Low-carbon opportunities in the agricultural sector

David Dent
Founder Director and Chief Technology Officer
Azotic Technologies Ltd
Special Adviser UK Parliamentary and Scientific Committee

The Agricultural Sector

- Farm Inputs
  - Land, labour, crop seeds, fertiliser, pesticides, livestock, animal feed
- Farm Production
  - Crops
  - Livestock
- Logistics, trade and distribution
- On-farm Processing

2

Types of Agricultural Businesses

- Inputs and technology providers – design, assemble or manufacture key inputs (pesticides, fertilisers) or equipment or machinery (tractors, seed drills, combine harvesters) for use in agriculture
- Producers (Farmers) – to sow, farm, and harvest crops, to raise poultry and livestock

3

The Carbon Problem in Agriculture The UK as an Example

- The UK agriculture inventory estimates current agricultural emissions to be around 48 $MtCO_2e$ or 8% of total UK greenhouse emissions
- These mainly comprise nitrous oxide (N_2O) emissions from the use of fertiliser on soils (54%) and methane (CH_4) emissions from enteric fermentation, a process related to digestive systems of cattle and sheep (38%)
- Agriculture is also responsible for CO_2 emissions arising from the use of pesticides (0.6 $MTCO_2e$), machinery (e.g. tractors) and consumption of fuel in farm buildings.

4

Innovative Solutions for the Agriculture Carbon Problem

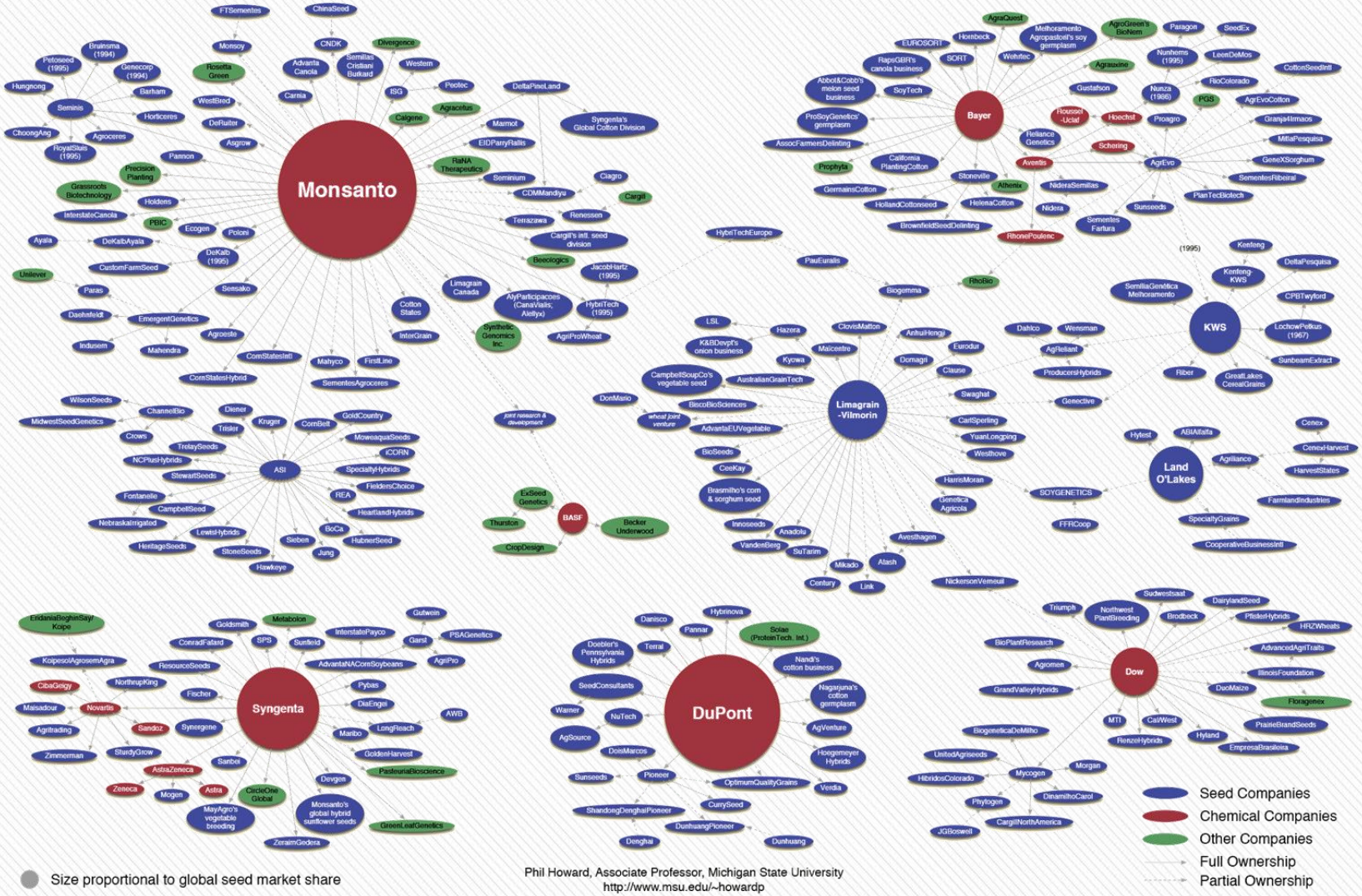
- SMEs innovate better than large companies
- Agriculture is dominated by large companies –

  Pesticides and Seeds: Monsanto, Syngenta, BASF, Dow & Dupont and Bayer

  Fertilisers: Agrium, CF Industries, Potash Corp. The Mosaic Company, Yara Int.
- The size and dominance of these companies belies the complexity of the sector

5

Seed Market Structure



Phil Howard, Associate Professor, Michigan State University
http://www.msu.edu/~howardp

Opportunities

- Seed: Breeders – 36 UK companies
- Pesticides: Microbes replacing agro-chemicals – 270+ plus companies in Europe
- Animal Feed: 2000+ companies in Europe
- Fertilisers: Micronutrient fertilisers (e.g nano-nutrients)- 450 companies in Europe, Microbes replacing nitrogen fertilisers e.g. Azotic Technologies Ltd

7

Azotic Technologies Ltd

- Established in 2012
- Purpose - to develop and commercialise the opportunity offered by the plant intracellular colonisation of crops by a strain of nitrogen fixing bacteria – *Gluconacetobacter diazotrophicus* (Gd)
- Commerialisation based on the research of Prof Ted Cocking at Nottingham University
- R&D Laboratories at BioCity Nottingham with a team of 24 scientists and technical staff

Efficacy of Intracellular Colonisation - Validation

Staple food crops: Wheat, maize and rice



Oilseeds:
Oil seed rape
Oil Palm

Every crop species evaluated with N-Fix Successfully colonised by Gd!

Commodity crops:
Tea, cotton and coffee

Forage crops:
Pasture grass, white clover, silage maize

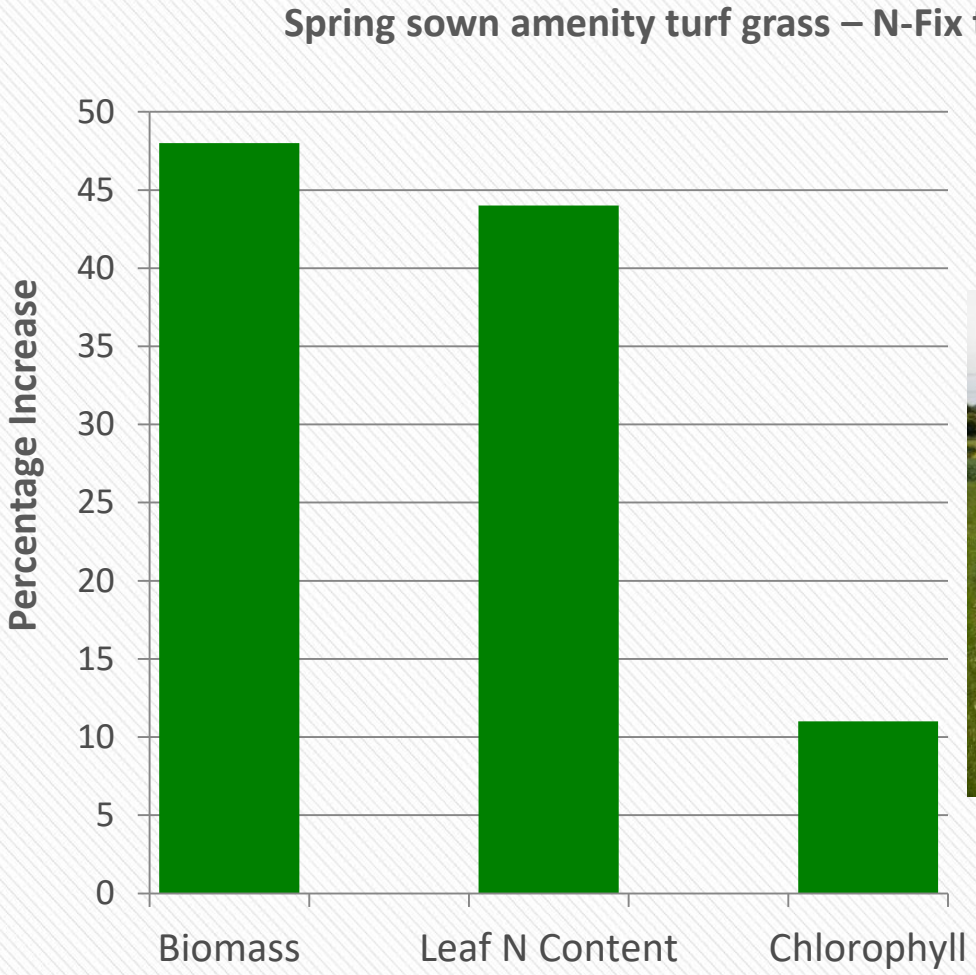


Horticultural crops:
Tomato and potato

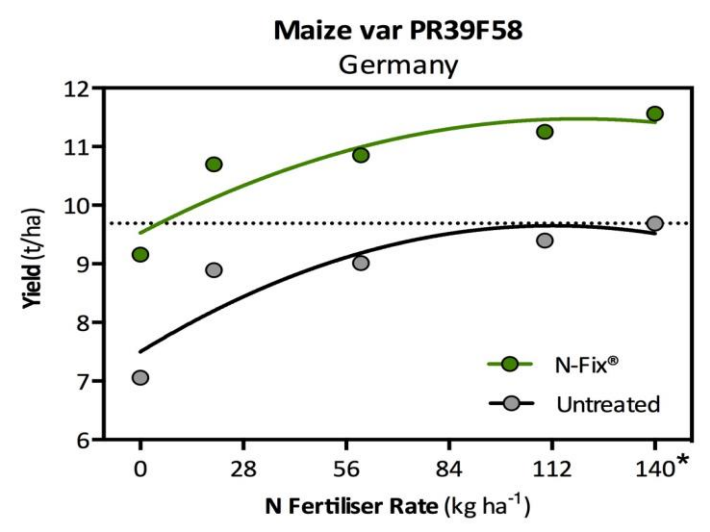
Ornamental and amenity:
Turf grass

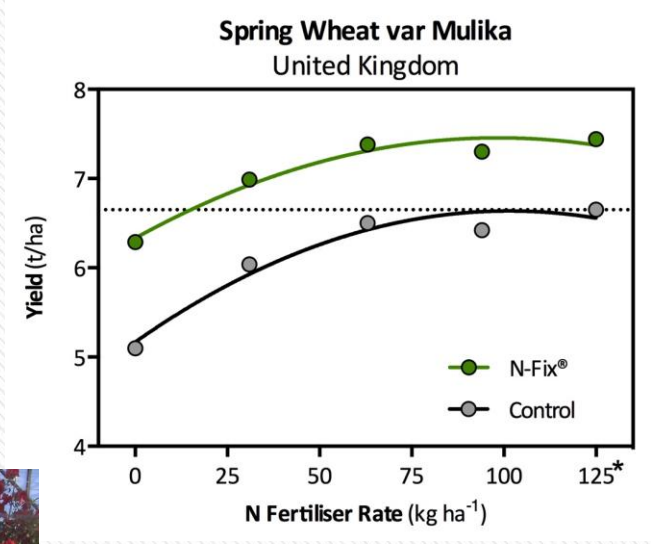
azotic

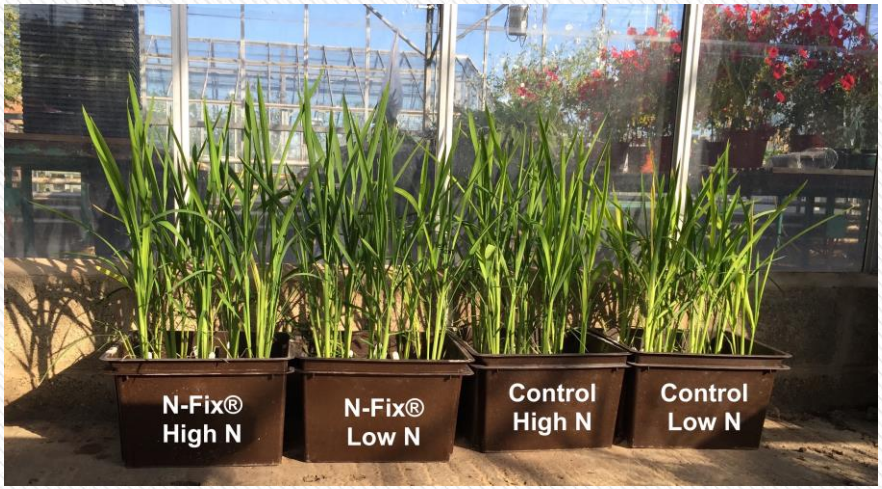
N-Fix in the Absence of Additional N Fertiliser



Yield and Fertilizer Benefits







Implications of Azotic N-Fix Technology on the Agriculture Carbon Problem

- Potentially applicable to every major agricultural row crop … globally!
- Reduction of nitrogen fertiliser use from between 25% - 85% of recommended rates
- Potential implications for nitrous oxide reductions in the UK alone are 13MTCO_2e.
- Global potential for agricultural nitrous oxide emissions are immense.

12

Conclusions

- Agriculture is a major contributor to greenhouse gases particularly methane from livestock and nitrous oxide from nitrogen fertiliser
- The apparent dominance of the agriculture input companies belies a more complex structure of SMEs that are offering innovative sustainable solutions for agriculture
- Solutions are possible in plant and animal breeding, animal feeds, micro-nutrition for plants and use of microbes to replace chemical pesticides and fertilisers
- By way of example Azotic Technologies Ltd has the potential through innovation to reduce nitrous oxide emissions for agriculture on average by ca. 50%.

Thank you

www.azotictechnologies.com
david@azotictechnologies.com