THE SOIL SUBSTRATUM INFLUENCE ON *PHALARIS ARUNDINACEA* L. SPECIES ON PEAT AND ASHES DERELICT LAND FROM THE TERMO-ELECTRIC POWER STATION SÎNPETRU-BRAŞOV

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RESEARCH ARTICLE

Abstract

The experiment was carried out in Grassland Research Institute in Mitscherlich pots with 8 kg capacity. The objective was to determine the Phalatis arundinacea L. species behaviour in different soil substratum conditions: soil, eutrof peat, ashes and few combinations between these.The few agrochemical analyses have performed in Romania on peat and ashes derelict land put in evidence high content K – 275 ppm and P – 45 ppm, $pH_{(H2O)}$ – 8,2 and low nitrogen content which can be realise by biologically processes legumes. The Phalaris arundinacea L. species had the best behavior in 25-50% peat and 50-75% ashes mixture substratum. It has obtained 55g/pot (17.5 t/ha) DM vegetative aerial parts and 77 g/pot (24.5 t/ha) DM roots, total biomass 42 t/ha., with 10% lower than the crop on normal, chernozemoid soil.

Keywords: termo-electric power station, eutrophic peat, renaturation with *Phalaris arundinacea*
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INTRODUCTION

The problem of ecological reconstruction of dumps of different origins is extremely urgent due to the pollution they cause to the environment and at the same time particularly complex due to the extreme substrate conditions for the establishment of grassy or woody vegetation that is cultivated (Cristea, et all, 1990, Harris et all, 1996, Jordan et all, 1997, Maruşca et all, 2020).

Slag and ash dumps resulting from coal-fired power plants are among the most polluting, requiring large investments to be renatured (Căpitanu et al., 1999, Dumitru et al., 1999).

After several field observations on the establishment of grassy vegetation on the slag and ash dumps from Sînpetru-Braşov, it was found that one of the perennial grasses adapted to this industrial waste and used vegetal layer (the eutrophic peat nearby) is *Phalaris arundinacea* L. (*Typhoides, Digraphis, Baldingera*) popularly known as reed canarygrass, gardener's garters, and ribbon grass. etc.

This species was initially noted for forage qualities, especially its very high production and vegetative propagation through rhizomes (Maruşca, Maruşca 1985, Samfira 2001, Marusca 2009, Filip (Tod), 2011).

The resistance of this species to excess humidity is well known, but less is known about its resistance to excessive dryness and alkalinity on ash dumps, which makes it considered a promising plant for the ecological restoration of such anthropogenic ally degraded lands. This latter fact prompted us to conduct several studies on the deportment of reed canarygrass on different substrates characteristic of the dumps from Sînpetru-Braşov

MATERIAL AND METHOD

To begin, several types of slag and ash from coal-fired power plants in Oradea, Timişoara and Doiceşti-Dâmboviţa were studied to be compared with those from the Braşov District Heating Plant (CET) and the Sînpetru landfill. For all of them, routine agrochemical analyses were performed at OSPA Braşov.

The actual experiments were carried out in MITSCHERLICH type vegetation pots with a diameter of 20 cm (315m^2) and a volume of 8 dm^3 in the following culture variants:

1- Chernozemoid soil from Măgurele Braşov (mt)

2- Eutrophic peat (P) simple (100%)

3- Sînpetru ash (A) simple (100%)

4- Peat layer (T) (25% of volume) over ash (C) (75% of the volume of the vessel)

5- P layer (50%) over C layer (50%)

6- Mixture P (25%) + C (75%)

7- Mixture P (50%) + C (50%)

To avoid the influence of genetic variability of the plant material and the errors that could have caused them, all *Phalaris arundinacea* L. plants came from a single clone whose rhizomes were divided into 21 equal parts and the plants were also distributed in the 7 variants in 3 repetitions.

Fertilization was carried out uniformly with complex chemical fertilizers of the formula 20-10-10, calculated at the level of 150 N kg/ha and 75 kg/ha P2O5 and K2O, taking into account the very poor content of peat in fertilizing elements accessible to plants. Filling the pots with the mentioned materials and planting the *Phalaris* rhizomes took place in October, after which the pots were kept over the winter in a microgreenhouse until spring, when they were transferred outdoors, after a cut in March.

Over the winter, through vegetative propagation, the plants occupied the entire surface of a pot, being then harvested the first time in July and the second time in September next year.

Next, the rhizomes and roots were removed from the pots together with the substrate which was then removed by washing under running water on a 2 mm sieve.

The vegetative mass and further the dry matter of the aboveground and underground parts were determined for the plant material samples.

RESULTS AND DISCUSSIONS

Following agrochemical analyses, it was found that the pH in H_2O of the ash varieties is around 8.2 (weakly alkaline) with deviations of ± 0.2-0.3, being from this point of view very close in value.

As expected, the potassium content is higher, being 275 ppm, the phosphorus content is also high, and being 45 ppm and the $CaCO_3$ content is on average 2.1% with an important role for the establishment of legumes.

The nitrogen supply of ashes is very low, therefore this element must be applied on this type of dump, until the protective grass carpet is installed.

Experiments in vegetation pots have highlighted the differentiated amount of biomass in the tested species *Phalaris arundinacea* L. depending on the nature of the support and the processing method, in layers or mixture.

In a very obvious way on the chernozemoid soil with very good natural fertility characteristics, the grass produced in two harvests in one year 67 g DM/pot aboveground mass and 82 g DM/pot underground mass in a ratio of 1: 1.22 and a total of almost 150 g DM/pot (table 1).

Table 1

Biomass of *Phalaris arundinacea* L. cultivated in vegetation pots on different supports

No.	Culture support	Dry matter Average /plot						Mass ratio 1. aboveground 2. underground	pH in H_2O
		1.			2				
		g	dif	%	g	dif	%		
1	Chernozemoid soil (C)	67	0	100	82	0	100	1 : 1,22	6,68
2	Eutrophic peat –P 100%	47	-20	70	50	-32	61	1 : 0,6	6,77
3	Ash– A 100%	52	-15	78	61	-21	74	1 : 1,17	6,81
4	Layer P 25%/C75%	55	-12	82	58	-24	71	1 : 1,05	6,73
5	Layer P 50%/C50%	56	-11	84	53	-29	65	1 : 0,95	6,80
6	Mixture P 25% + C75%	57	-10	85	76	-6	93	1 : 1,33	6,58
7	Mixture P 50% + C50%	54	-13	81	78	-4	95	1 : 1,41	6,82

Compared to this substrate considered as a control, lower amounts of biomass are recorded on all other materials. Thus, on 100% peat, a total biomass was obtained that was about 35% lower than on chernozemoid soil and on 100% ash, about 25% less.

Undecomposed eutrophic peat with a pH of about 8 proved to be the least favourable for plant growth and development due to its very low content in accessible nutrients and poor physical properties, especially the aero hydric regime. Similarly, ash is a rather

unfavourable support due to its low water retention capacity.

By mixing the two components peat + ash, maximum efficiency is achieved, with a decrease of only 11% compared to the control and an increase in biomass in favour of the underground one, an aspect that interests us the most.

The explanation of this result in variants 6 and 7 is given by a substantial improvement in the aero hydric regime of the substrate by mixing the two materials, which in this case complement each other.

Stratification with peat over ash did not give the expected results, due to the deficient properties of each material taken separately.

After repeated watering and atmospheric precipitation during the vegetation period, a basification of the substrate occurred, respectively from a pH of 8.0-8.2, after one year it reached an average pH of 6.6-6.8, which is very favourable for plant growth.

To more clearly understand the effect of the substrate on the *Phalaris arundinacea* species, the production achieved in vegetation pots was reported per hectare (Table 2).

Table 2

Dry matter (DM) production recalculated per hectare for the species *Phalaris arundinacea*, grown in

Nr. var.	Culture support	Dry matter production (t/ha)			Difference from controller	
		1.abovegroud	2 underground	Total (1+2)	+, -	%
1.	Chernozemoid soil (C)	21.3	26.1	47.4	0	100
2.	Eutrophic peat –P 100%	15.0	15.9	30.9	-16.5	68
3.	Ash– A 100%	16.6	19.4	36.0	-11.4	76
4.	Layer P 25%/C75%	17.5	18.5	36.0	-11.4	76
5.	Layer P 50%/C50%	17.8	16.9	34.7	-12.7	73
6.	Mixture P 25% + C75%	18.2	24.2	42.4	-5.0	90
7.	Mixture P 50% + C50%	17.2	24.8	42.0	-5.4	89

Thus, the biomass production achieved on the chernozemoid soil substrate reaches 47.4 t/ha and on the rest of the variants on substrates with 11-32% lower.

Of these substrates, the lowest productions were obtained on the 100% eutrophic peat variant where a total biomass of 30.9 t/ha is achieved, of which 49% aboveground and 51% underground.

The highest total biomass productions were obtained on the variants where peat and ash were mixed in proportions of 25+75 or 50+50%, with a biomass of 42-42.4 t/ha, of which 41-43% aboveground and most importantly 57-59% underground (rhizomes and roots) which consolidate the surface of the dumps.

CONCLUSIONS

Agrochemical analyses carried out on several slag and ash dumps have highlighted the high content of potassium (275 ppm) and phosphorus (45 ppm) with an average pH of 8.2 and a very low nitrogen content.

The species *Phalaris arundinacea* L. succeeds best on a substrate consisting of 25-50% peat mixed with 50-75 ash, on which it accumulates about 55 g DM/pot underground mass (stems and leaves) and 77 g DM/pot underground mass, in a pot with a diameter of 20 cm (315 m2) and a volume of 8 dm3 (liters).

Experimentations in vegetation pots of a wider assortment of plants on other types of soils or supports mixed with ash will lead to new biotechnical clarifications for the success of protective and consolidation vegetation with the acceleration of pedogenesis processes on these types of industrial dumps, with great difficulties in the direction of ecological restoration.

REFERENCES

Căpitanu, V., M. Dumitru şi colab., 1999: Impactul emisiilor termocentralelor asupra mediului ambiant, Recultivarea haldelor de cenuşă, Ed. "Risoprint"Cluj Napoca;

Cristea V. şi colab., 1990: Reconstrucţia ecologică a haldelor de steril minier, Contribuţii Botanice, pag. 33-37, Cluj Napoca;

Dumitru M., Gh. Blaga şi colab., 1999: Recultivarea terenurilor degradate de exploatările miniere din Bazinul Carbonifer Oltenia, Casa de editură "Transilvania Press" Cluj Napoca;

Filip (Tod) Monica, Marusca T., 2009: Results regarding to promovation in crop of *Phalaris arundinacea* cultivars, for production of forage and biomass, Eucarpia 2009 Conference INRA, XVIII-th Meeting of the Eucarpia Fodder Crops and Amenity Grasses La Rochelle – Franţa, Book of Abstracts, 11-14 mai, pp.75

Filip (Tod Monica) , 2011 : Contribuţii la extinderea în cultură pentru furaj şi biomasă a speciei *Phalaris arundinacea* L. în condiţii extreme de umiditate, Teza de doctorat, Facultatea de Agricultură, Universitatea de Ştiinţe Agricole şi Medicină Veterinară a Banatului, Timişoara

Harris, A.J., P. Biroh, J.P. Palmer, 1996: Land restoration and reclamation, Wesley Longman Ltd., Singapore;

Jordan III, W.R., M.E. Gilpin, J.D. Aber, 1997: Restoration ecology, a syntetic appreoch to ecological research, University Press, Cambrige, UK.

Maruşca T., Maruşca Letiţia Felicia, 1985: Consideraţii privind introducerea în cultură a speciei *Typhoides arundinacea* (L) Mnch pentru producerea de furaje, Revista de creştere a animalelor, nr.6, pag.24-30, Bucureşti.

Maruşca T., Blaj V.A., Zevedei P.M., Brejea R.P., Petreanu Antoanela, Bârlădeanu B., Rogojan C., 2020, Contribution to restoration of waste dumps of sulfur from the Călimani Mountains, Annals of the University of Oradea, Fascicle: Enviromental Protection, doi. org/10 528 1/Zenodo. 4362296, vol. XXXIV.

Samfira I., 2001, Cercetări privind biologia şi ameliorarea speciei *Phalaris arundinacea* L., Teză de doctorat, USAMVB Timişoara.

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