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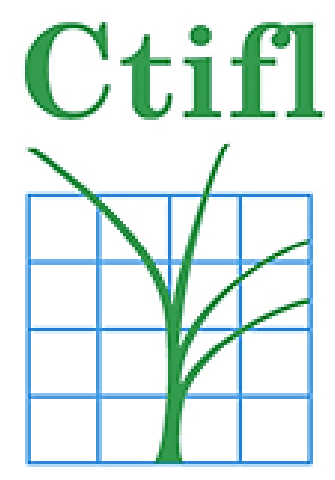
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The French walnut improvement program: preliminary investigations



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Objectives

- The world walnut production in 2016 reached more than **3.5 M tonnes** mostly provided by China, U.S.A. and Iran (FAOSTAT)
- France in **2016** were the **9th** producer with **39 kt** and **21,000 ha** with 2 Protected Designation of Origin ('Noix du Périgord' and 'Noix de Grenoble') and walnut is the most important crop other than apple
- The firsts breeding programs were led by **Eric Germain** in INRA and released 7 cultivars (e.g. 'Femor') but programs ended in 2007 with an **insufficient choice of cultivars**
- The new breeding program is led by **Ctifl** to better meet current and future needs, particularly in the context of **global competition**, **climate change** and **reduced use of plant protection products**
- The genetic lever is based on the **'INNOV'noyer'** project [1] which consists on the assessment of the French walnut germplasm genetic diversity, the identification of the genetic determinisms of traits of interest (e.g. pathology, phenology, fruit and kernel quality) by **Genome-Wide Association Study** and the establishment of necessary tools for a Marker-Assisted Selection achievement



➡ Preliminary investigations on pathological (*Colletotrichum acutatum*) and phenological aspects (budbreak and flowering dates)

1. Pathology

Evaluation of the tolerance of French germplasm to *Colletotrichum acutatum* using detached leaf assay

- *Colletotrichum acutatum*: Ascomycota, Glomerellaceae – complex of 29 species [2]
- Causes a form of anthracnose disease in a wide range of hosts
- *Colletotrichum* sp. present in French orchards since 1998-2000 [3] and characterized as necrotrophic on walnuts since 2008
- Identification in 2013-2015: 99% *C. acutatum* and 1% *C. gloeosporioides*
- Symptoms: from black spots with orange acervules on walnut to full necrosis, **loss of production**

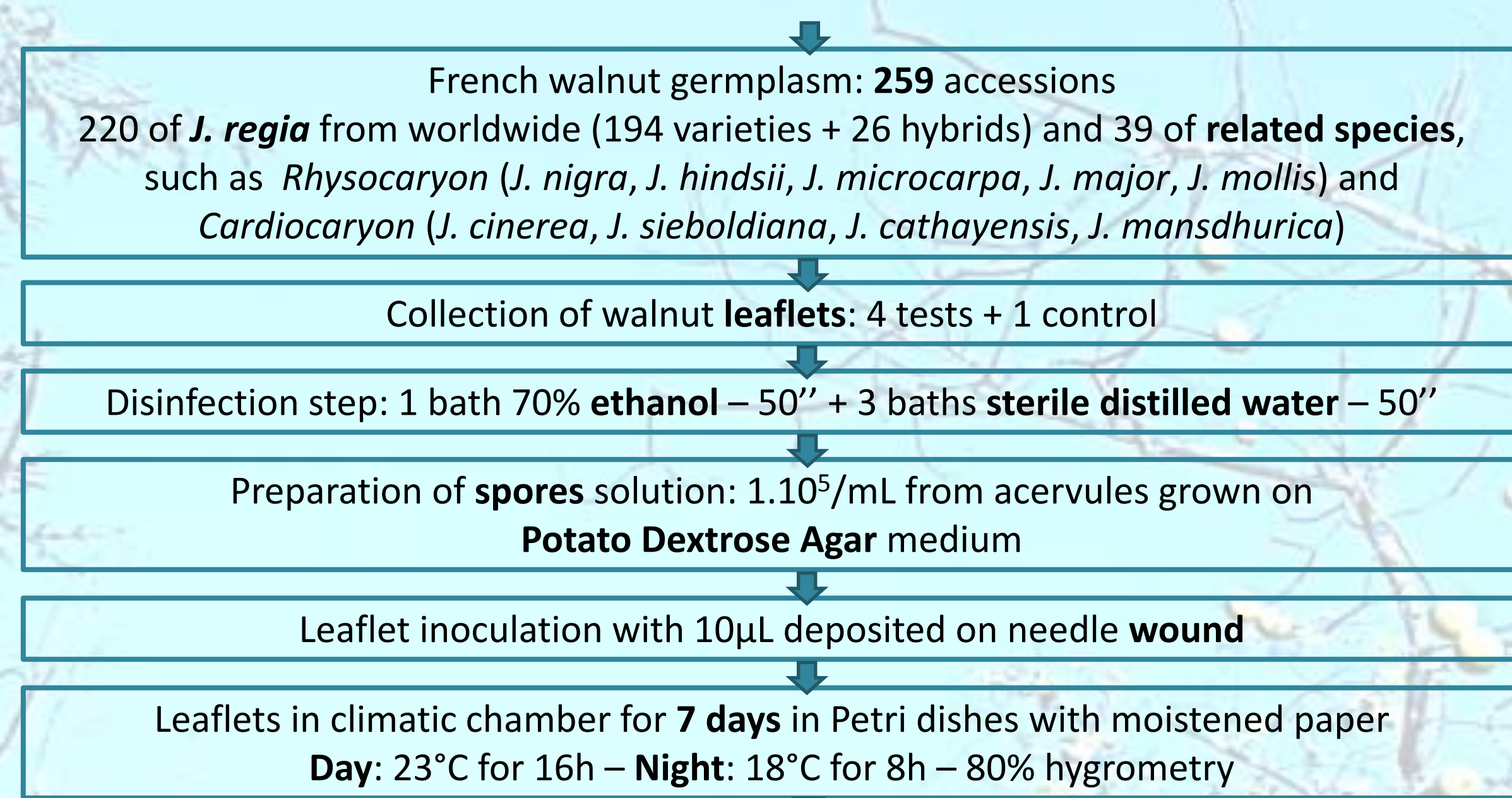


Fig 1: Detached leaf assay protocol



Fig 2: Detached leaf assay results

Results

a. Qualitative test with presence or absence of necrosis

b. Among the 259 accessions tested, all the *J. regia* accessions showed a presence of necrosis at 7 DAI

c. Nevertheless, 7 accessions among the related species showed an absence of necrosis at 7 DAI : 4 of *J. cinerea* and 3 of *J. sieboldiana*

2. Phenology

Study of budbreak date and male/female flowering dates using chronological data

- Monoecious tree, mainly dichogamous
- Impact of climate change on plants observed in last decades on phenology, in favor of an advance in flowering dates [4]
- Late spring frosts + early leafing = damages, **loss of production**
- Phenological data from 1989 to 2017 on *J. regia* cv 'Franquette' and cv 'Lara', from INRA (Toulence), Creysse and SENURA experimental stations, according to IPGRI descriptors by Eric Germain [5]

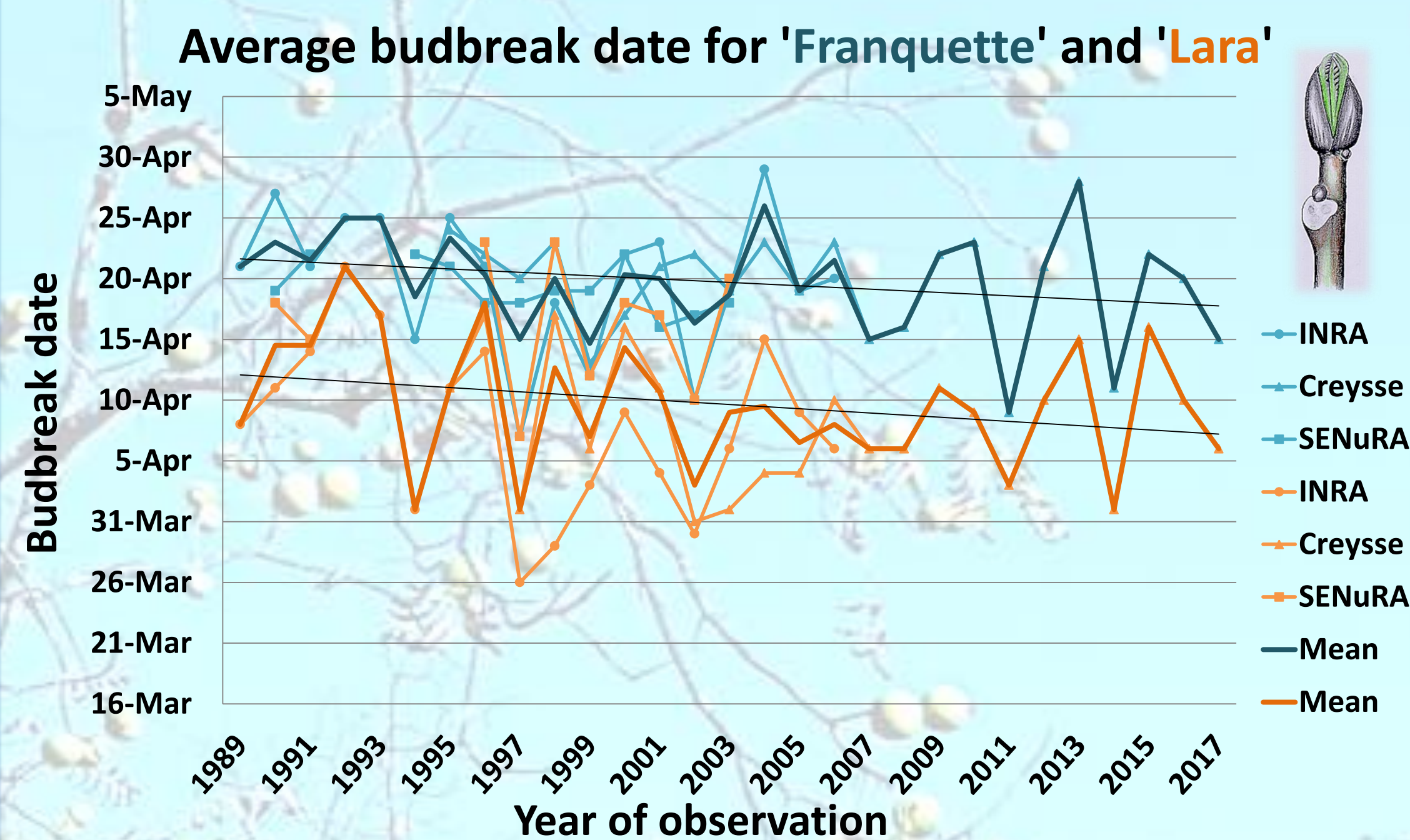


Fig 3: Budbreak date according to years

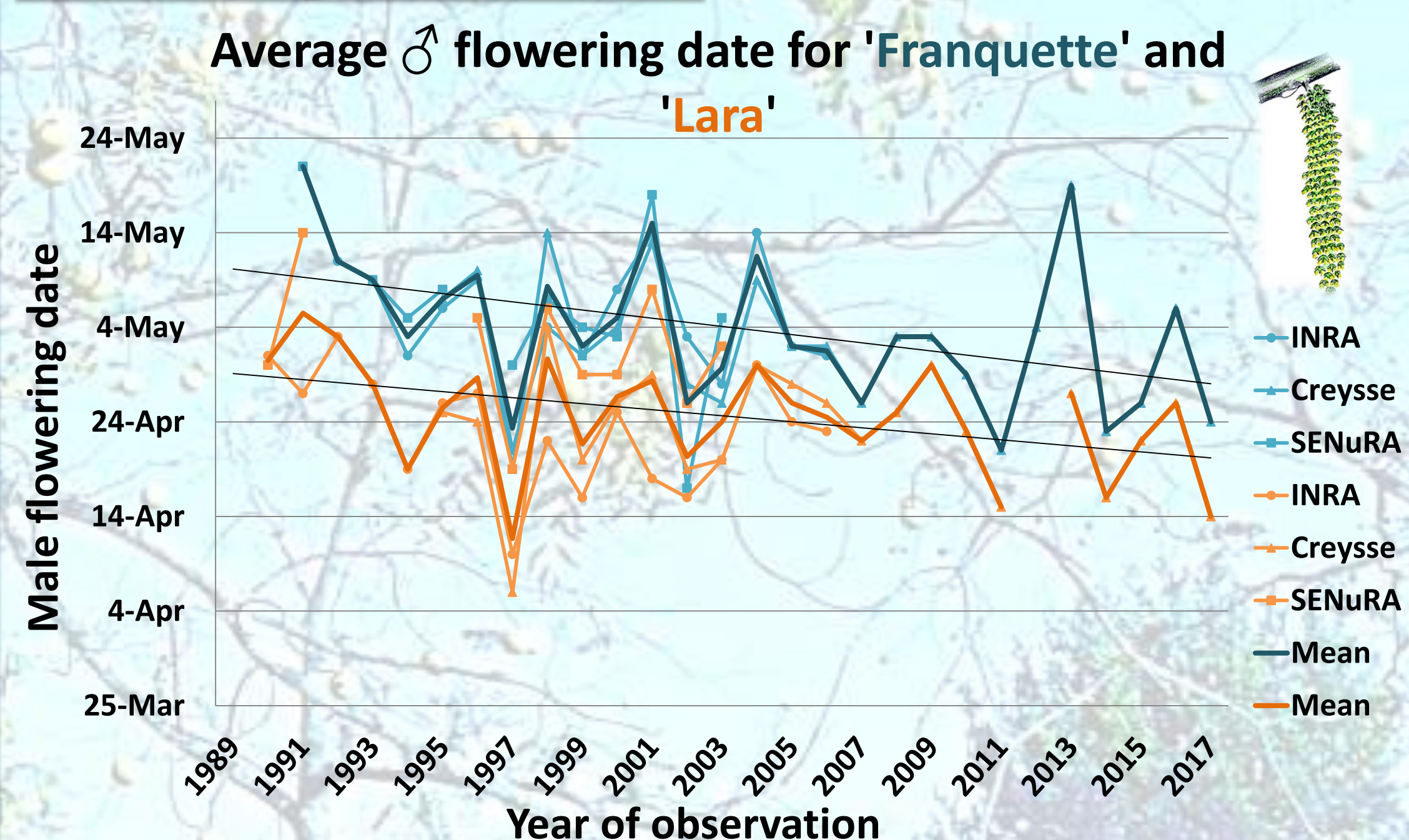


Fig 4: Male flowering date according to years

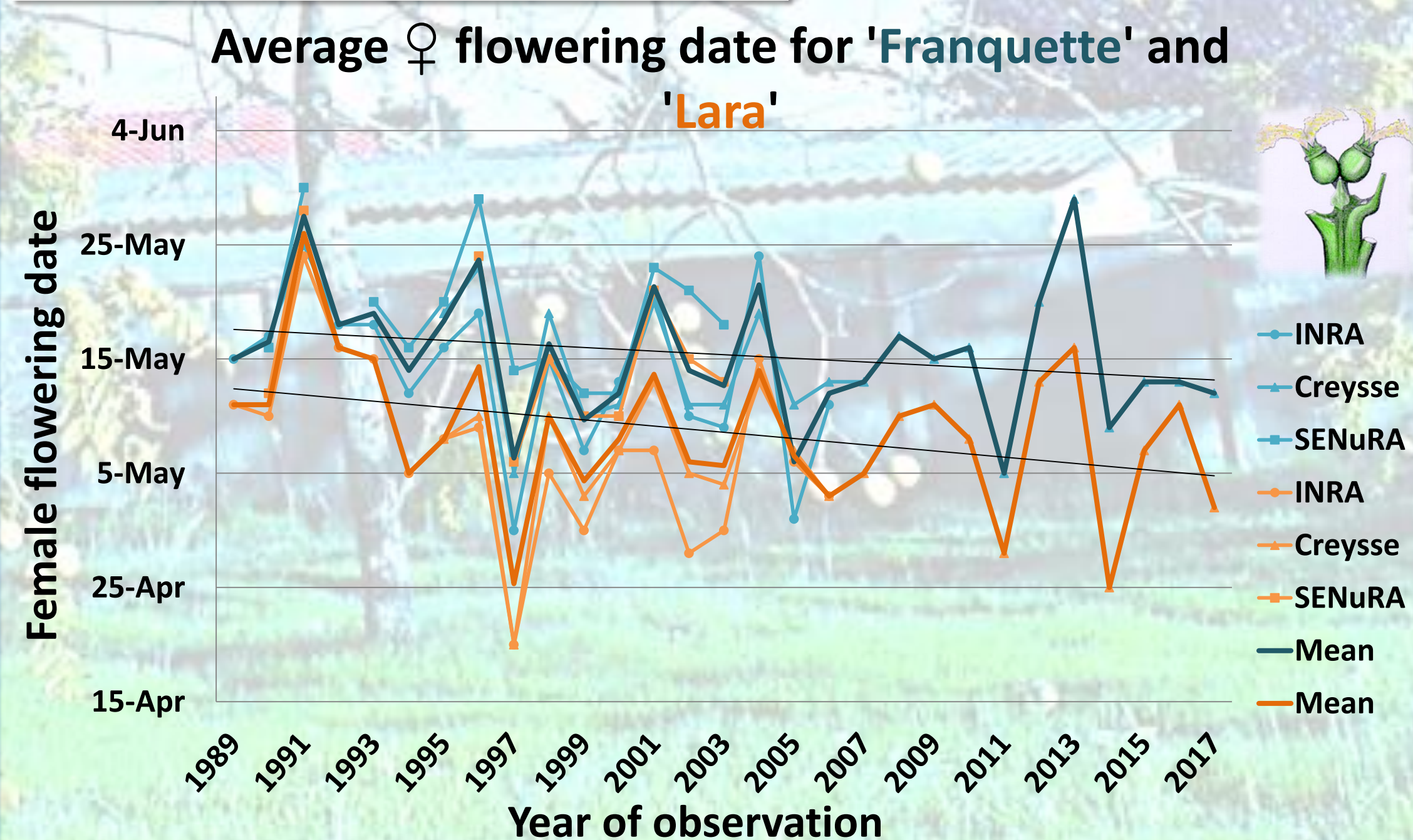


Fig 5: Female flowering date according to years

Results

a. Over the years, tendency to an advance of phenology → linked to climate change ?

b. 1994 and 1997: great advances in phenology and also, the warmer springs of the last 30 years in France

c. 2013: great delay in phenology and also, the coldest winter of the last 30 years in France

d. Comparable data for the 3 experimental stations and between 'Franquette' and 'Lara' cultivars

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