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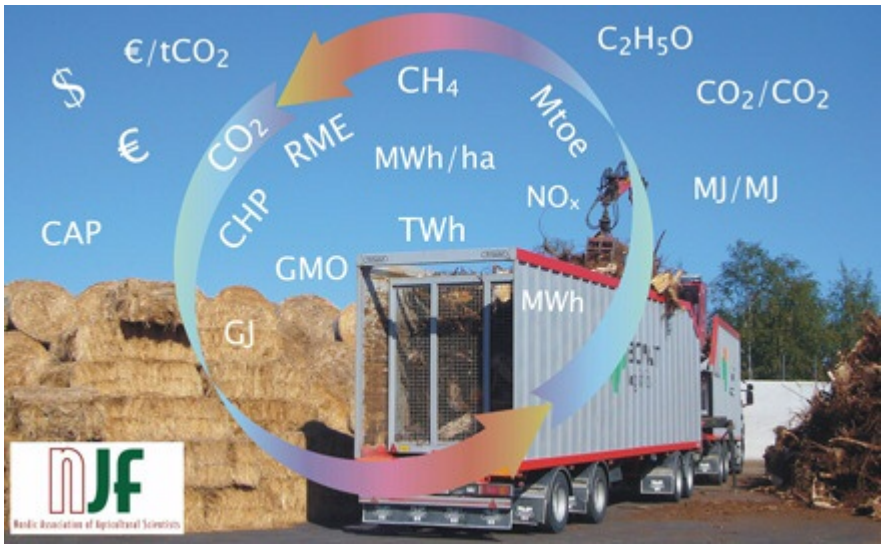

NJF Seminar 405

Production and Utilization of Crops for Energy

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The role of legumes in bioenergy production

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In the cultivation of field crops for bioenergy use, it is often considered desirable to balance the inputs with the outputs in order to maximize energy profit and minimize emissions of greenhouse gases (GHG). One of the key energy-consuming and GHG-emitting processes in crop cultivation is the production of nitrogen fertilizer. Legumes will therefore play a key role in energy cropping. Furthermore, it is an ecological paradigm that polycultures harvest more of the available resources than monocultures. We are investigating the role of legumes as components of bioenergy production. The target markets for these mixtures are those where the whole crop is used, such as burning for combined heat and power generation, fermenting to biogas, or pyrolysis in second-generation liquid biofuel manufacture.

Two separate experiments, one with annual species and the other with perennials, were established at Viikki in 2007 and further experiments are planned. Selected grasses, legumes (or nitrogen fertilizer) and additional species were sown singly or in blends of two or three species. Legumes were inoculated with the appropriate Rhizobium or Bradyrhizobium species before planting. Establishment was determined and at the time of writing, plots are being harvested for determination of fresh matter, dry matter and relevant quality attributes.

Each species was sown at 100% of conventional sowing density, even in mixed plots, to allow assessment of "winners" and "losers" in a competitive situation. The outcomes varied widely. Oilseed hemp had similar canopy structures to all three annual lupin species and there was little benefit to be seen in the hemp-lupin combination. Fresh matter yields of white lupin appeared to be excellent, also in combination with annual ryegrass. Maize growth was strongly reduced by faba beans, moderately by vetch and not visibly affected by annual clover, while the legumes grew well with the maize. Oilseed radish and phacelia both suppressed all co-cultivated species and need to be

sown at much lower densities to be useful components of mixtures. Several perennial legumes established well when co-sown with either reed canary grass or a pasture-grass species mix. Perennials offer further potential advantages of reduced soil disturbance and increased carbon sequestration in the perennating organs.

The results will also be used in modelling of both economic budgets and energy flows by collaborators. Legumes and phacelia also provided excellent foraging for bumblebees and honeybees, demonstrating an additional ecological service of the bioenergy crops. Future experiments will focus on some of the more productive crop combinations and manipulate species densities in order to optimize total productivity of the mixture.