National Agricultural Research Foundation
Cotton & Industrial Plants Institute
Sindos, Greece

# INTRA-CULTIVAR SELECTION AS A MEANS OF BREEDER SEED CONSERVATION

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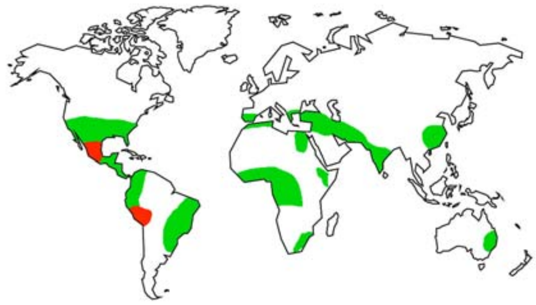
## Greece

**the main cotton producer in EU, the ninth in world**




**Cotton grows in central & northern Greece**

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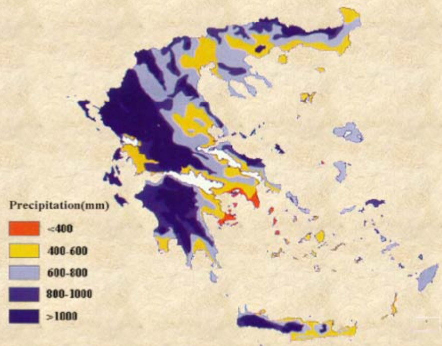
## Precipitation zones in Greece

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**Are elite cultivars genetically homogeneous?**

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**Intra-cultivar variation:**

Maize inbred lines:
Russell et. al., 1963. CROP SCIENCE 3:175-178
El-Eryani & Fleming, 1966. CROP SCIENCE 6:31-33
Sprague et. al., 1960. GENETICS 45:855-866
Tokatlidis, 2000. JOURNAL OF AGRICULTURAL SCIENCE 134:391-398
Gethi J.G., et al., 2002. CROP SCIENCE 42:951-957

Wheat:
Fasoula, 1990. EUPHYTICA 50:57-62
Tokatlidis et al., 2004. FIELD CROPS RESEARCH 86:33-42
Tokatlidis et al., 2006. CROP SCIENCE 46:90-97

Soybean:
Byth & Weber, 1968. CROP SCIENCE 8:44-47
Fasoula & Boerma, 2005. FIELD CROPS RESEARCH 91:217-229
Fasoula & Boerma, 2007. CROP SCIENCE 47:367-373

Tobacco:
Gordon & Byth, 1972. OLD. J. AGRIC. ANIM. SCI. 29:255-264

Sunflower inbred lines:
Zhang et al., 1995. GENOME 38:1040-1048

Rice:
Olufowote et al., 1995. GENOME 40:370-378

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**McClintock (1984):**

Genome is dynamic and can modify itself in response to environmental stresses.

**Rasmusson & Philips (1997):**

Elite gene pools have inherent mechanisms to provide a continuing source of new genetic variability, thanks to genome plasticity.

**Peterson (1997):**

Gene polymorphism, duplication of DNA sequences, and transposon elements can contribute to the vast genetic heterogeneity in maize.

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**Are cotton cultivars genetically homogeneous ?**

**Research team:**

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**Cotton cultivars**

**Christina: (BIOS AGROSYSTEMS, 1997)**

**Flora: (BAYERN, 1998)**

**Corona: (DELTA & PINE, 1992)**

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**INTRA-CULTIVAR VARIATION ASSESMENT**

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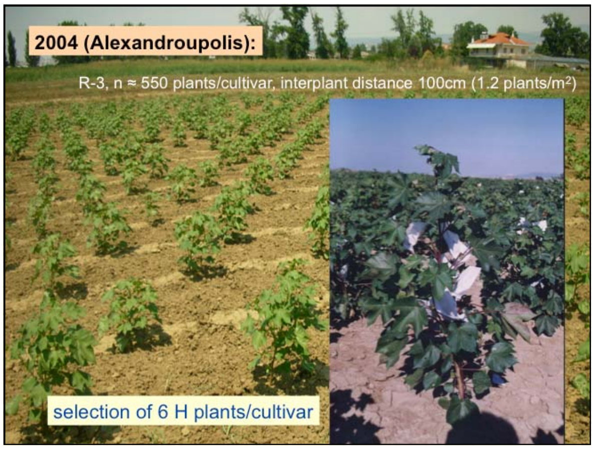
**2004 (Alexandroupolis):**

R-3, n ≈ 550 plants/cultivar, interplant distance 100cm (1.2 plants/m²)

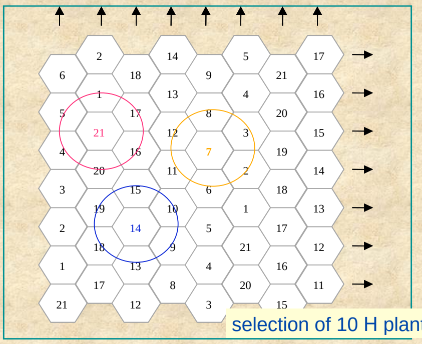


selection of 6 H plants/cultivar

**2005-2006 (Alexandroupolis-Thessaloniki-Larissa):**

**progeny evaluation of the 1st generation lines in a R-21 trial**

(70 plants/entry, interplant distance 100 cm)



selection of 10 H plants/line

## Traits measured

1. Fibre length
2. Fibre micronaire
3. Fibre strength
4. Fibre uniformity
5. Carbon isotope discrimination, Δ
6. Ash content
7. K concentration



### *Christina*

| entry | Length (mm) | Micronaire | Δ (‰) | Ash (mg/g) | K (mg/g) |
|---|---|---|---|---|---|
| 2 | 32·30 b | 4·467 a | 19·12 b | 197·8 bcd | 10·13 c |
| 3 | 30·95 c | 4·050 bc | 19·12 b | 201·3 bc | 9·905 c |
| 6 | 33·63 a | 4·183 ab | 19·26 ab | 195·1 cd | 10·43 bc |
| 8 | 31·95 bc | 3·617 d | 19·13 b | 205·0 ab | 11·16 ab |
| 11 | 33·97 a | 3·850 c | 19·34 ab | 192·7 d | 10·67 abc |
| 12 | 32·28 b | 4·033 bc | 19·48 a | 201·5 bc | 10·64 abc |
| check | 31·85 bc | 3·833 cd | 19·45 a | 210·3 a | 11·39 a |



### *Flora*

| entry | Length (mm) | Micronaire | Δ (‰) | Ash (mg/g) | K (mg/g) |
|---|---|---|---|---|---|
| 9 | 31·68 ab | 4·217 ab | 18·97 bc | 185·3 ab | 12·04 c |
| 10 | 30·35 c | 4·433 a | 19·16 abc | 179·9 b | 12·68 bc |
| 13 | 31·70 ab | 4·000 bc | 19·16 abc | 186·4 ab | 12·23 c |
| 15 | 31·52 b | 4·233 ab | 19·10 abc | 188·4 ab | 14·30 a |
| 18 | 32·42 ab | 3·750 c | 18·94 c | 183·8 ab | 12·67 bc |
| 19 | 32·65 a | 4·300 ab | 19·19 ab | 188·4 a | 12·11 c |
| check | 31·47 bc | 3·983 bc | 19·24 a | 186·8 ab | 13·31 b |

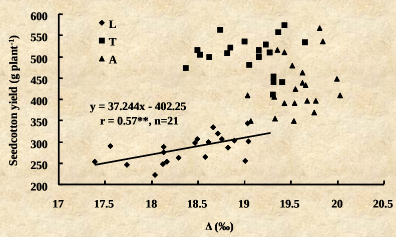


### *Corona*

| entry | Length (mm) | Micronaire | Δ (‰) | Ash (mg/g) | K (mg/g) |
|---|---|---|---|---|---|
| 1 | 31·35 bc | 3·950 ab | 18·79 a | 177·6 ab | 12·91 a |
| 4 | 30·48 c | 3·350 d | 18·87 a | 179·2 ab | 12·70 a |
| 5 | 32·63 a | 4·150 a | 18·27 b | 160·2 d | 12·97 a |
| 16 | 30·93 bc | 3·533 cd | 18·88 a | 185·2 a | 12·99 a |
| 17 | 30·45 c | 3·517 cd | 18·69 a | 173·9 bc | 12·59 a |
| 20 | 31·88 ab | 3·767 bc | 18·36 b | 169·2 c | 12·88 a |
| check | 31·65 ab | 3·550 cd | 18·67 a | 179·8 ab | 12·69 a |

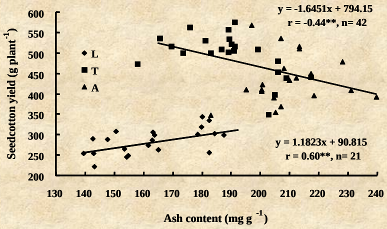


### Significant carbon isotope discrimination (Δ)-seedcotton yield in Larissa

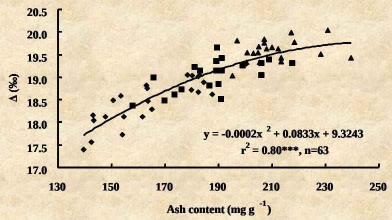





### Significant correlations between leaf ash content and seedcotton yield



## Significant leaf ash content-carbon isotope discrimination (Δ) relationship






## EXPLOITATION OF INTRA-CULTIVAR VARIATION



## 2007 (Alexandroupolis-Thessaloniki-Orestiada):

**progeny evaluation in dense stand (10 plants/m$^2$ ) in a "*split-plot*" trial**

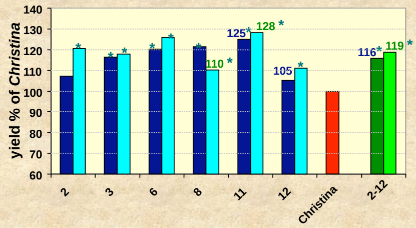
| Christina | | | | | | | | | Flora | | | | | | | | | Corona | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 11 | 2 | 6 | 7 | 8 | 12 | 12 | 9 | 9 | 19 | 10 | 13 | 15 | 18 | 14 | 14 | 17 | 17 | 21 | 16 | 5 | 1 | 4 | 20 | 20 |
| Corona | | | | | | | | | Christina | | | | | | | | | Flora | | | | | | | | |
| 5 | 5 | 20 | 4 | 17 | 1 | 21 | 16 | 16 | 6 | 6 | 7 | 2 | 12 | 8 | 3 | 11 | 11 | 13 | 13 | 9 | 15 | 19 | 14 | 10 | 18 | 18 |
| Flora | | | | | | | | | Corona | | | | | | | | | Christina | | | | | | | | |
| 19 | 19 | 15 | 9 | 13 | 18 | 14 | 10 | 10 | 1 | 1 | 17 | 20 | 16 | 5 | 21 | 4 | 4 | 8 | 8 | 11 | 3 | 6 | 7 | 12 | 2 | 2 |

border plots



## Seedcotton yield of the 6 *Christina* lines at 1.2 plants/m$^2$

(3 locations, n ≈ 150 plants/entry)

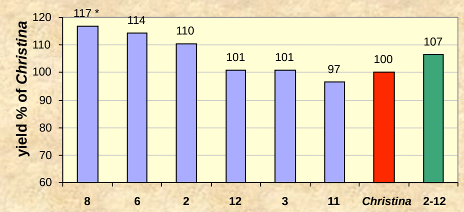



| | 2005 | 2006 |
|---|---|---|
| *Christina* | 418 g/plant | 318 g/plant |
| 2-12 | 484 g/plant | 378 g/plant |



## Seedcotton yield of the 6 *Christina* lines in dense stand (10 plants/m$^2$)

(2007, 3 locations)

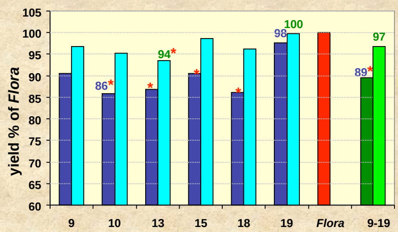



| | 2007 |
|---|---|
| *Christina* | 4740 Kg/ha |
| 2-12 | 5050 Kg/ha |



## Seedcotton yield of the 6 *Flora* lines at 1.2 plants/m$^2$

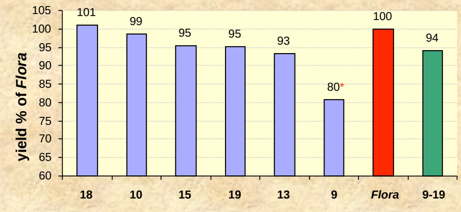
(3 locations, n ≈ 150 plants/entry)




| | 2005 | 2006 |
|---|---|---|
| *Flora* | 514 g/plant | 370 g/plant |
| 9-19 | 460 g/plant | 358 g/plant |

## Seedcotton yield of the 6 *Flora* lines in dense stand (10 plants/m²)

(2007, 3 locations)



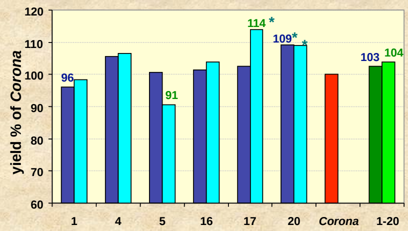

2007

| | |
|---|---|
| *Flora* | 5090 Kg/ha |
| 9-19 | 4790 Kg/ha |



## Seedcotton yield of the 6 *Corona* lines at 1.2 plants/m²

(3 locations, n ≈ 150 plants/entry)



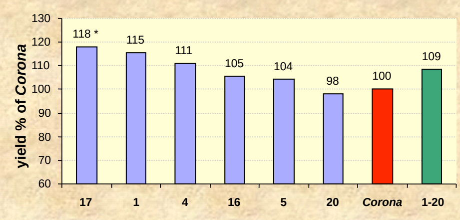

2005 2006

| | | |
|---|---|---|
| *Corona* | 432 g/plant | 310 g/plant |
| 1-20 | 443 g/plant | 322 g/plant |



## Seedcotton yield of the 6 *Corona* lines in dense stand (10 plants/m²)

(2007, 3 locations)




2007

| | |
|---|---|
| *Corona* | 4250 Kg/ha |
| 1-20 | 4620 Kg/ha |



Exploitable variation seems to exist within the cultivars. In Christina and Corona further progress was achieved in the second generation as it was shown in the absence of competition, and finally in dense stand there was a clear sign of cultivar's improvement regarding seedcotton yield per unit area. In both cultivars and in both generations lines had lower CV values than checks, perhaps reflecting narrower genetic variation. In contrast, in Flora negative response to selection was found. It was assumed that cross-pollination during breeder seed maintenance preserved heterozygosity and thus the applied strict-self pollination resulted in genetic segregation. Indicatively, CV of lines in both generations were on average by 11% higher than that of Flora. However, advanced by self-pollination the second generation considerably decreased the gap among lines and original cultivar from 11% in the first to 3% in the second generation, and this constitutes a clear sign that progressive selections may lead to new lines outperforming the cultivar



**JOURNAL OF AGRICULTURAL SCIENCE, 146, 483-490**

Tokatlidis I.S., C. Tsikrikoni, J.T. Tsialtas, A.S. Lithourgidis, P.J. Bebeli. 2008. **Variability within cotton cultivars for yield, fibre quality and physiological traits.**

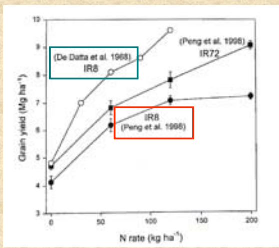
**FIELD CROPS RESEARCH, 107: 707-77**

Tsialtas J.T., I.S. Tokatlidis, C. Tsikrikoni, A.S. Lithourgidis. 2008. **Leaf carbon isotope discrimination, ash content and K relationships with seedcotton yield and lint quality in lines of *Gossypium hirsutum* L.**



**Peng, et al. (1999):**

**"Crop yield potential of rice cv. *IR8* reduced by around 20% during the past 30 years"**



## Conclusions

**The method of breeder's seed maintenance deserves reconsideration to avoid gradual degeneration. A new approach that exploits existing and newly developed genetic variation might be necessary. Selection within cotton cultivars must be perpetual to either conserve or upgrade it. This target is feasible at the single-plant level in the absence of competition that accentuates phenotypically the limited genetic variation.**

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***Thank you for your attention***

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