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Why do we need NBTs to be competitive?

Productivity Challenges for Growers

Growers require sustainable crop productivity and efficiency gains as they navigate multiple challenges.



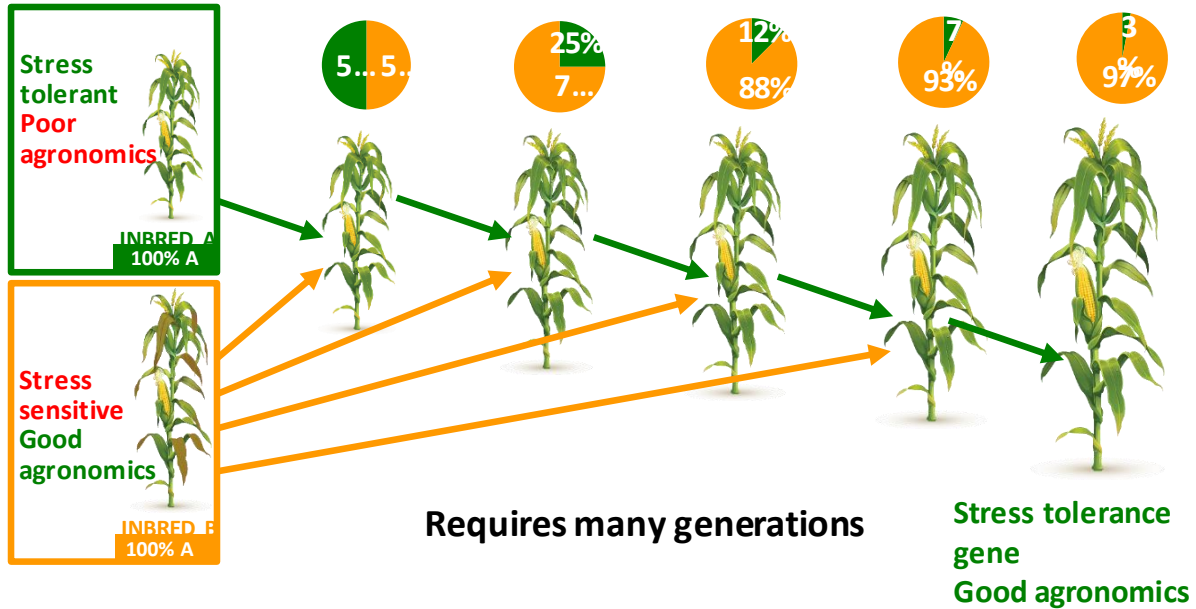
~ 3/4 of growers ranked
“productivity per acre”
as their #1 concern

	CROP PRODUCTIVITY
INCREASING SEED PERFORMANCE & PRODUCTIVITY	
OPTIMIZING PROFITABILITY IN ALL MARKET CONDITIONS	
ENHANCING OUTPUT & FUNCTIONALITY	
INSECT, WEED, DISEASE & NEMATODE CONTROL	
AGRONOMIC PERFORMANCE VERSUS OPERATIONAL CONSTRAINTS	

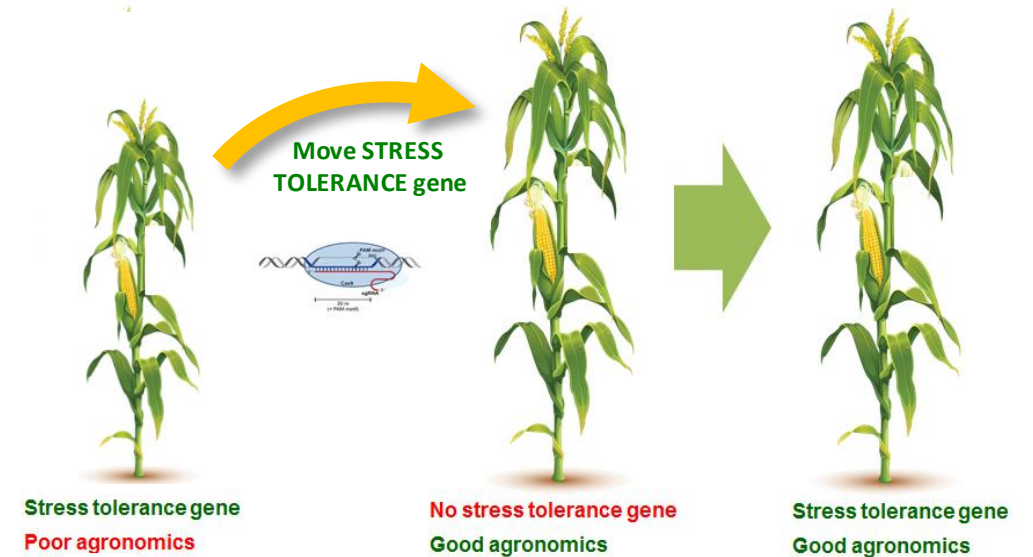
CROP PRODUCTIVITY	
BREEDING	
CRISPR	
BIOTECH	
CROP PROTECTION	
SEED APPLIED TECHNOLOGY	
DIGITAL SOLUTIONS	
AGRONOMIC SOLUTIONS	

CRISPR-Cas Accelerates Breeding of Traits

Conventional Breeding by Backcrossing



CRISPR-Cas Enabled Breeding



Vast Potential for Wide Array of Applications

CRISPR-Cas Furthers Innovation for Pioneer® Brand Products

	DISEASE RESISTANCE	YIELD & YIELD STABILITY	DROUGHT TOLERANCE	OUTPUT TRAITS	MATURITY
CORN	●	●	●		●
SOY	●			●	●
CANOLA	●	●		●	
RICE	●	●	●		●
WHEAT	●	●			
SUNFLOWER	●			●	



Developing solutions to the toughest agricultural challenges

... much beyond row crops

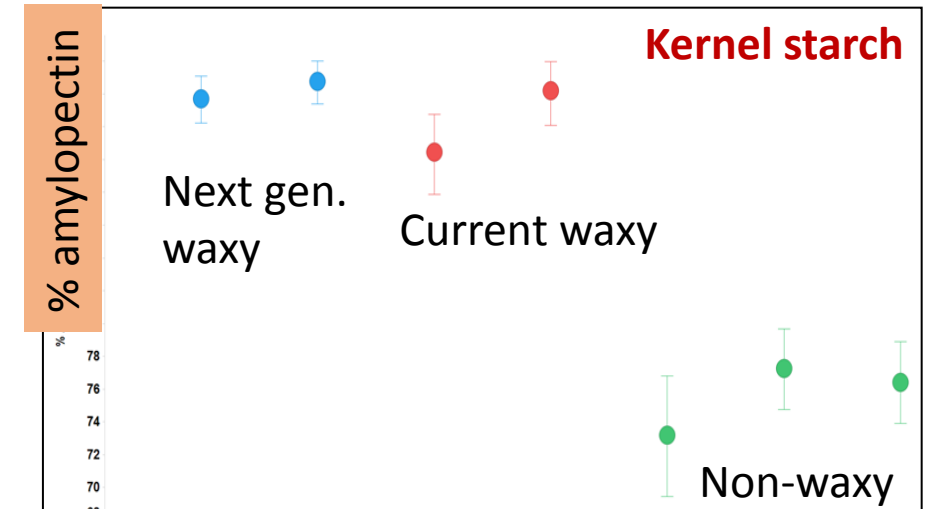
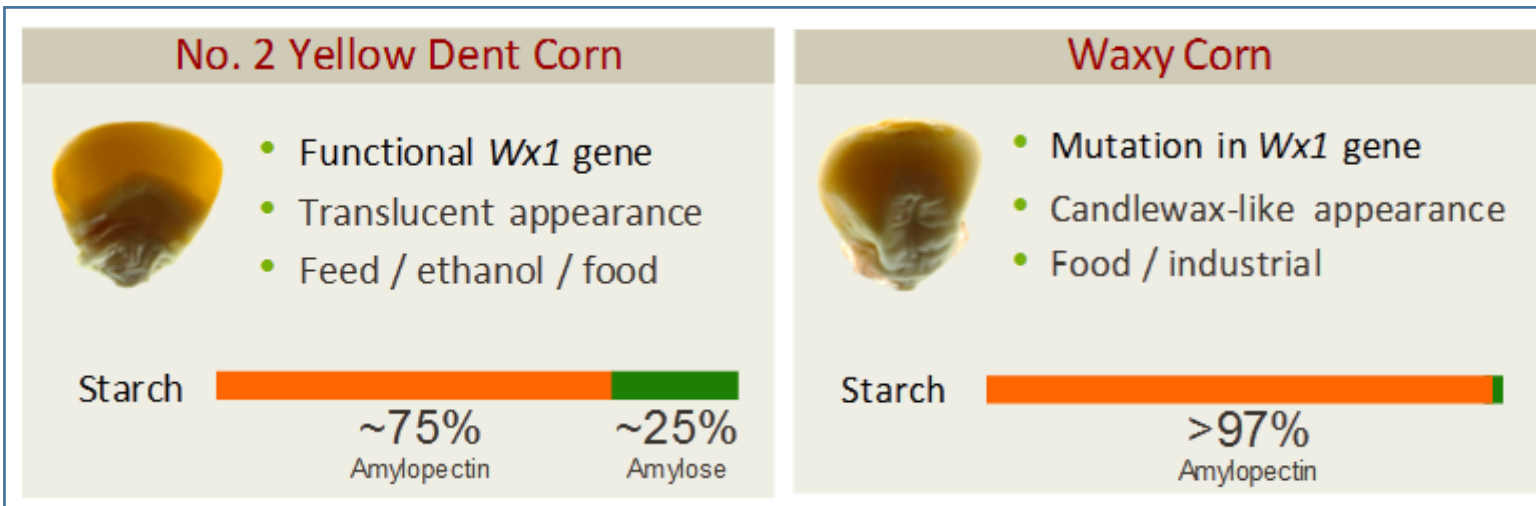


Products, benefits and concepts described herein will not be offered for sale or distribution until completion of field testing and applicable regulatory reviews.

* Source: Internal analysis and USDA.

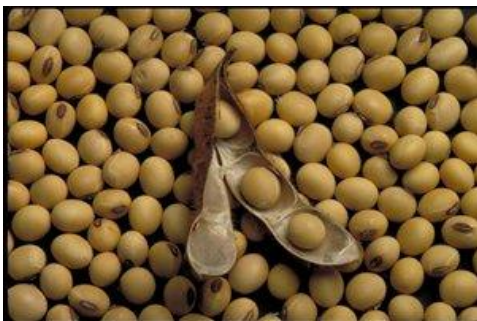
Next Generation Waxy Corn

- Targeted deletion of the *Waxy* gene directly in elite maize germplasms via CRISPR-Cas
- Expected to overcome current breeding challenges, meet grower's demands for hybrid seed in most modern, high yielding germplasms, and improve supply reliability for processors



Improved Oil Quality

REDUCED TRANS FAT SOYBEAN OIL



- High oleic and low linoleic acid content, eliminating the need for hydrogenation and the creation of trans fats.

<http://www.calyxt.com/products/reduced-trans-fat-soybean-oil/>

LOWER SATURATED FAT CANOLA OIL

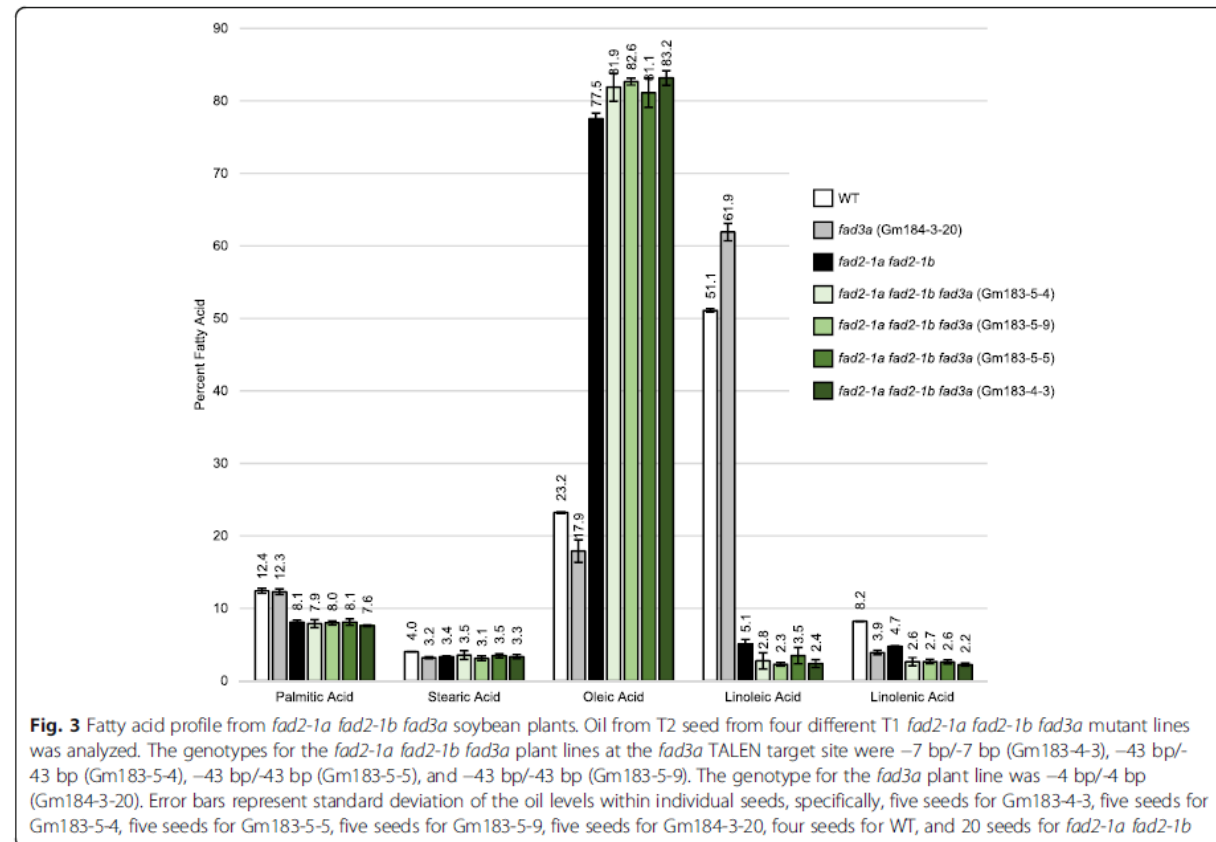


- Oil with less than 3.5% saturated fat by deactivating one enzyme responsible for the synthesis of saturated fatty acids.

<http://www.calyxt.com/products/lower-saturated-fat-canola-oil/>



Targeted disruption of soybean *FAD2* and *FAD3* genes via TALENs



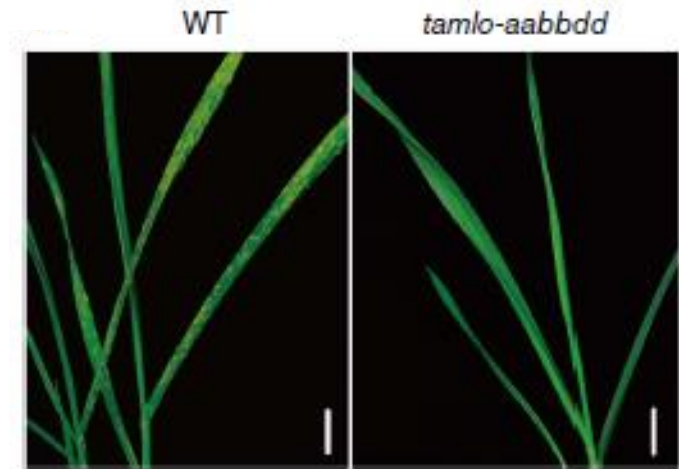
Demorest *et al. BMC Plant Biology* (2016) 16:225

Crops with Improved Disease Resistance



Powdery Mildew resistance in bread wheat

- Targeted disruption of wheat *TaMLO* genes, via TALEN or CRISPR-Cas
- Mutations induced in all three genomes (a,b,d); the same outcome through traditional mutagenesis would be much more challenging
- Broad spectrum resistance to powdery mildew

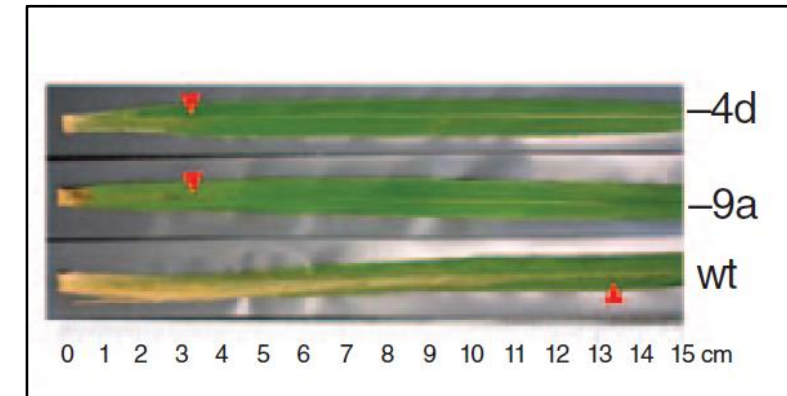


Wang et. al. (2014) Nature Biotechnol. doi:10.1038/nbt.2969



Bacterial blight resistance in rice

- Targeted disruption of rice *OsSWEET14* bacterial blight susceptibility gene, via TALEN
- Improved resistance compared to wild-type plants

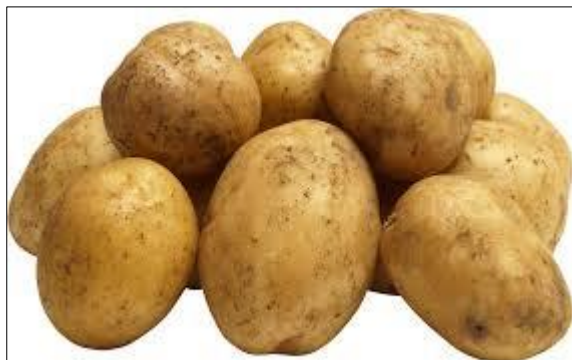


Li et. al. (2012) Nature Biotechnol. 30(5): 390



Improved Storage and Processing Characteristics

Improved quality potatoes

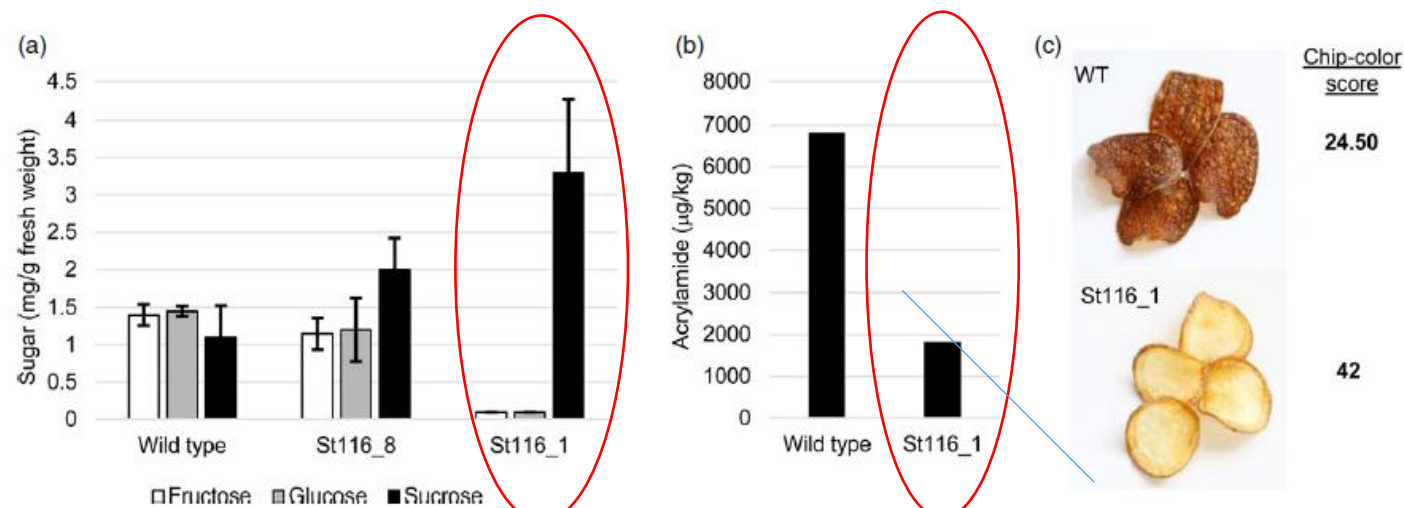
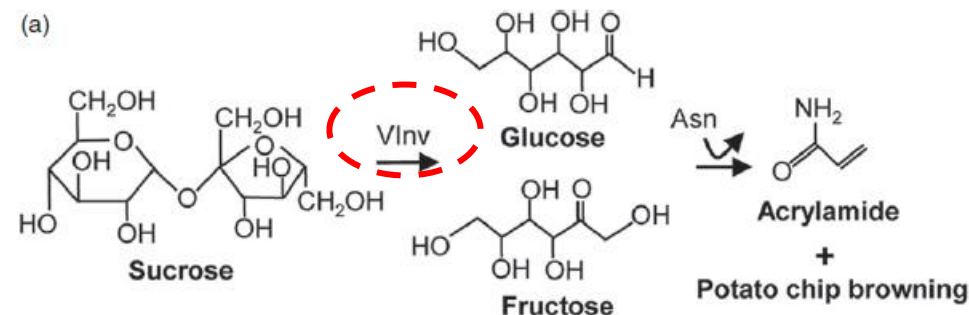


- Inactivation of the polyphenol oxidase responsible for black spot, enzymatic darkening and discoloration in tubers, via TALENs
- Intended phenotype: reduced black spot, resulting in increased tuber quality and less food waste

https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/16-320-01_air_inquiry.pdf



- Inactivation of the enzyme responsible for the degradation of sugars in the tuber, via TALEN
- Reduces the sweetening of cold-stored potatoes and creation of acrylamide during frying



Clasen et. al. (2016) Plant Biotechnol. J. 14: 169



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Thank You!