Effects of age and environment on the summer mortality in cupped oyster *Crassostrea gigas* during the first two years.

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Ifremer

Défi 2001-2005 : MOREST

Etude des MORtalités ESTivales chez *C. gigas*

Study of summer mortality in C. gigas

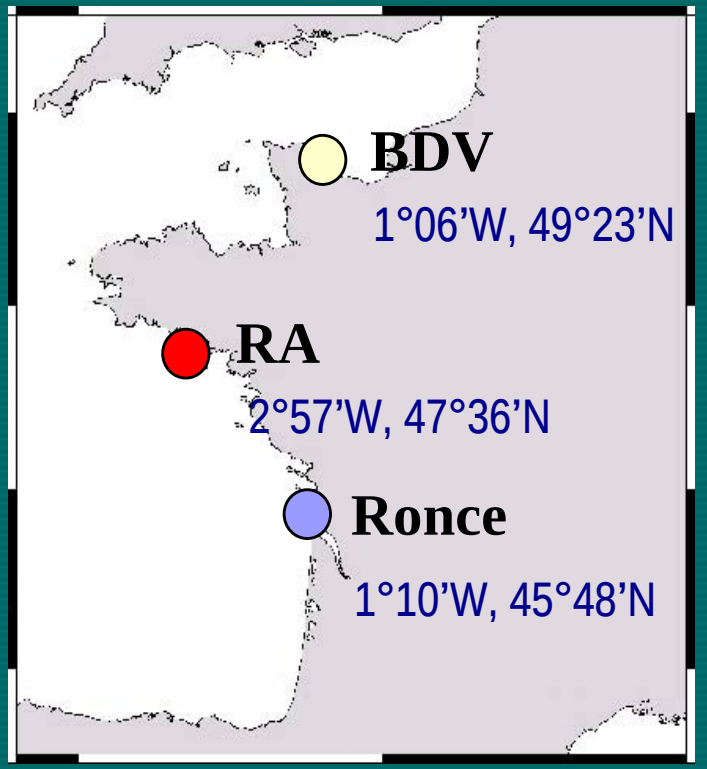
- a multidisciplinary program to better understand and face summer mortality

- Major genetic finding: selective breeding programs can improve survival for juveniles < 1 year-old

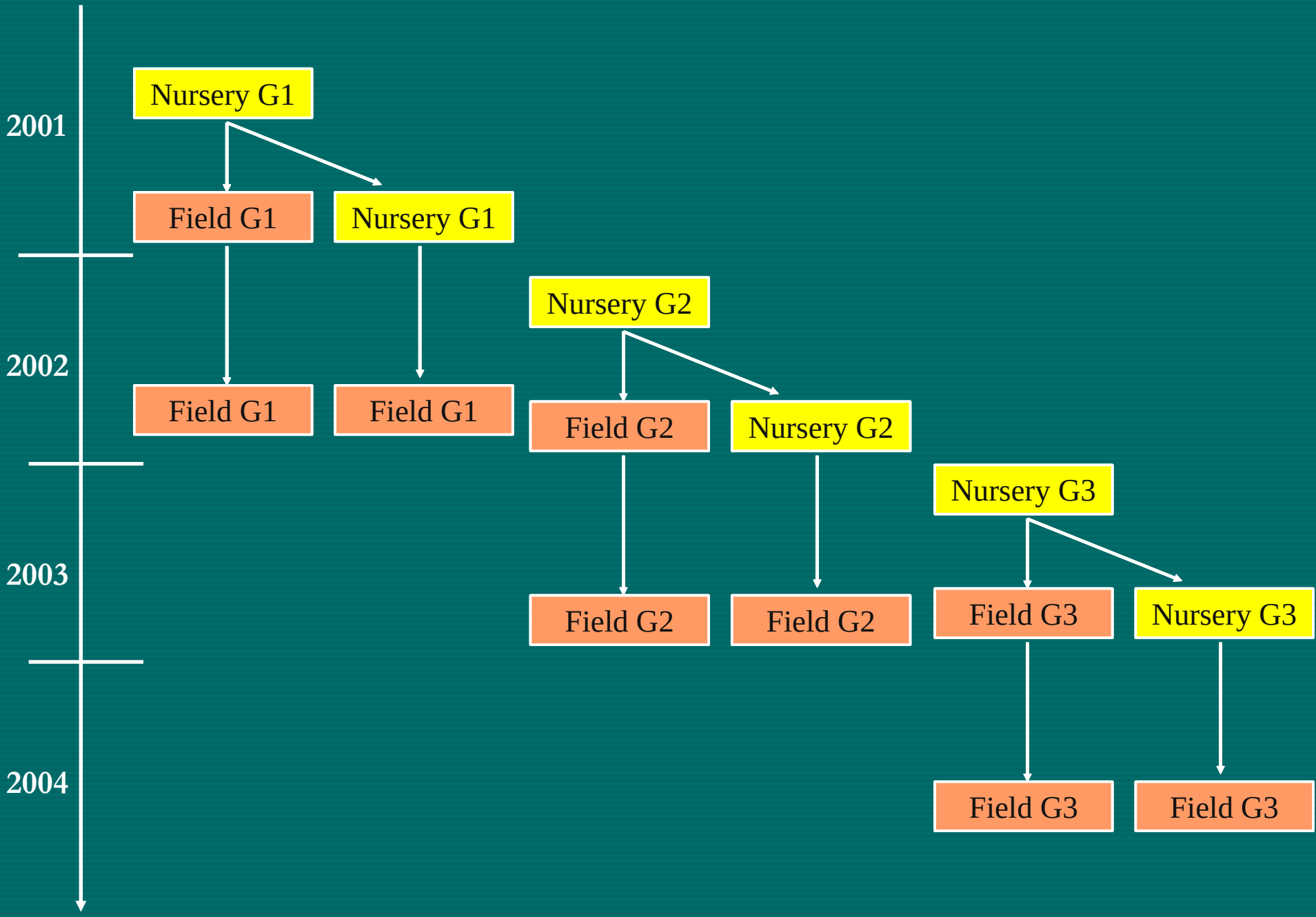
Ifremer

Hatchery spat produced and tested the same year:

- First generation (G1) 2001
- Second generation (G2) 2002
- Third generation (G3) 2003



BDV < Ronce < RA


2001
2002
2003
2004
Nursery G1
Field G1
Nursery G1
Field G1
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Nursery G2
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Field G2
Field G2
Nursery G3
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Nursery G3
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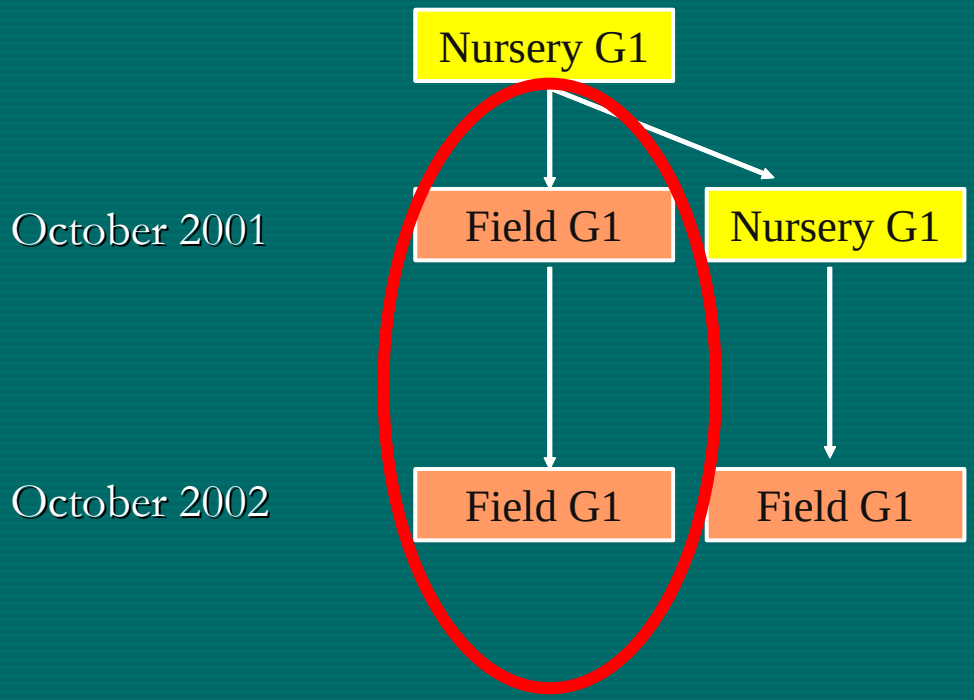
Field G3

G1

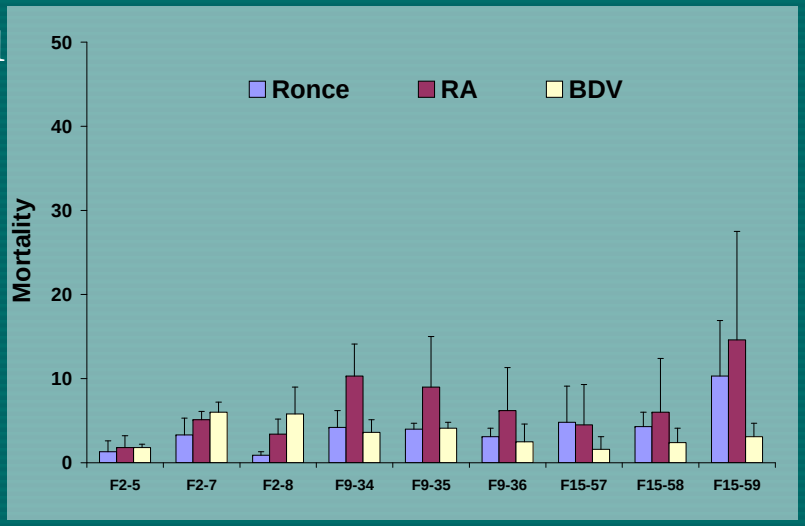
- 9 families selected ‘resistant’ (‘R’) in October 2001
- recorded mortality in October 2002 : 3 sites



G1 – 'R' group

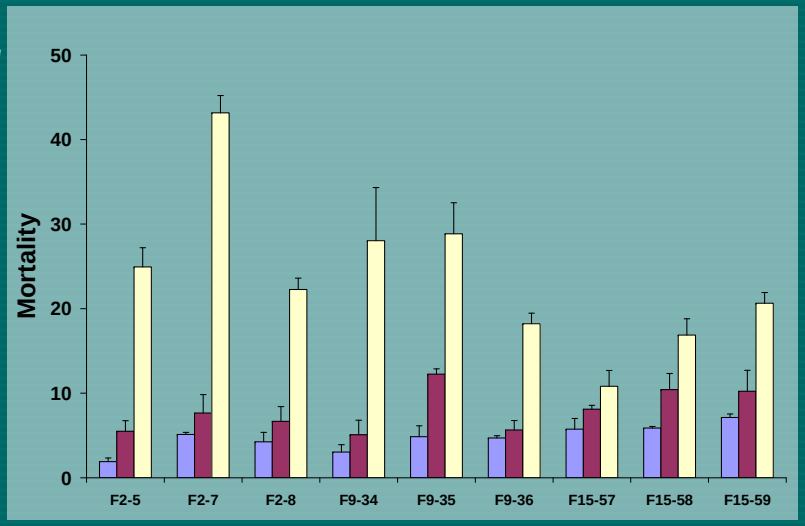
2001

6 months



2002

18 months



Year comparison

RA: 2001 (7%) = 2002 (8%); p = 0.13

Ronce: 2001 (4%) < 2002 (5%); p = 0.045

BDV: 2001 (3%) < 2002 (24%); p < 0.0001

Site comparison

2001: BDV = Ronce < RA; p = 0.002

2002: Ronce < RA < BDV; p < 0.0001

Cumulative: Ronce < RA < BDV; p < 0.0001

9% 14% 26%

Site-year interaction: p<0.0001

G1 – ‘R’ group

- RA and Ronce: high survival performances both years (i.e., 6 and 18 months-old)
- BDV: moderate mortality at 18 months-old

What happened for the ‘S’ families?

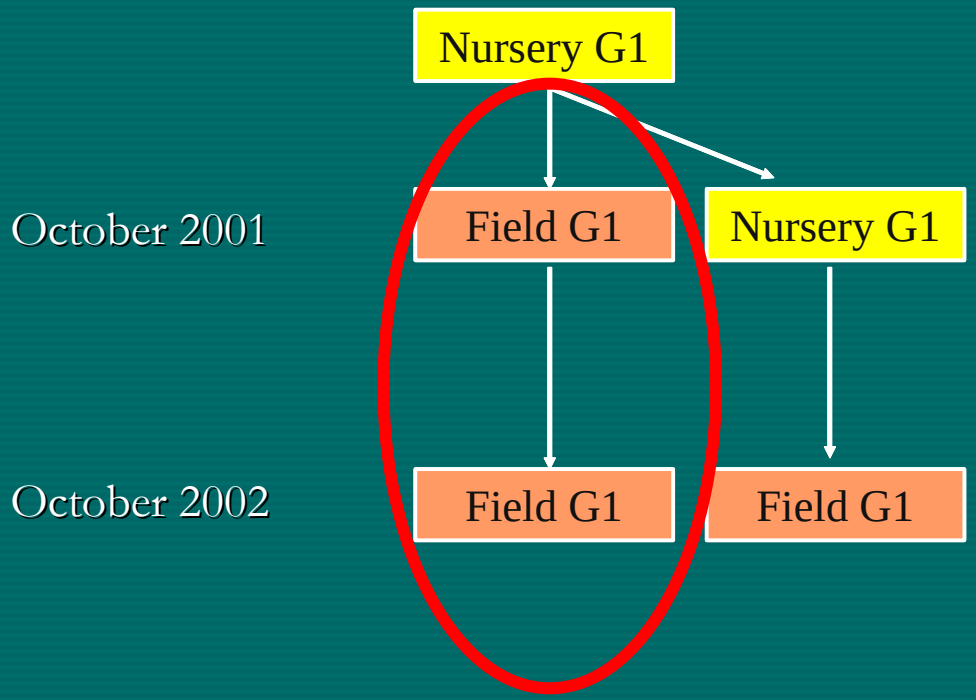
BDV G3

RA G1-G2-G3

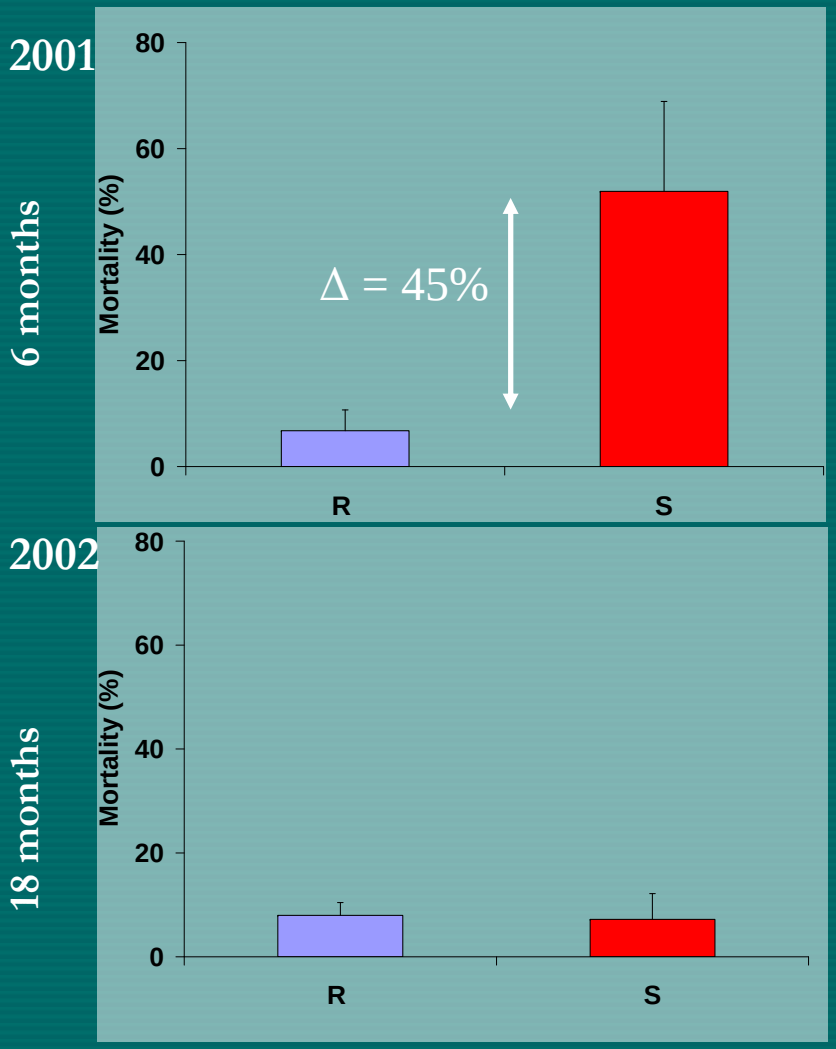
G1

- 9 families selected ‘resistant’ (‘R’) in October 2001
- 8 families selected ‘susceptible’ (‘S’) in October 2001

- recorded mortality in October 2002 : RA



G1 – ‘R’ and ‘S’ groups in RA



Group comparison

2001: R (7%) < S (52%); p < 0.0001

2002: R (7%) = S (8%); p = 0.09

Cumulative: R (14%) < S (55%); p < 0.0001

Year comparison

R: 2001 (7%) = 2002 (8%); p = 0.13

S: 2002 (7%) < 2001 (52%); p < 0.0001

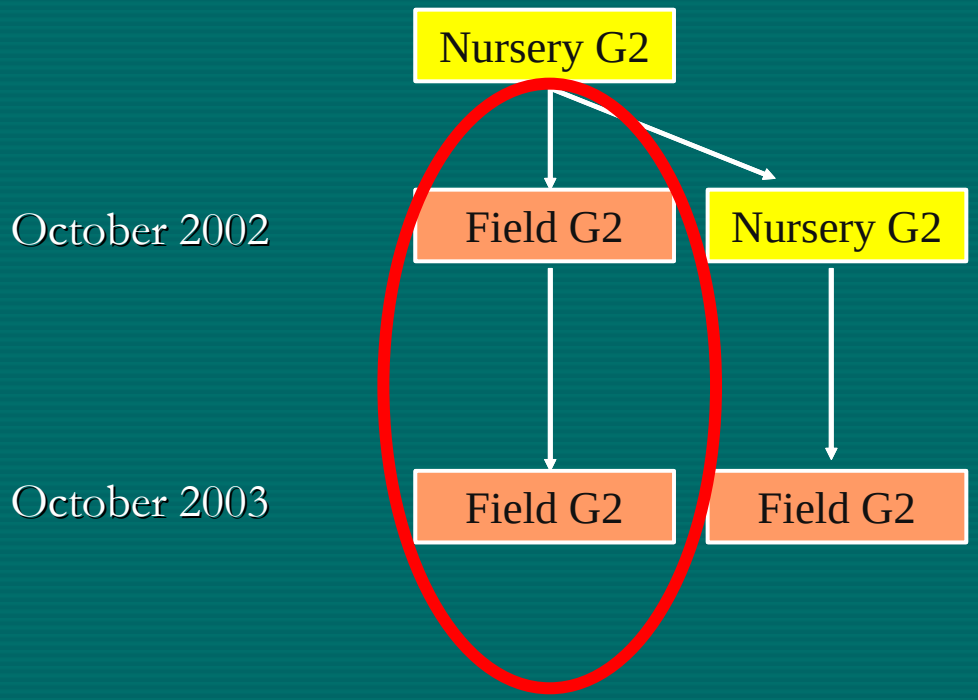
Group-year interaction: p<0.0001

6 months-old spat more sensitive than the 18 months-old ones to summer mortality

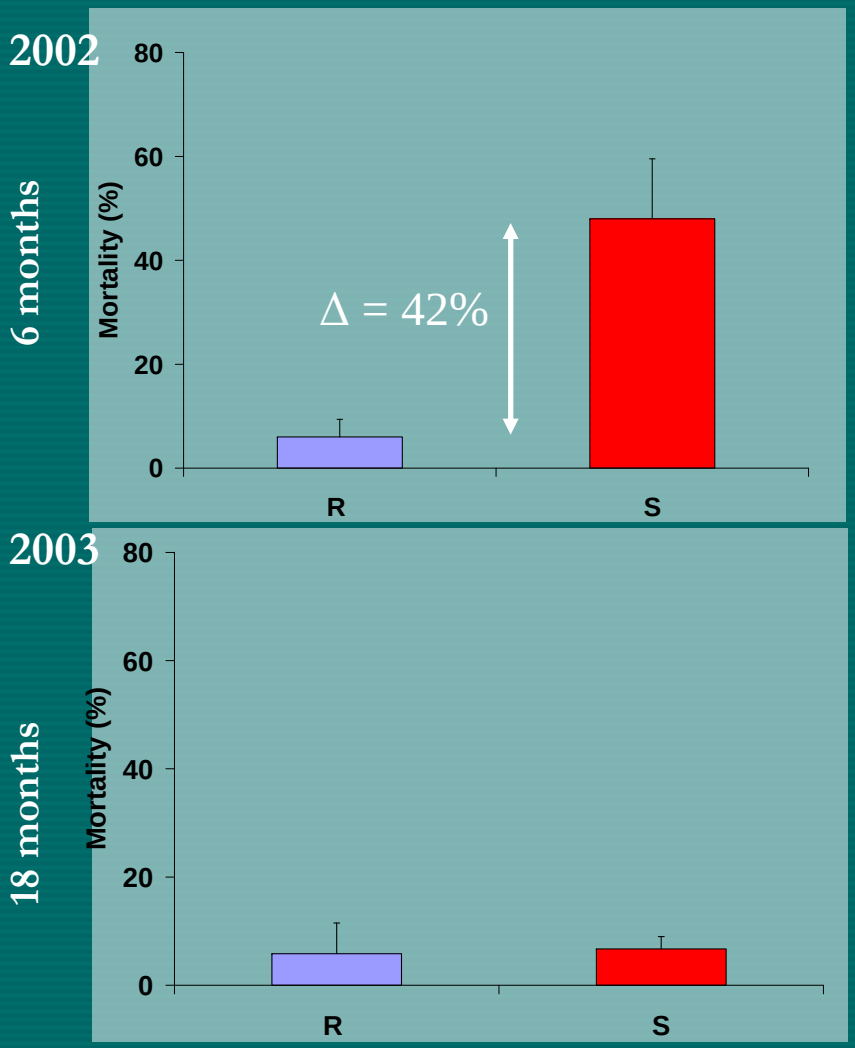
G2

- 5 families selected ‘resistant’ (‘R’) in October 2002
- 5 families selected ‘susceptible’ (‘S’) in October 2002

- recorded mortality in October 2003 : RA



G2 – ‘R’ and ‘S’ groups in RA



Group comparison

2002: R (6%) < S (48%); p < 0.0001

2003: R (6%) = S (7%); p = 0.28

Cumulative: R (12%) < S (52%); p < 0.0001

Year comparison

R: 2002 (6%) = 2003 (6%); p = 0.72

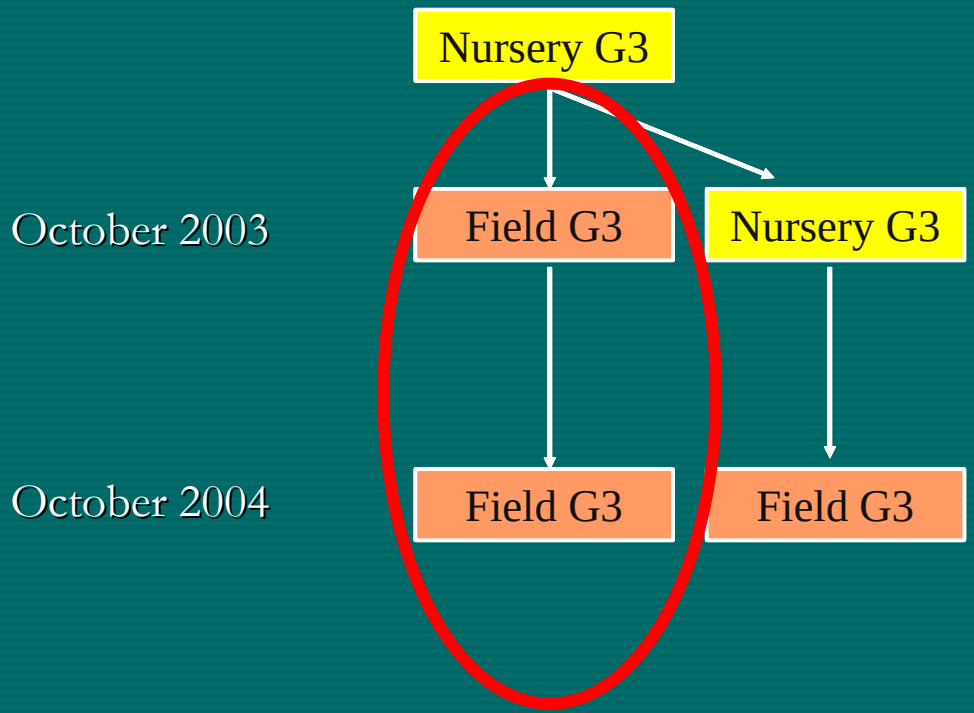
S: 2003 (7%) < 2002 (48%); p < 0.0001

Group-year interaction: p<0.0001

Confirm G1’s results

G3

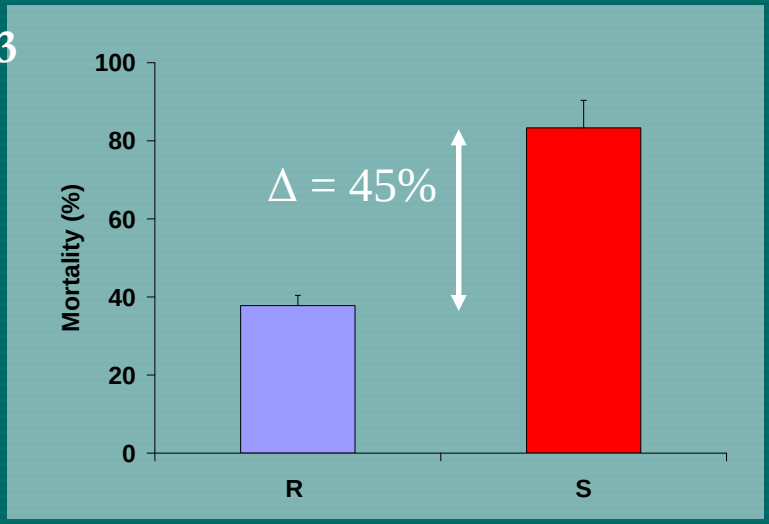
- 1 pool selected ‘resistant’ (‘R’)
- 1 pool selected ‘susceptible’ (‘S’)
- recorded mortality in October 2003 : RA



G3 – ‘R’ and ‘S’ groups in RA

2003

6 months



2004

18 months

No recorded

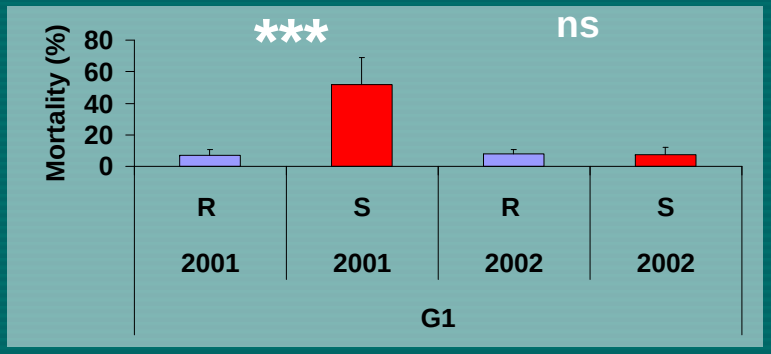
Group comparison

2003: R (38%) < S (83%) ; p < 0.0001

‘R’ and ‘S’ groups in RA

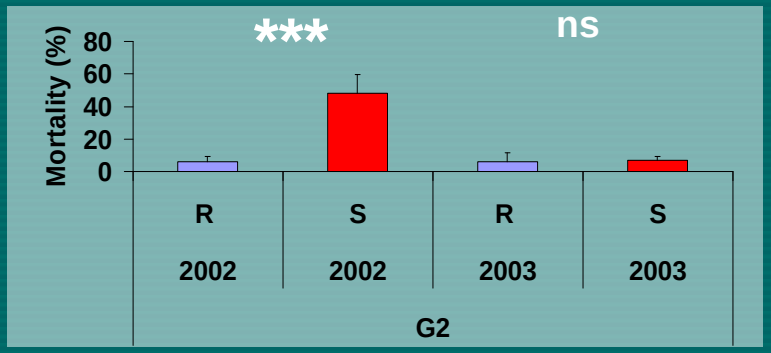
Deployed in the field the first year

G1



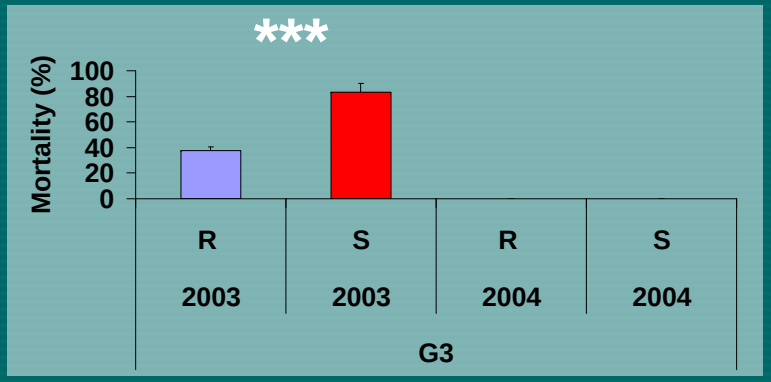
First year (6 months-old): highest mortality for the ‘S’ group and lowest for the ‘R’ one

G2



Second year (18 months-old): low and similar mortality for both group

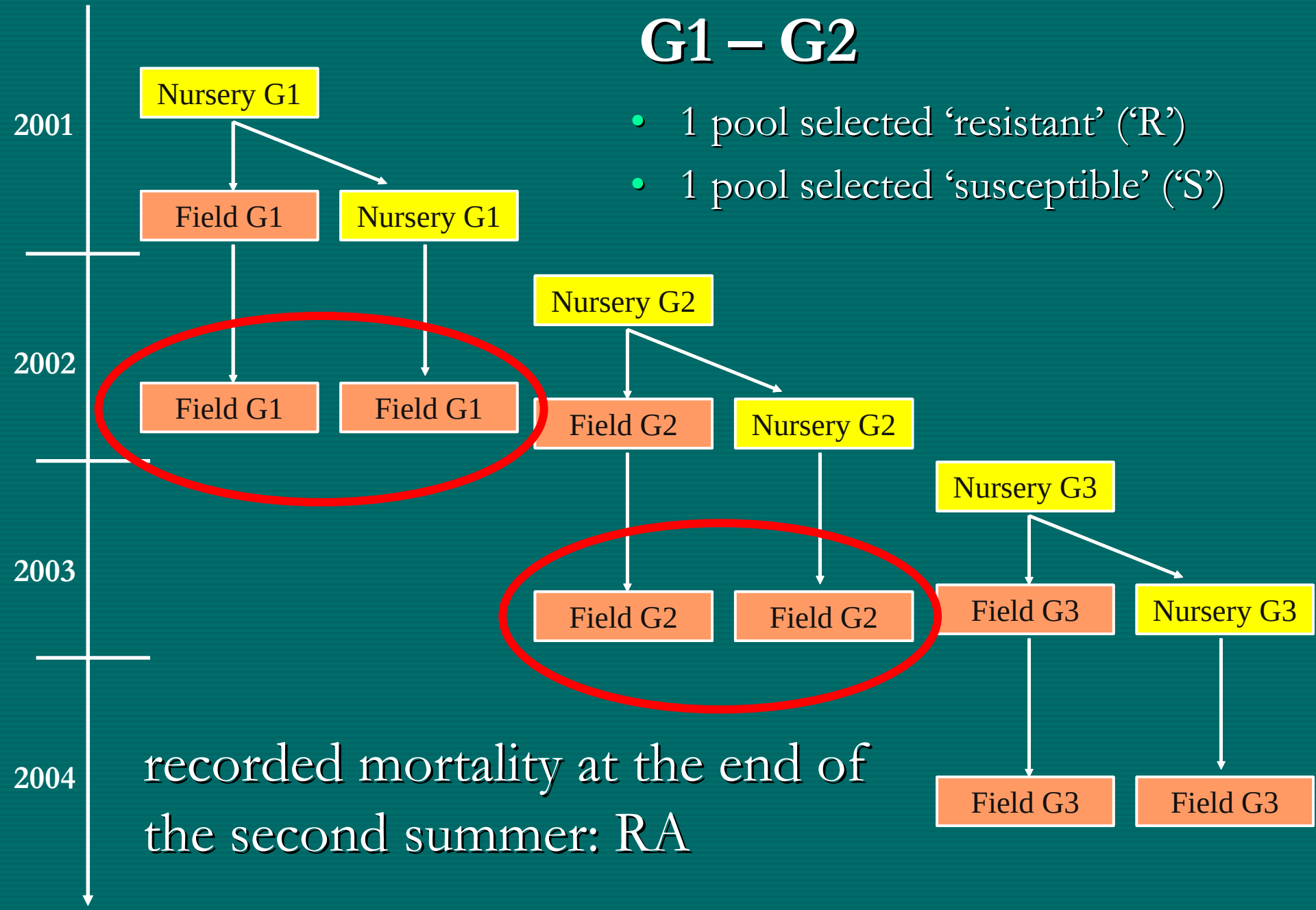
G3



‘S’: critical sensitive period during the first summer in RA

G1 – G2

- 1 pool selected ‘resistant’ (‘R’)
- 1 pool selected ‘susceptible’ (‘S’)



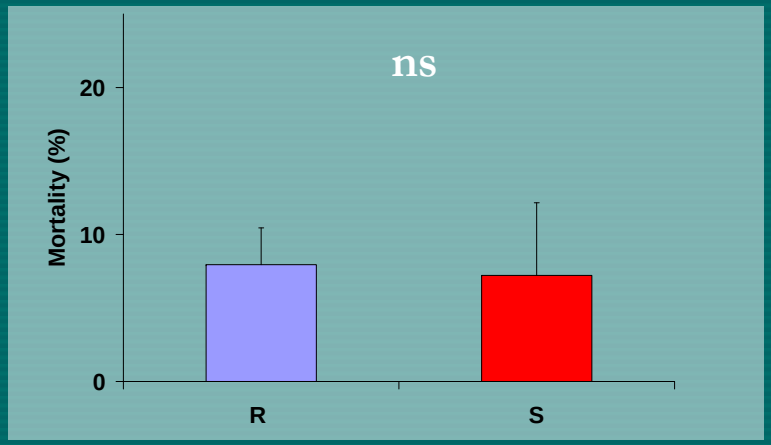
recorded mortality at the end of the second summer: RA

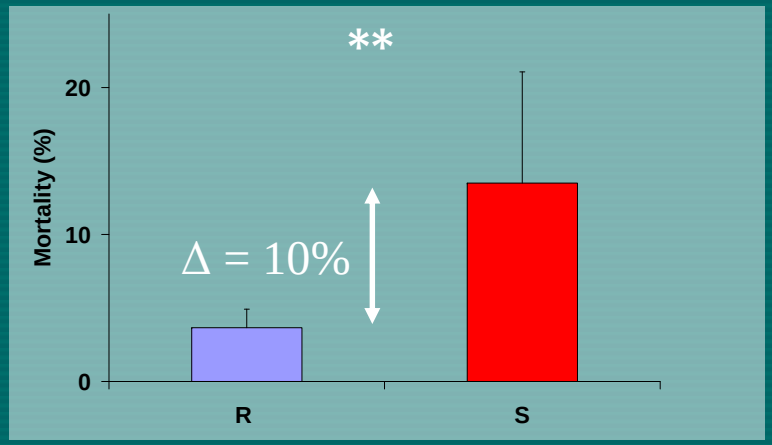
G1 and G2 – ‘R’ and ‘S’ groups in RA 18 months-old

Deployed in the field the first year

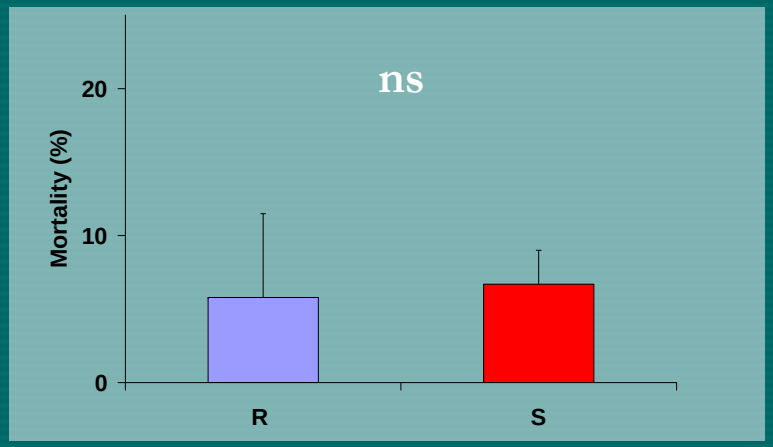
Preserved in nursery the first year

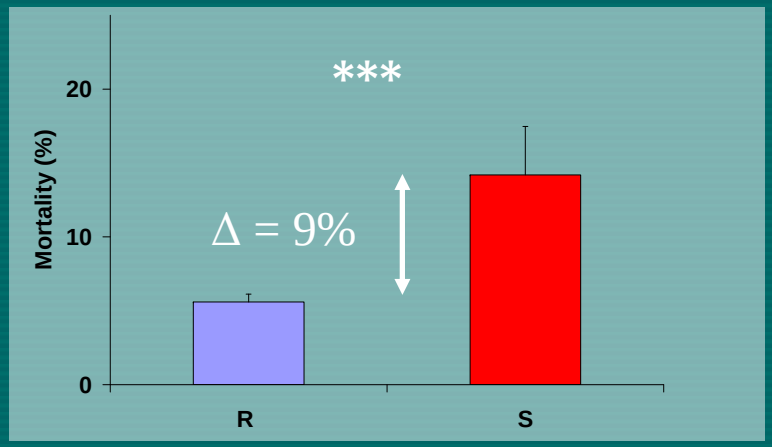
G1





G2





G1 and G2 – 'R' and 'S' groups in RA

- Deployed in the field the first year:
  - Δmortality = 45% ↔ Differential expression of *C. gigas* genes between R and S groups during summer mortality event that had affected only the S group the first year (i.e., spat < 1 year-old)
  - Δmortality = 1% ↔ No difference at 18 months-old : culling during the first year
- Preserved in nursery the first year:
  - Δmortality = 10% ↔ Differential expression of *C. gigas* genes between R and S groups during summer mortality at 18 months-old

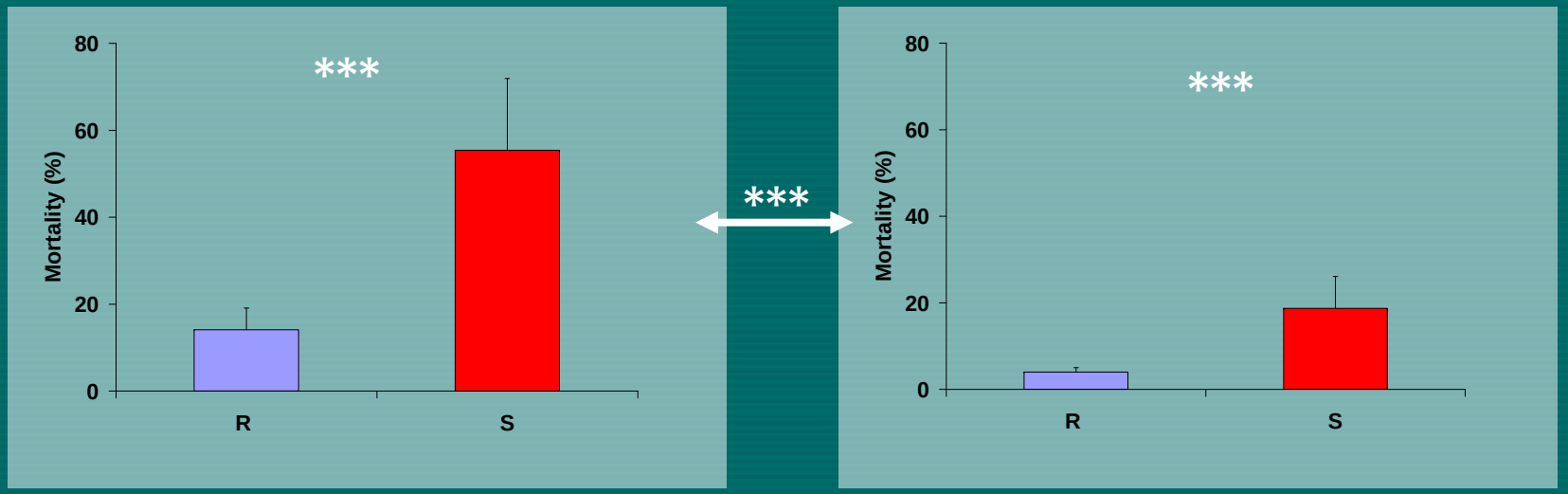
Same or different genes and/or lesser genes involved in summer mortality outbreak at 18 months-old than 6 months-old

G1 and G2 – ‘R’ and ‘S’ groups in RA
Cumulative mortality – 18 months-old

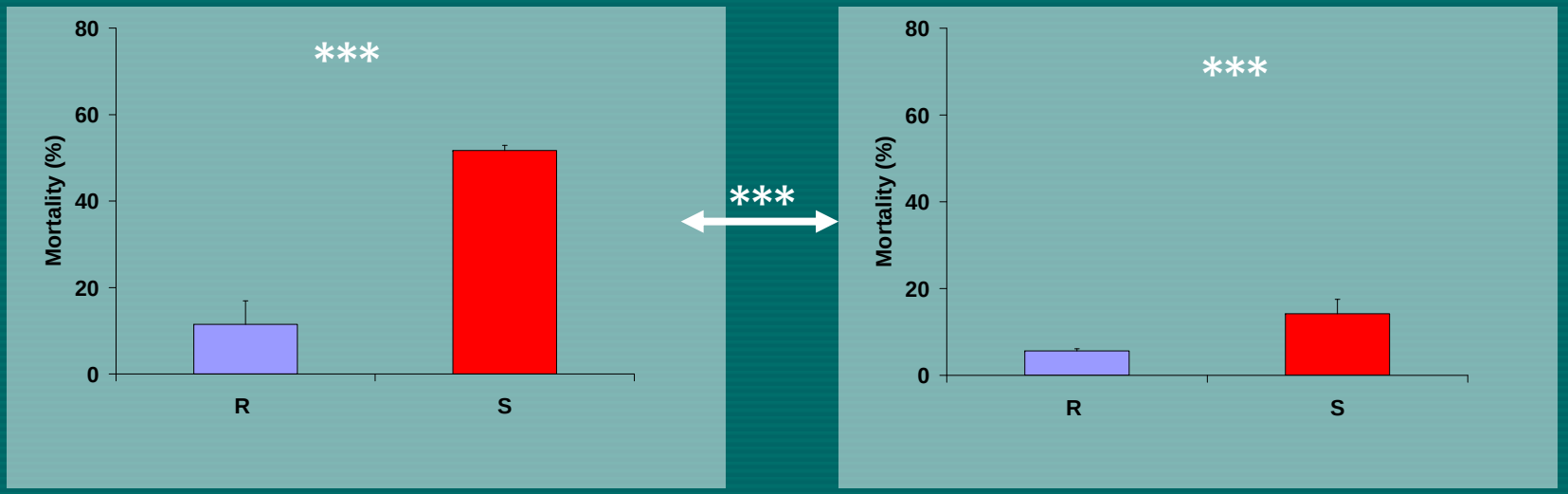
Deployed in the field the first year

Preserved in nursery the first year

G1

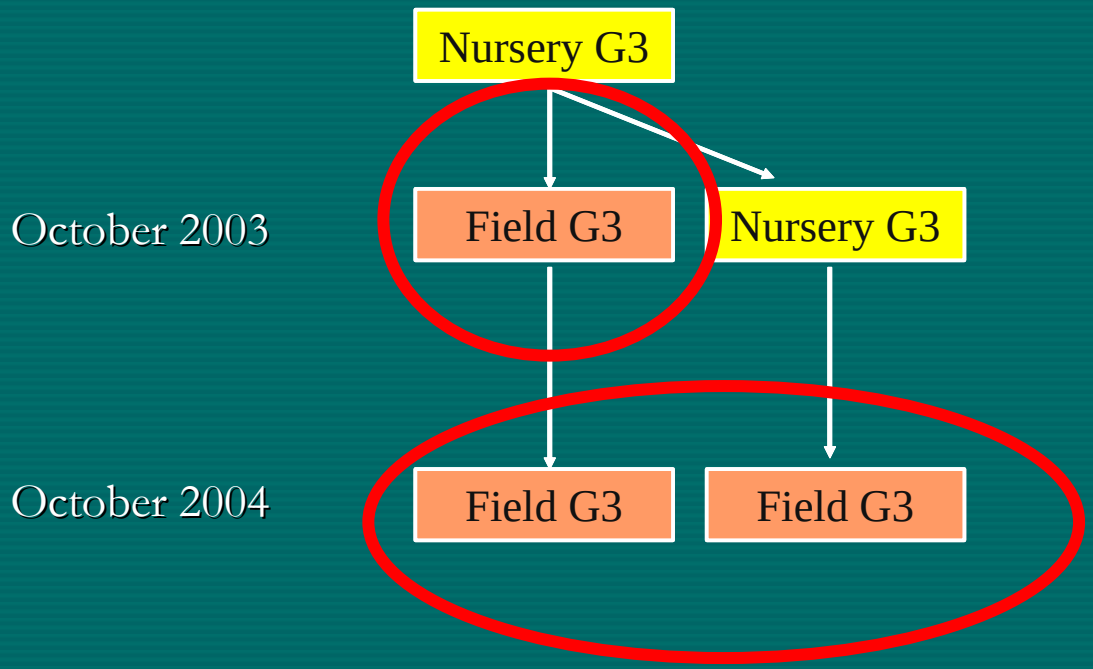


G2



G3

- 1 pool selected ‘resistant’ (‘R’)
- 1 pool selected ‘susceptible’ (‘S’)
- recorded mortality in October 2003 and 2004 : RA and BDV

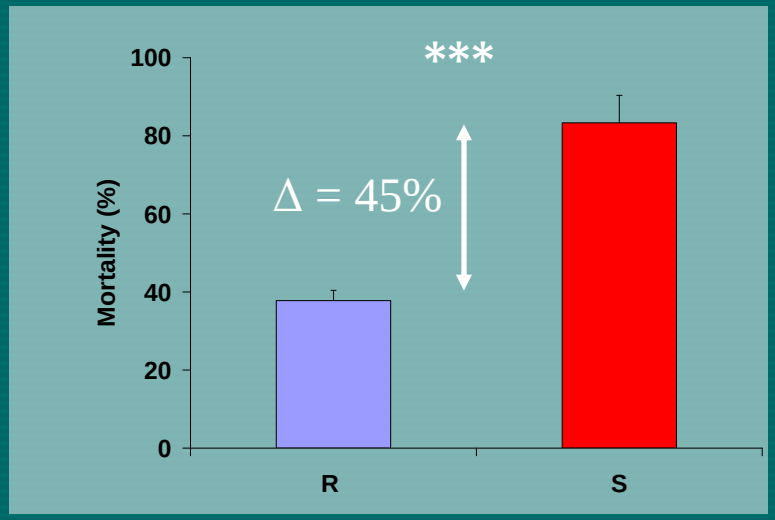


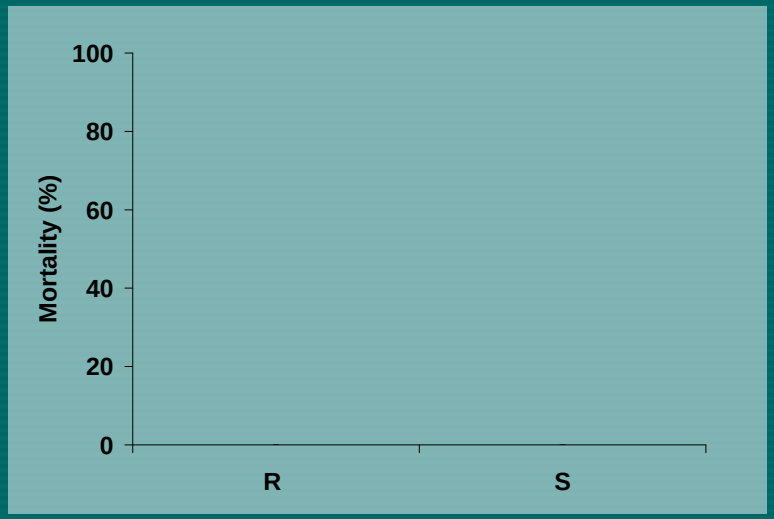
G3 - ‘R’ and ‘S’ groups in RA

Deployed in the field the first year

Preserved in nursery the first year

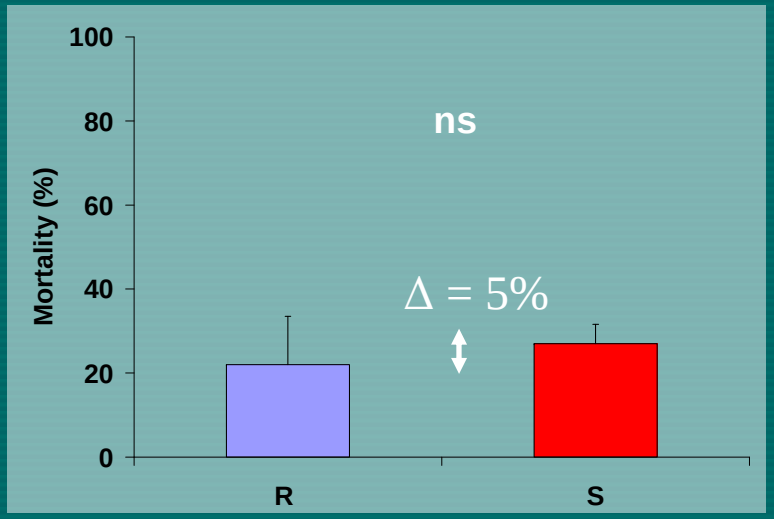
2003





2004

No recorded

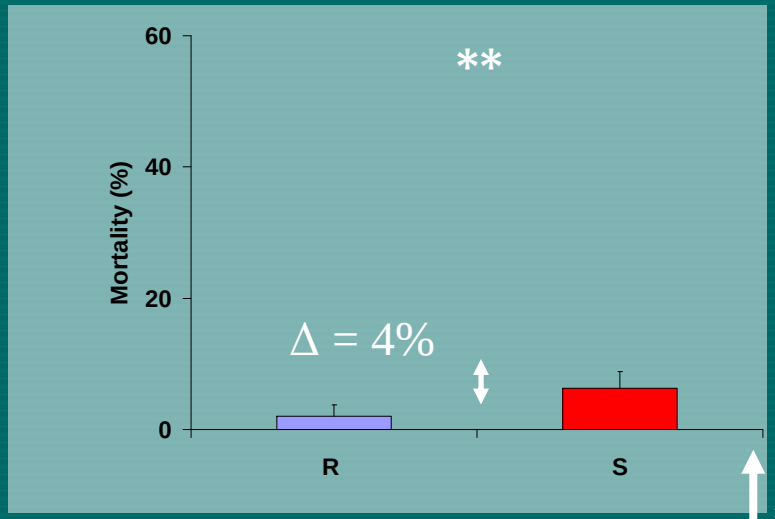


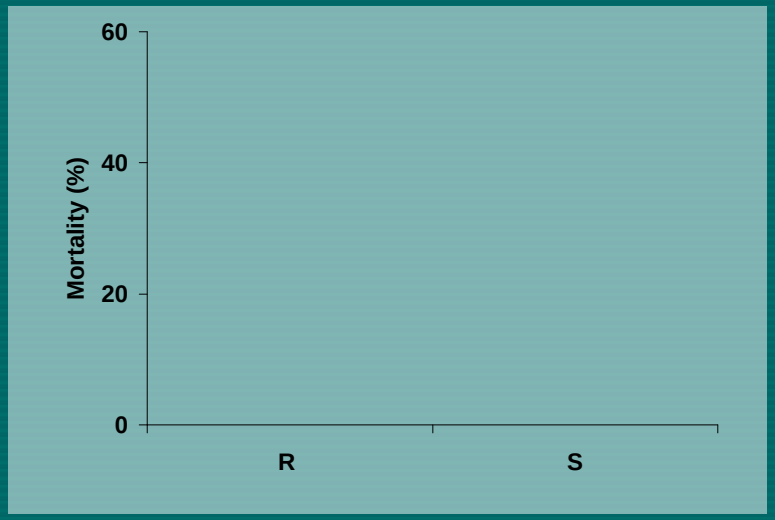
G3 - ‘R’ and ‘S’ groups in BDV

Deployed in the field the first year

Preserved in nursery the first year

2003





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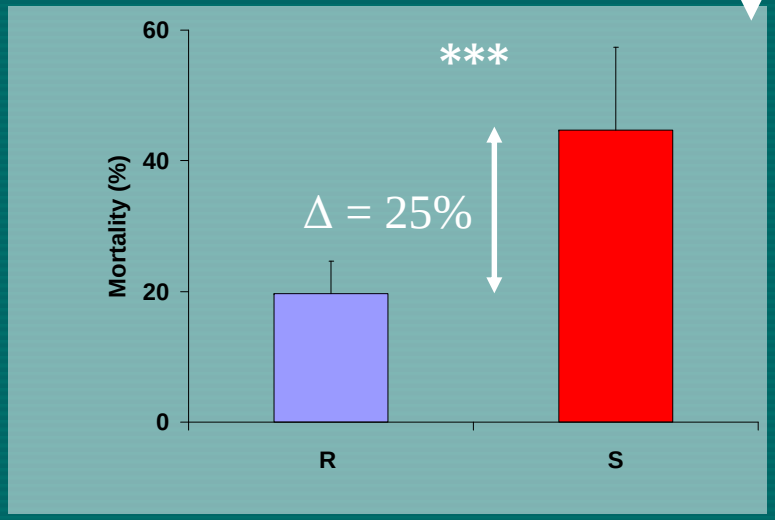
2004



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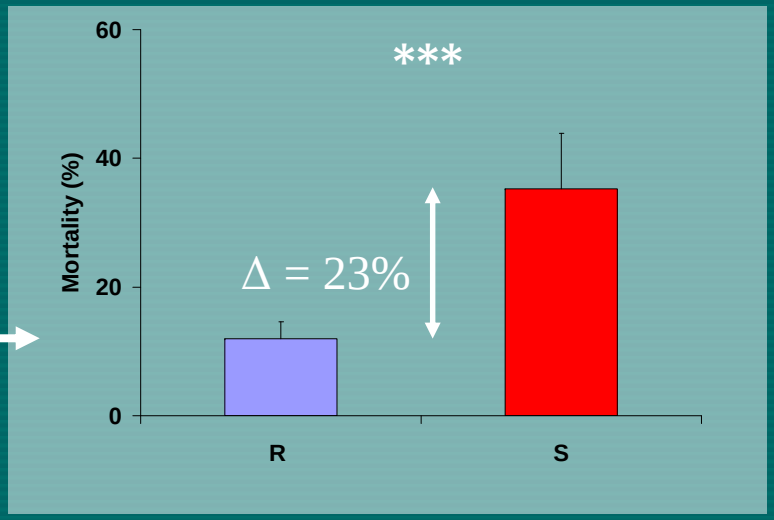

Conclusions

- Critical period to observe summer mortality:
  - RA: first year
  - BDV: second year

- Decrease mortality at 18 months-old by preserving spat the first year:
  - no emersion, high trophic level: BDV and culture in deeper water

Oyster management strategy according to the batch, age and environment

Perspectives

Identification of genes involved in summer mortality event

- Quantitative Trait Loci
- Suppressive Substractive Hybridation

- RA and BDV, 6 and 18 months-old

Acknowledgements

Hatchery, Nursery and Field teams:

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Laboratoire Environnement Ressources de Normandie