Private sector issues:

- Survive, grow, be profitable
- Translate R&D into commercial activity
- Drive market share, product penetration but maintain margin

- Difficulty in predicting the future
  - Choice of target food, biofuel crops
  - Choice of traits
  - Market access

- Partnerships or go it alone?
Funding R&D is *always* an issue

- Big Ag: 7.5-10% of turnover re-invested in R&D
- Early-stage companies: 100% and still not enough

- 9.1 years to Ag Chem commercialization
  Same or more for crop biotech products

- If transformation of Ag is going to be achieved through Research and Innovation, who is going to do it?
  - Innovation ≠ products
# GM crop development – funding issues

<table>
<thead>
<tr>
<th>Duration</th>
<th>Stage in Development</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 5 yrs</td>
<td>Gene Discovery</td>
<td>Discovery Research</td>
</tr>
<tr>
<td>1 – 2 yrs</td>
<td>Trait Optimization</td>
<td>Proof of concept</td>
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<tr>
<td>1 – 2 yrs</td>
<td>Proof of Concept in Model Plant</td>
<td>Crop PoC</td>
</tr>
<tr>
<td>1 – 2 yrs</td>
<td>Early Event Testing/ Development</td>
<td>Crop Development</td>
</tr>
<tr>
<td>5 – 8 yrs</td>
<td>Field Trials, Breeding, Reg. Approval</td>
<td>Commercialization</td>
</tr>
<tr>
<td>2 – 3 yrs</td>
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</table>

“Innovation” funds, Genomics programs, etc.

Large funding gap
- long-term, tedious
- rewards?

Business-driven or public good

From McElroy, Nat Biotechnol, 2003
Traits: is crop productivity still a focus?

- Yes!
- Farmgate crop receipts still primarily based on yield
- Most traits in pipeline address yield
  - HT, IR, drought tolerance, etc.
- However, quality traits are also important
  - Nutrition traits: high-lysine corn; Vistive™ soybeans; Nexera™ canola, etc.
  - Biofuel-related traits: oil profile, starch and cellulose degradability
Performance Plants Inc. trait pipeline

- Major traits:
  - Drought tolerance (YPT™)
  - Heat tolerance
  - Water use efficiency
  - Biomass enhancement (whole-plant)
  - Seed size enhancement

- Most traits in pipeline address yield, but looking at other opportunities
Food vs. fuel R&D

- Investment bubble – biofuels are hot
- Huge opportunity in biofuels may remove investment from conventional food/feed crop R&D
- New crops, new technologies, new business models needed
- Government policies will play a big role
GM crop vs. pharmaceutical development

R&D pipeline for an ag biotech (GM) product

R&D pipeline for a pharma biotech product

From McElroy, Nat Biotechnol, 2003