

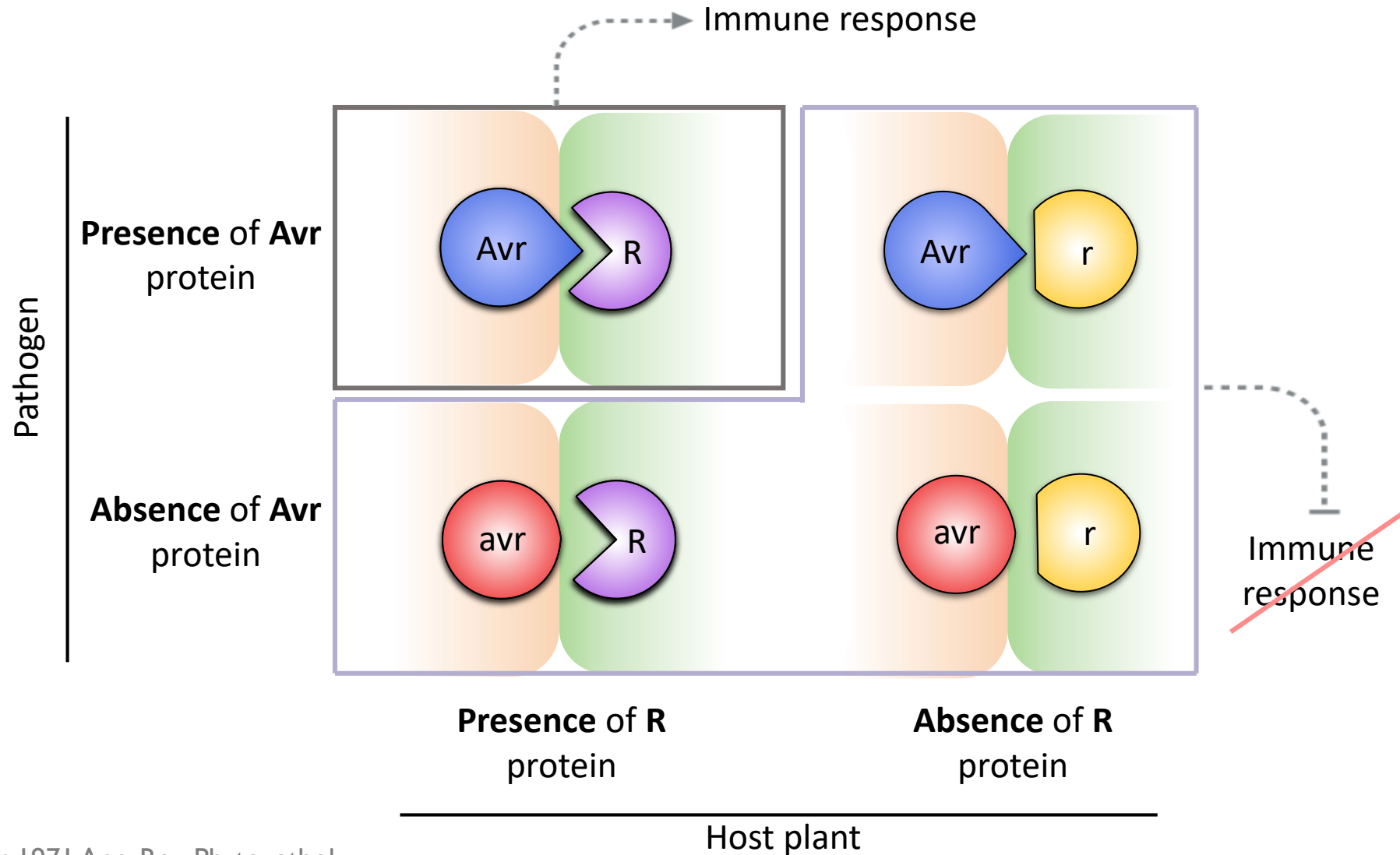
# Effect of ploidy and life cycle on plant resistance durability

Méline SAUBIN, Clémentine LOUET, Fabien HALKETT

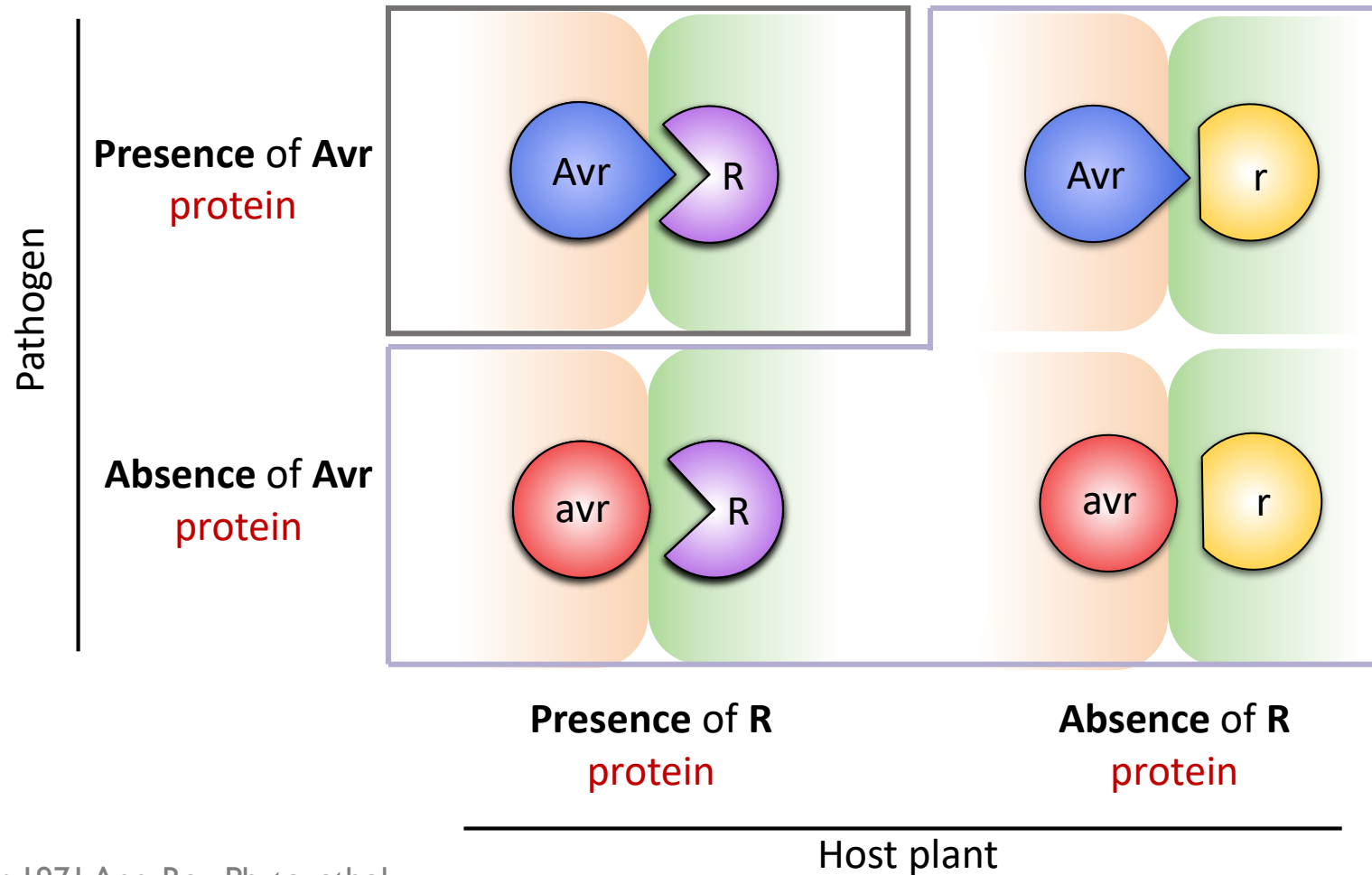
*1ère Réunion du Réseau E3GP3 (6-7 décembre à Paris en visio)*



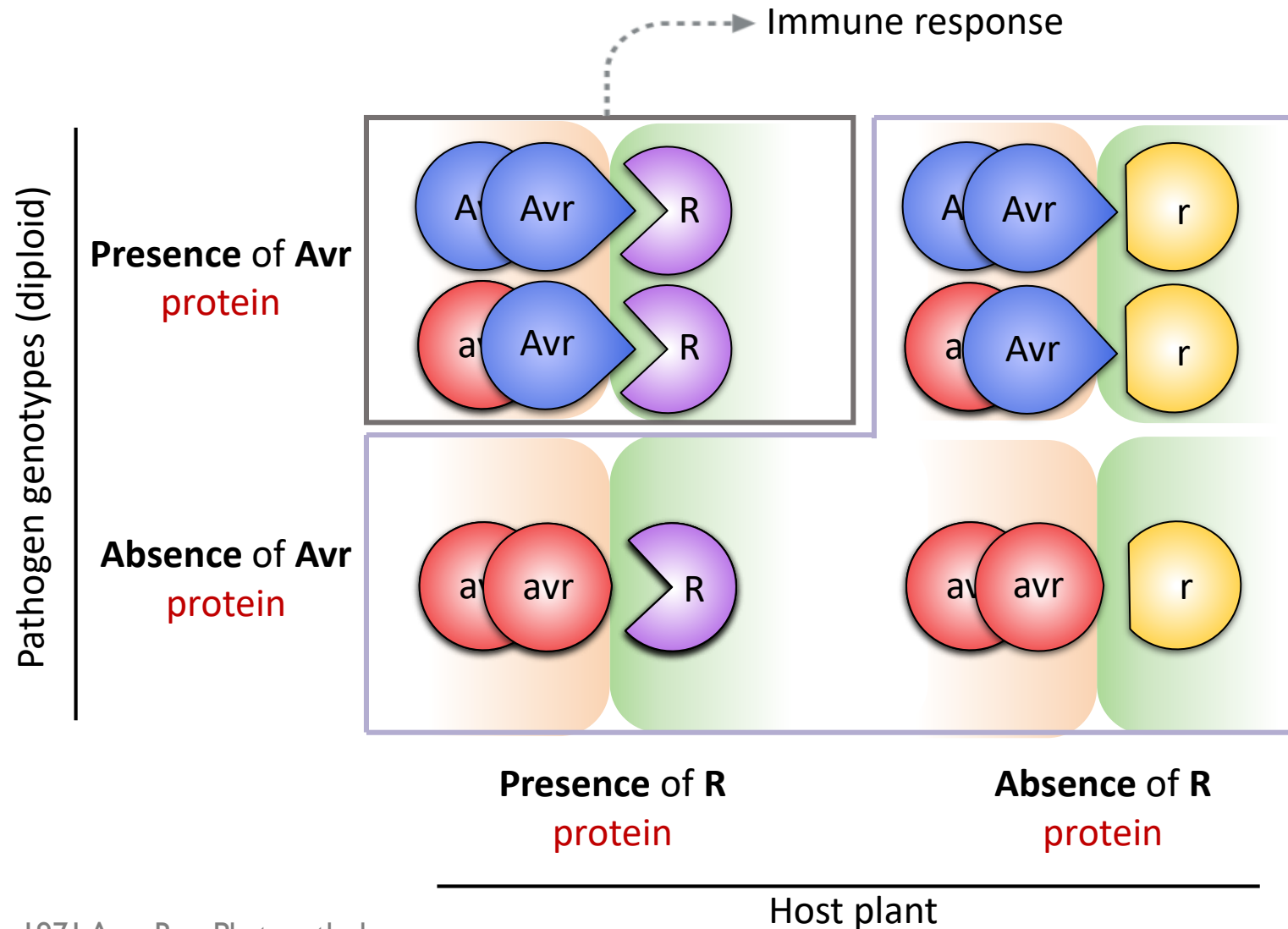
# The gene-for-gene relationship



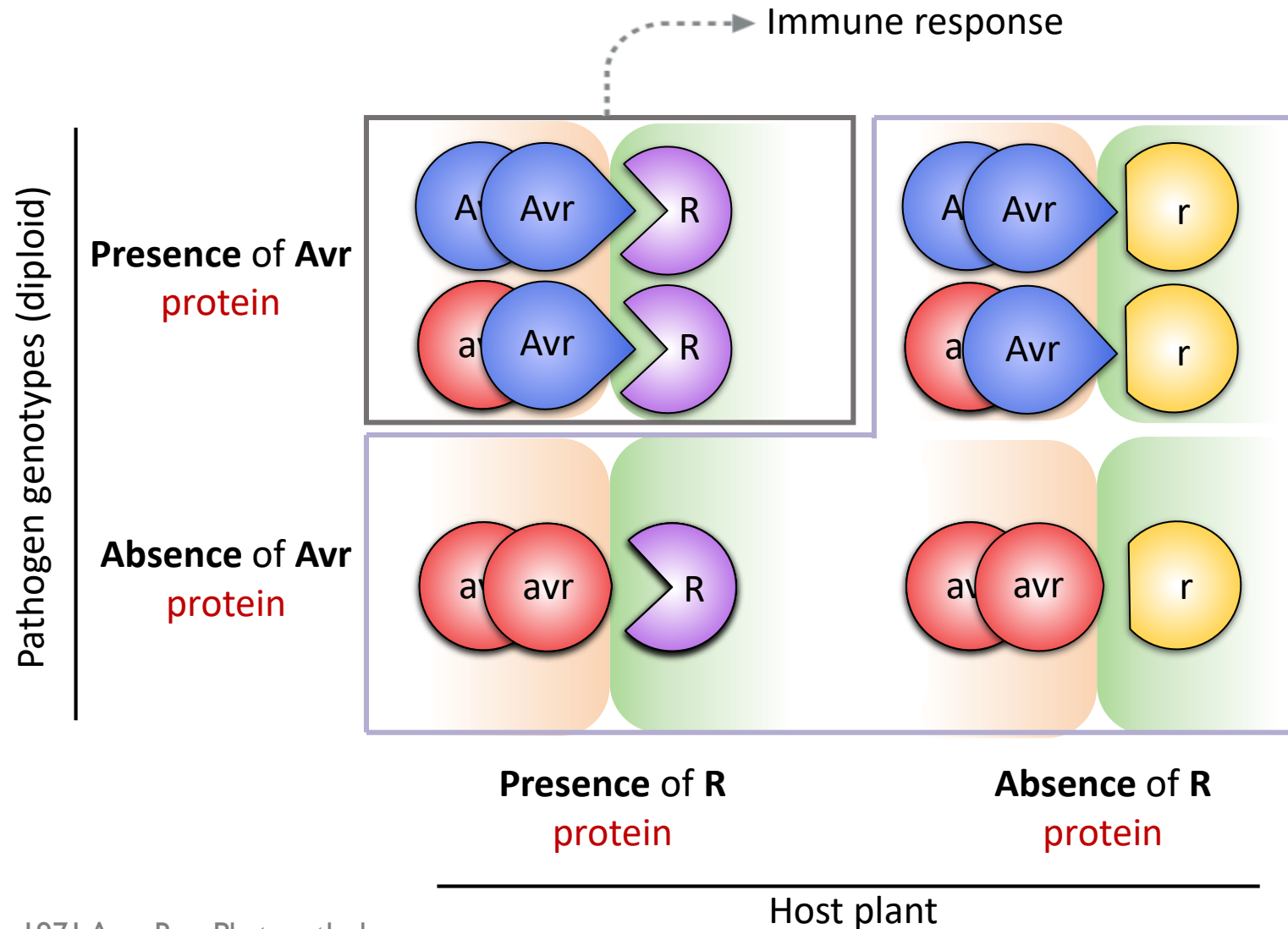
# The gene-for-gene relationship



In diploids, immunity is overcome at the homozygous state

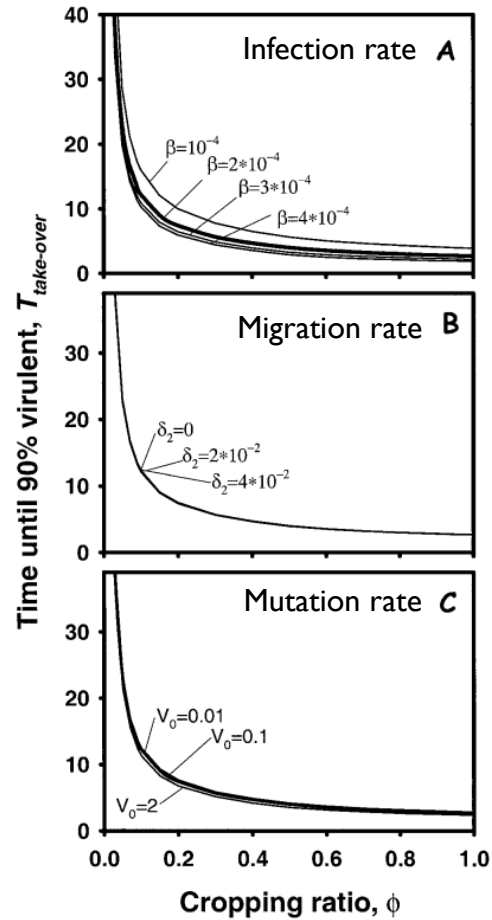
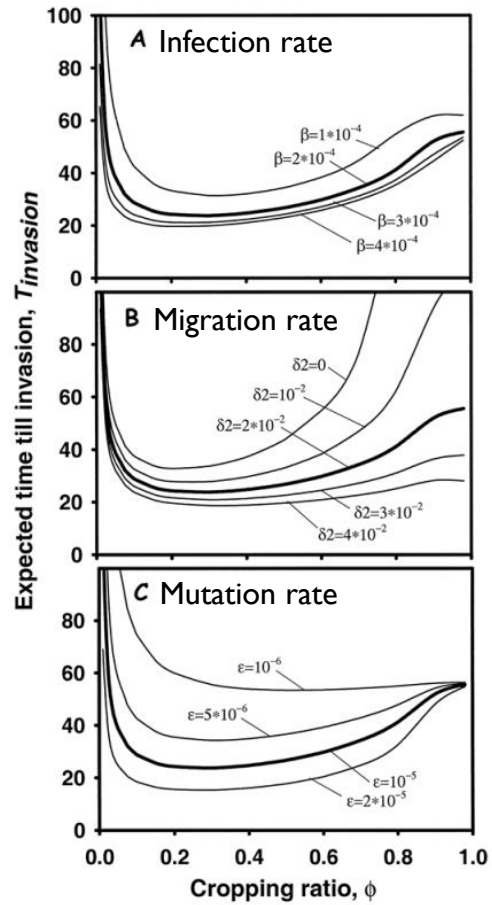


# In diploids, immunity is overcome at the homozygous state



Working hypothesis:  
At **initial** (heterozygous) state virulent allele is only subjected to **drift**.

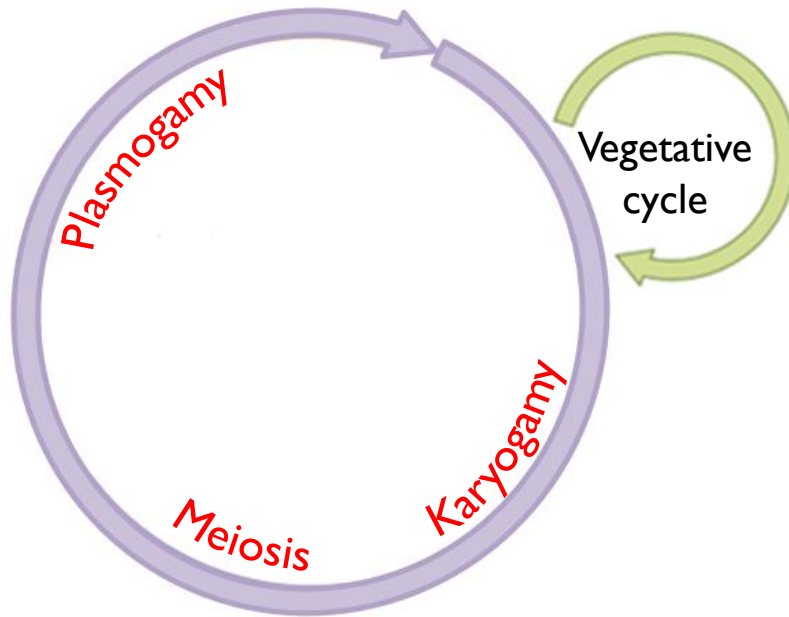
# Different measures of resistance durability



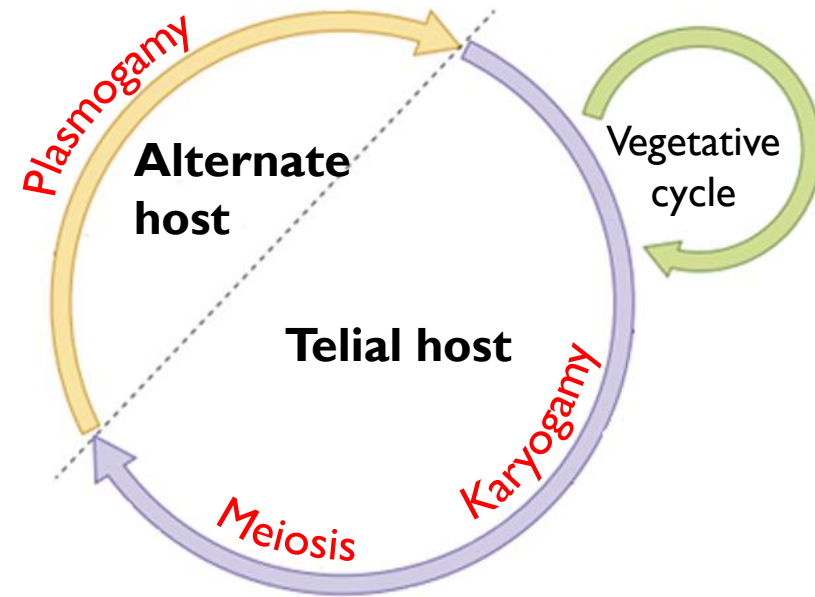
Different outcomes for different time points

# Two contrasted life cycles

Autoecious:  
One host species



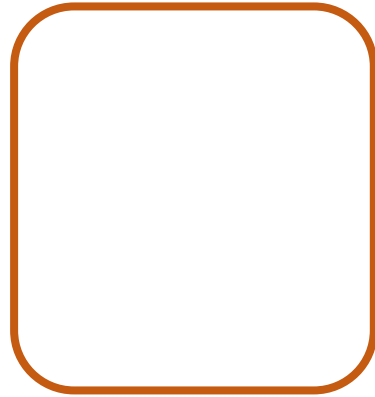
Heteroecious:  
Two different host species



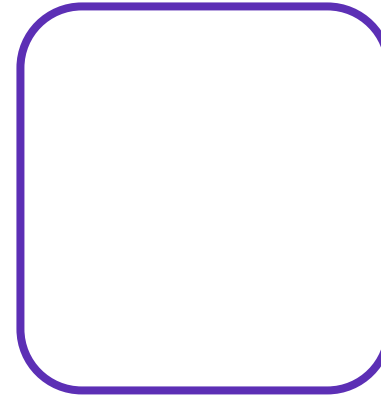
Adapted from Lorrain *et al.*, 2019 *New Phyt*

# Model 1: Without host alternation

Susceptible  
Hosts (S)

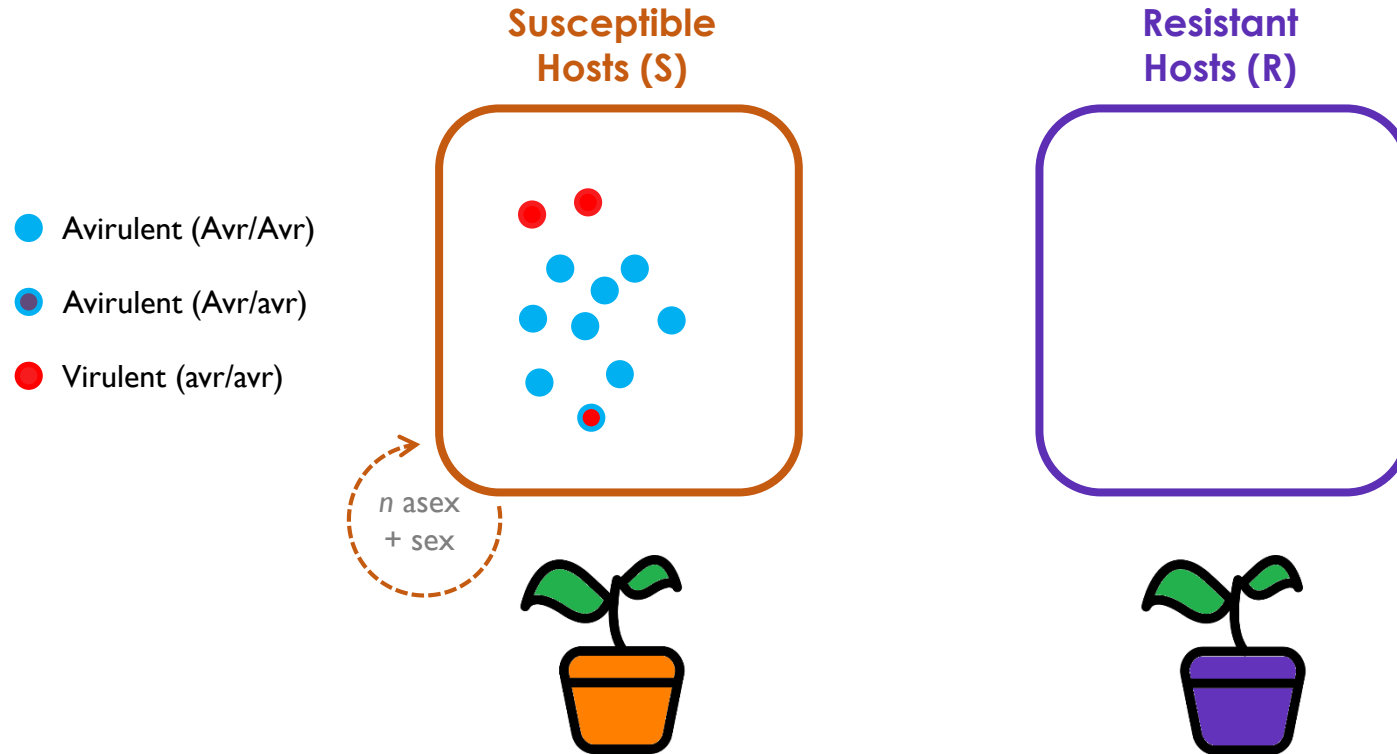


Resistant  
Hosts (R)

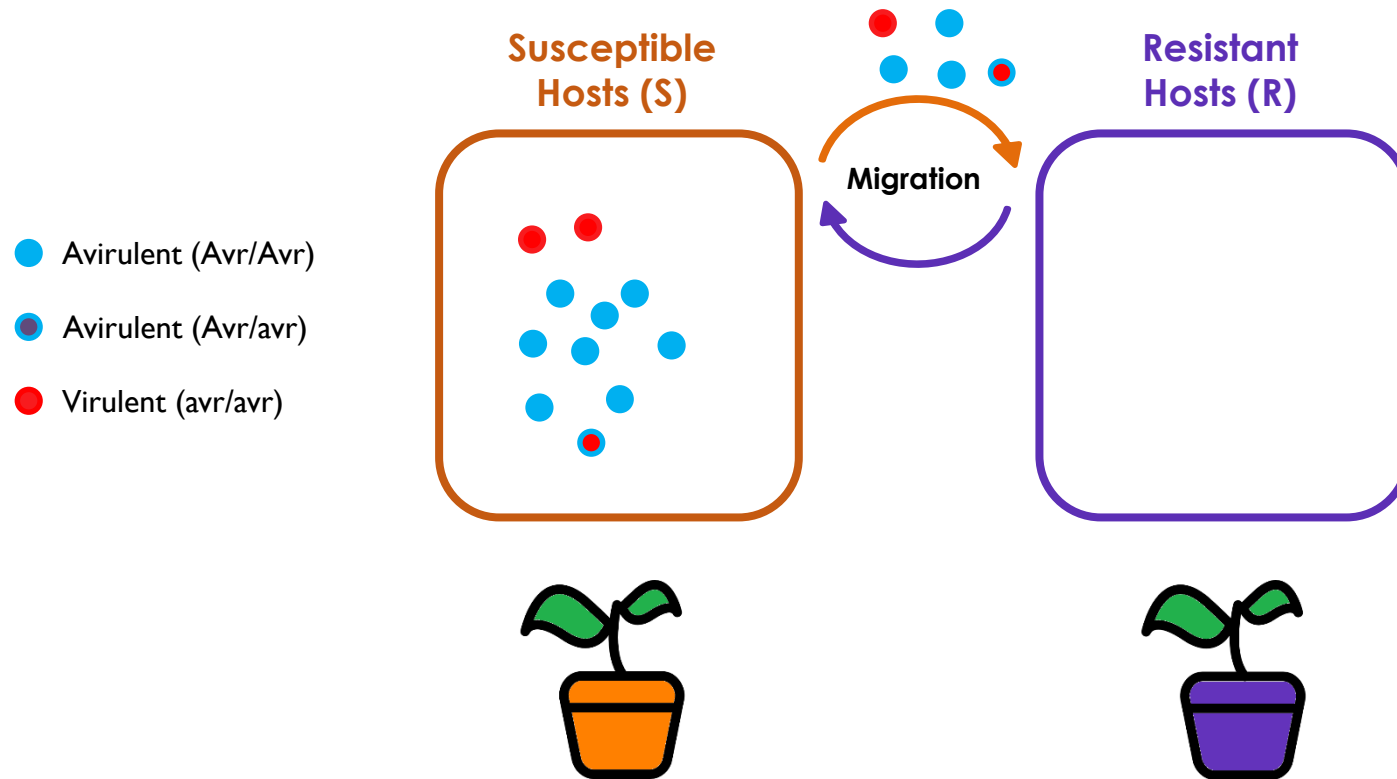




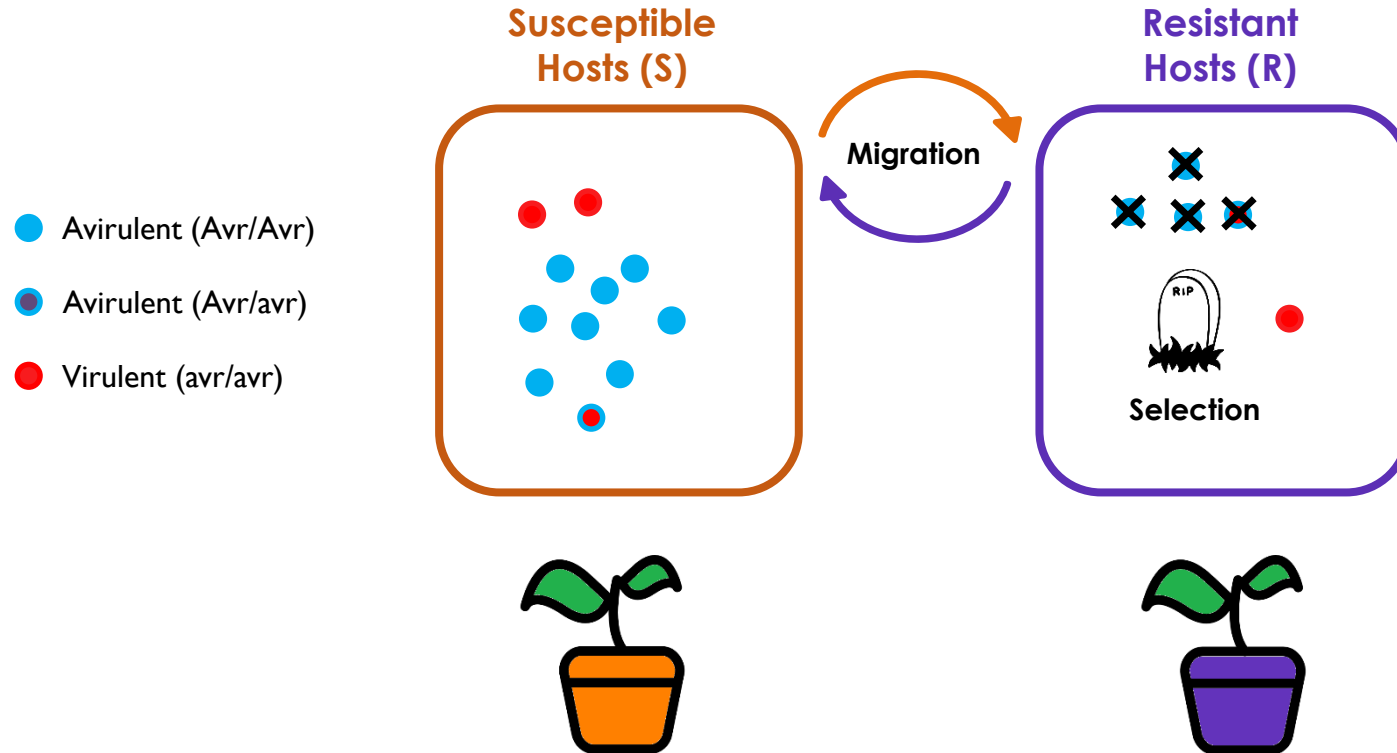
# Model 1: Without host alternation



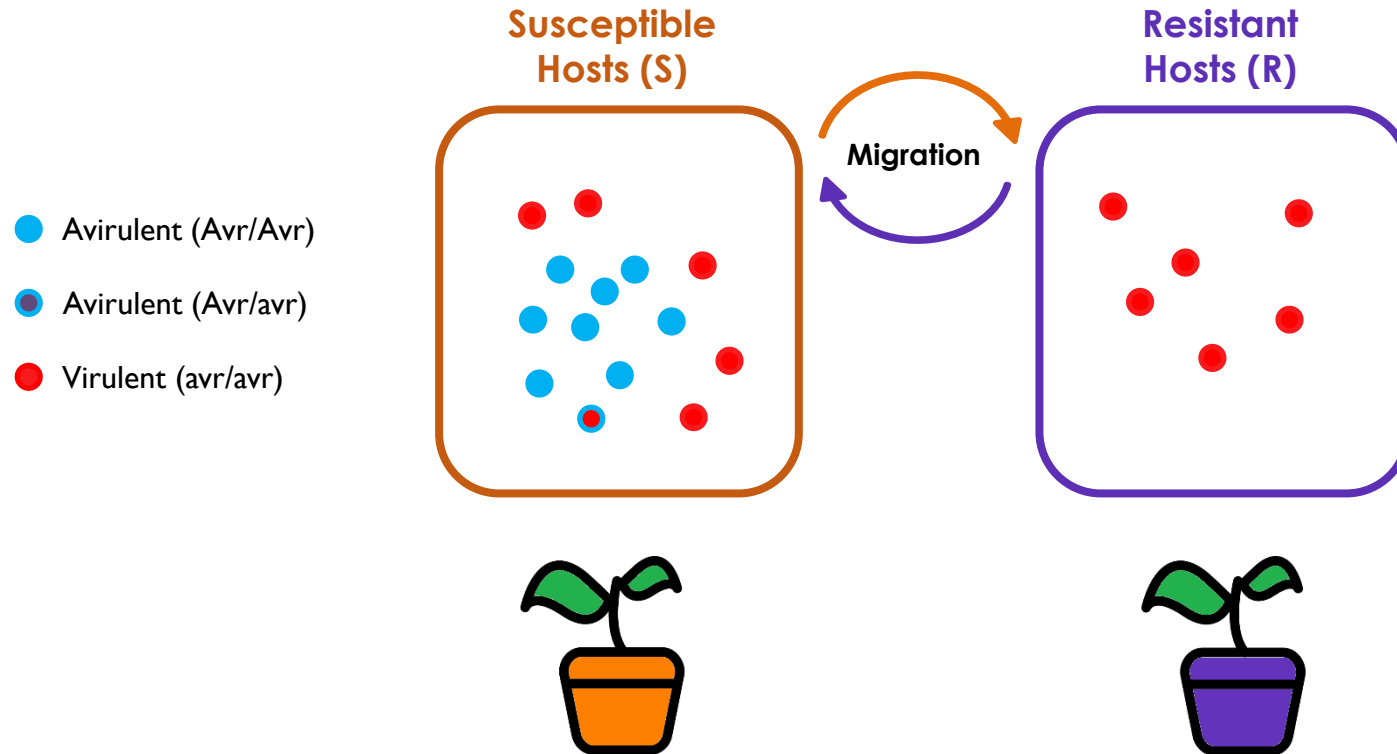
# Model 1: Without host alternation



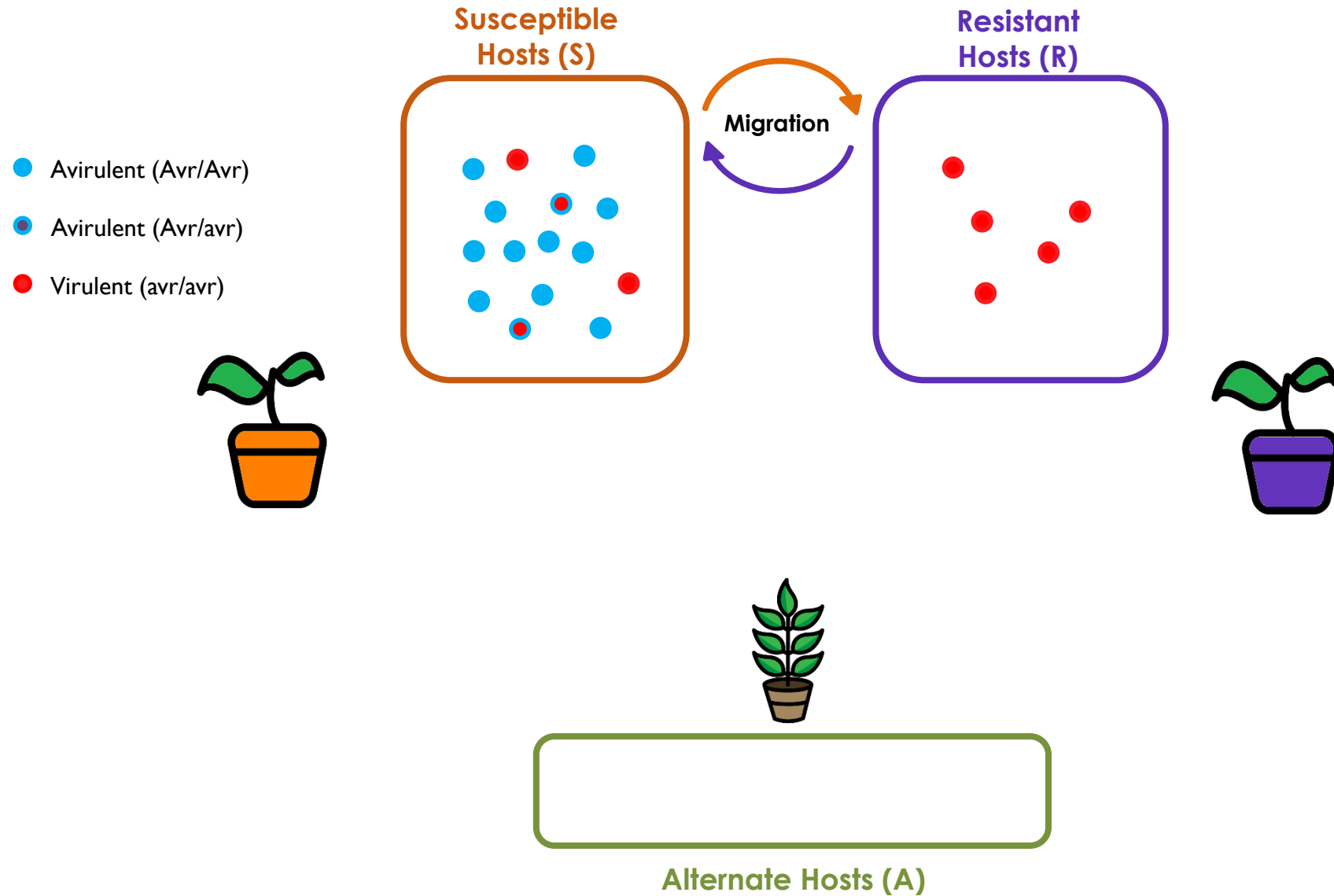
# Model 1: Without host alternation



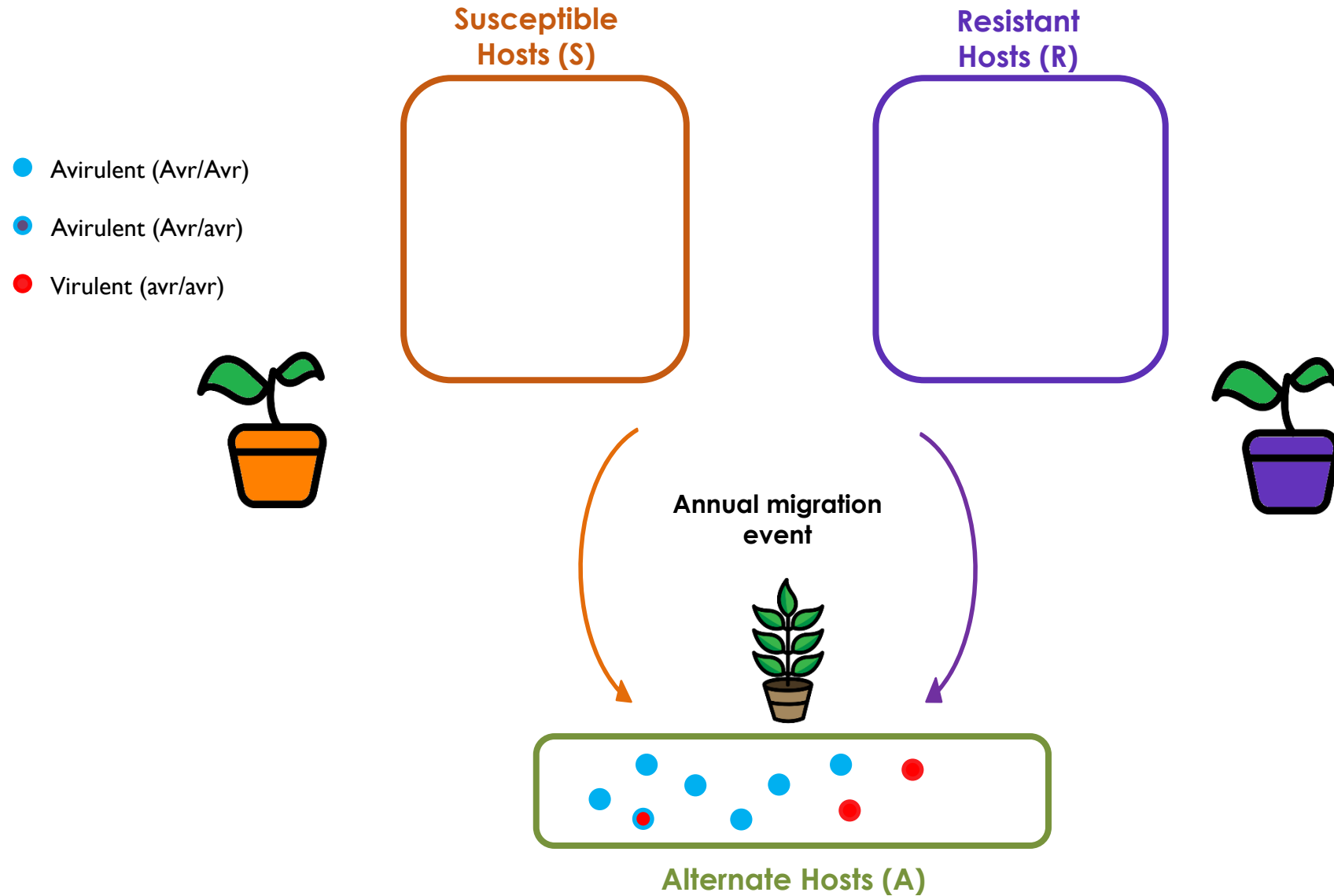
# Model 1: Without host alternation



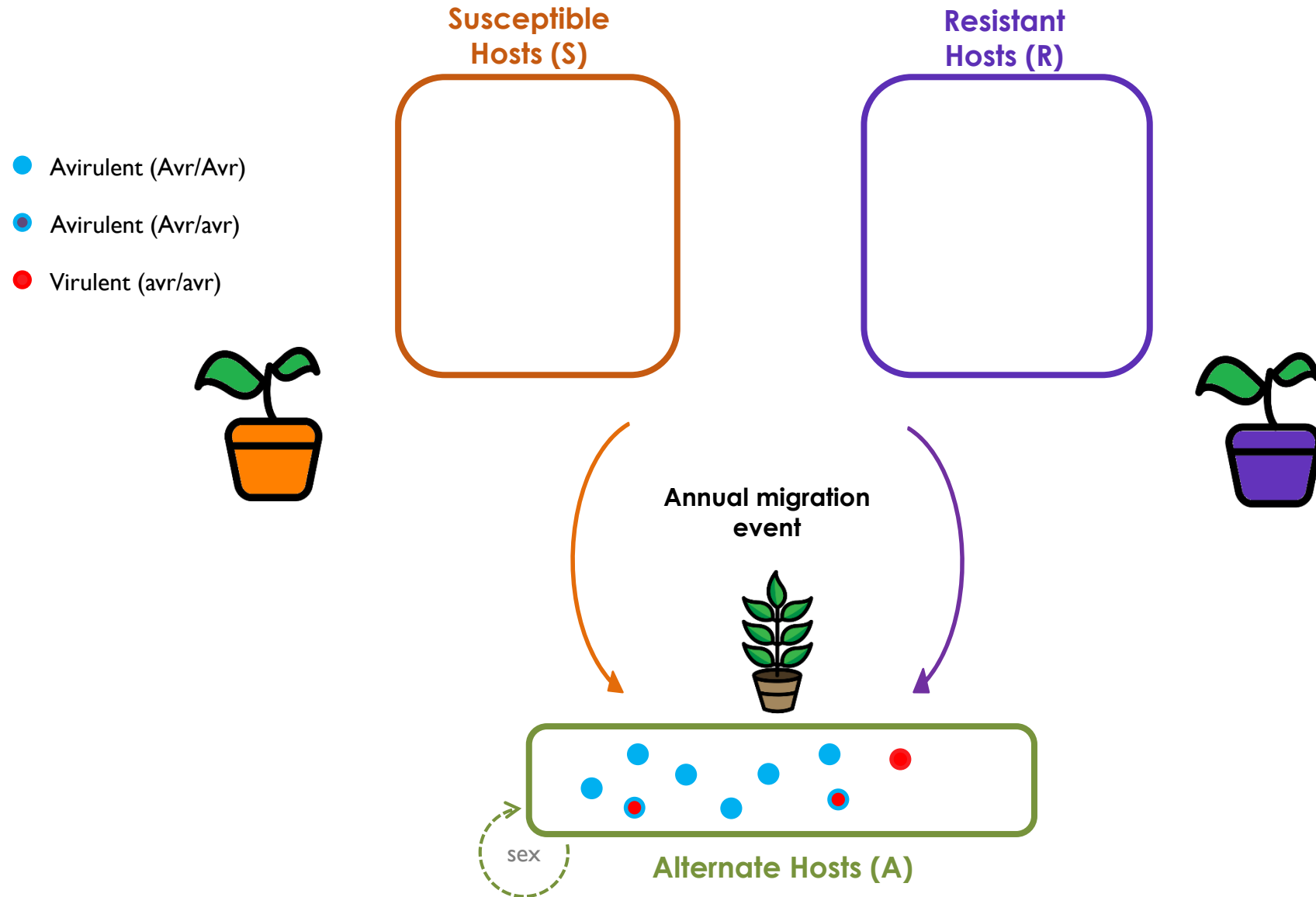
# Model 2: With host alternation



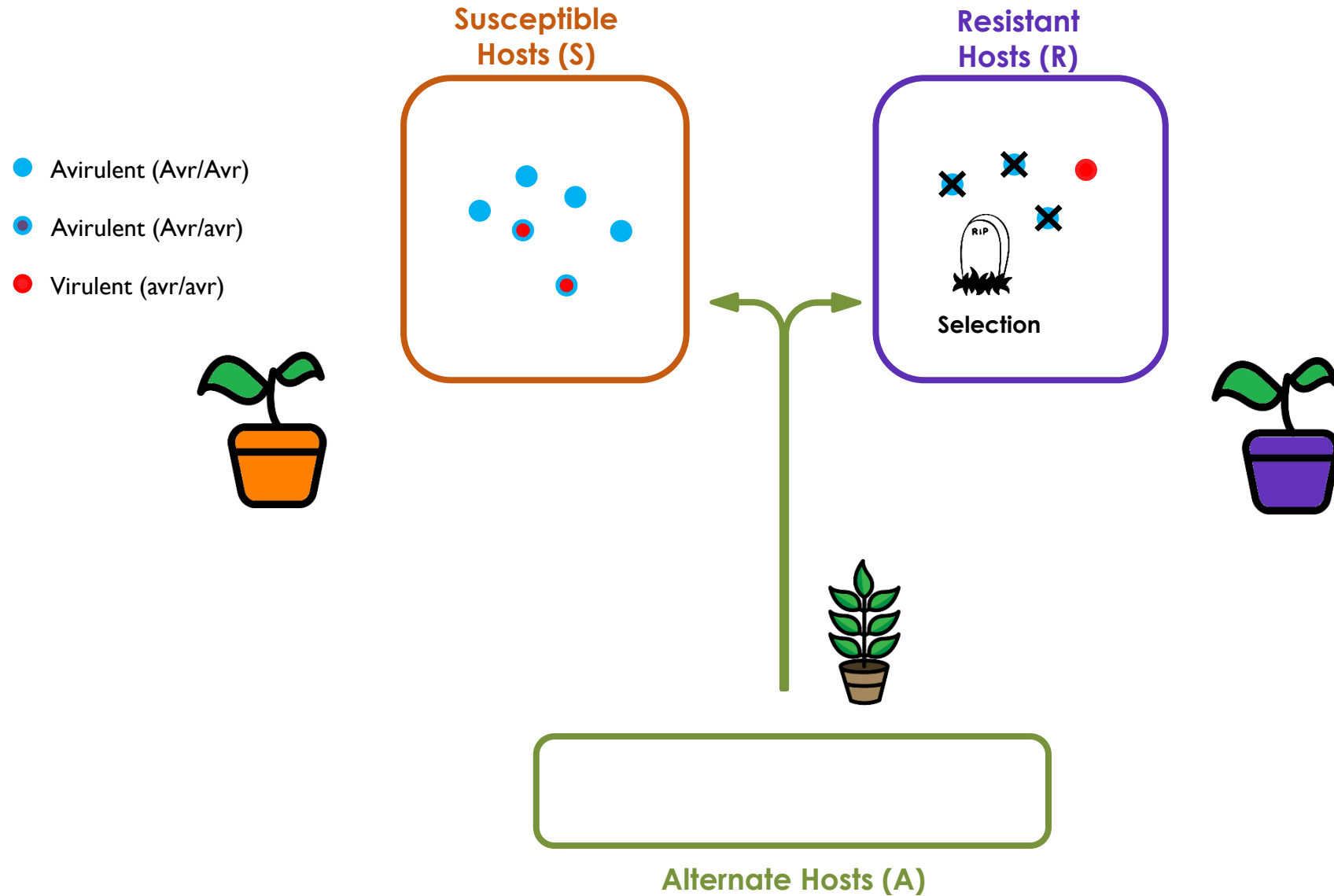
# Model 2: With host alternation



# Model 2: With host alternation

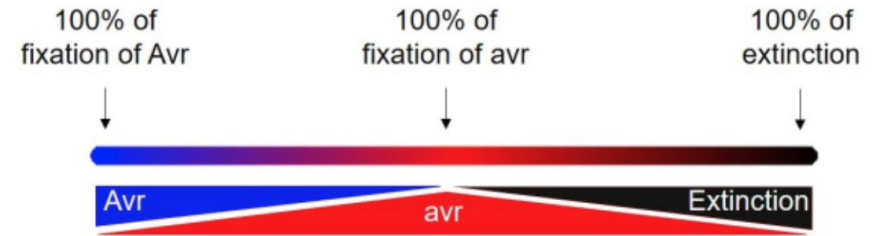
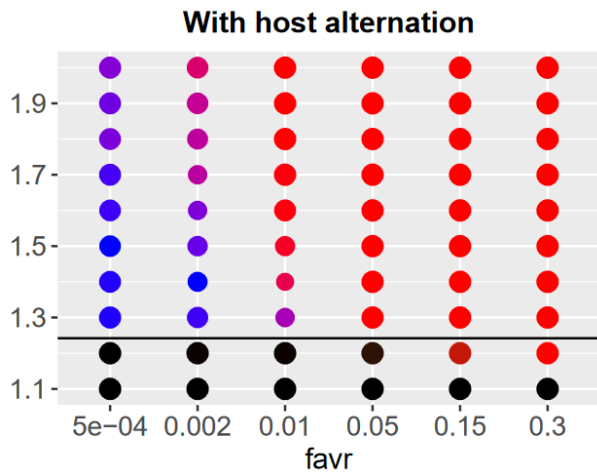
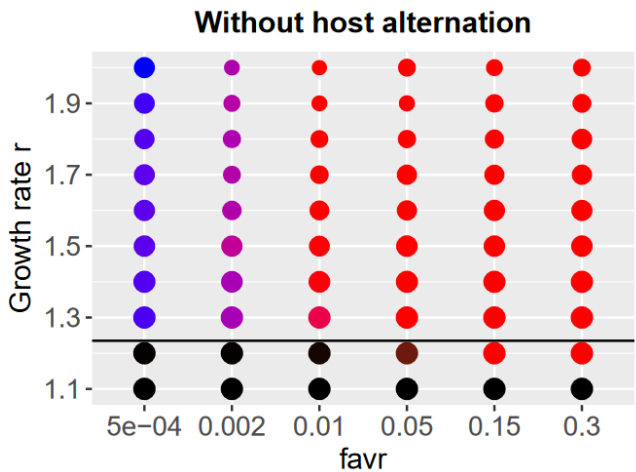
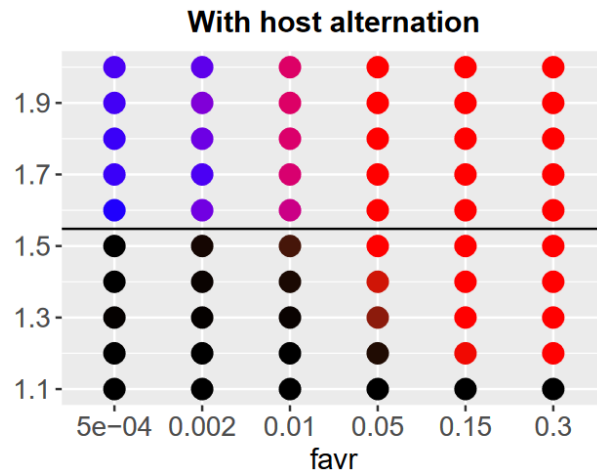
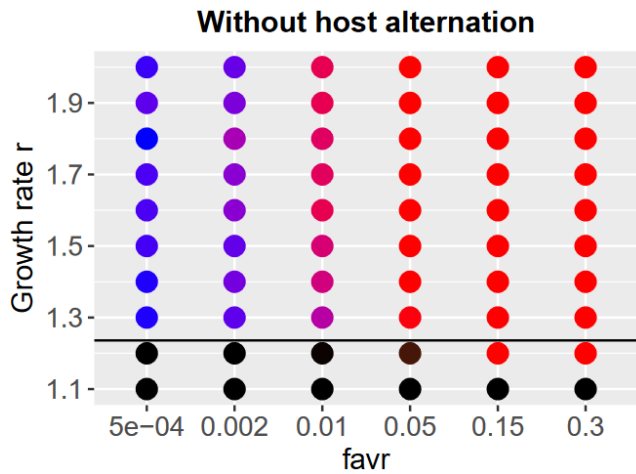


# Model 2: With host alternation





# Probability of virulent allele fixation



$propR = 0.9$



$propR = 0.1$

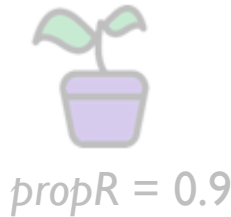
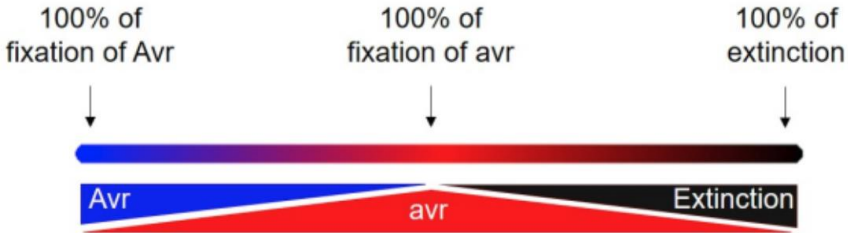
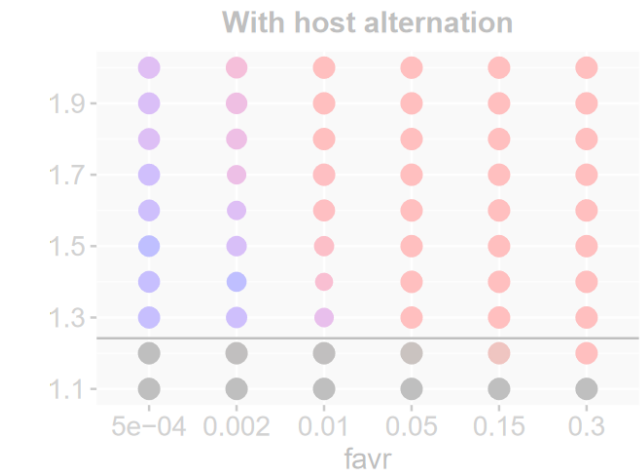
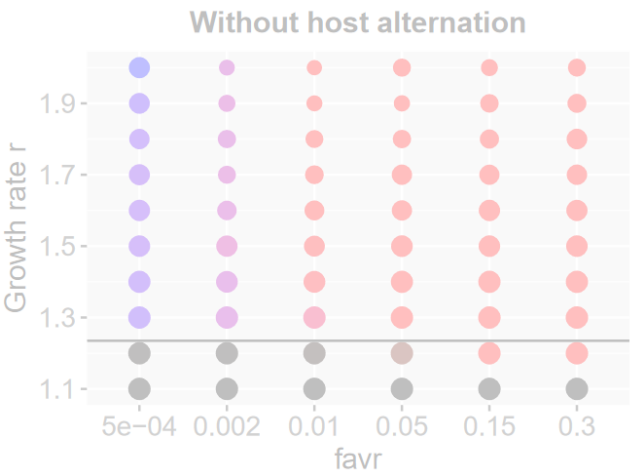
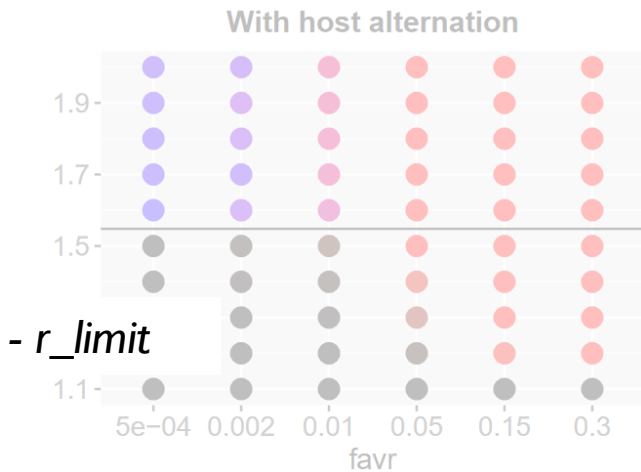
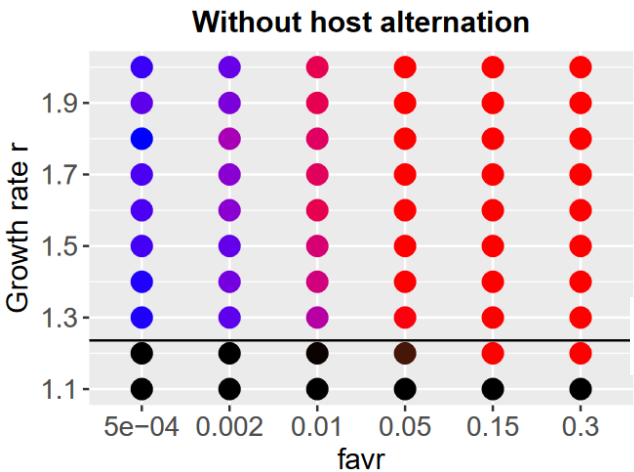
**Avr**: avirulent allele

**avr**: virulent allele

*favr* : initial proportion of virulent alleles

*propR* : proportion of resistant hosts in the landscape

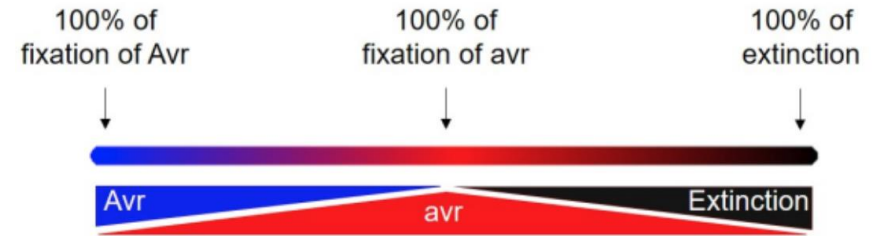
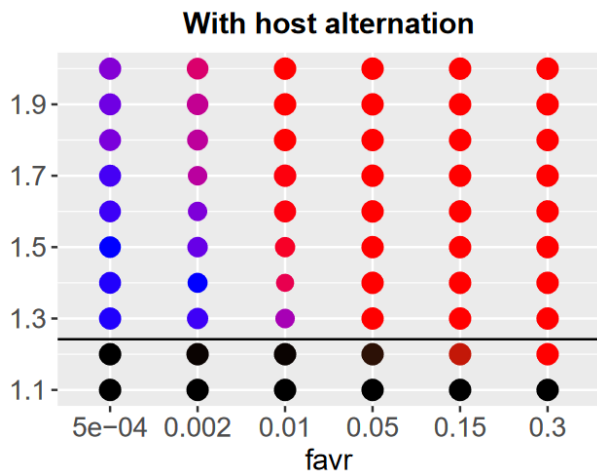
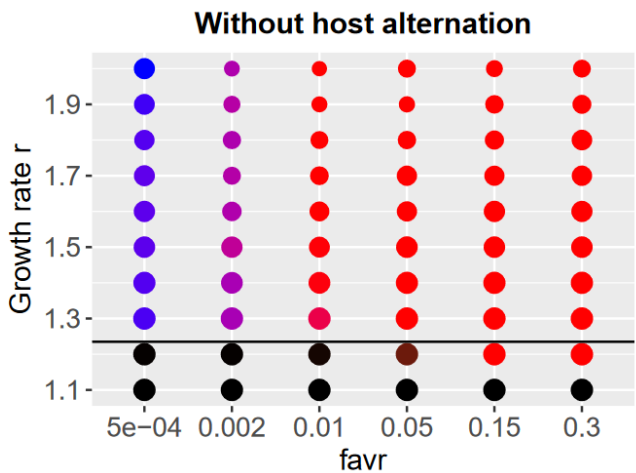
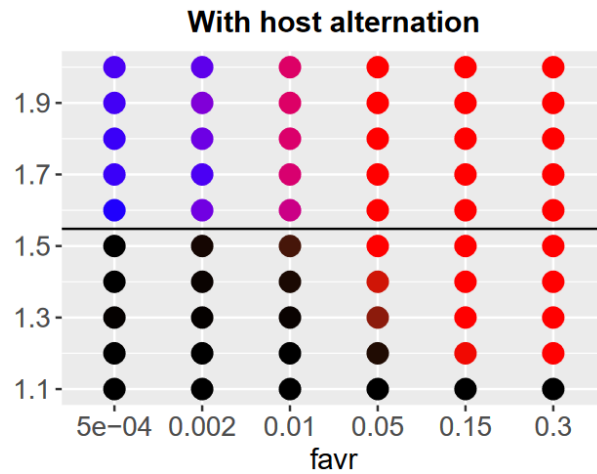
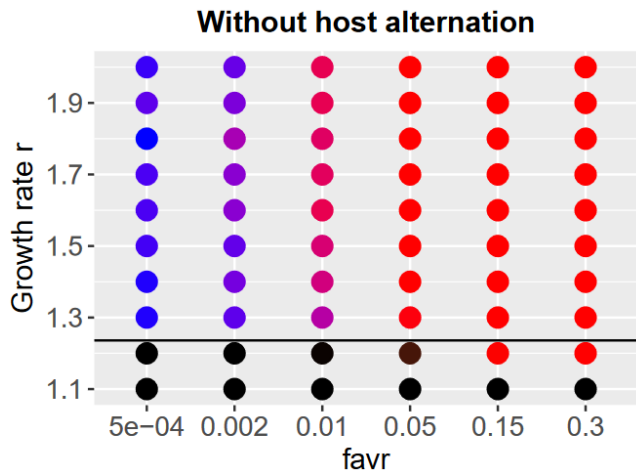
# Probability of virulent allele fixation



- Above  $r\_limit$ : fixation of either *Avr* or *avr*
- Below  $r\_limit$ : Resistance breakdown = Evolutionary rescue



# Probability of virulent allele fixation



$propR = 0.9$

- With HA  $r_{limit}$  increases with  $propR$  (more evolutionary rescue)



$propR = 0.1$

- The probability of virulence fixation may be higher for low than high  $propR$  values

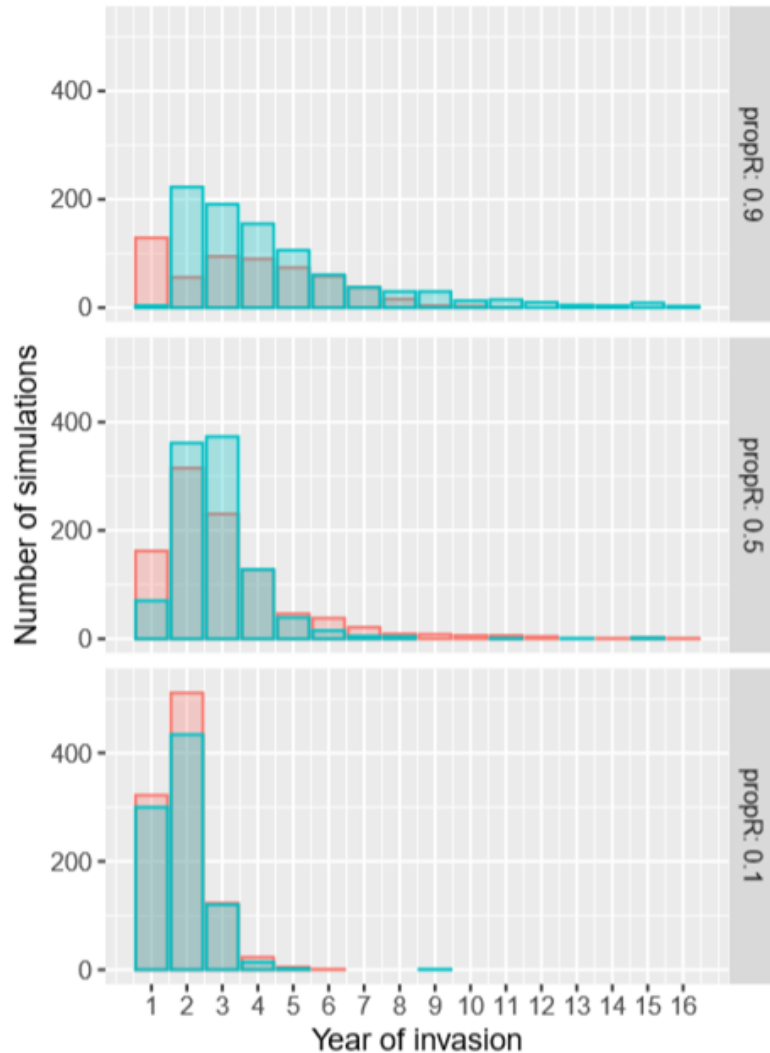
# Focus on two events

**Year of invasion**

**Year of resistance breakdown**

# Focus on two events

## Year of invasion



cycle With host alternation



$propR = 0.9$

Without host alternation



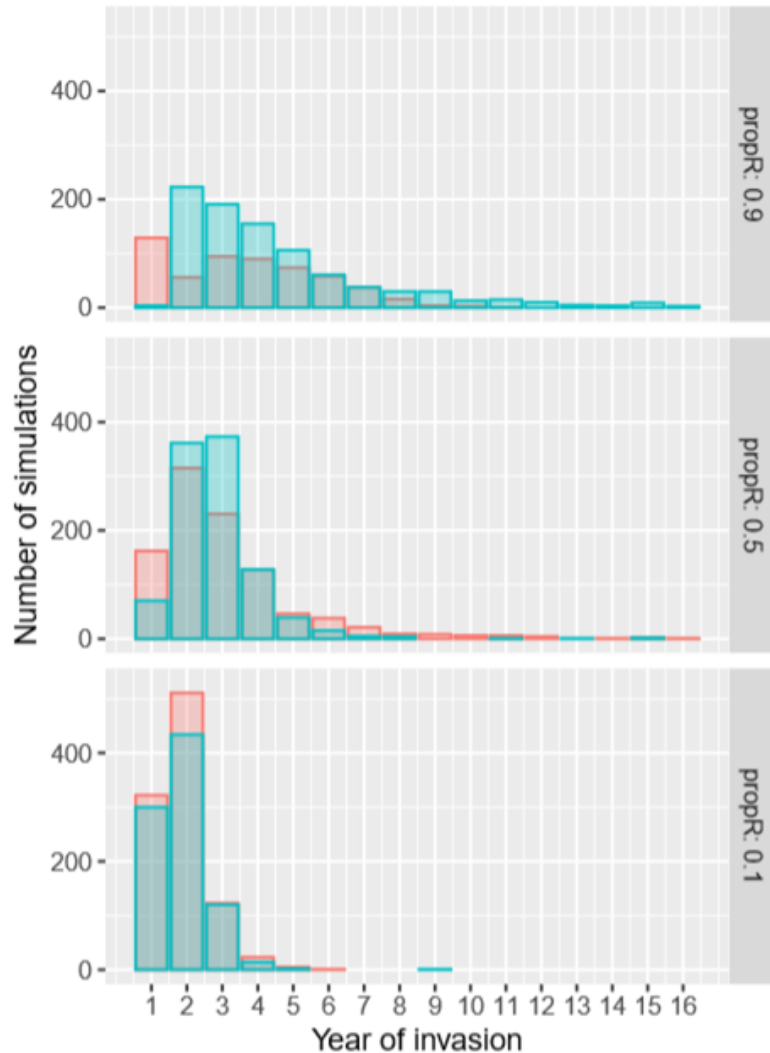
$propR = 0.5$



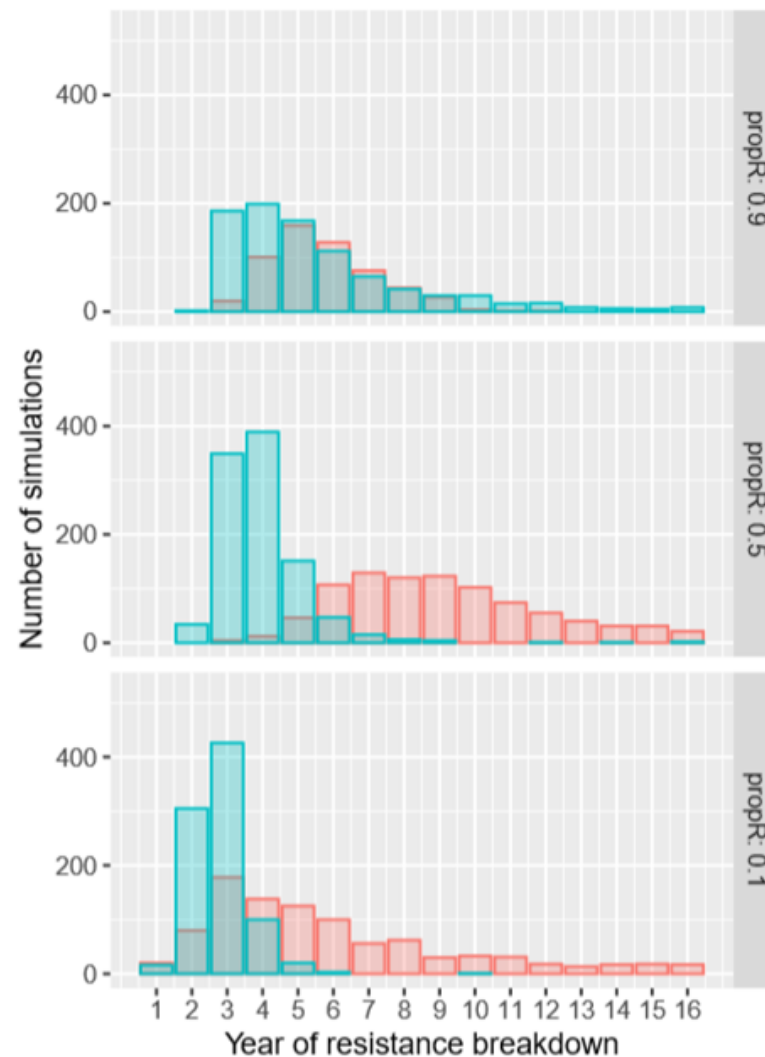
$propR = 0.1$


# Focus on two events

## Year of invasion





## Year of resistance breakdown




cycle  With host alternation




  
propR = 0.9

 Without host alternation



  
propR = 0.5

  
propR = 0.1

# Stochastic evolutionary trajectories

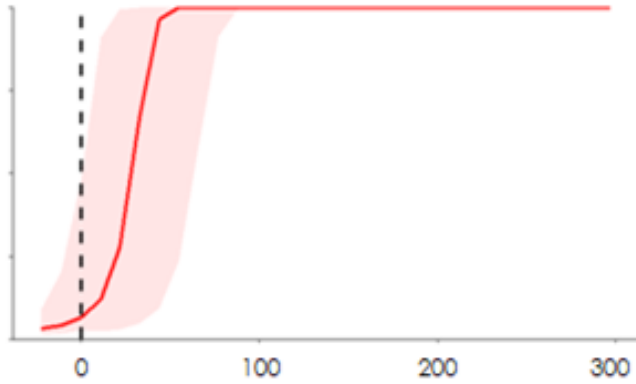
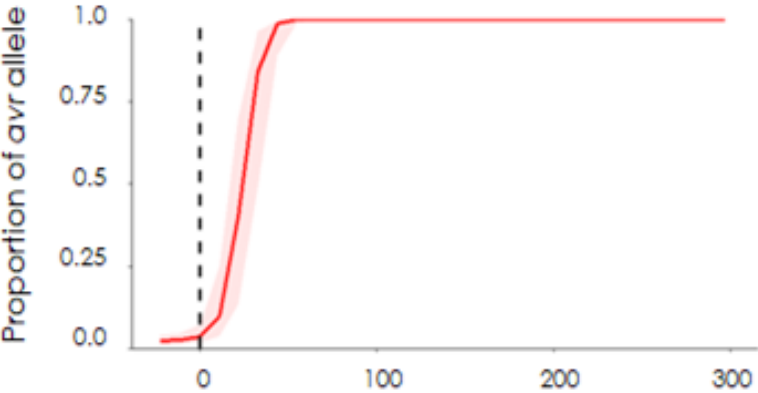


Without host alternation

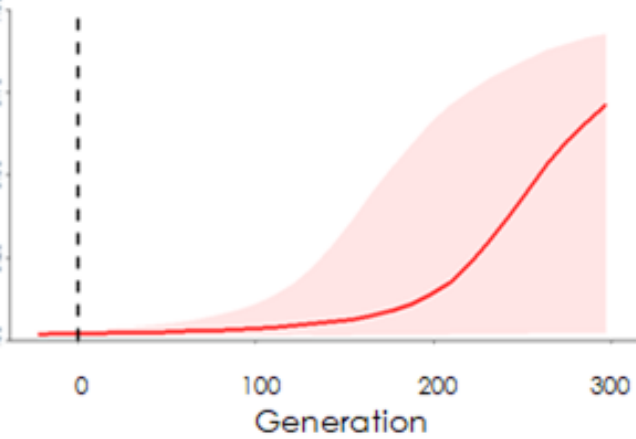
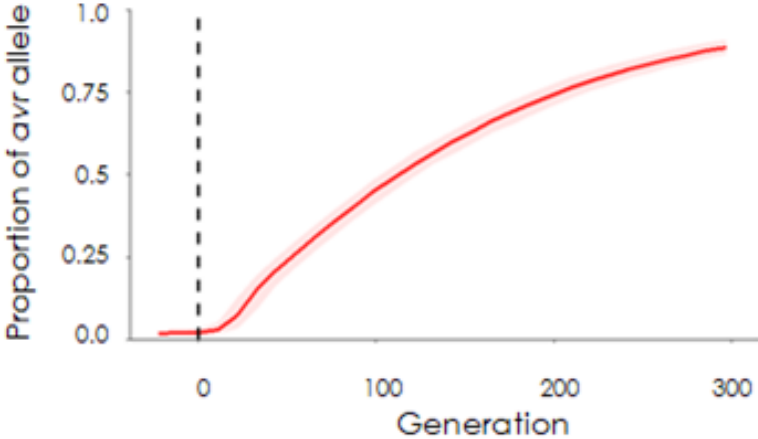


With host alternation

propR = 0.9

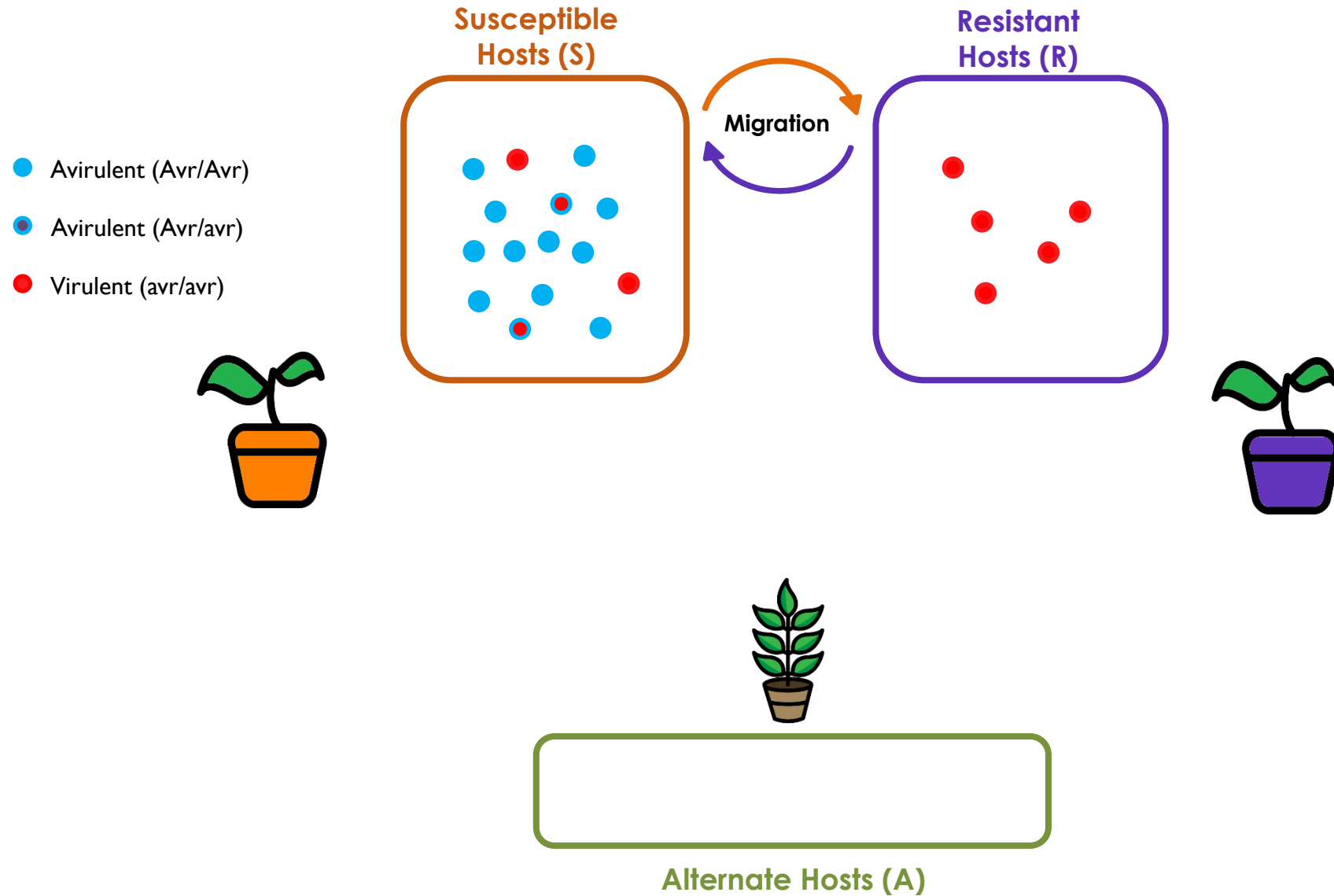


propR = 0.1



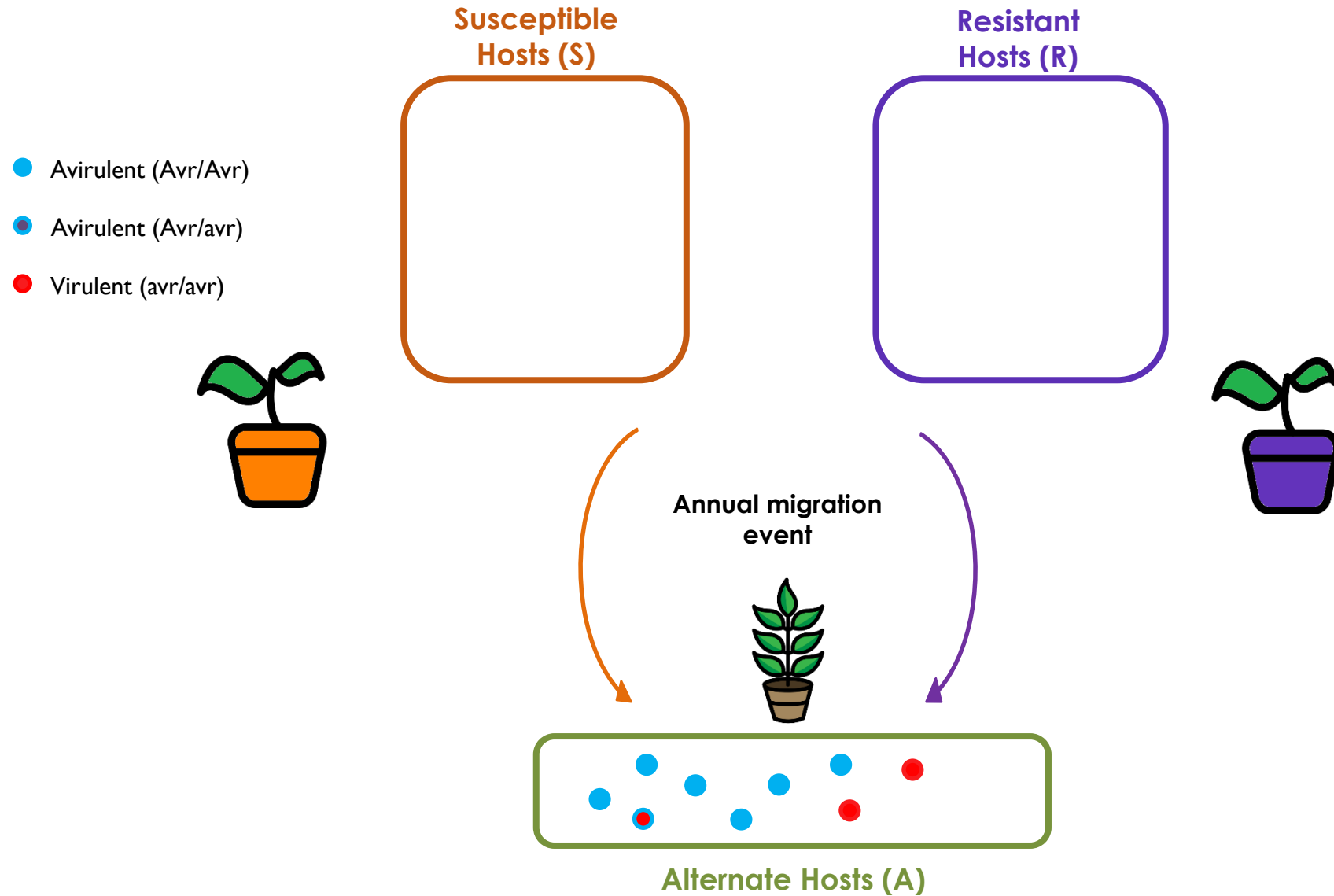
— Proportion of avr alleles

# Why host alternation enhance stochasticity?

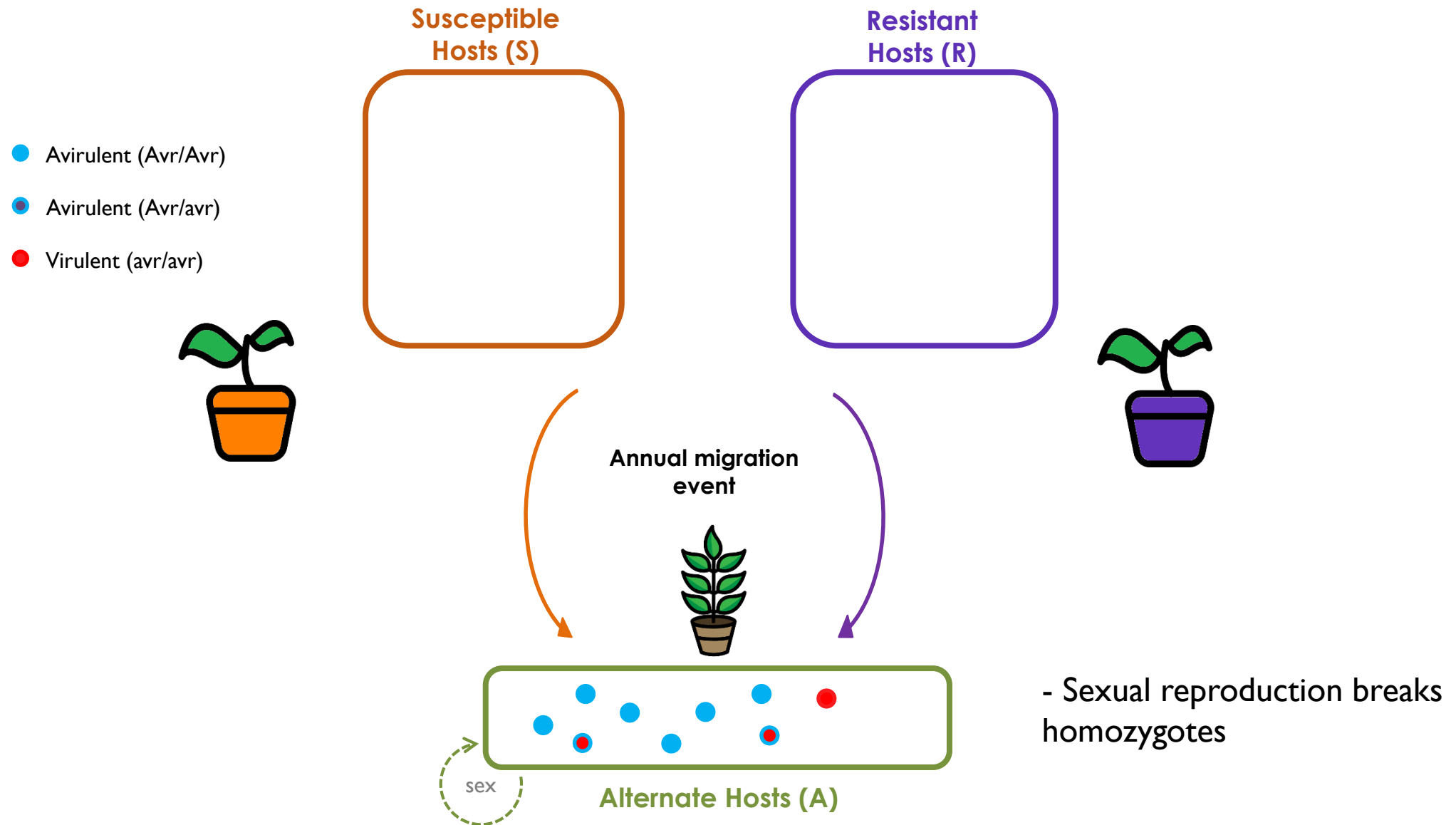




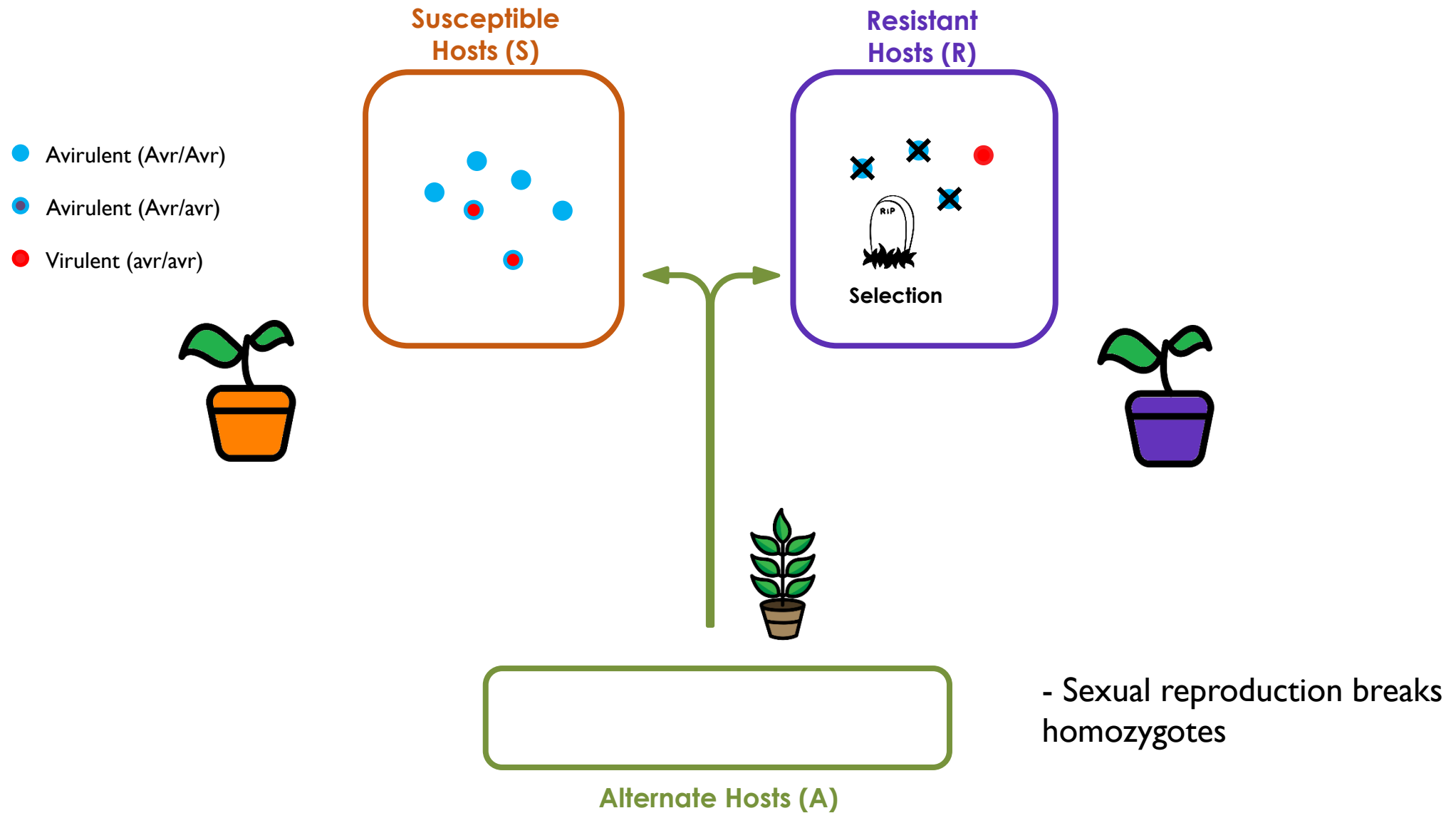
# Why host alternation enhance stochasticity?



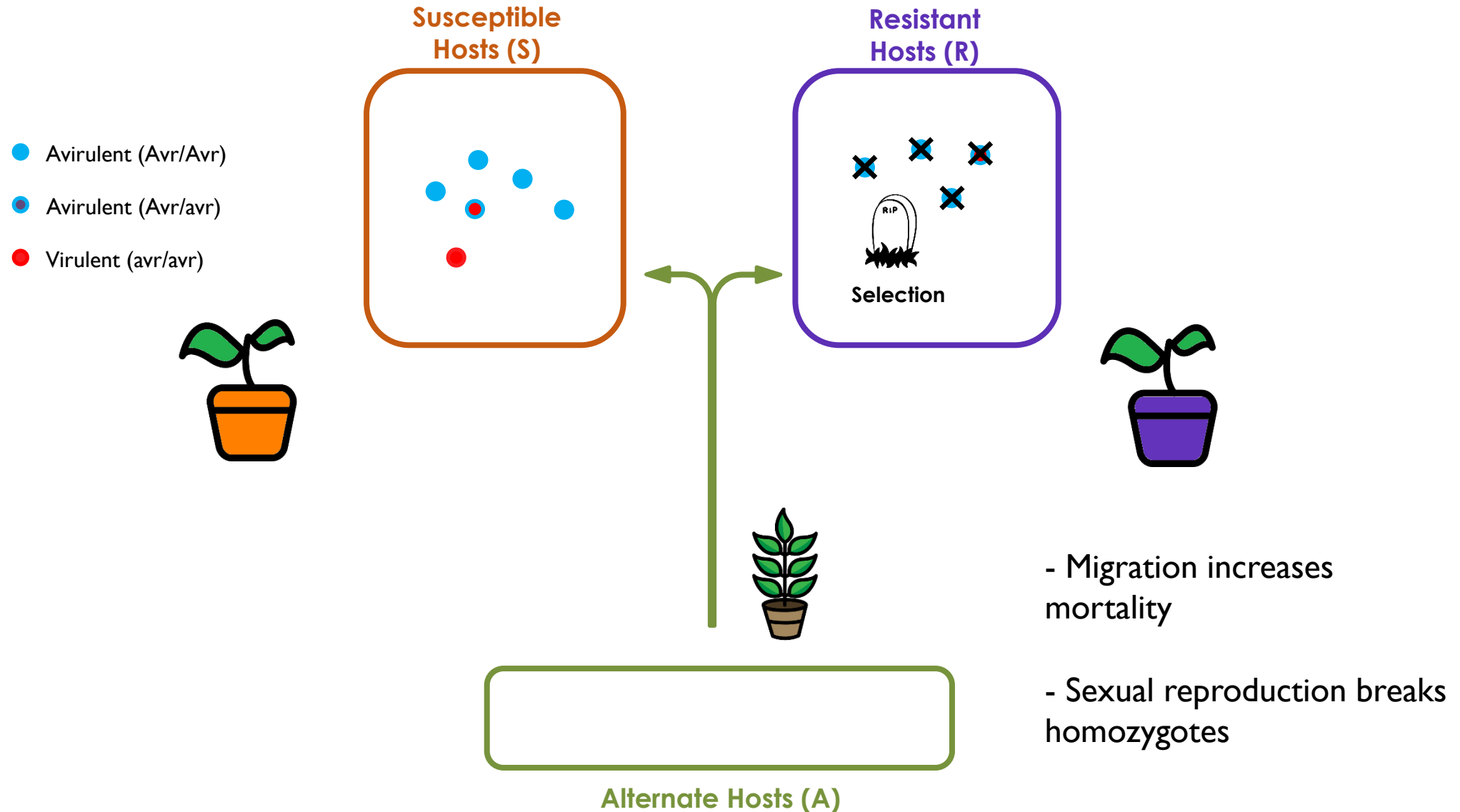
# Why host alternation enhance stochasticity?



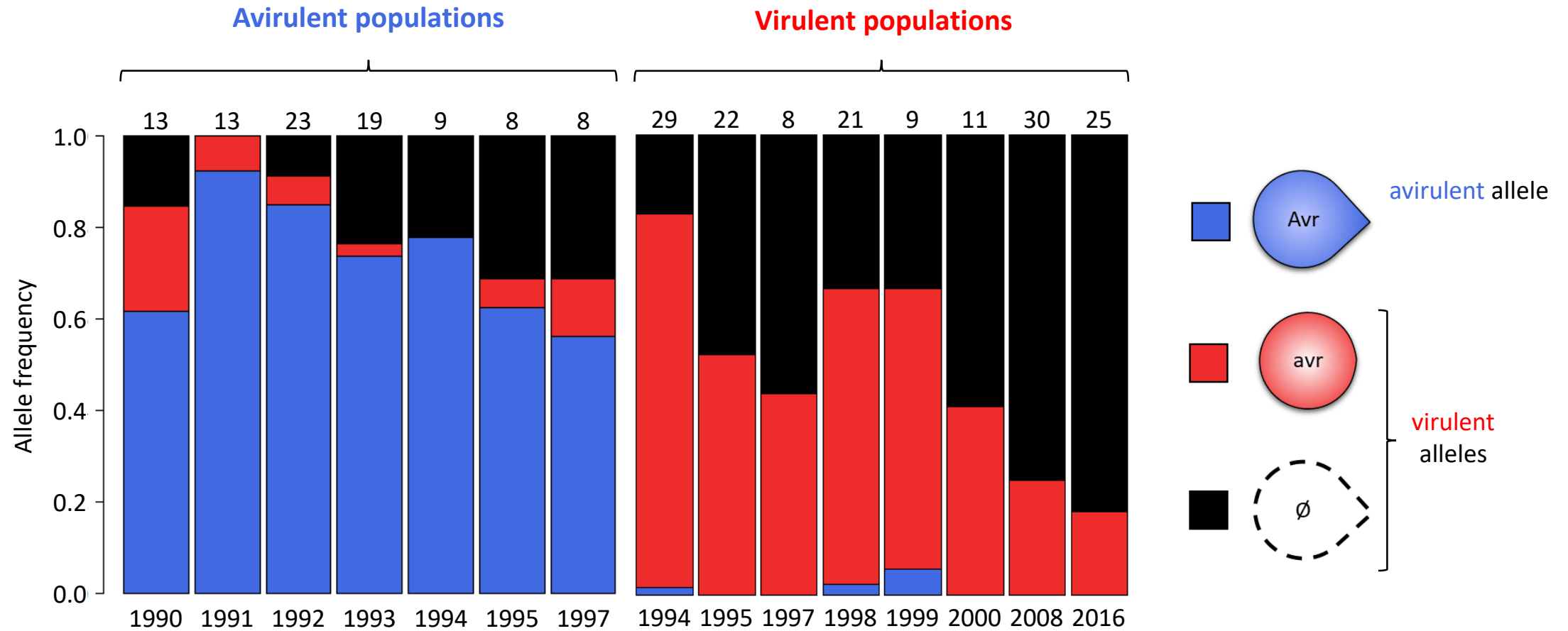
# Why host alternation enhance stochasticity?



# Why host alternation enhance stochasticity?



# Evolution of virulence from standing genetic variation



# Thank-You



## RESEARCH ARTICLE

-  Open Access
-  Open Peer-Review
-  Open Data
-  Open Code

## Impact of ploidy and pathogen life cycle on resistance durability

Méline Saubin<sup>1</sup>, Stéphane De Mita<sup>2</sup>, Xujia Zhu<sup>3</sup>, Bruno Sudret<sup>3</sup>, & Fabien Halkett<sup>1</sup>

ClonX<sup>2D</sup>

# Des indices Fst marqueurs d'un contournement de résistance

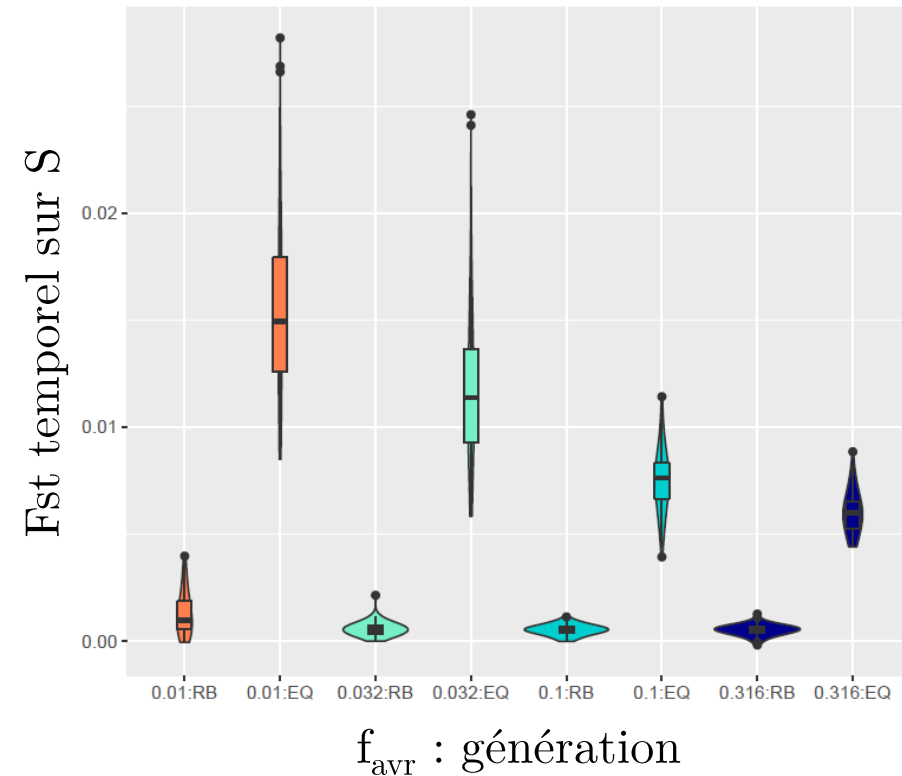
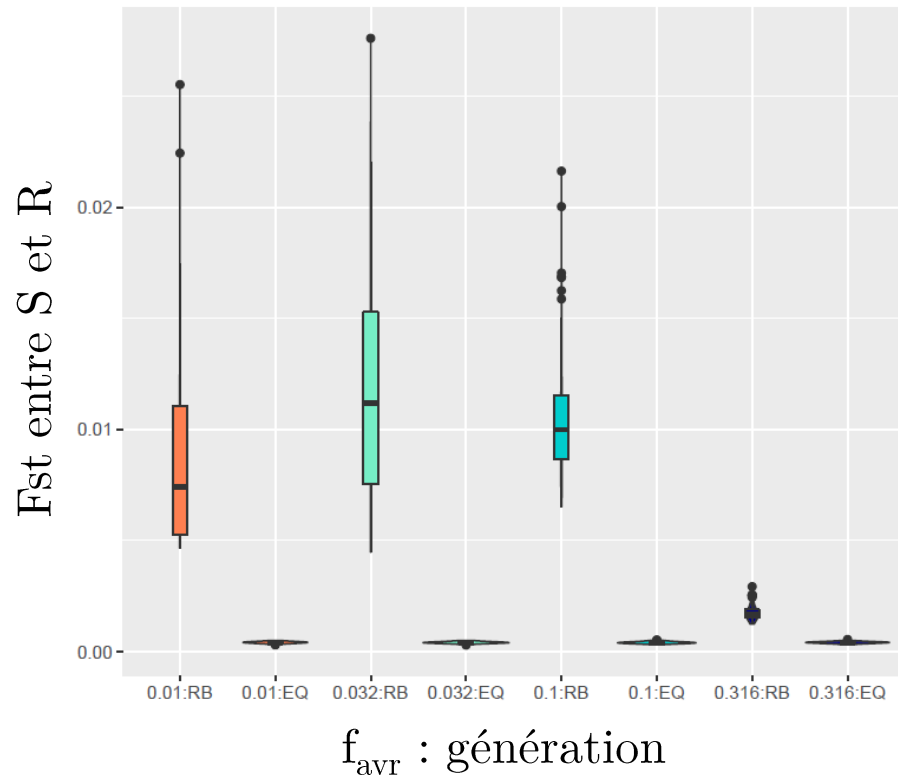
Fréquences initiales d'allèles virulents :

- $f_{avr} = 0.01$
- $f_{avr} = 0.032$
- $f_{avr} = 0.1$
- $f_{avr} = 0.316$

Génération d'évaluation des indices :

RB : Génération du contournement de résistance

EQ : Dernière génération de la simulation (retour à l'équilibre)



# Model I: without host alternation

