Gene Drives and their Potential for Weed Control

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Concerning RNA-Guided Gene Drives for the Alteration of Wild Populations

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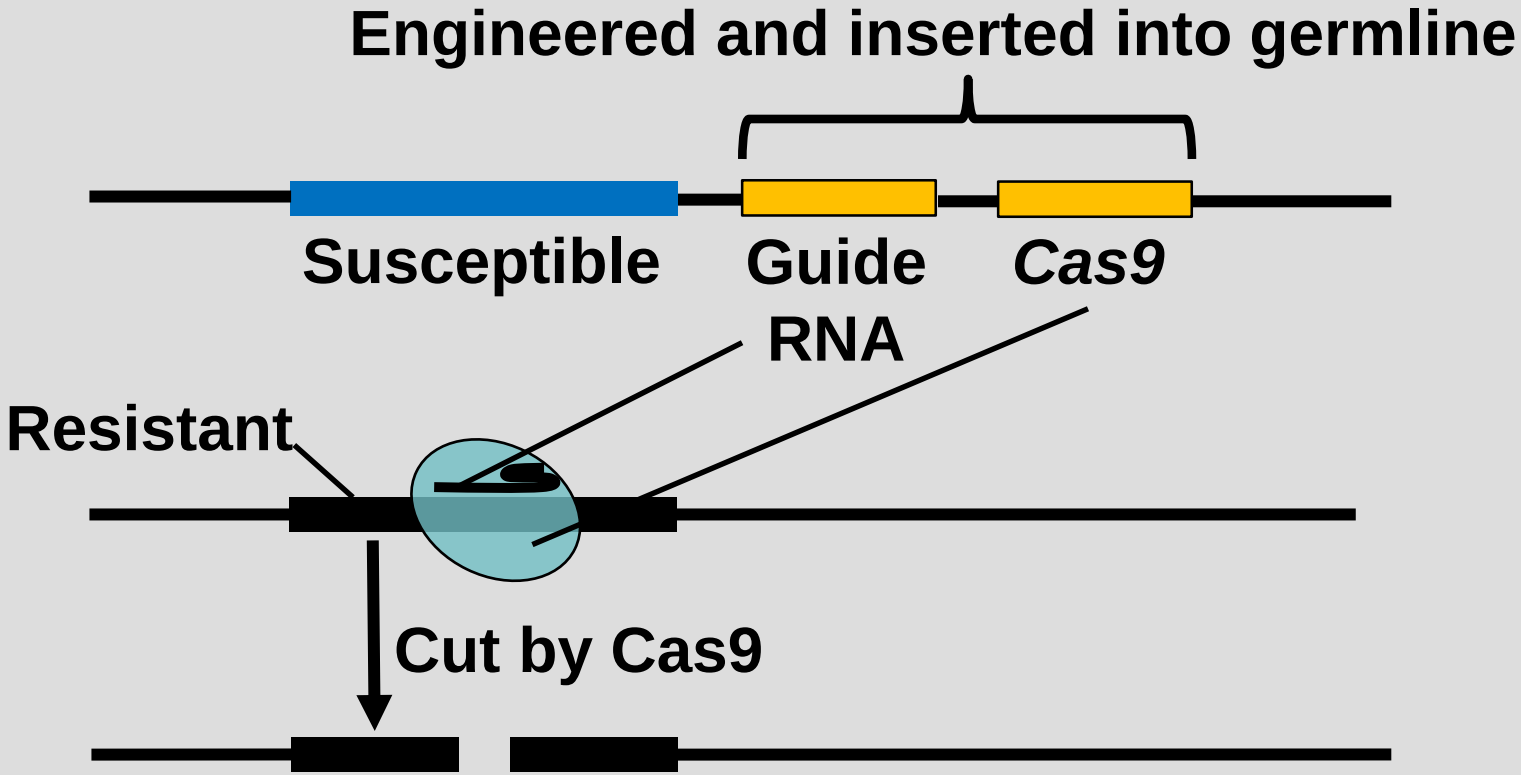
Abstract

Gene drives may be capable of add
populations of wild organisms, but their u
constraints. Here we consider the potenti
nuclease Cas9 to serve as a general metho
over many generations. We detail likely capabilities, discuss limitations, and provide novel
precautionary strategies to control the spread of gene drives and reverse genomic changes. The
ability to edit populations of sexual species would offer substantial benefits to humanity and the
environment. For example, RNA-guided gene drives could potentially prevent the spread of
disease, support agriculture by reversing pesticide and herbicide resistance in insects and
weeds, and c
effects and n
potential app
explore the responsible use of this currently theoretical technology.

"…RNA-guided gene drives could potentially…support agriculture by reversing pesticide and herbicide resistance in insects and weeds…"

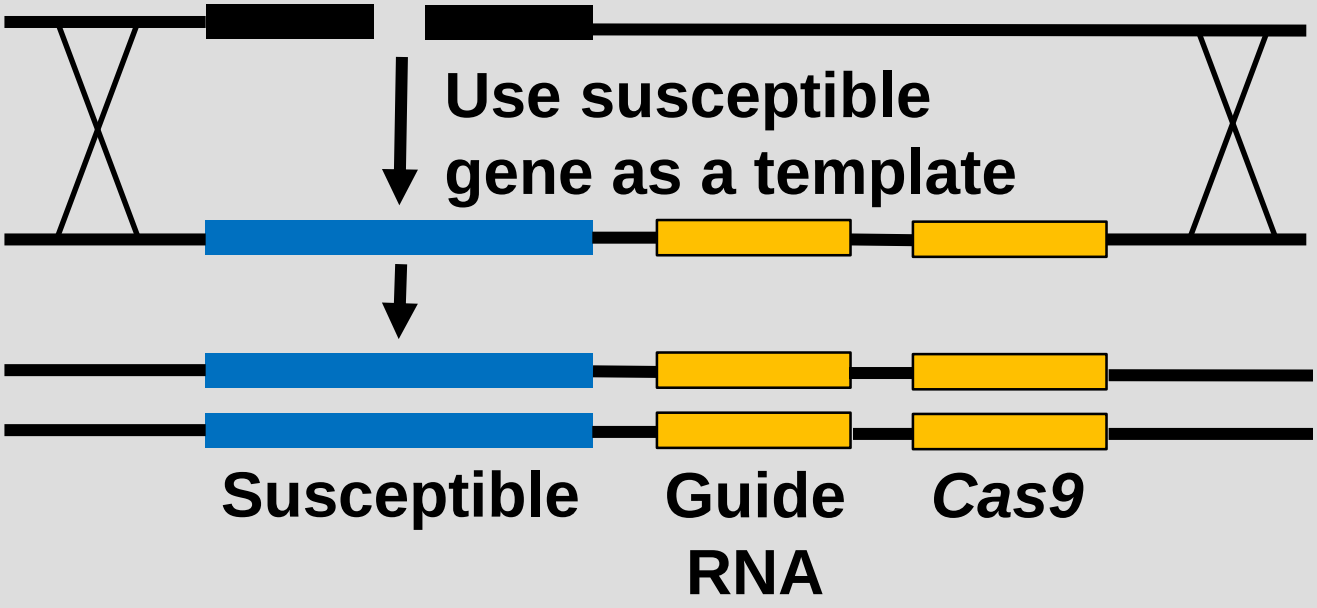
"…currently theoretical technology."

RNA-Guided Gene Drive

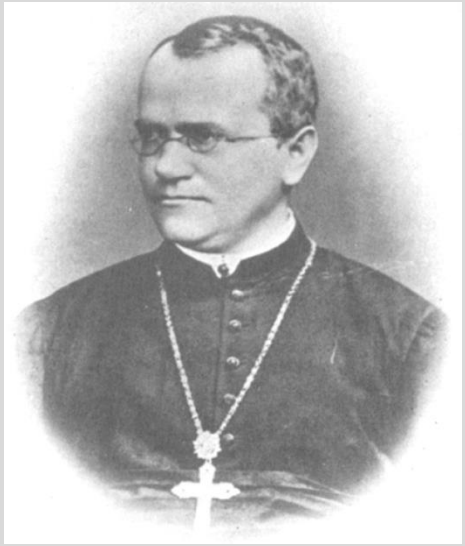


RNA-Guided Gene Drive

How does a weed repair the cut resistance gene?



Mendel's Law of Segregation



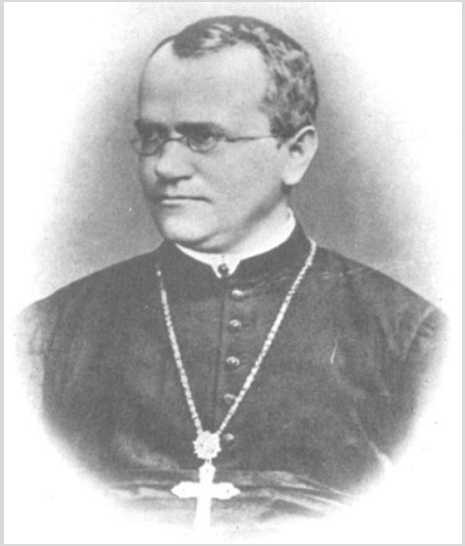
RS x RS

R 50% S 50% R 50% S 50%

R = Resistance

S = Susceptibility

Mendel's Law of Segregation



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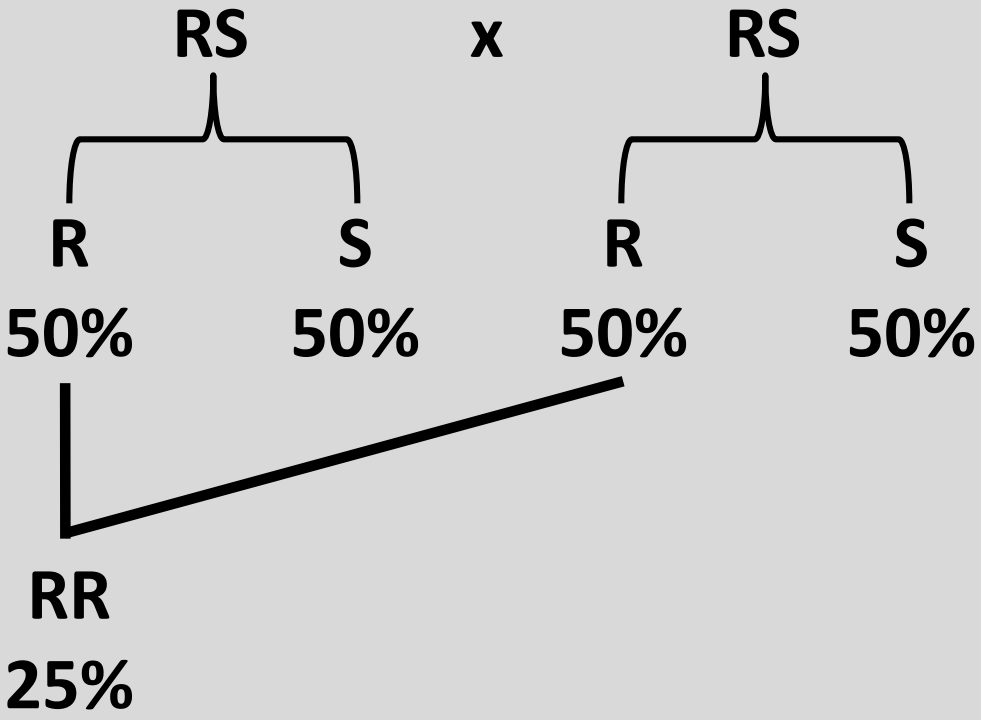

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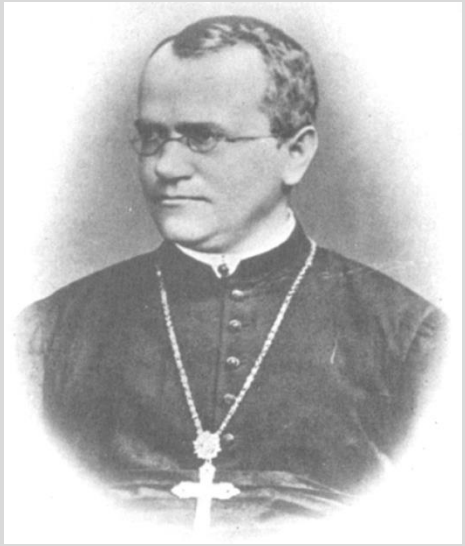

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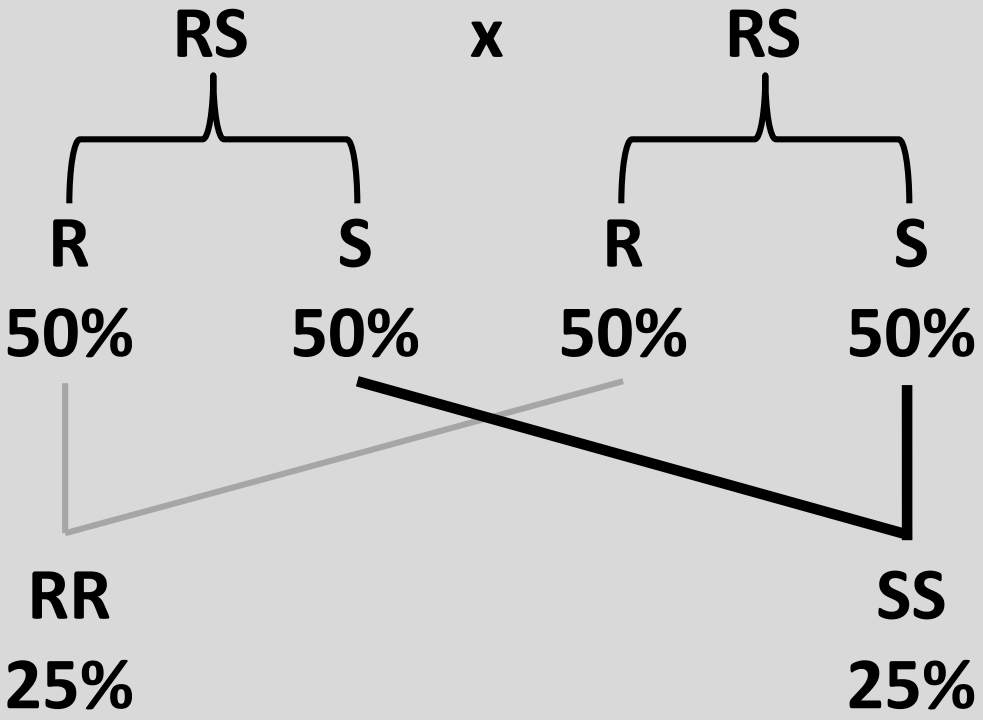
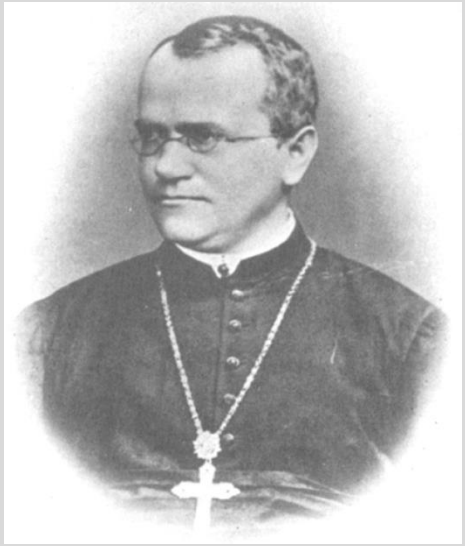
S = Susceptibility



Mendel's Law of Segregation



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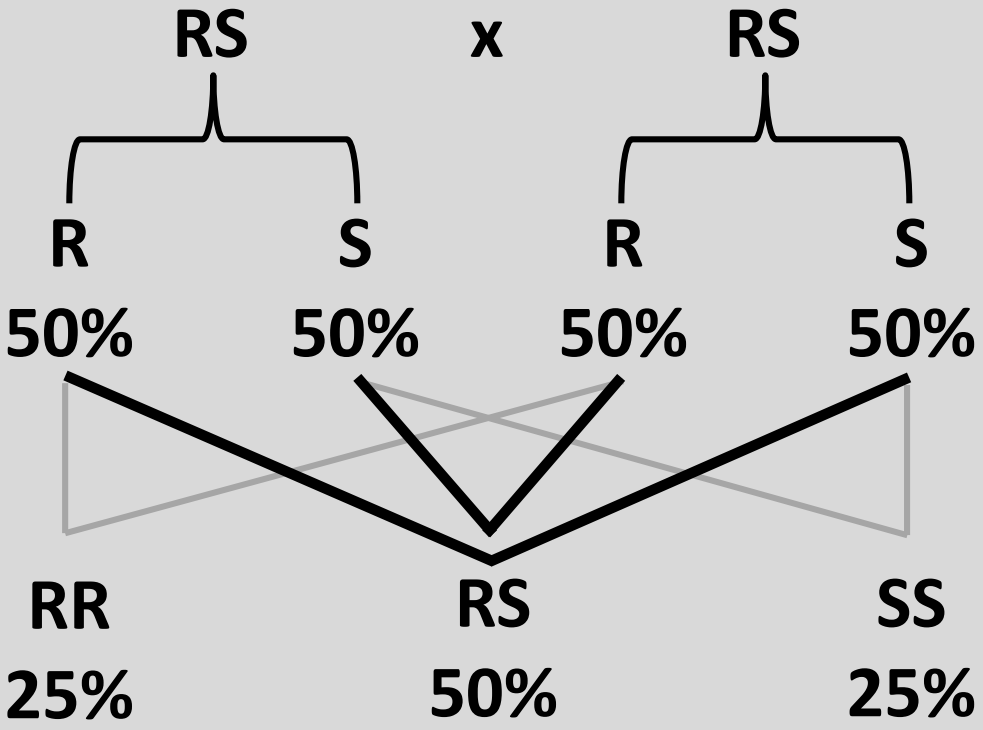
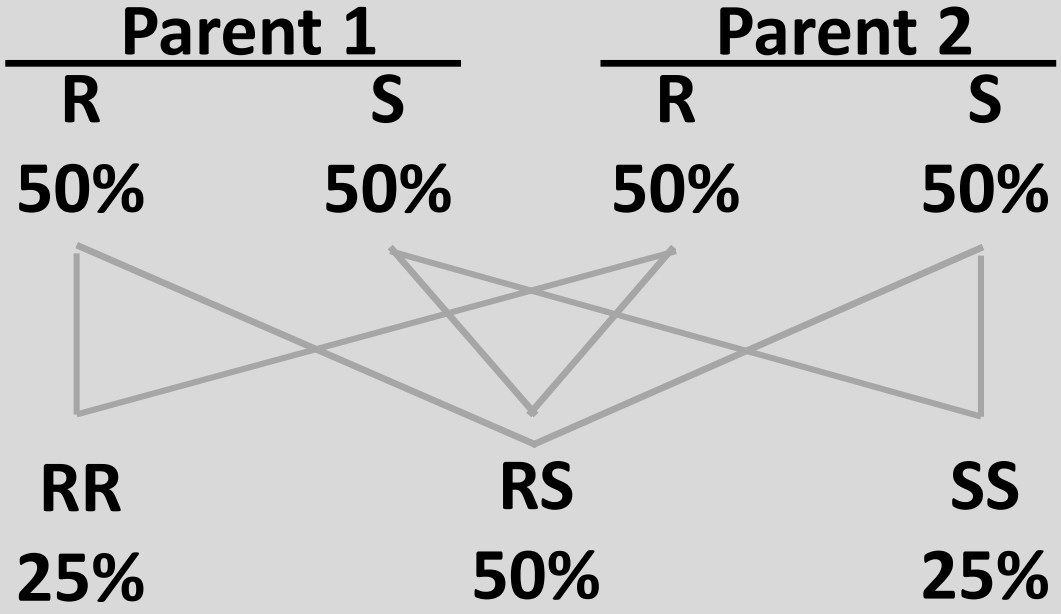
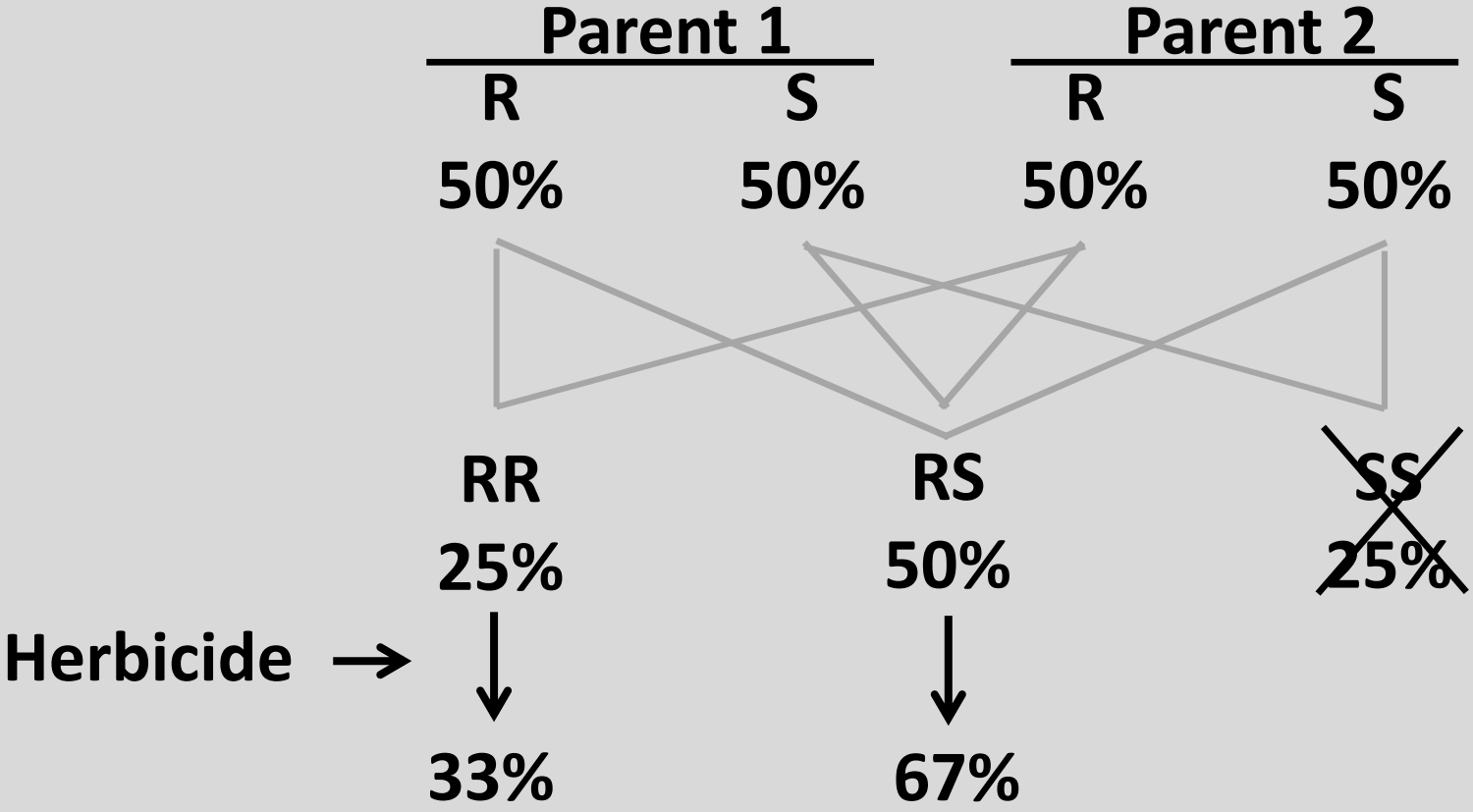


Herbicide Selection



Herbicide Selection

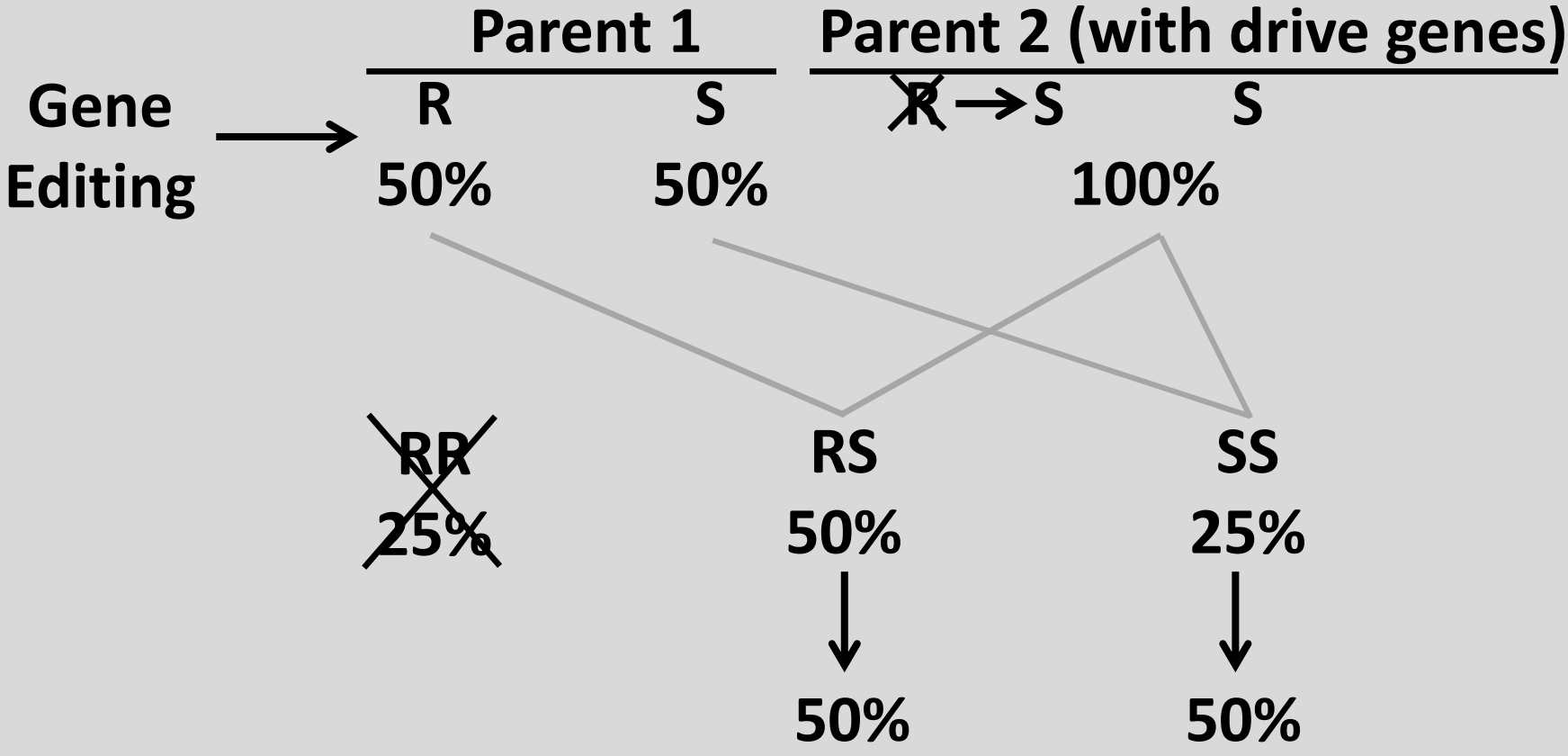


Gene Drive

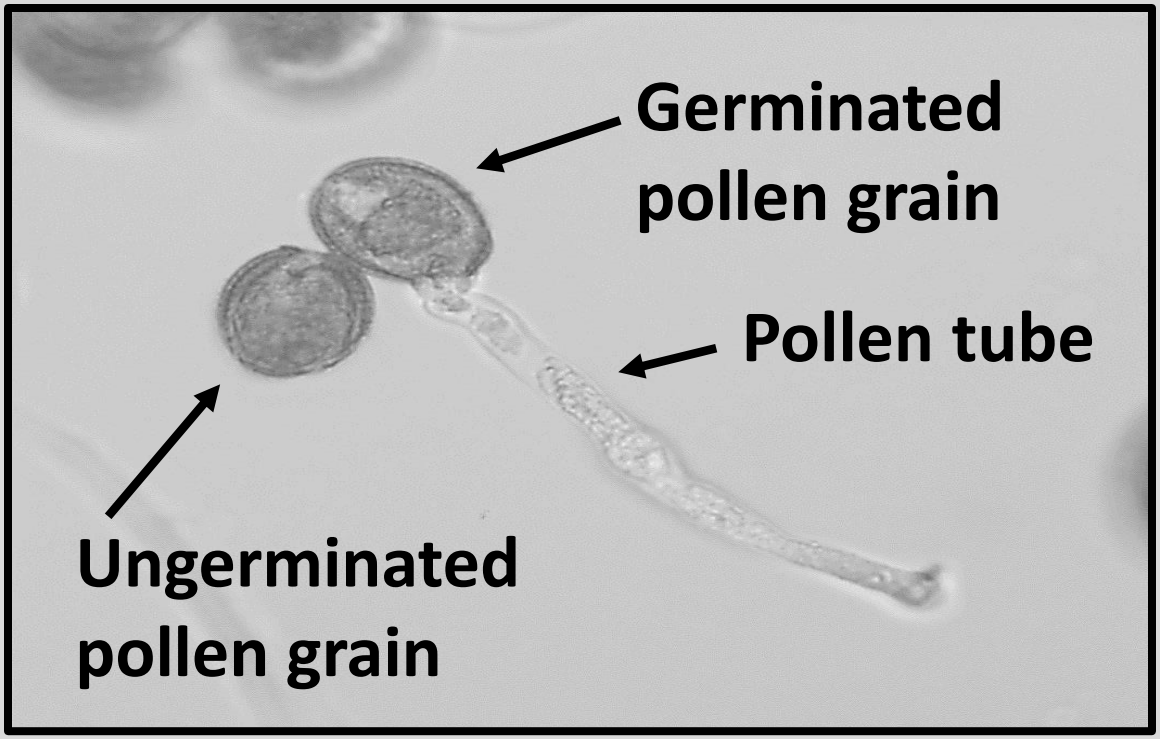
Parent 1		Parent 2 (with drive genes)	
R	S	R	S
50%	50%	50%	50%

RR	RS	SS
25%	50%	25%

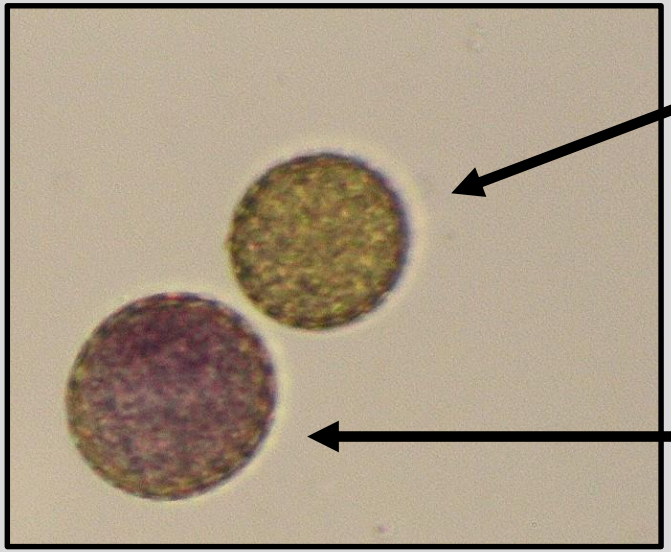
Gene Drive


Parent 1
Parent 2 (with drive genes)
Gene Editing
R
S
R → S
S
50%
50%
100%
RR
25%
RS
50%
50%
SS
25%
50%

B. rapa Pollen Germination



Waterhemp Pollen Viability



Nonviable pollen grain

Viable pollen grain

Thank You

- ND Agricultural Experiment Station
- ND Soybean Council
- ND State Board of Agricultural Research and Extension – Soybean
- USDA – National Institute of Food and Agriculture