

4<sup>th</sup> ICC Latin American Cereals Conference

13<sup>th</sup> International Gluten Workshop

11-17 March 2018  
Mexico City, Mexico

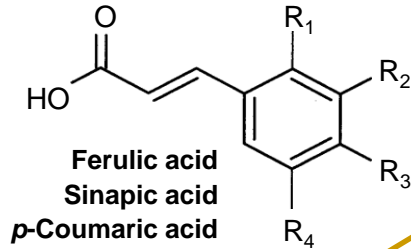


# PHENOLIC ACIDS PROFILE OF CIMMYT DURUM WHEAT CULTIVARS AND MEXICAN LANDRACES

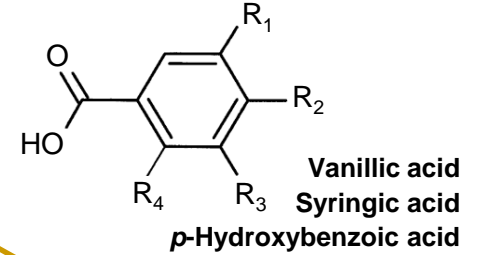
Barbara Laddomada

# BACKGROUND

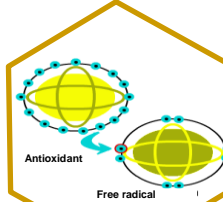
## Cinnamic derivatives



## Benzoic derivatives



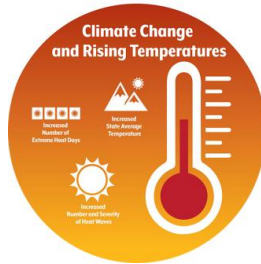
## PHENOLIC ACIDS



32.1 %  
**BRAN**  
46.9 %  
**ALEURONE**  
0.6 %  
**ENDOSPERM**  
20.0 %  
**GERM**



**DROUGHT**  
FAST PROBLEMS AND FUTURE SCENARIOS



$$h^2 = \frac{\sigma_G^2}{\sigma_P^2}$$

Genet Resour Crop Evol (2017) 64:587–597  
DOI 10.1007/s10722-016-0386-z

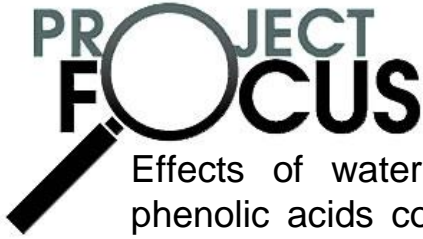
RESEARCH ARTICLE



Genetic variation for phenolic acids concentration and composition in a tetraploid wheat (*Triticum turgidum* L.) collection

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Lorena D'Amico · Marcello Salvatore Lomax · Romano Stenone ·  
Luciana Piarulli · Giovanni Mita · Antonio Blanco

# Project aims and field trials



Effects of water-deficit and heat stress on phenolic acids content, yield components and protein content in CIMMYT durum cultivars.



- Ciudad Obregon, Sonora, Mexico
- Six CIMMYT durum wheat cultivars
- 84 CIMMYT durum landraces
- Two-year evaluation (analyses of 2<sup>o</sup> year is in progress)
- RCB design, 2 replications
- Seven environmental conditions

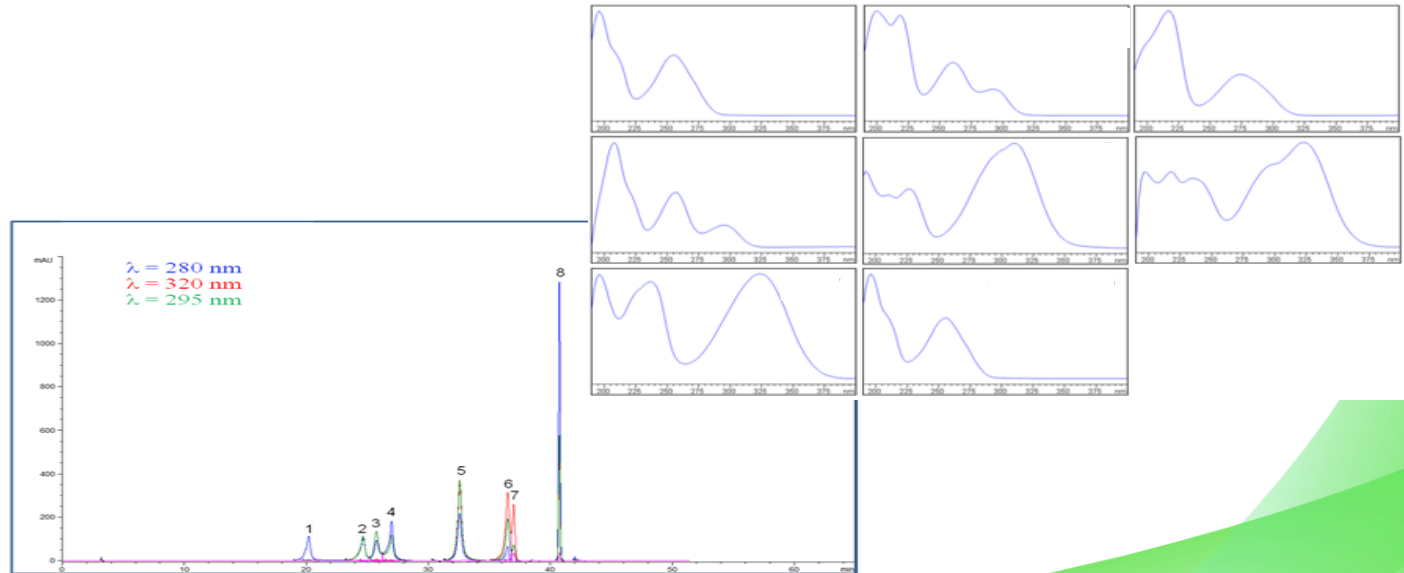
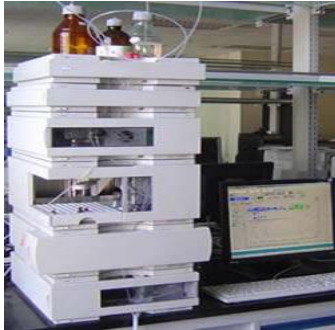
**MEXICALI C75 - YAVAROS C79 - ALTAR C84**  
**ATIL C2000 - JUPARE C2001 - CIRNO C2008**

1. FULL IRRIGATION WITH DRIP (OPTIMAL CONDITIONS)
2. FULL BASIN IRRIGATION
3. FULL IRRIGATION IN BEDS
4. MILD DROUGHT STRESS
5. SEVERE DROUGHT STRESS
6. MILD HEAT STRESS
7. SEVERE HEAT STRESS

# Phenolic acids analysis

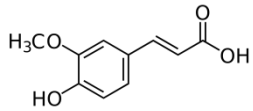


- Hexane
- NaOH hydrolysis
- Acidification
- Ethyl acetate

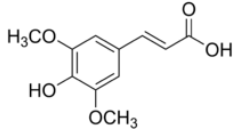


# Phenolic acid profile

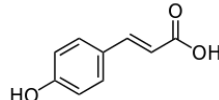
## Cinnamic derivatives



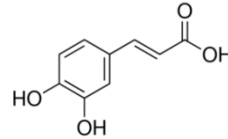
Ferulic acid



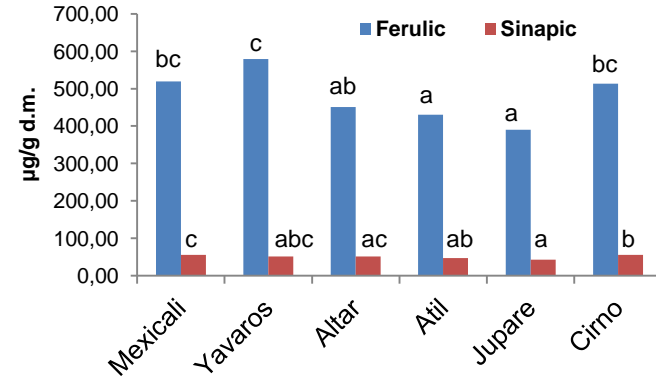
Sinapic acid



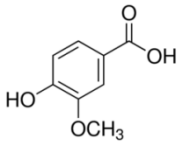
*p*-Coumaric acid



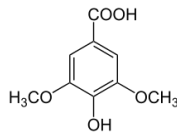
Caffeic acid



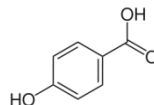
## Benzoic derivatives



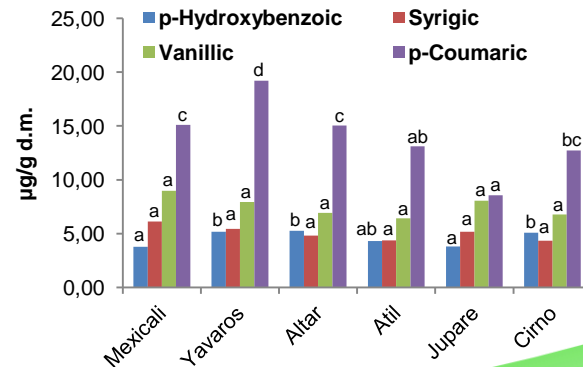
Vanillic acid



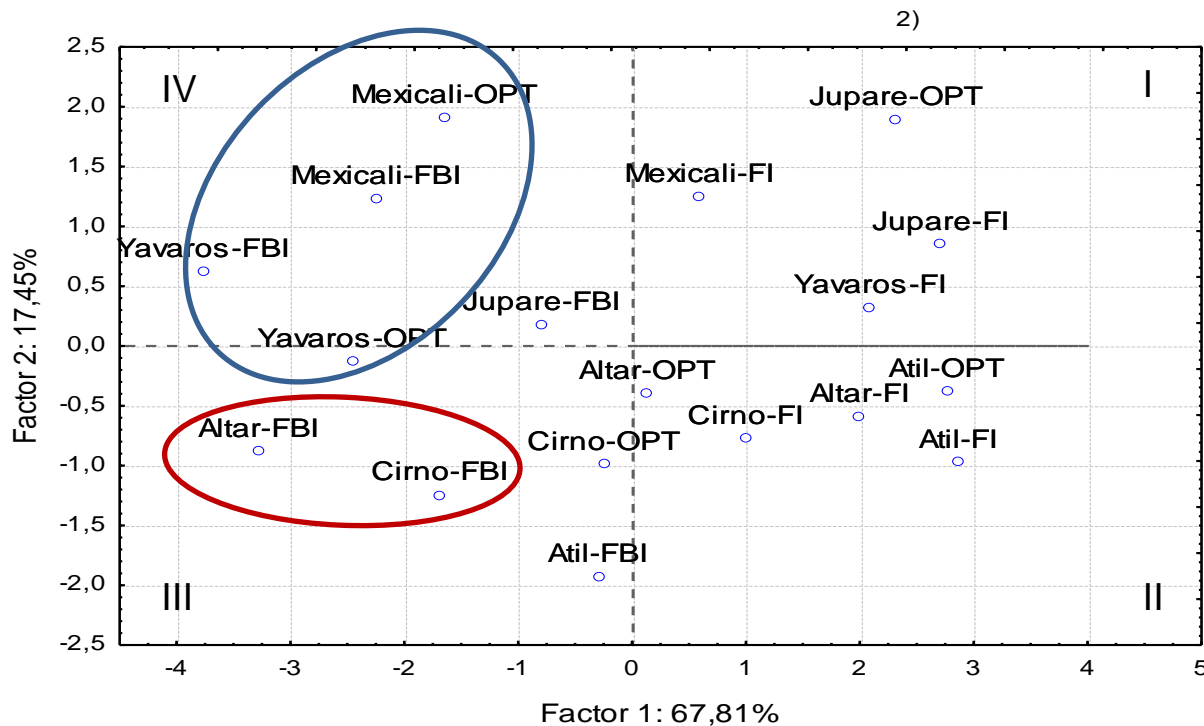
Syringic acid



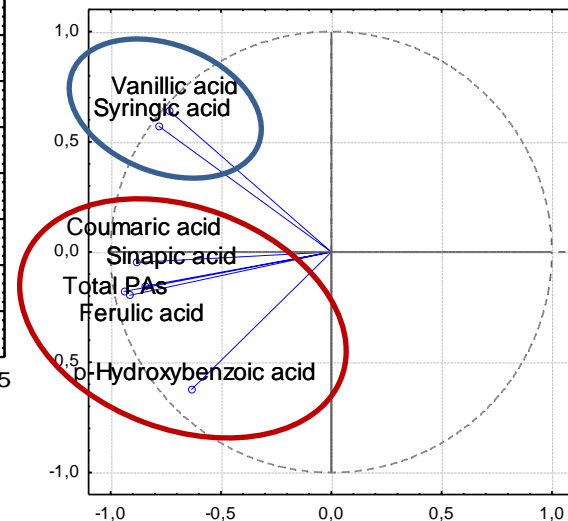
*p*-Hydroxybenzoic acid



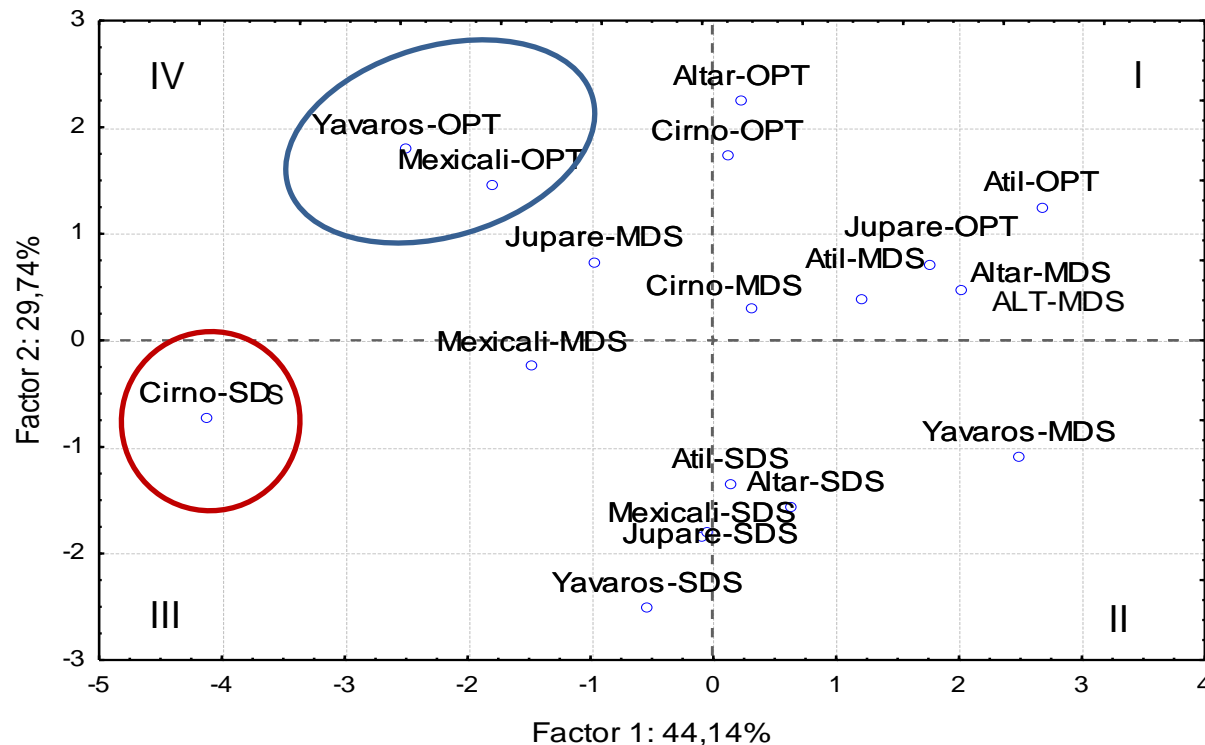
# PCA of phenolic acids in CIMMYT cultivars across three irrigation conditions



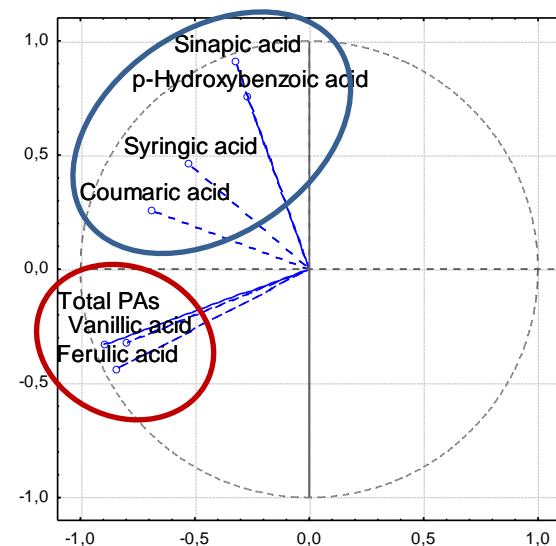
OPT = Optimal condition  
FBI = Full basin irrigation  
FI = Full irrigation in beds



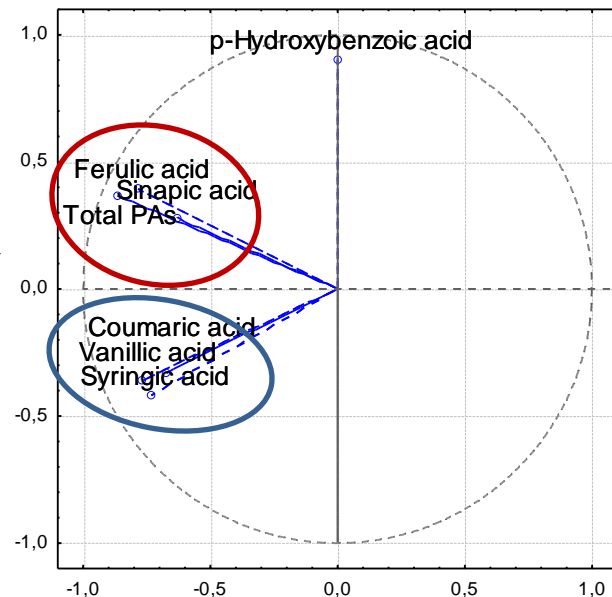
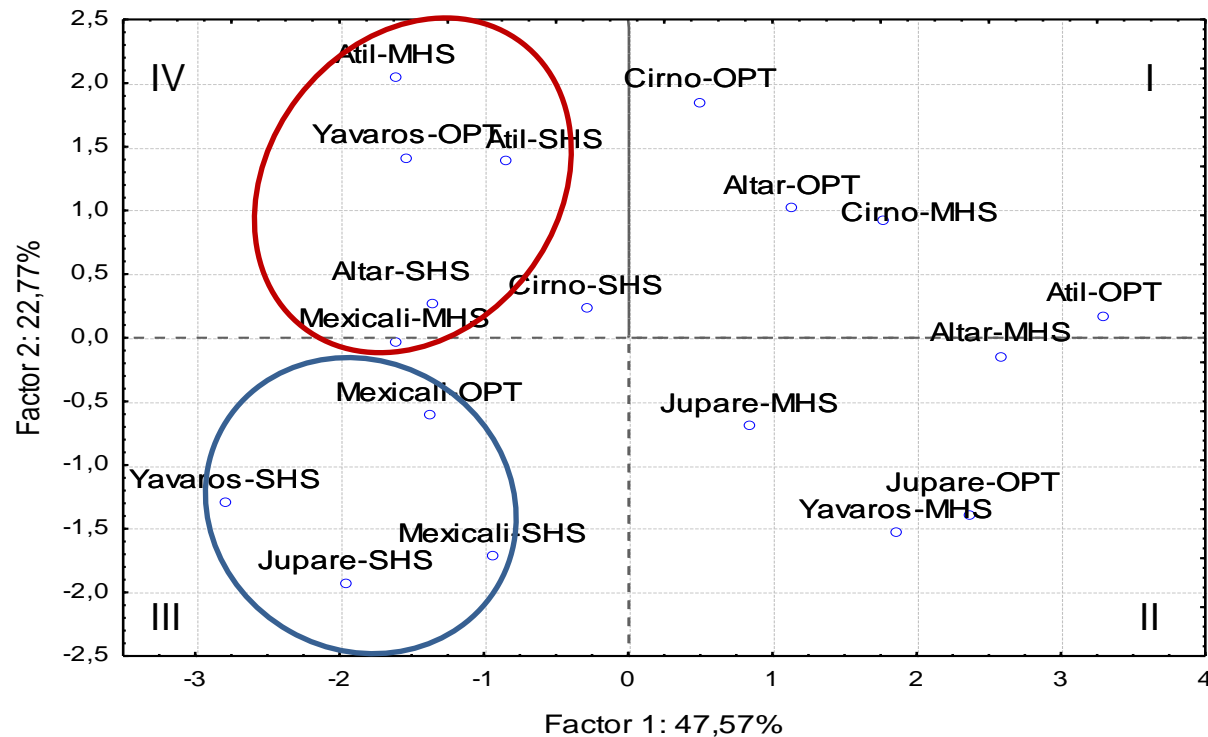
# PCA of phenolic acids in CIMMYT cultivars across optimal and drought conditions



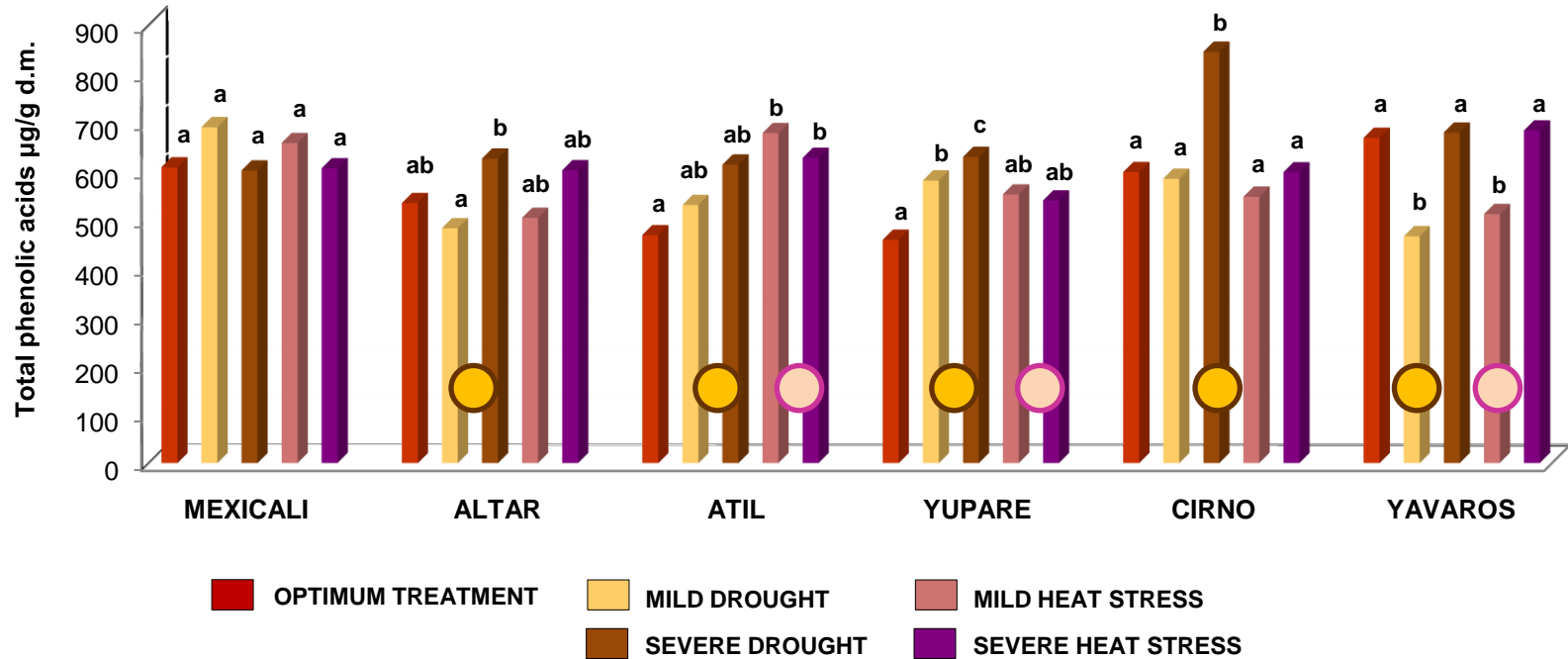
OPT = Full irrigation with drip  
MDS = Mild drought stress  
SDS = Severe drought stress



# PCA of phenolic acids in CIMMYT cultivars across optimal and **heat** stress conditions



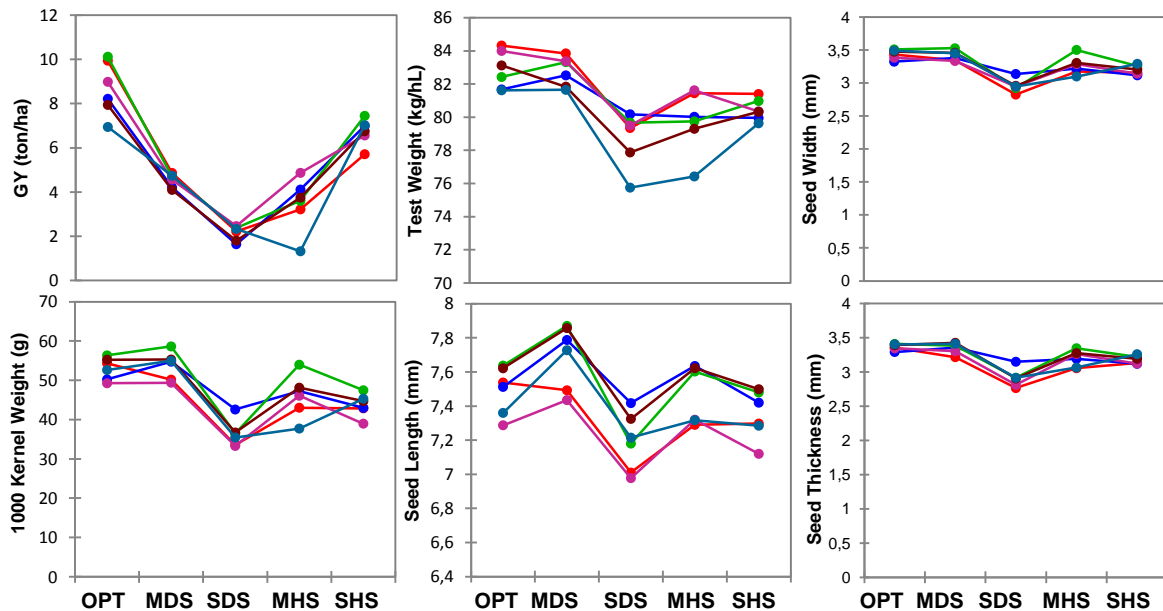
# Total phenolic acid content in CIMMYT cultivars across optimal and stress conditions



Significant differences within cultivars: OPTIMUM vs DROUGHT STRESS

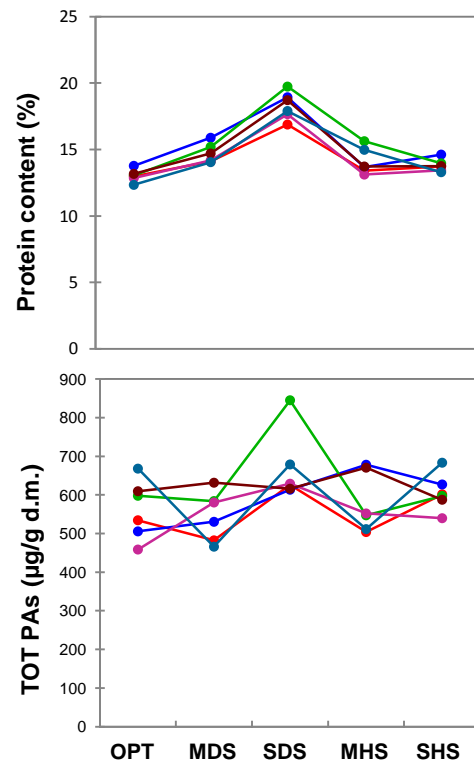
Significant differences within cultivars: OPTIMUM vs HEAT STRESS

# G X E interactions for yield components, protein content and total phenolic acids



ALTAR  
 ATIL  
 CIRNO  
 YUPARE  
 MEXICALI  
 YAVAROS

OPT: Optimal condition  
 MDS: Mild Drought Stress  
 SDS: Severe Drought Stress  
 MHS: Mild Heat Stress  
 SHS: Severe Heat Stress

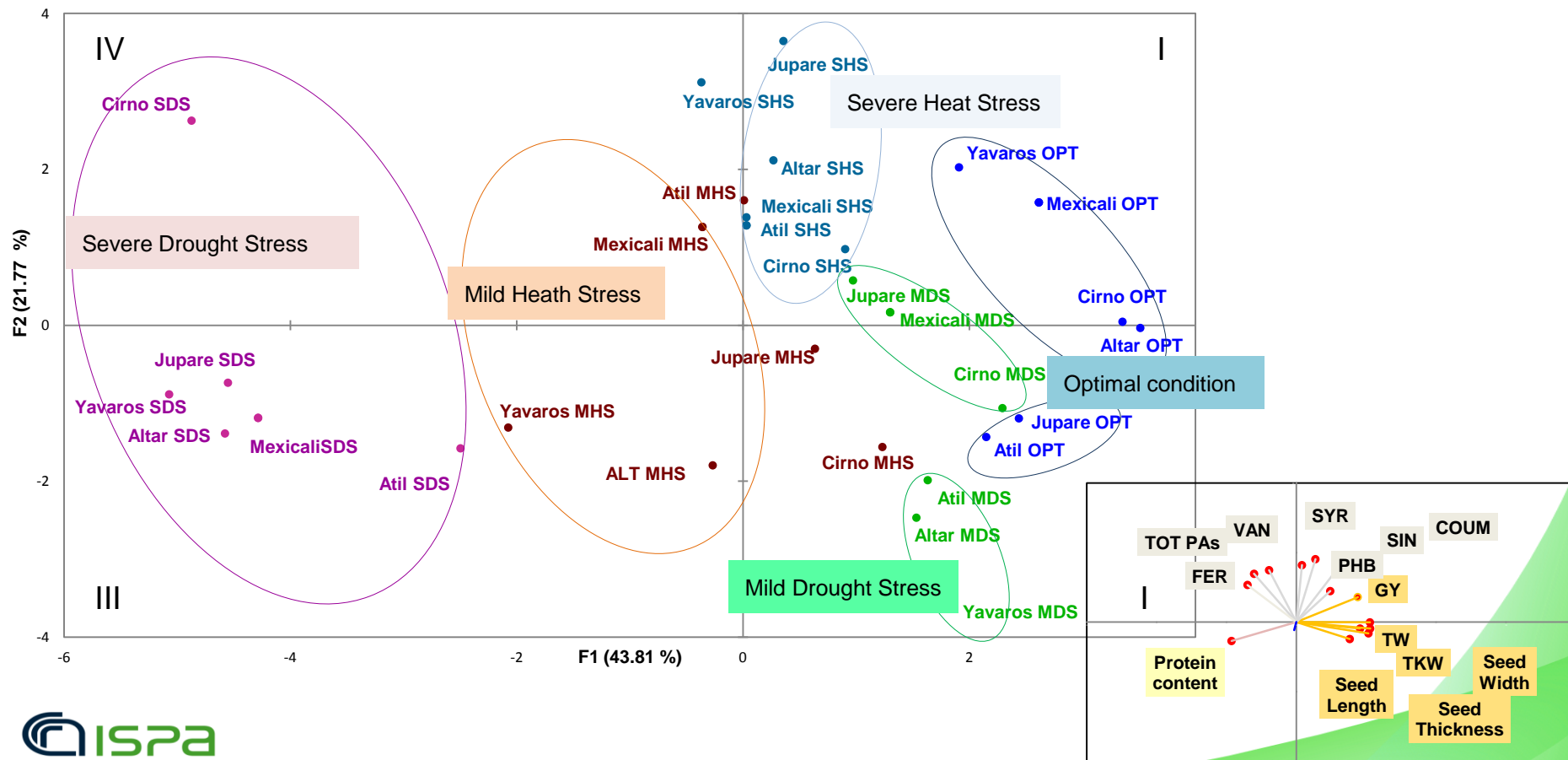


# Correlation analysis

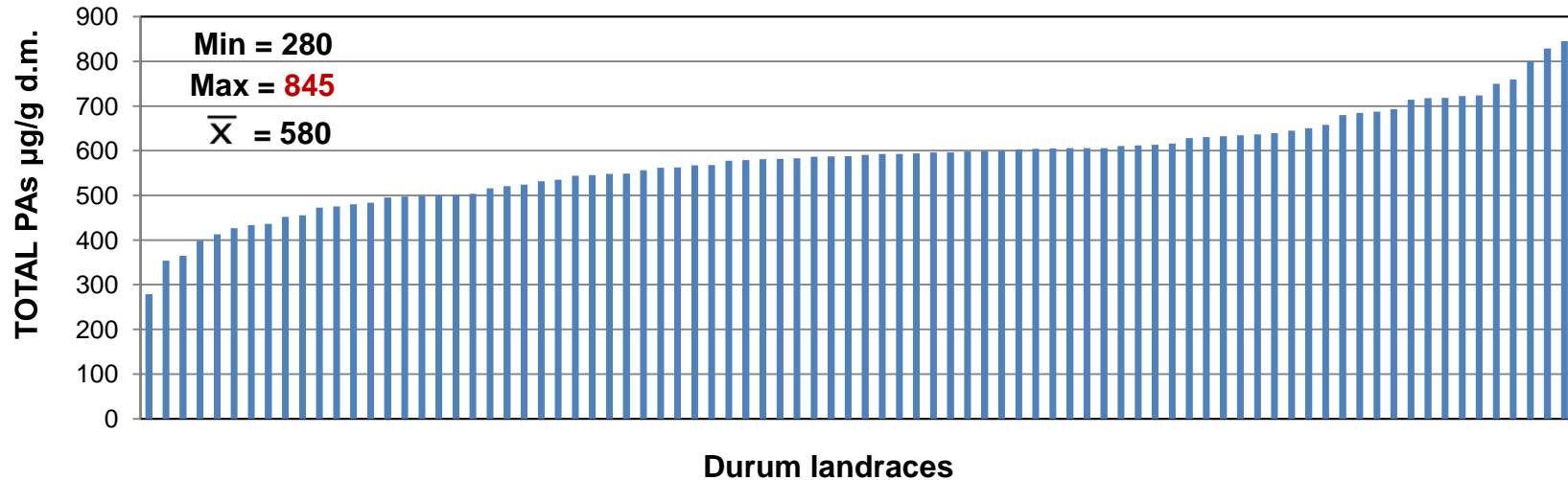
	<i>p</i> -hydroxybenzoic acid	Syringic acid	Vanillic acid	<i>p</i> -Coumaric acid	Sinapic acid	Ferulic acid	Total phenolic acids
Grain yield	<b>0.513<sup>***</sup></b>	<b>0.244<sup>*</sup></b>	-0.166	0.153	<b>0.618<sup>***</sup></b>	<b>-0.221<sup>*</sup></b>	-0.122
Test weight	<b>0.409<sup>**</sup></b>	-0.041	<b>-0.291<sup>**</sup></b>	-0.178	<b>0.381<sup>**</sup></b>	<b>-0.350<sup>**</sup></b>	<b>-0.295<sup>**</sup></b>
1000 kernel weight	<b>0.235<sup>*</sup></b>	-0.090	<b>-0.329<sup>**</sup></b>	-0.179	<b>0.223<sup>*</sup></b>	<b>-0.397<sup>**</sup></b>	<b>-0.361<sup>**</sup></b>
Protein content	<b>-0.492<sup>***</sup></b>	-0.158	<b>0.233<sup>*</sup></b>	-0.100	<b>-0.563<sup>***</sup></b>	<b>0.315<sup>*</sup></b>	<b>0.222<sup>*</sup></b>
Seed length	-0.034	-0.070	-0.145	-0.174	-0.003	<b>-0.254<sup>*</sup></b>	<b>-0.253<sup>*</sup></b>
Seed width	<b>0.266<sup>*</sup></b>	-0.023	<b>-0.293<sup>**</sup></b>	-0.092	<b>0.295<sup>**</sup></b>	<b>-0.418<sup>***</sup></b>	<b>-0.367<sup>**</sup></b>
Seed thickness	<b>0.233<sup>*</sup></b>	0.012	<b>-0.251<sup>*</sup></b>	-0.061	<b>0.298<sup>**</sup></b>	<b>-0.430<sup>***</sup></b>	<b>-0.376<sup>***</sup></b>

\*\*\*, \*\*, \*: P<0.001, P<0.01, P<0.05, respectively

# PCA on the whole data set based on environments



# Variability for total phenolic acids across CIMMYT durum wheat landraces



# Conclusions

- The phenolic acids profile of CIMMYT cultivars depended on the genotype (G), environments (E) and G x E interactions
- Drought and heat stress reduced yield performances and increased protein content and phenolic acids content
- A large variability for phenolic acids was found among CIMMYT durum landraces which could be used for breeding programs

# Acknowledgements



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Reg. CE n. 1698/2005 Programma di Sviluppo rurale per la Puglia 2007/2013.  
Misura 214 - Azione 4 Sub azione a) "progetti integrati per la Biodiversità".

