Breeding & Biotech to meet Agricultural and Cropping System Challenges

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Answer is

Plant Breeding has and will continue to be a significant factor in meeting Agricultural and Cropping System Challenges

Definitions/Parameters

- ***Agricultural vs Cropping System Challenges***
- ***Self-pollinated crops***
- ***Breeding is a discipline***
- ***Biotech is not!!*** – **just a set of new tools**

Challenges

- ***Thomas Lupton DG CIMMYT***

"Bring science back to Agriculture"

- ***Which way to interpret?***

Ag Science vs Science

- ***Nobel Prize vs Better for Farmers/Ag Industry***
- ***PBI vs CDC/Plant Sciences***
  - **AAFC????**

- ***Optimist or Realist??***

Who are breeder's customers?

- ***Producers***
  - ***must be profitable***
  - ***env't, quantity & quality interest***
- ***Processors/handlers***
  - ***must be profitable***
  - ***quality only interest***
- ***Regulators***
  - ***public good & safety – producer - processor – consumer balance***

Who are breeder's customers?

- ***Consumers/end-users***
  - ***public good***
  - ***quantity, quality and env't interest***
  - ***won't really pay but must***
    - **Political choices**
  - ***Int'l vs Domestic/ Hungry vs overfed????***

Sustainable Crop System??

- ***Economic***
- ***Environment***
  - **Farm level**
  - **Macro level**
    - *National/Global*

Economic

- ***Marketability***
  - **Physical and chemical quality**
  - **Differentiation**
  - **Premium quality**
    - *Critical for western Canada*
- **Cost of Production**

Quality

- ***Significant breeding success over past 30+ years***
- ***Canola example***
- ***Not exclusively genetic***
  - ***manipulation of environment via agronomy***
  - ***<u>physical</u> engineering re production and processing***
- ***Need to work together but as in Canola case often started by innovation at breeding level***

Environmental/Production Cost

- ***Production – Yield***
  - **Light/energy – unlimited**
  - **Water – big problem!**
  - **Env't – growing season and temp (especially night temps)**
    - **Reality of western Canada**
    - **C3 vs C4 etc.**
- **Not all about simply inherited herbicide tolerance!!!**
- **Rude awakening to come for BioTech Artistes!!**

Definitions/Parameters

- ➔ ***Breeding is a discipline***
- ➔ ***Biotech is not!!*** – **just a new set of tools**
  - ➔ **Small plot equipment**
  - ➔ **Computers**
  - ➔ **Quality screening tools like NIR, LECO……**

Definitions/Parameters

Breeding has been HIGH-JACKED by Biotech's

BIO-BULLSHIT!!!

Definitions/Parameters

➔ ***Who remembers***

“Somoclonal variation”

Challenges

- ***Gen eng / genomics saviour concept***
  - ***Deliberate or inadvertent snow job??***
  - ***Industry and government leaders misled***
- ***Public & Private management - unrealistic time frames***
  - ***popular press misleading***
  - ***biotech claims misleading***
    - **Important tool(s), but JUST a tool!!!**
    - **Where are the results?**
    - **Still plant breeding**

Challenges

- ***Australian drought tolerant wheat BioBullshit example!!***
  - ***Can't grow wheat without water!!***
  - ***Drought treatment > than our annual precip!!!!***
- ***Corn vs wheat yield***
  - ***More efficient or just able to use more H20 and nutrients which happen to be available in an env't that can support it ???***
- ***Nitrogen fixing cereals***
- ***Biology and time!!***

Challenges

- ***Application of new technologies/tools***
  - ***Just new tools – still have to do the breeding – thus adding cost????***
  - ***Often very expensive – justification??***
    - **What if old methods had those human and capital resources????**
    - **AU low phytate barley screening example**

Challenges

- ***Biology is about Compromises***
  - ***No free lunch***
  - ***All about carbon chains***
  - ***Only so many C atoms to go around!!***
  - ***Can't have > 100%***
  - ***Only so many inputs to go around!!***
  - ***Can't use > 100%***
  - ***Only so much "biological time" per day & per season***
  - ***Can't have more – espec W. Canada***

Challenges

- ***Confidentiality vs Public Good***
  - ***Pre-competitive aspects of R&D***
  - ***Confidentiality drives private investment***
  - ***Investment drives innovation or does innovation (often public) drive investment??***
- ***Conflict - public and private objectives??***
  - ***Both want innovation but one needs significant +ve cash profit***
  - ***Private may have to overstate potential to get investment = RISK.***
  - ***Public organizations/scientists forced in same trap***

Canadian Challenges

- ***Big Science***
  - ***Admin overload***
  - ***Control & credit without responsibility***
- ***Clusters!!!!***

Canadian Challenges

Cluster Bombs!!!!

Challenges

- ***Breeding is technical – but key is to understand the crop and how to apply the science efficiently – not force it upon the plant.***

- ***Public and corporate and government leadership does NOT understand basic biology let alone plant biology or production agriculture thus very susceptible to BioBullshit.***

Breeding per se

- ***All about creating/finding variability, phenotyping, selecting, combining and cutting corners.***

- ***New tools (Biotech) offer great Opportunity***
  - ***will allow/assist us to cheat and sort better and combine faster – but at what cost?????***

Challenges/Opportunities

- ***Genetic variability***
  - ***Is it there? Create it? Searching……***
  - ***Can we measure it? = Phenotyping***
- ***TILLING***
  - ***Mutagenesis***
  - ***Germplasm collections***
- ***Regulatory issues***
  - ***Canadian regulations!!!***
    - **"Sky is falling attitude"**
    - **Novel feed/food and PNT definitions……**

Opportunities

- ***Molecular mapping***
  - ***DArT, QTL, Association, SNPs***
- ***Improved phenotyping***
  - ***via better direction***
- ***Join phenotyping with DArT/QTL mapping***
  - ***Different for publication vs application***
  - ***E.g. TDF - MMAS may be help for initial screening***
  - ***Lots of "Ifs" but worth effort & cost***
- ***Better Parent selection***

Challenges - Phenotyping

All measurements are MARKERS – some are better than others

NOT invented by Biotech!!

➔ ***Genotyping has leapt forward but phenotyping has not***

➔ ***Most critical need***

➔ ***Need rapid inexpensive evaluation of large numbers of small samples***

- **Examples – NIR, Megazyme kits etc.**

Data integration

Now what the hell do we do with it ?

- ***Creating huge (unmanageable?) data sets***
- ***Bioinformatics***
  - ***Not the total answer***
  - ***Computer cannot understand biological/economic realities***
  - ***MUST use the "integrator" between your ears***

Answer is

Breeding has and will continue to be one of a number of positive contributing factors in meeting Agricultural and Cropping System Challenges using all the affordable tools available.

"Optimistic Realist"