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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**

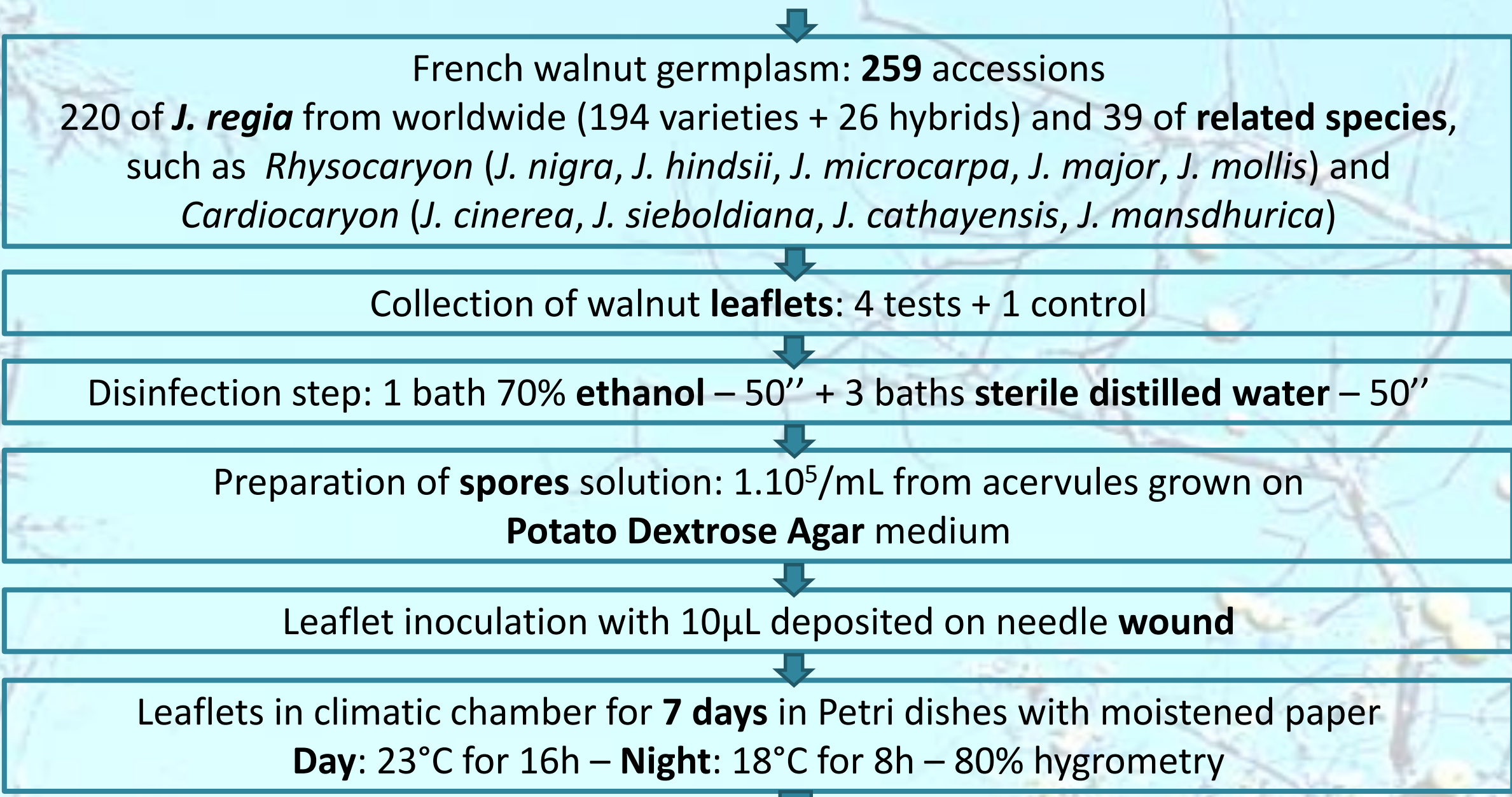


Fig 1: Detached leaf assay protocol

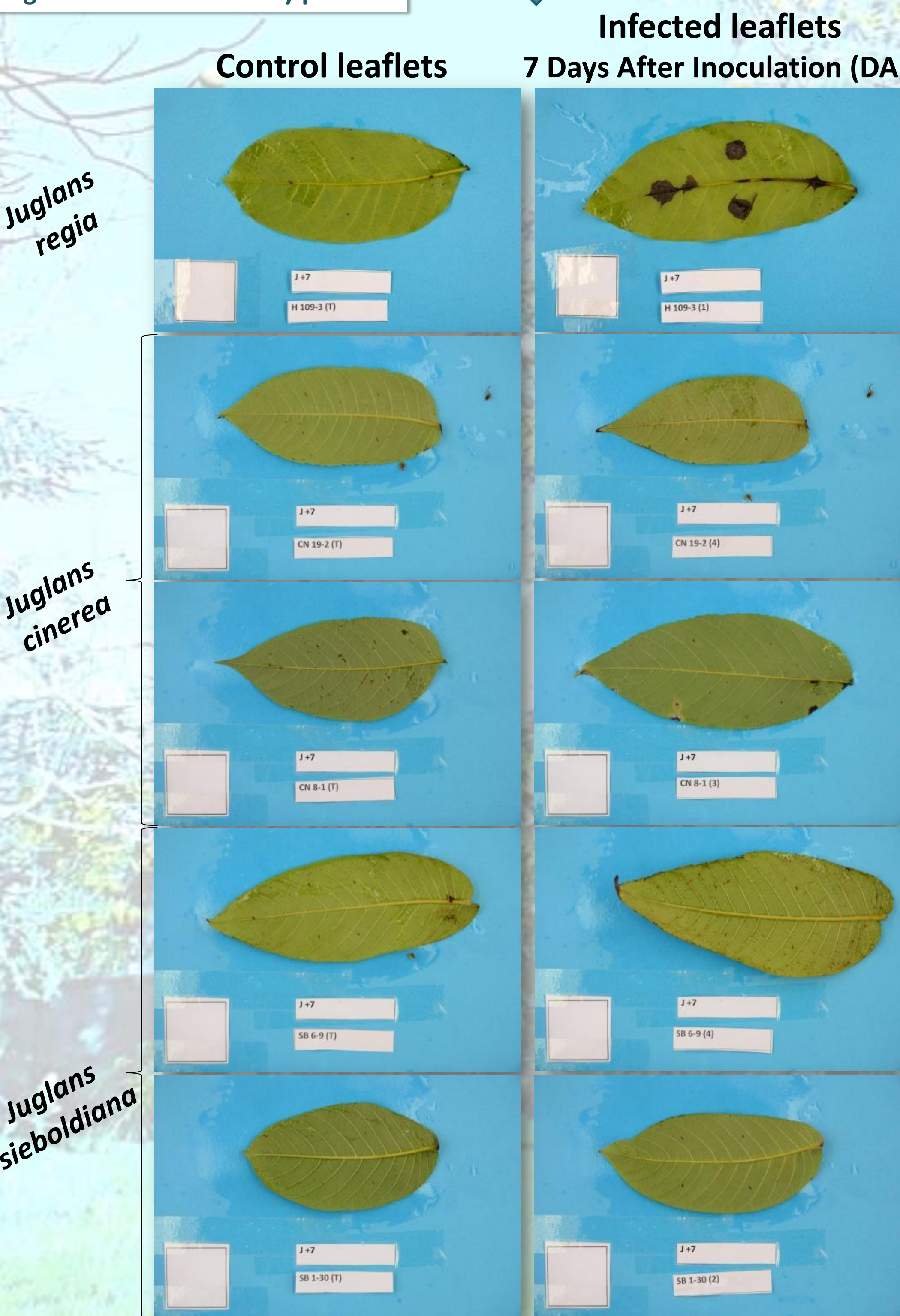


Fig 2: Detached leaf assay results

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 (Toulonne), Creysse and SENURA experimental stations, according to IPGRI descriptors by Eric Germain [5]

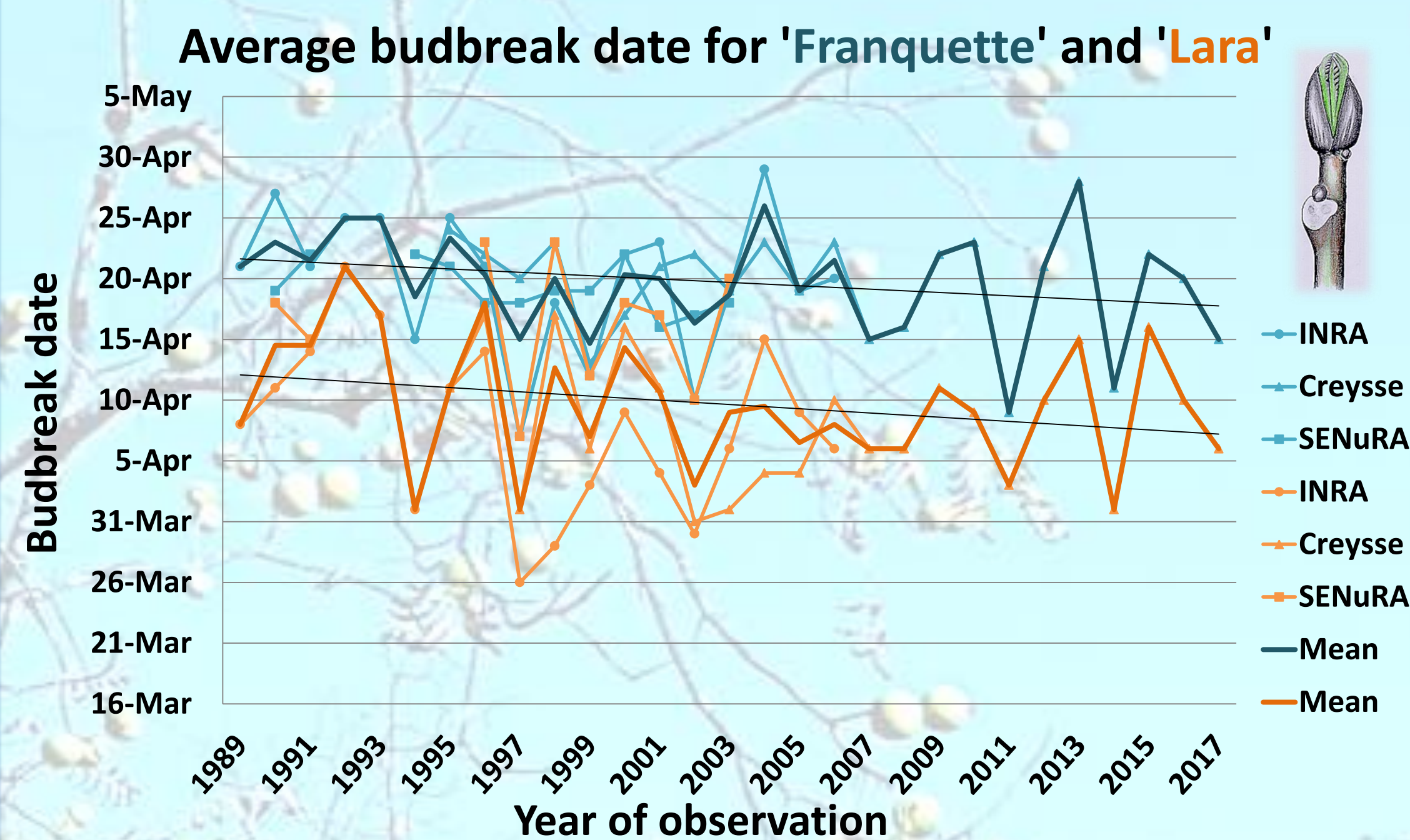


Fig 3: Budbreak date according to years

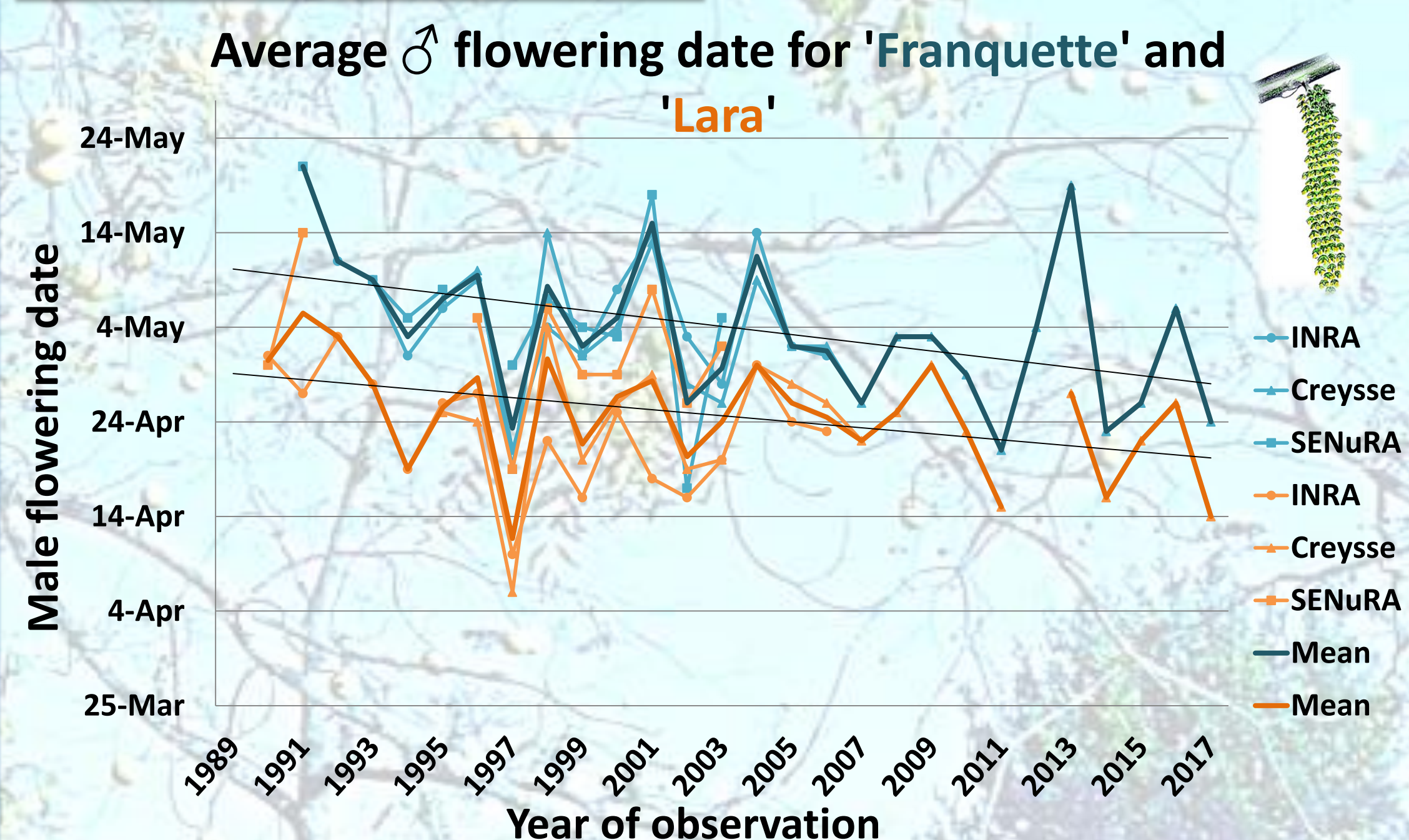


Fig 4: Male flowering date according to years

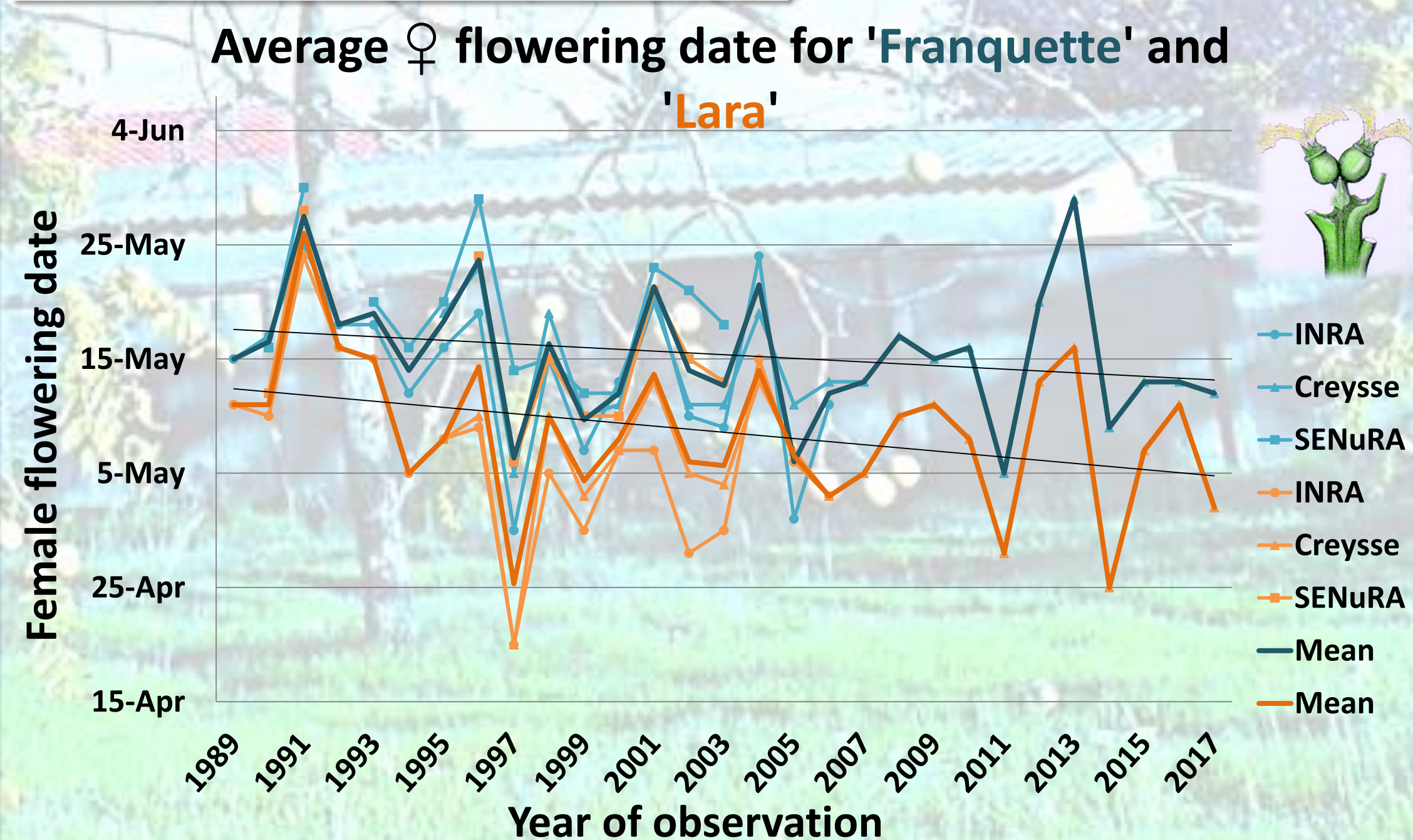


Fig 5: Female flowering date according to years

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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