

## SEVERAL MORPHO – PHYSIOLOGICAL ASPECTS IN *STACHYS SIEBOLDII* MIQ. – STUDY ON REGENERANTS PROVIDED *IN VITRO* AND IN CONVENTIONAL CULTURES

Daniel – Ioan Maftai, Diana – Elena Maftai

**Key words:** *Stachys sieboldii*, biometrical tests, *in vitro*

### INTRODUCTION

*Stachys sieboldii* Miq. (the Chinese artichoke) is a herbaceous perennial plant of the Lamiaceae family. *Stachys sieboldii* grows spontaneously in China, and it is named „tsanyungtzu”. Its tubers are edible, being introduced as a vegetable since 1888 by dr. M.T. MASTERS. As a legume, it was brought into culture in Europe, North America, Japan. The cultivated forms were ammeliorated, its tubers reached higher sizes than the spontaneous forms. This species is also used to cure high fever, diarrhoea, sore throats, internal bleeding, heart or liver diseases.

### MATERIAL AND METHODS

The vegetal material to initiate the *in vitro* cultures came from the Botanical Gardens “Anastase Fătu” from Iasi, and the one from conventional cultures was harvested from an experimental plot situated in Racova village (the county of Bacău). The plant material provided *in vitro* was obtained in the Genetics Laboratory of the University „Vasile Alecsandri” from Bacău.

Our research comprised several tests to assess some morpho-physiological indices: root, tuber, and stem length; number of nodes/stem, number of shoots/explant, fresh biomass (individual / total), dry biomass.

### RESULTS AND DISCUSSIONS

During our investigations we aimed to obtain certain data regarding the growth and development of the *in vitro* regenerants together with the plants that were not provided *in vitro*. There were effected biometrical measurements two successive years for 50 plants within each plot. The *in vitro* plants (generated on MS medium) were grown in field and there was noticed that the post - cultivation survival rate was of about 80%. The individuals grown in conventional cultures were obtained by means of tubers.

The analyzed morpho – physiological parameters were: the root length, the tuber length, the

aerial stem length, the fresh and dry biomass of roots and stems.

Regarding the root length, there was noticed an average of 12.4 cm during the first year and of 11.2 cm during the second year for the regenerants of conventional cultures. During the first year of vegetation the *in vitro* regenerants displayed an average root length of 10.3 cm, and of 11.4 cm during the second year. The maximum root length of the plants in conventional cultures was of 18.6 cm and of 17.3 cm, respectively, during the first year of vegetation, and for the *in vitro* plants – of 15.1 cm and respectively, 16.8 cm during the second year; the minimal length was of 6.8 cm in the plants obtained in conventional cultures during the first year and of 5.1 cm for the plants during the second year of vegetation. The *in vitro* regenerants displayed similar values of this parameter (5.4 cm during the first year and 5.9 cm during the second year). The results were presented in Figure 1, as it follows:

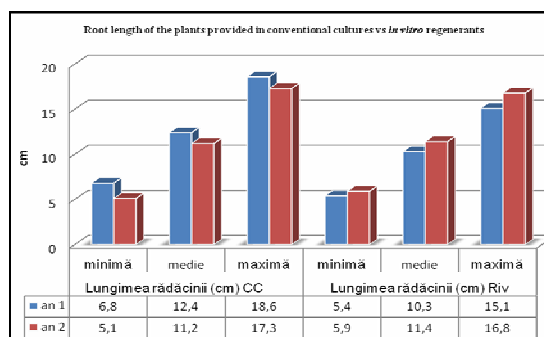


Fig. 1. Comparative analysis of the root length in *Stachys sieboldii* Miq. plants from conventional cultures vs *in vitro* regenerants on the MS medium (CC – conventional cultures; Riv – *in vitro* regenerants)

The total fresh biomass of the roots from conventional cultures ranged from 189.12 g during the first year, and 208.04 g during the second year; the *in vitro* regenerants' biomass was of 163.64 g during the first year and 192.48 g during the second year. After-drying total root biomass is displayed as

it follows: 33.24 g (during the first year) and 35.73 g (during the second year) for the plants grown in conventional cultures and 29.81 g (first year), and 36.02 g (anul II), respectively. The obtained data are displayed by the following graph:

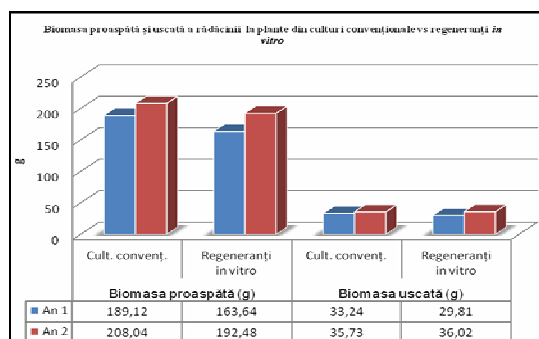


Fig. 2. The comparative analysis of the fresh and the dry biomass of the *Stachys sieboldii* Miq. roots provided in conventional cultures vs *in vitro* cultures – MS medium variant (Cult. convent. – conventional cultures)

In conventional cultures, the tubers of the first vegetation year displayed a maximum size of 3.94 cm, an average size of 2.85 cm and a minimum size of 2.04 cm; during the second year of vegetation, the maximum size was of 4.15 cm, the average size - of 3.01 cm, and the minimum size – of 1.86 cm.

The tubers harvested from the *in vitro* regenerants of the MS medium variant, displayed lower values compared to the tubers grown in conventional cultures during the first year of vegetation (the maximum size was of 2.83 cm, the average one – of 2.04 cm, and the minimum size was of 1.63 cm).

The much lower size of the tuber in this latter case may be explained by the fact that the plants (after the acclimatisation in the laboratory, and their transfer on experimental plots) suffered two weeks of dormancy.

The explanation may be that this discrepancy of the field acclimatisation that triggered a dormancy of plant growth and development affected the tuber size in regenerants. In order to complete the above-mentioned arguments, it was ascertained that the tubers in their second year of vegetation displayed similar values to those grown *ex vitro*.

The biometrical values of the tubers harvested from the second year *in vitro* – provided regenerants are the following: maximum size – 4.12 cm; average size – 3.15 cm; minimum size – 1.91 cm. These results were graphically displayed:

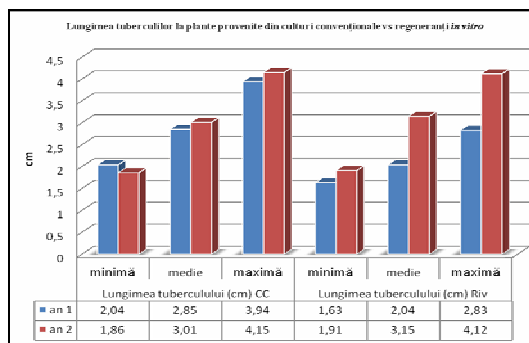


Fig. 3. The comparative analysis on the tuber length of *Stachys sieboldii* Miq. provided in conventional cultures vs *in vitro* regenerants grown on the MS medium variant (CC – conventional cultures; Iv - *in vitro* regenerants)

The last aim during the comparative analysis (conventional cultures vs *in vitro* regenerants) was represented by the biometrical measurements on the stems with leaves.

The biometrical tests on stem (the first two weeks of September) displayed close values both for the plants grown in conventional cultures and for the *in vitro* regenerants, during the two years of experiments.

Therefore, the plants from conventional cultures displayed maximum values for the stem length during the first year of vegetation - 69 cm, an average size of 58 cm and a minimum size of 41 cm. The fresh total biomass (of 50 individuals) was of 1748.5 g, and the dry one of 382.8 g. During the second year of vegetation it was registered a slight biomass growth, not relevant from the qualitative or quantitative viewpoint.

The maximum stem length reached 72 cm, the average was 60 cm, and the minimal value – of 43 cm. Regarding the fresh total biomass, the obtained value was of 1821 g, and the total dry biomass was of 401 g.

The values for the *in vitro* regenerants' stems during the first year of vegetation were: maximum length - 63 cm, average length of 55 cm, minimal length - 42 cm, total fresh biomass of 1690 g, dry biomass of 397.3 g.

The results of the biometrical measurements for the second year of vegetation were: maximum length was 64.5 cm, average length was 56 cm, minimal length was 40 cm, total fresh biomass reached 1722 g, and the total dry biomass was 376 g.

These results are graphically displayed as it follows:

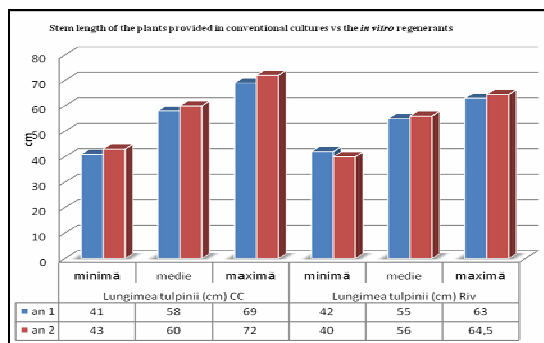


Fig. 4. The comparative analysis on the stem length of *Stachys sieboldii* Miq. from conventional cultures vs *in vitro* regenerants provided on the MS medium variant (CC – conventional cultures; Ivr - *in vitro* regenerants)

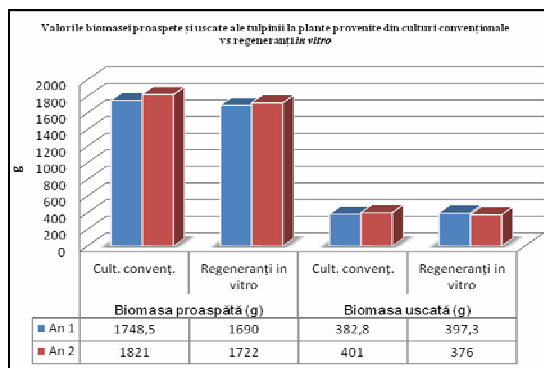


Fig. 5. The comparative analysis on the fresh and on the dry biomass of *Stachys sieboldii* Miq. from conventional cultures vs *in vitro* regenerants provided on the MS medium variant (CC – conventional cultures; Ivr – *in vitro* regenerants)

The tubers of *S. sieboldii* provided by the *in vitro* regenerants from the MS medium displayed lower values during the first year of vegetation, compared to the tubers grown in conventional cultures. The lower sizes of the tubers in this latter case may be explained by the fact that the plants (after laboratory acclimatisation and subsequent transfer to the experimental plot) suffered a two weeks stagnation.

## CONCLUSIONS

Our complex experiments on *Stachys sieboldii* Miq. comprised several tests on the variation of some morpho-physiological parameters in the neoplantlets regenerated from shoot tips and uninodal stem fragments on certain medium variants (enriched with growth regulators).

The *S. sieboldii* tubers, provided by the plants grown *in vitro* on the MS medium variant, displayed lower values during the first year of vegetation compared to the tubers grown in conventional

cultures. The tuber lower sizes in this case may be explained by the fact that the plants, after lab acclimatisation and field transfer, suffered a dormancy that lasted about two weeks.

After the acclimatisation and field transfer, the *in vitro* regenerants of *Stachys sieboldii* Miq. displayed a subsequent normal physiological activity, similar to the one in plants from conventional cultures.

## ABSTRACT

*Stachys sieboldii* Miq. (the Chinese artichoke) is a herbaceous perennial plant of the Lamiaceae family. *Stachys sieboldii* grows spontaneously in China. Its tubers are edible, and introduced as a vegetable since 1888 by dr. M.T. MASTERS. As a legume, it was brought into culture in Europe, North America, Japan. The cultivated forms were ammeliorated, its tubers reached higher sizes than the spontaneous forms. This species is also used to cure high fever, diarrhoea, sore throats, internal bleeding, heart or liver diseases.

Regarding our study, the vegetal material used for the *in vitro* cultures was provided by the Botanical Gardens “Anastase Fătu” from Iași, and the one from conventional cultures was harvested from an experimental plot situated in Racova village (the county of Bacău). This study aimed to bring up data on the individuals provided *in vitro*, and also on the plants grown in conventional cultures. The morpho - physiological indices were biometrically analyzed on test groups of 50 individuals each, during 2008 and 2009. The analyzed parameters were: root length, tuber length, aerial stem length, fresh and dry biomass of roots and tubers. The survival rate of the regenerants provided *in vitro* on Murashige – Skoog (MS) medium was of about 80 % after their transfer on the experimental plot. The plants in conventional cultures were obtained by means of tubers.

## REFERENCES

1. ARTENIE V., TĂNASE E., 1981 - Practicum de biochimie generală, Edit. Univ. "Al.I.Cuza" Iași, 209-210.
2. ARTENIE V., UNGUREANU E., NEGURĂ A.M., 2008 - Metode de investigare a metabolismului glucidic și lipidic - manual de lucrări practice, Edit. PIM, Iași.
3. BURNEA I. et al, 1977 – Chimie și biochimie vegetală, Ed. Did. și Pedag., București.
4. CIULEI I., GRIGORESCU E., STĂNESCU U., 1993 – Plante medicinale. Fitochimie și fitoterapie, I: 80-117, II: 733p.
5. GHIORGIȚĂ G., STĂNESCU I., 1997 - Quantitative studies on "in vitro" cultures of the *Stachys sieboldii* Miq. species. Acta Phytotherapica Romanica, 4, 2, 45-47.

6. GHIORGHIȚĂ G., GILLE E., PRISECARU M., STĂNESCU I., 1998 - Micropropagation and biomass accumulation in "in vitro" cultures of *Stachys sieboldii* Miq. In: Proced. IX-th International Congress of IAPTC. Jerusalem (Israel), 19-24 June, 76 (rezumat).
7. GHIORGHIȚĂ G., STĂNESCU I., GILLE E., 1998 - Biochemical investigations of "in vitro" and "ex vitro" cultures *Stachys sieboldii* Miq. In: Proced IX-th International Congress of IAPTC. Jerusalem (Israel), 19-24 June 1998, 143 (rezumat).
8. GHIORGHIȚĂ G., MAFTEI D.-I., NICUȚĂ D., MAFTEI D.-E., BĂDĂLUȚĂ N., 2011 - The study of several morpho-physiological indices of the *in vitro* regenerants of *Rhodiola rosea* L. and *Stachys sieboldii* Miq. An. Șt. Univ. „Al. I. Cuza” Iași, s.II, a. (Biol. Veget.), 57, 2, 53-60.
9. GUȘULEAC M., 1961 – Fam. Labiatae. In Flora R.P. Romane, 8: 87-397, Edit. Acad. Rom., București.
10. MAFTEI D.-I., MIHAI C., MAFTEI D. – E., 2010 - Comparative study of the glucose amount in conventional and in vitro cultures of *Stachys sieboldii* Miq., Stud. și Com., 23. Complexul Muzeal de Științele Naturii "Ion Borcea" Bacău, 30-32.
11. PERON J.Y., BRIARD M., 1998 – Flowering of Chinese Artichoke (*Stachys sieboldii* Miq.), Acta Horticulturae, 467: III International Symposium Diversification of Vegetable Crops, [http://www.actahort.org/books/467/467\\_16.htm](http://www.actahort.org/books/467/467_16.htm)
12. STĂNESCU U., MIRON A., HÂNCIANU M., APROTOSOAIE C., 2002 – Bazele farmaceutice, farmacologice și clinice ale fitoterapiei, Edit. „Gr. T. Popa”, Iași, II, 281 p.
13. STĂNESCU U., MIRON A., HÂNCIANU M., APROTOSOAIE C., 2004 - Plante medicinale de la A la Z; Monografii ale produselor de interes terapeutic, Ed. Gr.T.Popa, UMF Iași, II, 327p.
14. \* \* Flora of China, 1994 - 17, 178-184. 47. *Stachys* Linnaeus. 8, 251-268, 2001. *Rhodiola rosea*.
15. <http://en.wikipedia.org/wiki/Stachys>

#### AUTHORS' ADDRESS

MAFTEI DANIEL – IOAN – “Ion Borcea”  
Natural Sciences Museum Complex of Bacau, e-mail: [daniel\\_ioan\\_maftei@yahoo.com](mailto:daniel_ioan_maftei@yahoo.com);  
MAFTEI DIANA – ELENA – “Vasile Alecsandri” University of Bacău, Faculty of Sciences, Dpt. of Biology, Ecology and Environmental Protection,  
e-mail: [diana.maftei@ub.ro](mailto:diana.maftei@ub.ro)