

### Economics

- Northern agricultural transformation (Devèze, 2006; Levrat, 2010)
- Major socio-economic actor: >200 k growers + family (Sodécoton, 2014)



Background

## Sixty Years Of Cotton Breeding In Cameroon:

## Interaction Between Genetic Improvement And Rainfed Cropping Conditions

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## Crop Management (*G. hirsutum*)



- Rainfed
- 1 cultivar per climatic zone
  - L457 : North Region
  - L484 : Far North Region
- Planting date depends on onset of rainy season
  - June to mid-July
- Fertilization recommended
  - At thinning : 100 to 200 kg ha<sup>-1</sup> NPKSB 22-10-15-6-1%
  - At ridging : 23 kg ha<sup>-1</sup> N in North Region / Urea
- Pest management
  - 4 à 6 applications

**Seed cotton yields : 800 to 1400 kg ha<sup>-1</sup>**

Background

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## Main limiting factors

- Water availability
- Soil fertility
- Delayed planting dates

Background

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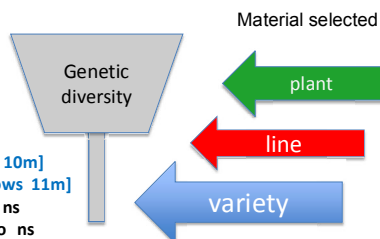


## Breeding / research & development company

- Aims
  - Increase fiber yield per hectare
  - Increase diseases resistance (*bacteriosis*)
  - Increase crop earliness
  - Increase fiber quality

### Method

F2 : 20 crossings  
F3 : 167 lines  
F4 : 106 lines  
F5 : 58 lines/ 1 row  
ME : 8 var. [4 rep x 4 rows 10m]  
EVA1 : 8 var. [4 rep x 7 rows 11m]  
EVA2 : 4 var. in 6 locao ns  
EVM : 4 var. in 19 locao ns  
EVP : 2 var. in 30 locao ns

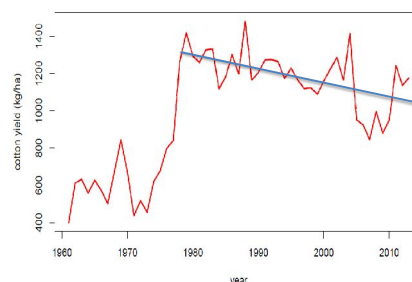


Background

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## Problem statement

- Seed cotton yield decrease from the 80s (Naudin et al., 2010)
- & High inter-annual variability

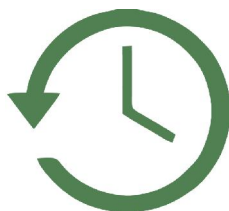


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## Evaluation of 60 years of cotton breeding in Cameroon

- Do recent cultivars are more productive than anciently released ones?
- Genetic gain =  $f$  (planting date) ?



Aims

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## Genetic material

- 10 cultivars widely grown in Cameroon (> 100 000 ha)

Cultivar	Abbrev.	Year of release
Allen Commun	AC	1950
N'Kourala (44-10)	NKOUR	1950
Allen 333-57	A333	1959
IRCO 5028	IRCO	1974
IRMA 96+97	IR9697	1981
IRMA 1243	IR1243	1985
IRMA A1239	A1239	1996
IRMA D742	D742	1999
IRMA L484	L484	2008
IRMA L457	L457	2009

Material & Methods

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## Experiments

- **Field in North Cameroon** Garoua 2012 :  
3 planting dates x 10 cultivars x 3 rep.



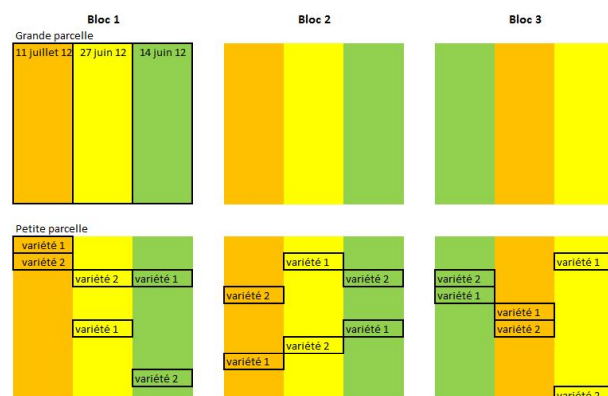
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## Experiments

- **Field in North Cameroon**, Garoua 2012 :  
3 planting dates x 10 cultivars x 3 rep.



Material & Methods

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## Experiments

- **Field in Far North Cameroon**, Maroua: Fisher's block
  - 1 planting date
  - 10 cultivars
  - 3 blocks
- **Greenhouse**, Montpellier, France
  - 10 cultivars
  - 4 replications
- **Rhizoscope**, Montpellier, France
  - 10 cultivars
  - 4 replications



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## Plant measurements

- Development and morphology
  - Phenology
  - Node numbers
  - Root architecture
- Radiation use efficiency variables
  - Leaf number
  - Single leaf area
  - Leaf area index
  - Photosynthesis activity
- Yield components
  - Boll number m<sup>-2</sup>
  - Aerial biomass
  - Harvest index
- Fiber quality



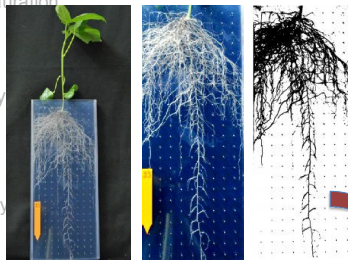
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## Plant measurements

- Development and morphology
  - Development phase duration
  - Node numbers
  - **Root architecture**
- Radiation use efficiency
  - Leaf number
  - Single leaf area
  - Leaf area index
  - Photosynthesis activity
- Yield components
  - Boll number/m<sup>2</sup>
  - Aerial biomass
  - Harvest index
- Fiber quality



RLD, PRER

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## Statistics

- **Genetic gain** (Schwartz and Smith, 2008)

Slope of the linear regression of plant characteristic on the **cultivar year of release**

- **Comparison of slope** of early plantings in Garoua vs. the latest planting in Garoua

$$Y_{ij} = \mu + \gamma x_i + A_i + b_j + \delta_j x_i + (Ab)_{ij} + D_j + E_{ij}$$

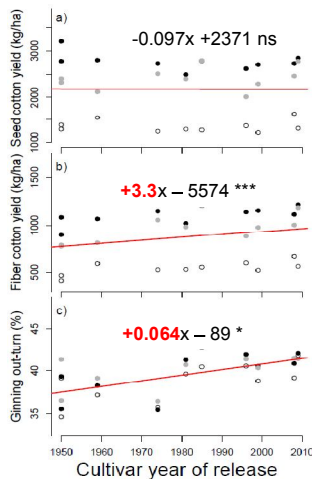
ns Non significant at  $\alpha = 5\%$   
 \* Significant at  $\alpha = 5\%$   
 \*\* Significant at  $\alpha = 1\%$   
 \*\*\* Significant at  $\alpha = 1\%$

Material & Methods

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## Fiber and seed cotton yields (kg ha<sup>-1</sup>)

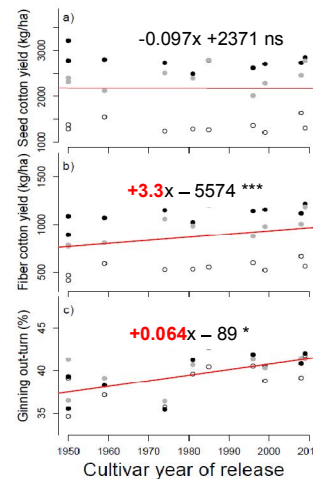


Results

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## Fiber and seed cotton yields (kg ha<sup>-1</sup>)



Results

200 kg ha<sup>-1</sup> in 60 years

+ 4 to 6% fiber

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## Different genetic gains for fiber quality

Management	Fiber length (UHML)		Strength	
	Slope (x10 <sup>-3</sup> )	Intercept 1980	Slope (x 1)	Intercept 1980
Early planting Garoua	ns	-	ns	-
Latest planting Garoua	-34.3* (±12.5)	29.8*** (±0.3)	-0.05** (±0.02)	32*** (±4)
Greenhouse	103*** (±9.9)	30.2*** (±0.2)	0.11** (±0.02)	31*** (±0.4)

Results

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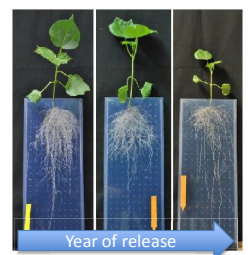


## Morphology-development

- # leaves: - 0.3 an<sup>-1</sup>
- # 1<sup>st</sup> fruiting branch node number increased
- Less hairy leaves
- Longer anthesis to boll opening

- **Early development stage**

- Reduced biomass and leaf area
- Increased distance between roots
- Reduced potential of mineral uptake by the roots



Results

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## Conclusion

- **+ 200 kg ha<sup>-1</sup> fiber in 60 ans** only due to **the ginning out-turn (+4 à 6%)** of seed cotton
- Reduced vigor at early stage
- **Increased potential of fiber quality** but also increased sensitivity to water deficit

=> Decrease in seed cotton yield in Cameroon is not due to cultivars

- Agronomy: late plantings (Gao et al, 201), lack of training of new farmers
- Climate: rainy season pattern (M'Blandoum et Olina, 2006)

Conclusion

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## Acknowledgements

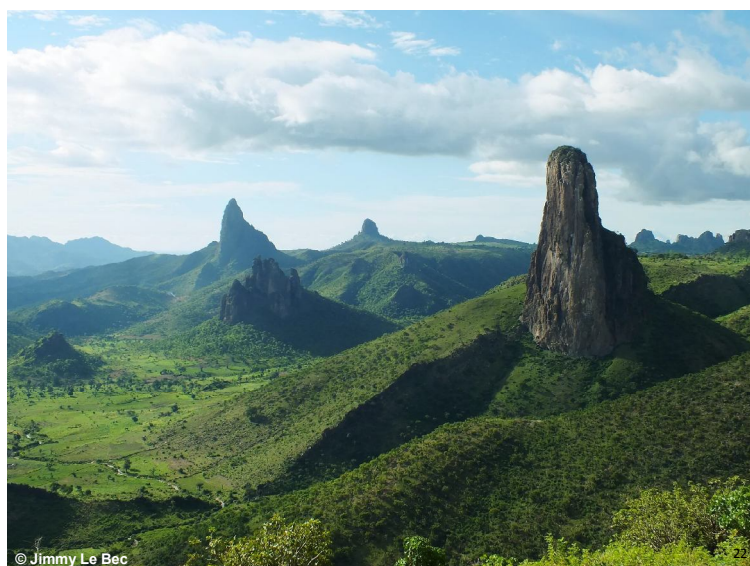
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Thank you

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## Range of values for yield components & fiber quality

Variables	Unit	Garoua G0	Garoua G1	Garoua G2	Maroua	Greenhouse
		Means S.E.	Means S.E.	Means S.E.	Means S.E.	Means S.E.
<b>Yield and components</b>						
Ginning out-turn	[%]	39.8 0.2	40.1 0.2	38.7 0.2	37.8 0.6	- -
Boll number per square meter	[# m <sup>-2</sup> ]	54.1 4	49.9 4	32.7 4	23.4 0.7	- -
Average boll weight	[g]	5.3 0.2	5.2 0.2	4.0 0.2	- -	- -
Seed cotton yield	[kg ha <sup>-1</sup> ]	2770 203	2408 203	1357 203	1139 32	- -
Fiber Yield	[kg ha <sup>-1</sup> ]	1105 83	965 83	542 83	457 16	- -
Seed index	[g/100 seeds]	9.4 0.2	8.8 0.2	8.2 0.2	9.1 0.1	- -
<b>Fiber quality</b>						
Yellowness index (-b)	[%]	9.3 0.1	9.0 0.1	9.0 0.1	10.9 0.1	8.5 0.1
Elongation	[%]	6.9 0.1	6.5 0.1	6.6 0.1	5.7 0.1	6.0 0.1
Standard fineness (Hs)	[ntex]	201 5	201 5	199 5	202 3	189 4
Micronaire index (IM)	-	3.7 0.1	3.6 0.1	3.7 0.1	3.7 0	4.0 0.1
Maternity ratio (MR)	[%]	82.4 2	80.5 2	82.8 2	81.3 0.8	89.1 1.6
Brightness (Rd)	[%]	79.6 0.2	79.5 0.2	79.9 0.2	77.7 0.2	79.6 0.2
Short fiber index (SFI)	[%]	6.8 0.1	7.1 0.1	6.9 0.1	7.4 0.1	- -
Strength	[cN tex <sup>-1</sup> ]	30.4 0.8	30.4 0.8	31.5 0.8	30.6 0.2	31.0 0.5
Upper half mean length (UHML)	[mm]	29.3 0.3	29.4 0.3	29.8 0.3	28.2 0.2	31 0.4
Uniformity index (UI)	[%]	84.4 0.2	84.0 0.2	84.4 0.2	83.5 0.1	85.8 0.2

Results

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## Statistics

Variables	Multiplying factor for slope estimates	Garoua			Maroua	Greenhouse	Plytron		
		±Slopes	[Prediction for 1980 G1	G2	Slope [Prediction for 1980]	Slope [Prediction for 1980]	Slope [Prediction for 1980]		
Fiber percentage [%]	10 <sup>4</sup>	64.7* (= 30.2)	39.7 (= 0.7)	40.0 (= 0.7)	38.6 (= 0.7)	103.8** (= 31.2)	37.7 (= 0.7)	-	-
Fiber yield [kg ha <sup>-1</sup> ]	1	3.3*** (= 0.8)	1101 (= 0.7)	962 (= 0.7)	539 (= 0.7)	2.3 ns (= 1.2)	455 (= 0.7)	-	-
Standard fineness (Hs) [ntex]	1	-0.03 ns (= 0.12)	201 (= 4)	201 (= 4)	200 (= 4)	-0.13 ns (= 0.20)	204 (= 4)	-0.8** (= 0.2)	192 (= 4)
Maternity ratio (MR) [%]	1	0.01 ns (= 0.04)	82.3 (= 1.7)	80.5 (= 1.7)	82.8 (= 1.7)	0.02 ns (= 0.08)	83.1 (= 1.7)	0.4*** (= 0.09)	87.0 (= 2.0)
Duration from emergence to 1 <sup>st</sup> open boll (††GDD)	1	0.3 ns (= 0.3)	1627 (= 40)	1336 (= 40)	1475 (= 40)	1.0* (= 0.4)	1884 (= 3)	-	-
Number of leaves at 61 DAP	1	-0.3** (= 0.1)	60 (= 4)	56 (= 4)	43 (= 4)	-0.1 ns (= 0.22)	41 (= 4)	-	-
No nodes up to 1 <sup>st</sup> fruiting branch	10 <sup>4</sup>	8.7* (= 3.5)	6.7 (= 0.1)	6.3 (= 0.1)	6.4 (= 0.1)	16.3** (= 4.9)	6.6 (= 0.1)	-	-
Leaf hair	10 <sup>4</sup>	13.8* (= 1.3)	0.8 (= 0.1)	1.1 (= 0.1)	1.3 (= 0.1)	-3.7 ns (= 4.7)	1.1 (= 0.1)	-	-
<b>Plots</b>									
Aerial plant biomass [mg plant <sup>-1</sup> ]	1	-	-	-	-	-	-	-7.7* (= 2.1)	1129 (= 67)
Plant leaf area [cm <sup>2</sup> plant <sup>-1</sup> ]	1	-	-	-	-	-	-	-1.5* (= 0.6)	233 (= 13)
Avg distance between roots [cm]	10 <sup>4</sup>	-	-	-	-	-	-	4.2* (= 1.8)	1.9 (= 0.04)
Potential root extraction ratio (PRER) [m <sup>2</sup> root/ha]	10 <sup>4</sup>	-	-	-	-	-	-	-68.8* (= 32.6)	14.2 (= 0.7)

Results

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