Traits targeted for genetic improvement

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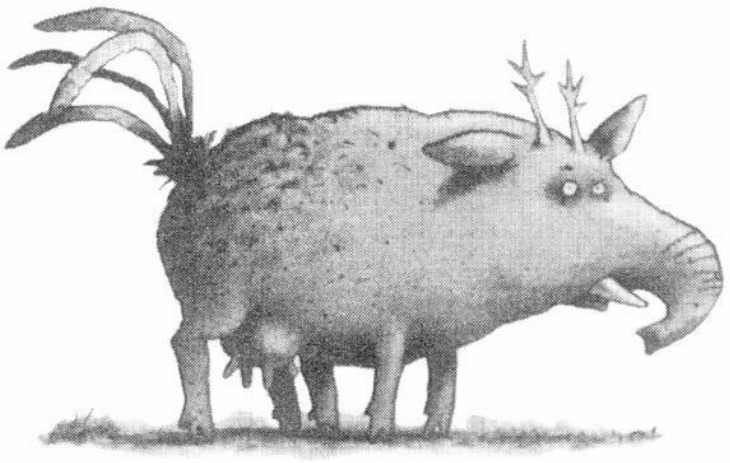
- Desiccation tolerance
- Heat tolerance
- Cold tolerance
- Shelf-life
- Cold activity
- Infectivity
- Propagation *in vitro*



The dream of all geneticists

Quantitative traits: allways a challenge for a geneticist

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- Phenotypic variance does not represent genetic variance
- Many genes involved – not all are known
- Interactions between the involved genes (dominance, epistasis, pleiotrophy) can make it impossible to correlate genetic markers with phenotypes

Genetic tools to improve beneficial traits

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- **Mutagenesis**
- **Transfer of genes from other species**

- **Exploitation of the natural genetic variability**

  - Marker supported selection for known genes

  - Identification of quantitative trait loci (QTL) - marker supported selection

  - Classical genetic selection: aggregation of beneficial alleles in one genotype

Selection for desiccation tolerance

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1. **Increase genetic variability:**
   cross-breeding of 8 *H. bacteriophora* isolates (hybrid strain)

2. **Determine heritability:**
   production of homozygous inbred lines, determination of phenotypic variability within and between the lines

3. **Select and propagate most tolerant individuals from the hybrid strain**

The heritability of desiccation tolerance
without previous adaptation phase

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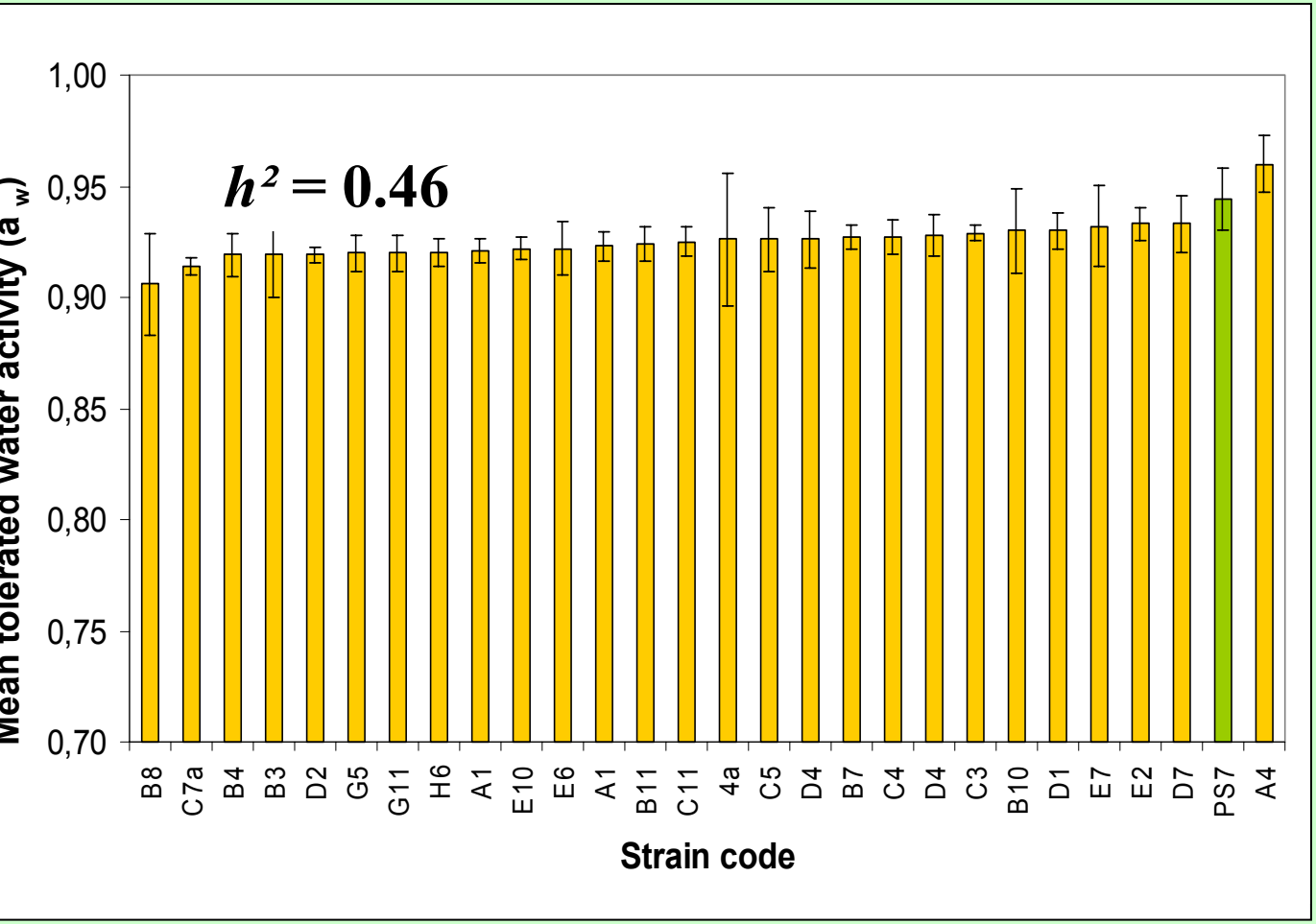

$$h^2 = \frac{\text{genetic variation}}{\text{phenotypic variation}}$$

The heritability of desiccation tolerance

With previous adaptation phase

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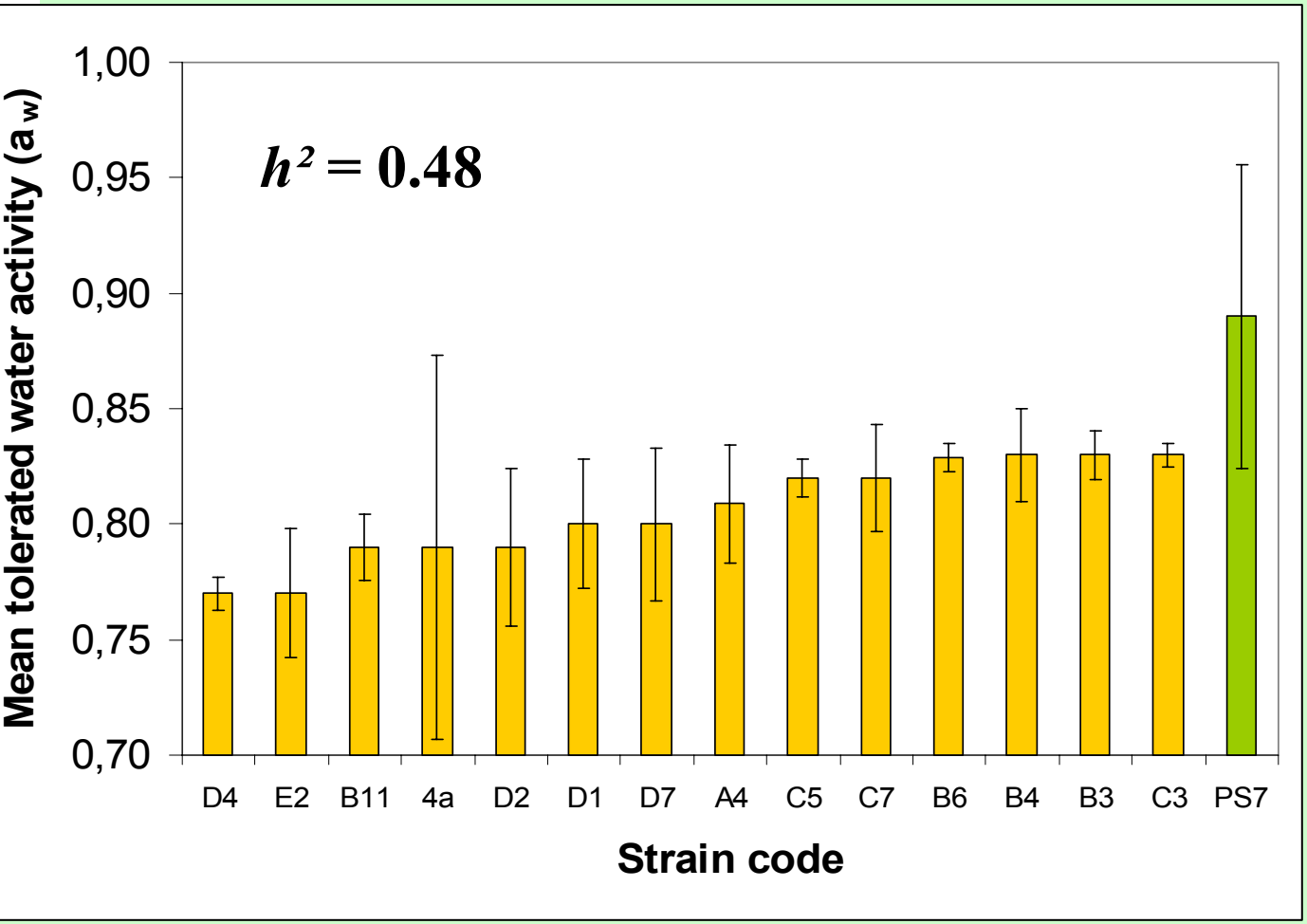

$$h^2 = \frac{\text{genetic variation}}{\text{phenotypic variation}}$$

Selection for desiccation tolerance with and without adaptation

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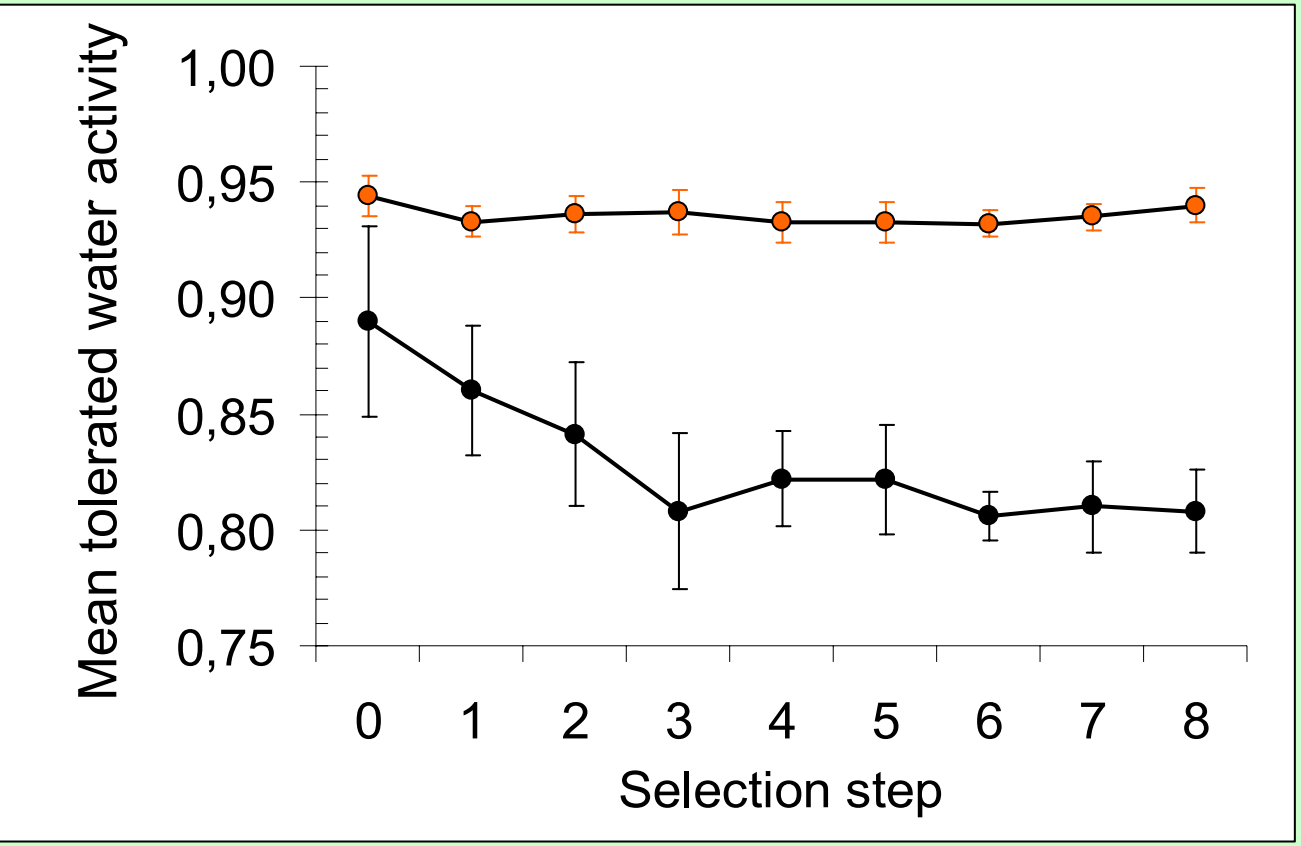

without adaptation

with adaptation

Selection for cold activity

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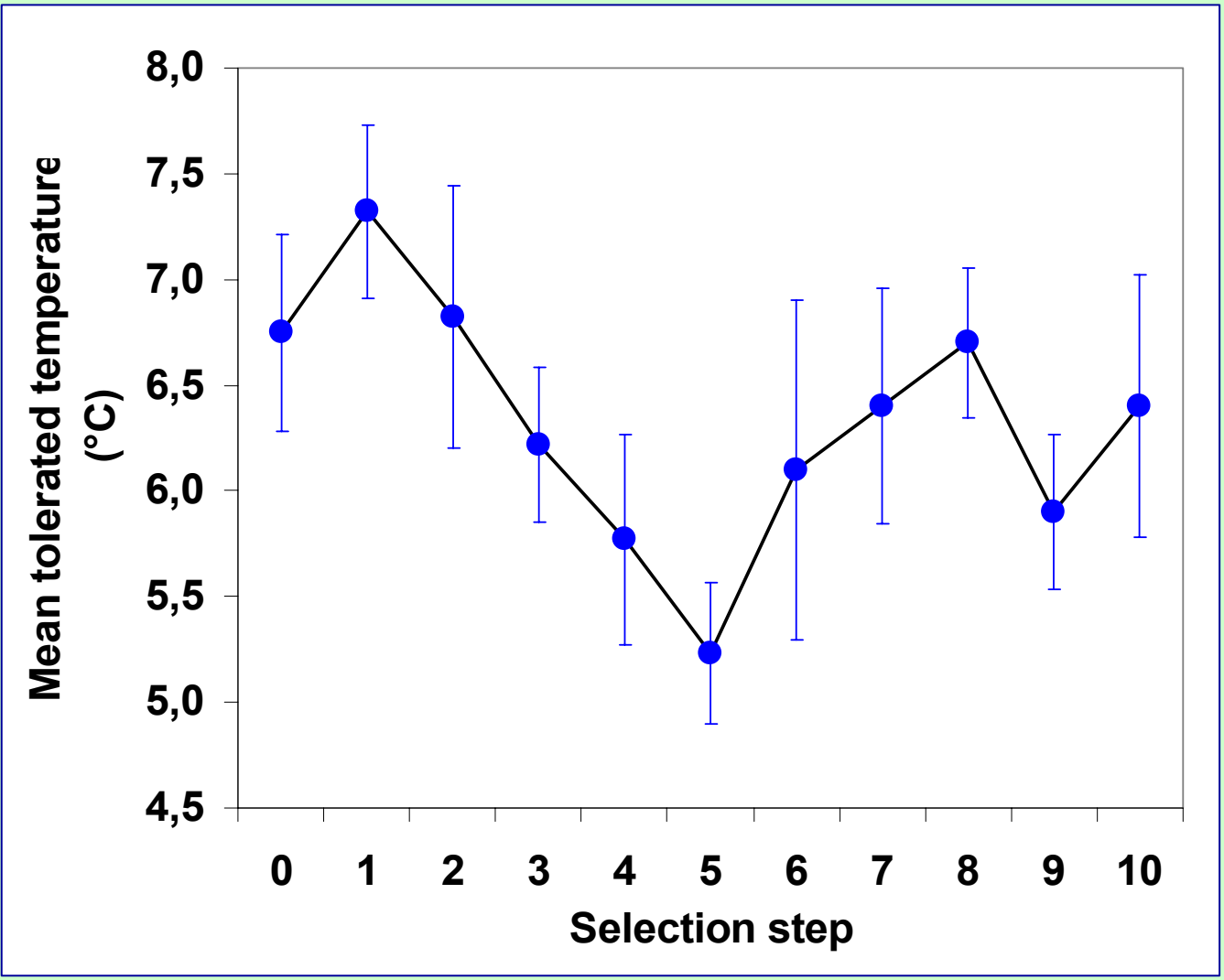

Selection for heat tolerance

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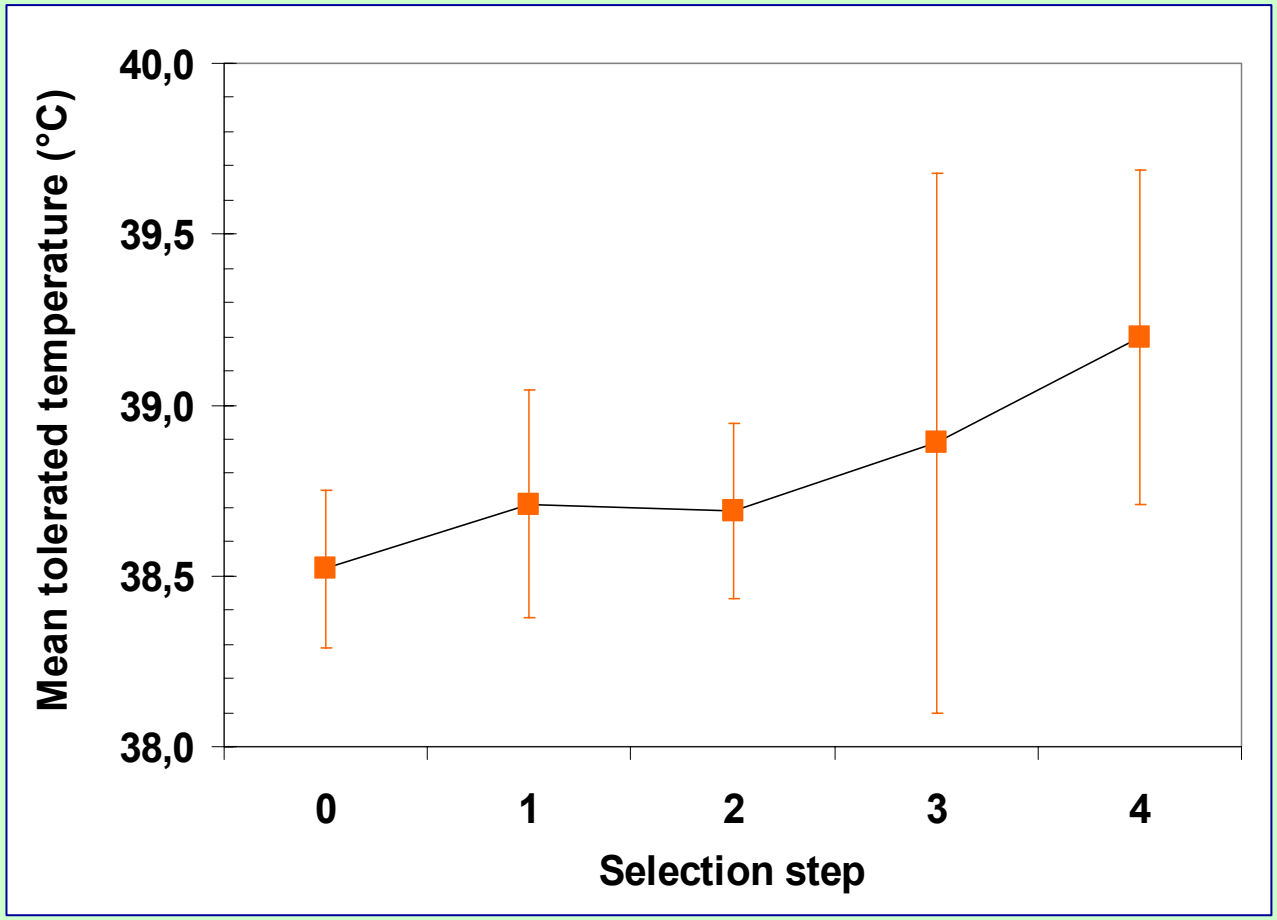

Conclusions

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- **Benefical traits can be enhanced by classical selection without major efforts**
  - Genetic variation is the most important prerequisite
- **So far, the exploitation of the natural genetic variability seems to be the best way to improve beneficial traits in commercial EPN products**