

SWITCHGRASS CULTIVATION ON RECLAIMED MINELAND WITH SOME AMENDMENTS

**Mykola Kharytonov¹, Mykhailo Babenko¹, Nadiia Martynova², Irina Rula¹,
Giovanni Pardini³, Maria Gispert³ and Eva Margui³**

¹Dnipropetrovsk State Agrarian and Economics University, Ukraine

²Oles Honchar Dniprovsky National University, Ukraine

³Girona University, Girona, Spain

Reclaimed mining rocks can be potential lands for biofuel feedstock production. Minelands are considered marginal because they often have low organic matter contents and adverse soil physical and chemical characteristics. Establishing perennial grasses such as switchgrass (*Panicum virgatum* L.) on these lands can be an economically viable option to produce cellulosic biomass with the addition of biological agents such as fertilizers, cinder and sewage sludge. To determine the effect of different amendments on the growth and development parameters of switchgrass plants growing on mining rocks a comprehensive study was conducted. The research was carried out at Pokrov land reclamation station of Dnipropetrovsk State Agrarian and Economic University during two years (2016–2017). The switchgrass seeds were sown on the experimental plot. Substrate was a mixture of loess-like loam and red-brown clay, which had passed through a long-term phytomelioration stage. The humus content in the substrate is about 1.5%. The ratio of humic and fulvic acids is 0.2–0.5, which indicates a weak humus accumulation and active destruction of the soil mineral part. The main minerals of rocks silty fraction consist of feldspar, calcite, illite, montmorillonite, chlorite and kaolinite. The near reserve of mobile phosphorus is represented by its medium-accessible forms. Five additive options were used: mineral fertilizer with a balance of nutrients N₆₀:P₆₀:K₆₀ kg·ha⁻¹; ash of sunflower husk and sewage sludge in amount 10 t·ha⁻¹; mixture of ash and sewage sludge (10 t·ha⁻¹); a double dose of sludge (20 t·ha⁻¹). All amendments were put into the soil once in spring in a dry form.

The year 2016 was rainier and more favorable for plant growth than 2017. The height of plants in this year varied from 105 to 120 cm. Addition of biologically active agents in the substrate had a positive effect on this morphometric parameter. The plant growth increased by 5% in the trial with mineral fertilizer and by 9.5% in the variant with sewage sludge. The addition of ash and a double dose of sludge had the greatest effect, the growth rate enhanced by 14.3%. In 2017 relatively long periods of drought, accompanied by high air temperatures, had a depressing effect on the growth and development of switchgrass plants. Their height did not exceed 90–110 cm. Nevertheless, the addition of tested amendments improved this index from 10% (ash) to 25.6% (sewage sludge). The greatest effect was due to a double dose of sewage sludge (41.3%). In the first years of cultivation, the dry biomass yield of switchgrass plants grown on a mixture of mining rocks was in the range of 4.5–5.9 DM t·ha⁻¹. Addition of amendments caused an increase in productivity. The least effect was obtained by the application of ash (+8.2%), the largest in the trial with a double dose of sewage sludge (+99.3%). Thus, it is possible to obtain biomass yields of up to 9 DM t·ha⁻¹ even in dry climate on minelands. To determine the effect of amendments on the uptake of trace elements with the switchgrass vegetative mass, the contents of copper and zinc in all experimental samples have been determined. The addition of ash and a mixture of ash and sewage sludge increased the copper content by 15% and 54%, respectively. Other variants of additives had no effect on this element absorption. The ash application increased the uptake of zinc with biomass by 4.5 times. At the same time, in the trial with sewage sludge, the zinc content was less by 10% than in the control. Thermal degradation of above-ground biomass from switchgrass specimens occurs within a temperature ranging between 30°C and 600°C. The main pyrolysis process proceeds in a range from approximately 200°C to 380°C. The application of mixture of a ash and sewage sludge, a double dose of sludge and especially mineral fertilizer increase the biomass reactivity of thermal decomposition of hemicellulose and cellulose.

Key words: Switchgrass, Mineland, Amendments, Heavy Metals, Biomass, Pyrolysis