New Genomic Techniques: State-of-the-Art Review

A systematic review on the technology developments and applicability

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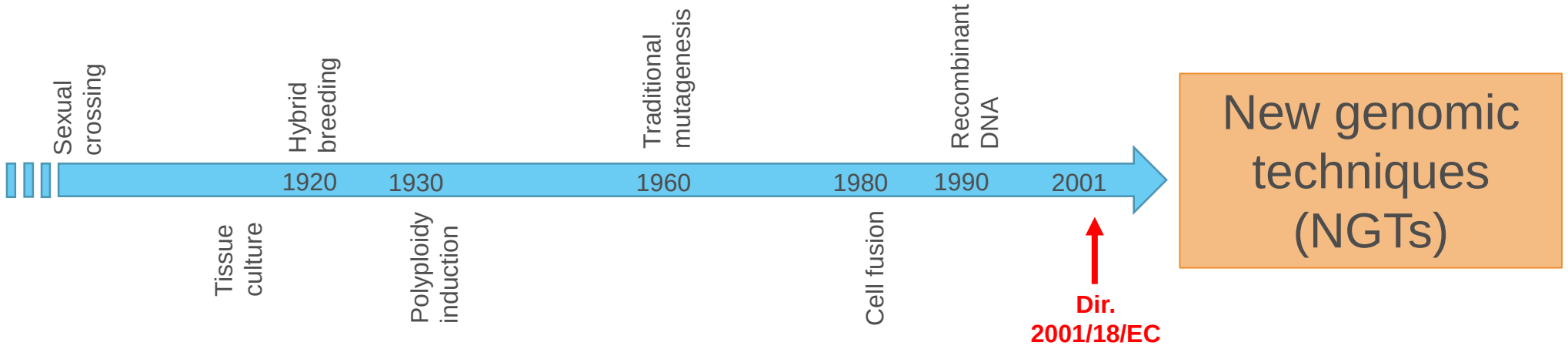
Advisory Group Meeting-DG SANTE , 19 May 2021

New Genomic Techniques



- NGTs = techniques which are capable to alter the genetic material of an organism, developed after the publication of Directive 2001/18/EC

here: A wide scientific-technical review of the current NGT landscape (plants, animals and microorganisms), independent of regulatory considerations

European Commission

Methodology

Systematic broad literature review (+ targeted scientific publications along the way)

Classification of NGTs

Structured in-depth analysis of mode of action, applicability and limitations

General characteristics of NGTs (1)

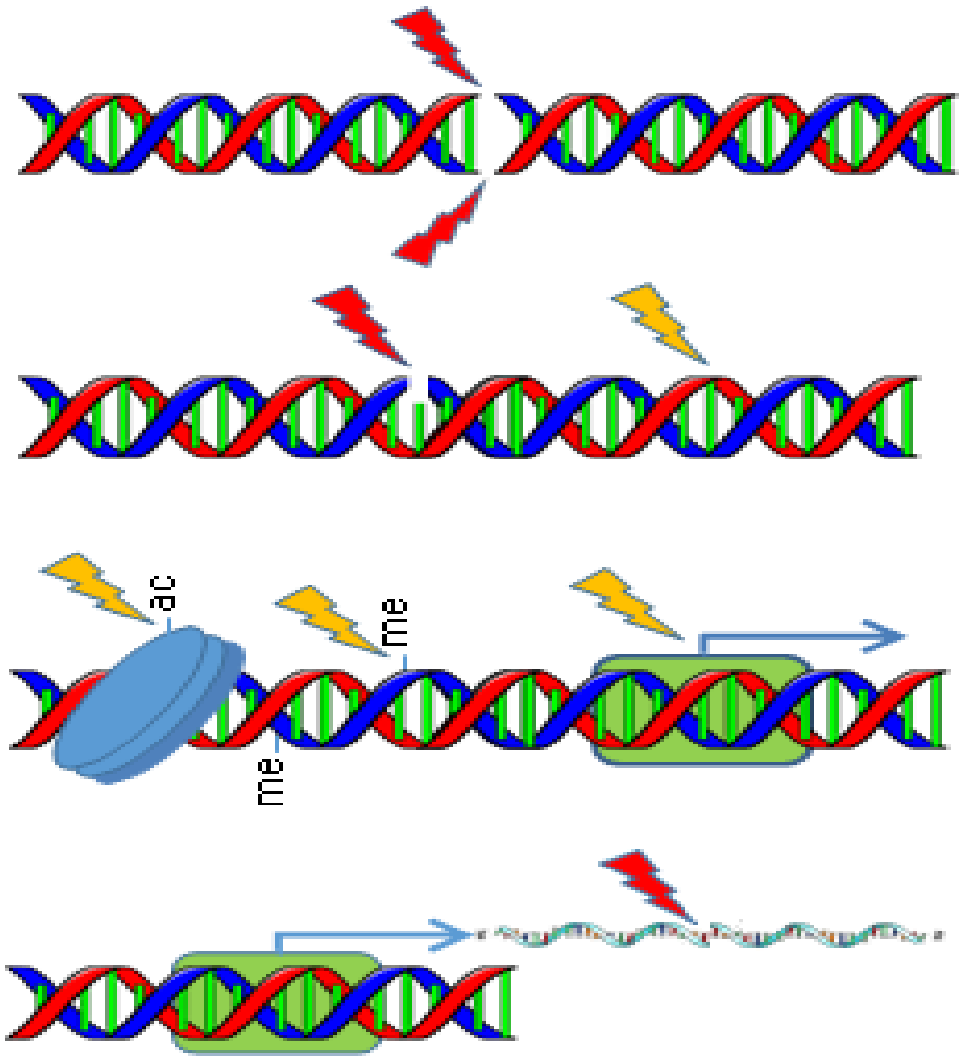
- Broad range of methods applied, including well-advanced techniques and techniques with proof-of-principle
- NGTs act at specific target DNA sequences rather than random
- Not each sequence could be targeted (restrictions)
- Also non-target sites showing similarities to the target site may be altered (experimental design crucial)

General characteristics of NGTs (2)

- Types of genomic alterations: *from single nucleotides to large deletions and insertions*
- Random sequence alteration **or** precise, predictable alterations
- Some NGTs could generate different kinds of alterations
- Some NGTs could generate multiple alterations simultaneously
- CRISPR-Cas* is the most prominent NGT and constitutes a versatile platform for many further developments

* Nobel Prize for Chemistry 2020

Classification of NGTs



Group 1: Genome editing involving a DNA double-strand break

Group 2: Genome editing without DNA double-strand break

Group 3: Editing of the epigenome

Group 4: Site-directed RNA editing

Current developments

- Increase efficiency of genome alteration
- Broaden the target range
- Increase the target specificity and reduce non-target editing

Conclusions

- Comprehensive overview of the major NGTs that have been developed for genome editing of plants, animals (including human cells) and microorganisms
- Dynamic and evolving field, particularly dominated by developments involving the versatile CRISPR-Cas platform
- The **same technique** can be used in various forms and may generate diverse alterations; the **same alterations** can be generated by different techniques
- The generated alterations are increasingly precise, both in terms of being localised at a specific target site and in terms of the intended DNA alteration
- NGTs allow sequence alterations within a shorter development time and alterations not achievable with older techniques

Thank you

LINK TO THE STUDY:
https://data.europa.eu/doi/10.2760/710056

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