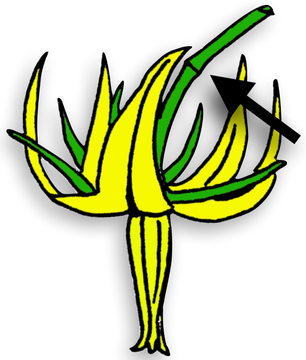
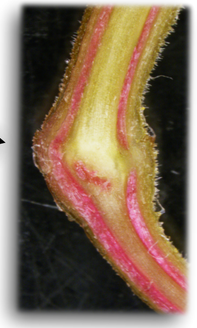
Lycopersicon is characterized by a pedicel joint, which is conspicuously enlarged and is the point of natural abscission of the flower or fruit

Genetic and Systematic Studies on Accessions of Lycospersicon from the Galapagos Islands
Author(s): Charles M. Rick

American Journal of Botany



joint



The "jointless" trait





jointed

jointless





https://www.youtube.com/watch?v=JFQwk1qzdPw

Negative Interaction (Epistasis) Between SV Mutations in Two MADS-box Genes

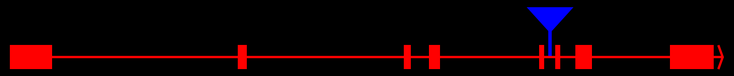
j2

Copia TE



A natural
double mutant

insertion



ej2



Soyk et al. (2017) Cell

Negative Interaction (Epistasis) Between SV Mutations in Two MADS-box Genes

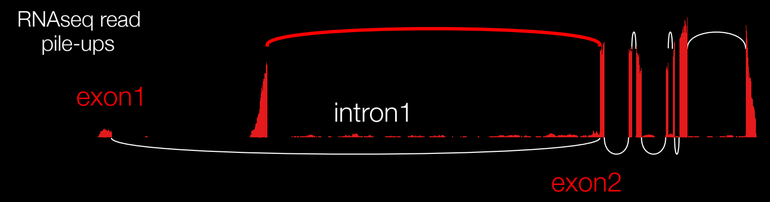
j2

Null Allele

Copia TE



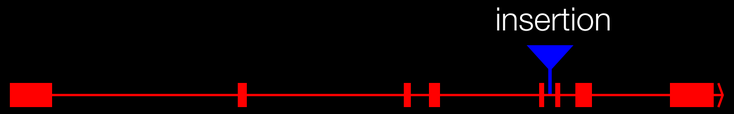
1st intron insertion: ~90% intronic start site



WT

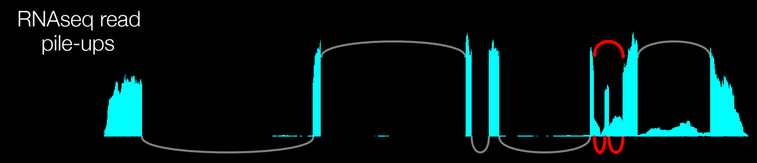
j2





ej2

Weak allele



5th intron insertion: ~50% mis-splicing

(exon skipping/intron retention)

WT

ej2^{W}

ej2^{CR}



Soyk et al. (2017) Cell

j2^TE

WT

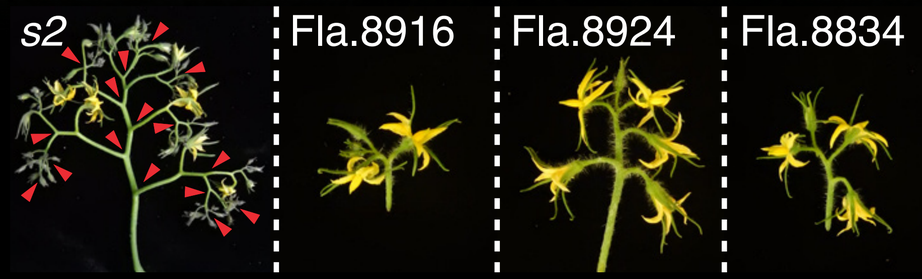
j2/j2



fresh-market tomato

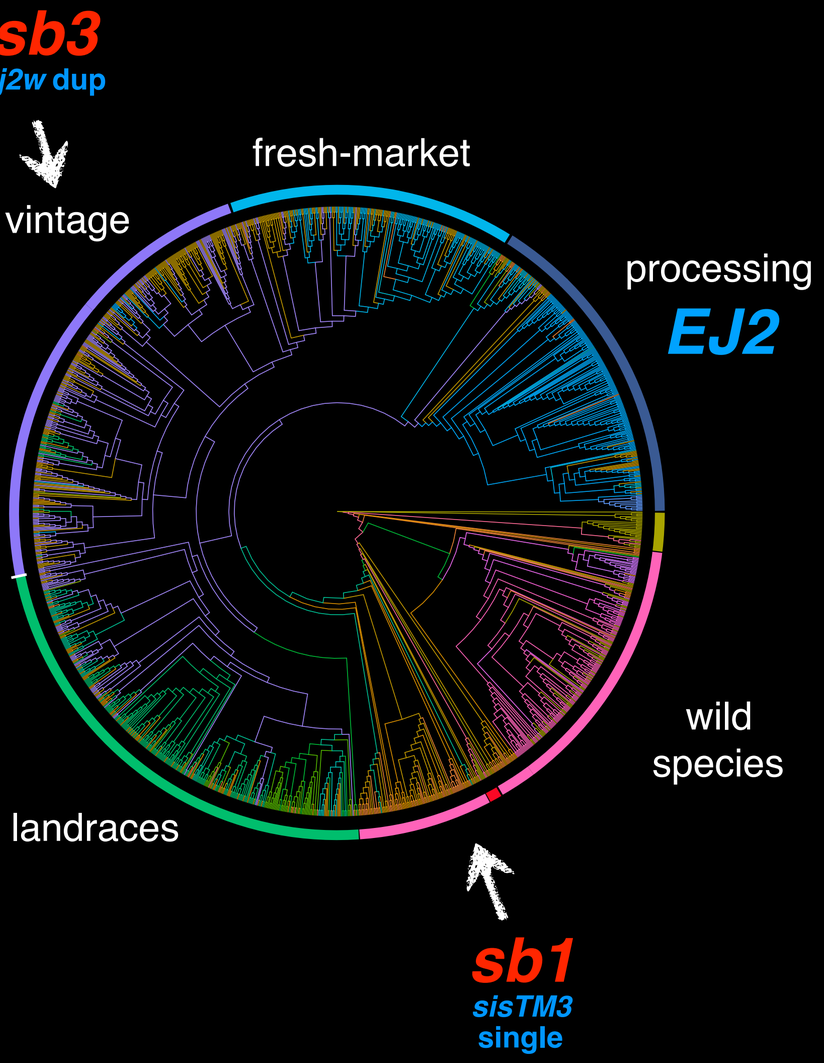


Many fresh-market lines carry **both** *j2^TE* & *ej2^W*…but no branching



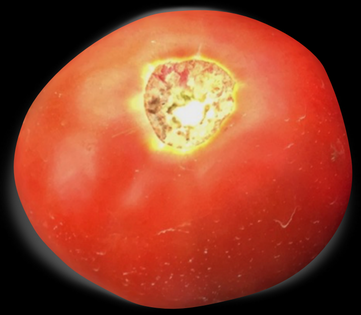
Soyk et al. (2019)
Nature Plants

Breeders exploited 4 SVs affecting 3 Genes to implement the jointless trait



Jointless fruits…

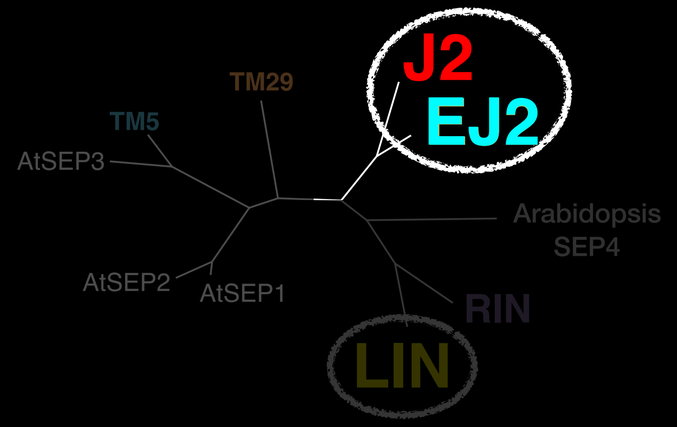
j2TE



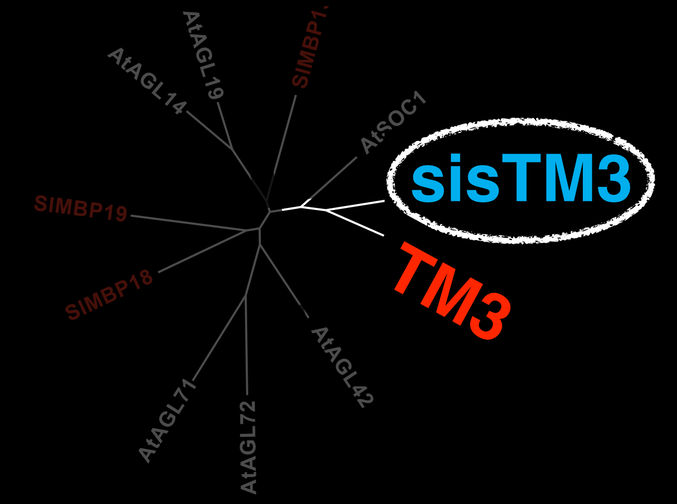
ej2w

…but branching





SOC1 clade
(sister clade to to J2/EJ2)



Alonge & Wang, et al, in prep.

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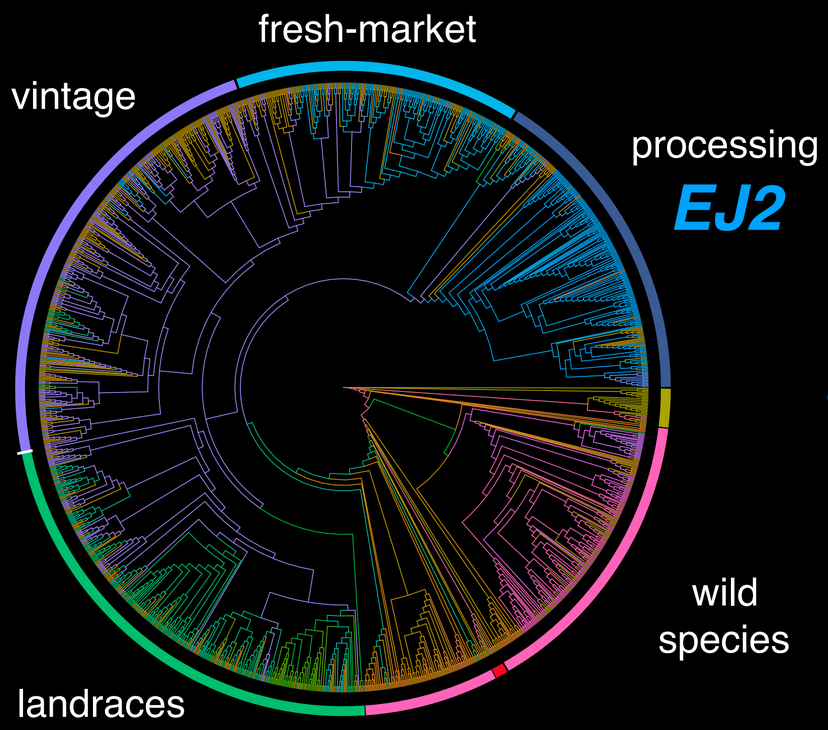
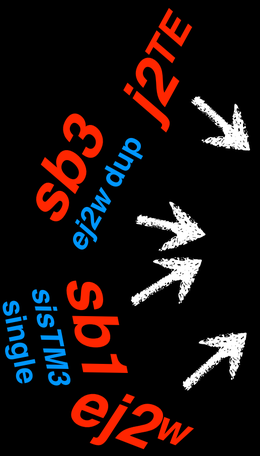
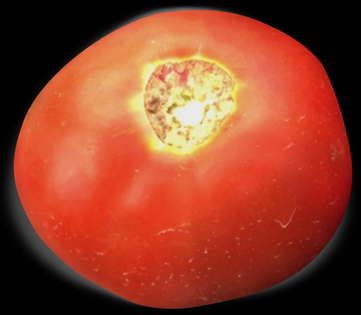


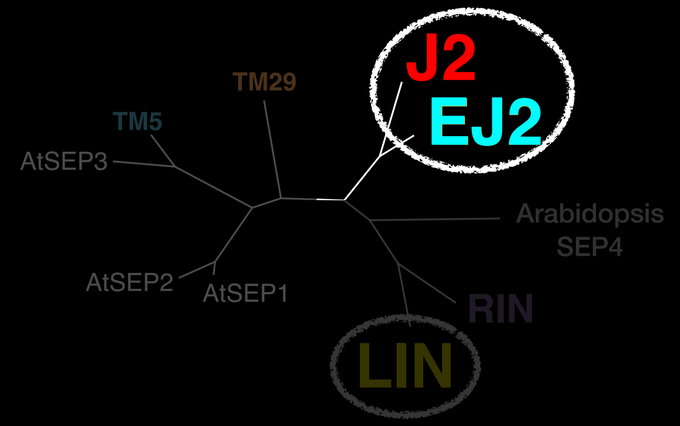


Jointless fruits…





restored inflorescences
and productivity



SOC1 clade
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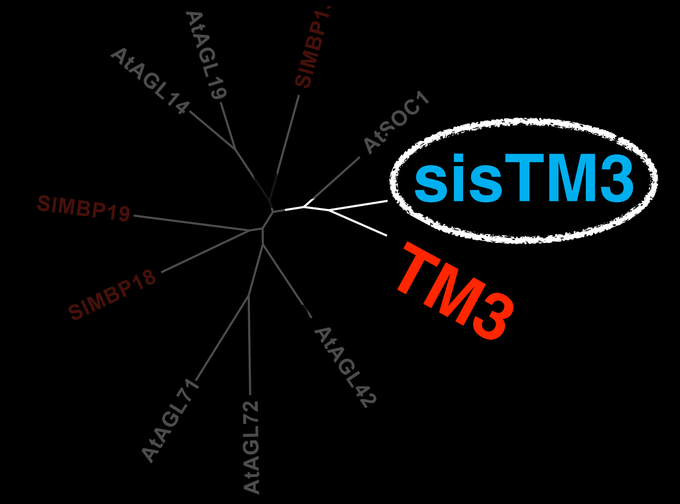
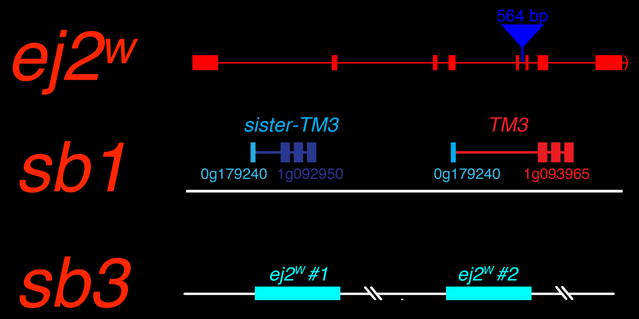


Alonge & Wang, et al, in prep.

Soyk et al. (2019)
Nature Plants

Determine background genotype



Edit (mutate) *J2* and breed accordingly



Sam Hutton



Customized strategies and predictable outcomes for *J2* gene editing

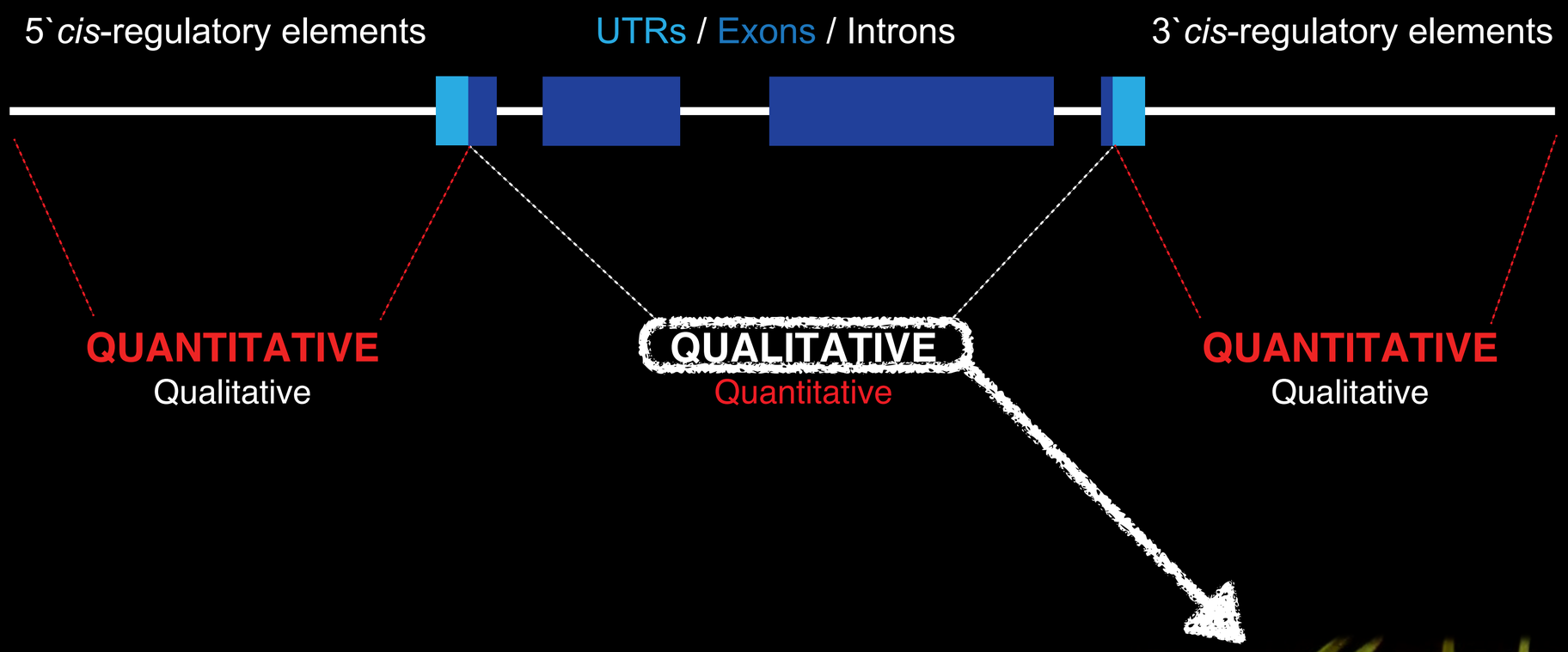
```
J2              GCTAGAGTTGAGCTCCTTCAACGTTCTCAAAGGTA(68)AGACATATTCTTGGAGAGGATTTGGGC

j2CR Fla.7946   GC--------------------------------TA(68)AGACATATTCTTG------ATTTGGGC
j2CR Fla.8624   GCTAG-----------------------------(68)AGACATATT----------ATTTGGGC
j2CR Fla.8735   GCTAGAGTTGAGCTCCTTCAACGTTCT--------(68)-------------------ATTTGGGC
```



Nature has provided diversity, but we can do more…

Generalized view of phenotypic outcomes from genome editing





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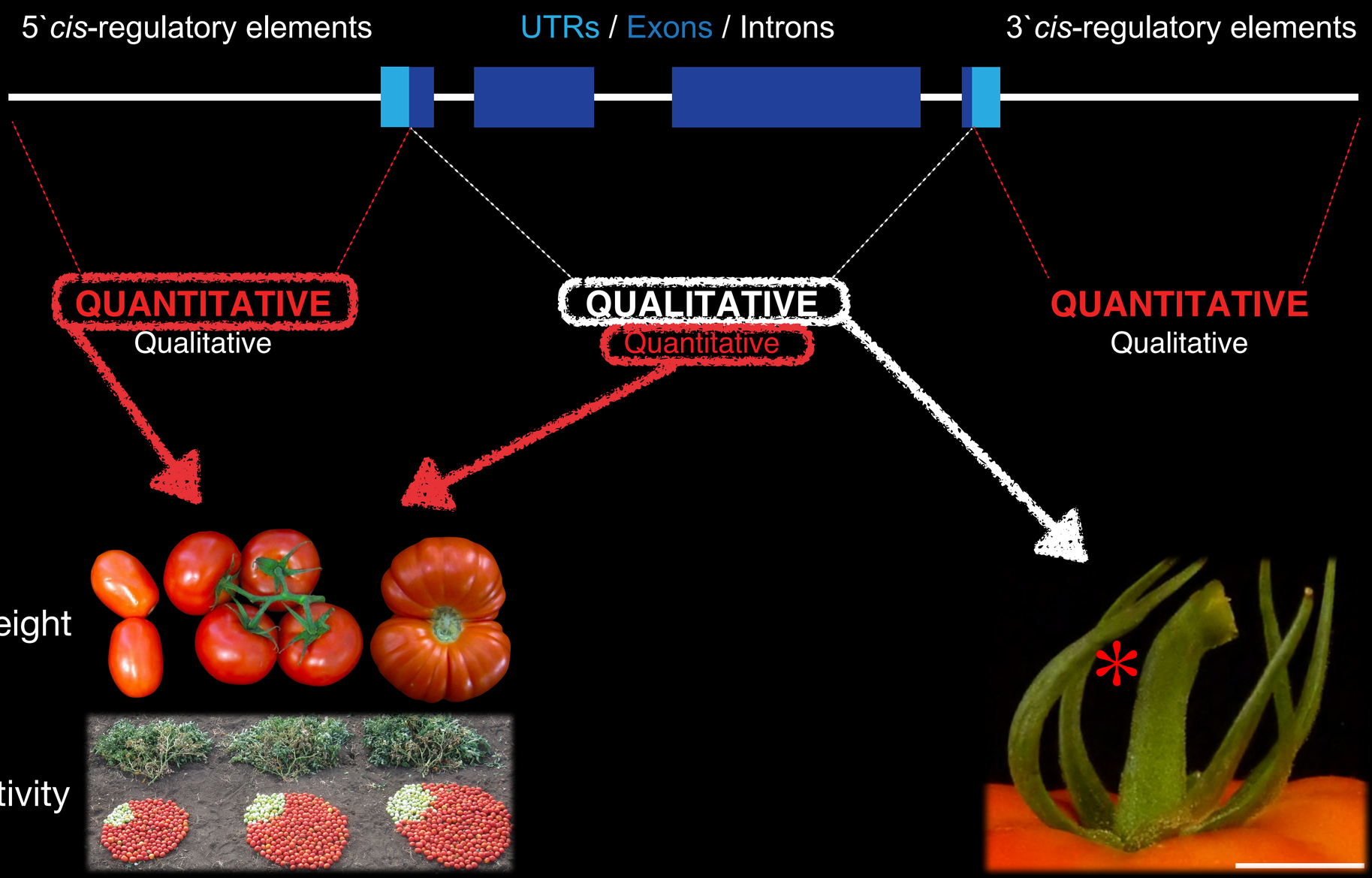


A regulator of stem (internode) length

Kwon et al, Nature Biotech, In Press

Sweet 100



CR-slerecta



florigen

antiflorigen

~~ANTIFLORIGEN~~

~~ANTIFLORIGEN HOMOLOG~~

~~STEM LENGTH REGULATOR~~

Kwon et al, Nature Biotech, (2019)

Indeterminate

Sympodial unit reiteration

3L
3L
8L
3L
3L
6L

WT

sp mutation

Determinate shoots

Determinate

0L
1L
2L
8L
0L
1L
1L
6L

sp

sp5g mutation

Early flowering & more compact

Double-determinate

0L
1L
1L
6L
0L
1L
4L

sp sp5g

sler mutation

Short internodes

Triple-determinate

0L
1L
1L
6L
0L
1L
4L

sp sp5g sler

Indeterminate | Determinate | Double-determinate | Triple-determinate



leaves removed

florigen

antiflorigen

~~ANTIFLORIGEN~~

~~ANTIFLORIGEN HOMOLOG~~

~~STEM LENGTH REGULATOR~~

Kwon et al, Nature Biotech, (2019)

Indeterminate

Sympodial unit reiteration

3L
3L
8L
3L
3L
6L

WT

sp mutation → Determinate shoots

Determinate

0L
1L
2L
8L
0L
1L
1L
6L

sp

sp5g mutation → Early flowering & more compact

Double-determinate

0L
1L
1L
6L
0L
1L
4L

sp sp5g

sler mutation → Short internodes

Triple-determinate

0L
1L
1L
6L
0L
1L
4L

sp sp5g sler

Indeterminate | Determinate | Double-determinate | Triple-determinate



leaves removed

Urban Agriculture

Vertical Farming Systems • Crops must be rapid cycling and compact • Currently only Leafy Greens





https://www.freightfarms.com/



Kwon et al, Nature Biotech, In Press

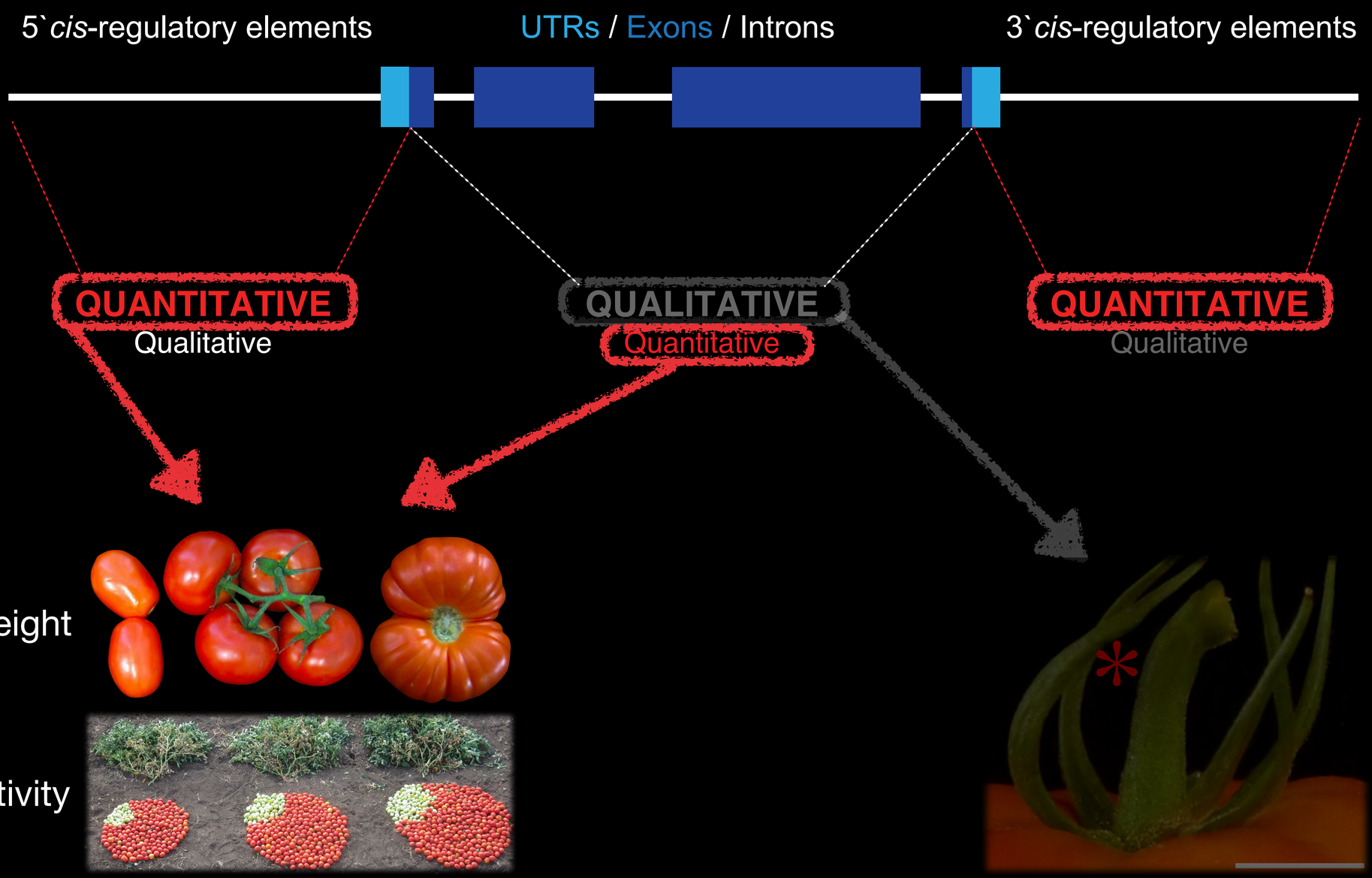


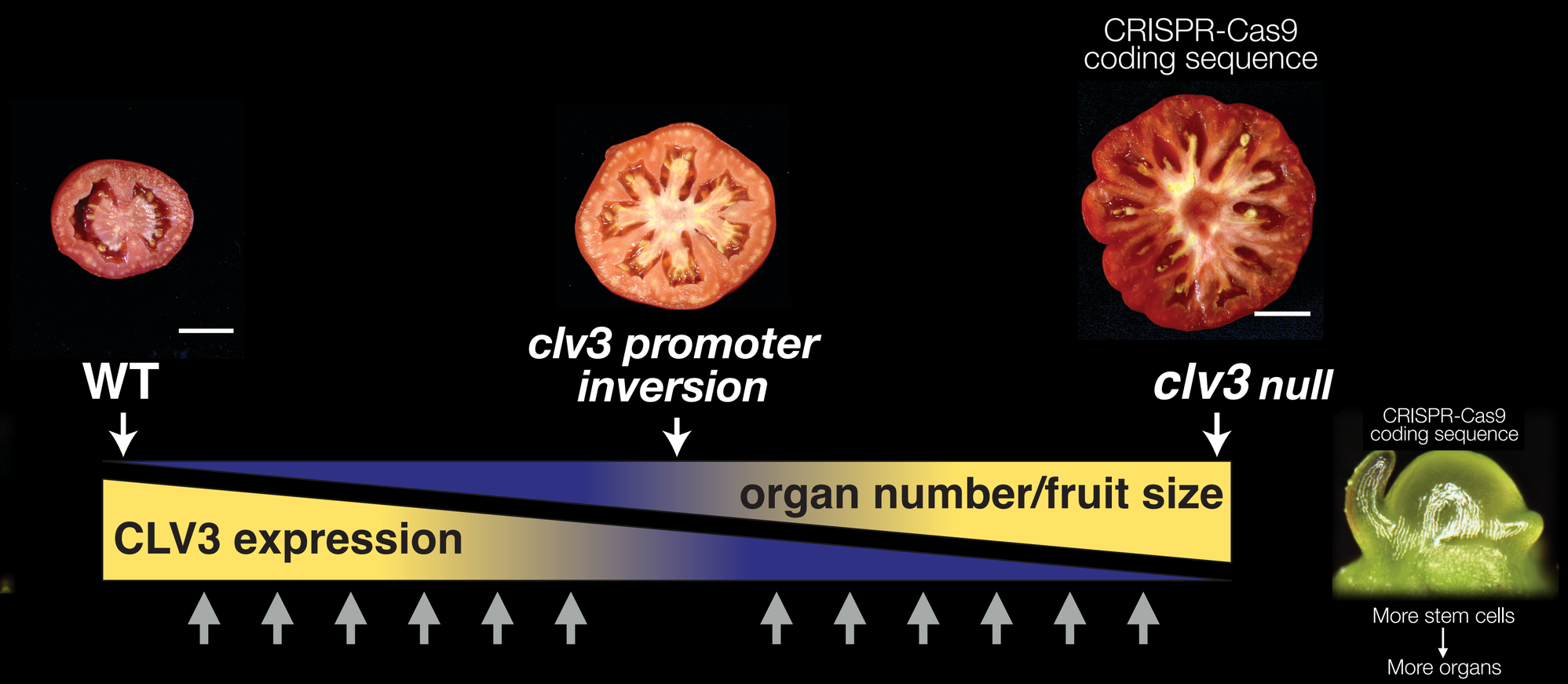


Kwon et al, Nature Biotech,
In Press

Nature has provided diversity, but we can do more…

Generalized view of phenotypic outcomes from genome editing





Promoter Mutagenesis by CRISPR-Cas9 multiplexing

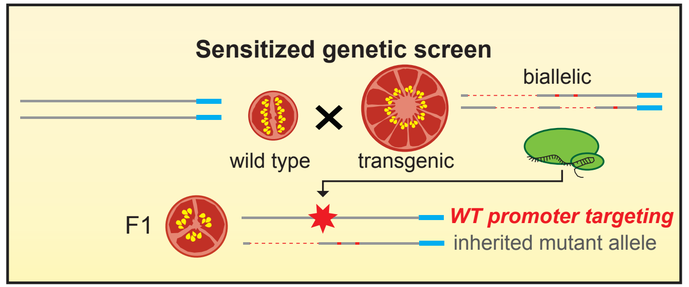


XU et al.
(2015) Nat. Gen.

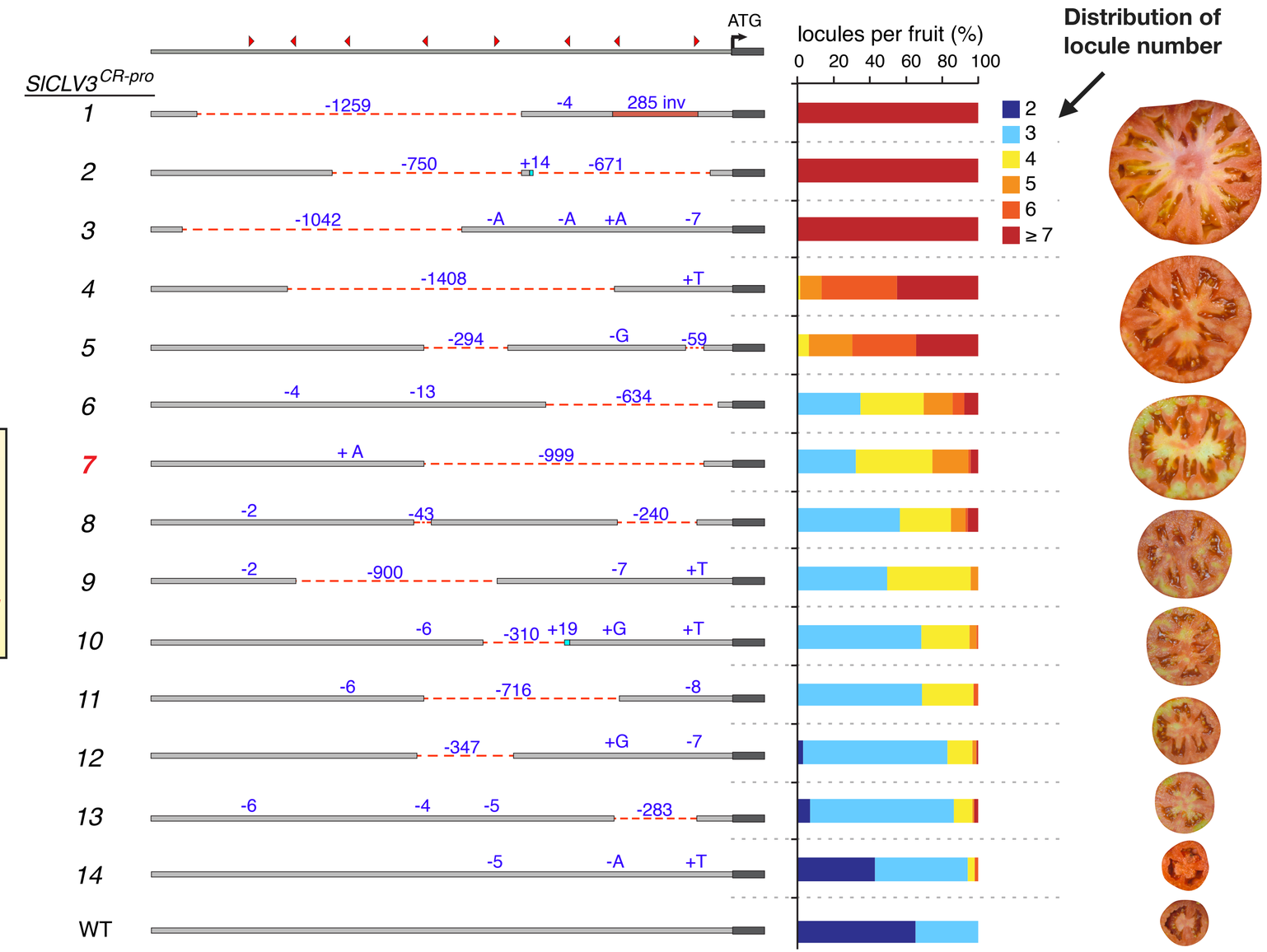
Rodriguez-Leal et al.
(2017) Cell

Multiple promoter alleles and a Range of Quantitative Variation

A genetic drive system to enrich for promoter alleles with phenotypic effects



Rodriguez-Leal et al.
(2017) Cell



Generate Libraries of Genetic and Quantitative Variation

5`*cis*-regulatory elements UTRs / Exons / Introns 3`*cis*-regulatory elements



https://www.videoblocks.com