



Invitation to hear research results on a novel land use concept: Closed loop nitrogen cropping for biogas energy

Workshop on Tuesday 19 June in Taupo at NZ Clean Energy Centre

Time: 11am – 3pm

No charge & lunch provided

The workshops will present the latest research findings, including crop trial results, for discussion by stakeholders of a new cropping system that can **address a range of environmental land management issues** at the same time that it produces **bioenergy in the form of biogas for local use**. One of the cornerstones of the concept is **nutrient recycling**, mostly eliminating the need for external fertiliser nutrient imports into the system. That is why we call it CLN, Closed-Loop Nitrogen Supply cropping. It can make bioenergy production truly sustainable.

Findings of this Plant & Food Research project, conducted under the MAF SLMACC scheme, offer a sustainable, scalable and practical way to produce biofuel to displace greenhouse gas (GHG) emissions from the use of fossil fuels by farm equipment and rural trucking, and enhance rural energy self-sufficiency and energy security. Substitution of fossil transport fuels with biofuels at scale will require purpose-grown energy crops. Anaerobic digestion to biogas was chosen as the preferred fuel production pathway, as it is proven, very scalable, compatible with a wide range of feed-stocks that can be grown with short lead-in times, while being also ideally suited to facilitate nutrient recycling as part of the CLN concept. While not a liquid biofuel, biomethane is the most efficient of all biofuels in terms of energy produced per ha of crop grown and therefore has the greatest GHG impact. It is also versatile; it can be used for heating/crop drying, power generation and transport fuel (the most valuable use of biogas). Furthermore the minimum individual set-up size at which biogas technology can be implemented, is much more compatible with existing farming structures, compared to other (liquid) biofuel alternatives.

Field test with various prospective biogas energy crops have confirmed that nutrient recycling via anaerobic digestate (biogas plant spent liquor) produced biomass yields equal to trial plots fertilized with synthetic N fertiliser. This makes it possible to achieve further GHG emission reductions (from N fertiliser manufacture) by virtue of the novel 'closed loop N supply' feature.

We identified very good cropping system options that rely on either perennial species or annual species. The annual sorghum bicolor (cultivar 'Jumbo') dry mass yields averaged 27 tDM ha⁻¹ in 2011 and the JA crops (Jerusalem artichoke) yielded equally well in 2012. Crimson clover (*Trifolium incarnatum*) can add 5-10 tDM ha⁻¹ annual dry matter yield to the system and be harvested prior to planting sorghum. Tickbean (*Vicia faba*) yield was even better, at >20 tDM ha⁻¹ in a mild winter. While these yields showcase the potential of novel crops under growth conditions that placed few restrictions on plant growth in 2011 and 2012, crop models and other approaches were used to estimate yield potential under more 'marginal' growth conditions. Phenology data from first and second year will be used to predict biomass yields for other marginal land classes throughout New Zealand. The combination of experimental and model analysis was used to create a map of biofuel potential of the novel energy crop production system for marginal lands in selected regions of NZ.

Biogas yields of the novel cultivars were determined at a collaborating laboratory in Vienna. The crops' methane potentials were determined both through plant nutrient analysis, as well as actual digestion tests under standardized laboratory conditions. Recorded methane yields of the novel crops were quite acceptable, given the high DM tonnage possible. Both sorghum and JA biogas gas yields per unit dry matter were lower relative to maize (the dominant biogas energy crop in Europe), however this shortfall can be compensated due to the novel crops producing more dry matter on sites with less consistent rainfall.

The careful combination of different biogas energy crops, result is a system that can be self-sufficient in N or even yield a surplus beyond the needs of the biomass crops, for use of food crops. This reduces competition between energy crops and food crops.

Based on experimental results, modelling was carried out to calculate the GHG impact of fossil fuel substitution with the biogas produced per ha of crop land. We also made a preliminary analysis of the economic feasibility of growing the crops for use in a biogas digester and subsequent purification of biogas to transport fuel standard. Several scenarios confirmed that both technical and economic feasibility can be achieved.

The workshop programme will also include a presentation on the energy crop Giant Miscanthus.

NO RSVP required for this workshop.

Please reply with contact details to rocky.renquist@plantandfood.co.nz if you want to receive the final report and/or summary.