# Establishment of a base population for breeding *Fraxinus excelsior* for reduced ash dieback

## Selection based on phenotypes after natural infection

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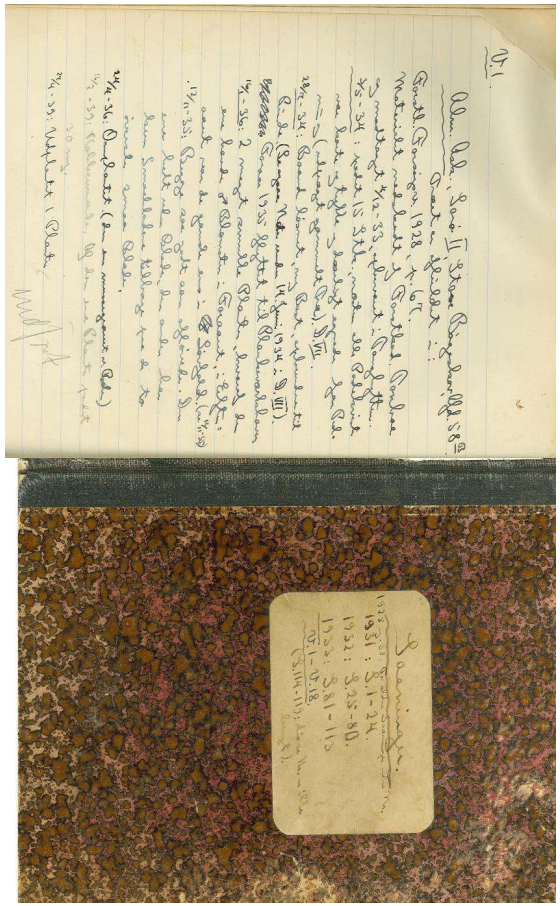
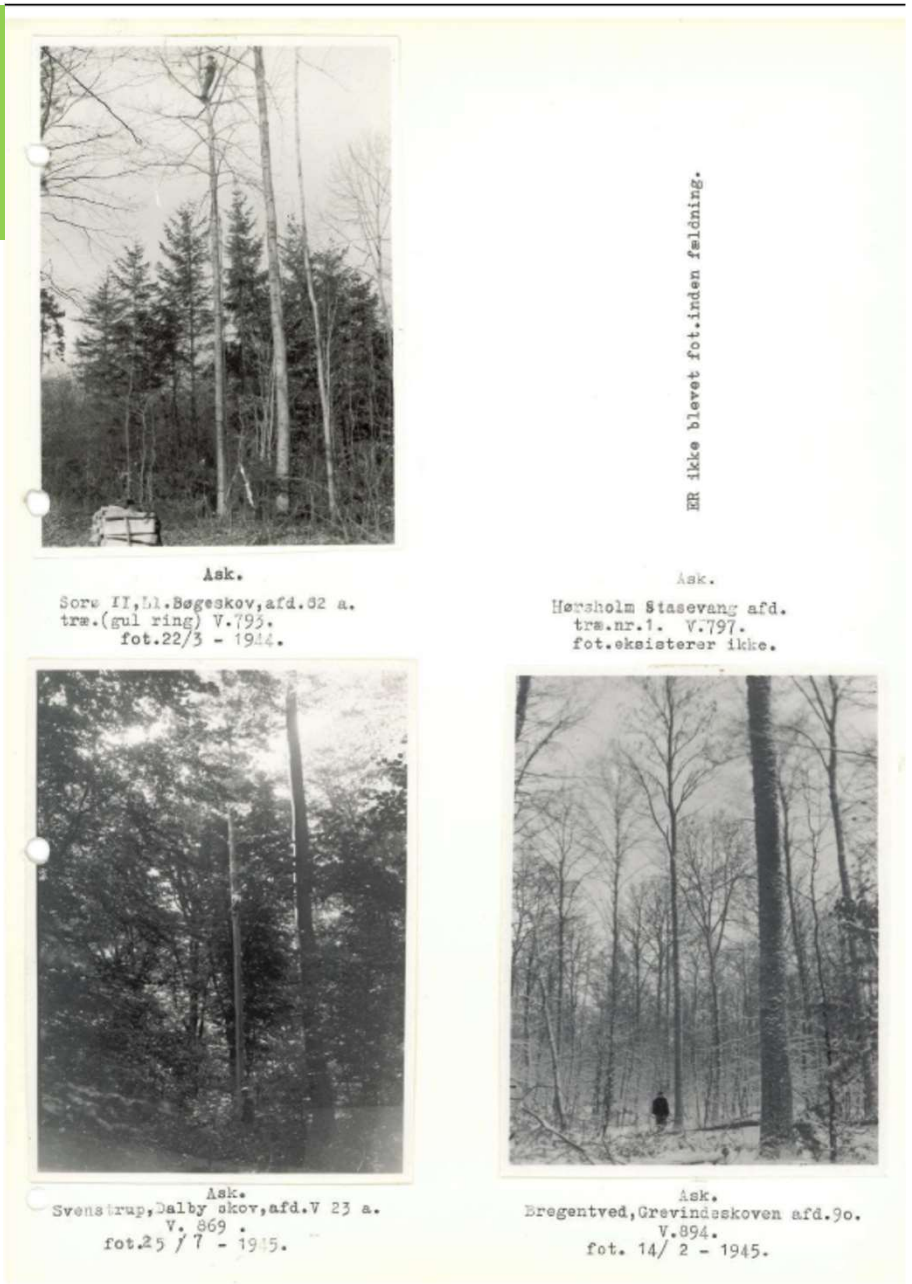
# Outline

- Tree improvement of ash in DK prior to ADB
- Estimates of genetic variation and heritability for resistance to ADB – based on exiting field trials
- **Selection for a breeding programme: mature trees in plantation and young trees in field trials**
- **Experience with Breeding Seed Orchard in Ash**
- Plans for development of a ADB breeding programme
- Lessons learned in relation to other species and future treats

# Tree improvement of ash initiated in 1940'ties

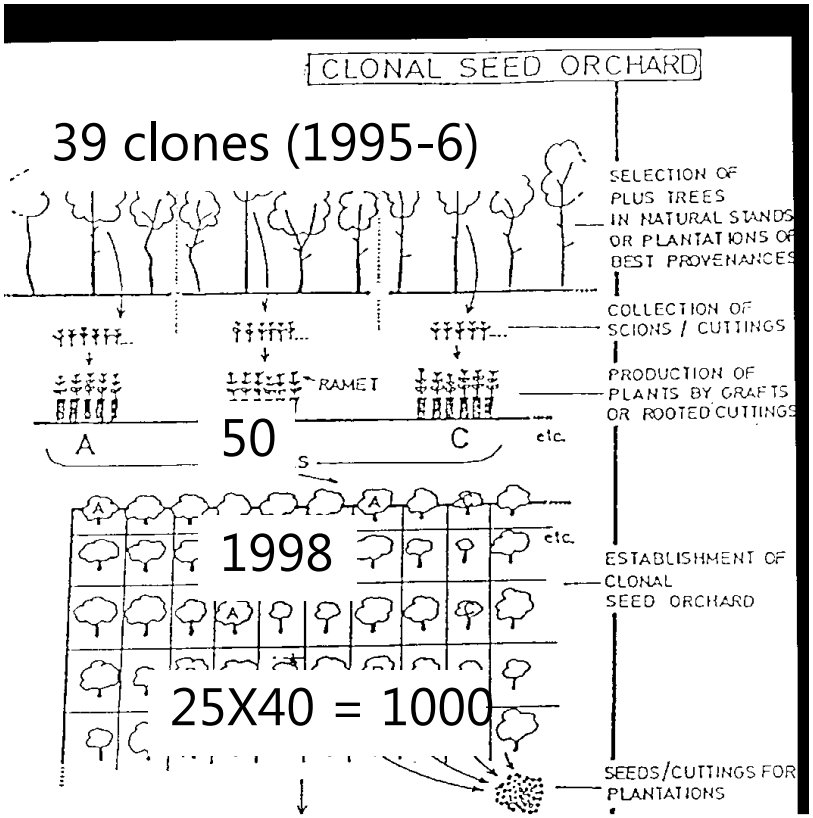
**Selection and CSO establishment 40'ties-> (3 CSOs, 10 clones)**
FP202,FP212;FP217 (all with only 1 male)





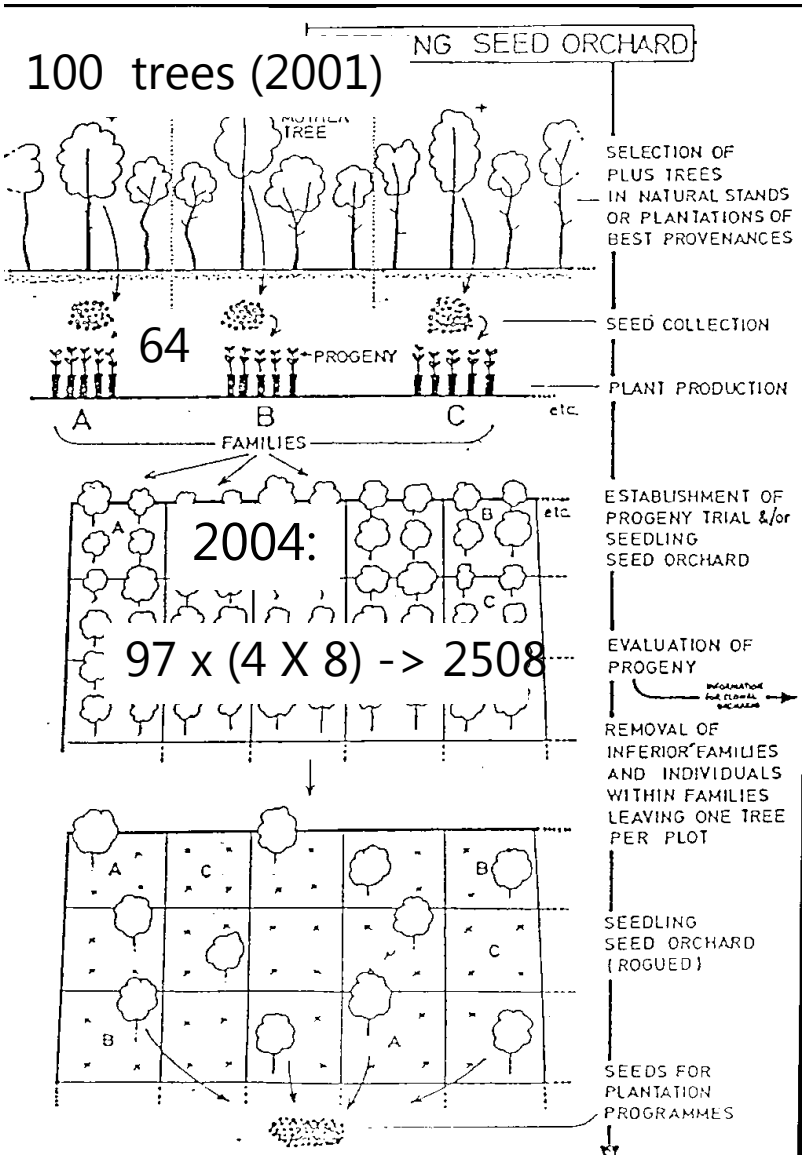

Source: Arboretum archives

# 1995: Diversification: 2 new CSOs with 39 clones (**29 new** +10 old)

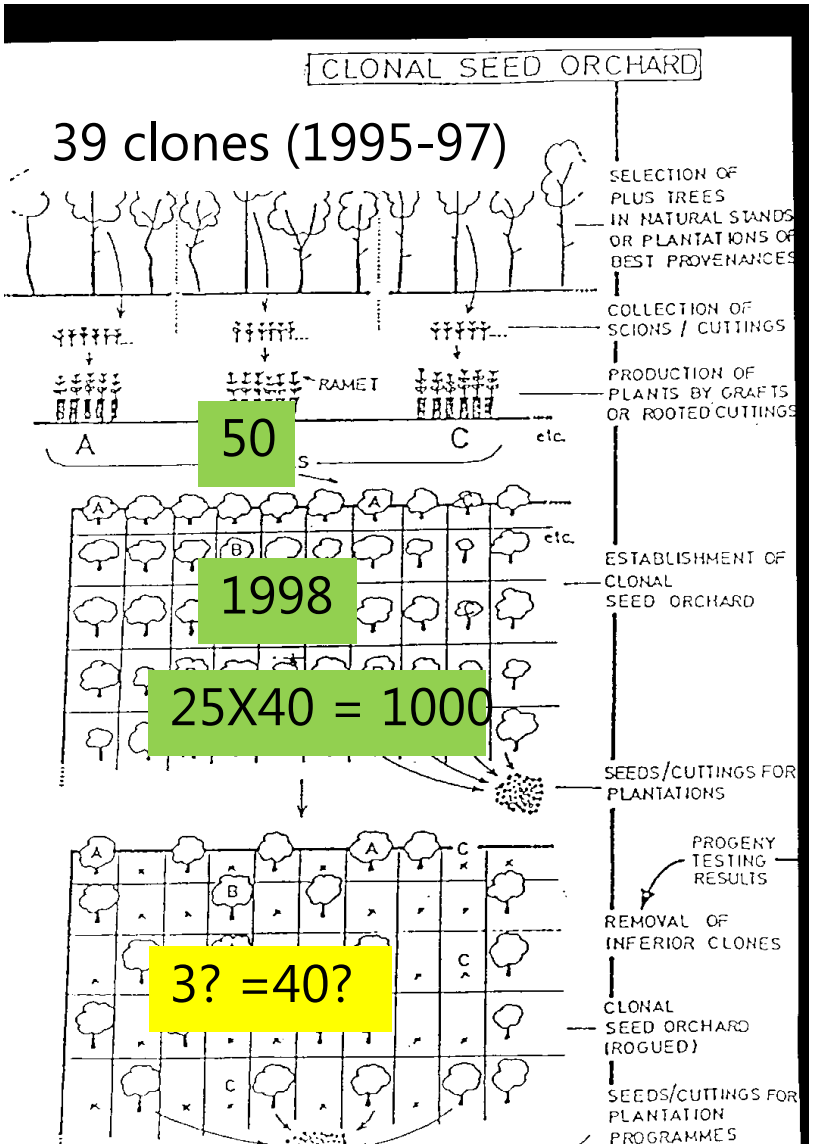



# Two sites:
# Tuse Næs + Tapsøre,

# 2002: SSO, Two sites: Randers + Vindingedal

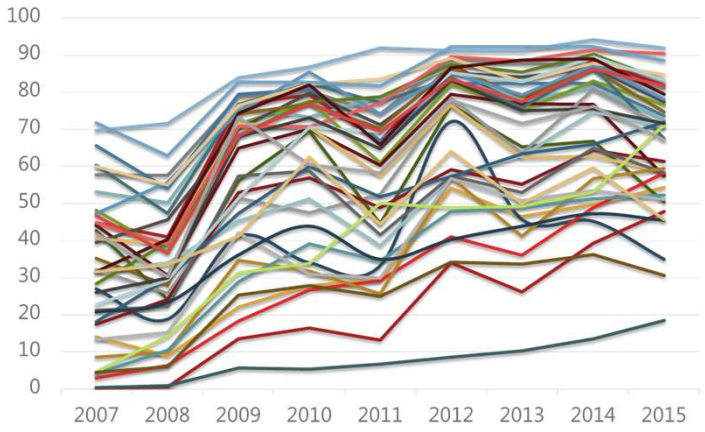



# Tuse Næs + Tapsøre, CSO, *Fraxinus excelsior*

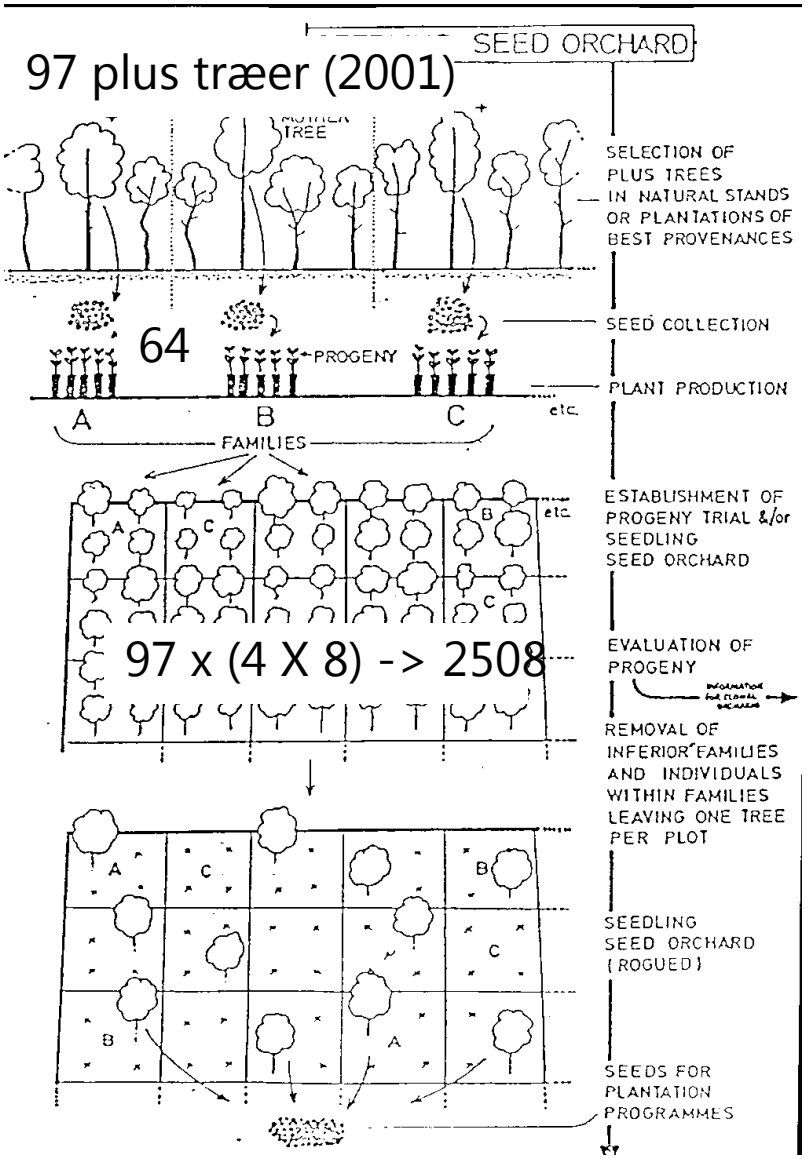




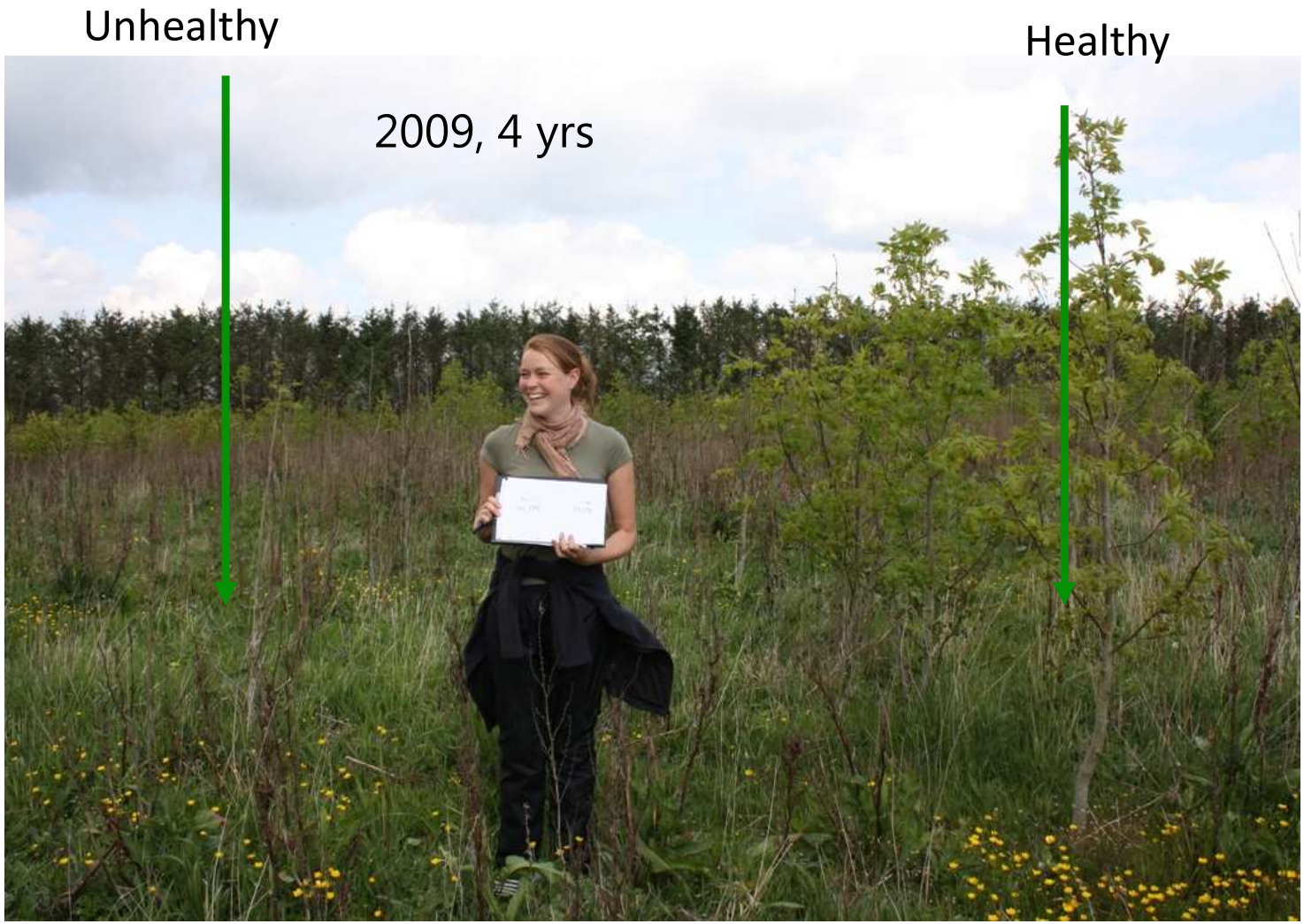
**2012: 1-2 reasonable clones, cannot be used for Seed collection ☹**



# SSO, Fraxinus excelsior

# Variation between half-sibs




2014, 9yrs

# Genetic parameters – from observations of natural infections in seed orchards

Table 2 Genetic and additive variance and heritability of susceptibility to ash dieback in *Fraxinus excelsior*

| | Location | Year | Age | Trial type | CVA/CVG | $H^2$ | $h^2$ |
|---|---|---|---|---|---|---|---|
| Denmark | Tuse Næs[a] | 2009 | 11 | Clonal | 0·38 | 0·40 | |
| | Tapsøre[a] | 2009 | 11 | Clonal | 0·39 | 0·49 | |
| | Randers[b] | 2010 | 7 | Half-sib | 0·40 | | 0·47 |
| | Silkeborg[b] | 2010 | 7 | Half-sib | 0·37 | | 0·37 |
| Sweden | Snogeholm[c] | 2011 | 19 | Clonal | 0·30–0·44 | 0·25–0·57 | |
| | Trolleholm[c] | 2011 | 19 | Clonal | 0·21–0·57 | 0·10–0·44 | |
| Lithuania | Telsiai[d] | 2010 | 5 | Half-sib/provenance | 0·39 | | 0·49 |
| | Kedainiai[d] | 2010 | 5 | Half-sib/provenance | 0·30 | | 0·40 |

Estimated CVA, coefficient of additive variance; CVG, coefficient of genetic variance; $H^2$, broad-sense heritability; $h^2$, narrow-sense h
standard error on heritability estimates.
[a]McKinney *et al.* (2011).
[b]Kjær *et al.* (2012).
[c]Stener (2012).
[d]Pliūra *et al.* (2011).

*McKinney et al : Plant Pathology 2014*

# New CSO programme

- Selection/Mature stage in plantations
- Selection /Young stage in progeny trials/SSO

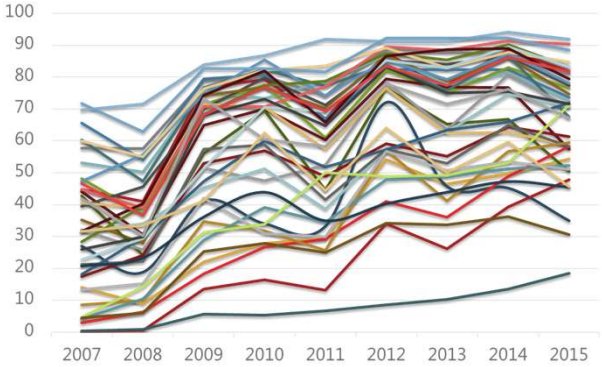

Kjær *et al* 2017
in: Vasaitis & Rasmus Enderle (editors), 2017

# Mature stage – will it work?

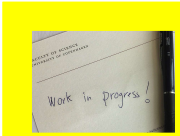
- Based on natural infections – differences in infection pressure..
- Differences in stress factors….
- Difference in age…..
- Differences in disease progress..

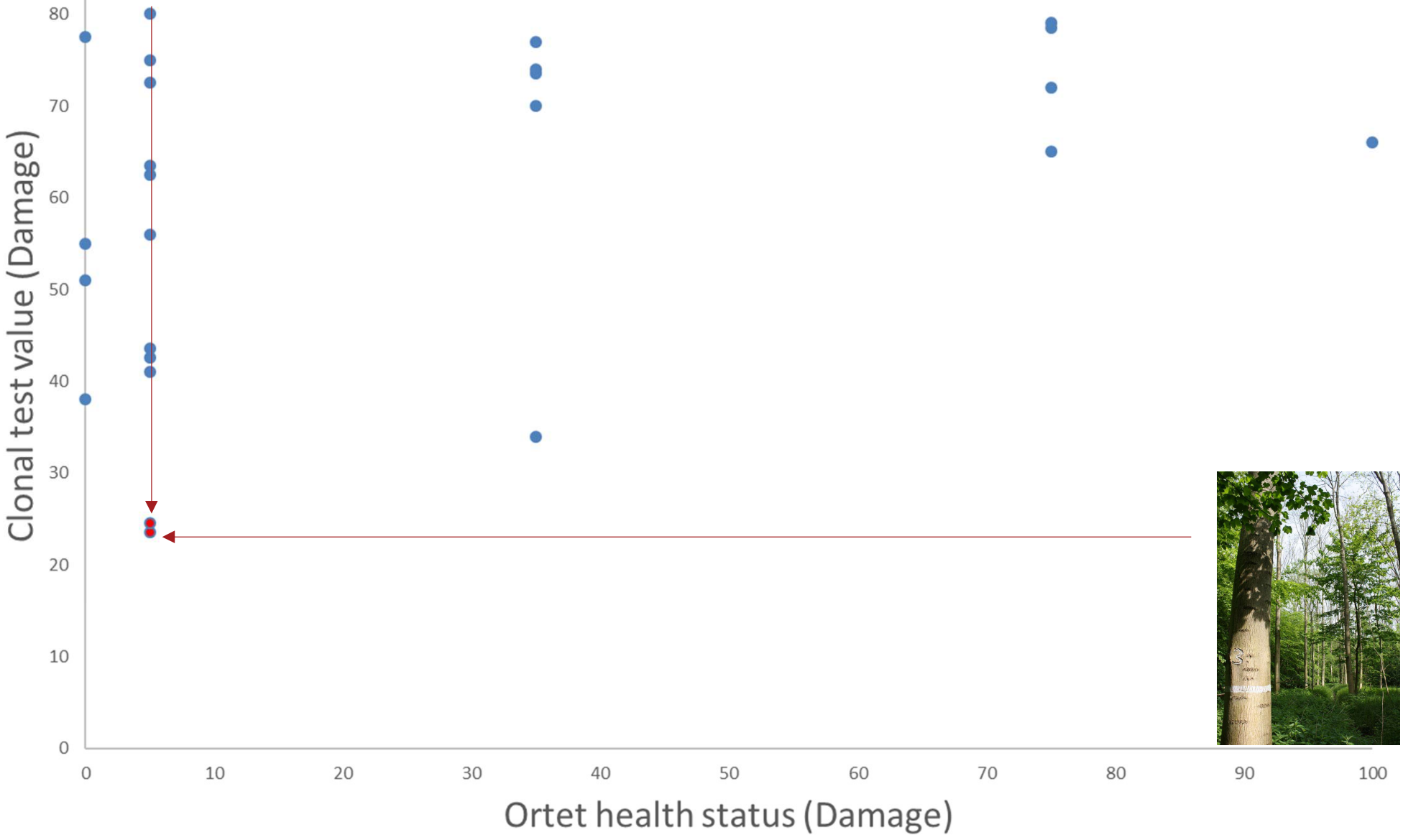
- No estimates of heritability related to mature stage

# 1995: Diversification: 2 new CSOs with 39 clones (**29 new** +10 old)




# 2009, 52% =0-A


Work in Progress!


Clonal test value (Damage)
0
10
20
30
40
50
60
70
80
90
Ortet health status (Damage)
0
10
20
30
40
50
60
70
80
90
100


# 2015, 17% 0-A

Clonal test value (Damage)

Ortet health status (Damage)

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90

*r=0.55*

# Selection in DK – mature age

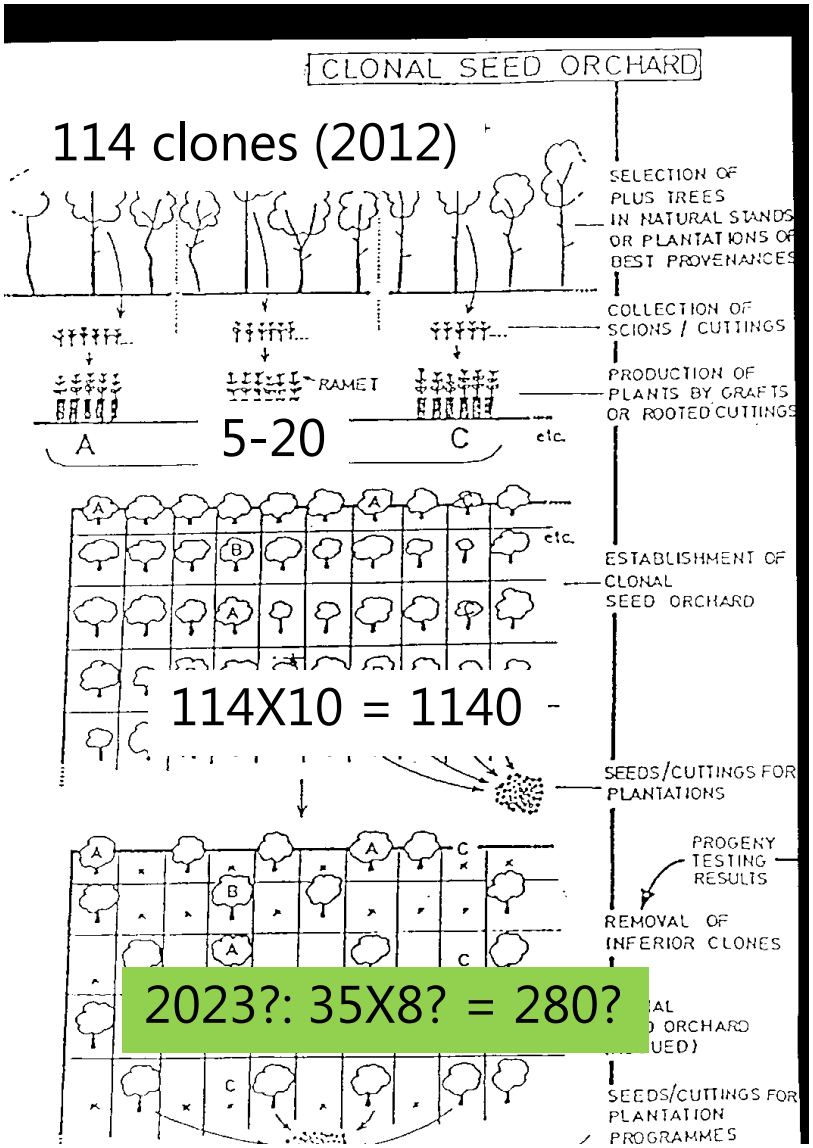
Approximately 180 clones (100+40+40)

grafted and in CSOs together with selection of juvenile trees

So far no progeny testing

4 CSO established

# Stærkende, CSO, *Fraxinus excelsior*




Early assessment (2017):

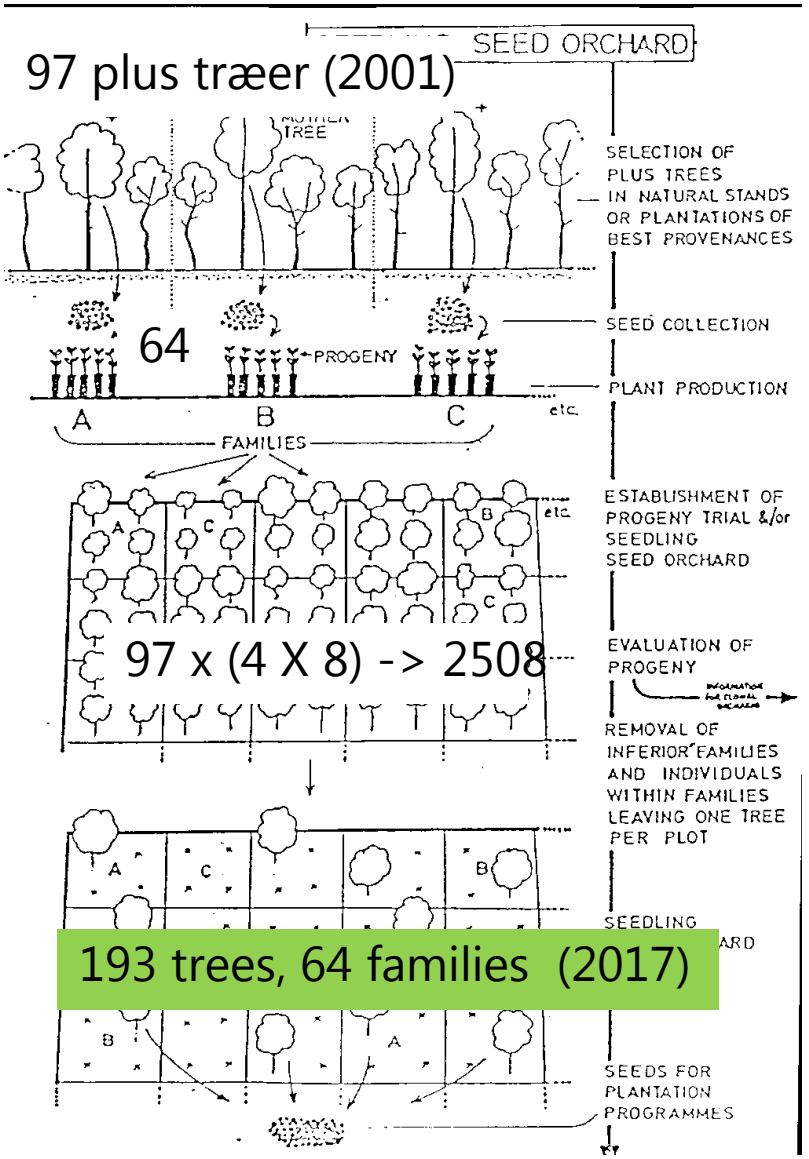
15-30 clones healthier than #35..

# Selection of mature trees can work, but

- Important to select in heavily infected stands
- Only pre-screening – testing needed
- *Juvenile* selection with *high selection intensity* in progeny trials seems to be most effective

# What happend in the SSOs?


# FP291, SSO, Fraxinus excelsior


Average crown damage ->10%

# FP291, SSO, Randers


Thinning: 2504 trees (2004) -> 193 trees (2017): **8% most healthy.**

Selection differential (damage score): S = 10% -85% = **-75%**
Selection differential (% healthy(0-b)): S = 100% - 8 % = **+92%**

**Gain?**

(Further thinnings: => 120 trees, corresponding to expected Ne ≈ 50 in crop).

Next step (2018) - tbd: **Selection of 40 trees, seed collection, 2 . Generation BSO?**

# Lessons learned?

- Selection for a breeding programme: Mature trees in plantation and young trees in field trials
- Experience with Breeding Seed Orchard in Ash
- Progeny trials and clonal trials important when new diseases become a problem

- Diversity panel with careful phenotyping: important for future research: genetic background, durability of resistance, MAS

# Thank you for your attention!

**Acknowledgement**

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