PLANT NUTRIENT RECYCLING FROM WASTE PRODUCTS OF BIOENERGY PRODUCTION

Sarmīte RANCĀNE[1,2], Aldis KĀRKLIŅŠ[2], Dagnija LAZDIŅA[3]
[1]LLU Research Institute of Agriculture, [2]Latvia University of Agriculture,
[3]Latvia State Forest Research Institute “Silava”
Zemkopības inst. 7, LV-5125, Skrīveri, Latvia
Email: sarmite.rancane@inbox.lv

Abstract. *The necessity to increase the share of renewable energy requires expanding the use of green energy. In Latvia one of the most suitable sources for bioenergy generation could be biomass obtained from perennial grasses. Grasses are modest in terms of soil conditions and do rather well on marginal lands that are unfavourable for food production and are currently unused [1]. The cultivation of grasses on degraded or exhausted agricultural soils can help in restoring the soil's organic carbon and improve its physical properties [2]. In the process of biomass combustion or its fermentation for biogas production waste products such as ash or digestate are obtained. This material is rich in plant nutrients and can be used for soil improvement and/or fertilisation of crops. In order to study the effectiveness of applying these waste products on reed canary grass (Phalaris arundinacea L.) and festulolium (×Festulolium pabulare) experimental trials were arranged in the central part of Latvia (56°42' N and 25°08' E) on Endoluvic Epistagnic Phaeozem (Loamic)/Stagnic Retisol (Cutanic, Drainic, Loamic) [3], fine sandy loam in 2012. In all fertiliser treatments: (wood ash – WA, digestate once per season – D1; digestate twice per season – D2 and mineral fertilisers – MF) the same amount of plant nutrients: N (100), P_2O_5 (80), K_2O (160) was provided annually. The missing quantities of elements in ash and digestate plots were compensated by mineral fertilisers. Fertilised treatments were compared with the control (C – not fertilised). For accounting of grass biomass two harvest regimes were used – two-cut per season and one-cut per season (late in autumn at the grass senescence) harvest systems. The chemical composition of grass biomass: ash content; total C, N, P, K, S; Ca and Mg were determined.*

Two-year trial results suggested that the productivity of perennial grass biomass was dependent on the type of fertilisers applied, grass species and harvest regime. The dry matter yields (DMY) in general were higher for reed canary grass (RCG): in two-cut harvest regime – the obtained DMY ranged from 4.08 to 8.57 t ha^{-1} in the 1st year of use and from 4.01 to 8.62 t ha^{-1} in the 2nd year of use. For festulolium in two-cut harvest regime DMY were 2.61-5.02 t ha^{-1} in the 1st year of use and 1.11-3.78 t ha^{-1} in 2nd year of use. Both species produced larger yields in one-cut harvest regime: 6.36 to 10.0 t ha^{-1} in 1st year of use and 4.74-7.11 t ha^{-1} in 2nd year of use for RCG; 3.54-7.73 t ha^{-1} in 1st year of use and 1.19-5.66 t ha^{-1} in 2nd year of use for festulolium. The largest DMY on average in two years for both grass species were obtained in fertilisation treatments using wood ash (WA) and mineral fertilisers (MF). The use of digestate provided a significant increase of DMY in comparison with the control, although it did not provide an equivalent yield increase as it was in WA and MF treatments due to partial emission of nitrogen in the form of ammonium. The chemical composition of grass biomass was mostly influenced by grass species and harvest regime: lower ash content (4.0- 5.4%) and hence more appropriate raw material for combustion can be obtained by mowing RCG once per season late in the autumn. RCG provided biomass with a relatively lower K (14.7-16.6 g kg^{-1}) and higher C (498.3-510.6 g kg^{-1}) content on average using the two cutting harvest regime.

Key words: *fertilisation, festulolium, reed canary grass, yield, biomass quality.*

REFERENCES

1. Barth S., Jones M., Hodkinson T., Finnan J., Klaas M. and Wang Z.-Y. (2014) Grasslands for forage and bioenergy use: traits and biotechnological implications. Grassland Science in Europe: 19, 438-449.
2. Potter K.N., Torbert H.A., Johnson H.B. and Tischler C.R. (1999) Carbon storage after long term grass establishment on degraded soils. Soil Science 164, 718-725.
3. World Reference Base for Soil Resources 2014: International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106, Rome: FAO. 2014. 181 p.