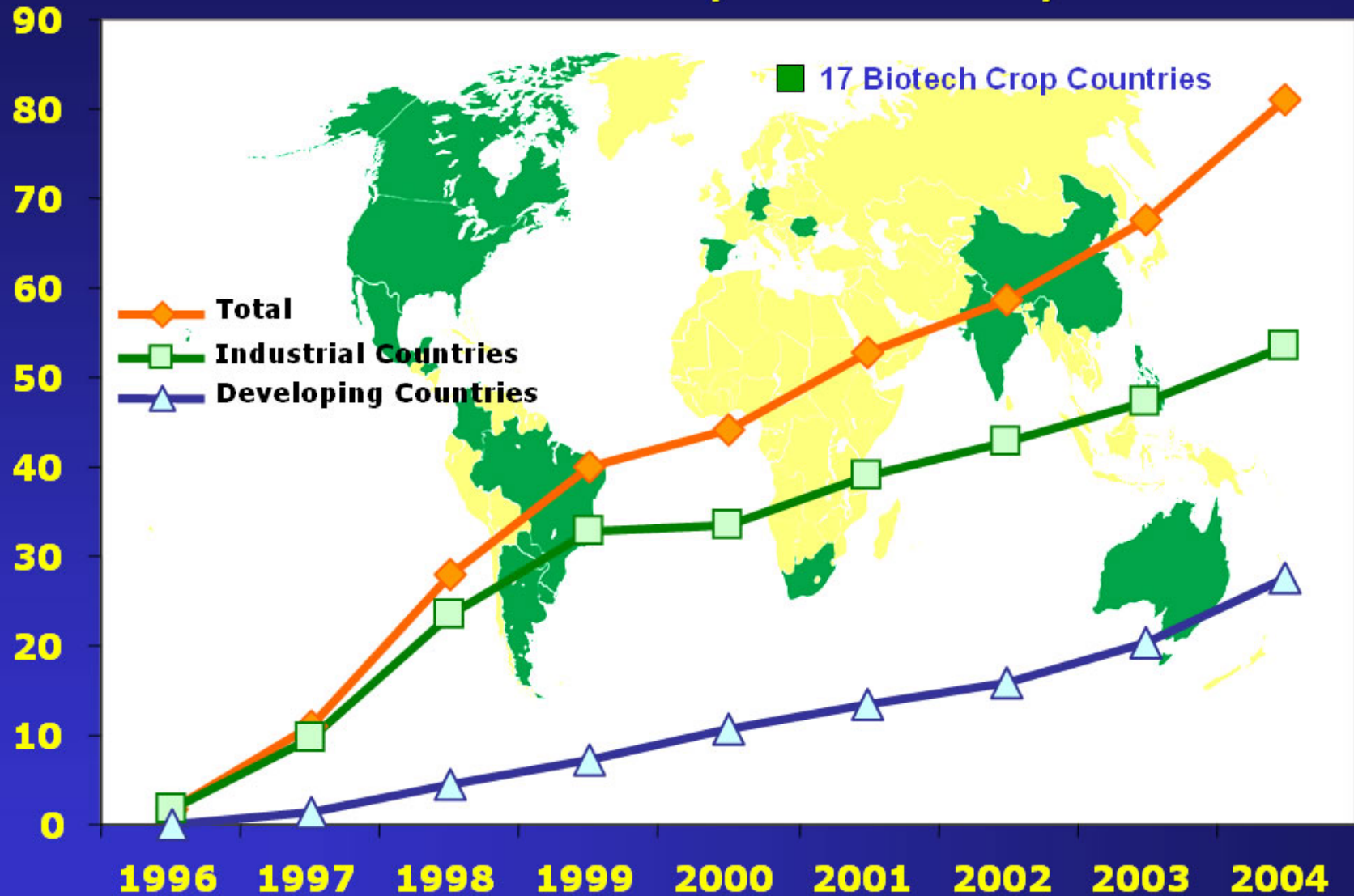


What's in the Biotech- Wheat Pipeline

Joel Ransom
NDSU – Extension
Agronomist



Global Area of Biotech Crops Million Hectares (1996 to 2004)



Increase of 20%, 13.3 million hectares or 32.9 million acres between 2003 and 2004

Source: Clive James, 2004

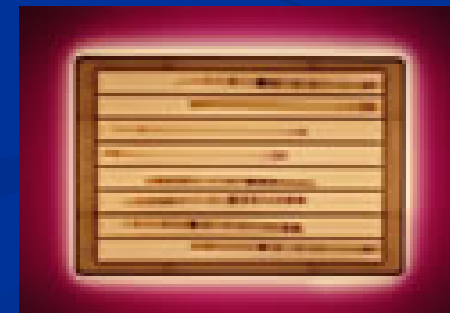
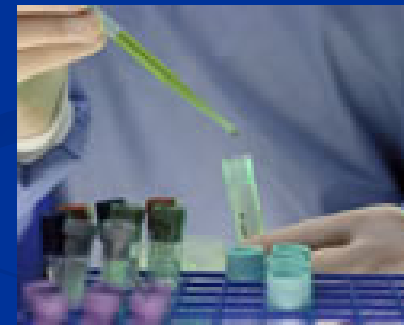
Biotechnologies used in crop variety development

- Marker assisted selection
- Tissue culture and embryo rescue
- Double haploids
- Genetic engineering or GM crops
- Genomics



Transformation process

- Isolating the DNA of interest
 - From virtually any living organism
- Gene cloning
 - Selecting DNA sequence
 - Gene design – promoters
- Transformation
- Backcrossing



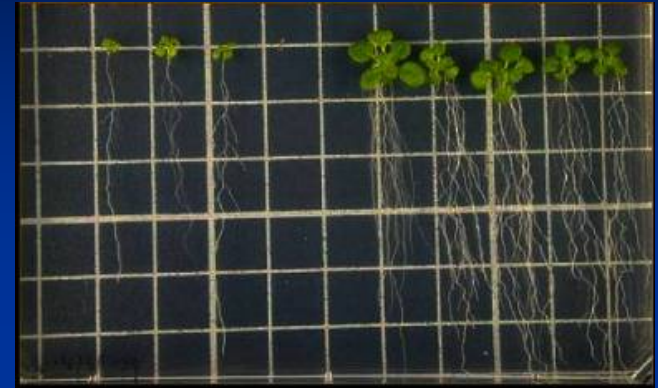
Dominant Biotech Crops, 2004

	Million Hectares	% Transgenic
Herbicide Tolerant Soybean	48.4	60
Bt Maize	11.2	14
Bt Cotton	4.5	6
Herbicide Tolerant Maize	4.3	5
Herbicide Tolerant Canola	4.3	5
Bt/Herbicide Tolerant Maize	3.8	4
Bt/Herbicide Tolerant Cotton	3.0	4
Herbicide Tolerant Cotton	1.5	2
Total	81.0	100

Source: Clive James, 2004

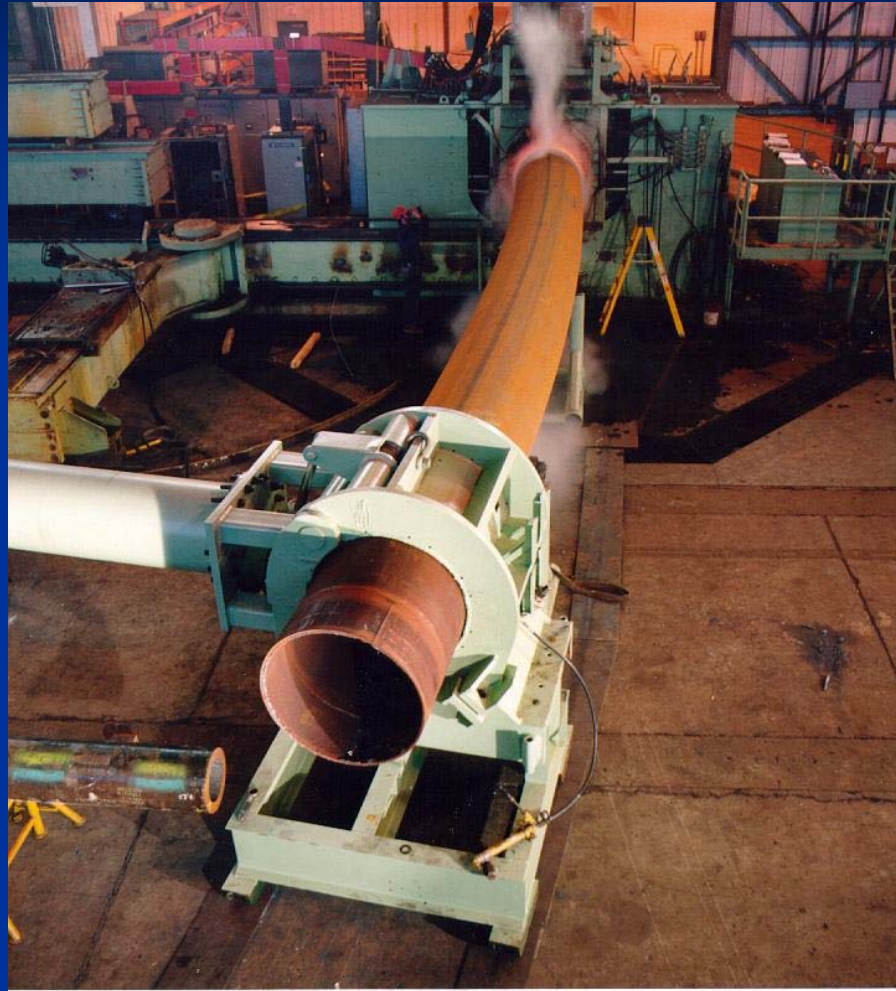
Biotech traits in the pipeline in other crops

- Nitrogen utilization efficiency
 - Gene from *Arabidopsis*
- Soybeans with high oleic oil
- Soybean oil with high Omega-3 fatty acid (Monsanto)
- Corn with improved phosphorous availability
- Golden rice



Filling the wheat biotech pipeline

- Traits developed for other crops (i.e. RR)
- Novel traits specific to problems of wheat



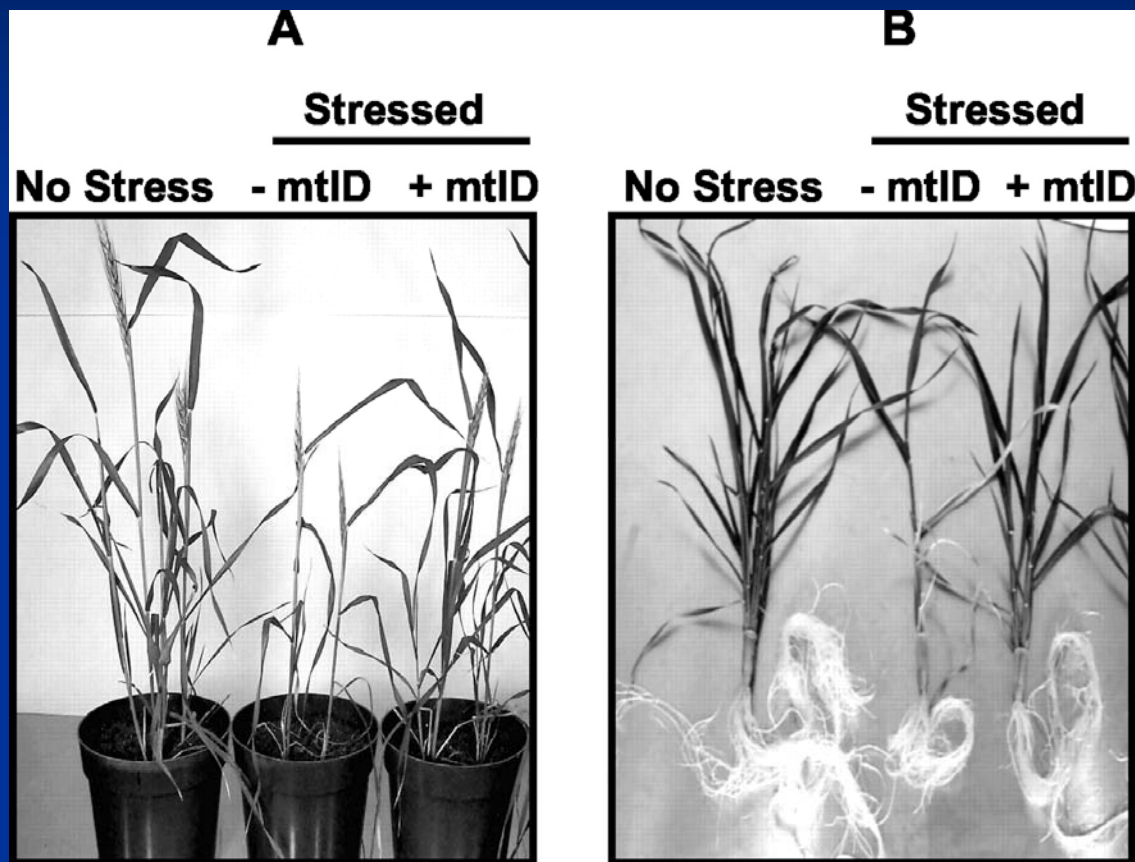
Biotech wheat traits in the pipeline

Drought Stress

- Gene from *Arabidopsis* (Mexico)
- Gene from barley (Egypt)
- Gene from bacteria (increases specific sugar - Cornell)
 - Some testing of trait has been conducted in ND



Water and salinity tolerance with mannitol-accumulating gene



Abebe et al., Oklahoma State University, 2003

Scab resistance

- Developed by Syngenta
 - Field testing stage
 - Could be available in 2011?
 - Some field testing in ND in 2005
- Developed by public groups
 - Some field testing conducted in 2005 in ND.



Restriction to the movement of products through the pipeline

- Consumer acceptance
- High cost of regulatory approval



Conclusions

- Biotechnology has improved efficiency of plant breeding
 - Tools (i.e. double haploids, marker assisted selection) routinely used in NDSU breeding programs
- Genetic engineering offers novel and rapid means of improving crops that has positively impacted other crops
- Several biotech traits in wheat are being evaluated
- Lack of consumer acceptance and high development costs constrain movement in the pipeline