

## Prospects for environmentally-sound biodiesel crops

By Steve Wratten

Interest in biofuels has grown globally in the context of the world consuming 13.4 billion litres of oil daily, with the likelihood (according to 2008 expectations) of it increasing by 140 million litres a day, equivalent to 890,000 barrels a day @ 159 litres a barrel. A simple way of understanding this is that the daily water flow over the Niagara Falls is similar to daily world oil use. Further context is that the peak rate of annual discovery of oil reserves was 1964. The New Zealand Government has a Biofuel Sales obligation which requires oil companies to meet a biofuels sales quota. By 2012 biofuels must make up 3.4 percent of the energy content of all diesel and petrol sold in New Zealand, but probably the blend required will increase beyond 3.4%. The current supply of biodiesel feedstocks in New Zealand is limited, however, and the government requirement is likely to need a largely imported biofuels supply. That has led some commentators to suggest the government requirement should be modified or withdrawn (see the article by Dr Jan Wright, Parliamentary Commissioner for the Environment, on Page \* \* \* ).

Biodiesel is a generic term for alkyl esters produced from biological fats and oils. It is usually produced using a mono-alcohol (methanol or ethanol) in a transesterification reaction catalysed by an alkali (sodium hydroxide or potassium hydroxide). While any fat or oil can be used in this process, the economics of production and the quality and quantity of the product are heavily dependent on the choice of feedstock. In the near future, tallow and used cooking oil will be the dominant feedstocks for commercial production in New Zealand. However, the volume of these is constrained below the potential demand for biodiesel and a need for alternative feedstocks has been recognised. The primary feedstock in the US, soy, is unsuitable for cultivation in New Zealand. In Europe, most biodiesel is produced from rapeseed but cultivation is intensive, with a negative effect on the overall energy balance of the fuel, and with potential environmental costs. Importation of tropical oils such as palm oil also has disadvantages, including unsustainable cultivation practices and the financial, environmental and security costs of transport.

Biofuels have the potential to substitute for some of that “fossil” oil. The need for substitution is driven by rapidly increasing carbon dioxide concentrations in the atmosphere, caused by burning fossil fuels, with associated global warming which is suggested to cause a 0.5m rise in the sea level by the end of the century. Also, although predictions differ, “peak oil” is approaching. However, a high level of research, technology and policy development is required to make that a reality. Current biofuels fall into three major groups: bioethanol, biodiesel and “biojoules” (representing heat from biomass such as wood).

Recent analyses worldwide have addressed the sustainability of the production of some biofuels, however, in terms of: (1) life-cycle analysis of energy inputs compared with outputs in the form of biofuel; (2) the fact that some biofuel feedstocks are foods; (3) the fact that some feedstocks require high-quality agricultural land; (4) the fact that some feedstocks require high inputs of water, fertiliser and pesticides. For example, publications by Zah *et al.* 2007, Pickett *et al.* 2008 and Scharlemann and Laurance 2008 indicate that some of the most important biofuels, such as those produced from corn (maize), sugarcane and soy perform poorly in many contexts. For example, “... multibillion-dollar subsidies for US corn production appear to be a perverse incentive from a rational cost-benefit perspective ...”. (Scharlemann and Laurance 2008).

The New Zealand Government, through its Foundation for Science, Research and Technology (FRST), is investing in a wide portfolio of biofuel research, while overseas, investment is massive and increasing. For example, BP is investing US\$500 million in biofuels research.

The Lincoln University Biodiesel Research Programme is funded for six years by FRST and is entitled: “Developing with Chevron New Zealand, novel, second-generation biodiesel feedstocks to improve New Zealand’s economic and environmental performance”. Chevron New Zealand and Chevron Ventures, San Francisco, are key partners in this work, along with Biodiesel New Zealand (part of Solid Energy New Zealand), Taharoa C Block Incorporation, near Hamilton, Ngai Tahu, Crop & Food Research, and others. This unique team aims to meet three objectives:

(1) Led by Dr Dick Martin of Crop & Food Research, this will demonstrate best practice management packages to ensure that oilseed rape and other selected oil and latex producing crops grow to their potential.

(2) Led by Professor Alison Stewart of the Bio-Protection Research Centre, this will investigate plant yield and quality enhancing microbial bio-inoculant technology already successful in pasture to increase per hectare oil harvest.

(3) Led by Professor Steve Wratten, of the Bio-Protection Research Centre, this will employ unique “ecological engineering” approaches to enable production of biodiesel feedstocks in a manner which enhances the ecological and environmental quality of farmland, rather than depleting it.

Oils will be analysed for their suitability for transesterification and biodiesel quality by Biodiesel New Zealand and Chevron Ventures Ltd. The involvement of under-used Maori land on both main New Zealand islands should provide the opportunity for new, sustainable uses for this land in the future.

Given the urgent need to address the criticisms of Scharlemann *et al.* (2008), Pickett *et al.* (2008) and Zah *et al.* (2007), this recent funding is timely and will open up the opportunity to address the challenges facing New Zealand’s and global energy needs. However, current predictions of future global energy needs are based on the economic and political paradigm of continued economic growth. Current predictions are that the world economy will expand from US\$54 trillion to US\$400 trillion by 2030. As long ago as 1987, Bruntland questioned whether there should or will be “Limits to Growth”. That report was issued at a time of energy crises. Today we are facing new energy crises relating to global warming, “peak oil”, rapid increases in world population and individual wealth of some sectors of society and exceptional increases in oil prices, impacting on food costs. New approaches and paradigms are sorely needed to address these issues and our biodiesel programme should help in some way. Perhaps it’s a naive notion, but people in the richer nations should consider going on an “energy diet”.

## References

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