna*, *M*. x *piperita* var. *black*, *M*. *spicata* is obviously higher than that of spontaneous taxa (*M*. *longifolia*, *M*. *aquatica*, *M*. *pulegium*). These taxa were collected in the same phenophase, so the process of photosynthesis is greater in the leaves of cultivated taxa, compared with those collected from spontaneous taxa.

It was recorded a significant quantitative increase of chlorophyll *a* from the vegetative phenophase to senescence in the case of *M*. *aquatica* and *M*. *pulegium* taxa. At three of the taxa studied (*M*. *longifolia*, (Negreşti), *M*. x *piperita* var. *black*, *M*. *spicata* the maximum amount of chlorophyll *a* was recorded at flowering and at the other two (*M*. *longifolia* (Cioatele), *M*. x *piperita* var. *columna* the maximum amount of chlorophyll *a* was recorded in vegetative phenophase.

In the case of chlorophyll b was found a similar dynamic, the values recorded being obvious lower. The variations recorded for chlorophyll a and chlorophyll b change the relationship between the two fractions of chlorophyll, the highest value being reached during the flowering period of the plant (3.404 mg/g fresh matter) at the *M*. x *piperita* var. *columna* taxon.

In all three vegetative phenophases is observed that the ratio of chlorophyll *a* and chlorophyll *b* varies from 2.034 to 3.404; the lowest value was registered at senescence, while the lowest value was reached in the flowering phenophase. We see therefore that the ratio of 3/1 expressed in specialty literature for many species is not recorded constantly throughout the period analyzed [BURZO & al. 1999; TOMA & JITĂREANU, 2000; ZAMFIRACHE, 2005].

Carotenoid pigments are found in small quantities, 0.0001 to 0.0006 mg/g fresh matter, compared with chlorophylls a and b. The maximum value, 0.0006 mg/g fresh matter for carotenoid pigments was recorded during the flowering period for *M. spicata* taxon.

The intensity of photosynthesis varies throughout the year. With the increase in leaf size the number of chloroplasts and the amount of chlorophyll also increases, the photosynthesis process becoming more intense [BĂDULESCU, 2009]. If we analyze the foliar tissue indicators at the studied taxa, it appears that the process of photosynthesis records significant increases throughout the growing season in proportion to the chlorophyll content. The intensity of this process stays constant thereafter.

Tab. 2. Dry foliar matter and water content at species of the genus *Mentha* L. during the growing season in 2010

Taxon	Vegetative stage	S.U. (g%)	H_2O (g%)
Mentha longifolia (L.) Huds. (Negreşti)	Vegetative	27.21	72.79
	Flowering	28.36	71.64
	Senescence	32.81	67.19
Mentha longifolia (L.) Huds. (Cioatele)	Vegetative	29.87	70.13
	Flowering	28.02	71.98
	Senescence	39.11	60.89
Mentha aquatica L. (Caraorman)	Vegetative	19.35	80.85
	Flowering	27.12	72.88
	Senescence	27.75	72.25

Mentha pulegium L. (Caraorman)	Vegetative	19.18	80.82
	Flowering	22.59	77.41
	Senescence	28.20	71.80
Mentha x *piperita* var. *columna* L. (Vaslui)	Vegetative	20.51	79.49
	Flowering	21.68	78.32
	Senescence	23.28	76.72
Mentha x *piperita* var. *black* Mitcham. (Piatra Neamț)	Vegetative	16.61	83.39
	Flowering	30.11	69.89
	Senescence	31.78	68.22
Mentha spicata L. (Piatra Neamț)	Vegetative	15.73	84.25
	Flowering	29.35	70.65
	Senescence	35.60	64.40

Water content: from research conducted at the studied taxa we noticed that in the vegetation period it was recorded the highest water content, which decreased gradually towards fructification (Tab. 2). The highest value was registered in the vegetative phenophase - 84.25 g% in *M. spicata* species, and the lowest value of 60.89 g% was obtained from the species *M. longifolia* collected from Cioatele area, Vaslui County; we consider this water content to be sufficient for the physiological processes in normal parameters at the plants investigated. The observed values for water content of taxa analyzed, range from 70.13 to 84.25 g% for vegetative phenophase 69.89 to 78.32 g% for flowering and from 60.89 to 76.72 g% senescence.

Dry matter accumulates during the development of the plant, its highest value occurring in senescence 39.11 g% of the species *M. longifolia* collected from the area Cioatele. The values obtained in the vegetative phenophase range from 15.73 to 29.87 g% at flowering from 21.68 to 29.35 and from 23.28 to 39.11 g% at senescence.

At the studied taxa a similar trend is observed concerning the water content and dry foliar matter throughout the whole vegetation season; as an exception we report the situation of *M. longifolia* taxon collected from the area Cioatele, which has the lowest content of dry foliar matter at flowering phenophase (28.02 g%).

Therefore it is observed a quantitative increase in dry matter content throughout the vegetation period inversely proportional to the decrease of water content. This was also observed by other authors as ZAMFIRACHE & al. (1997, 2005), BURZO & al. (1999), STRATU (2002) etc., at many other species. All these results indicate that the investigated plants have a higher metabolic rhythm in the phenophase of vegetation, and afterwards it decreases gradually towards fruition.

Conclusions

The taxa taken into account, according to the foliar investigated indicators, show that the intensity of photosynthesis varies throughout the whole vegetation season, this process increasing proportionally with the quantity of assimilative pigments.

The content of foliar water and dry matter of the analyzed taxa suggests that the physiological processes take place at an alert pace during phenophase and decrease progressively towards senescence.

Acknowledgements

This article was made possible with financial support within the POSDRU/88/1.5/S/47646 project, co-funded from the Social European Fund, via Human Resources Development Operational Programme 2007-2013 and by program "Developing the innovation capacity and improving the impact of research through post-doctoral programmes" POSDRU/89/1.5/S/4994.

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