The impact of crop management on the life cycle assessment for biofuels

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Current position and drivers for biofuel

- UK biodiesel production plants are operating and bioethanol plants are in construction.
- In 2008 the Renewable Transport Fuels Obligation (RTFO) will secure a limited market for UK biofuels; incorporation is set at 2.5% (by volume, increasing to 5% by 2010).
- Biofuel production is increasing worldwide to;
  - reduce greenhouse gas (GHG) emissions - current biofuel processes show savings of around 50% compared with fossil fuels
  - secure the national fuel supply
- Understanding the environmental impact of agronomic practices enables;
  - maximum benefits to be gained from biofuels
  - production of feedstock with optimal efficiency
  - communication of pros and cons of different feedstocks
  - effective strategies to be developed

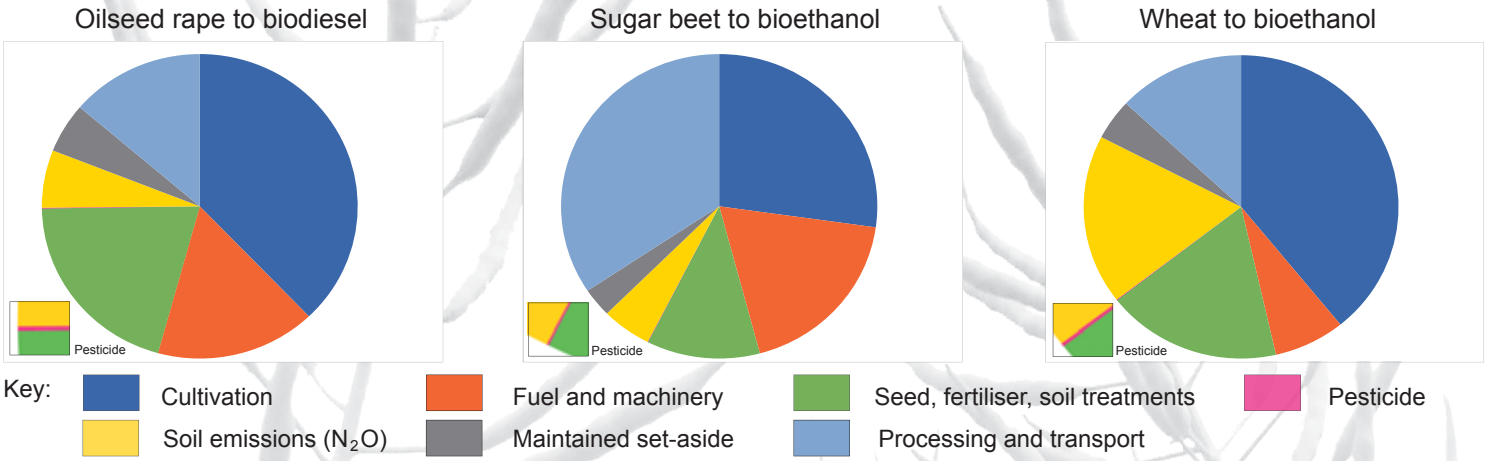
The study

We report findings of a Defra-funded project (Ashley *et al*, 2007) which aimed to quantify the impact of agricultural and other inputs on GHG emissions savings achieved by UK biofuels.The effects of fertilisers and pesticides on crop yield and GHG emissions were taken into account.

What is life cycle assessment?

- Awareness of energy use and GHG emissions from the whole supply chain is essential. The approach stretches from crop feedstock production, transport, processing, delivery and use in vehicles.
- It brings an understanding of agricultural inputs and their impact to manufacturers and policy makers.

Figure 1: Relative contributions (%) of cultivation practices to GHG emissions from biofuels



Optimising pesticide input

- Excluding pesticide treatment may reduce crop yield. This in turn would impact on GHG emissions savings achieved by the resultant biofuel.
- Pesticide production is energy (and therefore GHG) intensive, but relatively small quantities are applied per hectare compared with fertilisers.
- Using appropriate levels of pesticides and herbicides in the cultivation of fuel crops may be beneficial from a net GHG emissions savings perspective.

Findings

Pesticide treatments in a growing programme have little impact on GHG emissions savings achieved by the resultant biofuel, contributing less than 1% of GHG emissions across the life cycle.

Fertiliser has a large impact on life cycle GHG emissions. Approx. 35% to 38% of total GHG emissions from biofuel production can be attributed to the use of nitrogen fertilisers in feedstock production. A further 6-28% of total GHG emissions arise when nitrous oxide is emitted from cultivated soils.

Optimising fertiliser input

- There is scope to reduce fertiliser use in biofuel feedstock production without affecting fuel yield.
- Optimum GHG emissions savings per hectare might be achieved when nitrogen fertiliser is reduced from 180 kg/ha to 80-90 kg/ha (oilseed rape for biodiesel).
- This reduces the yield of oilseed rape by around 9% across the lifecycle of the biofuel produced (Mortimer & Elsayed, 2006).

Implication for yield

- If oilseed rape is in short supply, there might be a necessary compromise between producing the maximum quantity of fuel and producing less fuel at increased GHG emissions savings.
- Without effective carbon and sustainability accreditation for fuel crops, such as those proposed under the RTFO, and given the limited supply of UK biomass, yield may take priority over GHG emissions savings.

The future - optimising feedstock

- Future technologies are likely to use lower input crops and lignocellulosic feedstock such as short rotation coppice willow, miscanthus and cereal straw.
- LCA studies for these new technologies show significant improvements in GHG emissions savings over existing crops and processes.
- For example the Well-To-Wheels LCA (Edwards *et al*, 2007) shows GHG emissions savings of around 90% for these technologies.