

Crop genetic improvement technologies for sustainable agricultural innovation

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with input from

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Global agricultural and societal challenges

- Food security – in the face of population growth, changing consumption patterns, climate change (mitigation and adaptation), social and economic instability (urbanisation)
- Sustainable balance of supply and demand
- Avoiding further loss in biodiversity
- Degraded agricultural land (ca. 25% globally)
- 60% more production over next 40 years (on same land area)
- Additional demand from the bioeconomy – livestock feed, renewable energy and chemical feedstocks

Innovation Union ?

All paths to innovation should be examined.



Source: <http://innovationsmanagement.ideeologen.de>

Project/Report “Planting the Future”

Aims

- To explore implications for EU policy-making of alternative strategic choices in utilising crop genetic improvement technologies for sustainable innovation of agriculture
- To compare what is happening in other economies who have adopted GM crops more actively
- To collaborate with African experts in agricultural biotechnology to evaluate how previous EU policy debates have affected African countries
- To examine multiple EU issues for regulatory reform: science base, public engagement, intellectual property, new environmental challenges, other applications in the bioeconomy

Endorsement of the report



*Anne Glover, Chief Scientific Adviser to the
President of the European Commission*

“The ‘Planting the Future’ report of the European Academies’ Science Advisory Council (EASAC) is an authoritative, joint statement of the national science academies in the EU Member States.”

“The conclusions of the report are based on the best possible evidence and I endorse its conclusions whole-heartedly.”

“There is no evidence that GM technologies are any riskier than conventional breeding technologies and this has been confirmed by thousands of research projects.”

“Finally, we shouldn't forget that there are also other promising novel plant breeding technologies, post-GM, and we shouldn't make the mistake of regulating them to death as we have done with GM.”

*Interview at
<http://www.euractiv.com>*

Scope of “Planting the Future”

- Started as work on the issue of „GM crops“ but decision was taken to broaden the scope
- Current debate on New Plant Breeding Techniques (NPBT): including 8 new technologies (regulation?), excluding GM technology (regulated)
- Report’s definition: Crop genetic improvement technologies including NPBT (as defined), GM technology, and other emerging technologies

Techniques that crop breeders use to create new plant varieties: GM & NPBT (1)

- ***Transgenesis (GM)***: transfer a gene (DNA coding region) from another organism.
- ***Cisgenesis***: transfer a gene to a plant of the same or closely-related species (inter-fertile).
- ***Intragenesis***: insert a reorganised, full or partial gene derived from the same species (usually combined with a promoter or terminator from another gene of the same species).
- ***Targeted mutagenesis***: specific mutation produced by a Site Directed Nuclease (SDN) technology.

Techniques that crop breeders use to create new plant varieties: GM & NPBT (2)

- *Transient introduction of recombinant DNA*: mutations directed by **oligonucleotides** or **infiltration techniques** give rise to end products that can be similar to, and indistinguishable from, plants derived through conventional plant breeding.
- *Other techniques*: **RNA-induced DNA methylation** (gene silencing) and **reverse breeding** -> intermediate products are genetically modified but end products are indistinguishable from plants obtained through conventional breeding. **Grafting** a non-genetically modified scion onto a genetically modified rootstock -> chimeric plant where only the lower part carries the genetic transformation.

Recent OECD workshop: Conclusions

- Risk assessment principles apply to any new plant variety, regardless of techniques used in development
- Product is the focus; expressed phenotype(s)
 - **Not** regulatory trigger
 - **Not** technique
- Technique may be useful in product characterisation
- No new safety issues identified for new breeding techniques
- Can a simplified assessment be done in certain cases?

OECD Workshop on Environmental Risk Assessment (ERA) of Products Derived from Novel Plant Breeding Techniques (NPBT), 10 February 2014, Paris

Case studies from comparator countries: Specific focal points

- Impact of GM herbicide-tolerant soybean in Argentina
- Socio-economic impact of Bt cotton in India
- History of developments in Bt cotton in Australia
- Trends in GM research in Brazil
- Regulatory system for plants with novel traits in Canada



Case studies:

Emerging cross-cutting issues

- Export of agricultural commodities is increasingly part of economy of competitor countries. One consequence is stimulus to basic science and innovation.
- Vital to distinguish between any specific effect of a technology and consequences of other changes in agronomic practice and social developments.
- Increasing volume of evidence to document benefits of GM crops. GM technology itself has no greater adverse impact than any other technology used in plant breeding.
- Streamlined, transparent, effective regulatory frameworks can be devised that encourage investment and innovation – must focus on product/trait rather than on technology.

Analysis of connections between EU and African agriculture by Science Academies

- Involved academies from 13 African countries; case-studies from Ghana, Uganda, Tanzania and Kenya
- Evidence shows that EU actions historically constrained use of crop genetic improvement technologies in African countries, creating difficulties for farmers, scientists, policy-makers
- Recently, increasing activity in Africa to characterise and cultivate GM crops to address local needs
- Significant opportunities for information-sharing and R&D partnership between EU and Africa to strengthen local systems
- Continuing role for science academies to work together to identify science and technology priorities, strengthen centres of excellence, contribute advice to support policy-making and public debate

Conclusions: what are the strategic priorities for the EU?

- Land use, innovation and productivity
 - The EU is falling behind competitors
 - Biotechnology for crop improvement must be part of response to societal challenges
- Regulation
 - Requires evidence-based framework with firm foundation in sound science
- Promoting competition
 - Stimulating open innovation
- Global context
 - Understanding the wider consequences of EU decisions
 - Tackling policy disconnects between EU domestic objectives and the development agenda

EASAC recommendations (1)

- Public engagement: **“Speak up, stand up, gang up!”** (Anne Glover)
 - Scientific community must articulate consequences of research findings and opportunities for innovation
 - Key role of European Innovation Partnerships (EIP) in agriculture
- Achieving coherence in policy for agricultural innovation
 - For example: integration of GM crop objectives with Integrated Pest Management strategies
 - Reformulating regulatory framework to focus on product/trait; science-based, transparent, proportionate and predictable, taking account of international experience and evidence

EASAC recommendations (2)

- R&D
 - Capitalising on Horizon 2020
 - Attending to infrastructure and training
 - Support for public-private sector collaboration
- International partnerships
 - EU can learn from rest of world about “what works” in regulatory practice and innovation
 - EU must also take into account impact of decisions on others
 - New opportunities for collaboration in research and innovation

In conclusion

- The potential of crop genetic improvement technologies is very significant
- It is urgent for the EU to capture these benefits
- This requires better policy coherence to exploit the research and technologies that the EU was instrumental in generating
- We have collective responsibility to provide and utilise scientific solutions to improve agricultural productivity globally and reduce the adverse impact of agriculture on the environment
- **All available approaches – traditional and novel – must be deployed in the wise application of knowledge to improved agronomic practice**

Thank you very much for your attention



Photo:
Anke
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Those who want the world to continue as it is, do not want the world to continue.