

# TOCOPHEROLS COMPOSITION ON SOYBEAN UNDER HEAT AND WATER STRESS DURING GRAIN FILLING: VARIATION ACCORDING TO CANOPY POSITION

VEAS Rodolfo<sup>1\*</sup>, ERGO Verónica<sup>2</sup>, ASÍS Ramón<sup>3,4</sup>, LASCANO Ramiro<sup>1,3,4</sup>, RONDANINI Deborah<sup>4,5</sup>, CARRERA Constanza<sup>1,4</sup>  
<sup>1</sup>IFRGV-CIAP-INTA Córdoba; <sup>2</sup>FCEFYN-SECyT-UNC Córdoba; <sup>3</sup>FCQ- UNC Córdoba; <sup>4</sup>CONICET; <sup>5</sup>FAUBA.  
 Email: \*veas.rodolfo@inta.gov.ar

## INTRODUCTION

Tocopherols in soybean oil are antioxidant compounds and contribute to the nutraceutical value of the grain because they can improve the functionality of the immune system<sup>1</sup>.

The accumulation of these antioxidants occurs in parallel with the oil during grain filling<sup>2</sup>. Therefore, environmental stresses during this period could affect both the content and the final composition of tocopherols present in the grain.

## OBJECTIVES

- 1 Determine the impact of heat stress (HS), water stress (WS) and its interaction (HS×WS) on content and final composition of soybean tocopherols, and analyze if there is positional variability within the canopy.
- 2 Establish relationships between tocopherols, oil, grain weight and ecophysiological variables.

## MATERIALS & METHODS

**Experimental site:** INTA Manfredi, Córdoba, Argentina (31° 49' S, 63° 46' O)

**Crop season:** 2015-2016.

**Experimental design:** split-split plot with 2 replications.

**Water levels:** i) irrigation (near field capacity under drip irrigation); ii) water stress (~25% of available water content) from R5.5<sup>3</sup> until R8<sup>3</sup>.

**Genotypes:** Alim 5.09 (42% protein) and Jocketta (37% protein).

**Temperature levels:** i) non heat stress (at environmental temperature) ii) heat stress (brief periods of exposure to temperature >32°C for 6hs per day, during 15 days from R5.5<sup>3</sup>).

**Variables:**

1. Alpha, beta, gamma, and delta tocopherol concentration (%) and content (mg)<sup>4</sup>.
2. Total tocopherols are the sum of different tocopherol isoforms.
3. Oil concentration (%)<sup>4</sup>
4. Grain weight (mg grain<sup>-1</sup>)
5. Canopy temperature (°C)
6. Photosynthesis (μmol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup>).

All variables, except canopy temperature and photosynthesis, were measured in two canopy positions: upper and lower.

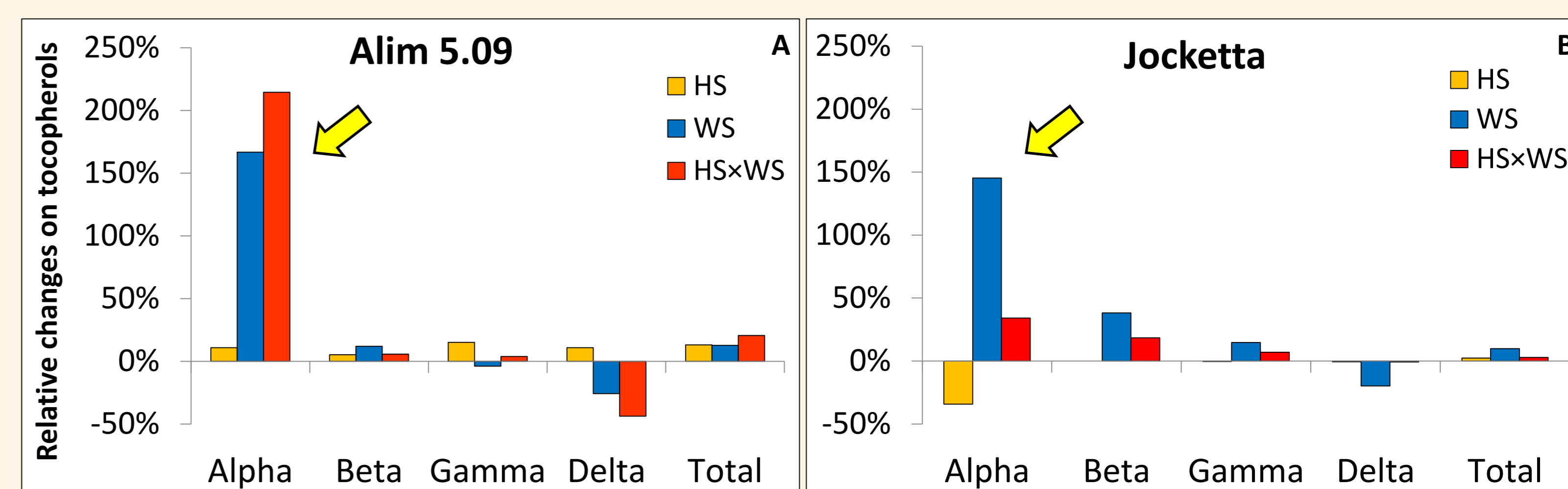


## RESULTS

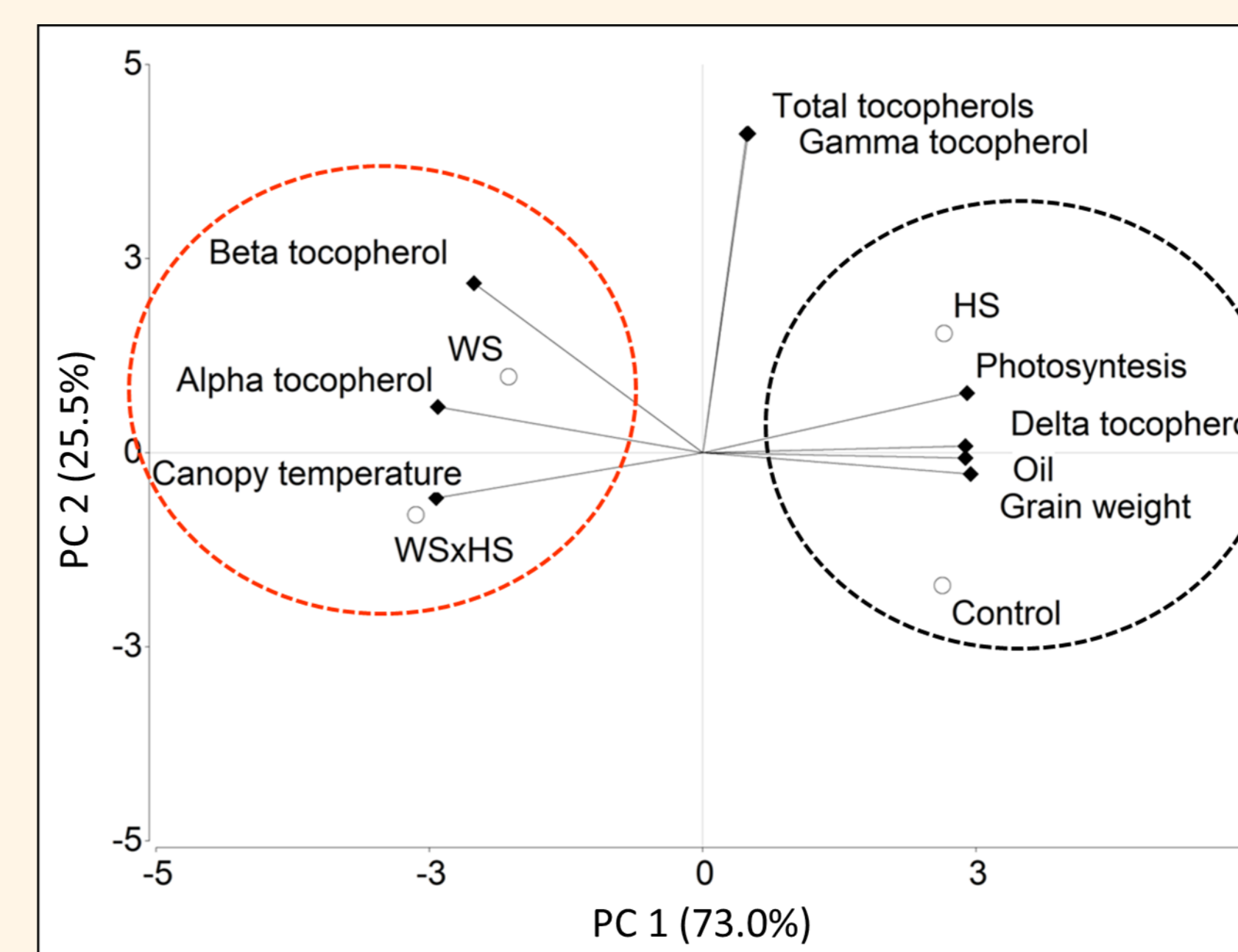
**Table 1.** Significance of different water levels (non-water-stressed and water-stressed plots), temperature levels (non-heat-stressed and heat-stressed plots), genotypes (Alim 5.09 and Jocketta) and canopy position (upper and lower) and their interactions on different tocopherol isoforms concentrations (μg g grain<sup>-1</sup>).

Source	Alpha	Beta	Gamma	Delta	Total
Water level (WL)	**	ns	ns	**	ns
Genotype (G)	**	**	**	*	ns
Temperature level (TL)	ns	ns	ns	ns	ns
Canopy position (CP)	ns	ns	ns	ns	ns
WL×G	**	*	ns	ns	ns
WL×CP	ns	ns	**	ns	**
G×CP	ns	ns	ns	ns	ns
WL×G×CP	ns	ns	**	ns	*

\*, \*\* significance at p<0.05 and 0.01 respectively; ns: not significant. Only significant interactions were shown.



**Fig 1.** Changes of alpha, beta, gamma, delta and total tocopherols concentration relative to the control (%) depending on the treatments applied: heat stress (HS), water stress (WS) and HS×WS of the two soybean genotypes (A) and (B).



**Fig 2.** Biplot showing different tocopherol isoforms (μg g grain<sup>-1</sup>), grain weight (mg grain<sup>-1</sup>), oil (%) and ecophysiological variables in two soybean genotypes: Alim 5.09 and Jocketta under treatments: control, heat stress (HS), water stress (WS) and HS×WS.

## CONCLUSIONS

- 1 Tocopherol composition was modified by water deficit, increasing alpha tocopherol and decreasing delta tocopherol without significant changes in total tocopherols. There was not positional variability within of canopy (Table 1 and Fig. 1).
- 2 Delta tocopherol, oil, grain weight and photosynthesis were positively and strongly correlated, and were located towards irrigated plots (control and HS), indicating the strong dependence of the grain weight and oil on current photosynthesis (Fig. 2).
- 3 The positive association between canopy temperature and alpha tocopherol under water deficit would indicate the relevance of temperature in the synthesis of these compounds (Fig. 2).

## REFERENCES & ACKNOWLEDGEMENTS

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