



# GE AS A POTENTIAL SOLUTION TO BIOSECURITY THREATS IN AGRICULTURE



10<sup>th</sup> Annual Forest Biosecurity Workshop, 29-Feb-12  
Innovative Solutions for Biosecurity Problems – does GE have a role?

## GE: one size doesn't fit all any more!

- First 15 years – predominantly control of pest plants and pest insects in rowcrop or high-cultivation systems



- Next:
  - More traits (including customer and environmental benefits)
  - More crops (including local, boutique, market-specific)
  - More countries (not just transnational companies)
  - More targeted (e.g. RNAi, zinc finger nucleases)
  - More responsive to some consumer needs (e.g. cisgenics/intragenics)
  - More options (e.g. GM rootstocks, GM-for-organic combinations)



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## Biosecurity context

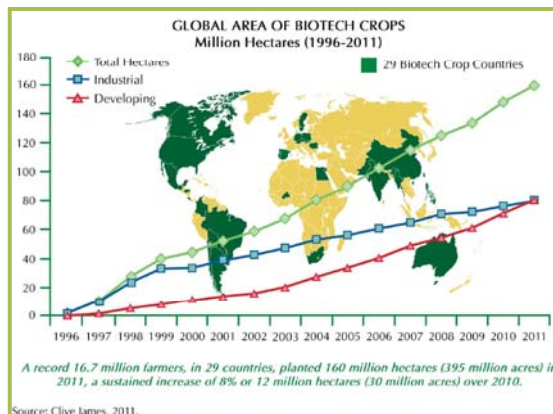
- Response to the threat of:
  - Plants that are pests (few GE solutions)
  - Pests that threaten plants (GE solutions)
  - Diseases that threaten plants (GE solutions)
- Threats to existing agricultural base are to continuity of supply (of food, textiles, biomaterials, and increasingly biofuels)
  - And the sustainability of sustainability
- Yield losses due to insects worldwide 30% (usually invasive species)
- Need defence traits in existing varieties



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## GE in agriculture: global context

- Last year, global GE acreage grew by more than the area of the North Island
- GE was planted on  $\frac{1}{30}$  of global agricultural land
- Less tillage, reduced pesticide use, more farmer profit, greater security of supply



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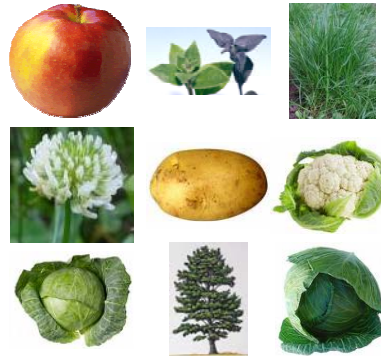
# GE in agriculture: NZ context

## Here

- Imports
  - 54 events in 8 species approved for food use
  - New cotton and soy approvals in 2011
- Trials
  - Petunias (1998)
  - Sugar beet (1999)
  - Potato x 2 (1998)
  - Onion (2003)
  - Brassicas (2007)
  - Radiata pine (today)



## Ongoing work in NZ\*



\*Subject to regulatory and market approvals



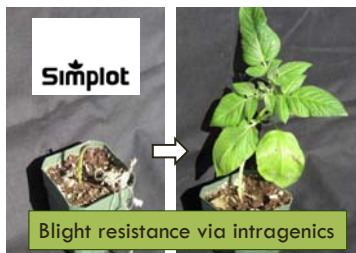
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# GE example

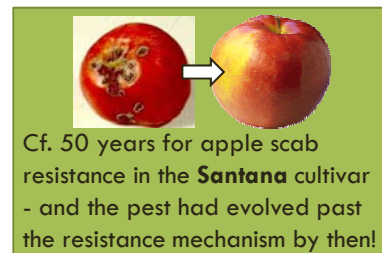
- Potato is intensively chemicalized worldwide
- Huge problem of linkage drag of legacy traits from undomesticated potatoes



**Toluca and Bionica** non-GE varieties took 37 years of introgression breeding



Blight resistance via intragenesis



Cf. 50 years for apple scab resistance in the **Santana** cultivar - and the pest had evolved past the resistance mechanism by then!



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# More GE examples

## Insect resistance in cotton

- ~80% global cotton: US, CN, AU, AR, IN, BR, MX, SA, CO, BF
- Massive reductions in pesticide use (↓77% in China)
- US\$2.9bn gain (65:35 ↑yield vs ↓costs)
- Less tillage, more C sequestration, less C use (344Mkg CO<sub>2</sub> equiv.)
- Huge success story: 0.5% of agricultural land; your clothes

## Virus-resistance in papaya, squash, melon, and clover

- Now approved for fresh-fruit consumption in Japan
- More details in Dr Walter's presentation

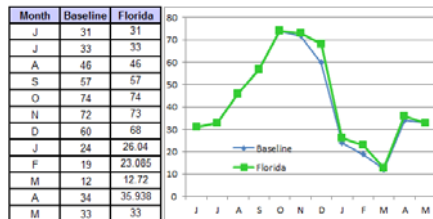
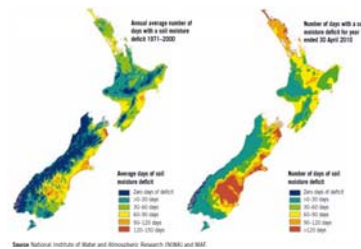


Brookes & Barfoot (2010)  
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# If the answer is GE, what was the question?

## “How can we farm sustainably and productively?”

- Sustainability needs
  - ▣ ~30% yields worldwide currently lost to pests
  - ▣ Globally, humanity need 6-30% more food per land unit (Future of Food & Farming report, 2011)
  - ▣ Impending inevitable climate change



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## If GE is the answer, what was the question?

- Economic gains:
  - Sustainable intensification
  - Globalization and falling costs of production in low-GDP competitors
  - Efficiencies available by combining best approaches
  - Flattening or shrinking organics premiums

The top 100 questions of importance to the future of global agriculture

Jules Pretty<sup>1</sup>, William J. Sutherland<sup>2</sup>, Jacqueline Ashby<sup>3</sup>, Jill Auburn<sup>4</sup>, David Baulcombe<sup>5</sup>, Michael Bell<sup>6</sup>, Jeffrey Bentley<sup>7</sup>, Sam Bickersteth<sup>8</sup>, Katrina Brown<sup>9</sup>, Jacob Burke<sup>10</sup>, Hugh Campbell<sup>11</sup>, Kevin Chen<sup>12</sup>, Eve Crowley<sup>13</sup>, Ian Crute<sup>14</sup>, Dirk Dobbelaere<sup>15</sup>, Gareth Edwards-Jones<sup>17</sup>, Fernando Funes-Monzote<sup>18</sup>, H. Charles J. Godfray<sup>19</sup>, Michel Griffon<sup>20</sup>, Phirek Gypmantisir<sup>21</sup>, Lawrence Haddad<sup>22</sup>, Siosua Halavatau<sup>23</sup>, Hans Herren<sup>24</sup>, Mark Holderness<sup>25</sup>, Anne-Marie Izac<sup>26</sup>, Monty Jones<sup>27</sup>, Parviz Koohafkan<sup>28</sup>, Rattan Lal<sup>29</sup>, Timothy Lang<sup>30</sup>, Jeffrey McLeese<sup>31</sup>, Alexander Mueller<sup>32</sup>, Nicholas Nisbett<sup>33</sup>, Andrew Noble<sup>34</sup>, Prabhu Pingali<sup>35</sup>, Yvonne Pinto<sup>36</sup>, Rudy Rabbinge<sup>37</sup>, M. H. Ravindranath<sup>38</sup>, Agnes Rola<sup>39</sup>, Niels Roling<sup>40</sup>, Colin Sage<sup>41</sup>, William Settle<sup>42</sup>, J. M. Sha<sup>43</sup>, Luo Shiming<sup>44</sup>, Tony Simons<sup>45</sup>, Pete Smith<sup>46</sup>, Kenneth Strzepeck<sup>47</sup>, Harry Swaine<sup>48</sup>, Eugene Terry<sup>49</sup>, Thomas P. Tomick<sup>50</sup>, Camilla Toulmin<sup>51</sup>, Eduardo Trigo<sup>52</sup>, Stephen Twomlow<sup>53</sup>, Jan Kees Vis<sup>54</sup>, Jeremy Wilson<sup>55</sup> and Sarah Pilgrim<sup>1</sup>

36. *What practical measures are needed to lower the ideological barriers between organic and GM, and thus fully exploit the combined potential of both GM crops and organic modes of production in order to achieve agroecological management practices compatible with the sustainable intensification of food production?*

Pretty et al. (2010) International Journal of Agricultural Sustainability 8(4): 219-36



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## Competitive application of GE in stock agriculture

### Australia

- Current GE stockfeeds:
  - Domestic GE cottonseed and canola meals
  - Imported GE soybean and canola meals
  - GE canola stubble
- Flowering clover field trials 1997-2002; ongoing clover field trial since 2003/04 (open flowering since 2008/09); ryegrass trials since 2007/08
- Post-release conomic evaluation shows no market access problems or loss of economic gains

### New Zealand

- Current GE stockfeeds:
  - No domestic production of GE plants in NZ
  - Several events dual-approved for food and feed import
  - No GE forages
- No field trials of forages whatsoever
- Data-free debate over potential market access problems, import restrictions, and effects on export profitability



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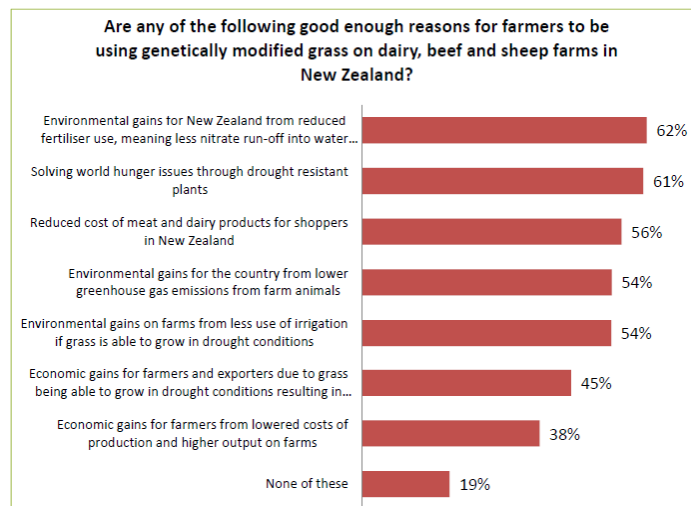
## Caveats, risks, unknowns for NZ

- GE is just one part of the overall solution
  - Not a silver bullet
- MAS very important but...
  - requires multiple breeding generations, accessible resistance mechanisms, pliable genetics, manageable genomes, proven utility in outcrossers, etc
- Risks, both perceived and real...
  - Dangers to food consumers – none shown after 16 years of use and consumption; methods-based regulatory regimes treat GE differently from traditional plant breeding products
  - Opportunity costs – offset by gains, magnified by naysayers
  - Dangers to marketing and the NZ brand – see next slides and Professor Knight's presentation
- Legal impediments – see Geoff's talk

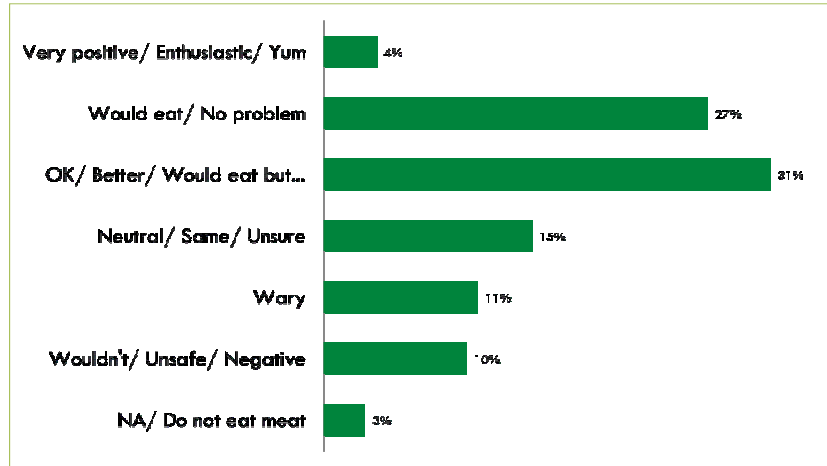


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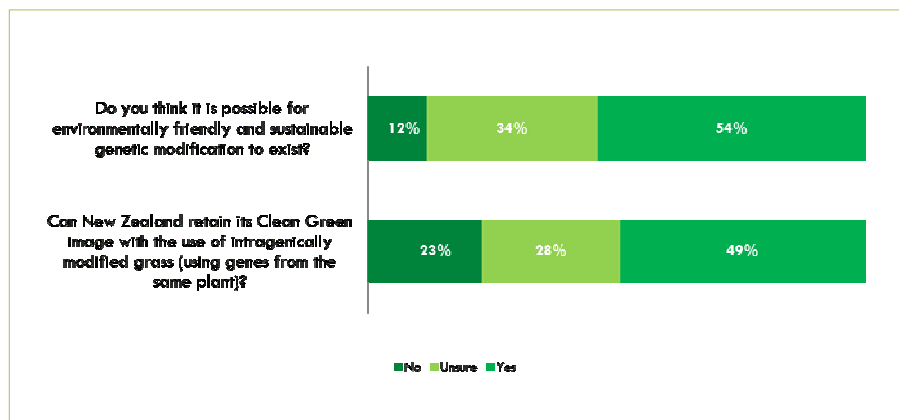
## Are any of the following reasons for farmers to be using genetically modified grass on farms in New Zealand?



2011: How would you feel about eating a steak from cattle that had grazed intragenic pasture modified to reduce its environmental footprint?



## Sustainability and Clean Green Image



# Thank you



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