Photoperiodic winter pea breeding

- abiotic (and biotic) stress aspects -

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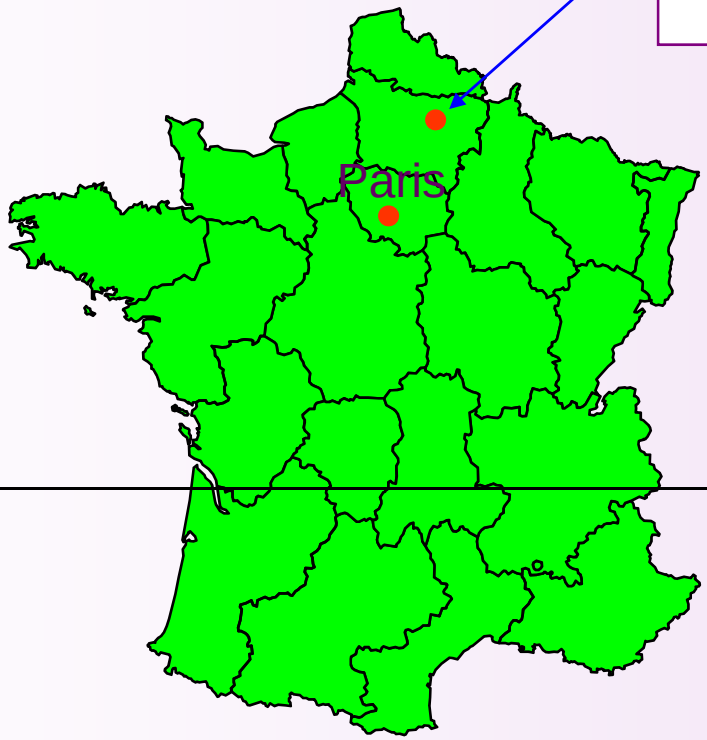
UMR-INRA-USTL Plants and Abiotic Stress
INRA – ESTREES-MONS

Geographical position

INRA ESTREES-MONS
Frost resistance
and earliness



Novi Sad
latitude

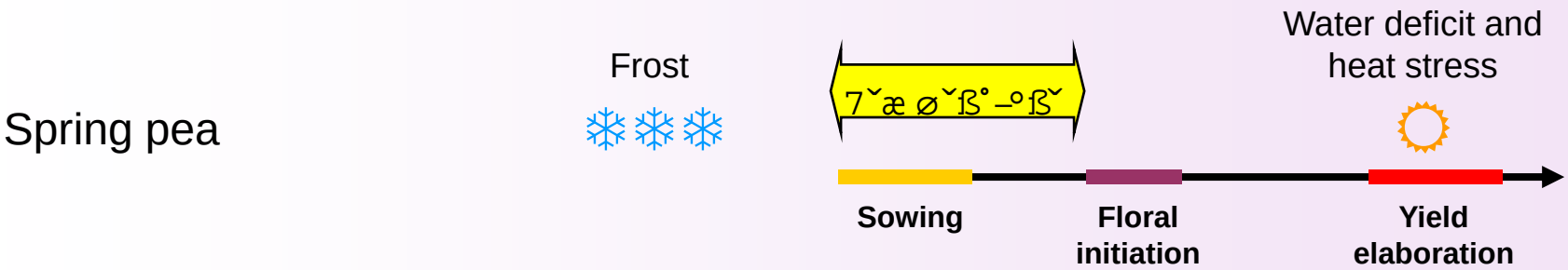
100 km

1970s : a new challenge for French and European agriculture

- Soya : world protein market monopol for livestock food
- 1973 : american embargo on soya, whereas
- In France and in Europe : rapid expansion of livestock industry
- A «protein plan» to promote French protein-rich plants products
- Pea (and so faba bean) was chosen as the main support of a new «protein» industry

First : development of spring pea

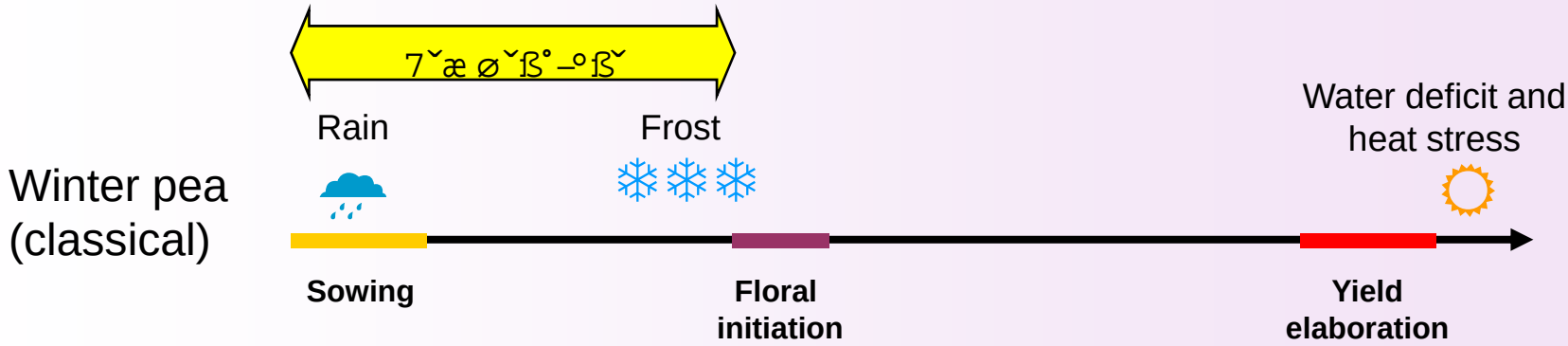
- The first spring protein pea variety : Finale (1973)
- Many foliar disease problems
- The first « afila » variety : Solara (1986)
- Development cycle of spring pea



Risk of low and unstable yield for farmers

Moving and increasing the development cycle length : toward winter pea

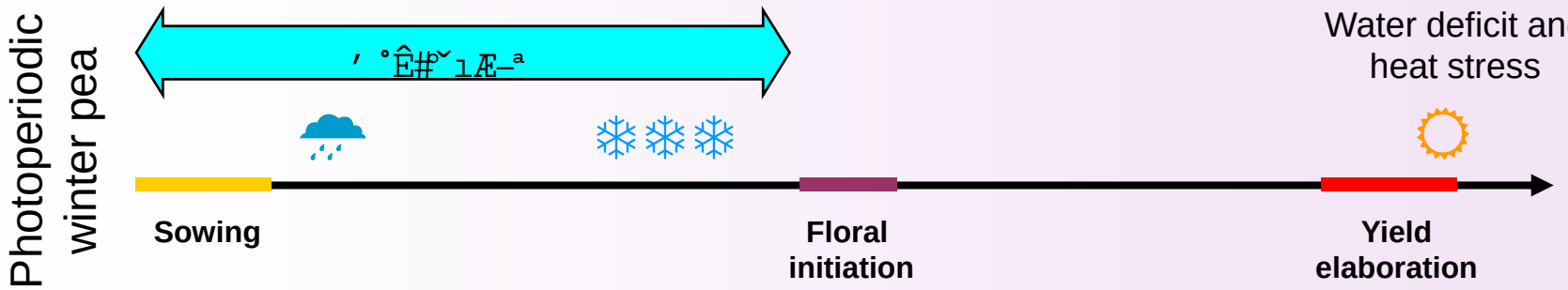
- Derivation of winter protein peas by improving frost tolerance of spring peas
- Sowing period moved to middle autumn
- Yield elaboration period avoiding stresses



Risk of frost damage at the end of winter, problems for sowing

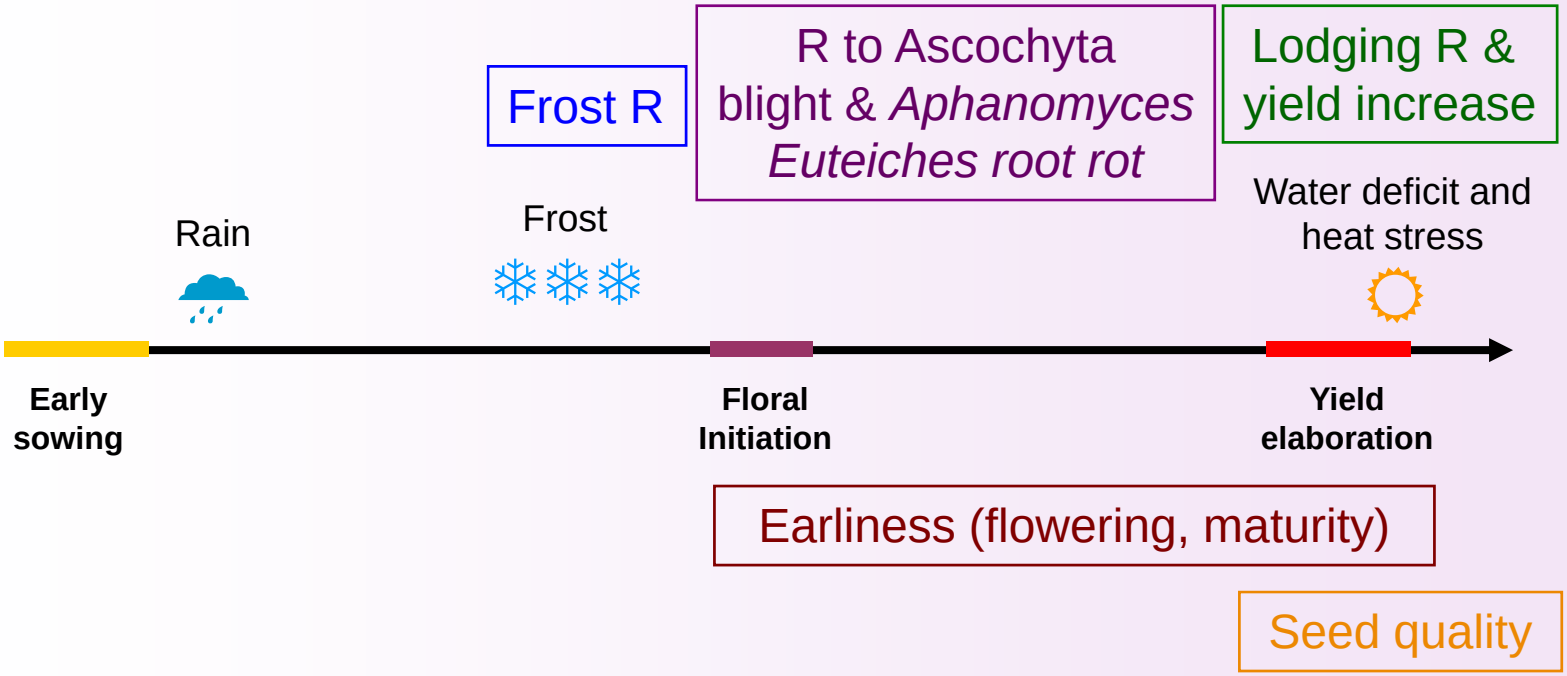
How to avoid late winter frost : toward a photoperiodic winter pea

- The gene Hr (High Response to photoperiod) : a way to control floral initiation (FI)
- Lejeune et al. 1999 : the line Champagne (forage pea) has FI only for a 13h30 and upper photoperiod length
- Sowing period moved earlier in the autumn

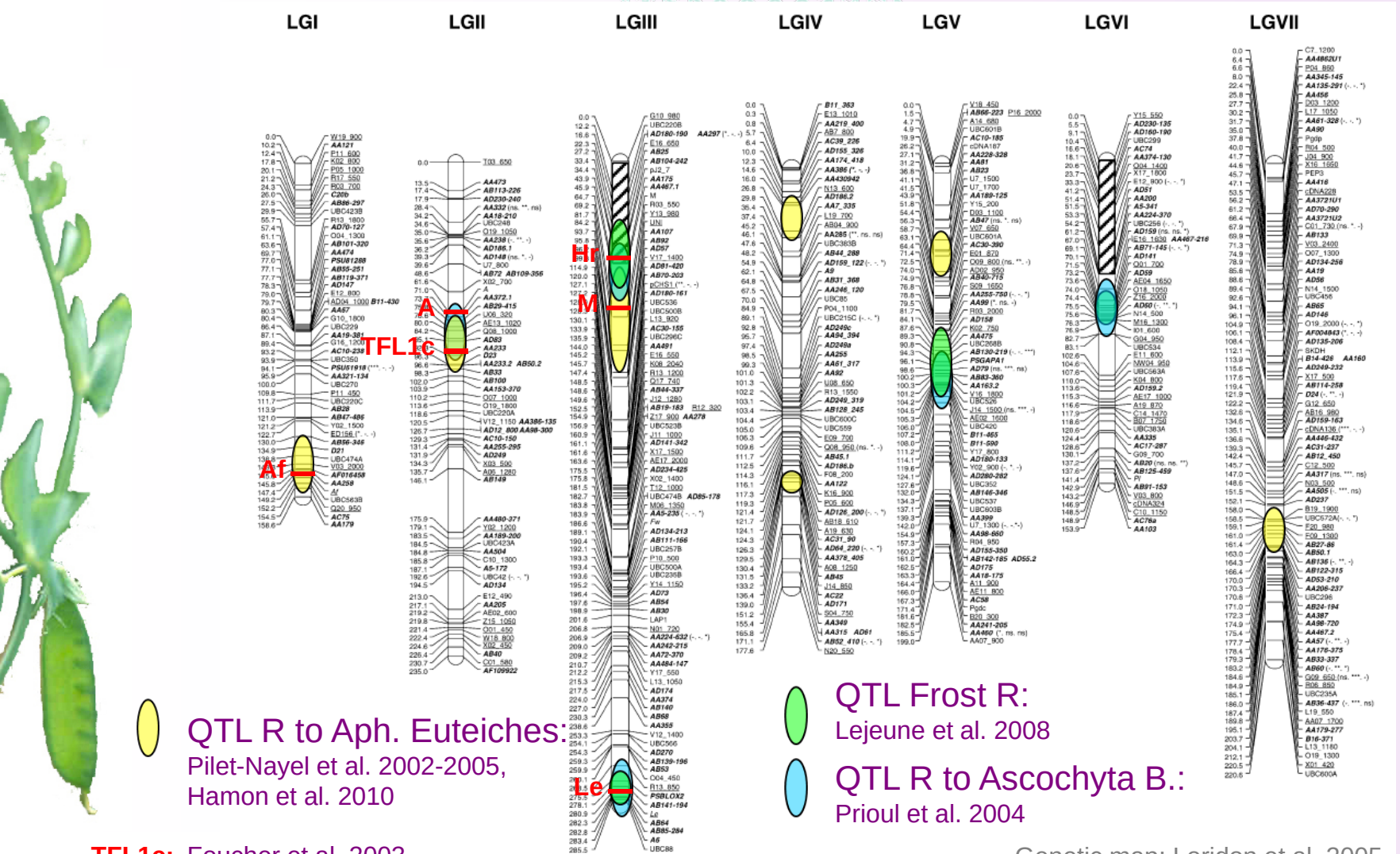


The first photoperiodic winter pea INRA prototype line : 886/01 (Etévé et al.)

- 886/01 : INRA Research line x classical winter pea
- A first prototype line yet to improve



The state of the art : genes, QTLs, markers …



QTL R to Aph. Euteiches:
Pilet-Nayel et al. 2002-2005,
Hamon et al. 2010

TFL1c: Foucher et al. 2003

QTL Frost R:
Lejeune et al. 2008

QTL R to Ascochyta B.:
Prioul et al. 2004

Genetic map: Loridon et al. 2005

Then a mixed breeding scheme (1)

- A marker assisted selection for:
  - Photoperiodic control
  - Seed and plant morphological traits
  - Earliness at flowering
  - Frost resistance
  - Disease resistance

Combined with …

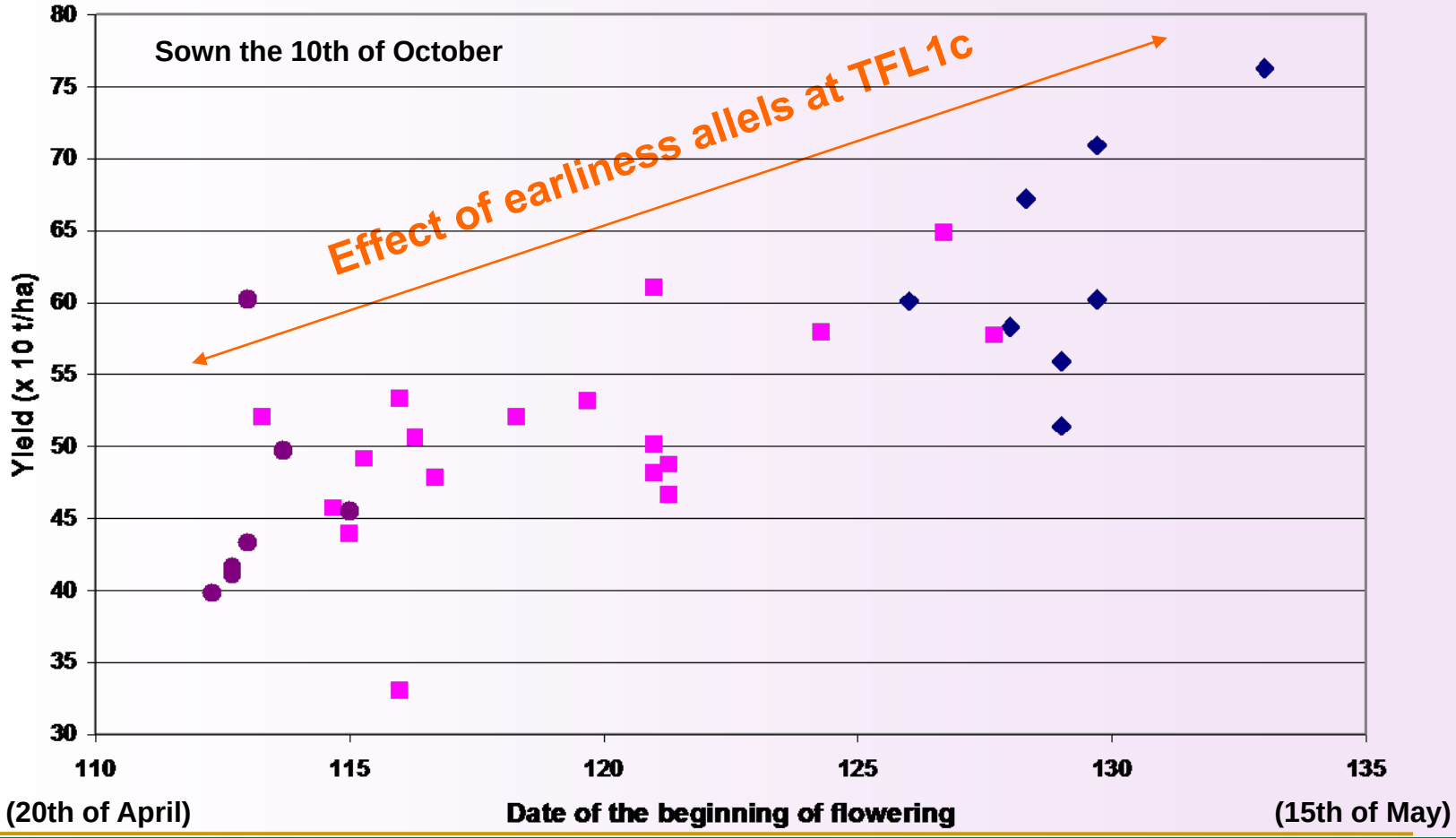
Then a mixed breeding scheme (2)

- A more classical approach, and so:
  - Field testing
    - Earliness at flowering and maturity
    - Frost resistance
    - Disease resistance
    - Lodging resistance
    - Yield
  - And/or controlled conditions testing
    - Disease resistance
  - And lab testing
    - Seed protein concentration
    - Anti-trypsic activity

Genetic material to be combined

- Registered varieties
  - Spring type
  - Classical and photoperiodic winter type
- Research lines
- Cultivated and wild accessions from the Biological Resources Centre

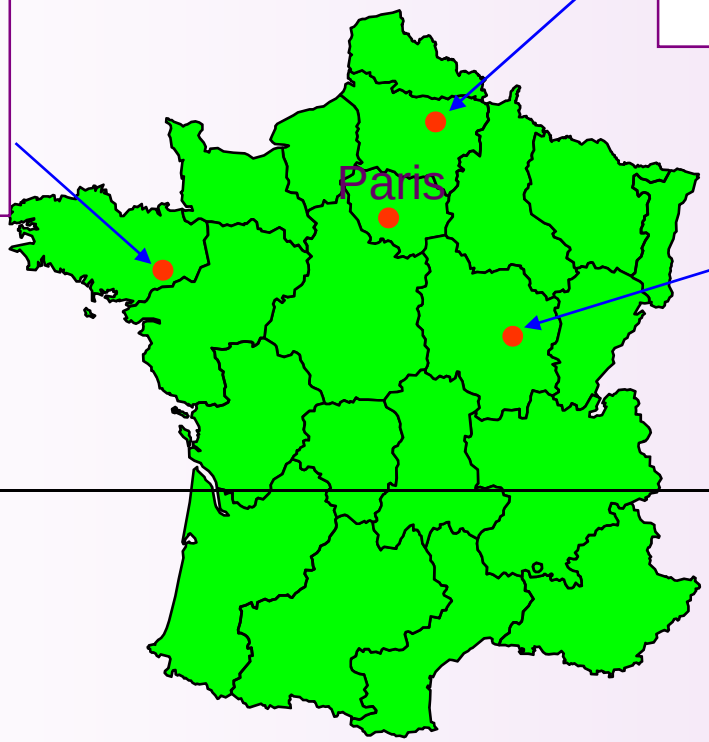
Some characteristics of INRA photoperiodic breeding lines in 2011



INRA teams of geneticists involved in the WINPROT breeding program

INRA ESTREES-MONS
Frost resistance
and earliness

INRA RENNES
Disease resistance



INRA DIJON
Yield and seed quality
Biological resources

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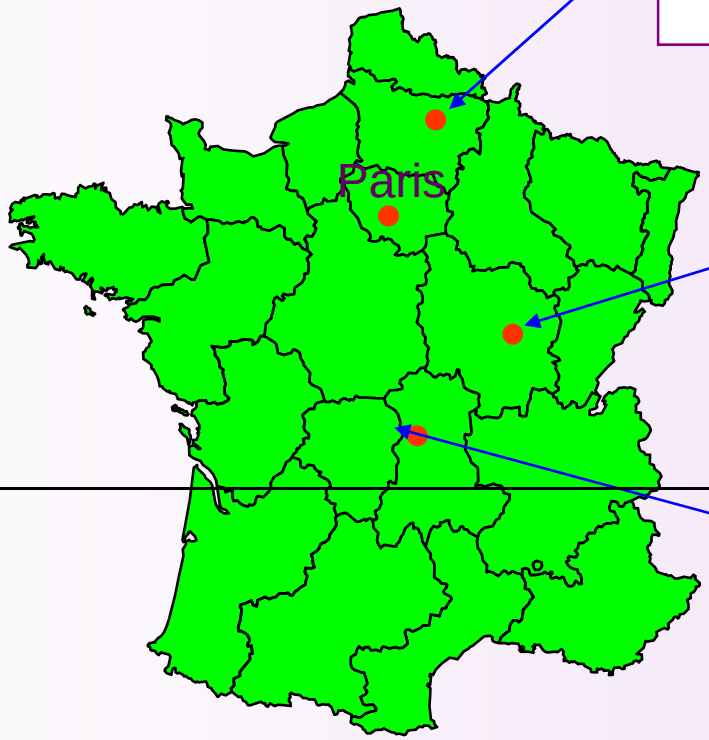
latitude

100 km

A multi-site experiment for frost resistance screening



INRA ESTREES-MONS
Frost resistance and earliness

INRA DIJON
Yield and seed quality
Biological resources

INRA THEIX
Experimental unit

Novi Sad latitude

100 km

Thank you for your attention!