VIRGINIA FANPETAL-BASED DIGESTION RESIDUE FOR VIRGINIA FANPETAL FERTILIZATION PURPOSES

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Abstract: This paper presents the results of the impact of the Virginia fanpetal feed residue-based fertilization upon the height and diameter of sprouts, biomass yield concentration of N, P, K, Mg and Ca in the plants of Virginia fanpetal. A larger size and height of stems and yield of grass and dry matter was observed after having higher doses of the Virginia fanpetal-derived digestion residues. More effective utilization of the concentration of magnesium was noticed after the application of the tested residue as potash fertilizer than in the case of the residue applied solely. It was shown that digestion residue of Virginia fanpetal can be used as a fertilizer.

Selection

Due to the need for production of biomass in possibly the largest cities, alternative crops gain more and more importance in our country. Among crops that are often cultivated for energy purposes, willow, maize, rape, Virginia fanpetal should be mentioned [Denisiek 2005; Shawlowski ET AL.]. Virginia fanpetal, not so long ago was not yet well known in Poland, and it plant that may be comprehensively used as fodder, for realization of energy purposes. Usefulness of Virginia fanpetal for energy purposes, according to Shawlowski and Smoliński (2011), is proven by its high content of hydrogen and

However, every crop needs to be supplied with nutrients in order to use optimal yield. The literature refers to optimal fertilizer doses for Virginia fanpetal, that depending on soil quality are kept within the following limits: 100-150 kg N ha⁻¹, 50-150 kg K₂O ha⁻¹, 10-20 kg P₂O₅ ha⁻¹ [Bujack 2004]. Fertilization only contributes to the quantity of biomass but also to the content of elements in biomass [Kośmiewski and Wiśniewska 2006, 2008, 2010, Borkowska and Koshi 2008]. Fertilization does not necessarily have to be based on application of mineral fertilizers that are expensive and require high energy input into taxation. Digestion residues obtained from gasification of biomass should be used as fertilizer, especially for energy crops. This opportunity is indicated by Pichota (2011). The research aimed at assessment of the impact of the Virginia fanpetal methane-based digestion residues upon the yield and the content of a selection of macro-elements in Sida hermaphrodita Lusty.

Methodology

The pot experiment was conducted in the vegetation hall of the University of Warmia and Mazury in Olsztyn as four-experiment m-statics in polyethylene pots type Klick-Brackmann - 10 kg of soil containing glauconite composition of hard sandy clay. Doses of the digestion residue were set out according to the nitrogen content (Table 1). Due to the little content of potassium, the tested residue was additionally applied to combinations undergoing fertilization. The soil was mixed with the digestion residue or the digestion residue and potassium, and next the vases were filled in with it to plant seedlings of the Virginia fanpetal. The digested residue was obtained in result of the methane-based digestion of the Virginia fanpetal carried out at the Biotechnology Department of the University of Warmia and Mazury in Olsztyn. The soil water content of 70% of the water content at field capacity was maintained throughout the whole vegetation period.

The digestion residue represented silicate reaction. In the chemical context of the digestion residue, nitrogen was dominant, whereas sodium represented the lowest percentage share (Table 2).

The Virginia fanpetal was harvested after the vegetation period. The cut crops were weighed, measured and the weight of green sprouts was determined. Chopped and dried - in the temperature of 105°C - biomass was re-weighed in order to specify the content of dry matter. The samples prepared in that way were crushed and underwent analysis. The experiment samples were mineralized in H₂SO₄ with the oxidant H₂O₂. After mineralization the following was specified: N - distillation method, P - colorimetric method (vanadium-and-molybdenum method), K and Ca - AES method (atomic emission spectrometry), Mg - ASA (atomic absorption spectrometry).

Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Treatment</th>
<th>g per pot</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Digestion Residue- 225 g per pot</td>
<td>0.5</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.038</td>
</tr>
<tr>
<td>3</td>
<td>Digestion Residue- 455 g per pot</td>
<td>1.0</td>
<td>0.2</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.075</td>
</tr>
<tr>
<td>4</td>
<td>Digestion Residue- 684 g per pot</td>
<td>1.5</td>
<td>0.3</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.113</td>
</tr>
<tr>
<td>5</td>
<td>Digestion Residue- 225 g per pot + K</td>
<td>0.5</td>
<td>0.1</td>
<td>0.5</td>
<td>0.5</td>
<td>0.2</td>
<td>0.038</td>
</tr>
<tr>
<td>6</td>
<td>Digestion Residue- 455 g per pot + K</td>
<td>1.0</td>
<td>0.2</td>
<td>1.0</td>
<td>1.0</td>
<td>0.4</td>
<td>0.075</td>
</tr>
<tr>
<td>7</td>
<td>Digestion Residue- 684 g per pot + K</td>
<td>1.5</td>
<td>0.3</td>
<td>1.5</td>
<td>1.5</td>
<td>0.6</td>
<td>0.113</td>
</tr>
</tbody>
</table>
The digestion residue significantly and noticeably lengthened the sprouts of Virginia flanpet (Table 3). Each larger dose of the residue improved the yield that was still better in effect of higher potassium content, after repeated doses of this component. It bears noting that Virginia flanpet grows on the field of digestion residue grew the smallest. This indicates the need to

c this plant.

The higher the dose of the digestion residue was, the thickness of stems of the plant was thicker (Table 3). Potassium was of lesser importance for the growth of stems – the same doses of digestion residue used without or with


On the basis of the conducted research it was proven that the digestion residue significantly increased the quantity of green and dry matter of the tested after fertilization of the Virginia flanpet-based biomass (Exhibit 1). The amount of biomass produced by the Virginia flanpet was mostly dependent on the dose of digestion residue. This residue along with nitrogen, indispensable for growth and development of plants, were added to the


The research output of other authors proved beneficial impact of nitrogen on the length of stems of the Virginia flanpet and the quantity of produced sprouts (Borkowska and Doły 2003). In another paper, Borkowska et al. (2009) noted that nitrogen did not have any impact upon the density of stems but it mainly needs them higher, on the other hand better developed and longer stems were obtained after having been fertilized with higher doses of phosphorus.

According to Kusia et al. (2008) the yield potential of the tested plant is big, and it is dependent on soil quality and fertilization.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height [cm]</th>
<th>Diameter of Sprout [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>23.3</td>
<td>4.63</td>
</tr>
<tr>
<td>Digestion Residue – 228 µg per pot</td>
<td>40.5</td>
<td>5.38</td>
</tr>
</tbody>
</table>

The digestion residue had a positive impact upon the concentration of nitrogen in the plants of Virginia flanpet (Exhibit 2). Higher doses of the residue caused significant increase in the content of N. This needs to be specified as a natural reaction of the tested plant because by means of increasing the dose of the digestion residue, more and more nitrogen was concurrently added. Addition of potassium increased the efficiency of nitrogen absorption by the Virginia flanpet and consequently in the plant tissues more nitrogen was accumulated. It needs to be underlined that the digestion residues derived from the Virginia flanpet did not contain much potassium.

The rising doses of digestion residue derived from the Virginia flanpet caused the phosphorus content in the plants to decrease (Exhibit 3). The smallest dose of the residue caused the P to accumulate in the tissues of the tested plant in significantly lower volume. This could be caused by the signified content of Ca in the digestion residues used for the research purposes and by retaining phosphorus to the form insoluble in water, e.g.: Ca₃(PO₄)₂. Conversion of phosphates into less dissolvable forms will limit its absorption by plants.

Potassium content, similarly to nitrogen, linearly increased concurrently with increasing dose of the digestion residue with which this component had been
Additional potassium-based fertilization resulted in furthering the quantity of the component accumulated in the plants. Magnesium concentration in the dry matter of the tested plant was directly proportional to the potassium content (Exhibit 5). This inter-relation is explainable. Potassium is the antagonist of magnesium and strongly limits its use. Along with the digestion residue, magnesium and potassium were however potassium content was over 5.8-fold higher than magnesium in the residue tested under this research. So, it is understandable that the potassium-based fertilization contributed to further decrease in the content of Mg in the Virginia fenspetals. Among all the elements used under the conditions, the content of calcium in the Virginia fenspetals did not vary much (Exhibit 2).

Fertilization does not only influence productivity of plants but also the chemical content. BORKOWSKA AND LIPIŃSKI (2008) and MABAS AND WISNIEWSKA (2008, 2010) obtained mostly varied content in the plants of Virginia fenspetals. Similarly, the output of the conducted on our own indicates that depending on the nutrient content in a accumulation of N, P, K and Mg may vary to a great extent. Concentration active elements also depends on the developmental stage of a plant. Thus in Virginia fenspetal-derived biomass, the content of mineral components may differ as it is reported by various authors.
3. Potassium applied along with the residue limited the concentration of magnesium in the Virginia fannpetal.

Literature


