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A COMPARATIVE ANALYSIS OF THE HISTOLOGICAL STRUCTURE OF TUBERS GROWN ON STERILE HEAPS AND RESPECTIVELY IN ORDINARY SOIL

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ABSTRACT. Only a small number of plants and few phyto-representatives from these species are capable of growing on the heaps of sterile that resulted from mining activities at great depths (Gh. Bârlea, 2008). Our paper sets out to make an analysis of the histological alterations induced in wild plants that have grown on sterile substratum compared to the histological structure of the wild plants that have grown in ordinary soil.

Keywords: *Centaurea cyanus* L., *Polygonum cuspidatum* Sieb. et Zucc. *(Reynoutria japonica* Houtt.), sterile heaps, root, tubers

INTRODUCTION

The polluted environment offered by the sterile heaps obviously leaves its mark on the plant species that populate these areas. This mark can be observed both in the outer look and in the inner structure of the plants. (Nădişan I., 1979). This paper is going to highlight and analyse the inner structural alterations of the tubers.

MATERIALS AND METHODS

Consist in: a root of ***Centaurea cyanus* L.** prevailed from a plant that grew in ordinary soil and a plant from a sterile heap (from the sterile heap in Săsar) and a tuber of ***Polygonum cuspidatum*** Sieb. et Zucc. (*Reynoutria japonica* Houtt.) prevailed from a plant grown in ordinary soil and a plant grown on sterile heap (on the sterile heap in Sasar), red methyl dye, optical microsope.

In order to identify potential differences between the histologic structure of the plants grown on sterile heaps (devoid of soil) and the ones grown in ordinary farming soil we have cut cross sections of various organs, that were then dyed with methyl red, have taken comparative pictures on the optical microscope, initially with a weak lens (4X), then with an stronger one (10X), in order to highlight the inner tissues. The witness-plants had been picked from farming areas not far from the Sasar sterile heap, but on the other shore of the river by the same name, so as not to be susceptible of the same kind of pollution. The identification of the species was done in accordance with „*Flora ilustrată a României*" (Ciocârlan V., 2000) and, "*A Magyar flora kepekben*" (Javorka S., Csadody V., 1968). These species had been decided on bearing in mind the fact that they can be found in a large number in the Baia-Mare Depression and on sterile heaps.

RESULTS AND DISCUSSIONS

On analysing the microcopic samples of fresh plants we were able to infer that differences exist between the plants that grow in ordinary soil and those from sterile heaps. These differences were analysed under the microscope and will be presented in the microscopic pictures that follow:

Root of ***Centaurea cyanus*** L, a plant that can be frequently found in the Baia-Mare Depression, and on the sterile heaps, especially on the one in Săsar.

In as far as the root of ***Centaurea cyanus*** L. is concerned:

- With the plant that grew on sterile soil (Fig. 4) the suber from the outer layers is thicker, as defence mechanism, but at the same time flawed because of dehydration and pollutants;
- With the plant that grew on sterile soil, the bark, as storing tissue, manages to accumulate fewer substances than normal, and that's why it looks thinner than the plant in ordinary soil (fig.3), the deficiency consists both in as far as the number of cells is concerned, which are fewer, and in their volume, which is smaller;
- With the plant that grew on sterile soil (fig.2), the endodermis, as protective layer, presents some necrosis areas, probably because of the accumulation of pollutant elements from the underlayer, but it is also uneven, due to the scarcity of nourishing substances on the sterile heap;
- With the plant that grew on sterile soil, the ligule and liber are thinner because of the weaker activity of the cambium. Also, at the affected plant, the metaphloem and the metaxylem are far lower, or may sometimes be absent altogether, compared to the normal plant, and this is why these layers are thinner. We can state that the soil conditions have led to a deficient growth of protoxylem and protophloem which thus have not been turned into metaxylem and metaphloem;
- With the plant that grew on sterile soil, the cambium is inhibited by the components of the layer having thus an activity that is hindered both towards the ligule, and towards the liber, which leads to a slower development of the plant;
- With the plant that grew on sterile soil, the medulla is wider than with the plants that grew in

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ordinary soil, taking up the space that has been left unoccupied following the poor development of the outer layers;

- With the plant that grew on sterile soil the medullary rays are better outlined than in the plants that grew in ordinary soil, breaking up the perixyl ring, which shows a hindering in the normal development of the plant from the sterile heap, especially if we are to coroborate this fact with the inhibitting of the cambial activity.

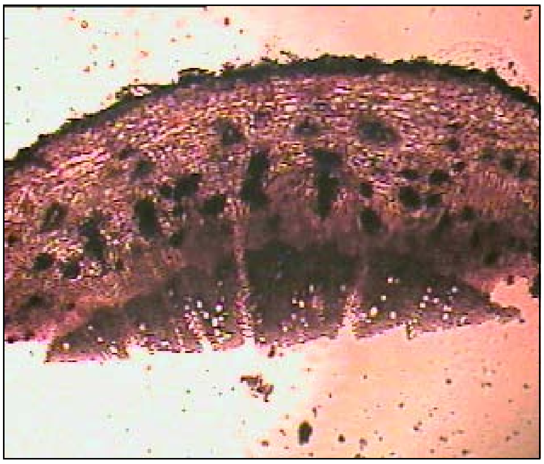

Fig. 1 Cross-section of the root of *Centaurea cyanus* L. Collected from a plant that grew in ordinary soil, x 10

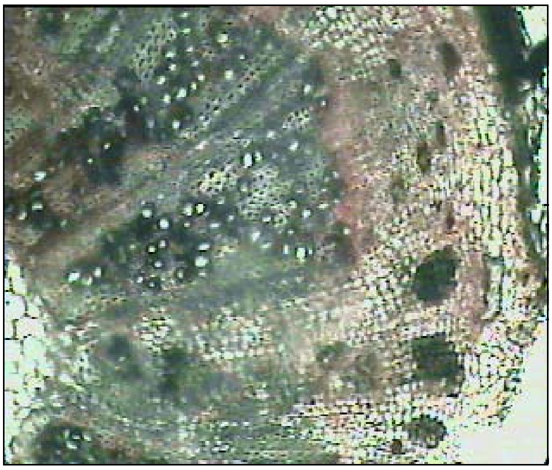

Fig. 2 Cross-section of the root of *Centaurea cyanus* L. Collected from a plat that grew on sterile soil, x 10

Fig. 3 Cross-section of the root of *Centaurea cyanus* L. Collected from a plat that grew in ordinary soil, x 10

Fig. 4 Cross-section in the root of *Centaurea cyanus* L. Collected from a plat that grew on sterile soil, x 10

2. Tuber of ***Polygonum cuspidatum*** Sieb. et Zucc. (*Reynoutria japonica* Houtt.).

In as far as the ***Polygonum cuspidatum*** species Sieb. et Zucc. (*Reynoutria japonica* Houtt.) is concerned, we have noticed that this plant grows very well on sterile soil especially on the Sasar heap. This is the reason why we have paid special attention to this plant, choosing to cut cross-sections of the tuber. Thus, when we compared the plant from the sterile heap with the one from the normal soil we came to the conclusion that:

- With the plant from the sterile soil the epiderm is approximately as exholiated as in the one from normal soil, that is not very much;
- With the plant from the sterile soil the suber resembles very much the one of the plant from the normal soil, that is, it is tubular, exholiated at the outside, consisting of 6 layers of cells;
- With the plant from the sterile soil the bark is just as uneven, 2-3 layers of cells, but maybe thinner than with the plant from the normal soil (Fig.5) where there are 3-4 layers of cells;
- With the plant from the sterile soil (fig. 6) the strenghthening tissue shows definite arches opposite the perixyl, 5-6 layers of cells and does not differ very much from the normal plant in which there occur only small bundles opposite the perixyl, made up of 10-20 cells, mainly in the liber;
- With the plant from the sterile soil the liber has bundles of strenghthening tissue, whereas in the plant from normal soil it is more flat, even, also with bundles of strenghthening tissue;
- With the plant from the sterile soil the ligule looks similar to the one from the normal soil (Fig. 8), that is even with 20 % metaxylem;

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- With the plant from the sterile soil the medullary rays show no alterations as compared to the plant that grew in normal soil,the latter being clear and narrow;
- With the plant from the sterile soil the medulla does not differ very much from the one grown in normal soil, either, having lots of leucoplasta (amiloplasta).

So, we can say that even though the organ under survey has grown on sterile soil it does not show significant differences, maybe only insignificant ones compared to the ordinary situation.

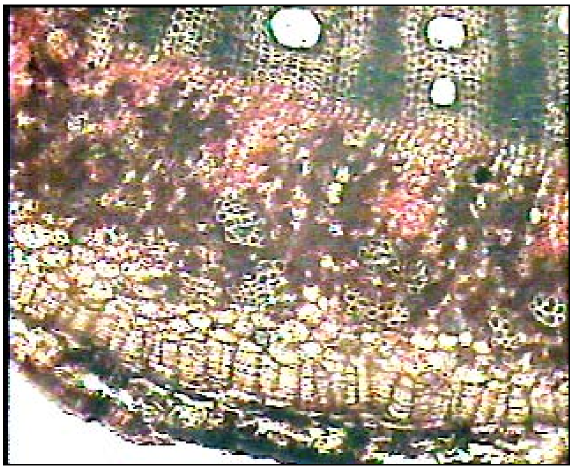

Fig. 5 Cross-section in tubers of *Polygonum cuspidatum* Sieb. et Zucc. (*Reynoutria japonica* Houtt.) collected from a plant that grew in normal soil, x 10

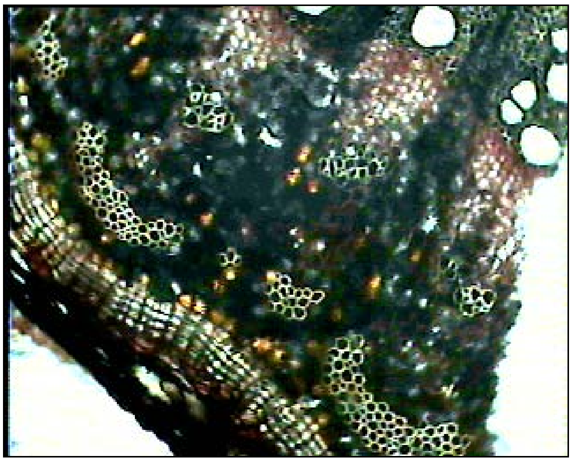

Fig. 6 Cross-section in a tuber of *Polygonum cuspidatum* Sieb. et Zucc. (*Reynoutria japonica* Houtt.). Plant from sterile soil, x 10

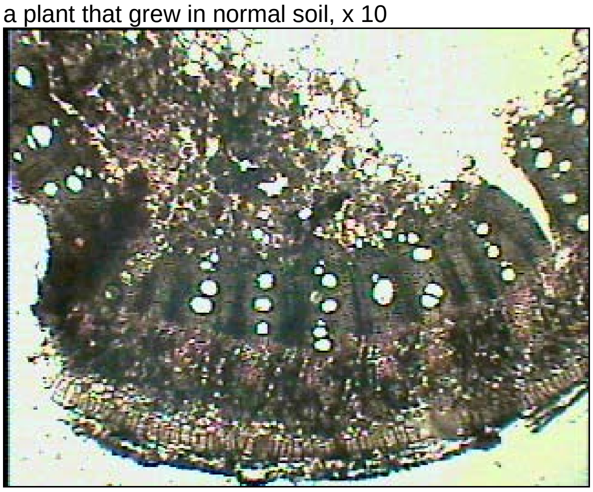

Fig. 7 Cross-section in a tuber of *Polygonum cuspidatum* Sieb. et Zucc. (*Reynoutria japonica* Houtt.). Plant from normal soil, x 10

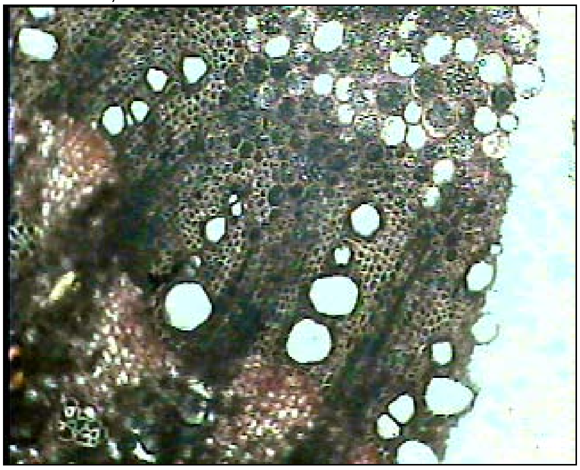

Fig. 8 Cross-section in a tuber of *Polygonum cuspidatum* Sieb. et Zucc. (*Reynoutria japonica* Houtt.). Plant from sterile soil Detail, x 20

CONCLUSIONS

Considering the things we have presented above we can conclude that:

1.The ***Centaurea*** genus is very well represented among the grassy plants that grow on the sterile heaps in the Baia-Mare Depression. This is the reason why the species has been selected as microcopic samples. We can also observe that the alterations that have occurred in the structure of these plants due to their growth on sterile soil are not that significant as to prevent their growing on these heaps. However, it is obvious that having grown on sterile substratum the plants are shorter and thinner since they are forced to consume a lot of energy in developing defence mechanisms against pollutants, but the representatives of this species grow in larger or smaller number on considerable areas on all heaps, especially on the Sasar one. Thus, we can say that certain plants, and ***Centaurea cyanus*** L. is one of these, are capable of adapting themselves well-enough to sterile substratum, so that even though inhibitive differences do appear as compared to the plant in normal soil, they are still able to populate these areas with a good coverage at least for the period while a layer of soil is being formed.

Of course, there exist other grassy plants that are even more widely spread and with a greater density on these sterile heaps such as: ***Erigeron canadensis*** L., ***Phragmites australis*** (Cav) Trin. Ex Steud., ***Rumex acetosella*** L., etc., but it is ***Centaurea*** **cyanus** L. that is the best suited to be used for cross-sections and as microcopic samples, in order to highlight the alterations that the sterile soil has on a plant.

2. ***Polygonum cuspidatum*** Sieb. et Zucc. (*Reynoutria japonica* Houtt.) is a „wonder of nature" and a true champion of the ecological adaptation to harsh conditions even on other areas from the north-west of the country, too **(**G. Ardelean, C. Karacsonyi, 2005) but it cannot be found farther south as it does not grow in the Arad county (A. Ardelean, 2006). Even though the locals do not like the plant at all, exactly because of the aggressiveness with which it spreads over the farming areas, that is exactly for the character for which it should be appreciated, this species is the most valuable representative for the repopulating of the areas that are completely bare with a view of forming new soil. From the analysis of the microscopic cross-sections shown above one can observe that the alterations that occurred at this species following the fact that it grew on sterile soil are far less significant than with other plants, being negligible also from the point of view of the plant's development on this substratum. The plans grow well, and at places, very well, regardless of the slope, moisture content, cardinal orientation or other co-habitant species, even though the substratum has not been placated with soil.

If the sterile heaps were placated with soil, ***Polygonum cuspidatum*** Sieb. et Zucc. (*Reynoutria japonica* Houtt.) would successfully populate and spread over large areas by itself, undoubtedly leading to, at least in the conditions from the Baia-Mare Depression, a consistent (especially in the presence of other species, too) and rapid (few years) development of a stratum of soil sufficient for the rooting of a great number of other plants, both grass and bushes or even trees later on. The only disadvantage (if we can call it this way) of this species is its capacity to eliminate the competitors that might try to settle in the same area, and that's why there are few species that will associate with it, and those that do cannot be called „associates". Among these species there are ***Agrostis capillaris*** L. (A. tenuis Sibth.), ***Phragmites australis*** (Cav) Trin. Ex Steud., ***Betula pendula*** Roth (sin. *B. verucosa* Ehrh.) that can also be often found on the sterile heaps.

3. The species ***Polygonum cus- pidatum*** Sieb. et Zucc. (*Reynoutria japonica* Houtt.) was planted directly in sterile substratum which does not get congested and which rooted very well , in proportion of 70-75% of the cuttings, andcurrently these plants stand for the vast majority of representatives of this species. Anyway, the future of this species seems affected neither by pollutioin, nor by the competition of other species. Not being a local species, ***Polygonum cuspidatum*** Sieb. et Zucc. (*Reynoutria japonica* Houtt.) does not have natural enemies in the area of the Baia-Mare Depression, enemies capable of destrying it or of prevent its spreading. Very resistent and undemanding it spreads in the urban and periurban areas among the blocks of flats and in any kind of soil at a speed that sometimes creates problems due to the volume of grass it produces, but above all because of the large areas that it covers. This is why we have to take advantage of this species and cover in plants the sterile areas where other plants do not grow so well. It is obvious that in spite of the high costs, the covering with fertile soil of the sterile will turn to the best account the ecological potential of this plant.

4. The final conclusion is that the sterile affects the majority of plants that grow on the heaps, but there are plants that are able to successfully adapt to these conditions, ***Polygonum cuspidatum*** Sieb. et Zucc. (*Reynoutria japonica* Houtt.) being one such species.

REFERENCES

Ardelean A., 2006, Flora şi Vegetaţia Judeţului Arad, Editura Academiei Române Bucureşti.

Ardelean G., Karacsonyi C., 2005, Flora vegetaţia fauna şi ecologia nisipurilor din nord-vestul României, Ed.Daya, Satu Mare .

Bârlea Gh., 2008, A study on barren gangues in the Baia Mare Depression, "V. Goldiş" University Press Arad.

Ciocârlan V., 2000, Flora ilustrată a României, Editura Ceres.

Javorka S., Csadody Vera, 1968, A Magyar flora kepekben, Ed. Studium, Budapest.

Nădişan I., 1979, Implicaţiile poluării asupra vegetaţiei din zona Municipiului Baia Mare, Baia Mare.