

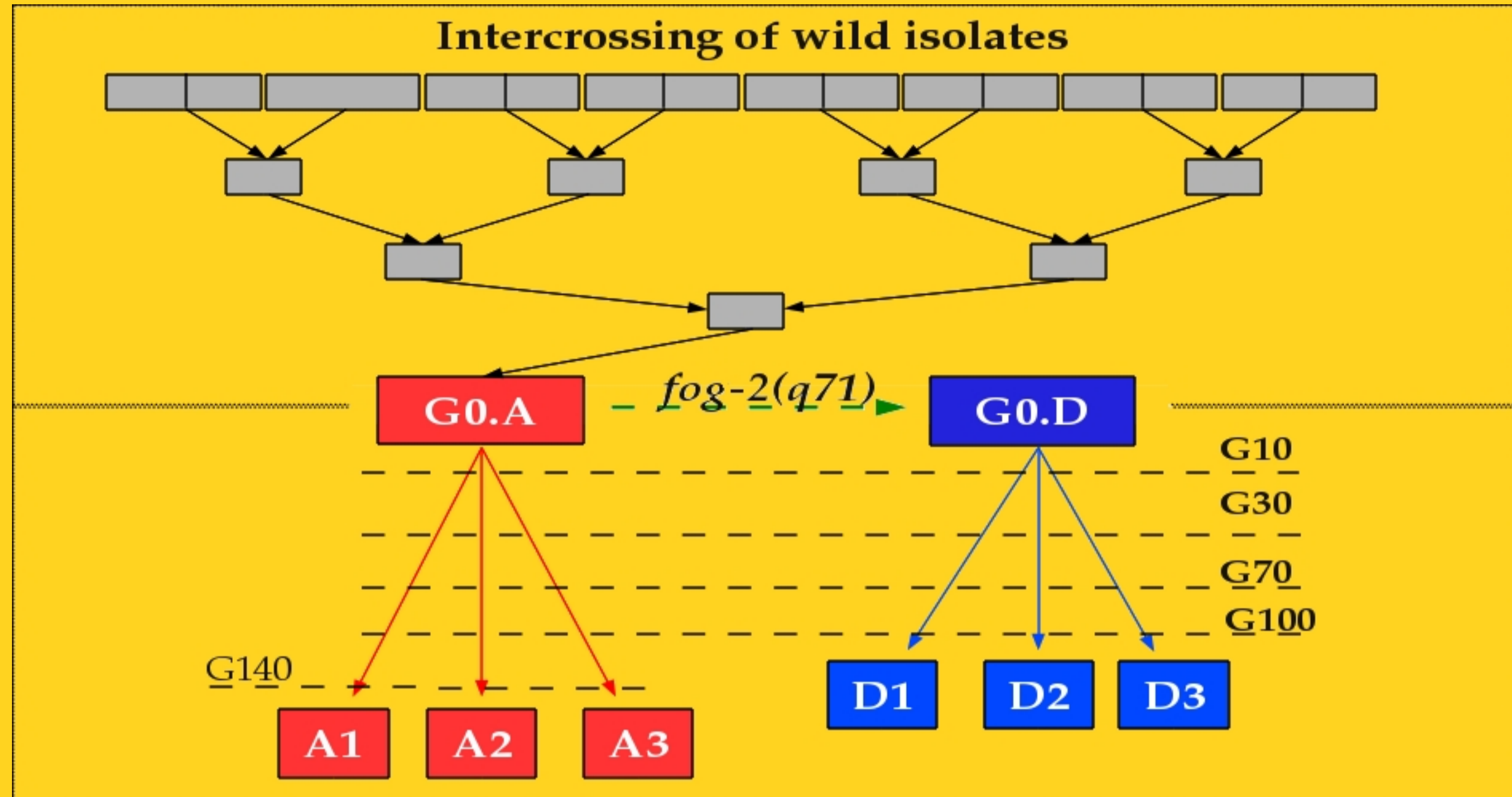
# Evolution of inbreeding depression and outbreeding depression revealed in 100 generations of laboratory adaptation in *C. elegans*

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## Experimental evolution with two different mating systems



Comparison of experimental evolution in *Caenorhabditis elegans* for 100 generations under androdioecy (A populations, males and hermaphrodites) or dioecy (D populations, males and females) imposes different inbreeding rates

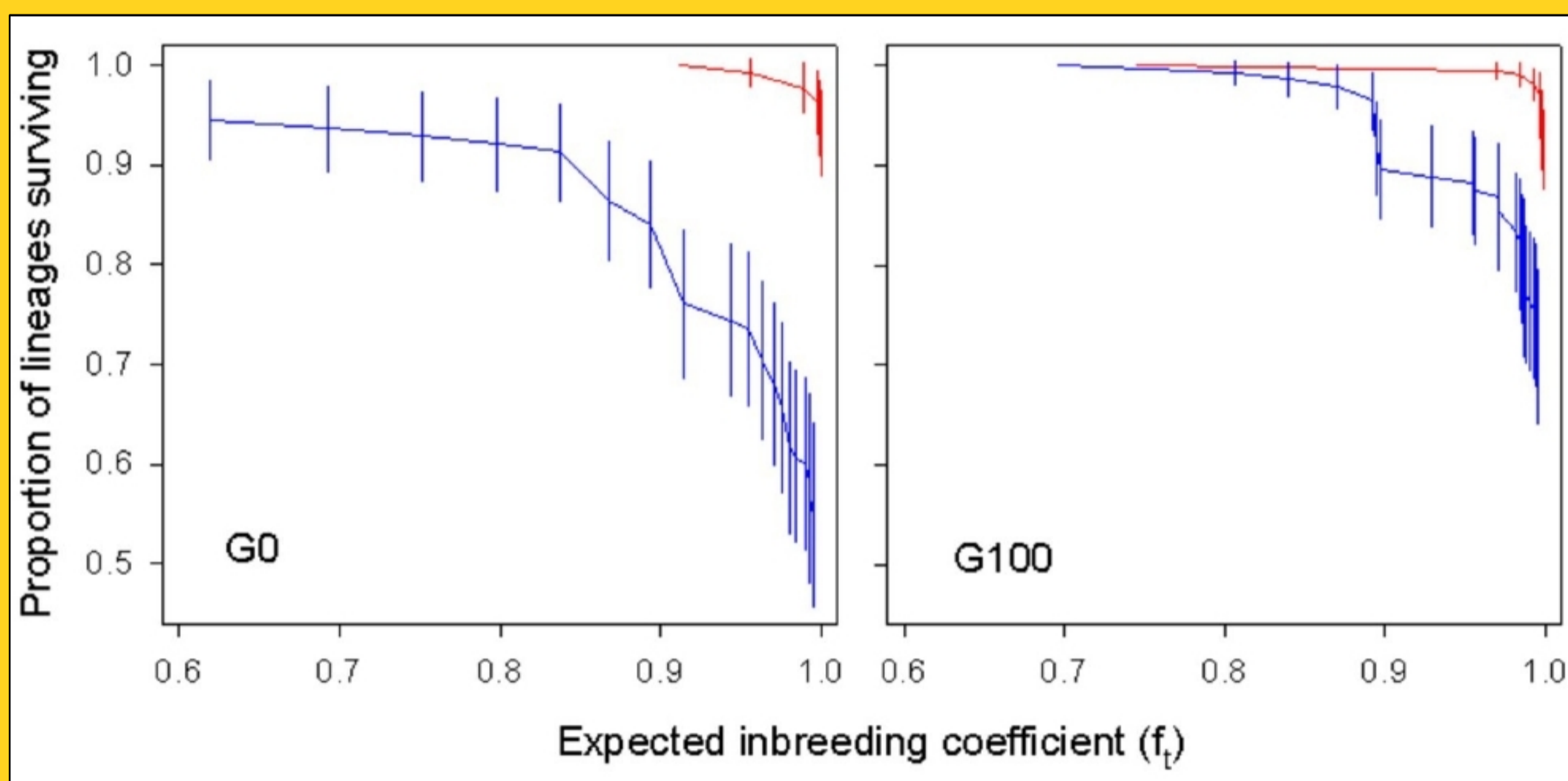
Fitness estimates obtained by:

- egg-to-adult viability
- survival rates during enforced inbreeding at different generations

Molecular diversity assayed at biallelic SNPs:

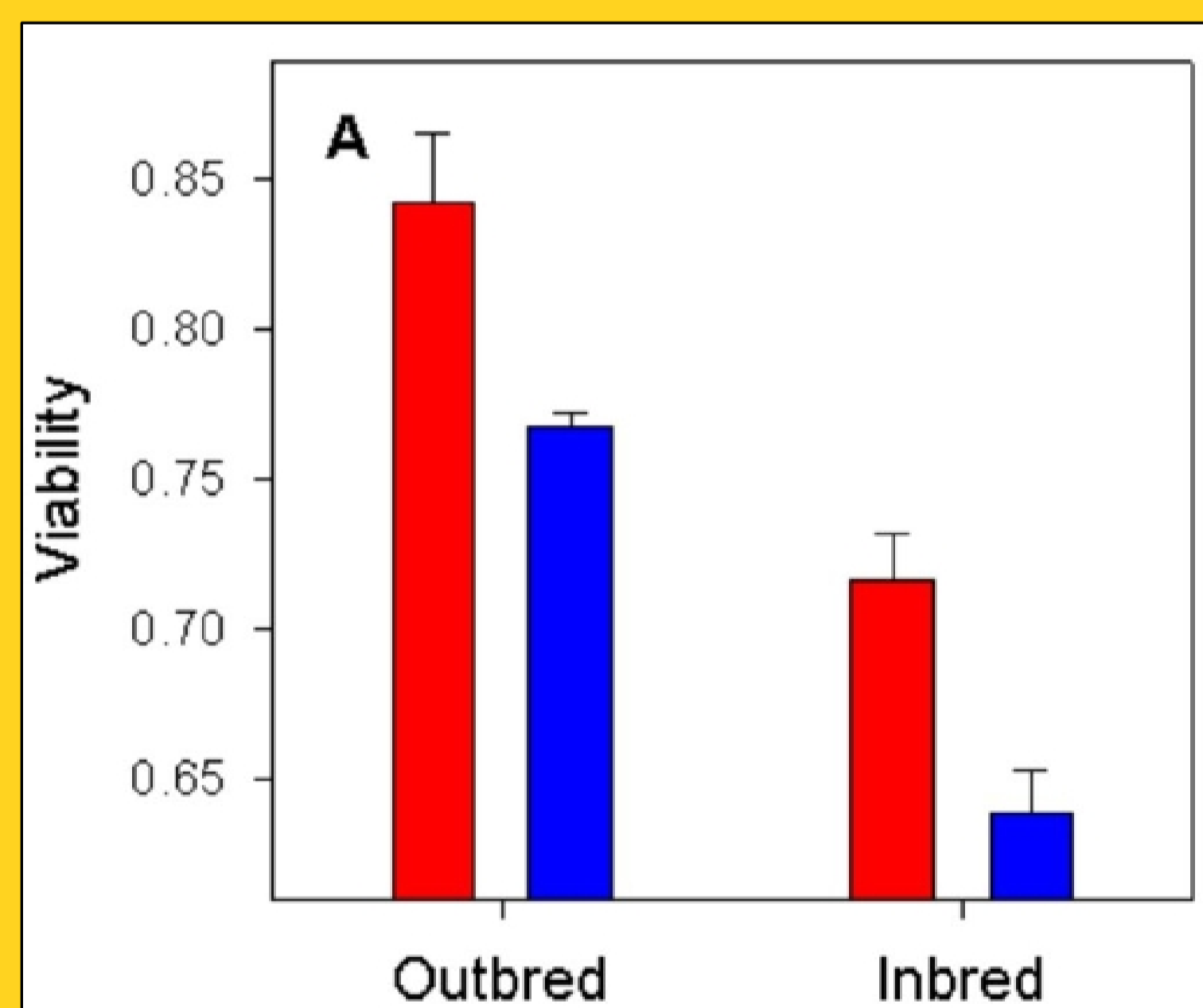
- correlation with viability during experimental evolution
- before and after enforced inbreeding and comparison with neutrality expectations

## RESULTS



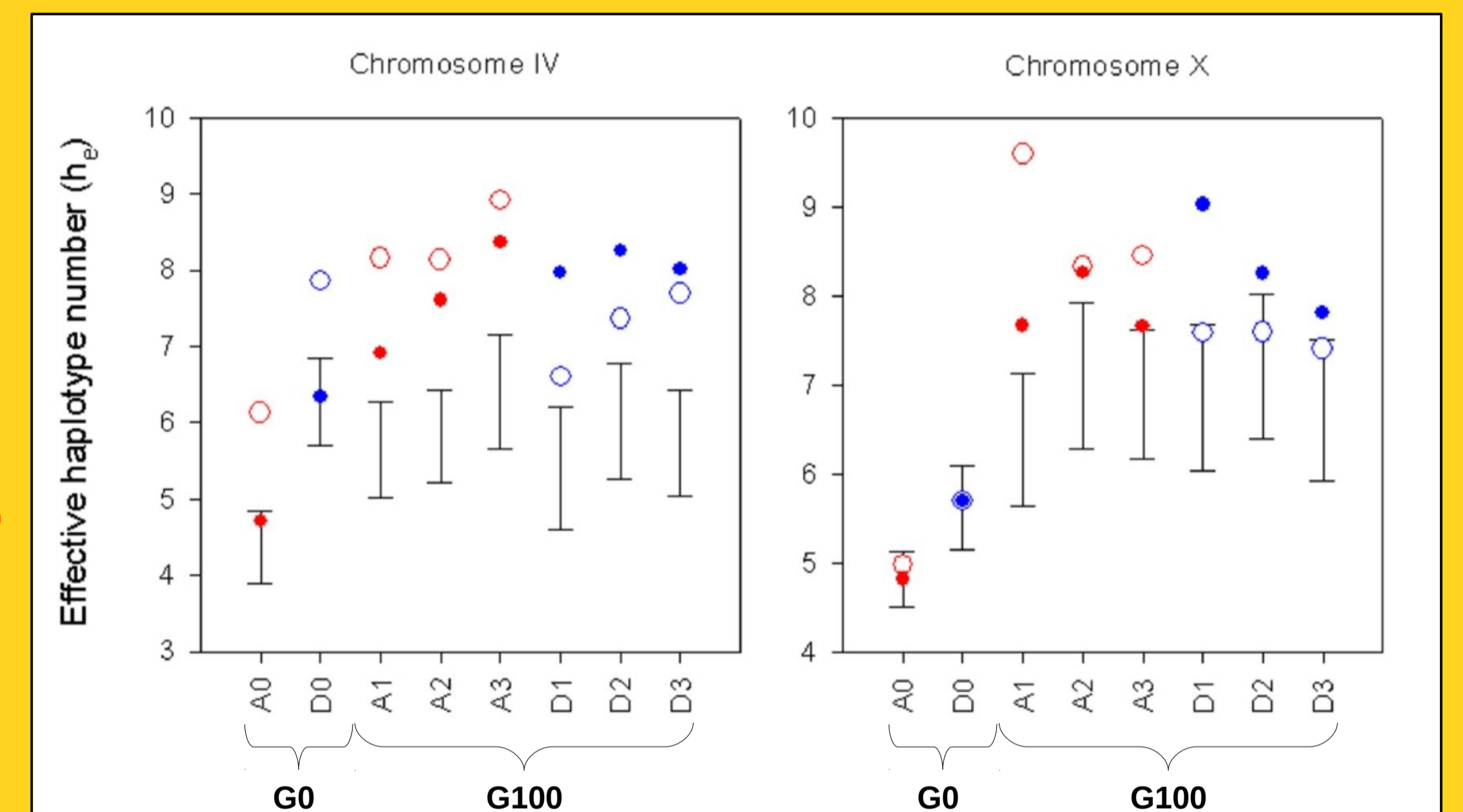
**Dioecious populations have higher risk of extinction with inbreeding.** The proportion of lines that survive multiple generations of inbreeding by selfing (red) in androdioecious populations or sib-mating (blue) in dioecious populations are shown as a function of the expected inbreeding coefficients. Error bars are 2xSD.

**Egg-to-adult viability confirms inbreeding and outbreeding depression in ancestrals (G0).**



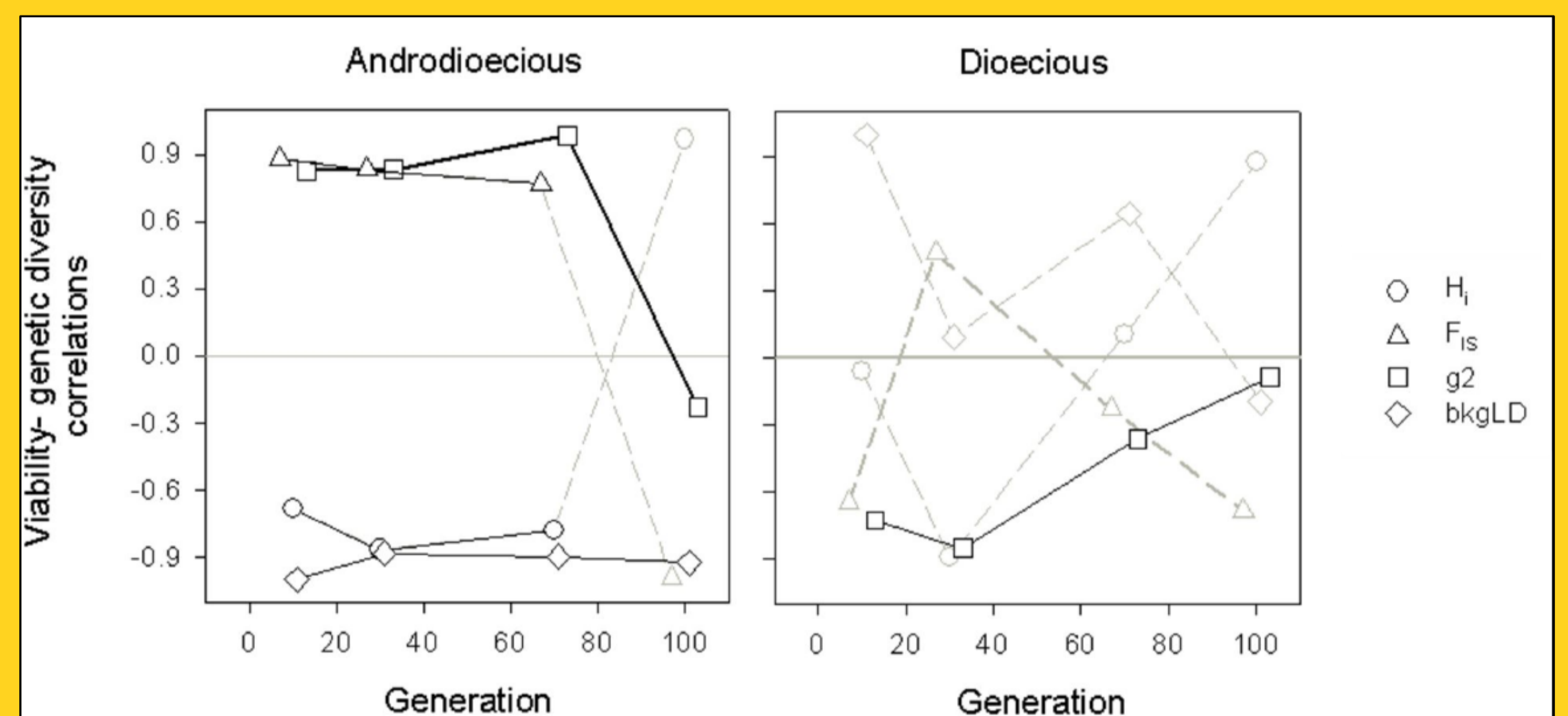
Reduction of viability with inbreeding reveals the presence of inbreeding depression that can be due to deleterious recessive alleles both in androdioecious and dioecious populations and derived inbred lines. However, these data also show initial outbreeding depression since dioecious populations have lower viability than androdioecious populations, regardless of the level of inbreeding. Interestingly, outbreeding and inbreeding depression are not independent. Error bars show one SEM.

**Diversity excess after inbreeding suggests overdominant selection in both mating systems.**



Effective haplotype number, across windows of 10 SNPs - is shown as:

- filled circles → mean of the experimental populations before inbreeding;
- open circles → mean of the experimental populations after inbreeding
- error bars → 95% CI of 1,000 Monte-Carlo neutral simulations of selfing or sib-mating.



**Selection for the maintenance of population structure in androdioecious populations but not in dioecious populations.**

- $H_i$  → mean proportion of heterozygous SNPs /individual
  - $F_{is}$  →  $1 - (\text{observed heterozygosity/expected heterozygosity})$
  - $g_2$  → average covariance in pairwise SNP heterozygosity
  - $bkgLD$  → genetic distance at which LD ( $r^2$ ) reaches background levels
- Diversity  
Disequilibrium (structure)

Correlations with viability were most obvious under androdioecy. Tests across all generations showed a significant correlation of viability with  $bkgLD$  ( $p=0.02$ ), and marginal significance with  $g_2$  ( $p=0.06$ ). In solid lines, comparisons that are significantly different from zero, grey dashed lines otherwise.

## CONCLUSIONS

- High inbreeding rates influence adaptation by efficient purging of deleterious recessive alleles which in turn create the opportunity for balancing selection.
- Low inbreeding rates influence adaptation by the maintenance of deleterious recessive alleles and, possibly, by the maintenance of the coevolved sets of loci known to be common among wild *C. elegans* isolates.
- Coevolved sets of loci may determine mating system evolution in *C. elegans* by favouring selfing as a means to purge deleterious alleles generated during mixing of populations or favour outcrossing in the presence of overdominant selection.