

New modification technologies

A public research perspective

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- 8 departments
- 75 research units
- 1450 researchers
- Services & technology
- From science to societal value
- Public outreach



Biomedical research

- Neurobiology
- Cancer
- Inflammation
- Cardiovascular

Plant research

- Climate adaptation
- Plant diversity
- Innovative crop care
- Sustainable bioenergy
- Crops & health

Structural biology & microbiology

New modification technologies

their relative importance in public research

1. Site directed nucleases

2. Agro-infiltration

Cisgenesis/intragenesis

3. RdDM

ODM

Grafting

Synthetic biology

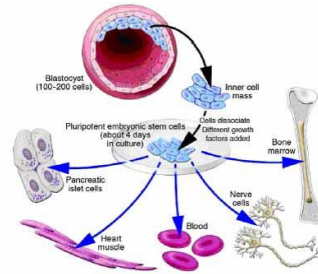
4. Reverse breeding

Genome editing

Genome editing is everywhere



Cell culture



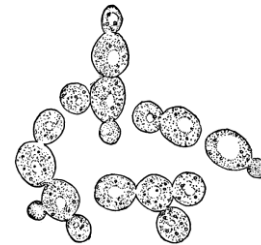
Human



Insects



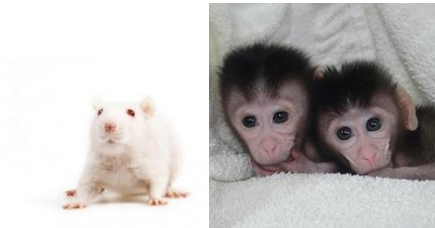
Plants



Micro-organisms



amphibians



Animals



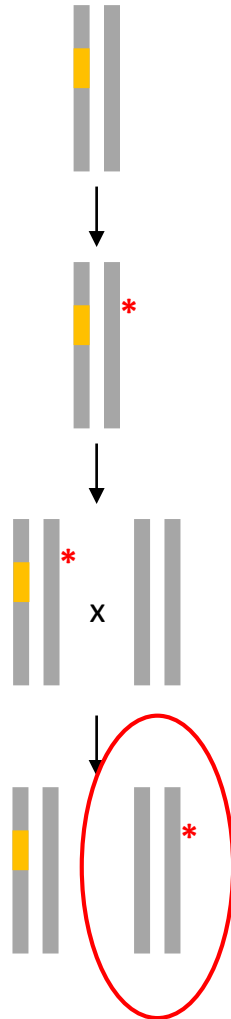
Fish

Some concrete examples

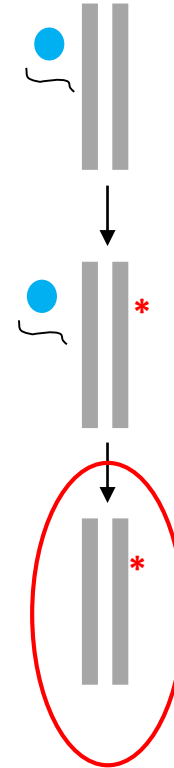
- HIV-resistant white blood cells (CCR-5 gene mutation)
- Yeast in which a mutation is reverted to the wild-type
- Gut organoids with mutations introduced into oncogenes turning them into a carcinoma
- Fungal resistant wheat
- Herbicide tolerant oilseed rape
- Arabidopsis with a mutation in the PsBs gene
- Gene repaired human embryonic stem cells
-
-
- The list is endless.....

In plants: genome edit delivery by *A.tum* or directly

Agrobacterium mediated transformation
(Cas9 + guide RNA gene cassette)



Direct Cas9 delivery
(Cas9 + guide RNA complex)



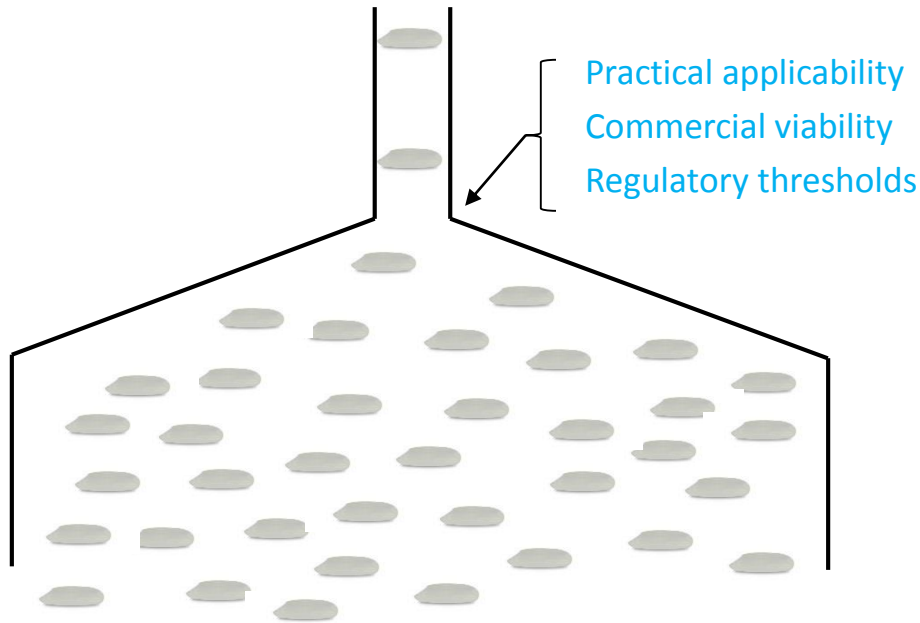
Bulks of additional precision genetic variation



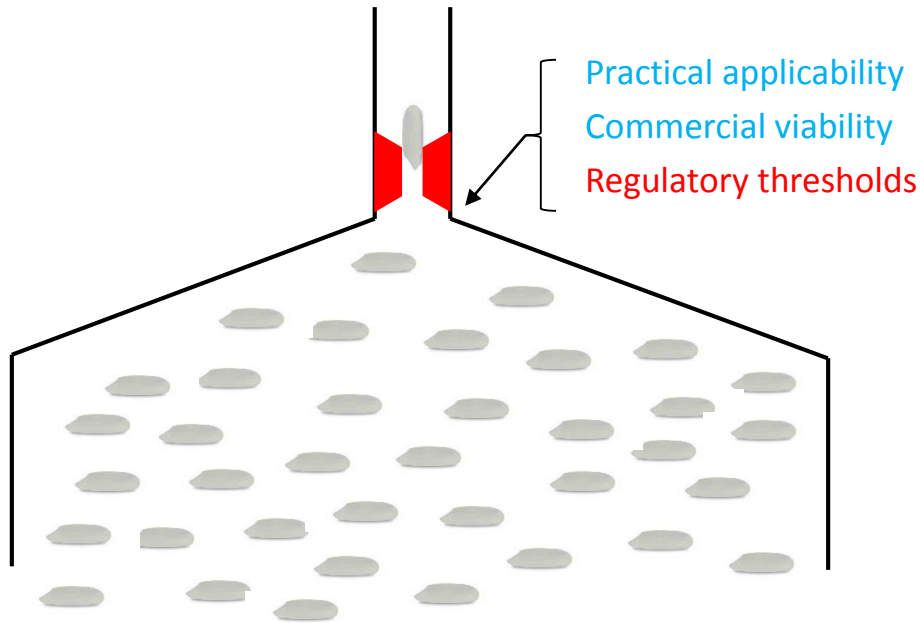
Public research is mostly contained use



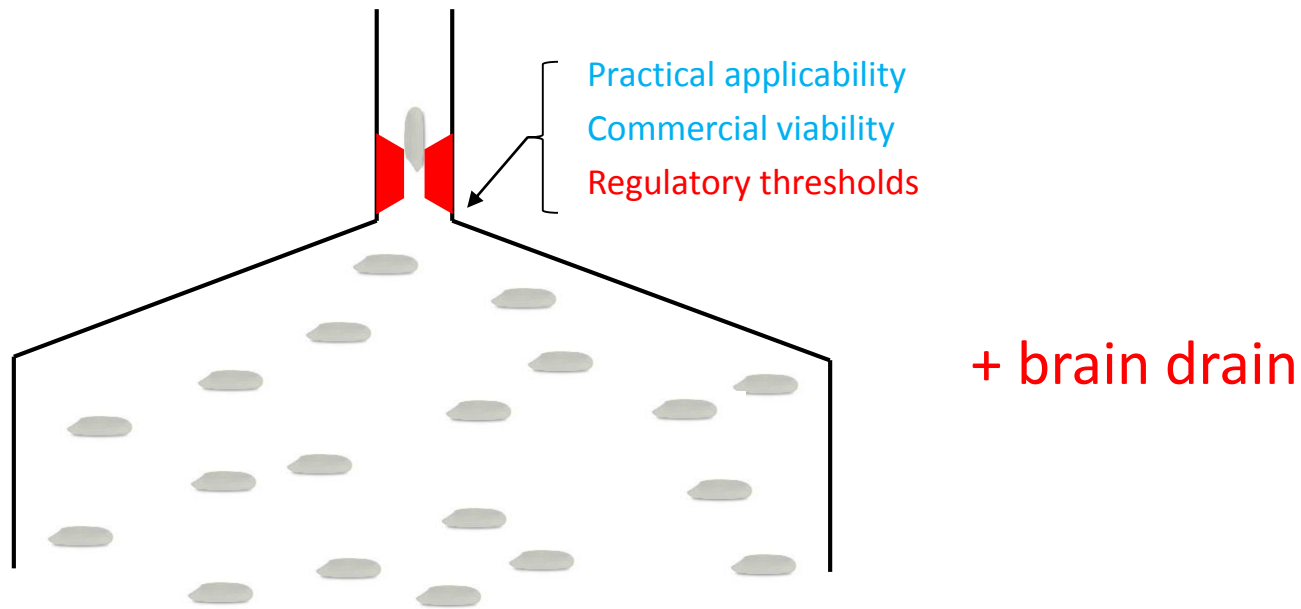
The funnel between public research and commercial application



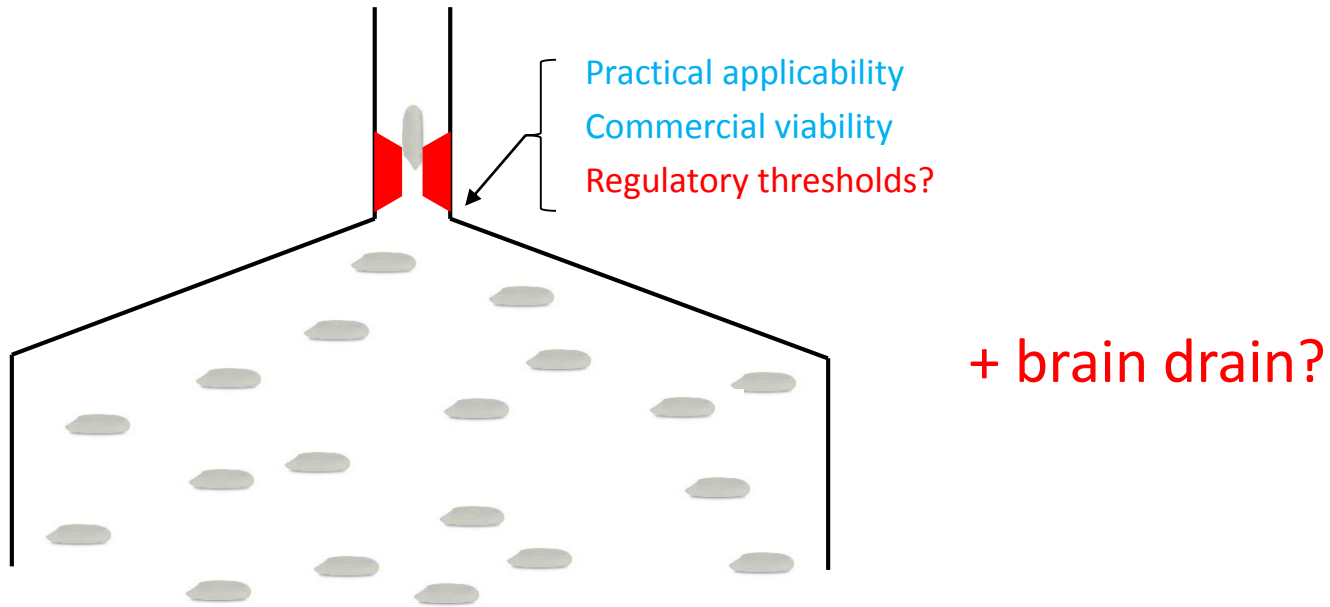
The funnel between public research and commercial application **for GM**



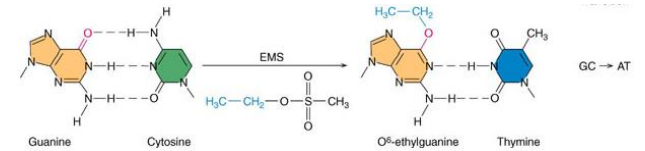
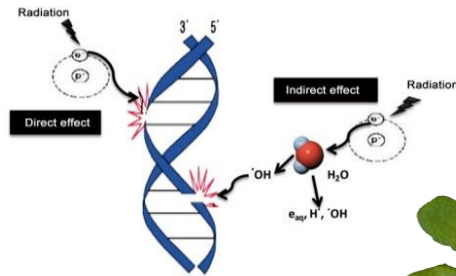
The funnel between public research and commercial application for GM



The funnel between public research and commercial application for NBTs?



The Arabidopsis PsbS mutant



The radiation mutant

A.



B.



The chemically induced mutant

The T-DNA mutant

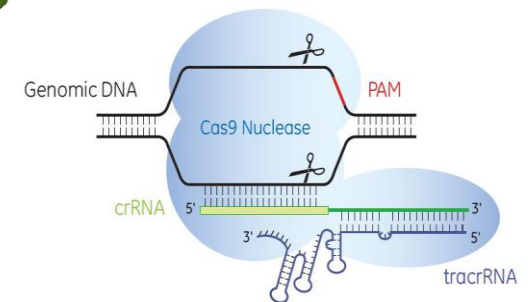
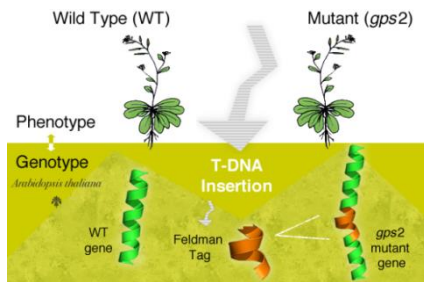
C.



D.



The genome edited mutant



Does technology matter? And how to co-exist?



The negative consequences of a restrictive regulatory regime for NBTs

Table 12. Influence of the decision about the regulation of NBTs as indicated by interviewees.

Low intensity		Postponement of decision		High intensity	
will use	94%	No change in strategy	67%	No change in strategy	44%
will not use	6%	Do research abroad	22%	Do research abroad	33%
		Stop working on NBTs		Stop working on NBTs	11%
		Move company abroad ⁷	6%	Move company abroad ⁷	6%
		All research abandoned ⁸	6%	All progress destroyed ⁸	6%

Source: Masters thesis, Harro de Moor, University of Utrecht

Process AND product regulatory trigger

LMO: any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology

GMO: an organism in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination

Conclusions

- New modification techniques are important in public research
- Genome editing is nothing less than a revolution
- Even though public research is mostly contained use, upstream constraints do impact this research seriously
- Many different technologies can generate the same traits
- A legal interpretation that is too much process based leads to a discriminatory and disproportionate regulatory regime