การทดสอบแม่ไม้และการทดสอบลูกหลาน

Clonal test and progeny test

Vitoon Luangviriyasaeng

RFD

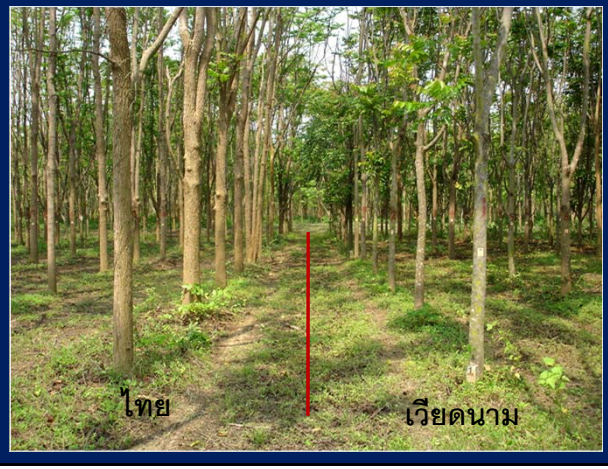
Genetic trials

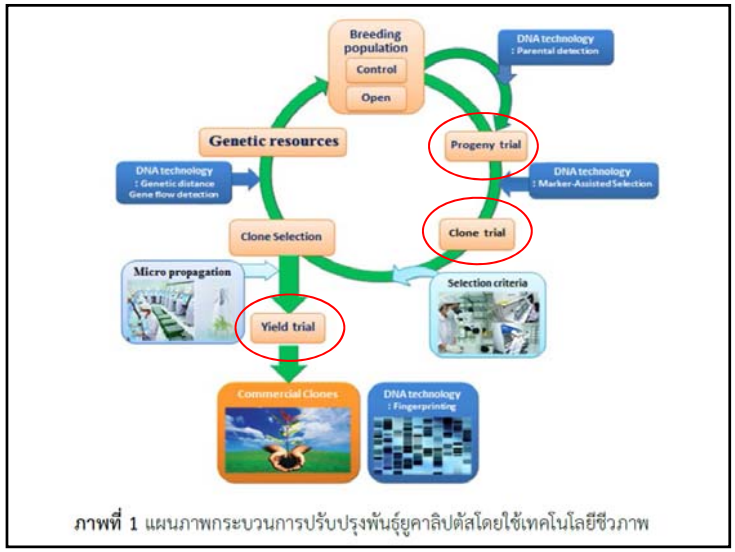
- แปลงทดลองชนิดไม้ (Species trial)
- แปลงทดลองถิ่นกำเนิด (Provenance trial)
- แปลงทดลองชนิดและถิ่นกำเนิด (Species and provenance trial)
- แปลงทดสอบสายพันธุ์ หรือ แปลงทดสอบลูกหลาน (Progeny trial)
- Provenance and progeny trial
- Clone progeny trial
- Genetic gain trial / Yield trial

Acacias Introduced in Asia

- 1985 -1987 Australian species/provenance trials in Thailand introduced > 20 species of lesser-known acacias

แปลงทดลองถิ่นกำเนิดยมหิน กาญจนบุรี (7 ปี)

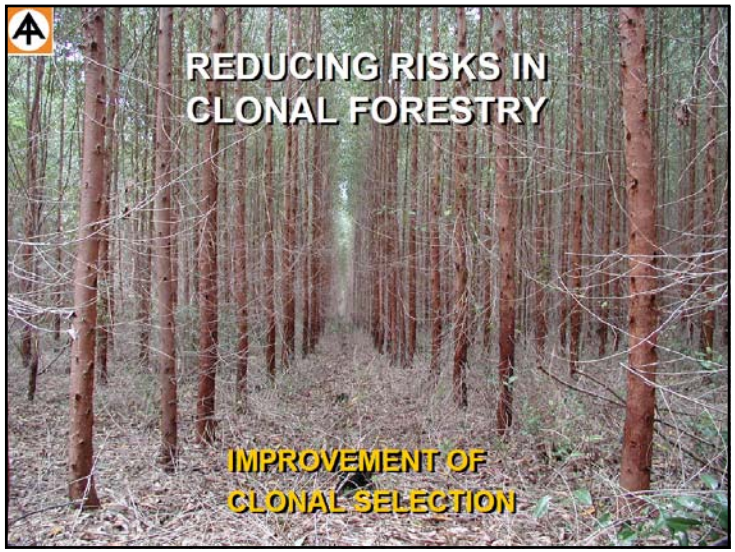




ภาพที่ 1 แผนภาพกระบวนการปรับปรุงพันธุ์ยูคาลิปตัสโดยใช้เทคโนโลยีชีวภาพ


Clonal poplar – Eastern Oregon

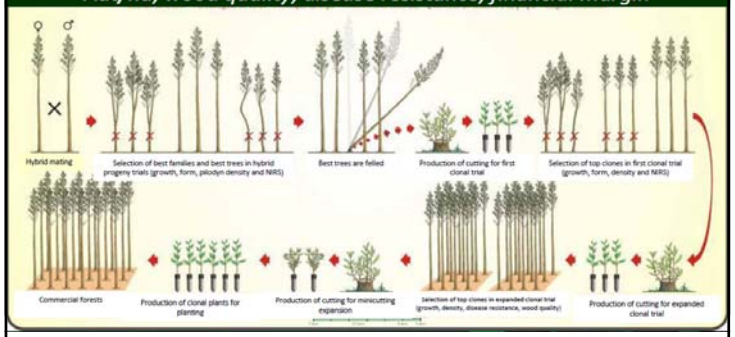

2012/07/23


REDUCING RISKS IN
CLONAL FORESTRY
IMPROVEMENT OF
CLONAL SELECTION


โรคเชื้อราที่ใบ

Steps taken for the selection of new elite clones

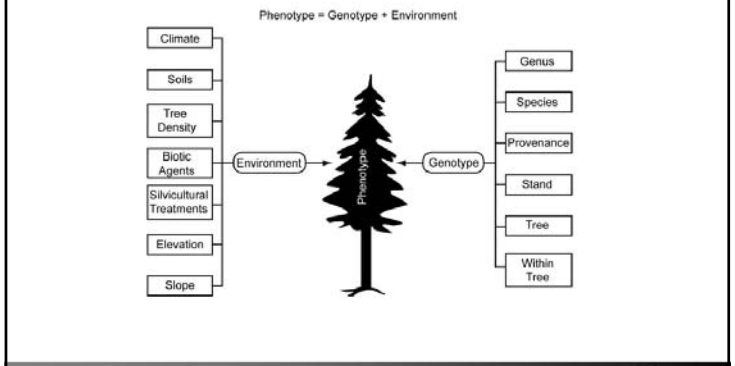
Selection parameters: trunk and crown form, % bark, productivity Adt/ha; wood quality; disease resistance, financial margin

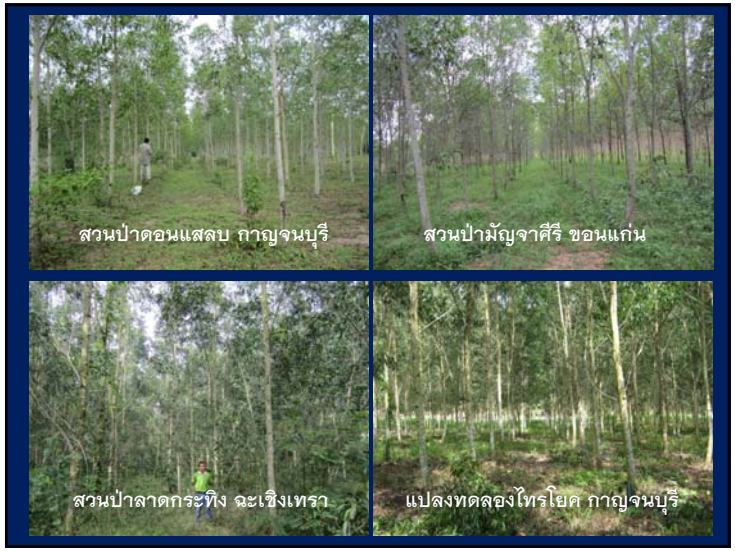


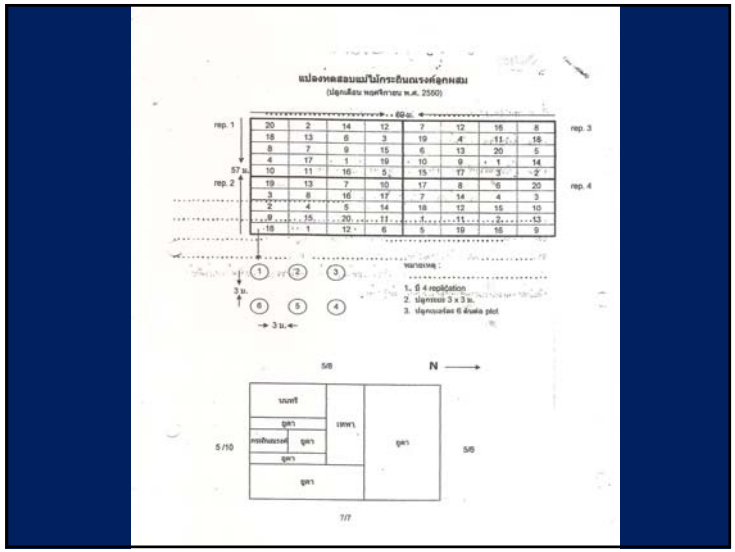
Vegetative propagation (clonal propagation) of selected superior families or clones

- Captures maximum genetic gain (additive and non-additive)
- Candidate clones must be tested in the planting environment
- Danger of narrow genetic base, vulnerable to pest and disease (example - only one clone in a big plantation)
- A good clonal forestry program must be based on a good sexual breeding program

The nature of variation in forest trees

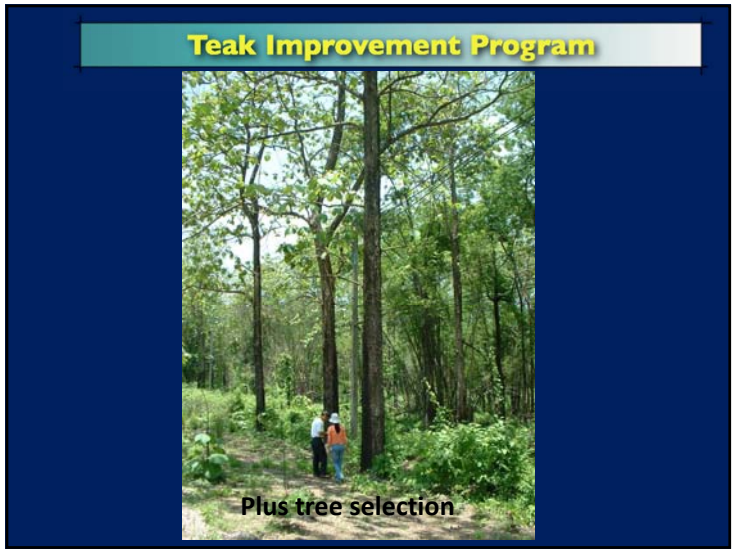






ตารางแสดงค่าเฉลี่ยการเจริญเติบโตของสายต้นไม้กระถินณรงค์ลูกผสมที่ปลูกในท้องที่ต่าง ๆ

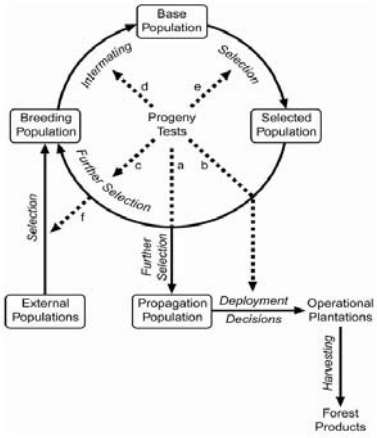
No.	Clone	DL		MK		SK		LK		SY	
		HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH
1	AA1	9.63	8.03	10.06	10.12	10.75	11.56	12.58	11.05	16.33	13.82
2	AA2	9.72	8.55	9.40	8.65	9.13	8.71	12.45	13.36	16.14	12.29
3	AA3	9.64	10.67	9.68	9.41	10.33	9.61	11.11	8.89	15.64	13.58
4	AA4	9.88	8.47	10.43	9.90	9.53	8.91	11.17	8.07	16.32	12.41
5	AA5	10.17	8.29	10.00	9.39	11.31	11.00	11.92	9.75	16.27	13.18
6	AA6	9.73	8.45	9.29	9.21	10.46	9.02	9.57	7.08	15.76	12.66
7	AA7	10.09	8.31	9.74	9.39	10.74	9.88	14.01	11.12	16.93	13.39
8	AA8	10.63	8.85	10.32	9.67	10.14	10.48	12.68	9.98	15.73	11.68
9	AA9	9.29	7.86	9.79	9.27	10.31	9.39	11.02	8.32	15.95	12.46
10	AA10	10.05	9.44	9.96	9.33	10.02	9.26	12.25	9.13	15.63	11.73
11	AA11	9.38	9.25	8.87	8.80	10.29	9.81	12.24	10.46	15.07	10.48
12	AA12	10.06	7.82	9.54	8.92	10.56	9.05	12.80	9.96	16.44	11.89
13	AA13	10.61	8.63	8.93	7.76	9.54	8.52	12.78	8.71	16.02	10.75
14	AA14	9.04	8.29	9.72	9.22	11.85	11.64	11.97	9.42	15.89	12.28
15	AA15	9.46	8.04	10.48	10.04	10.02	9.42	13.34	10.27	16.54	12.55
16	AA16	9.76	8.39	10.53	10.32	9.81	8.29	12.81	9.86	16.19	13.06
17	AA17	9.88	8.68	9.88	10.24	8.98	8.08	11.19	8.96	16.26	12.26
18	AA18	10.25	8.88	9.54	8.72	9.32	7.80	13.11	10.43	16.32	12.50
19	AA19	8.91	8.16	9.74	9.08	10.18	9.79	11.55	8.92	15.66	11.23
20	AA20	9.67	8.78	10.85	10.67	10.29	11.04	11.11	9.22	16.64	14.18
Mean		9.79	8.59	9.84	9.41	10.18	9.56	12.08	9.65	16.09	12.42
Significant level		ns	ns	ns	ns	***	***	***	***	***	***
LSD		1.18	1.81	1.51	1.96	1.03	1.17	1.06	0.85	0.63	0.83
CV(%)		8.5	14.8	10.8	14.7	7.1	8.7	6.2	6.2	2.7	4.7
Eucalyptus		9.36	6.93	7.63	10.21	8.86	12.96	7.68	9.86	-	-



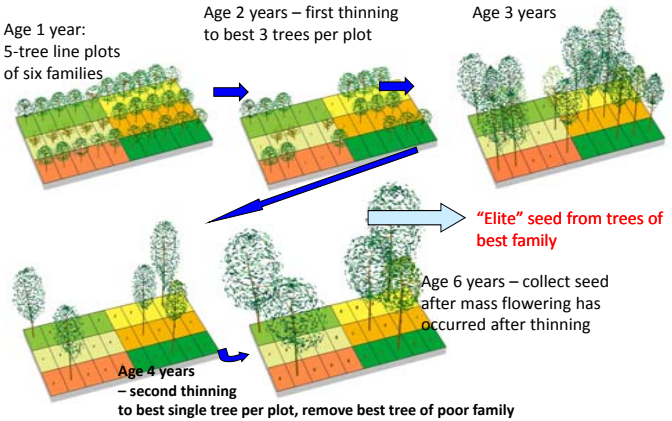

SELECTION AND
MULTIPLICATION

แปลงทดสอบสายต้นไม้สนประดิพัทธ์ กาญจนบุรี

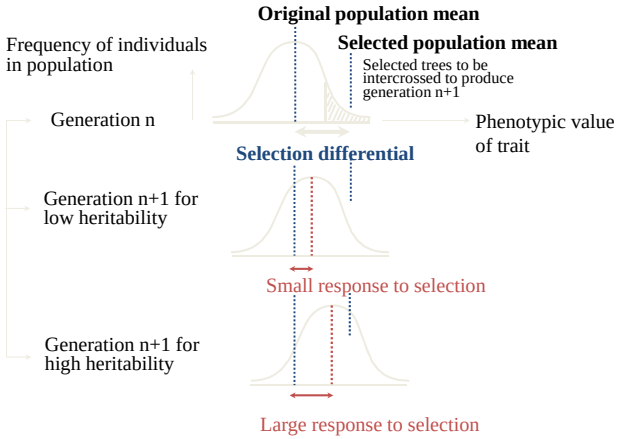
Progeny testing (Genetic Testing) is central to TI



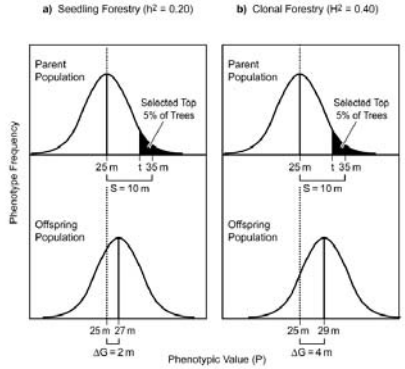
Developing part of a seedling seed orchard from a progeny trial



Response to selection with high and low heritability

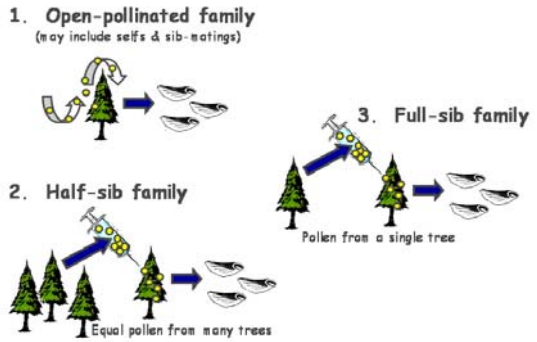


The goal of selection

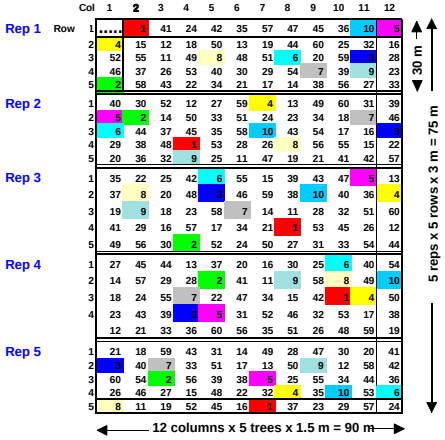


White et al. 2007; Fig. 13.2

Types of families



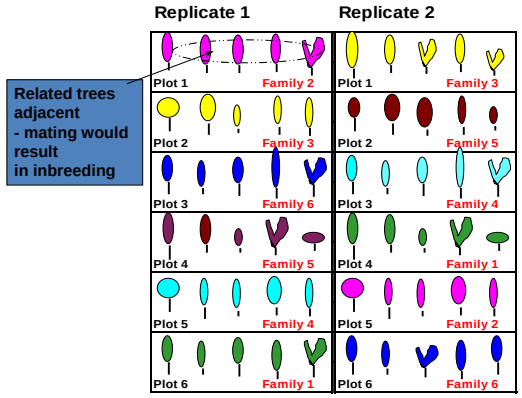
Computer design for seedling seed orchard with 60 families



- 60 progenies
- 5 tree row plots
- 5 replicates
- 5 rows and 12 columns
- spacing 3m between rows
- spacing 1.5m between trees within rows

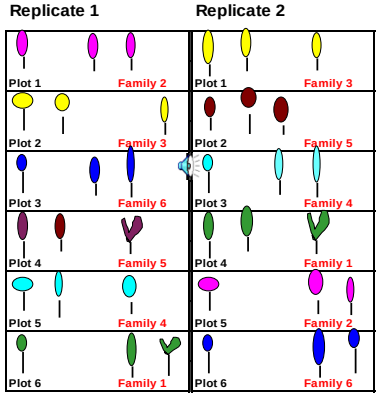
Within-plot thinning of seedling seed orchards

First assessment



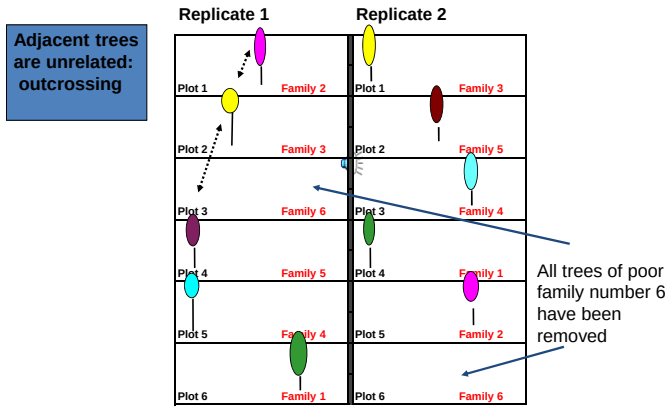
Within-plot thinning of seedling seed orchards

Second assessment



Final thinning of seedling seed orchards

Third assessment

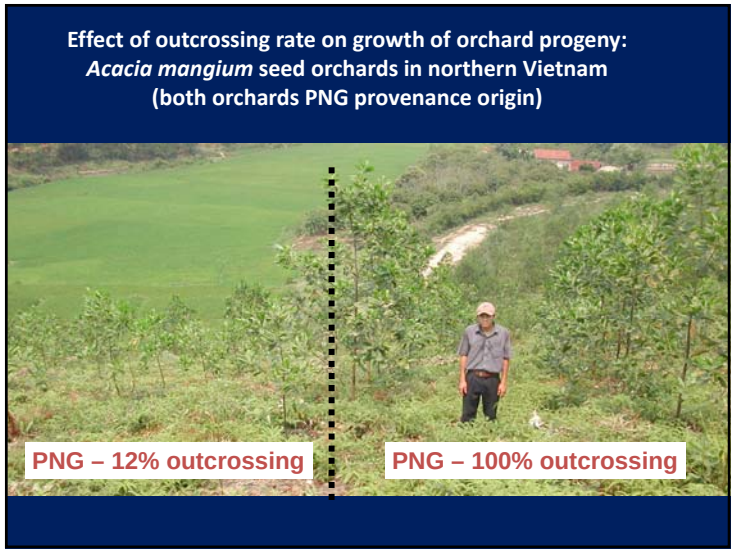


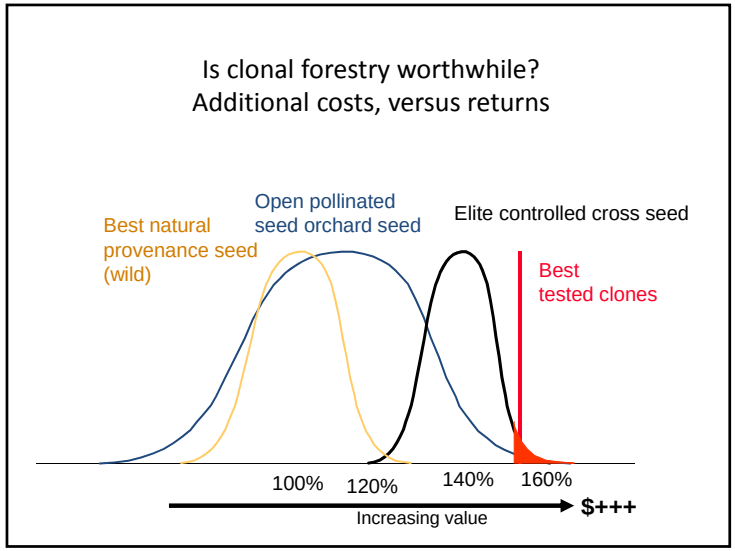
Eucalyptus camaldulensis Seedling Seed Orchard IFGTB, India (FORTIP)

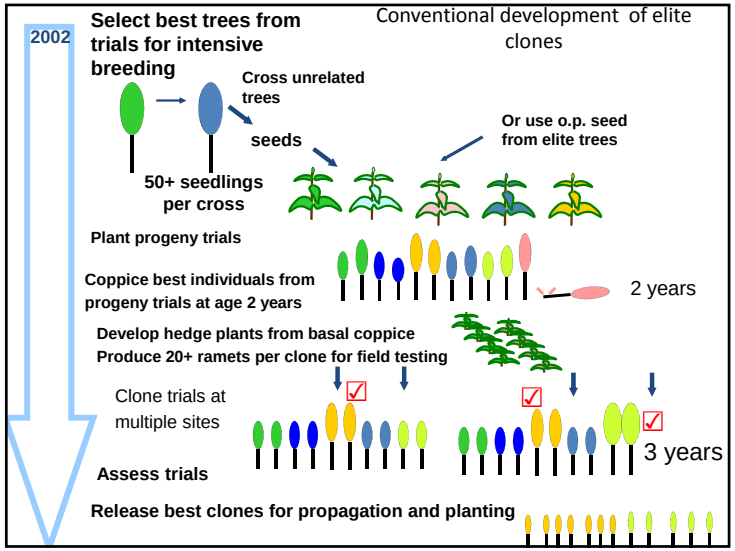
176 o.p. families

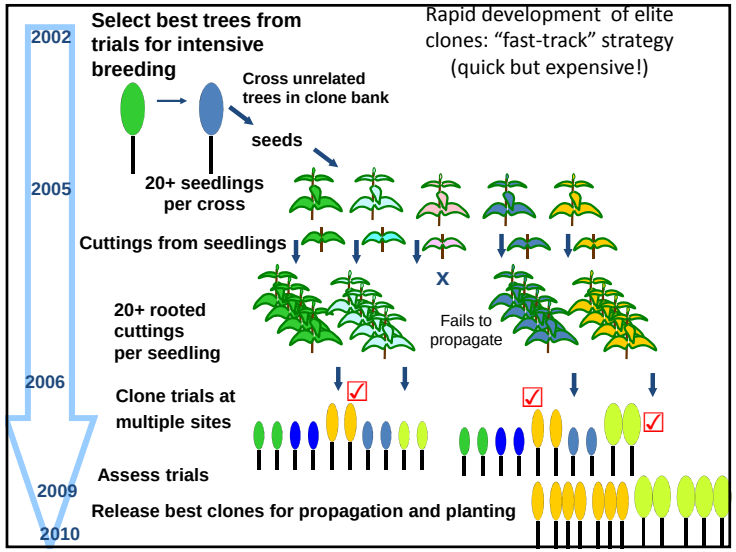
- 15 Indian selections
- 161 families from Australian natural provenances

5 replicates of 3-tree line plots of each family
Total of 2640 trees
Note family-to-family variation!


Effect of outcrossing rate on growth of orchard progeny:
Acacia mangium seed orchards in northern Vietnam
(both orchards PNG provenance origin)
PNG – 12% outcrossing
PNG – 100% outcrossing


Is clonal forestry worthwhile?
Additional costs, versus returns
Best natural provenance seed (wild)
Open pollinated seed orchard seed
Elite controlled cross seed
Best tested clones
100%
120%
140%
160%
$+++
Increasing value


2002
Select best trees from trials for intensive breeding
Conventional development of elite clones
Cross unrelated trees
seeds
Or use o.p. seed from elite trees
50+ seedlings per cross
Plant progeny trials
Coppice best individuals from progeny trials at age 2 years
2 years
Develop hedge plants from basal coppice
Produce 20+ ramets per clone for field testing
Clone trials at multiple sites
3 years
Assess trials
Release best clones for propagation and planting


2002
Select best trees from trials for intensive breeding
Rapid development of elite clones: "fast-track" strategy (quick but expensive!)
Cross unrelated trees in clone bank
seeds
2005
20+ seedlings per cross
Cuttings from seedlings
x
20+ rooted cuttings per seedling
Fails to propagate
2006
Clone trials at multiple sites
Assess trials
2009
Release best clones for propagation and planting
2010

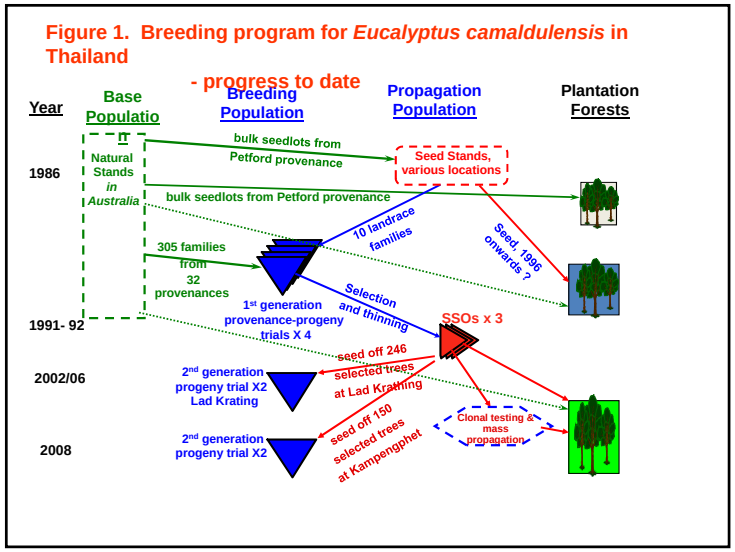


Figure 1. Breeding program for Eucalyptus camaldulensis in Thailand
- progress to date
Year
Base Populatio n
Breeding Population
Propagation Population
Plantation Forests
1986
Natural Stands in Australia
bulk seedlots from Petford provenance
Seed Stands, various locations
bulk seedlots from Petford provenance
10 landrace families
Seed, 1998 onwards ?
305 families from 32 provenances
1st generation provenance-progeny trials X 4
Selection and thinning
SSOs x 3
1991- 92
seed off 246 selected trees at Lad Krathing
2002/06
2nd generation progeny trial X2 Lad Krating
Clonal testing & mass propagation
seed off 150 selected trees at Kampengphet
2008
2nd generation progeny trial X2

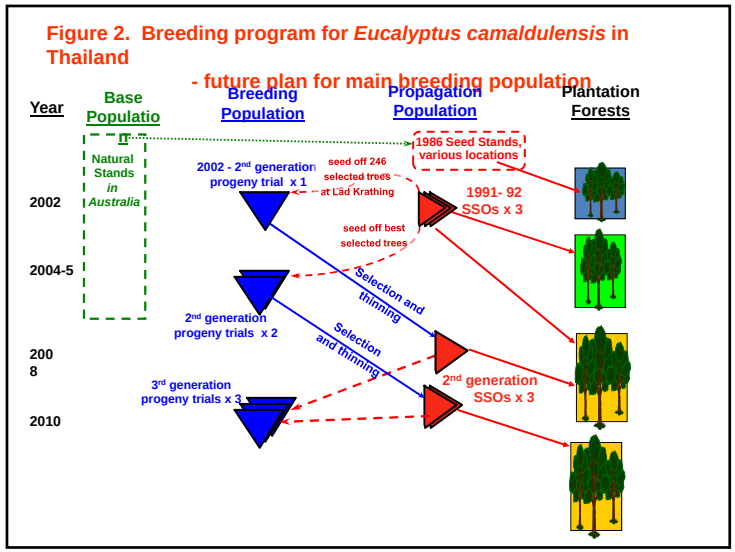


Figure 2. Breeding program for Eucalyptus camaldulensis in Thailand
- future plan for main breeding population
Year
Base Populatio n
Breeding Population
Propagation Population
Plantation Forests
Natural Stands in Australia
1986 Seed Stands, various locations
2002 - 2nd generation progeny trial x 1
seed off 246 selected trees at Lad Krathing
1991- 92 SSOs x 3
2002
seed off best selected trees
2004-5
Selection and thinning
2nd generation progeny trials x 2
Selection and thinning
200 8
3rd generation progeny trials x 3
2nd generation SSOs x 3
2010

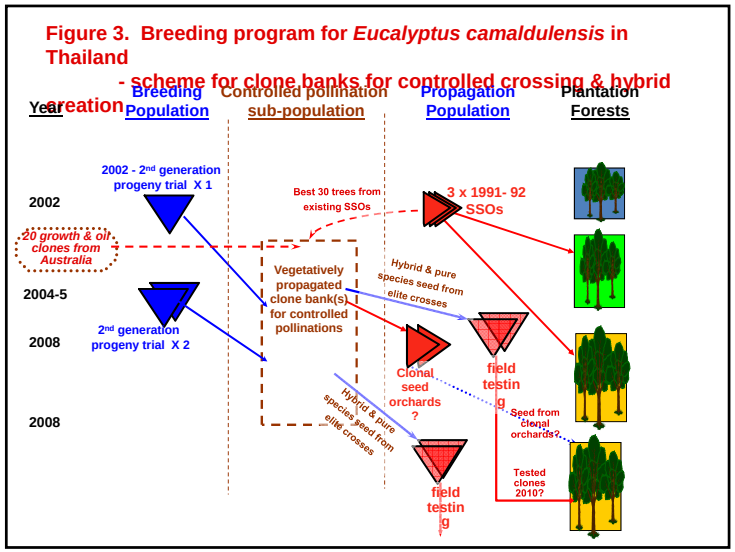
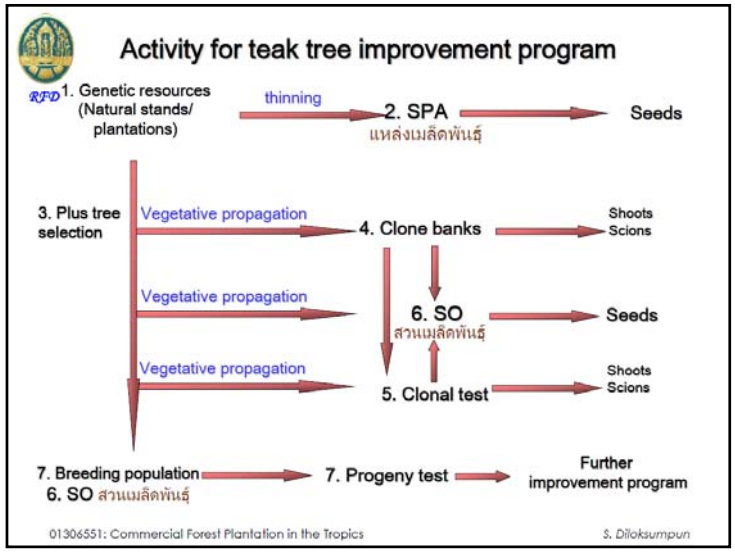
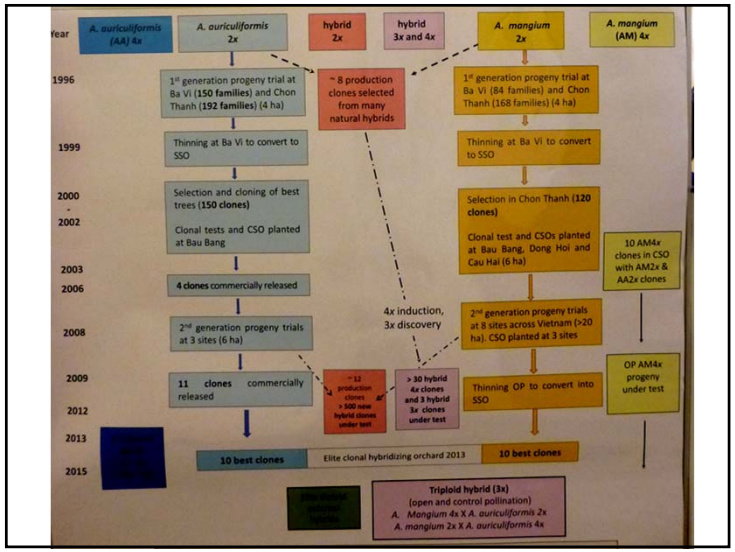
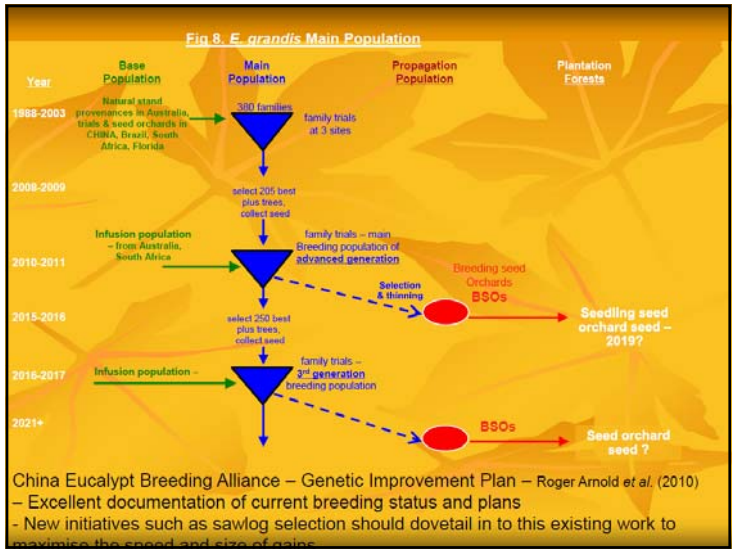


Figure 3. Breeding program for Eucalyptus camaldulensis in Thailand
- scheme for clone banks for controlled crossing & hybrid creation
Year
Breeding Population
Controlled pollination sub-population
Propagation Population
Plantation Forests
2002 - 2nd generation progeny trial X 1
Best 30 trees from existing SSOs
3 x 1991- 92 SSOs
2002
20 growth & oil clones from Australia
Vegetatively propagated clone bank(s) for controlled pollinations
Hybrid & pure species seed from elite crosses
2004-5
2nd generation progeny trial X 2
2008
Clonal seed orchards ?
field testin g
Seed from clonal orchards ?
Hybrid & pure species seed from elite crosses
Tested clones 2010?
2008
field testin g







China Eucalypt Breeding Alliance – Genetic Improvement Plan – Roger Arnold *et al.* (2010)
– Excellent documentation of current breeding status and plans
- New initiatives such as sawlog selection should dovetail in to this existing work to maximise the speed and size of gains