Researches Regarding the Adaptation Process of the Species *Miscanthus Giganteus* under the Conditions of Fly Ash Deposit from Utvin, Timis County

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Abstract

*Miscanthus giganteus* is a large, perennial (up to 20 years) grass hybrid of *M. sinensis* and *M. sacchariflorus* native to Japan. It is a C4 carbon fixation plant, and thus exhibits greater photosynthetic efficiency and lower water use requirements than other kinds of plants. It has very low nutritional requirements – it has high nitrogen use efficiency and therefore is capable of growing well on barren land without the aid of heavy fertilization. *M. giganteus* is a sterile hybrid, therefore propagates vegetative through its rhizomes and that it is a completely non-invasive species. In this paper are presented the results of this grass species growing on fly ash deposit Utvin after the first year from the planting. Order to stimulate the process of vegetative from the first year, have used three different fertilizing: with sewage sludge, with cattle manure and mineral supplement such as N.P.K. We have also provided an adequate irrigation during dry periods of the summer. The best germination percentage was obtained in variants fertilized with sewage sludge and manure of cattle. Further the same variations recorded a good growth rate and higher biomass production. However, good production of biomass produced in the first year of all variants show a good adaptability of the species *M. giganteus* to arid biotope conditions of the fly ash dump.

Keywords: ash deposit, biomass, *Miscanthus giganteus*.

1. Introduction

*Miscanthus giganteus* is a large herbal plant of Andropogoneae family (Figure 1), which multiplies through rhizomes (Figure 2). It originated from Yokohama, Japan, from where it was brought to Denmark by Aksel Olsen in 1935. Whence, it spread to Europe and then to North America. It is a perennial and resistant to environmental conditions species. It is often incorrectly called "elephant grass", expression

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Figure 1. *M. giganteus* in the first year of vegetation
which actually belongs to Pennisetum purpureum species. Over time it was known as Miscanthus sinensis 'Giganteus', M. giganteus, Miscanthus ogiformis Honda, and Miscanthus sacchariflorus var. brevibarbis (Honda) Adati [1].

Recently, following the result of Royal Botanic Gardens research activity in Kew, England, it was established that Miscanthus giganteus is a sterile hybrid resulted from the crossing of species M. sinensis and M. sacchariflorus [1-4]. In fact, it is an all triploid with a total of 3n = 57 chromosomes [5]. Longevity can reach up to 20 years and in height it may reach up to 3-4 meters. Energy production per hectare is up to 20 t DM. Due to its special energy potential; M. giganteus was classified as C4 energy plants [6].

In Europe, starting 1983 it has been researched and studied to produce, by combustion, heat and power (thermal and electrical energy) [7, 8]. Since 2005, the USA government has encouraged research into green energy using herbaceous plants as raw material for production of ethanol as bio-fuel for means of transportation. In this regard, because of its potential to produce large amounts of biomass, there has been granted great importance to the species Miscanthus giganteus [9].

In our country, the first company which imported it from Austria was ARGE Miscanthus. Following some experiments conducted at Copsa Mică by Horia Barbu from "Lucian Blaga" University of Sibiu and Teodor Vintilă from B.U.A.S.V.M. Timisoara, with rhizomes from ARGE Company, were obtained outstanding results even on fields unsuitable for grain crops [10]. With gained experience, the specialists of ARGE company from Romania show that M. giganteus can be cultivated on land polluted with sterile or fly ash from thermal power station, can be used as a protective curtain around deposits of garbage and toxic waste, as protective road curtain against blizzard snow or even as ornamental plant. According to ISTIS data (State Institute for Variety Testing) from Bucharest, art variety of this species was registered in the national catalog of varieties of crop plants in Romania starting December 18, 2012.

Knowing the remarkable biotic potential of this species resulted from resistance, longevity and biomass wealth, it was considered that Miscanthus giganteus could become an important factor of stabilization and grassing of thermal power station fly ash from landfills. Therefore, in consequence of earlier collaboration between COLTERM S.A. Timisoara and B.U.A.S.V.M. Timisoara, on to stabilizing and grassing attempts of thermal power station fly ash stored in a location near locality Utvin, Timiș county, and in accordance with ARGE Miscanthus company from Romania, decided to plant Miscanthus giganteus rhizomes on thermal power station fly ash, in one of the completed areas of the deposit.

2. Materials and methods

It was elected an area of 400 m² in a completed area of the fly ash deposit. Because fly ash is a mineral residue devoid of organic matter, it was intended supplementation with organic and mineral fertilizers applied directly to the planting nest. For this, we used semi-humid sludge from municipal sewage treatment station of the Aquatim Timisoara, well fermented manure from didactic resort of B.U.A.S.V.M. and complex fertilizers NPK 15:15:15. Rhizomes of Miscanthus giganteus came from Austria, being brought by the ARGE Miscanthus Company. Planting was done on May 10, 2012. The experimental unit consisted of three equal plots (variants), each with an area of 100 m² (20x5 m):
- Variant V1 - fertilization with sewage sludge (50 t/ha-5 kg/planting hole);
- Variant V2 - fertilization with manure (50 t/ha -5 kg/planting hole);
- Variant V3-mineral fertilization (100 kg N15P15K15/ha-10 g/planting hole).

The planting of rhizomes was done on 5 rows, with 20 nests on a row. There have resulted 100 nests per plot, returning a nutrition area of 1 m²/nest and rhizome. Planting nests were dug at a
depth of 15 cm. After mixing the fertilizer with fly ash, the rhizome was set, covered with fly ashes, and finally the settlement of the nest was made (Figure 3).

![Figure 3. Rhizomes planting](image)

With the technical support from Colterm S.A., were mounted four sprinklers and established a period of watering 3 times a week, about 2 hours per watering round.

The followed biological parameters were sprouts forming ability of planted rhizomes, number of sprouts/rhizome, maximum height of sprouts and biomass production at harvest.

### 3. Results and discussion

One month after planting was found that there were nests in which the rhizomes had not formed sprouts. Number of nests without sprouts was 3 in V1, 8 in V2, and 9 in V3. Therefore, compared to 100 nests planted with rhizomes, sprouts capacity was 97% in V1, 92% in V2 and 91% in V3 (Table 1).

After almost three months of growth, plants have developed very well in variants fertilized with sewage sludge and organic manure, and weaker growth in chemical fertilization version. At this date, plant heights ranged between 90 to 170 cm in V1, 70 to 150 cm in V2 and 30 to 120 cm in V3 (Figure 4). It’s outstanding the good development of plants from V1 and V2 variants.

<table>
<thead>
<tr>
<th>Specification</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of rhizomes planted/No. of rows</td>
<td>20/5</td>
<td>20/5</td>
<td>20/5</td>
</tr>
<tr>
<td>Ability of sprouts (%)</td>
<td>97</td>
<td>92</td>
<td>91</td>
</tr>
<tr>
<td>Average no. of sprouts/nest ($\bar{x} \pm s$)</td>
<td>27.52 ± 1.26$^\text{a)$}$</td>
<td>26.76 ± 2.02$^\text{a)$}$</td>
<td>8.32 ± 3.22</td>
</tr>
<tr>
<td>Average height of the sprouts (cm) ($\bar{x} \pm s$)</td>
<td>165 ± 2.23$^\text{a)$}$</td>
<td>123 ± 3.66$^\text{a)$}$</td>
<td>45 ± 2.01</td>
</tr>
<tr>
<td>Biomass production at harvest (kg/ha)</td>
<td>3145</td>
<td>3010</td>
<td>560</td>
</tr>
</tbody>
</table>

$^\text{a)$} p \leq 0.01$

![Variant V1](image)  ![Variant V2](image)  ![Variant V3](image)

**Figure 4.** *M. giganteus* in the first year of vegetation

In March of the following year were measured biological parameters and was made harvesting of the vegetal biomass production above-ground. The results are presented in table 1.

At the end of the first growing season, it is found that *M. giganteus* plants that received organic fertilizer at planting recorded the best results. Sprouts in both V1 and V2 showed a luxuriant growth, showing an average of over 26-27 sprouts/rhizome. As in the case of the number of sprouts, their average height has been significantly higher ($p \leq 0.01$) in organic fertilized variants.
compared to the chemically fertilized variant. As a matter of fact, the best results are obtained in case of the variant fertilized with sewage sludge, which can be a positive factor for our results regarding to opportunity of ecological valorization of the waste resulting from purging wastewater in cities. Sprout height, plant density and uniformity are well highlighted in the organic fertilized plots. Consequently, it resulted a uniform and compact aspect of vegetation in for both variants, compared to variant V3 (Figure 5).

Dry biomass production after the first year of vegetation was almost 6 times higher in organic fertilized variants (3145 kg/ha to V1 and 3010 kg/ha in variant V2) than mineral fertilized variant (560 kg/ha in variant V3). We emphasize that the biomass production of the species *M. giganteus* has, over its longevity, increased and continuous development, touching its highest potential after 3-4 years. Moreover, due to lack of profitability, in the first year is not recommended biomass harvesting for bio-fuel.

Based on these preliminary results we can say that the species *M. giganteus* easily adapts on thermal power station fly ash, provided organic fertilization of germinating substrate in which rhizomes are planted. It is also necessary that in the first year of vegetation, during the summer months the plants to have an irrigation period for 2-3 days a week. Rhizomes planted directly into fly ashes, by ensuring N₁₃₃P₁₅₃K₁₅₃ type of chemicals and irrigation, sprout and sunrise. Furthermore, although the species *M. giganteus* has eurybiont potential, plants of this version have however a reduced growth rate, resulting a low surface coating index.

4. Conclusions

On the results obtained after the first year after planting *Miscanthus giganteus* rhizomes there are outlined the following conclusions:
- *Miscanthus giganteus* crop establishment on thermal plant fly ash dumps resulting from burning lignite, can be a feasible agro-techniques solution that, at minimum cost, obtained grassing of this arid biotope and blocking deflation ashes;
- Because ashes from deposit doesn’t contain organic material, organic fertilization of rhizomes planting nests is required with a quantity of 5 kg/plant (50 t/ha). For this you can use sewage sludge or manure;
- Irrigation in the first year of vegetation, three times a week, is a basic agro-technical requirement for periods of high temperature and drought in summer;
- Given the ecological use of organic waste materials resulting from wastewater treatment in urban areas, we recommend the use of sewage sludge as fertilizer.

References