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IX Finnish Symposium on Plant Science, May 17–19, 2010, Joensuu, Finland

Abstracts

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Reports and Studies in Forestry and Natural Sciences

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(63) Evaluation of maize and hemp cultivars as bioenergy crop

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We are cultivating annual and perennial crops as monoculture and as mixed culture to investigate plant biomass use for production of renewable energy sources in northern latitudes. Prerequisites for sustainable energy production are high biomass production and low inputs of fossil fuels in agricultural operations as well as synthetic fertilizers and pesticides.

In addition to biomass quantity, also its quality is significant factor since different bioenergy technologies have different quality requirements. Biological fermentation methods benefit from high concentrations of soluble sugars and starch, in lignocellulosic mass using methods different pre-treatments are needed to convert cellulose and hemicellulose fibres more approachable to hydrolysing enzymes. Biomass quality and its usefulness can vary depending on plant species, harvesting time, fertilizer use as well as weather and soil conditions. Similarly different plant parts can vary in their chemical composition due to divergent translocation of different elements and partitioning of soluble sugars and storage carbohydrates in growing plants.

We have grown different hemp (*Cannabis sati*va L.) and bioenergy maize (*Zea mays* L.) cultivars in 2007–2009 at Viikki Experimental Farm, University of Helsinki. Samples of 1 m^{-2} per plot were harvested in the autumn during the growing season and in the following spring for quantity and quality of biomass produced. Maize yield varied highly year by year from 15 t DM/ha to near 30 t DM/ha whereas hemp was merely cultivar dependent as the yield between cultivars varied from 6 t DM/ha to 14 t DM/ha. The chemical composition (Al, B, C, Ca, Cl, Cu, Fe, K, Mg, Mn, N, Na, P, S, Si and Zn) of the samples was analysed from dried, ground subsamples. The quantity of inorganic elements varied markedly between the studied species and cultivars. Cl and K content was highest at the lowermost plant parts whereas N and P content was highest in the uppermost plant parts and ears. Even though, the losses in biomass in spring harvest are marked, the loss of water and inorganic elements (except for Al and Fe which increased) in the biomass is economically important especially in case the material is used for combustion since high alkali metal (K and Na) and silicon (Si) concentrations in biomass can cause slagging and corrosion in combusting process. Both crops are high in straw cellulose and low in lignin content, and thus they are suitable for biomethane or bioethanol uses. Studied crops did not lodge during autumn rains, and thus they are also suitable for combustion. Cooperative research group is analysing the processes of biomethane and bioethanol production. Economic aspects will be evaluated by cooperative partners at the University of Helsinki, Department of Economy.