Tobacco cultivars evolution in France 1989-2006 and impact to the raw matter.

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3. UCAPT (Union des Coopératives Agricoles de Planteurs de Tabac)

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Institut du Tabac

2006 CORESTA CONGRESS – Paris, 15-20 October

History of tobacco breeding, France

➔ Before 1963: Dark Air-cured

- ✓ Mostly Paraguay
- ✓ PVY^N resistant
  - no problem with the new occurrence of PVY^N in Europe (50's)
- ✓ Tolerant to black root-rot → withstands low infestations

➔ 1963: Blue-mold epidemic

- ✓ F1 hybrids with Hicks resistant
- ✓ Breeding Dark Air-cured for blue-mold res.
  - TMV + blue-mold res.

➔ PBD6 (Schiltz, 1967): blue-mold + TMV res.

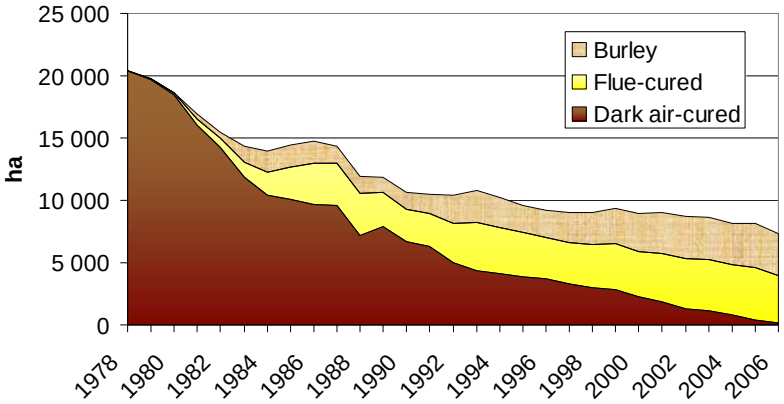
- ✓ First introduction of a new cultivar

History of tobacco breeding, France

➔ 1980: first attempts to produce flue-cured

- ✓ Cultivars lacking adaptation
  - Disease resistance problems

    Black root-rot, PVY
  - And / or too late for leaf maturity



➔ Renewal of breeding objectives:

- ✓ Leaf quality to meet international standards
- ✓ Resistances to black root-rot, $PVY^{N,}$
  - AlsoTMV, Blue-mold, Powdery mildew
- ✓ Early leaf maturity

➔ Extension of the breeding to flue-cured.

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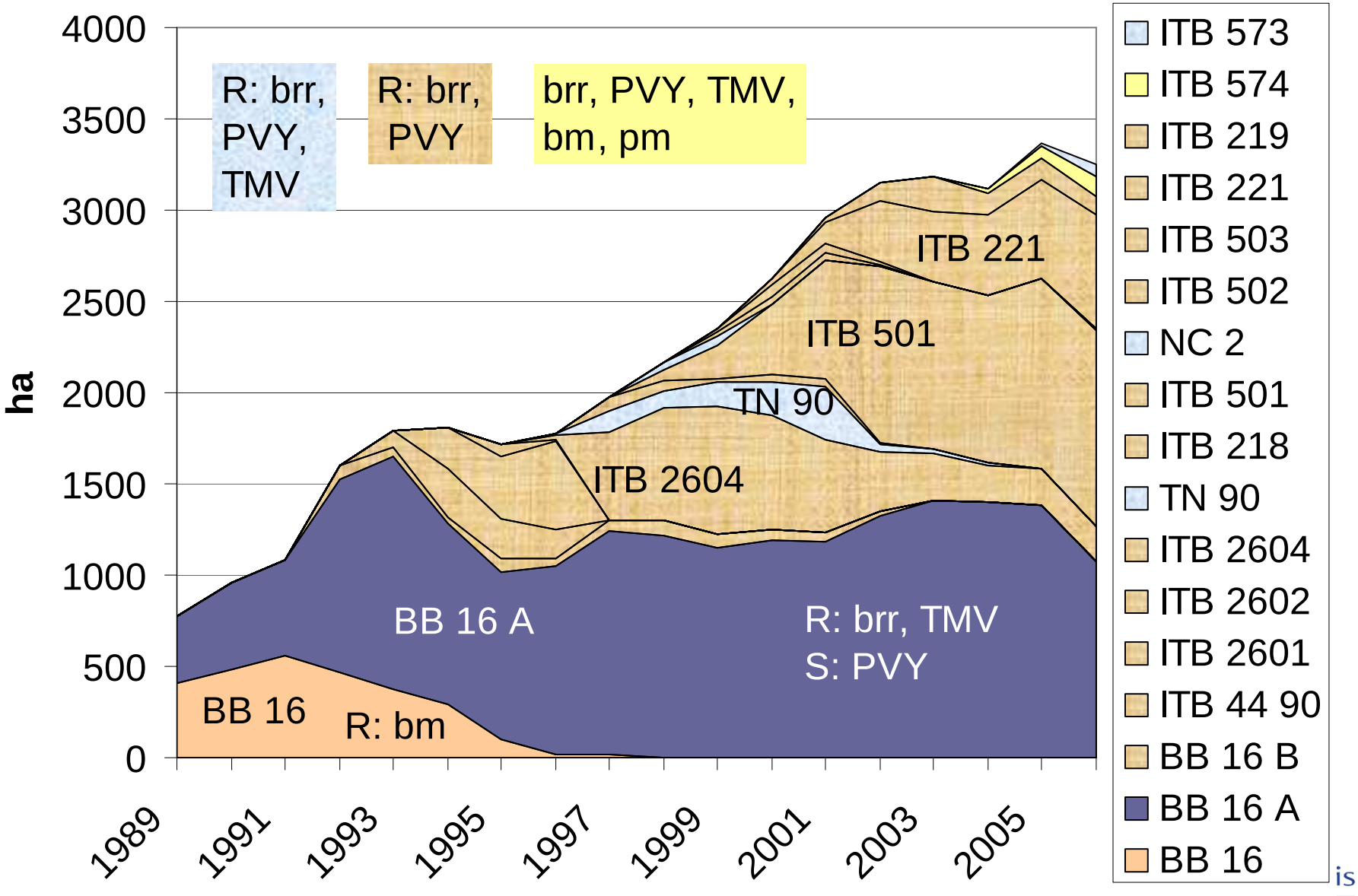
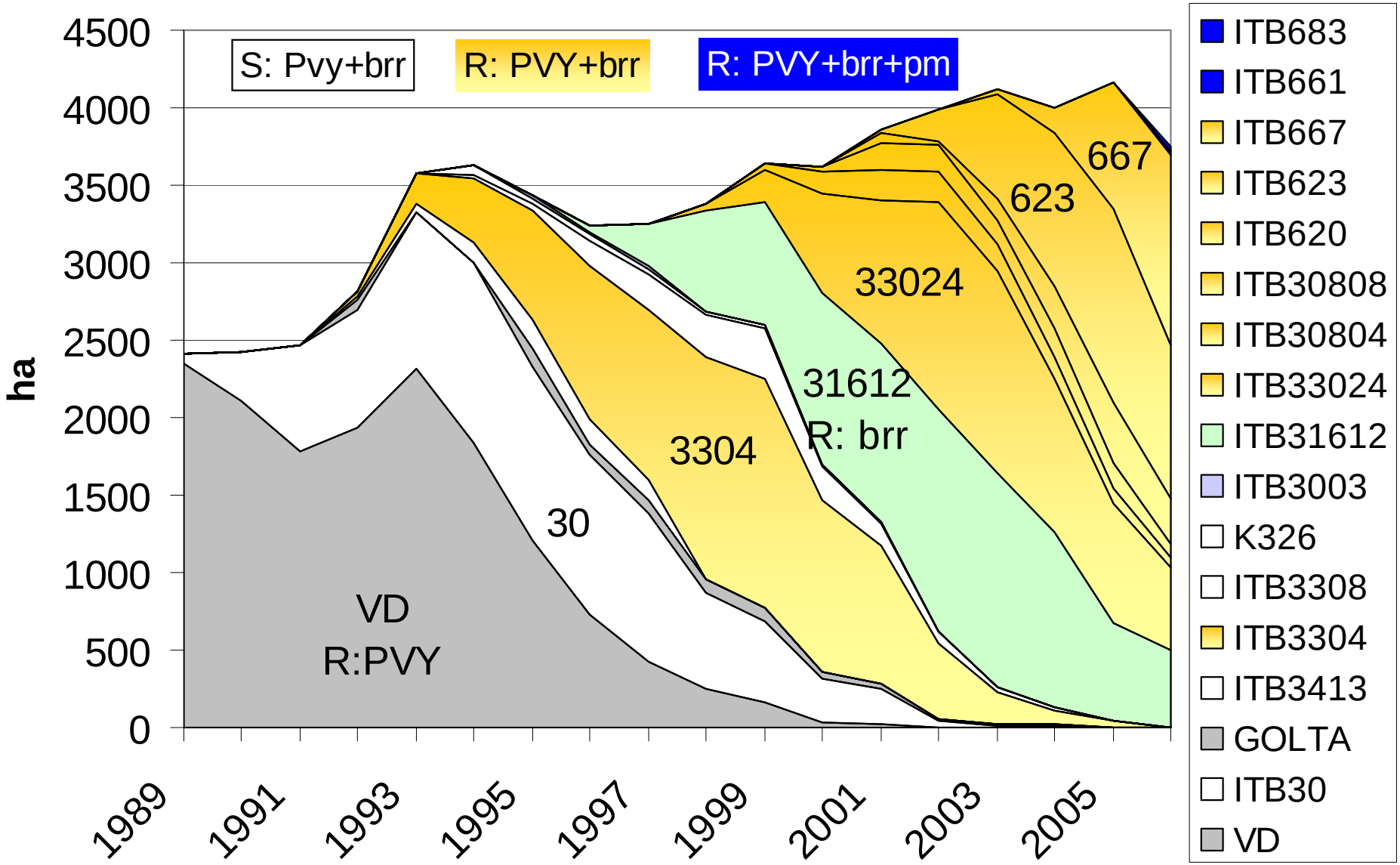
Burley acreage 1989-2006



Flue-cured acreage 1989-2006



Tobacco cultivars evaluation

➔ Joined effort involving:

- ✓ Growers cooperative union: UCAPT
- ✓ Extension: ARREAT, ANITTA
- ✓ ALTADIS – Institut du tabac

➔ 3 steps:

- ✓ Preliminary RCB field trials, Bergerac:
  - Yield, leaf chemistry and quality
- ✓ RCB field trials, (multilocal since 2001)
  - Same traits + Standardised smoking test (Tar, nicotine) + smoking panel
- ✓ Small scale release (30 ha)
  - Comparison to reference variety (UCAPT)

Question

➔ **Important renewal of cultivars:**

- ✓ Potential for leaf quality may vary according to cultivars

➔ **Generalization of disease resistance genes:**

- ✓ PVY: va gene → lower leaf exudates
- ✓ Brr: resistance from *N. debneyi* origin, supposed to be detrimental to leaf quality in flue-cured
- ✓ Any disease res. gene may affect leaf quality.

➔ **How the cultivar turnover affected leaf quality and chemical equilibrium ?**

Material and methods

1. **Grouping of data from RCB field trials.**
2. **Least square estimates of cultivar effects for different traits.**
3. **Combining cultivar effects with the acreage devoted to each cultivar in each year.**
4. **Flue-cured: comparing results with evolution of raw tobacco bought by Altadis over several years in France.**

M&M 1. Field trials

➔ Randomized Complete Blocks

	Replicates	Plants / plot
Step 1	2	50
Step 2	3	150

➔ Leaf quality

- ✓ All leaf levels
- ✓ Quality score (1:low – 5: best).
  - mean of 3 leaf buyer panels.
- ✓ Quality index (0-100)
  - Leaf level separated among quality classes that have pre-defined scores.
  - QI= the weighed mean of scores.

Quality class	Scores Bey	FC
A	100	100
B	80	85
C	65	75
D	25	25
E	5	5
Non-descript	0	0

➔ Flue-Cured: Average Harvest Date

$$\frac{\text{(date 1 x weight 1) + (date 2 x weight 2) + …+ (date n x weight n)}}{\text{total weight}}$$

M&M 1. Field trials (cont.)

➔ Leaf sampling

- ✓ Before 1999: cigarettes & powder from whole leaves.
  - 4 leaf levels, weighed results over levels.
- ✓ Starting 1999: cigarettes & powder from strips
  - Threshing of a representative sample:

    According to quality classes

    Burley: mediane + top, FC: 4+5th harvests

➔ Chemical analysis or NIRS estimate

- ✓ Nicotine, total nitrogen, ashes, reducing sugars (FC).

➔ Smoke evaluation

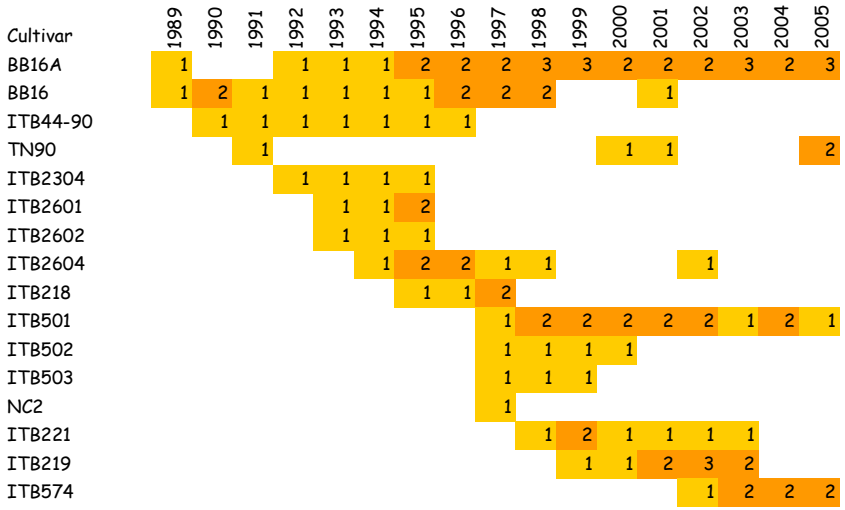
- ✓ Cigarette sample: target pressure drop (SODIMAT, 55 mm WG)
- ✓ ISO4387 mechanical smoking → tar and nicotine yields (mg/cig).

M&M 2. Estimating cultivar effects

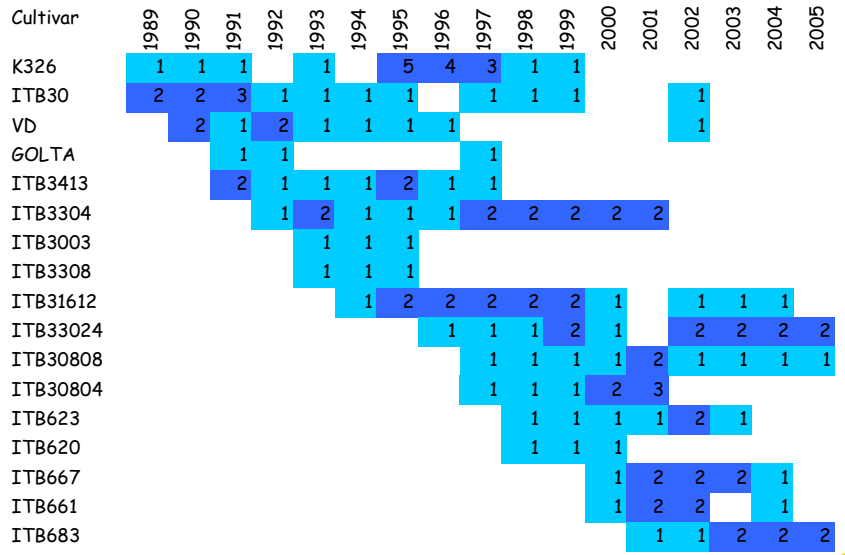
- **Grouping RCB data**
  - Cultivars: reference + tested at least for 2 years
  - Multilocal trials: averaged over all location
- **Least square estimates of cultivar effects**
  - Value = constant + cultivar effect + trial effect + residual
    - Variance analysis: Statgraphics ® *Plus* V 5.1
  - Every trial homogeneous for methodology and climate
  - Variations linked to climatic conditions (year) and methodology are captured into the trial effect.

2. Estimating cultivar effects (cont.)

Burley
86 cultivars, 341 data
among which
16 developed, 126 data



Flue-cured
131 cultivars, 488 data
among which
17 developed, 156 data



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M&M 3. Combining data with acreages

- **Acreage grown with each variety**
  - ✓ from 1989 to 2006
  - ✓ source: ANITTA
- **Each year: genetic potential of the tobacco crop = weighed mean of cultivars effects x acreage.**
- **Evolution from 1989 to 2006.**

Results: Burley (1)

➔ Assessment of cultivars

- ✓ field and tobacco quality data

Variable	50% flo	Leaf number	Yield	maturity score	QI	Quality score
Unit	days	n	kg/ha	1-5	%	1-5
n	289	274	337	271	327	332
cultivars	80	80	86	80	85	86
trials	35	32	47	33	44	46
P(F cultivar)	0,000	0,000	0,000	0,000	0,000	0,000
P(F trial)	0,000	0,000	0,000	0,000	0,000	0,000
R^2	90	80	82	67	77	79
Constant	68	21,4	3377	3,0	72	2,9

dat: days after transplantation

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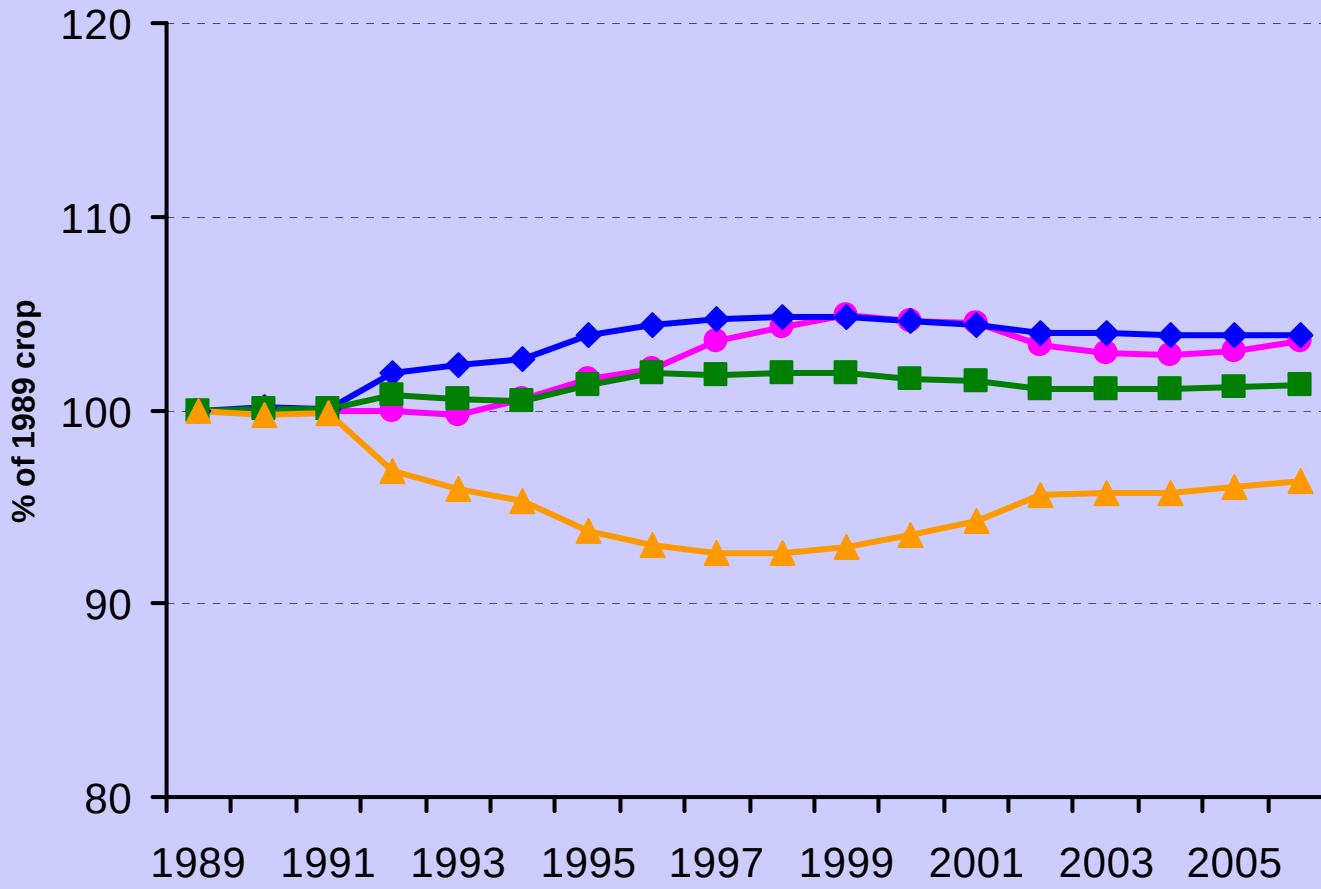
Results: Burley (2)



50% flo 65.7- 68.3 days

Yield 3.1 – 3.2 T/ha

leaf nb 20.7 – 20.9

maturity 3.1 – 3.0

Weighed averages of cultivars effects x acreage, burley, field and leaf quality data

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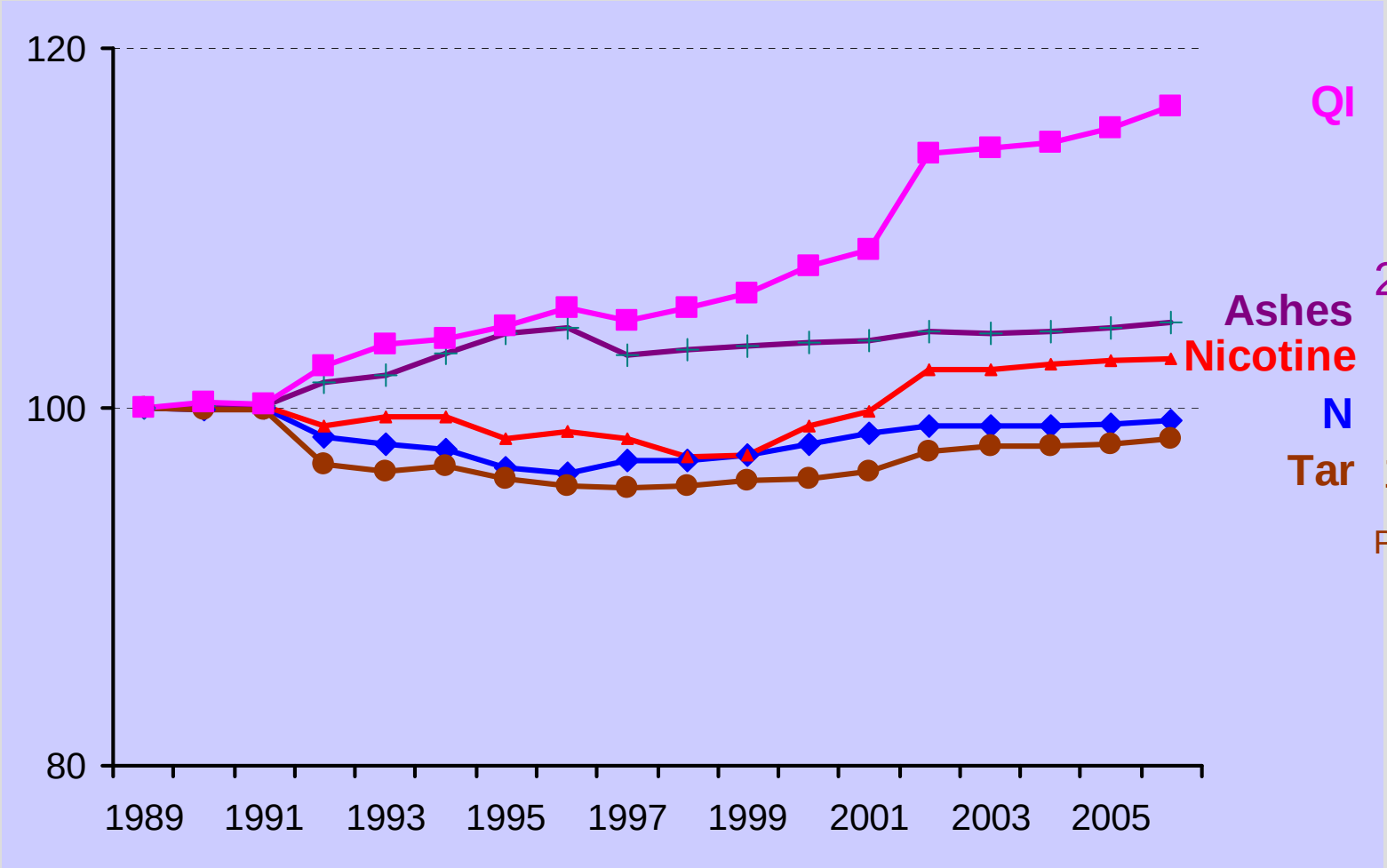
Results: Burley (3)

➔ Assessment of cultivars

- ✓ chemical equilibrium and tar potential

Variable	Ashes	Nicotine (leaf)	N	Tar	nicotine / cigarette
Unit	%dm	%dm	%dm	mg/cig	mg/cig
n	329	340	340	185	185
cultivars	86	86	86	64	64
trials	45	48	48	35	35
P(F cultivar)	0,000	0,000	0,000	0,000	0,000
P(F trial)	0,000	0,000	0,000	0,000	0,000
R^2	94	85	93	93	89
Constant	22,4	3,5	4,0	14,6	2,6

Results: Burley (4)



QI	68 - 79
Ashes	21.2 - 22.2 %dm
Nicotine	3.7 – 3.8 %dm
N	4.1 – 4.0 %dm
Tar	15.0 – 14.8

Puros no filter mg/cig

Weighed averages of cultivars effects x acreage, burley, chemical and tar potential data

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Results: Flue-cured (1)

➔ Assessment of cultivars

- ✓ field and tobacco quality data

	50% flo.	Leaf nb.	Yield	Maturity score	AHD	QI	Quality score
Unit	dat	nb	kg/ha	1-5	dat	0-100	1-5
n	332	323	486	289	350	486	367
nb cultivars	94	94	131	89	102	131	104
nb trials	43	42	71	40	44	71	49
P(F cultivar)	0,000	0,000	0,000	0,000	0,000	0,000	0,000
P(F trial)	0,000	0,000	0,000	0,000	0,000	0,000	0,000
R2	95	91	95	87	95	90	77
Constant	74,0	20,2	3416	2,7	109,4	61,3	2,6

dat: days after transplantation

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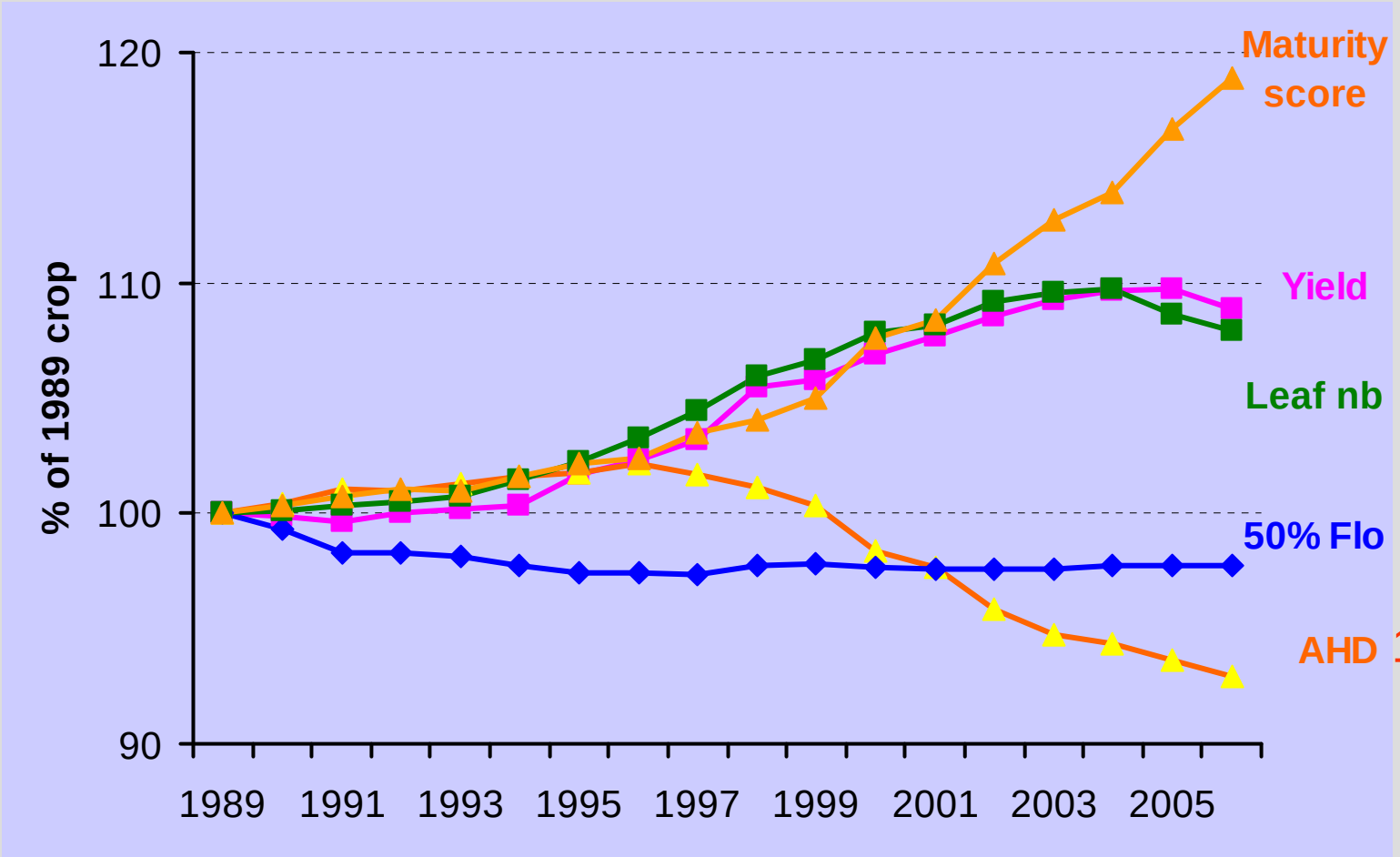
Results: Flue-cured (2)



Weighed averages of cultivars effects x acreage, flue-cured, field and leaf quality data

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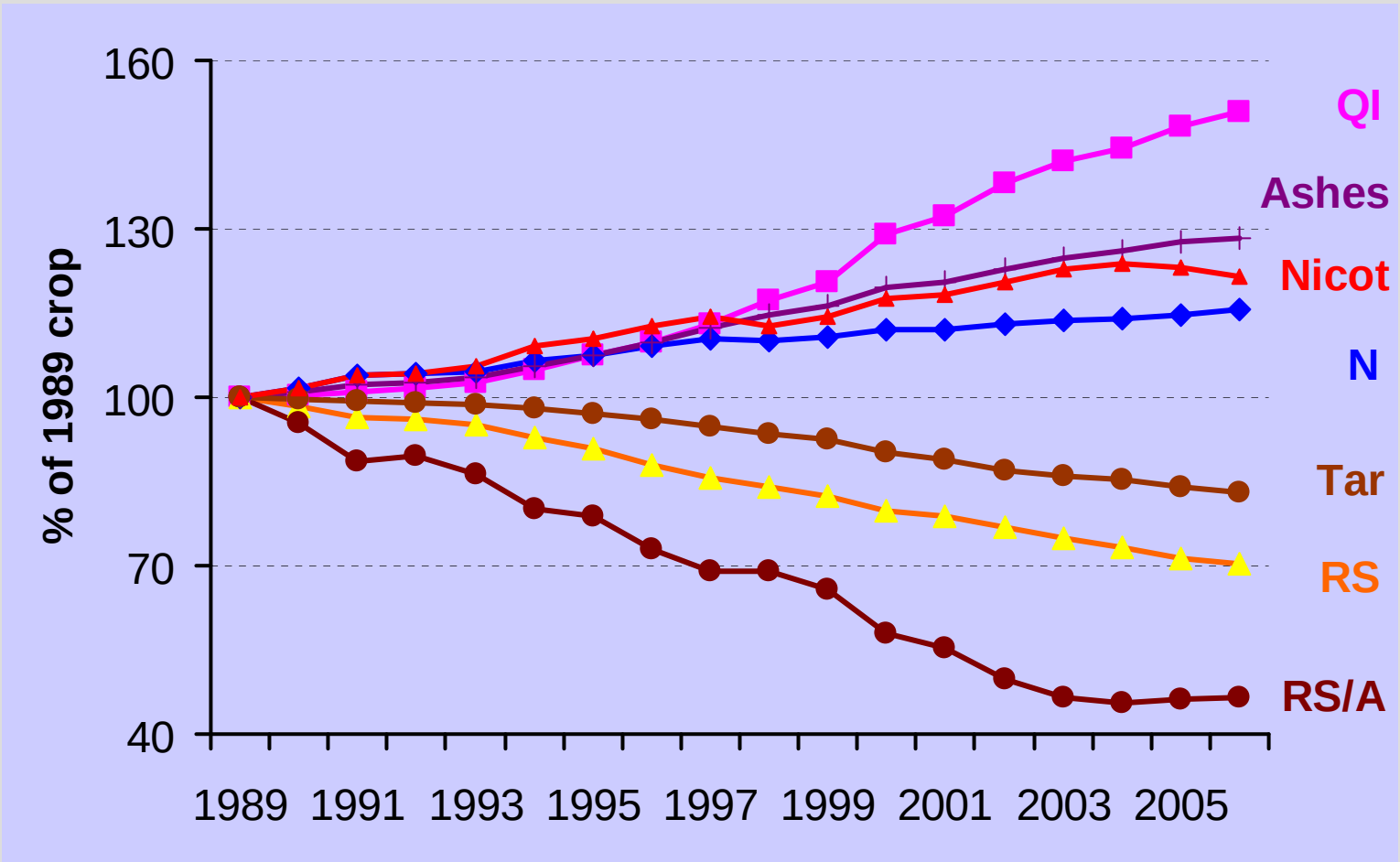
Results: Flue-cured (3)

➔ Assessment of cultivars

- ✓ chemical equilibrium and tar potential

	Red. sugars	N	Ashes	Nicotine (leaf)	RS/A	Nicotine / cigarette	Tar
Unit	%dm	%dm	%dm	%dm	%	mg/cig	mg/cig
n	486	477	416	488	378	265	265
nb cultivars	131	130	121	131	112	95	95
nb trials	71	69	58	72	61	49	49
P(F cultivar)	0,000	0,000	0,000	0,000	0,000	0,000	0,000
P(F trial)	0,000	0,000	0,000	0,000	0,000	0,000	0,000
R2	91	94	94	96	91	97	96
Constant	17	1,9	14	1,5	17,1	1,4	18,9

Results, Flue-cured (4)



QI	48 - 74	
Ashes	11.4 - 14.6	%dm
Nicot	1.1 – 1.3	%dm
N	1.6 – 1.9	%dm
Tar	20.9 – 17.4	Puros no filter mg/cig
RS	22.1 – 15.5	%dm
RS/A	35 – 16	

Weighed averages of cultivars effects x acreage, flue-cured, chemical and tar potential data

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French Flue-cured evolution

➔ Chemical analysis of Altadis raw tobacco lots 1994-2005: similar evolution.

Variance analysis for GFS

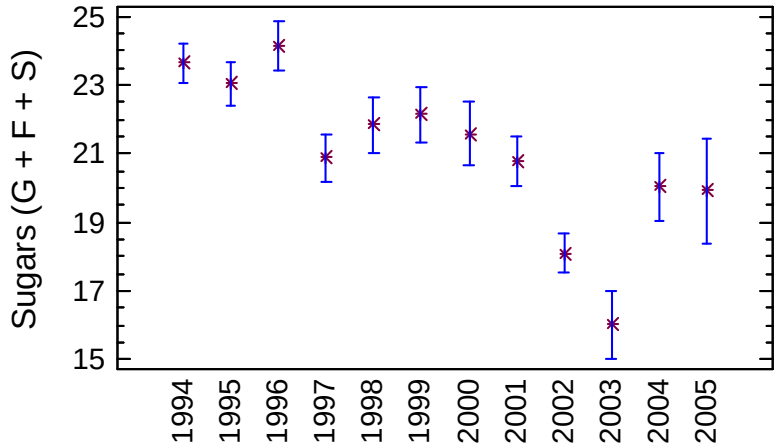
Source	Sum of squares	df	Mean square	F	Proba.
EFFECTS					
A: CROP_YEAR	493,999	11	44,909	20,44	0,0000
B: GRADE	2084,91	10	208,491	94,89	0,0000
RESIDUE	204,344	93	2,19724		
TOTAL (CORRECTED)	2978,43	114			

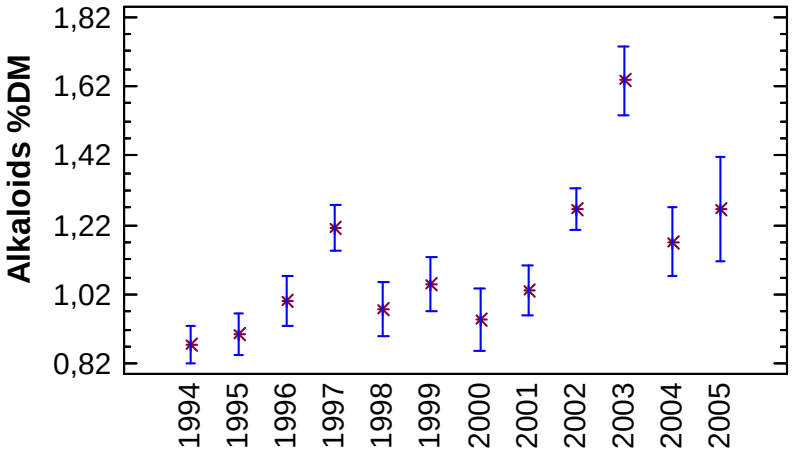
Variance analysis for alkaloids

Source	Sum of squares	Df	Mean square	F	Proba.
EFFETS PRINCIPAUX					
A:CROP_YEAR	3,39042	11	0,30822	14,35	0,0000
B:GRADE	3,6947	10	0,36947	17,20	0,0000
RESIDU	1,99734	93	0,0214768		
TOTAL (CORRECTED)	9,47617	114			

Tous les F sont basés sur l'erreur résiduelle quadratique moyenne.

Means and 95% lsd intervals





Conclusions (1)

➔ **Improvement of the genetic potential for leaf quality (body, color, grain…)**

- ✓ Flue-cured (QI : + 60%), and Burley (QI: +18%)
- ✓ Concomitant with generalization of disease resistance genes
  - « va » gene, N. debneyi derived res. to the Black root-rot.

➔ **Flue-cured**

- ✓ Earlier leaf maturity
  - Sharp decrease in sugar content and sugar / alkaloid ratio
  - 15% decrease in tar potential
- ✓ Slight increase in nicotine (from 1.1 to 1.3 % dm) except in most recent years

➔ **Burley**

- ✓ Stability for the chemical equilibrium and tar potential

Conclusion (2)

- ➔ **Renewal of cultivars was an essential tool for developing the French production of blond tobacco.**
- ➔ **Improvement of leaf quality (leaf body, color, grain…) and chemical equilibrium genetic potential : help to design better products.**

Thank you for your attention