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Studies Regarding Tailings Pond Seepage Water from Mining Activities over *Avena sativa* L. Germination Influence

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Abstract

Cultivation of oat in the limiting areas of tailings pond might be regarded as one of the possibilities that could lead to the general amelioration of these places. In order to characterize the waste products, to determine and evaluate the components that may be leached from waste products and that can affect the limiting areas of tailings pond, leaching tests were performed. In this paper, we have observed the influence of eluate, obtained from leaching tests, on seed germination, radicle and coleoptyle development as well as on the amount of accumulated dry matter for *Avena sativa* L., genotypes. According to our researches, we may conclude that the studied genotypes of *Avena sativa* L. showed tolerance to eluate while values registered for seed germination, radicle and coleoptyle development as well as dry matter content were comparatively higher than those registered for the control variant.

Keywords: *Avena sativa* L., germination, eluate, radicle, coleoptyle

Introduction

The copper ore derived from mining is submitted to a concentration technological process that allows obtaining of copper concentrates and as waste products, the sterile. The sterile fraction is separated and hydro-gravitationally transported to tailings pond. (European IPPC Bureau, 2004)

The tailings pond used for storage of sterile from mining activities may have negative influences on environment reflected in water quality, air, vegetation and general aspect of a region if appropriate measures are not being taken. The arrangement and cultivation of the regions found in the proximity of these tailings pond could represent one of considered measures, in order to have a general amelioration of the area and maintaining stability through erosion prevention, preservation of the endemic vegetation and attaining of large grain yields represents one of the measures that must be carefully considered (Pietraru, 1982).

The cultivation of oat in the adjacent regions of talings pond represent one of the measures that must be taken in order to generally ameliorate the problems created by them.

For characterization of waste products as well as the determination and evaluation of the components that may be leached and which may affect the adjacent regions, leaching tests are necessary to be performed. The release of the soluble compounds during water contact is regarded as a mechanism that could generate a possible threat for environment during reuse or elimination of the waste products. (***SR EN 12457, 2003)

The inducement of seed germination and shoots growing by the osmotic solution which have low value of osmotic potential (P.O.) - (0.3 - 1.0 bar) represent obvious process in our research. This process, observated by other researchers at: pea, maize, cotton, barley, sun-flower, oat (Gong *et al*. 2001; Hanson and Hitz, 1982; Hussain *et al*., 1997; Sumalan *et al*., 2003; Sumalan *et*. *al*., 2004; Voican and Delian, 1995), is not elucidated yet. For example, at pea, the intensity of roots growing show an ascending curve between 0.0 - 7.0 bar, over this value the growth is inhibit (Walter, 1983).

Within the paper, we have studied the influence of eluate, obtained from leaching tests, on seed germination, radicle and coleoptyle growth as well as on accumulated dry matter amount in *Avena sativa* L. genotypes.

Materials and methods

The leaching test was performed according to SR EN 12457-1: 2003 using a liquid-solid ratio (L/S) = 2 L/Kg, the leaching agent being considered the distilled water.

In order to determine the metal concentration, was used an atomic absorption spectrophotometer Varian SpectrAA Varian with graphite furnace GTA 110 and AA hydride module.

In case of cultivated species, the biological material taken into this study was represented by: *Avena sativa* L. with Mureş, Brunea, Sibot and Rusca Teregova genotypes.

Was also considered two experimental variants, the control variant V0 with distilled water and V1 variant of eluate. The considered physiological indices were germination potential after 96 and 192 hours, the radicle and coleoptyle growth dynamics as well as the amount of accumulated dry matter.

In this direction, was prepared filter papers placed in sterile Petri dishes with 150 mm in diameter. In order to determine the germination potential of a seed sample was considered a number of 50 seeds for each of the 6 repetitions. Watered germination substrate was realized with distilled water and eluate, respectively. Seeds were formerly sterilized using 0.1 % HgCl2 solution (washing the seed with distillated water, immersed the seed in HgCl2 0.1%, 1-3 minute, after that, washing the seed 3 X with distillated sterile water, 3 min/washing) (Badea and Sandulescu, 2001) and subsequently placed on germination substrate at equal distances. Seeds were then covered with filter paper moisturized with 5 mL of distilled water and eluate.

The thermostat was previously sterilized with alcohol and in order to maintain air moisture at 95%, below it has been placed a tray containing water which was replaced every three days.

Was regarded as germinated seeds, those that developed normal radicle and coleoptyle. The normal radicle had to present the same length as seed length and the coleoptyle half length of the seed length.

At the first seed counting at the pre-established time interval (96 hours), was counted and removed from the germination substrate, the normal germinated seeds as well as rotten and pathogen attacked seeds.

At the second counting, after 192 hours the operation was repeated. The amount of dry matter was determined in terms of weight, after previous drying in the oven at 105°C for 2 hours.

Results and discussion

Regarding the germination capacity in oat (Avena sativa L.), it has been observed high index values in all studied genotypes in the V1 variant with eluate, after 96 hours (Fig. 1).

After 192 hours (Fig. 2), the differences between genotypes are relevant both for control variant as well as for eluate, the germination potential being higher in case of Mures genotypes, 73.0 ± 1.41 % in V0 and in case of Rusca Teregova genotypes 90.25 ± 3.88 % in V1, respectively. Sibot genotypes have registered weak germination values in variants, 25.5 ± 7.41 % (V0) and 26.5 ± 1.62 % (V1), respectively. Difference between germination potential have been found in oat, cress, bean (Gong *et al*., 2001), barley (Hussain *et al*., 1997), sunflower (Sumalan *et al*., 2004), and pea (Voican and Delian, 1995).

Tab. 1. The main chemical indicators for eluate

Indicator	Experimental value (mg/L)
As	0.01
Ba	3.25
Ca	27.25
Cd	n.c.
Cr total	0.05
Cr hexavalent	0.02
Cu	n.c.
Fe	n.c.
Hg	n.c.
Mg	0.3
Mo	n.c.
Mn	n.c.
Ni	0.05
Na	162.67
Pb	n.c.
Sb	n.c.
Se	n.c
Zn	n.c.
NH4+	0.06
NO3-	16.80
NO2-	0.35
Cl-	465.00
F-	4.75
PO43-	0.06
SO42-	225.00
pH	7.18

Regarding the germination capacity in oat (*Avena sativa* L.), it has been observed high index values in all studied genotypes in the V1 variant with eluate, after 96 hours (Fig. 1).

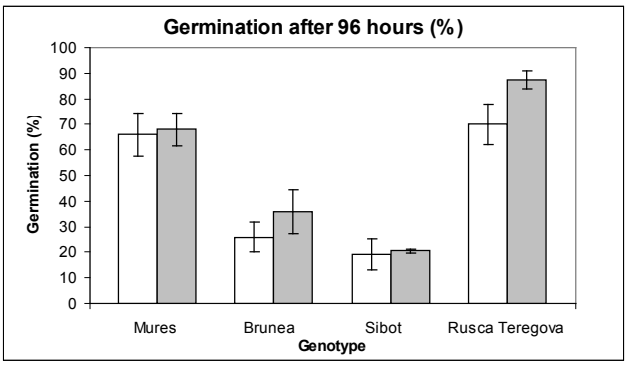

Fig. 1. Estimative values for germination after 96 hours in *Avena sativa* L. species

After 192 hours (Fig. 2), the differences between genotypes are relevant both for control variant as well as for eluate, the germination potential being higher in case of Mures genotypes, 73.0 ± 1.41 % in V0 and in case of Rusca Teregova genotypes 90.25 ± 3.88 % in V1, respectively. Sibot genotypes have registered weak germination values in variants, 25.5 ± 7.41 % (V0) and 26.5 ± 1.62 % (V1), re-

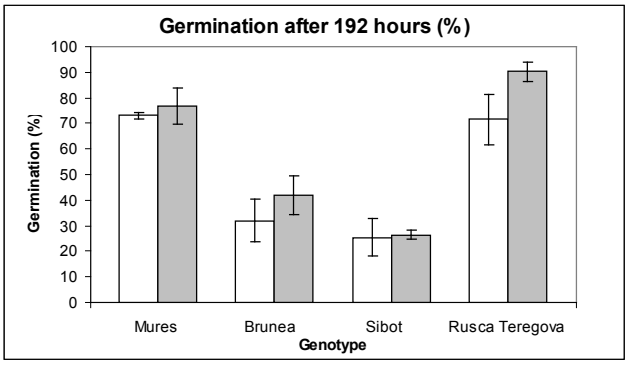

Fig. 2. Estimative values for germination after 192 hours in *Avena sativa* L. species

spectively. Difference between germination potential have been found in oat, cress, bean (Gong *et al*., 2001), barley (Hussain *et al*., 1997), sunflower (Sumalan *et al*., 2004), and pea (Voican and Delian, 1995).

The intensity of radicle growth in case of *Avena sativa* L. indicated a normal growth rate for V0 variant while for V1 variant this registered an increasing for all genotypes. In case of eluate, the most tolerant genotype proved to be Mures, with a radicle length of 3.82 ± 0.16 cm, after 96 hours from germination (Fig. 3), and 6.72 ± 0.74 cm, after 192 hours from germination (Fig. 4).

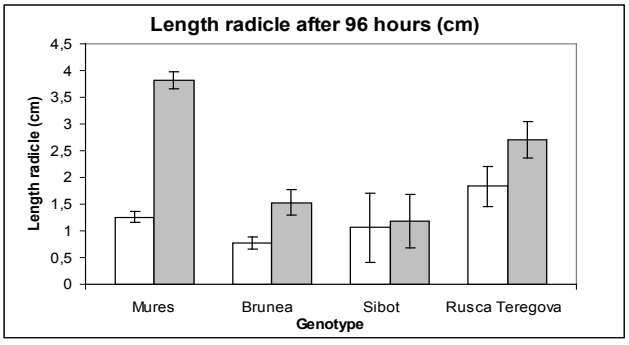

Fig. 3. Estimative values regarding the radicle growth after 96 hours for *Avena sativa* L. species

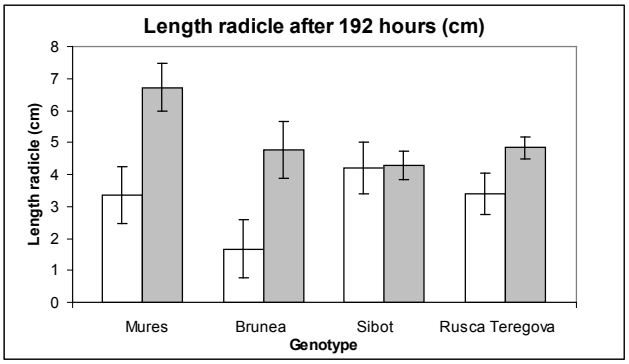

Fig. 4. Estimative values regarding the radicle growth after 192 hours for *Avena sativa* L. species

Regarding the coleoptyle growth, in the control variant (V0), it has been registered the shortest length for all studied genotypes while in V1 variant growth was higher. The differences were also observed between genotypes, the best genotype proved to be Rusca Teregova with values of 3.70 ± 0.38 cm after 96 hours from germination (Fig. 5), and Mures with value of 8.04 ± 0.12 cm, after 192 hours from germination (Fig. 6).

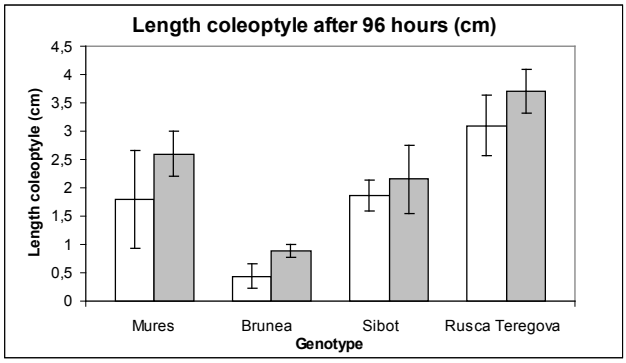

Fig. 5. Estimative values regarding the coleoptyle growth after 96 hours for *Avena sativa* L. species

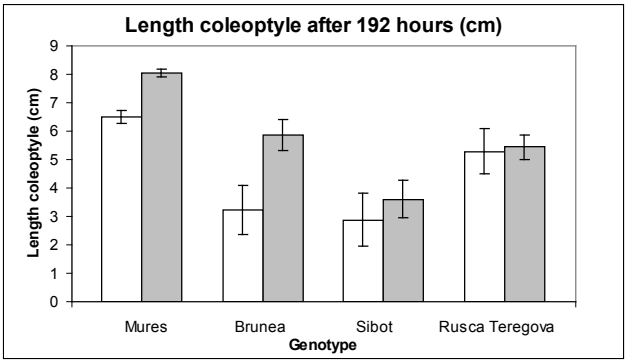

Fig. 6. Estimative values regarding the coleoptyle growth after 192 hours for *Avena sativa* L. species

Different growth enhancements (radicle and coleoptyle) have been found in barley (Hussain *et al*., 1997) and oat (Sumalan *et al*., 2003; Sumalan *et al*., 2004).

The dry matter content was higher in the radicle than in the coleoptyle for all studied variants and genotypes. These results are compatible with other previous studies (Sumalan *et al*., 2003; Sumalan *et al*., 2004). It has been observed high index values in all studied genotypes in the V1 variant with eluate.

The extent of dry matter content registered high values in case of Mures variety for radicle, 12.03 ± 0.45 % (Fig. 7) and in case of Rusca Teregova variety for coleoptyle, 11.60 ± 0.18 % (Fig. 8).

Conclusions

As a result, we may conclude that the studied genotypes belonging to *Avena sativa* L. are tolerant to eluate and registered values for caryopsis germination, radicle and coleoptyle growth and dry matter content higher than the control variant for which distilled water was used.

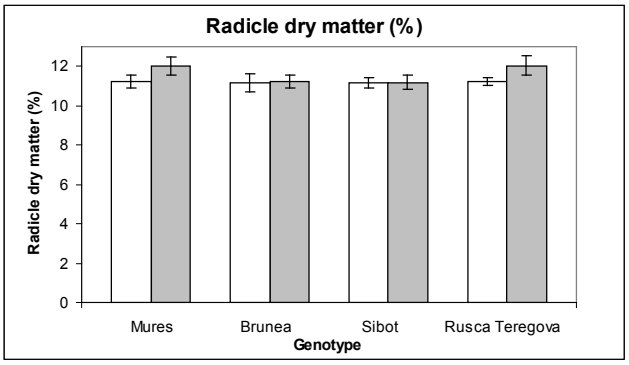

Fig. 7. The dry matter content from radicle determined for *Avena sativa* L. species

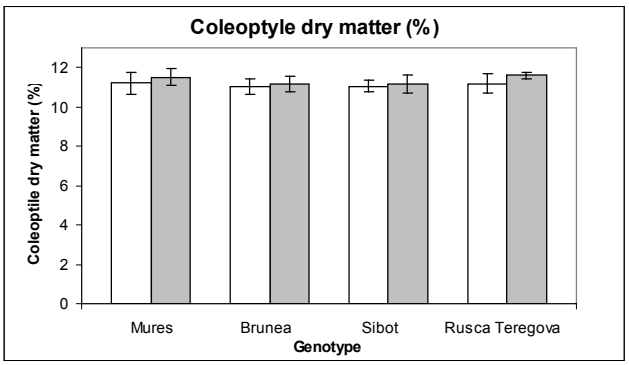

Fig. 8. The dry matter content from coleoptyle determined for *Avena sativa* L. species

The germination potential being higher in case of Mures genotypes, 73.0 ± 1.41 % in V0 and in case of Rusca Teregova genotypes 90.25 ± 3.88 % in V1, respectively.

Regarding the radicle and the coleoptyle growth, the best genotype proved to be Mures, with a radicle length of 3.82 ± 0.16 cm, after 96 hours from germination, and 6.72 ± 0.74 cm, after 192 hours from germination and Rusca Teregova with a coleoptyle length of 3.70 ± 0.38 cm after 96 hours from germination, and Mures with value of 8.04 ± 0.12 cm, after 192 hours from germination.

The extent of dry matter content registered high values in case of Mures variety for radicle, 12.03 ± 0.45 % and in case of Rusca Teregova variety for coleoptyle, 11.60 ± 0.18 %.

The seed germination and plants growing is higher in eluate than in distillated water because this solution have lower osmotic potential (P.O.) value (0.3 – 1.0 bar).

References

Badea, E. M., D. Sandulescu (2001). Vegetal Biotehnology. Biotech Fundation, Bucuresti (in Romanian).

European, IPPC Bureau (2004). Best available techniques for management of tailings and waste-rock in mining activities, Sevilla, Spain.

Gong, P., B. M. Wilke, E. Strozzi and S. Fleischmann (2001). Evaluation and refinement of a continuous seed germination and early seedling growth test for the use in the ecotoxicological assessment of soils, Chemosfere, 44 (3).

Hanson, A. D. and W. D. Hitz (1982). Metabolic responses of mesophytes to plant water deficits. Annu. Rev. Plant Physiol. 33:163-203.

Hussain, G., A. A. Al-Jaloud, S. A. Al-Shammafy, S. Karimulla and S. O. Al-Aswad (1997). Effect of saline irrigation on germination and growth parameters of barley (Hordeum vulgare L.) in a pot experiment, Agricultural Water Management, 34 (2).

Pietraru, J. (1982). Halde pentru Depozitarea Slamurilor, Cenusilor, Zgurilor, Sterilelor si Deseurilor Menajere, Editura Tehnica, Bucuresti.

Sumalan, R., C. Dobrei and A. Pop (2003). The effects of water defficit on main physiological processes on oat (Avena sativa L.), Lucr.St. Facultatea de Horticultura, Biotehnologie si biodiversitate, Ed. Agroprint, Timisoara, 37-43.

Sumalan, R., D. Tomozei, R. Sumalan and A. Pop (2004). Researches concerning the physiological mechanisms of osmotic stress tolerance on the germination seeds process in sunflower (Helianthus annuus L.), International Conference of Sustainable Agriculture and European Integration Processes, Univ. Novi Sad.

Sumalan, R., A. Pop, C. Dobrei (2004). Researches concerning the physiological responses of some oats genotypes (Avena sativa L.) on drought stress conditions, Simp. Internattional Horticultura, Stiinta, Calitate, Diversitate si armonie, Lucr. St., anul XLVII-vol. 1 (47), seria Horticultura, Ed. "Ion Ionescu de la Brad, Iasi.

Voican, A. Viorica, E. Delian (1995). Cercetari privind unele procese la germinarea semintelor de mazare in conditii de stres hidric, Lucr. St. USAMV, seria A, vol. XXXVIII, Bucuresti.

Walter, H. (1983). The water supply of desert plants, p. 199-205. In: "The water relations of plants", A. J. Rutler Eds. Wiley, N.Y.,.

*** SR EN 12457-1:2003.