

# An ecological perspective on dose for insect resistance management

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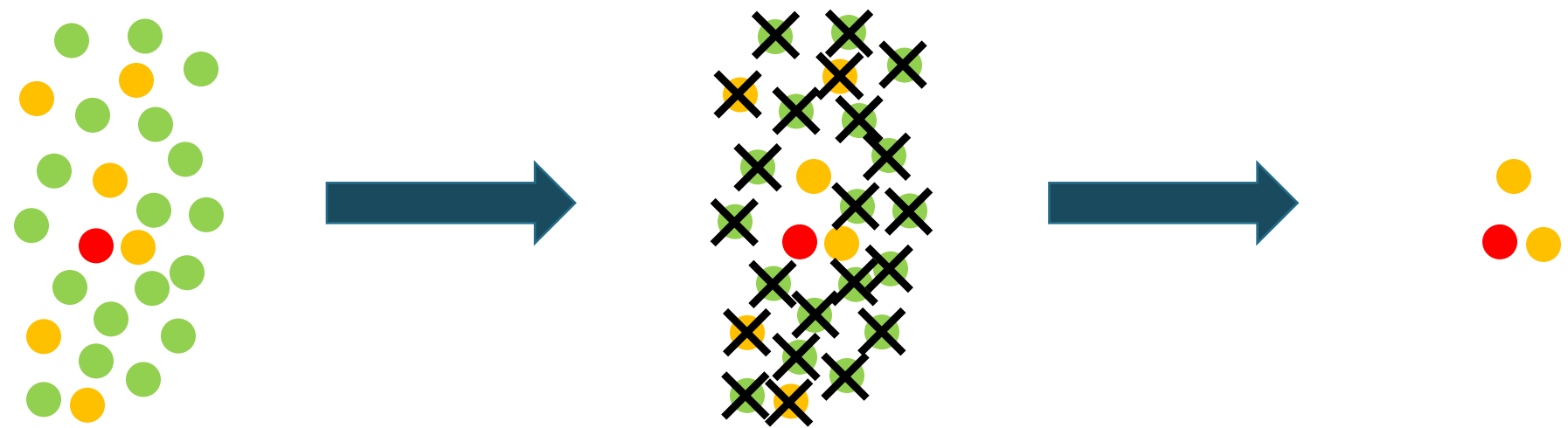
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Entomology 2017  
Denver, CO



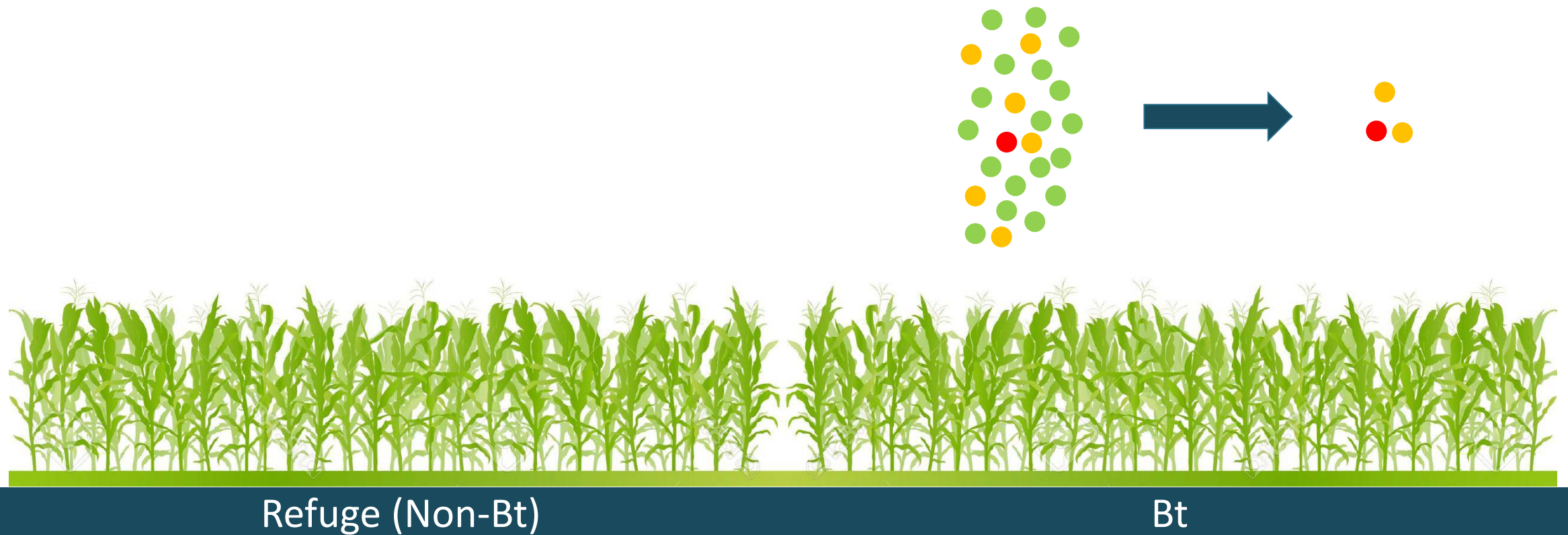
# Direct effect of selection for Bt resistance



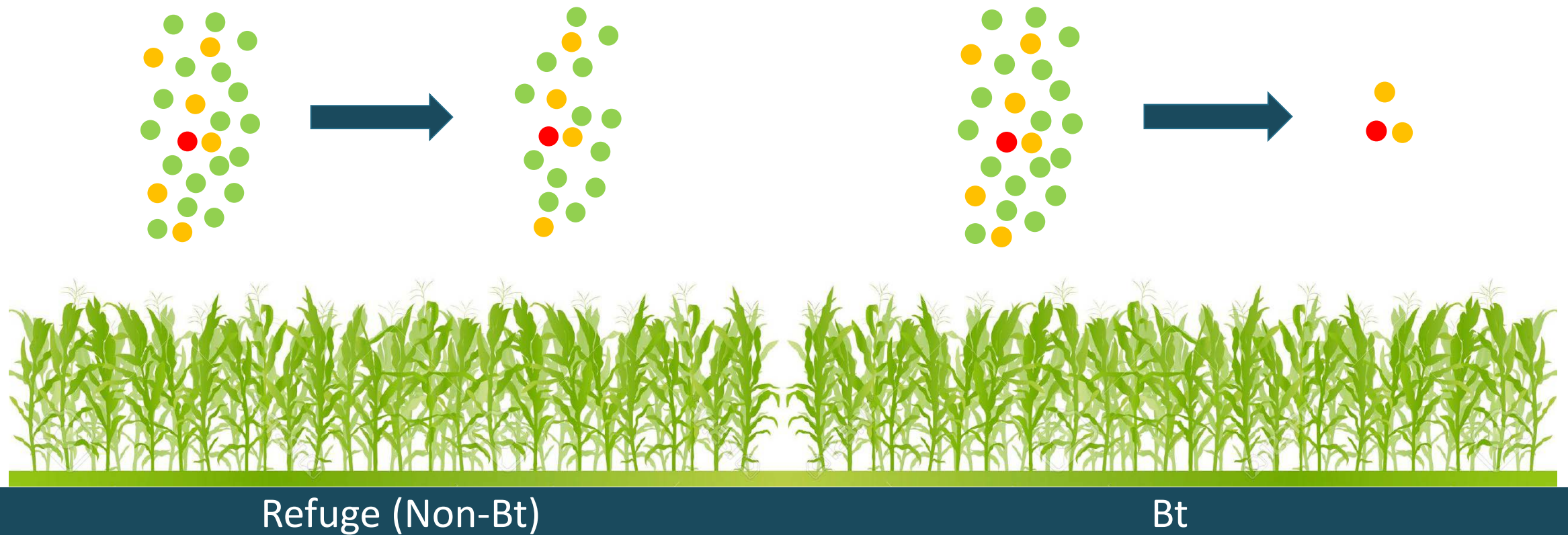
# Indirect effect of selection



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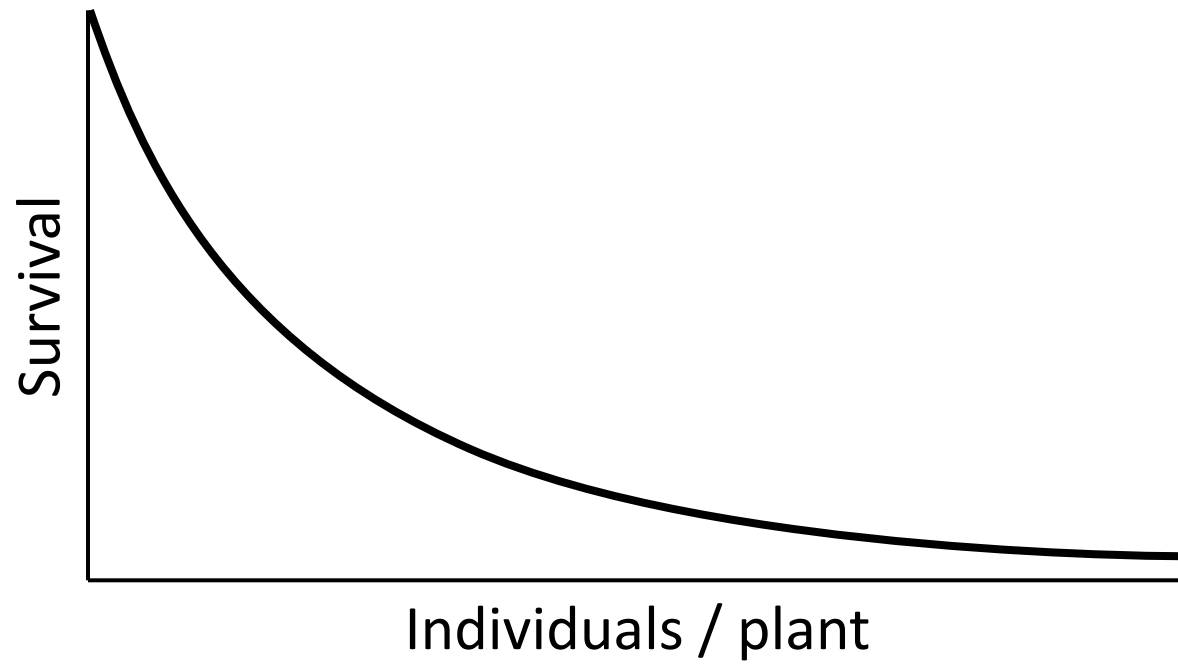


# Indirect effect of selection





# Density dependence



# Indirect effect of selection

Density dependence

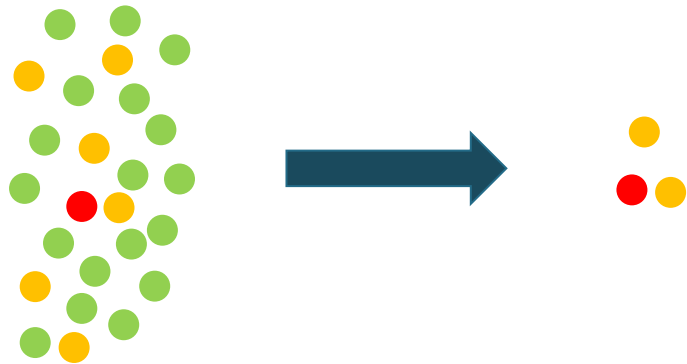


# Indirect effect of selection



# Measuring direct and indirect selection

Direct



Indirect



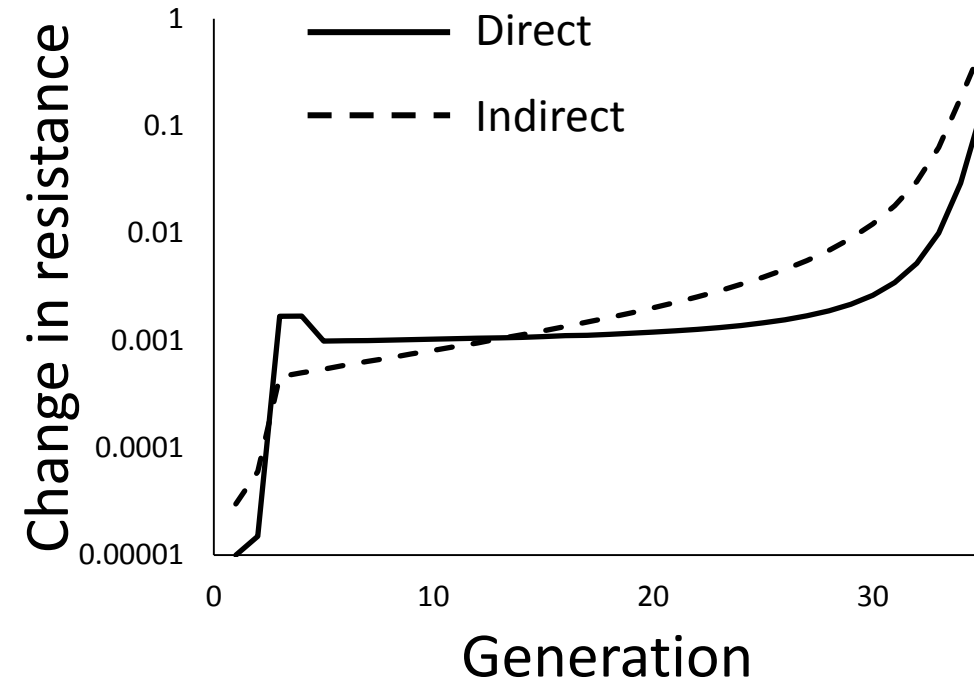
# Direct vs. indirect selection

Susceptible survival

0.0001

Maximum population growth rate

40



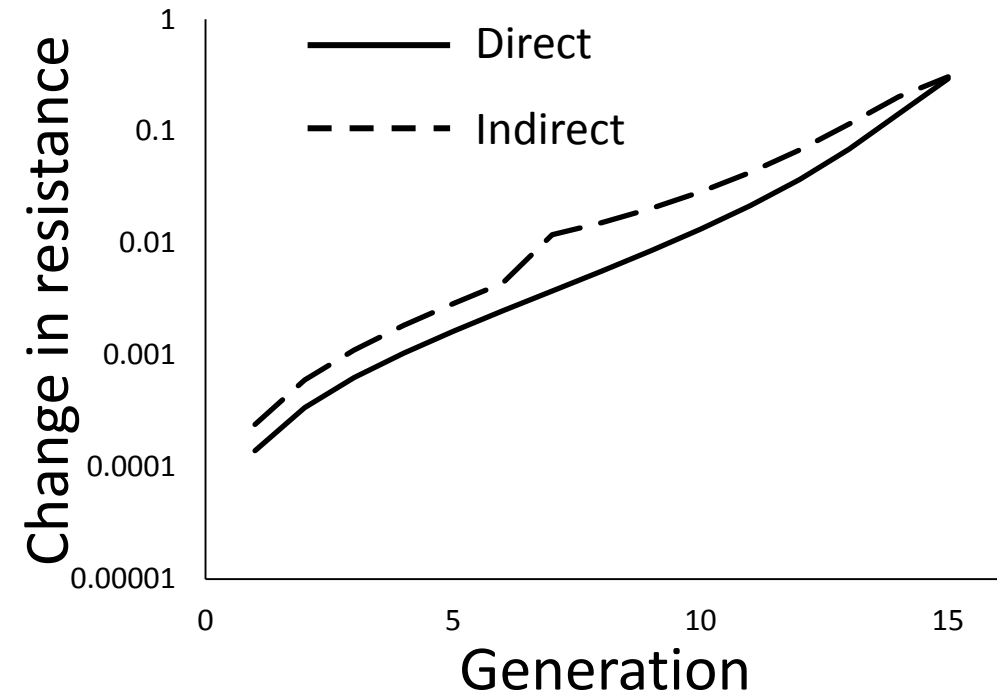
# Direct vs. indirect selection

Susceptible survival

0.1

Maximum population growth rate

40



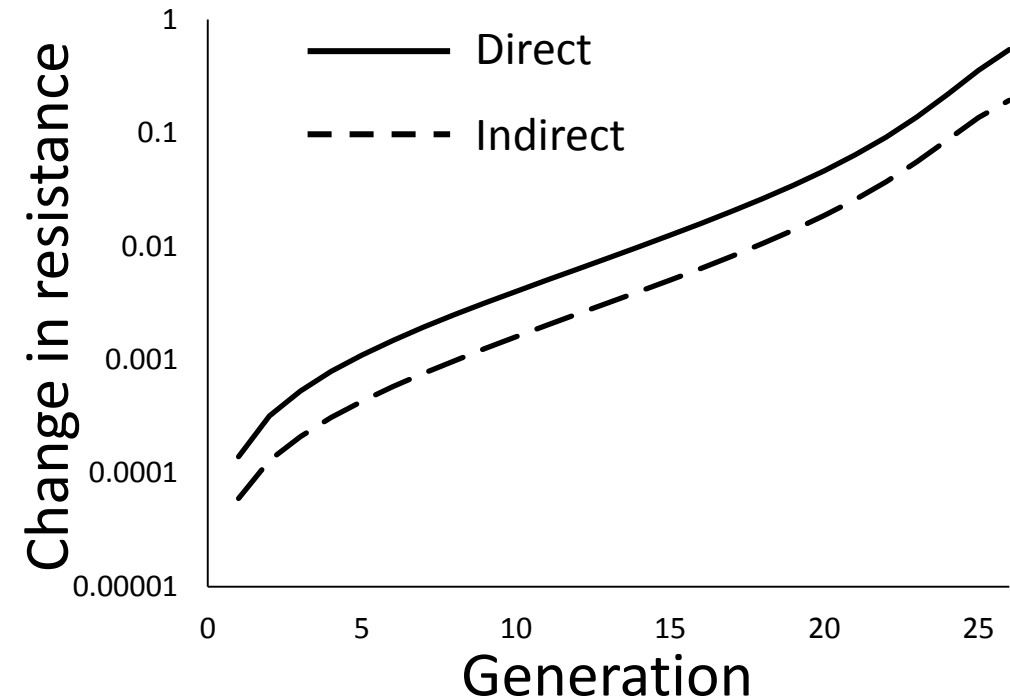
# Direct vs. indirect selection

Susceptible survival

0.1

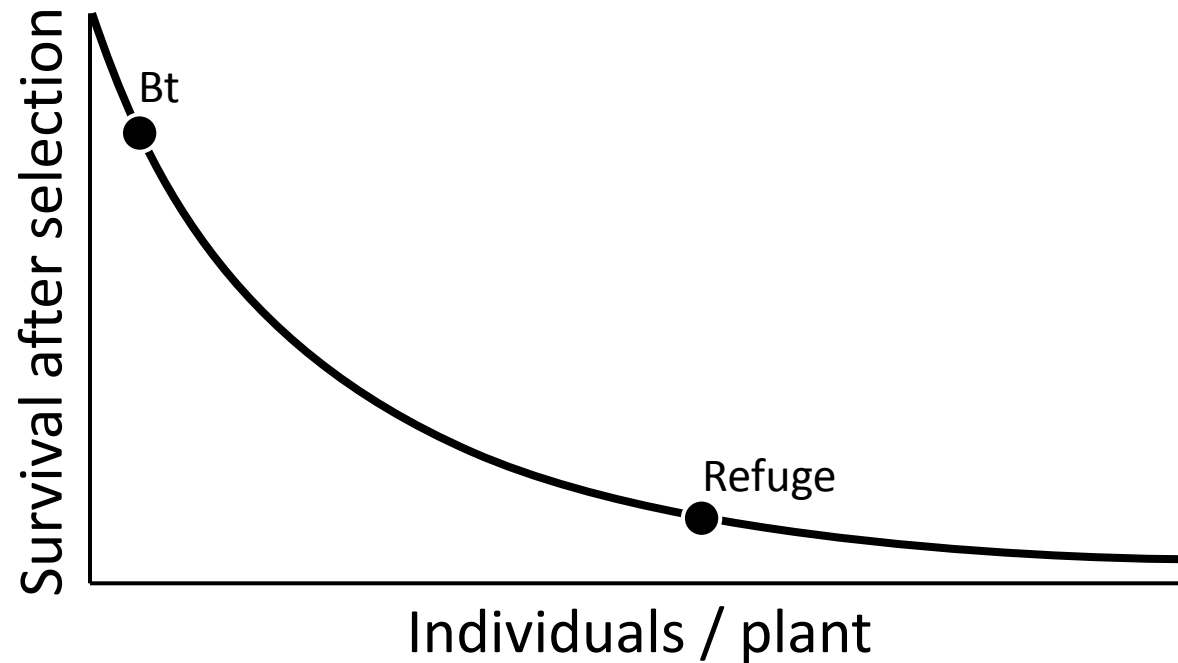
Maximum population growth rate

5



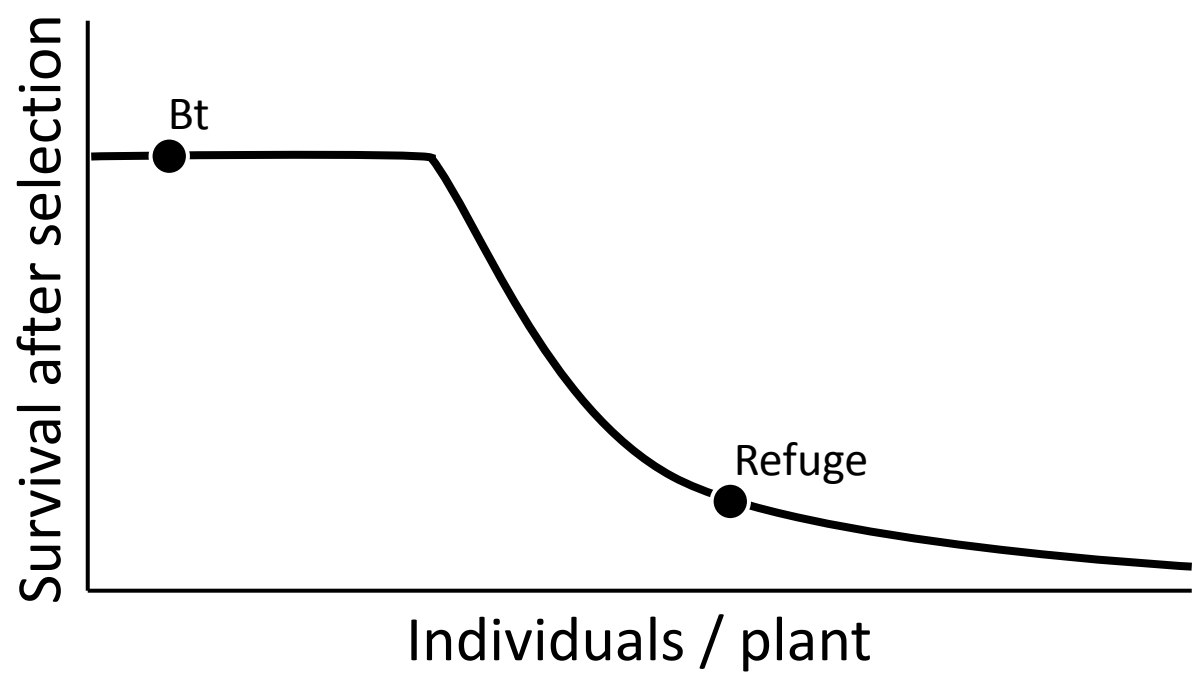


# Density-dependent survival after selection

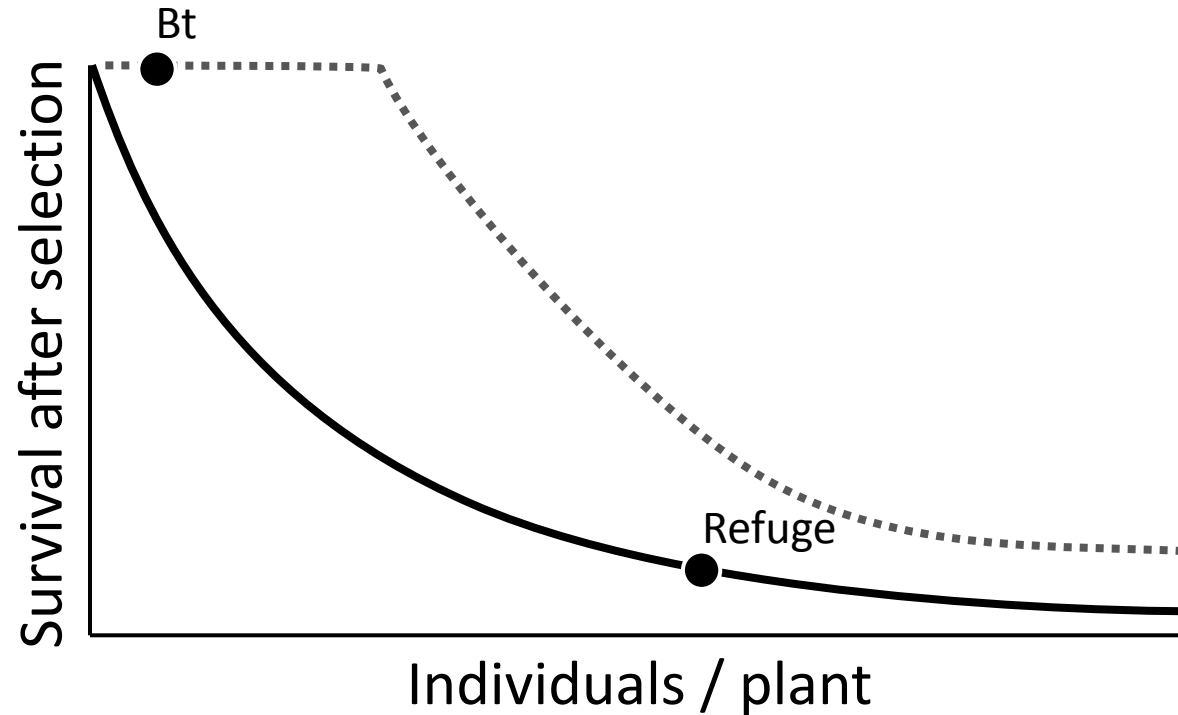




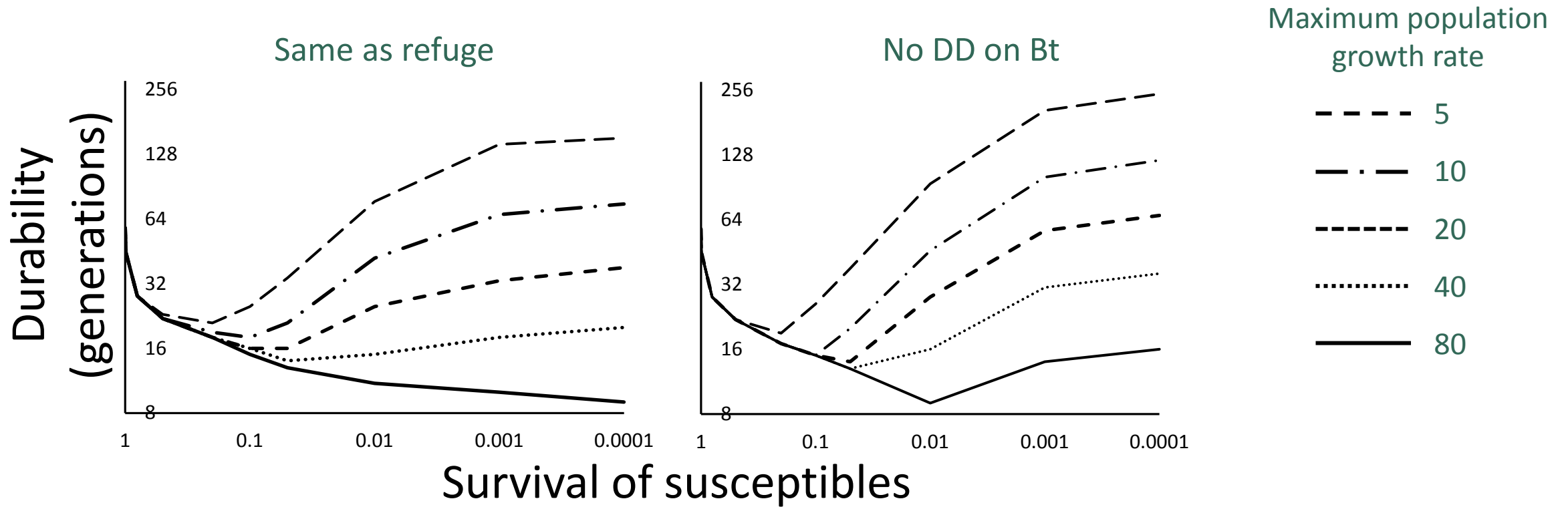
# Density-dependent survival after selection



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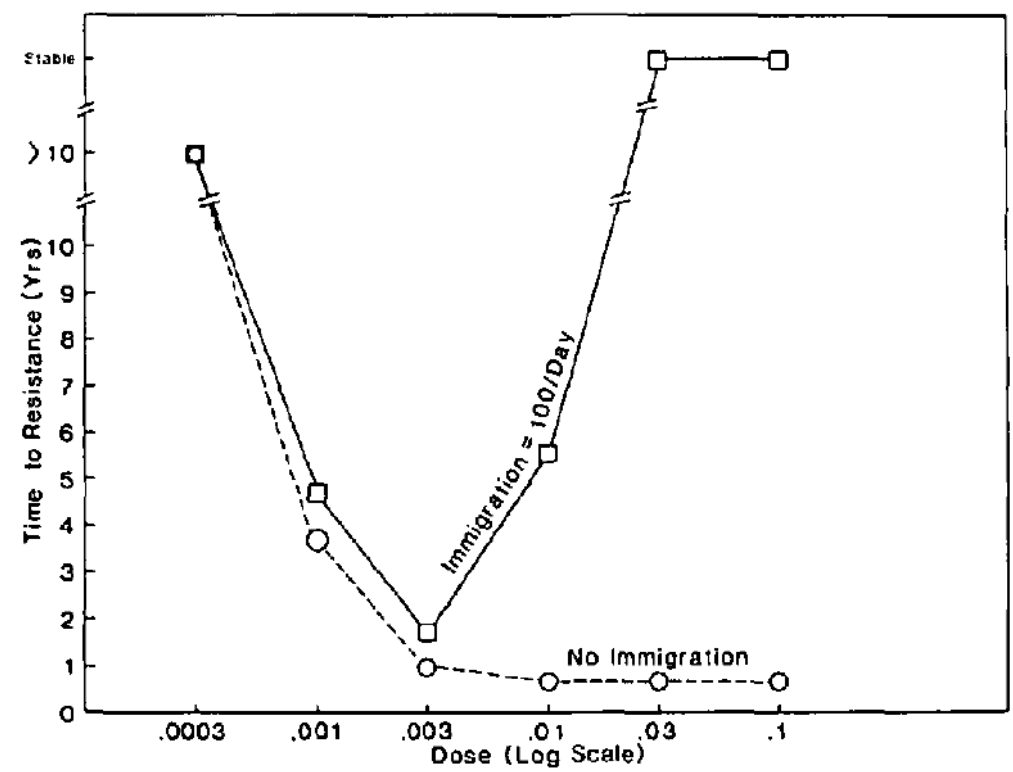


# Population growth rate is as important as dose



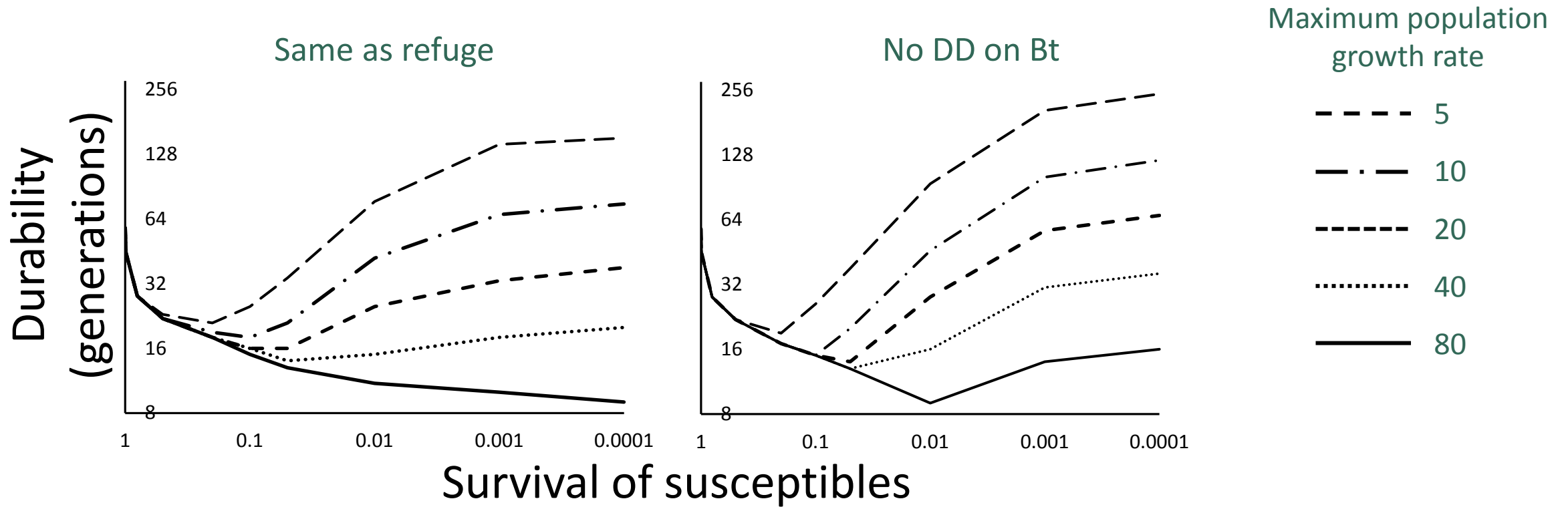


# Population growth rate is as important as dose

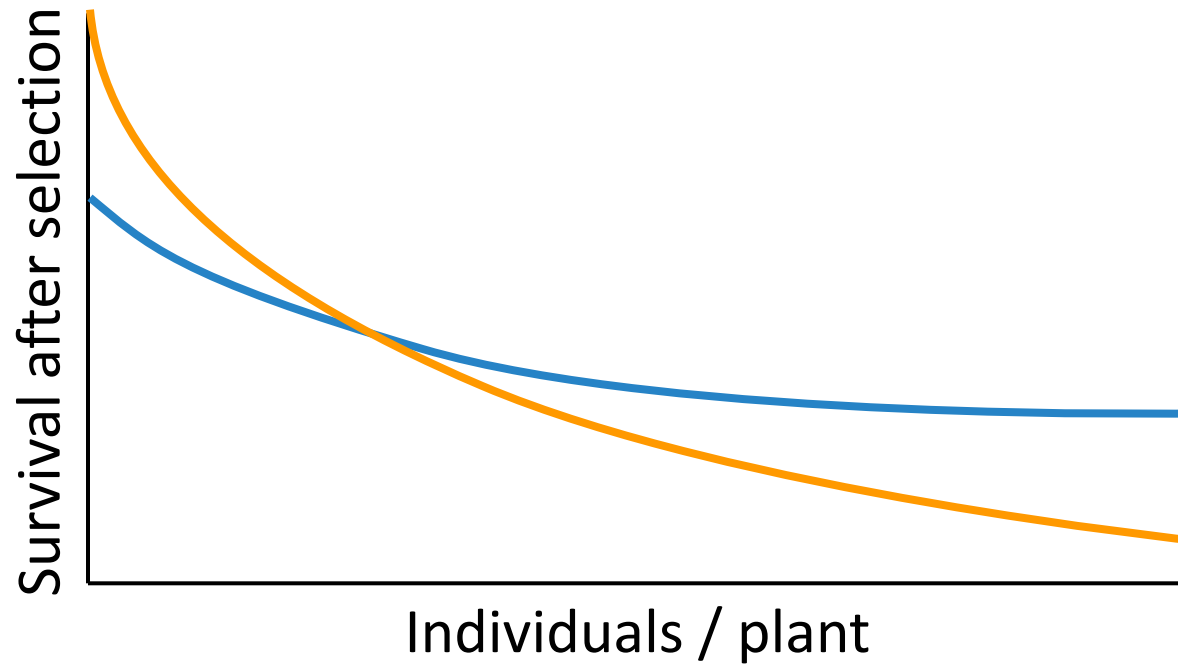


Tabashnik and Croft 1982

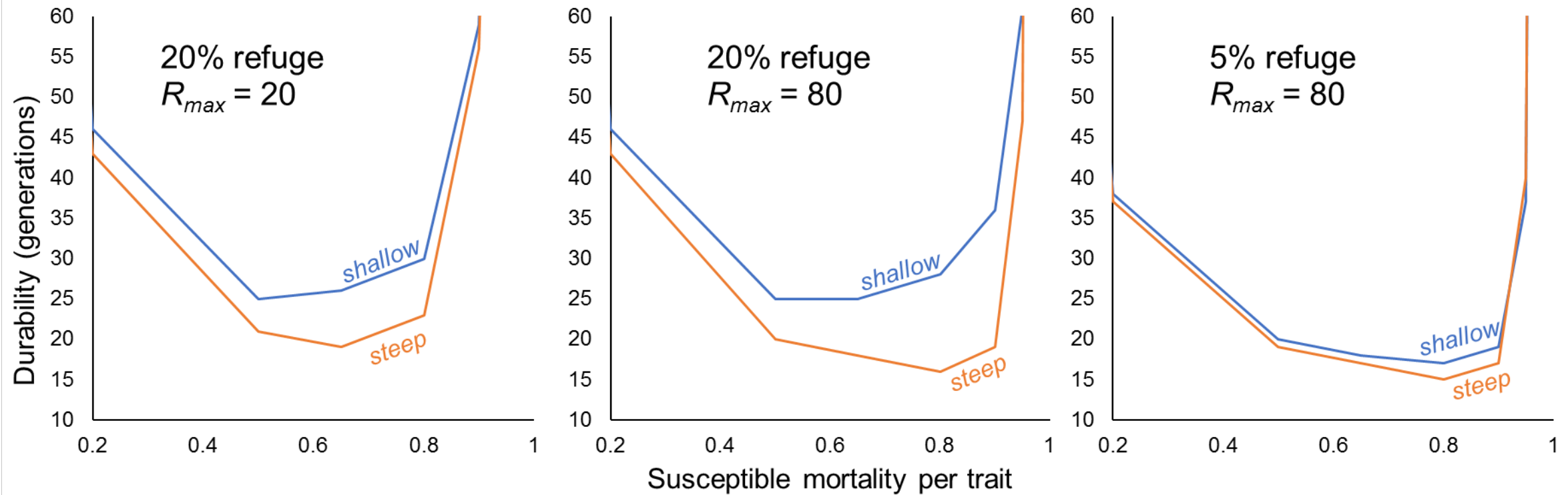
# Population growth rate is as important as dose



# The “shape” of density dependence



# The “shape” of density dependence



# Conclusions

- Ecology is a meaningful part of the response to selection for Bt resistance
- Maximum population growth rate is as important as dose in determining durability
- The shape, or strength, of density dependence may also be important
  - Unless:
    - Refuge is small
    - Density dependence is negligible on Bt plants

# Recommendations

Broaden the concept of high dose  
to consider ecology

*One bug's high dose  
is another bug's low dose*

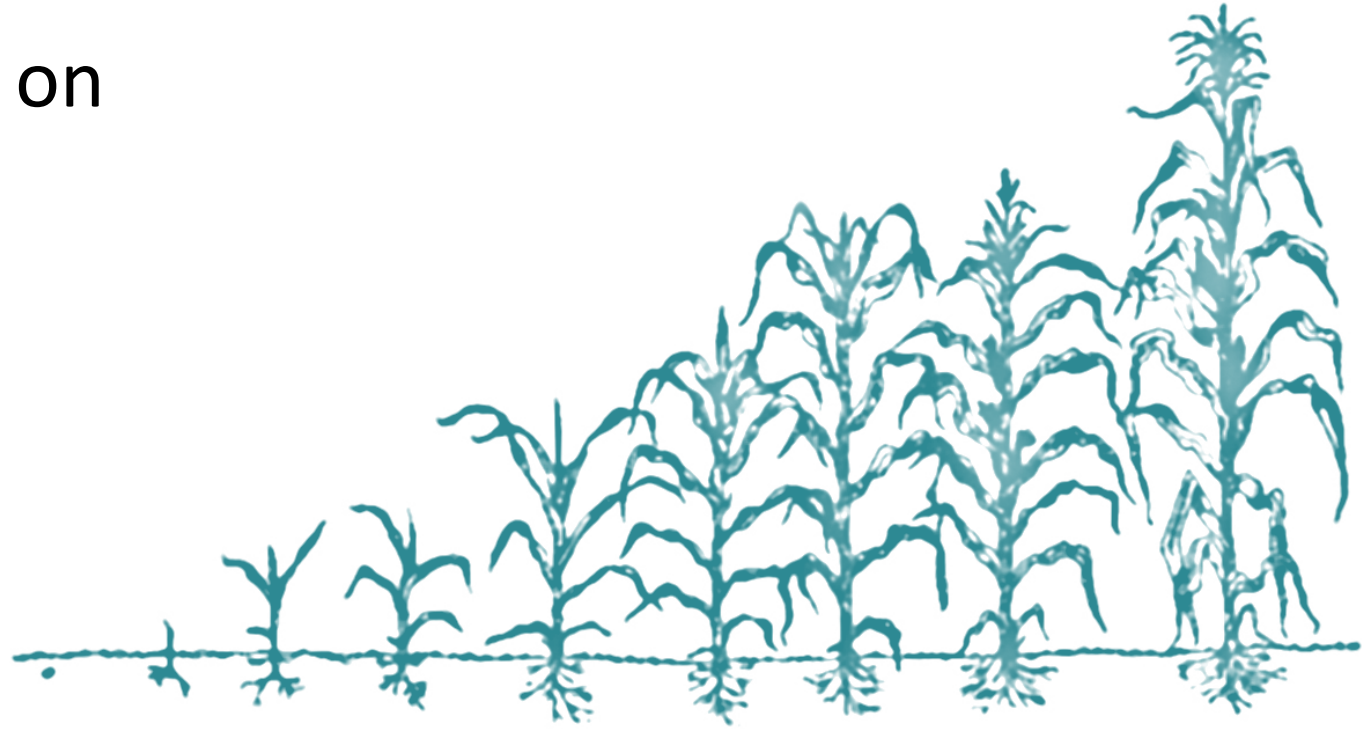


# Recommendations

Measure density dependence on  
Bt plants

*Is it there?*

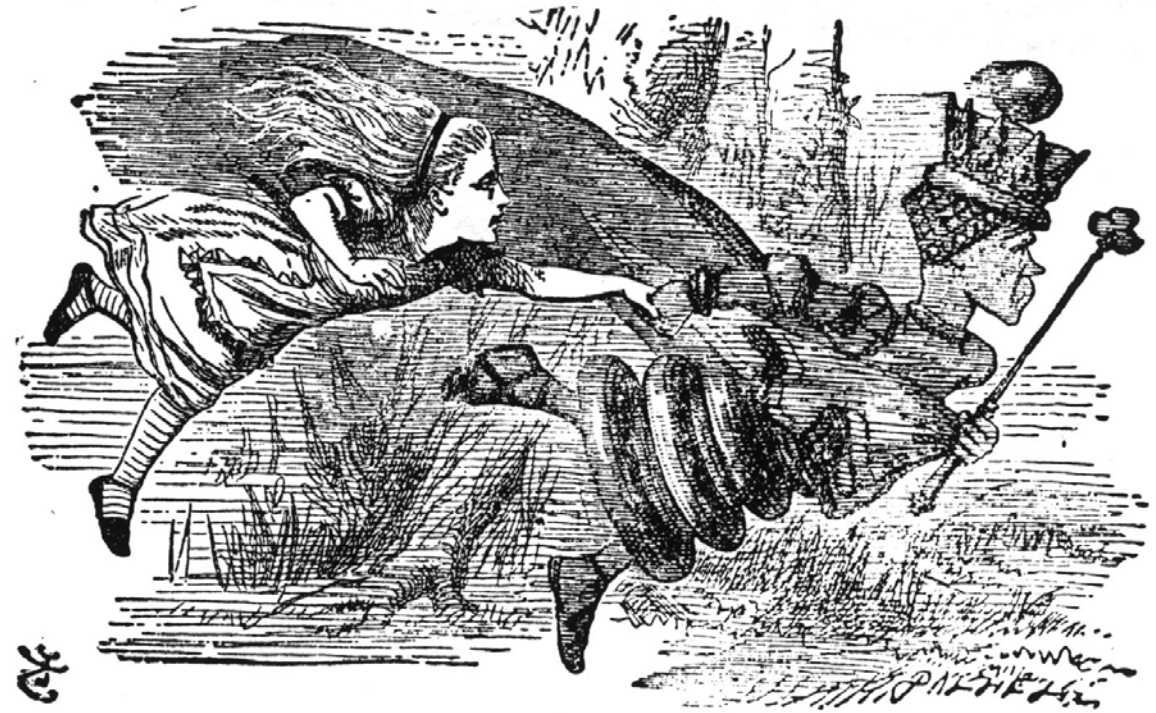
*Does it differ from the refuge?*



# Recommendations

Clearly, there is a role for IPM

*Reduction of maximum population growth is an extension of durability*



# Thank you

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