Genetic Engineering (GM) and Biofuels Production

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Content

- Context: Bio-energy production
- What is Genetic Engineering (GM)?
- Applications of GM
- GM in biofuels production
Types of Bio-Energy

1. Electricity
   Major CO₂ emitter in SA
   Lots of interest in renewable energies: Solar, wind, biomass (IPPs)

2. Transportation
   Second only to electricity as CO₂ emitter in SA (Sasol)
   Liquid fuels have high energy density (MJ/kg storage)
   SA has industrial biofuels strategy

3. Low quality thermal energy (heat)
   Unsuitable for electricity production
   Industrial/domestic applications

Biomass for Energy

◆ “First generation” crops
   – Vegetable oils, starch grains, sugar
   – Food and non-food crops

◆ Lignocellulosic biomass (“second generation”)
   – Pulp wood, timber, construction
   – Residues and energy crops

◆ Municipal solid waste

◆ Algal biomass (“third generation”)

Starch crops

- Wheat
- Triticale
- Rye

Lignocellulose sources

- maize stover
- bagasse
- woodchips
- Miscanthus as energy crop
What is GM?

- Classical breeding (“crossing”)
  - Intra-species method of genetic manipulation that is based on selection of preferred traits in crosses between genetically distinct versions of the same species
  - Performed with plants, animals, microbes for centuries; DNA manipulated inside of living cells
- “Genetic engineering (GM)” is manipulation of DNA outside of living cells, since early 1980’s
  - Allows transfer of genetic material between completely different types of organisms (commonality in DNA structures)
    » Inter-species transfer of genetic material
  - Allows creation of completely new genes/proteins for inclusion/production in living organisms
  - Can be done with plants, microbes, animals (GMOs)
Examples of GM Applications

- Production of insulin for diabetes
  - GM yeast produces human-like insulin to replace porcine (pig) insulin
  - All insulin produced/used in the world for +25 years has been produced with GMOs
- Human vaccines by producing viral proteins in microbes
  - Hepatitis B: Efficacy and cost; +25 years
  - Human papillomavirus (HPV): Only technical option
  - Proteins do not contain viral DNA and are therefore inactive

Examples of GM Applications

- Mainstay of GM technology has been pharma
  - 25% of new pharmaceutical products are from GMOs
  - Mainstay of GM technology has been pharma
  - Stringent clinical testing (7 years) and monitoring after release of pharmaceuticals and vaccines produced with GM technology
  - Extensive proof of safe GM technology; products injected into blood stream
- Production of industrial enzymes
  - 90% of products from GMOs
  - Use in washing powder, food products, textiles, etc.
Examples of GM Applications

◆ Most controversial application of GM has been in food production
  – Engineering new traits into food crops
  – Concerns over safety of GM technology, etc.
◆ Key discussion point: Control of food crop distribution by companies supplying GM crops
  – GM technology allows widespread patent protection of innovations in the engineering of food crops
  – Comparison of commercial strategies of GM crops with non-GM crops protected by breeder rights

GM in Biofuels Production

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