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

Lionel Dégremont , Pierre Boudry, Patrick Soletchnik, Edouard Bédier, Michel Ropert, Jean-François Samain

Ifremer

Défi 2001-2005 : MOREST

Etude des MORtalités ESTivales chez *C. gigas*

Study of summer mortality in C. gigas

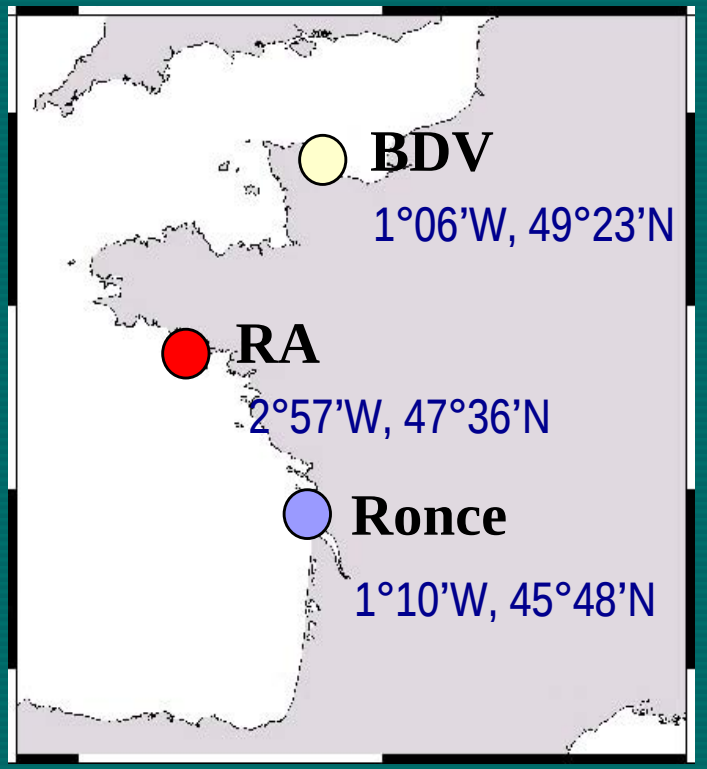
- a multidisciplinary program to better understand and face summer mortality

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

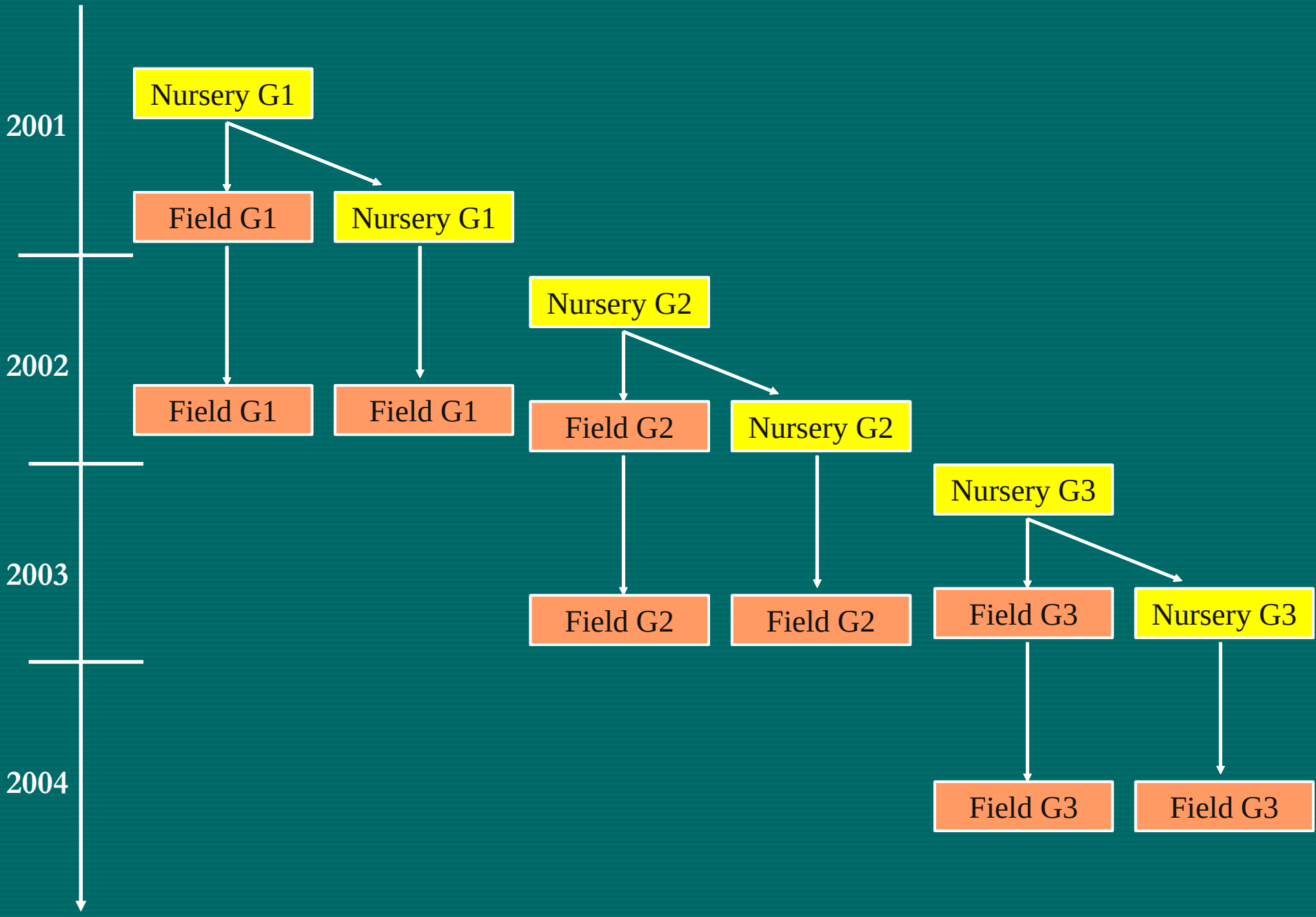
Ifremer

Hatchery spat produced and tested the same year:

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

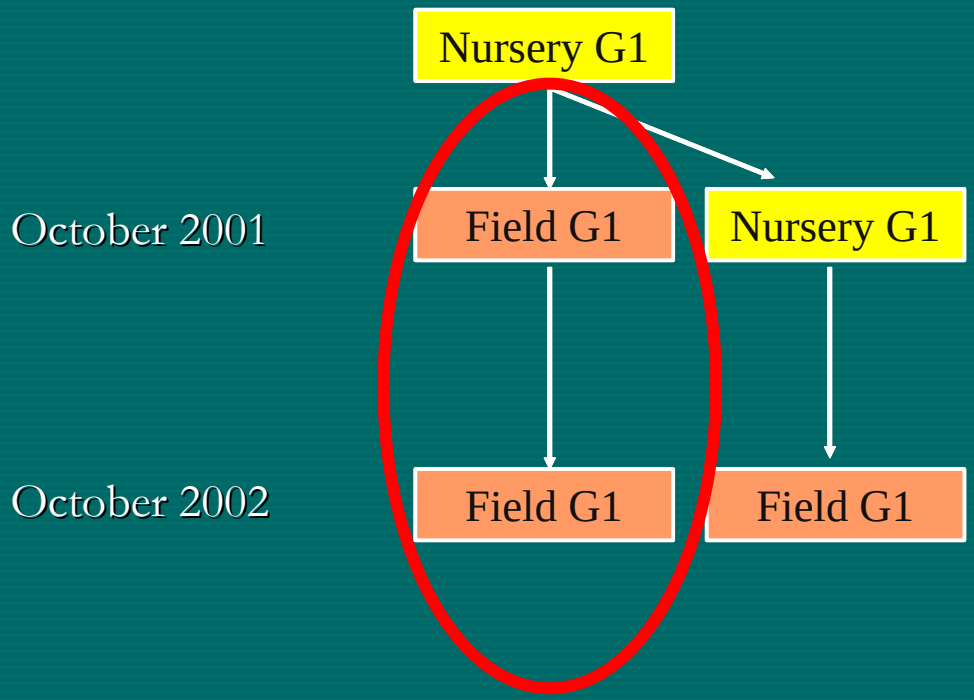


BDV < Ronce < RA


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

G1

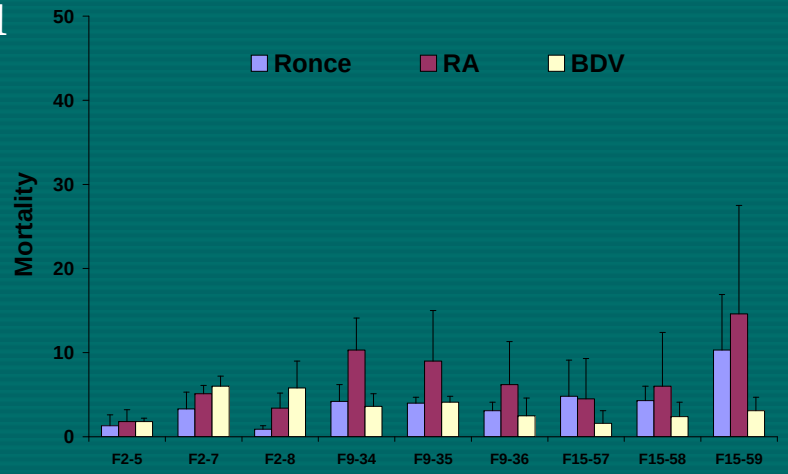
- 9 families selected ‘resistant’ (‘R’) in October 2001
- recorded mortality in October 2002 : 3 sites



G1 – 'R' group

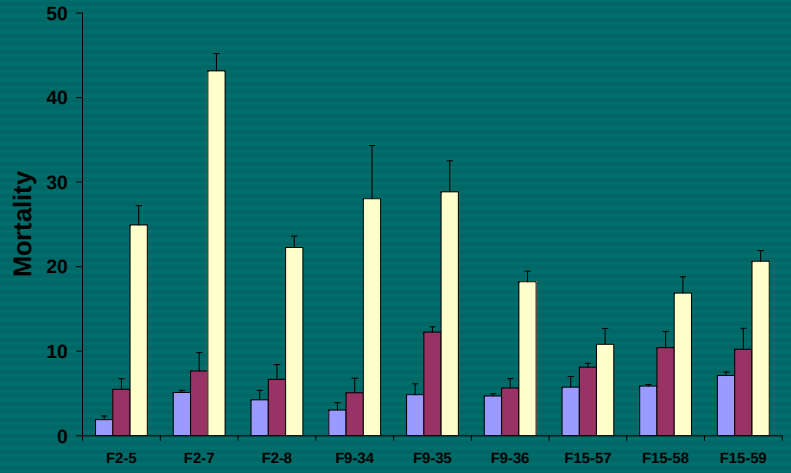
2001

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?

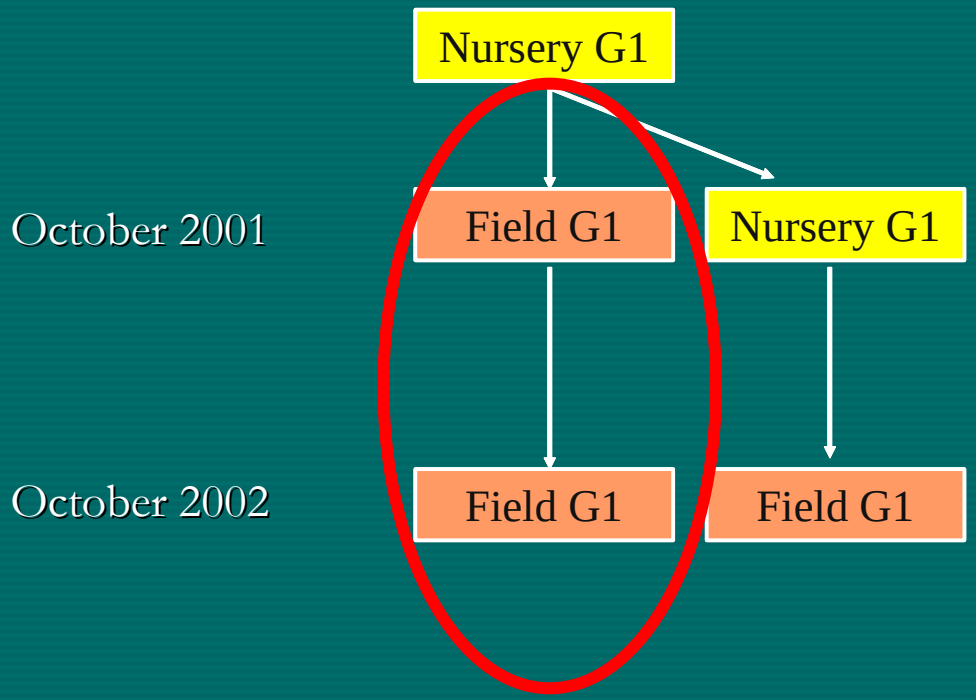
BDV G3

RA G1-G2-G3

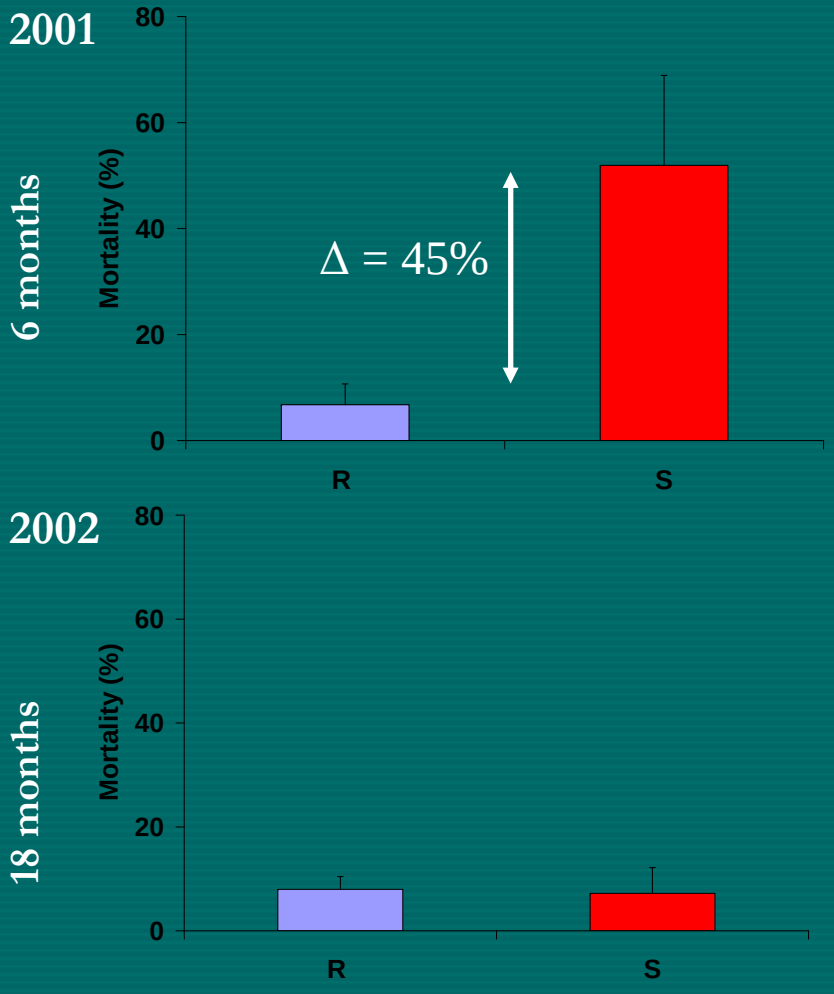
G1

- 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

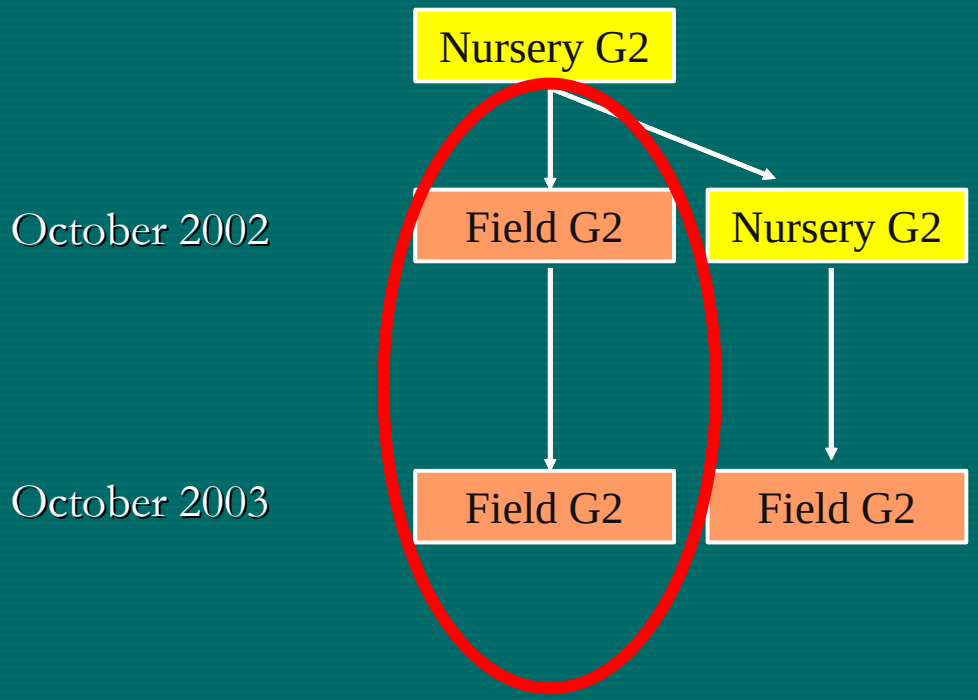
Group-year interaction: p<0.0001

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

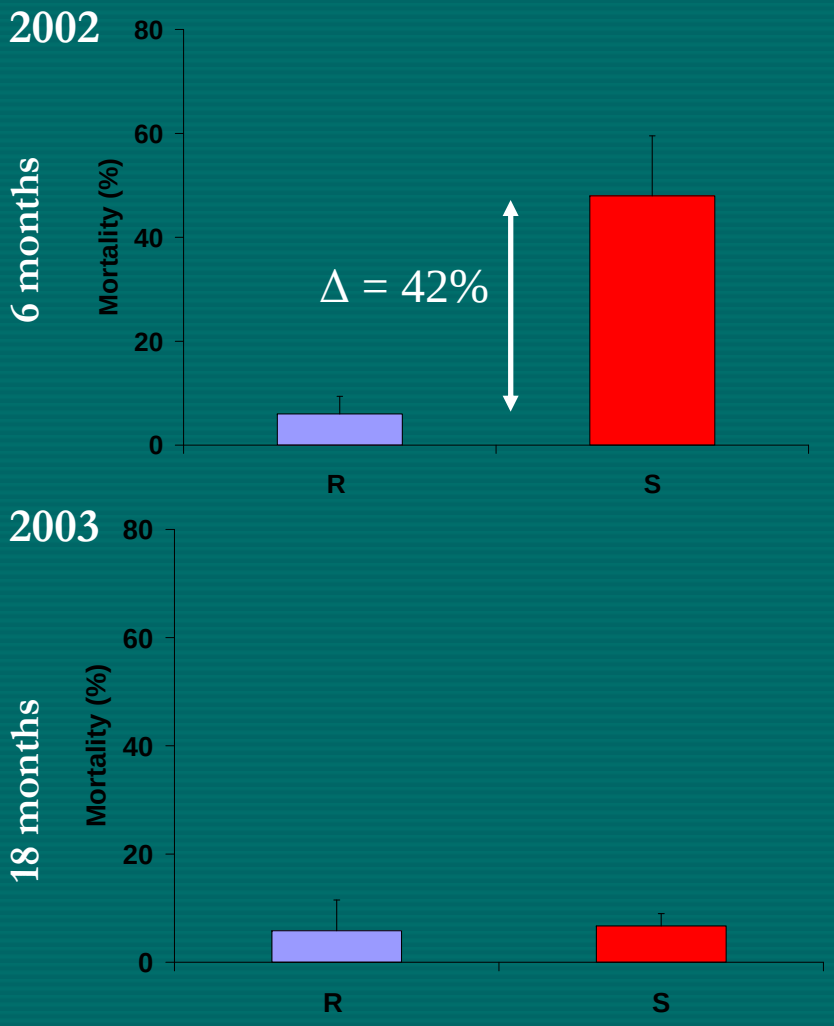
G2

- 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

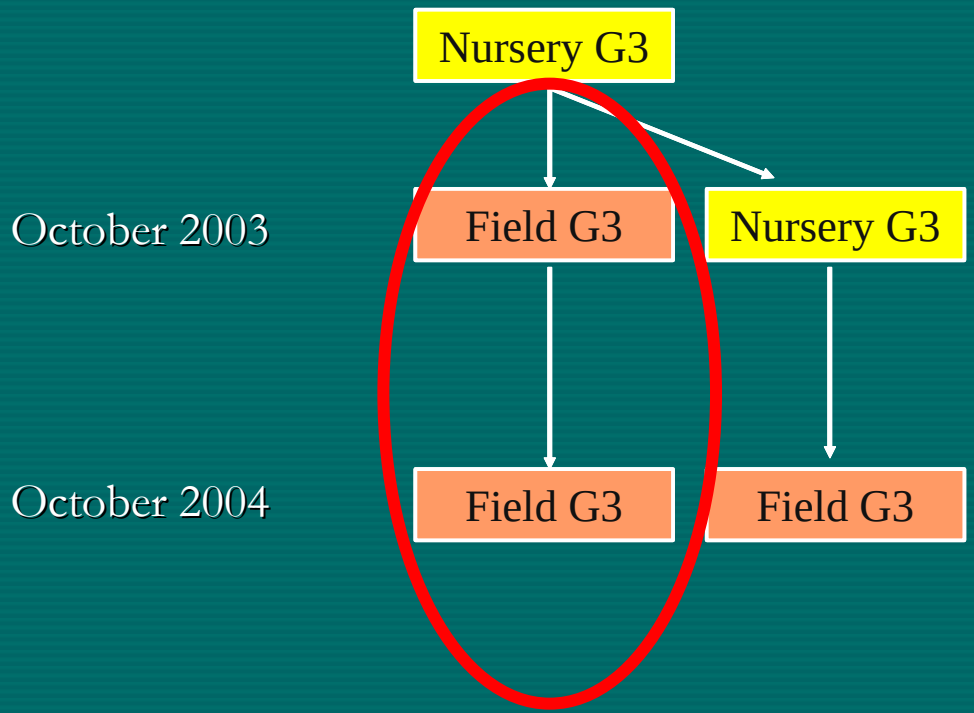
S: 2003 (7%) < 2002 (48%); p < 0.0001

Group-year interaction: p<0.0001

Confirm G1’s results

G3

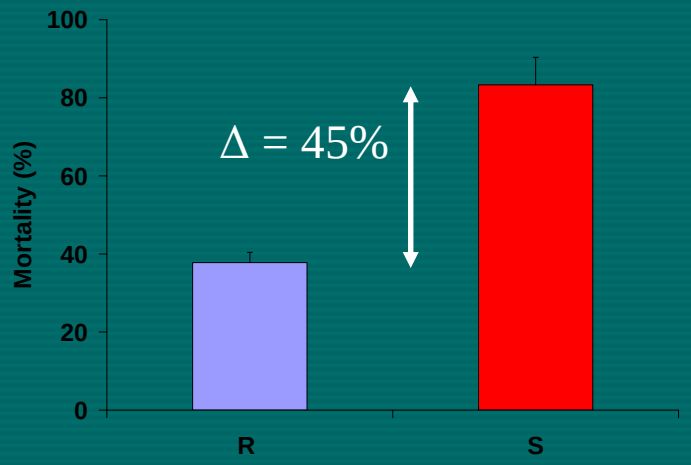
- 1 pool selected ‘resistant’ (‘R’)
- 1 pool selected ‘susceptible’ (‘S’)
- recorded mortality in October 2003 : RA



G3 – ‘R’ and ‘S’ groups in RA

2003

6 months



2004

18 months

No recorded

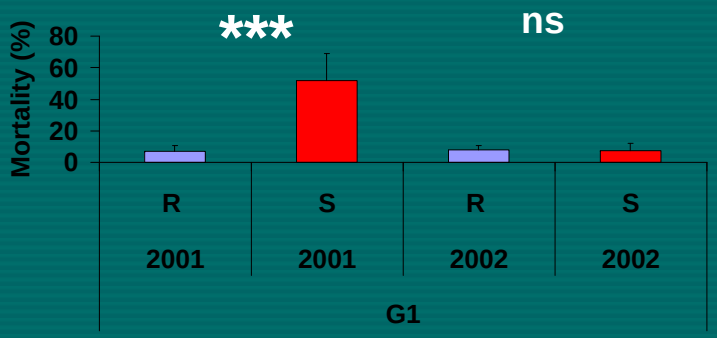
Group comparison

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

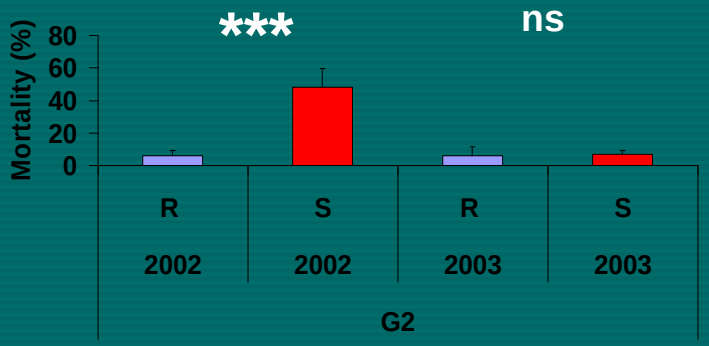
‘R’ and ‘S’ groups in RA

Deployed in the field the first year

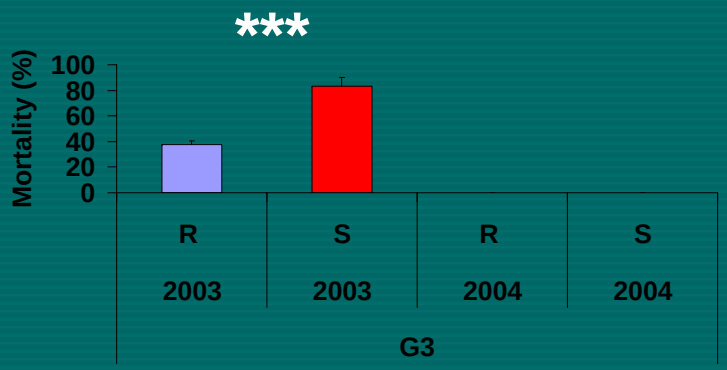
G1



G2



G3



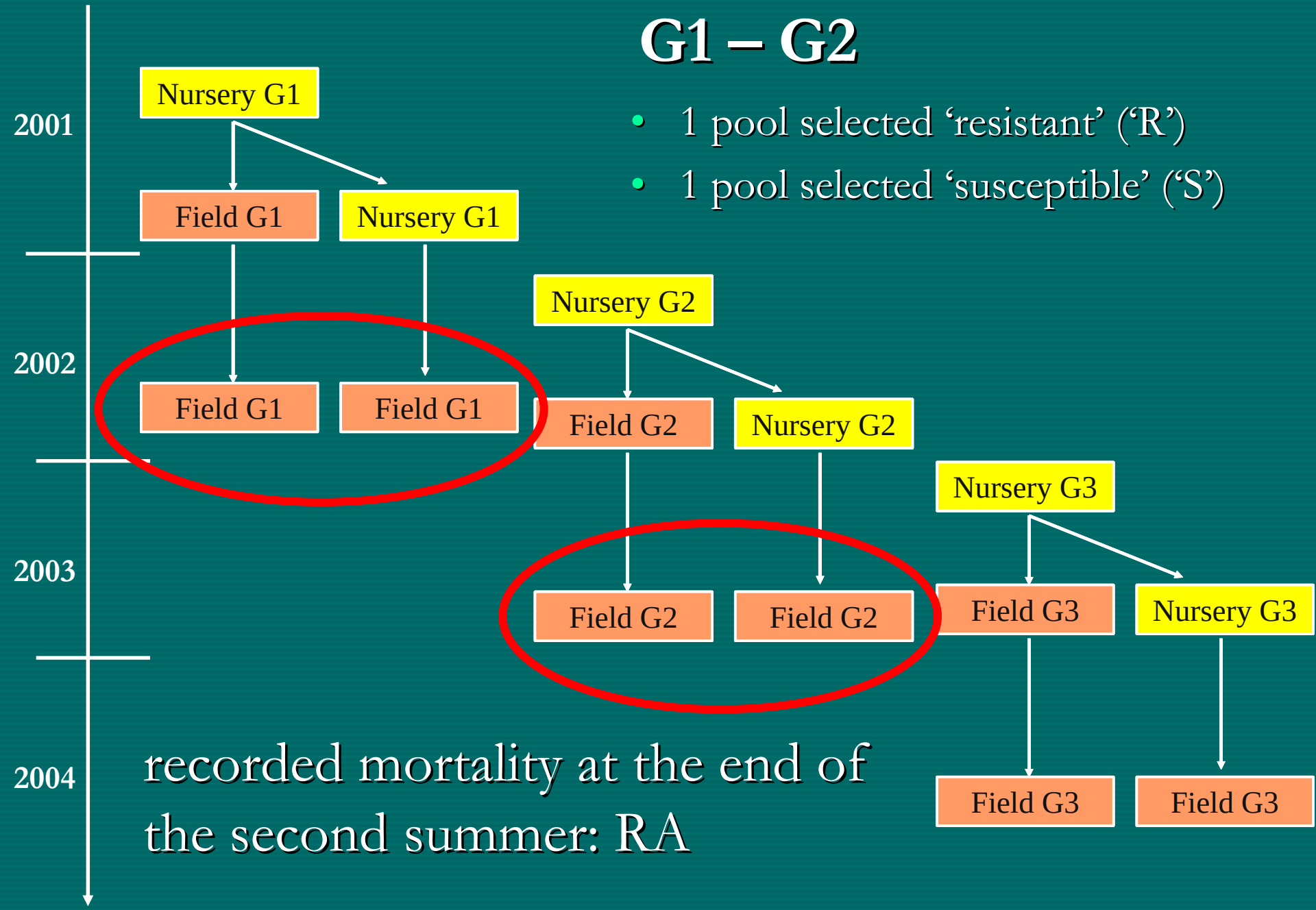
First year (6 months-old): highest mortality for the ‘S’ group and lowest for the ‘R’ one

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

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

G1 – G2

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



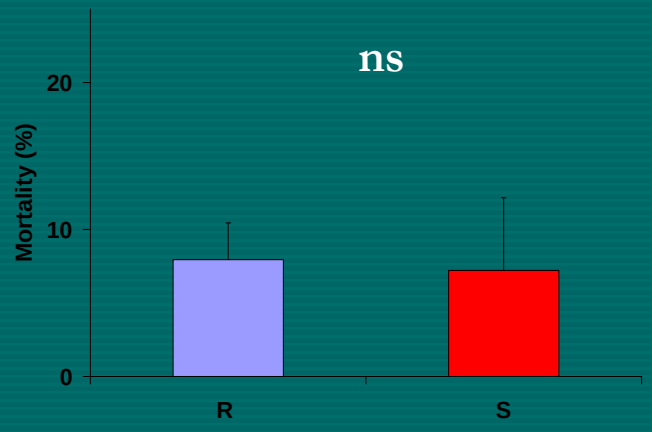
recorded mortality at the end of the second summer: RA

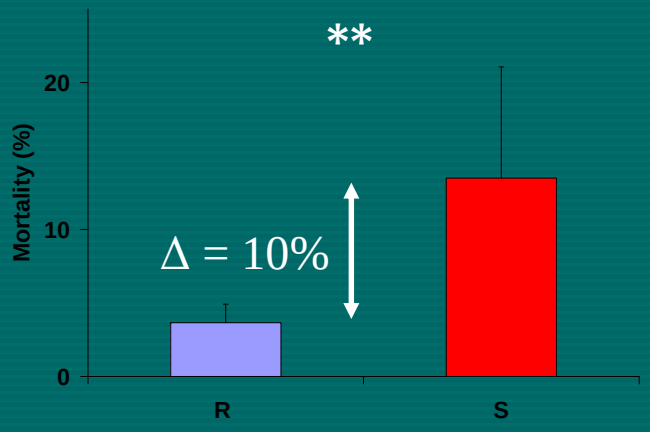
G1 and G2 – ‘R’ and ‘S’ groups in RA 18 months-old

Deployed in the field the first year

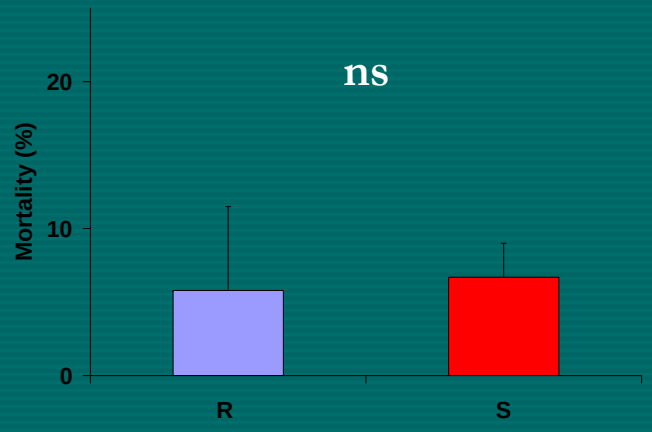
Preserved in nursery the first year

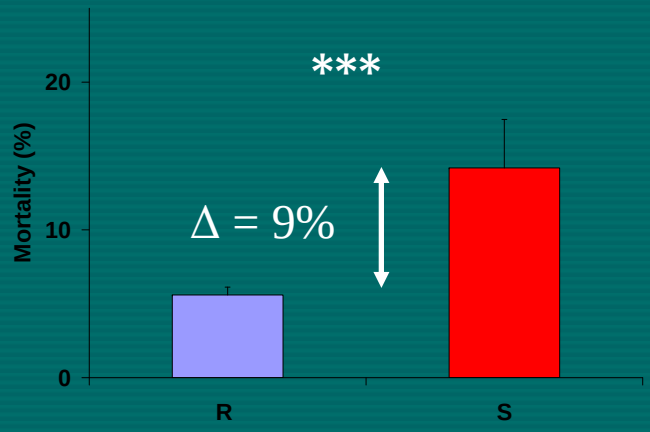
G1





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

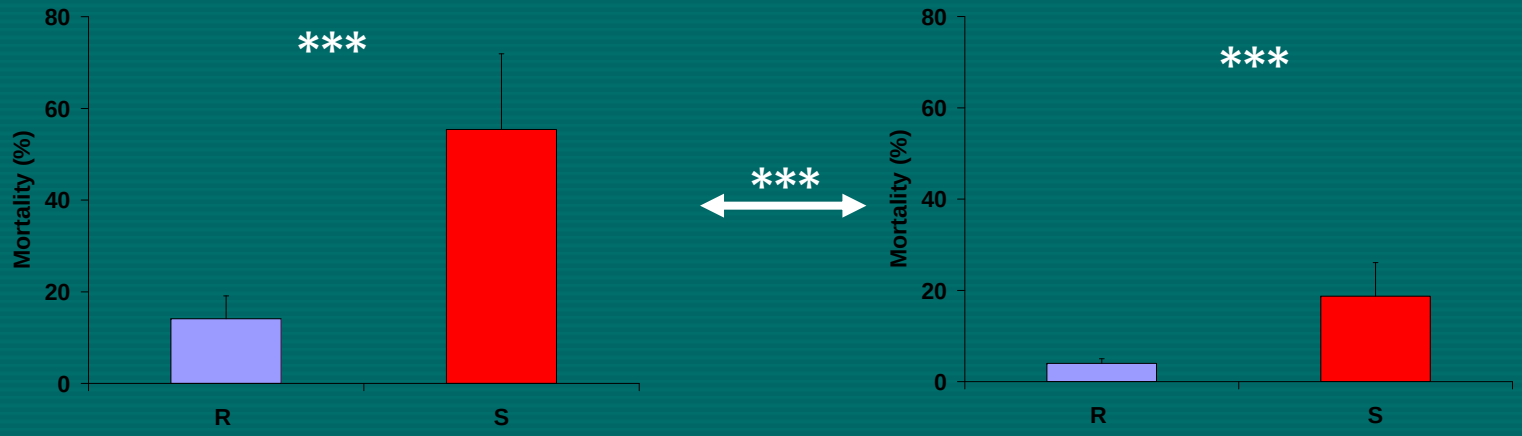
Same or different genes and/or lesser genes involved in summer mortality outbreak at 18 months-old than 6 months-old

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

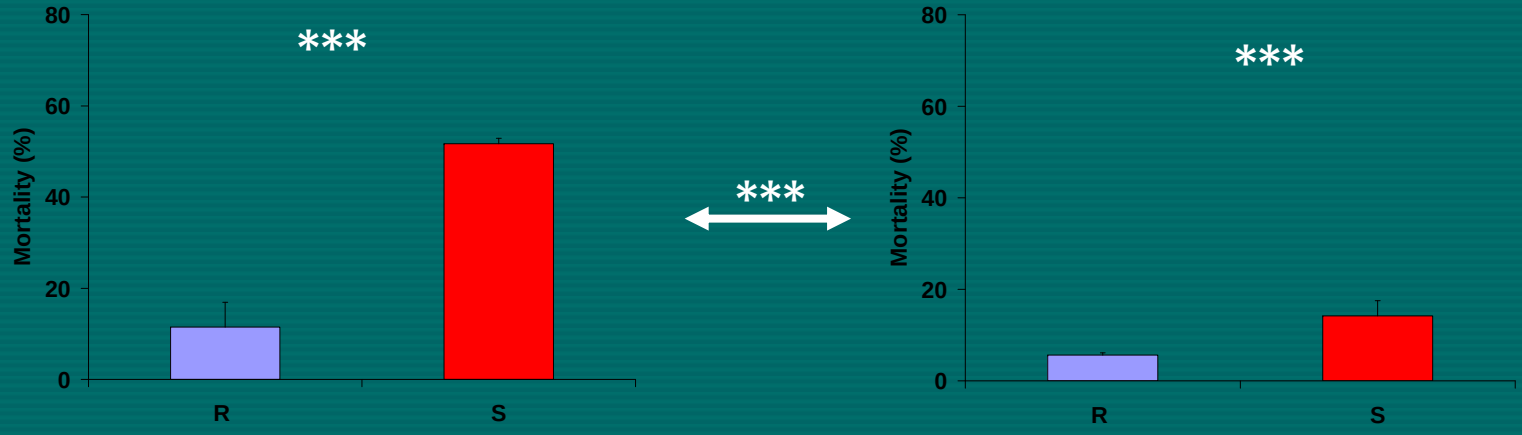
Deployed in the field the first year

Preserved in nursery the first year

G1

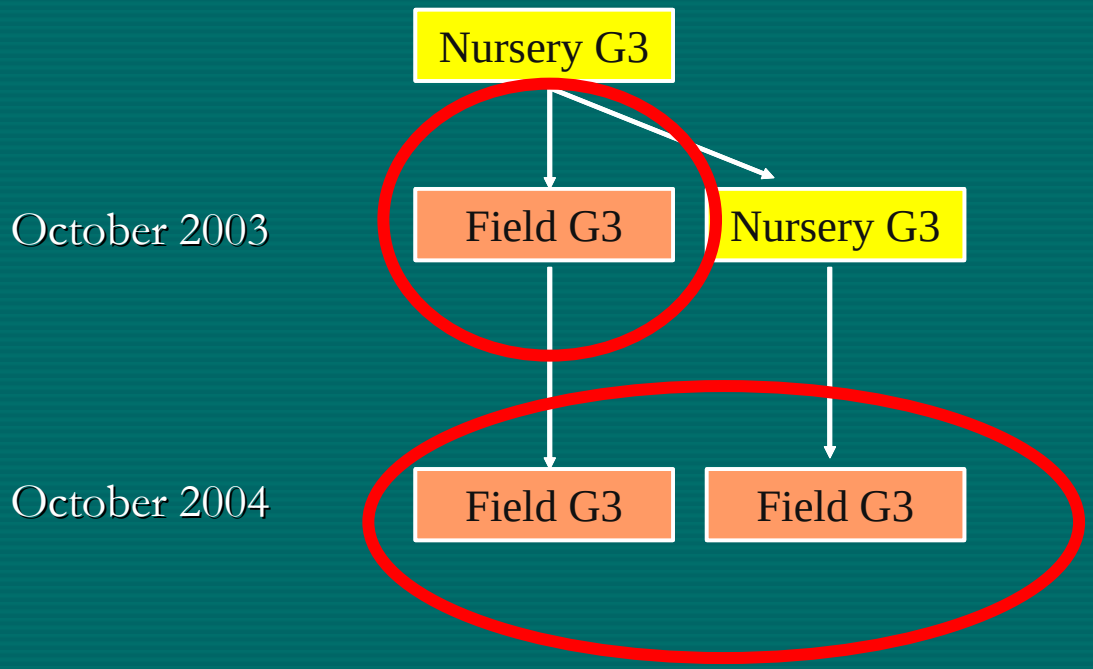


G2



G3

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

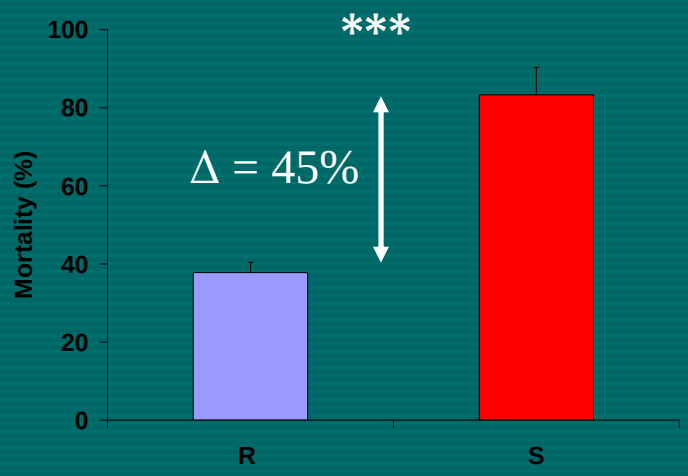


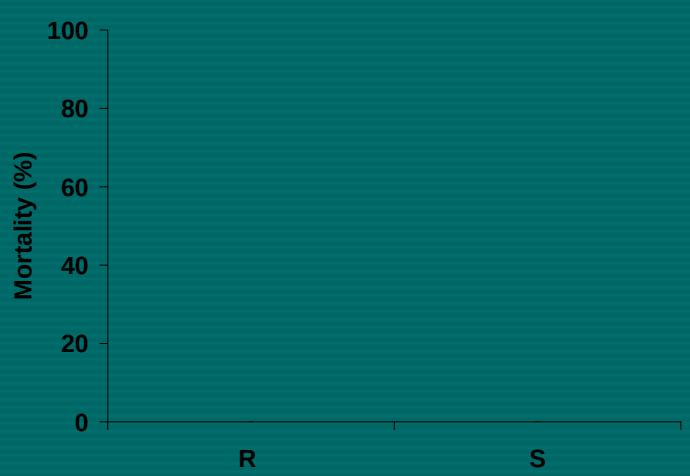
G3 - ‘R’ and ‘S’ groups in RA

Deployed in the field the first year

Preserved in nursery the first year

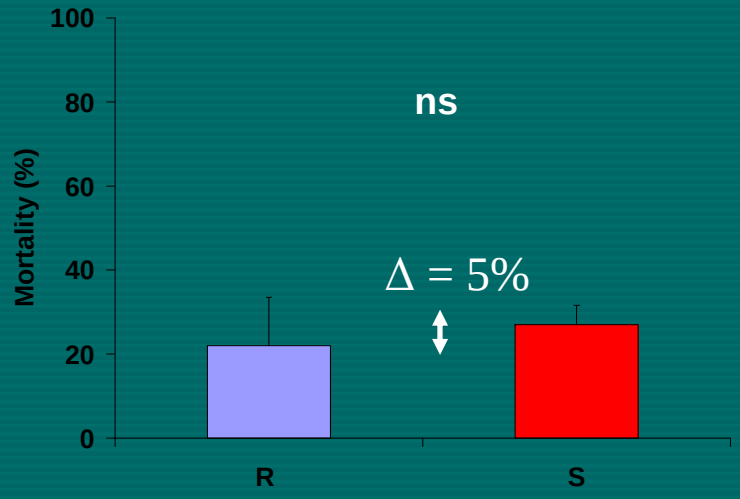
2003





2004

No recorded

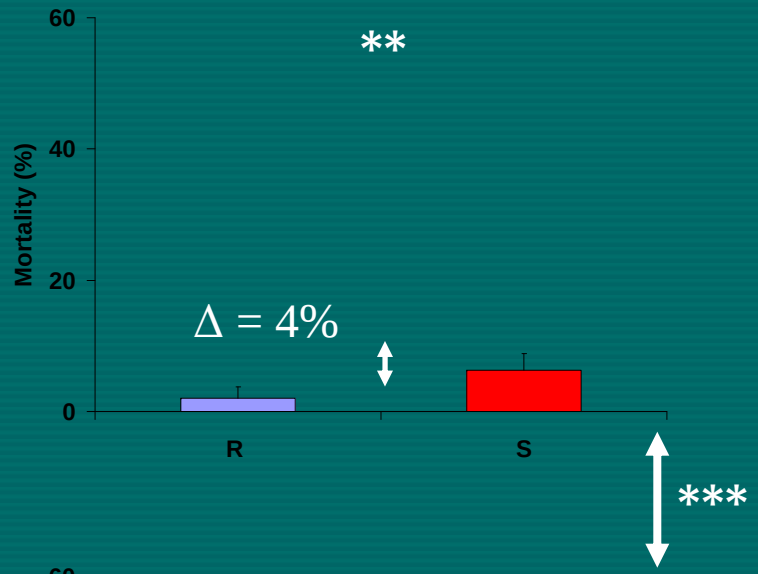


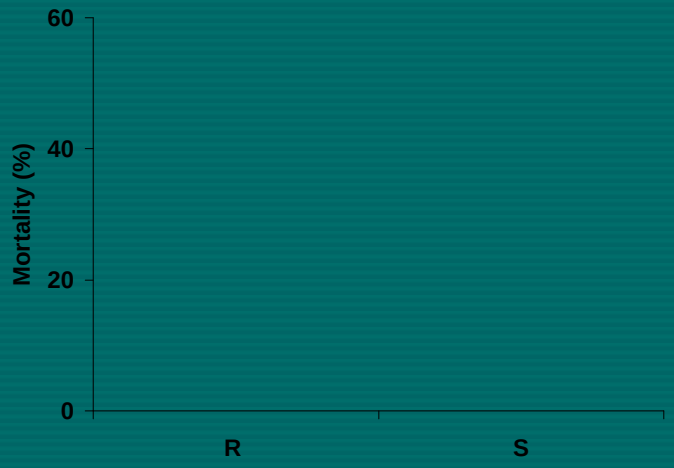
G3 - ‘R’ and ‘S’ groups in BDV

Deployed in the field the first year

Preserved in nursery the first year

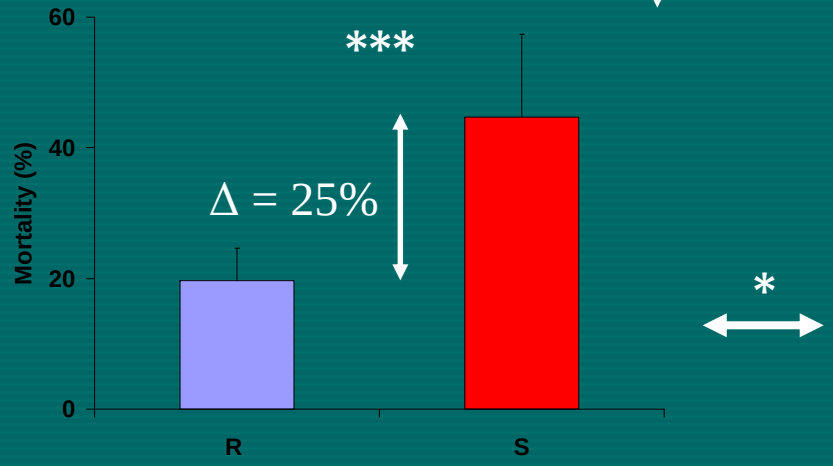
2003



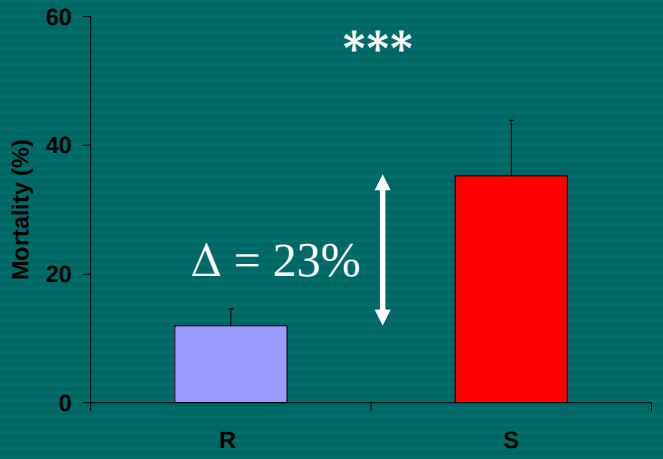


***

2004



*



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:

Laboratoire de Génétique et Pathologie

Laboratoire Conchylicole des Pays de Loire

Laboratoire Environnement Ressources de Poitou-Charentes

Laboratoire Conchylicole de Bretagne

Laboratoire Environnement Ressources de Normandie