Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Targeted Trait Improvement through Biotech

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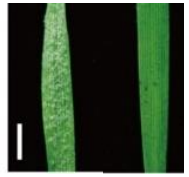
New Breeding Technology – Gene editing

"Genetic scissors: a tool for rewriting the code of life"
- The Nobel Prize in Chemistry 2020

The era of gene editing

- Built on genomics and gene identification
- Precise, genome-wide and time-saving
- Successful applications in crop improvement
- Non-GM end products (SDN-1 type)



Wheat disease resistance

Maize drought tolerance

Canola herbicide resistance

High nitrogen use rice

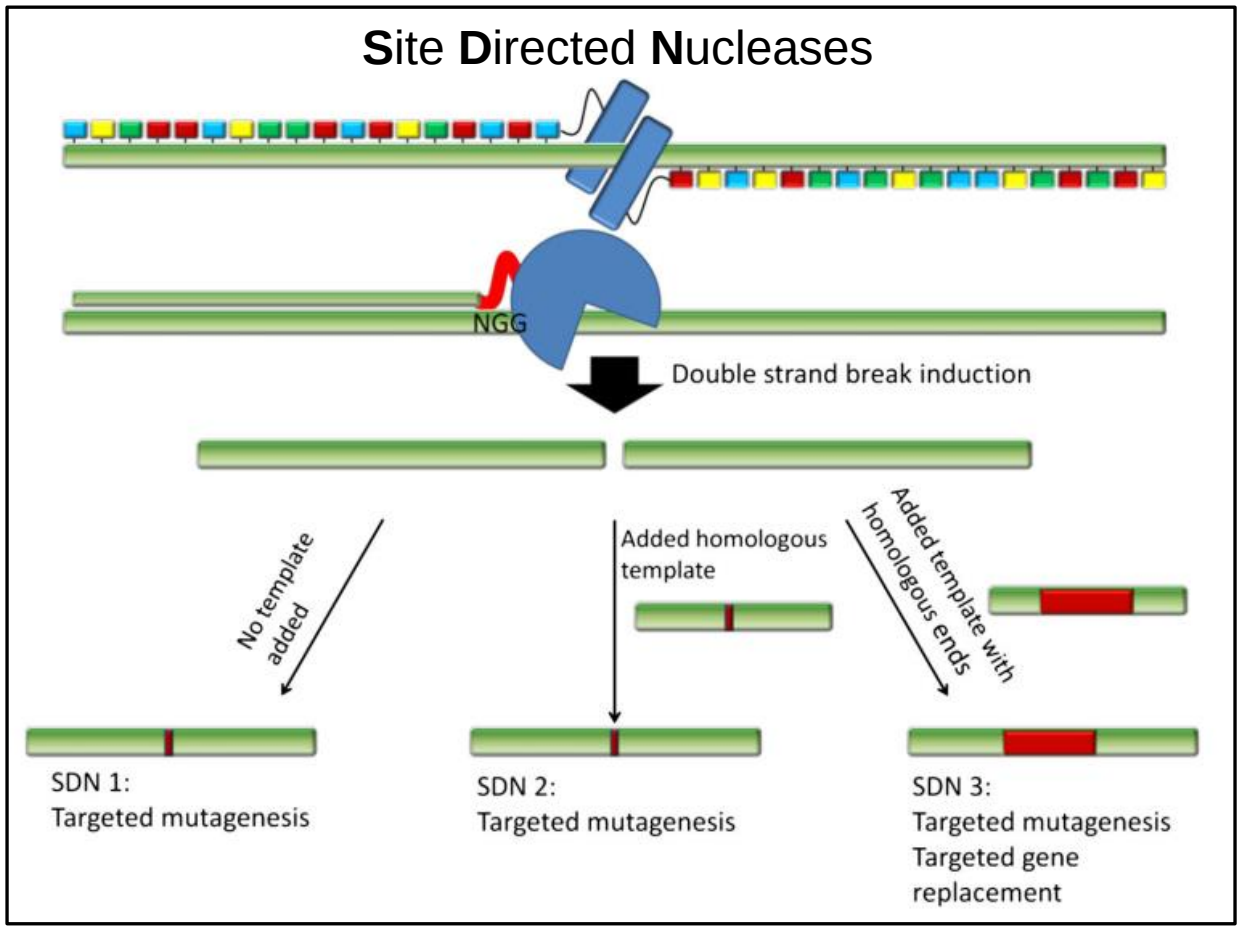
Anti-browning mushroom

High oleic soybean

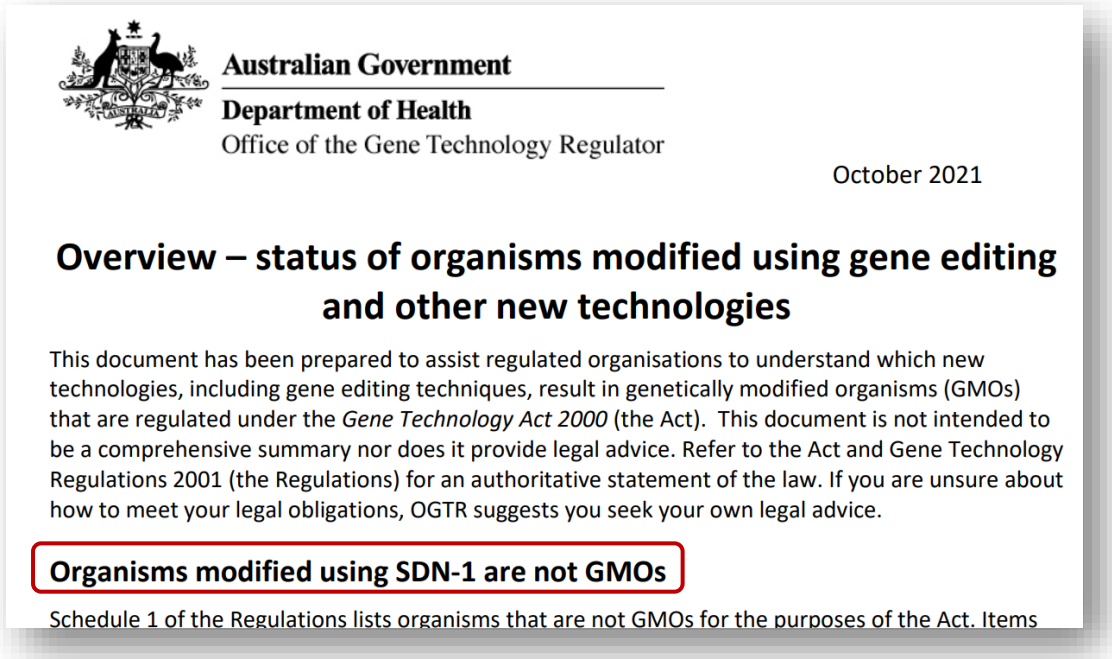
High omega-3 flax

Tasty tomato

How does it work?



***SDN 1**: DNA break is repaired without the use of an added template.*



Australian Government
Department of Health
Office of the Gene Technology Regulator

October 2021

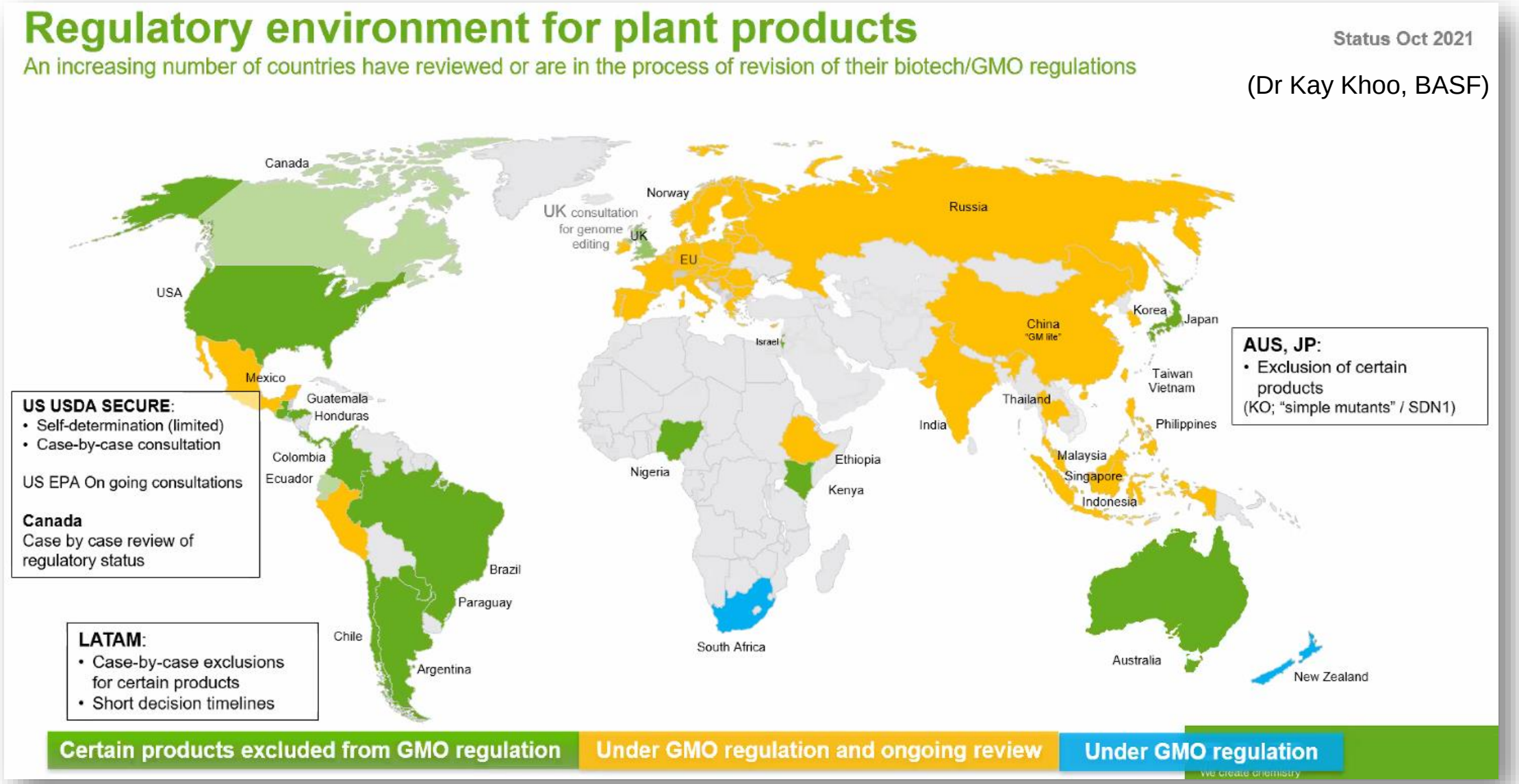
Overview – status of organisms modified using gene editing and other new technologies

This document has been prepared to assist regulated organisations to understand which new technologies, including gene editing techniques, result in genetically modified organisms (GMOs) that are regulated under the *Gene Technology Act 2000* (the Act). This document is not intended to be a comprehensive summary nor does it provide legal advice. Refer to the Act and Gene Technology Regulations 2001 (the Regulations) for an authoritative statement of the law. If you are unsure about how to meet your legal obligations, OGTR suggests you seek your own legal advice.

Organisms modified using SDN-1 are not GMOs

Schedule 1 of the Regulations lists organisms that are not GMOs for the purposes of the Act. Items

Upon commercialization



(Dr Kay Khoo, BASF)

Dr Yong Han, DPIRD Industry Day 2021

Real products on the market

February 26, 2019

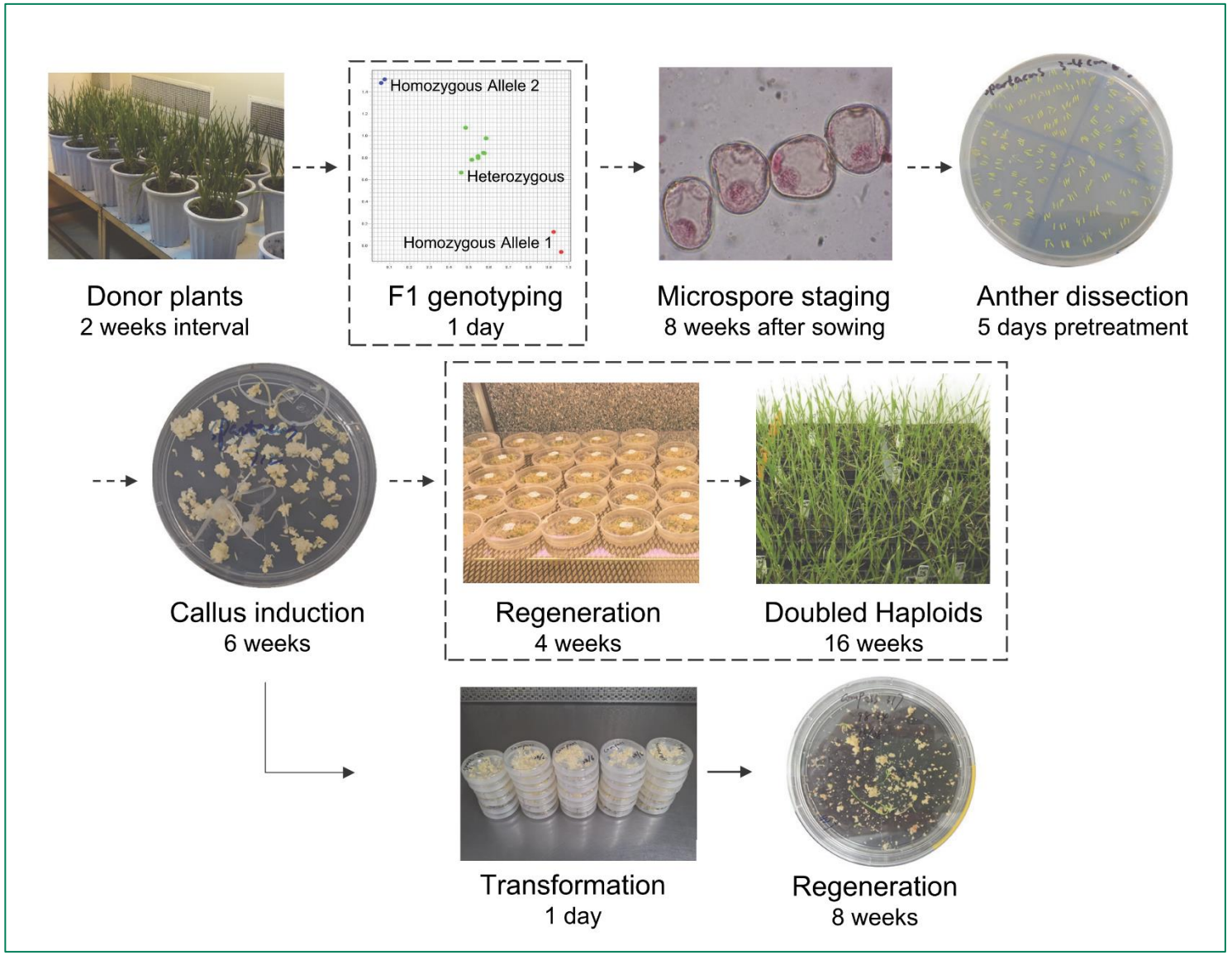
First Commercial Sale of Calyxt High Oleic Soybean Oil on the U.S. Market

Calyxt successfully markets Calyno™ High … Soybean Oil as a premium, high-

: Sanatech Seed
eed Co., Ltd., together with its partner for sales Pioneer EcoScience Co, Ltd., has announced that
rcial sales of Sicilian Rouge High GABA, their genome-edited tomatoes with increased gamma-
ic acid (GABA) will begin on September 15, 2021.

Wheat anti pre-harvest sprouting

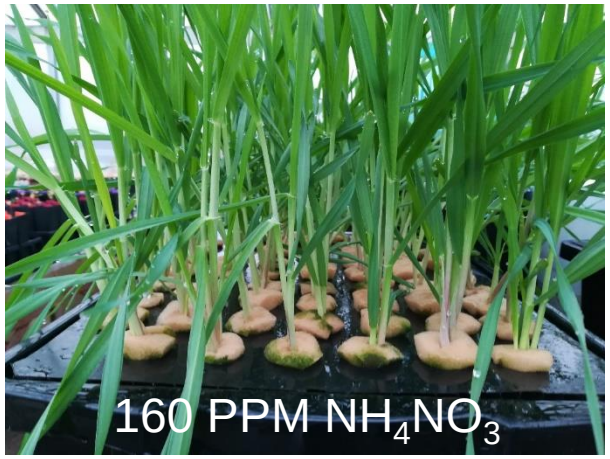
Editing commercial barleys

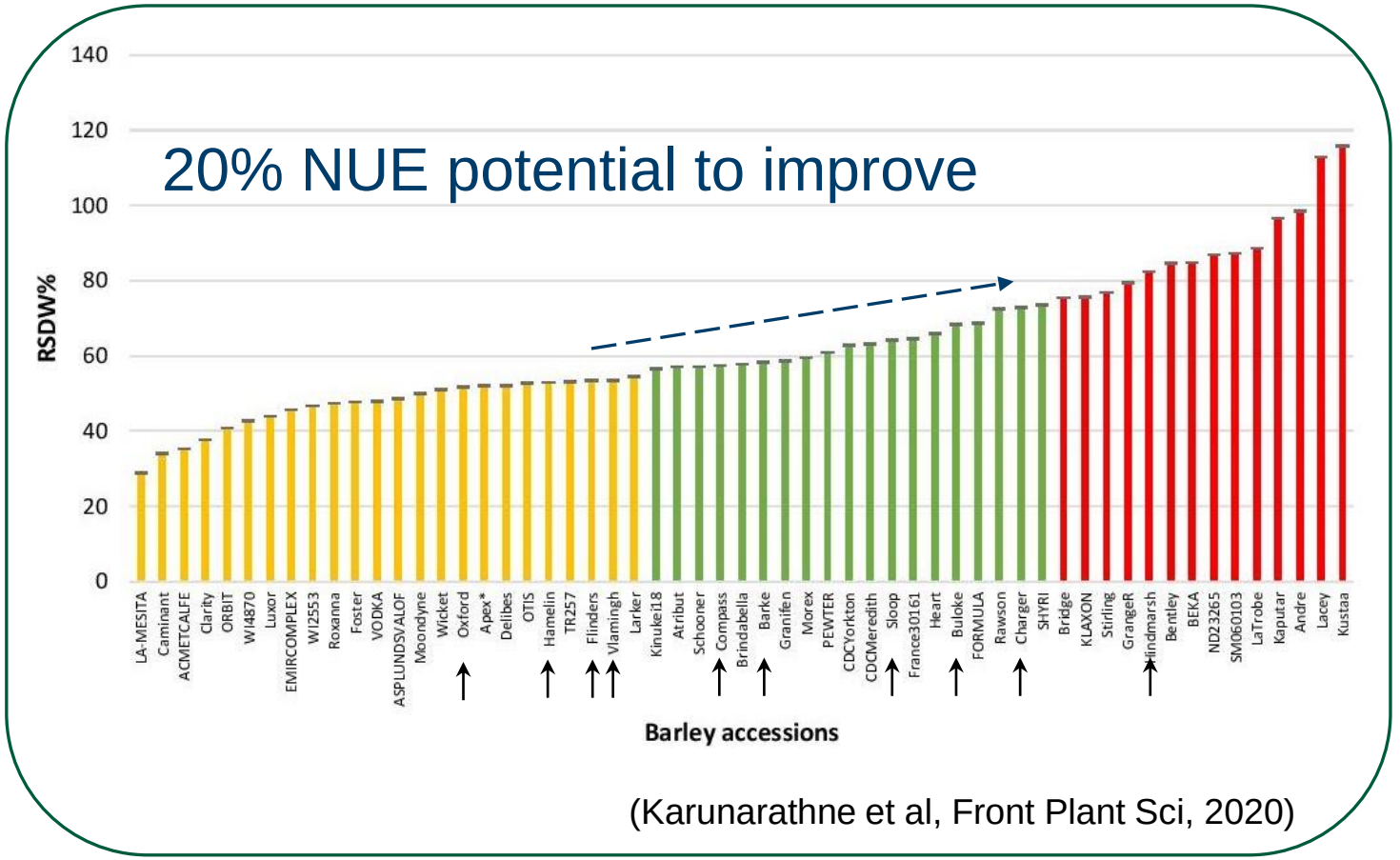


- ❑ SDN-1 type mutation
- ❑ Commercial and model varieties
- ❑ 53% average mutation rate
- ❑ Over 70% small indels (< 3 bp)

(Han et al., Plant Communications, 2021)

Australian barley NUE performance





(Karunarathne et al, Front Plant Sci, 2020)

- Variations and low to medium NUE
- Struggling for desirable protein for export markets
- Variety for exploration

HvARE1 gene mapped under low-N

Marker	Trait	-log10 (p)	
L7H314872268	RSL (Relative **shoot length**)	2.8	overlap within a 0.4Mb region
L7H314872470	**No. of leaves**-under low-N	2.3	
D7H310311917	RRDW (Relative **Root Biomass**)	2.7	overlap within a 4Mb region
	RSDW (Relative **Shoot Biomass**)	2.5	
	RSL (Relative **shoot length**)	2.2	

It is a chloroplast envelope membrane protein expressed in;

SEN: Senescing leaves (56 DAP)

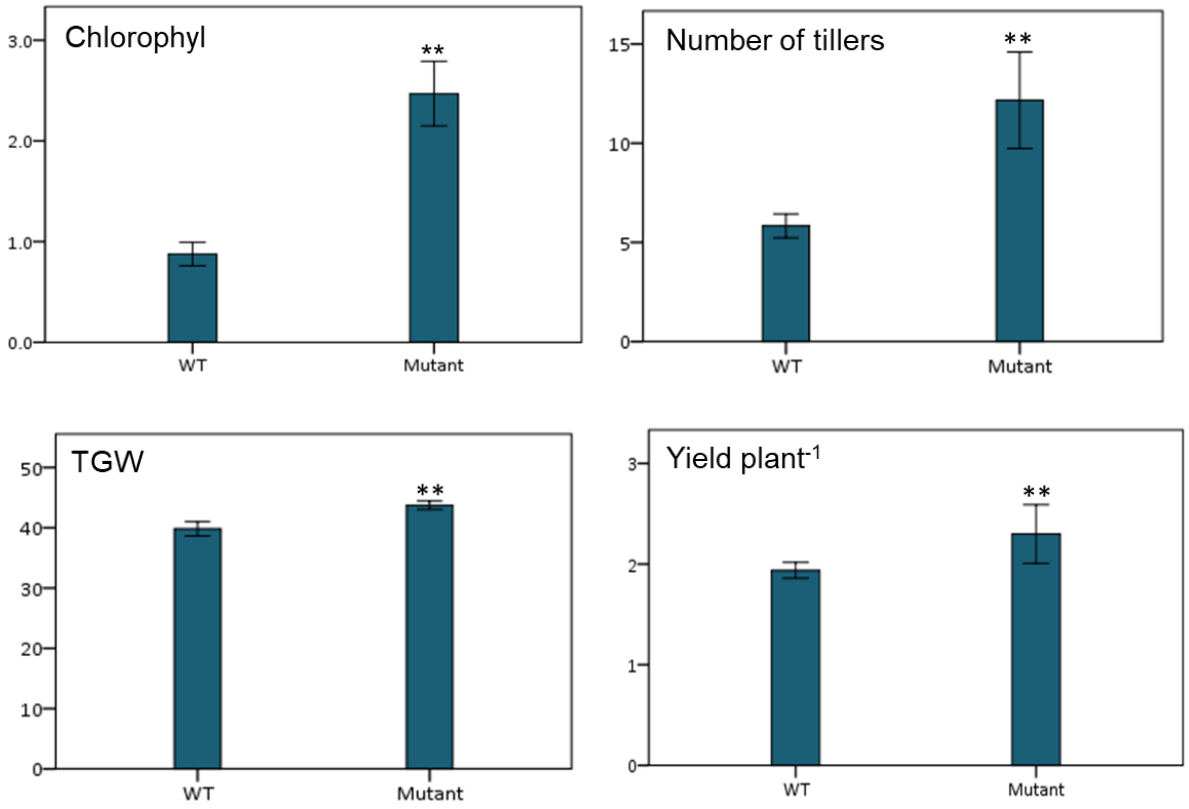
LEA: Shoots from seedlings (10 cm shoot stage)

Editing, mutation and phenotype

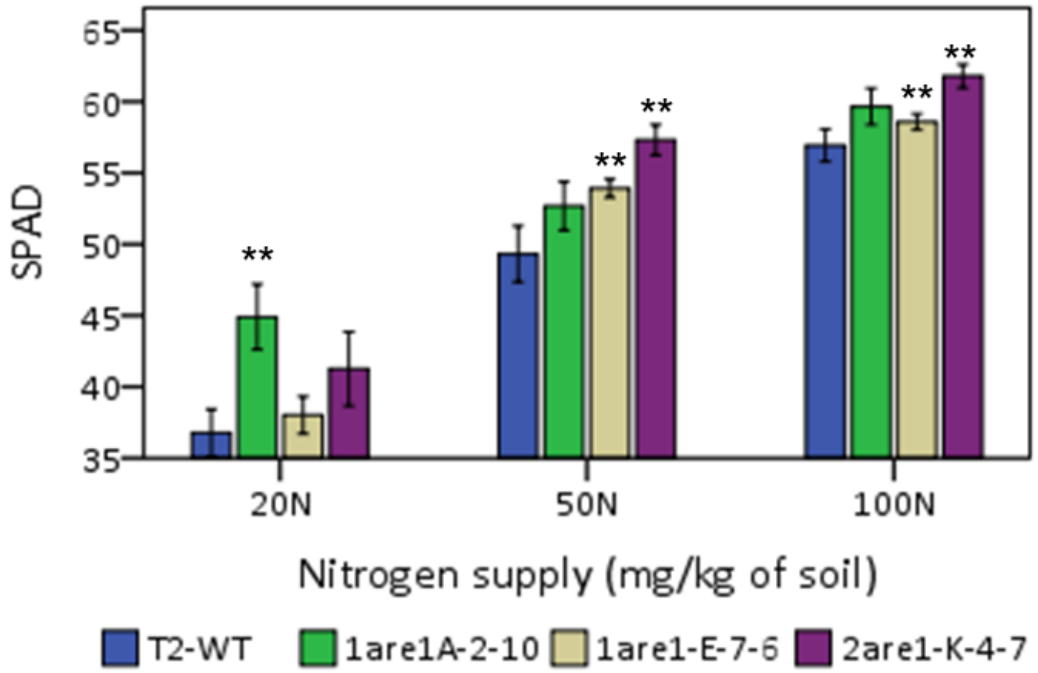
WT-GP	5’-GAACGATGAGGAAGAGAGCCTGG-3’	
1*are1*-E-9	5’- -AACGATGAGGAAGAGAGCCTGG-3’	-1bp
1*are1*-A-2-10	5’-GAACGATGAGGAAGAGAGCCT- - -3’	-2bp
1*are1*-A-6	5’-GAACGATGAGGAGGAGAGCCTGG-3’	+/-1bp
1*are1*-E-7-6	5’-GAACGATGAGGAGGAGAGCCTGG-3’	+/-1bp

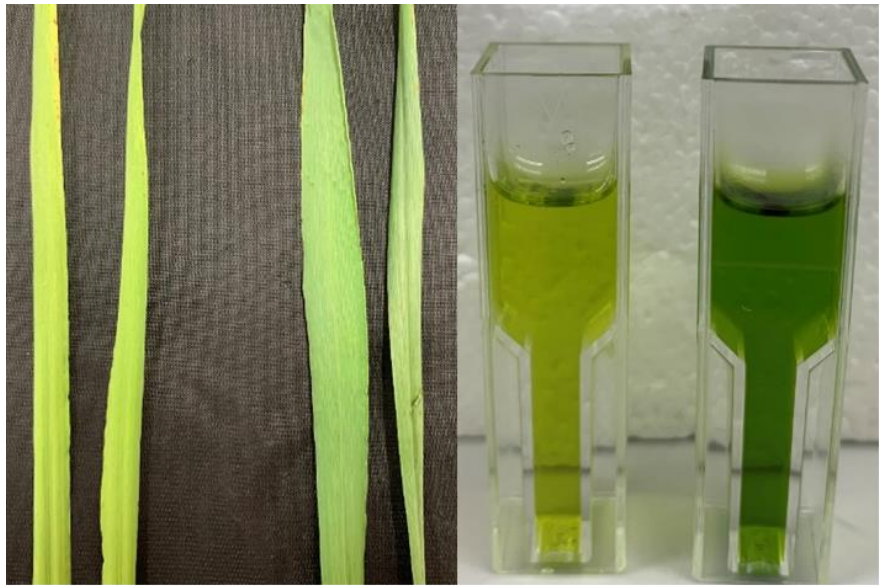
WT Mutant WT Mutant

(Karunarathne et al., in revision)

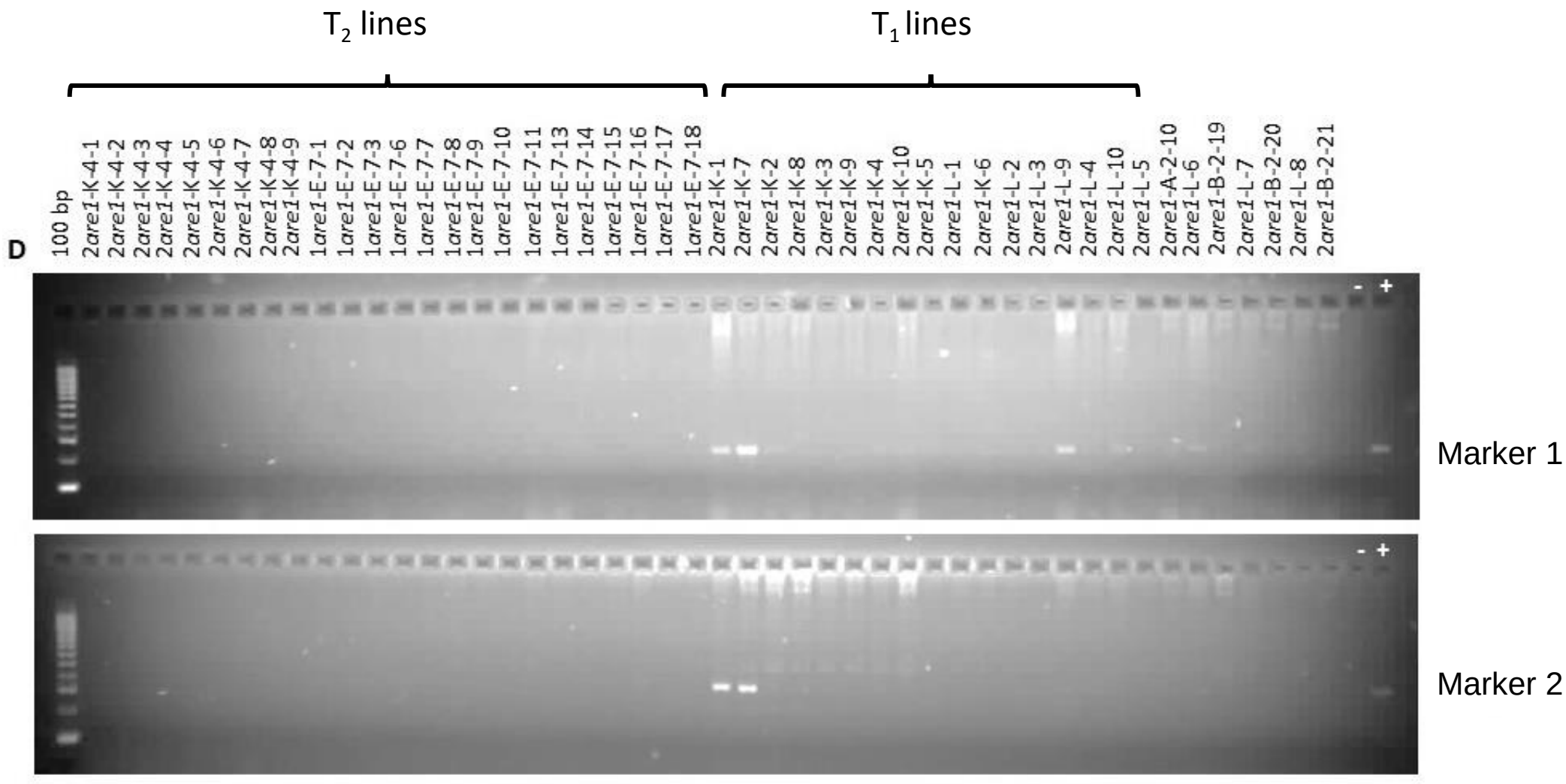


Improving barley NUE





Foreign DNA in mutants?

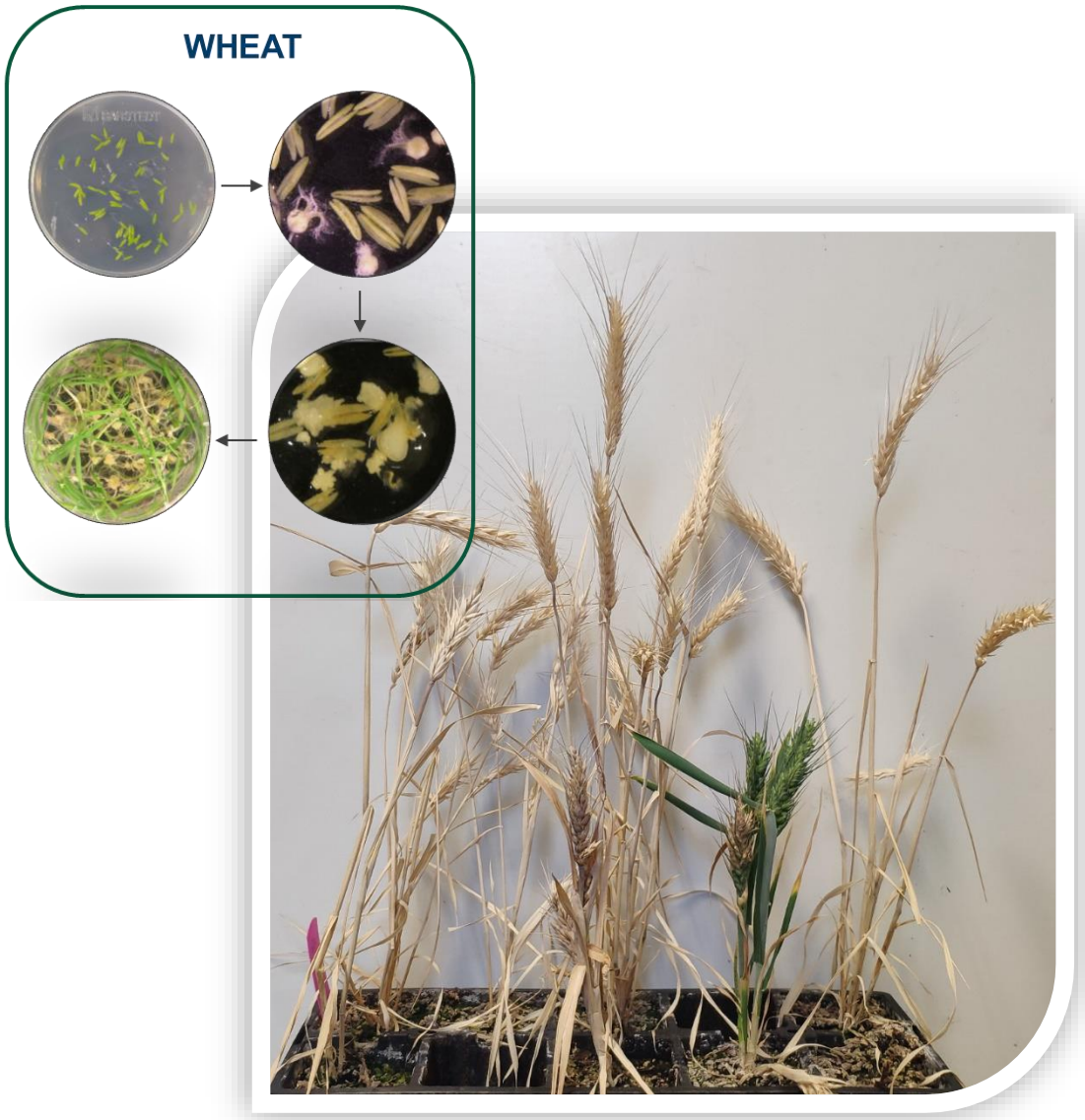


Marker 1

Marker 2

✓ Backcrossing advanced lines

Genetic fine-tuning wheat, legumes and more



Hard-to-transform crops

Lupin for herbicide resistance

Leucaena for sterility

Summary

- Gene editing for crop improvement is robust, with a positive response among the research community, breeding industries and funding agencies.
- Efficient editing platforms have been established for WA's major crops at DPIRD.
- Advanced crop lines with improved traits have been developed and will be transformed to superior varieties with greater profitability.

Acknowledgement

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Thank you

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