

# Does soluble dry-matter represent a net benefit on yield under potential conditions? – First insights

\*Carolina Rivera-Amado<sup>1</sup>, Gemma Molero<sup>1</sup>, John Foulkes<sup>2</sup> and Matthew Reynolds<sup>1</sup>

<sup>1</sup> International Maize and Wheat Improvement Center (CIMMYT), Apdo. Postal 6-641, 06600 Mexico DF, Mexico  
<sup>2</sup> Division of Plant and Crop Sciences, School of Biosciences, University of Nottingham, Leicestershire, LE12 5RD, UK  
\*Corresponding author's email: a.rivera@cgiar.org

## Background

- Spike dry-matter (DM) could be increased by reducing DM in the middle stem internodes at flowering (Rivera-Amado et al. 2019).
- Differences in water soluble carbohydrate (WSC) concentration at flowering can affect the growth of reproductive organs, harvest index and yield (Dreccer et al. 2019).
- Studies investigating associations between WSC and sink traits under optimal growing conditions are scarce.

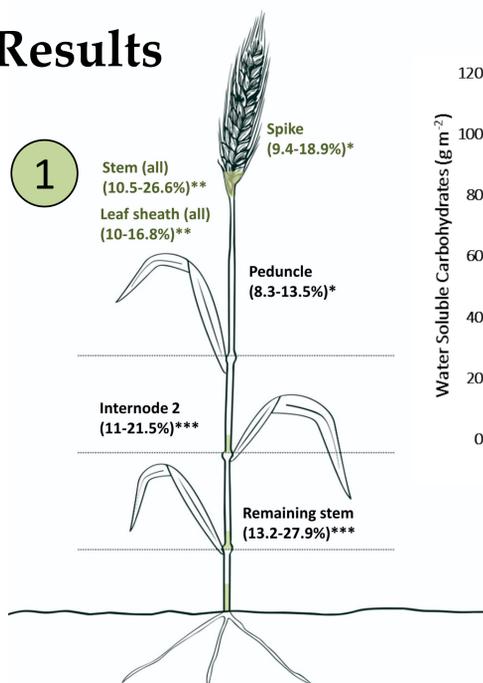
## Objectives

- 1 To demonstrate genetic variation in soluble and structural dry-matter partitioning in the stems, stem internodes, spike and leaf sheaths at flowering.
- 2 To illustrate how this genetic variation can affect the growth of reproductive organs.
- 3 To examine how the dynamics of spike and stem WSC accumulation during grain filling influence grain number (GN), harvest index (HI) and grain yield (GY).

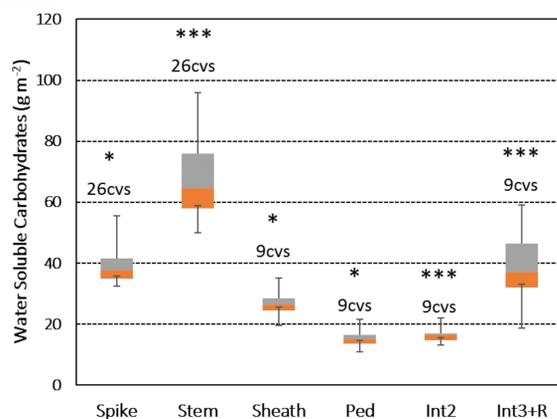
## Materials and methods

- ✓ 2 field cycles: 2011-12 and 2012-13
- ✓ 26 CIMMYT elite spring wheat genotypes
- ✓ Obregon, Mexico (27°N, 110°W, 38 masl)
- ✓ Fully irrigated conditions
- ✓ Biomass samplings at initiation of booting and 7 days after anthesis
- ✓ Sampling of 20 shoot every week after anthesis
- ✓ Selection of a subset with 9 cultivars for stem internode WSC analysis (restricted range of anthesis date).
- ✓ Dry-matter partitioning analysis across plant organs (weights).
- ✓ WSC-analyses in the spike, stem, sheaths, peduncle, internode 2 and remaining internode (Yem and Willis 1954; Galicia et al. 2009)

## Results



**Fig. 1 WSC (%) in the different organs of the plan at A7 (black font subset 9 cultivars, green font 26 cultivars).**

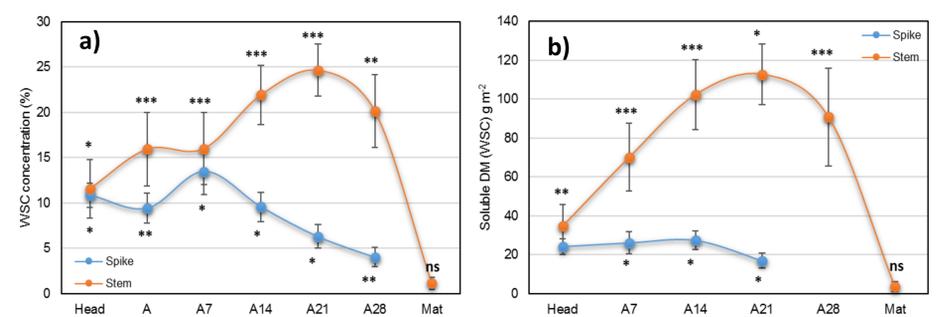


**Fig. 2 WSC (g m<sup>-2</sup>) in different plant organs at A7 for 26 and 9 cultivars in two seasons.**

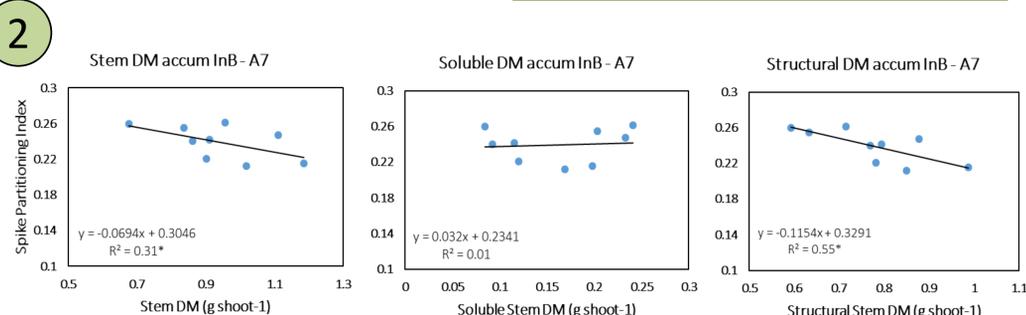
Results from the field experiments showed highly contrasting phenotypes for WSC % in the different plant organs, such as spikes, stems, stem internodes and leaf-sheaths.

**3 Table 1. Genetic correlations between harvest traits and WSC % in stem/spike during grain filling for the 26 cultivars in two seasons (shaded values are significant at least at a P value <0.05).**

	Head	A7	A14	A21	A28	Mat
GY	-0.02/-0.24	-0.09/0.05	-0.11/0.07	-0.07/-0.20	-0.30/0.02	0.03
HI	<b>0.71/0.31</b>	<b>0.48/0.43</b>	<b>0.56/0.21</b>	<b>0.76/0.20</b>	0.20/-0.01	-0.02
GN	<b>0.53/0.67</b>	<b>0.57/0.48</b>	0.24/0.20	0.06/0.08	<b>-0.37/0.05</b>	-0.13
TGW	<b>-0.58/-0.73</b>	<b>-0.51/-0.48</b>	-0.25/0.25	-0.08/-0.15	0.26/-0.06	0.24



**Fig. 4 a) Stem WSC % and b) WSC amounts (g m<sup>-2</sup>) in stems and spikes during grain filling in the 26 CIMCOG cultivars**



**Fig. 3 Spike partitioning index (SPI; spike DM/above-ground DM) vs stem DM accumulation per shoot during stem elongation (initiation of booting – 7 days after anthesis) in the 9 cultivars for two seasons.**

Differences in expressions of WSC % had an effect on associations between traits at vegetative stages and traits at harvest. Although higher DM partitioning to WSC appeared to be associated with higher GN and higher HI, net yield effects need to be studied in the context of breeding for higher WSC under optimal growing conditions.

### References

- Dreccer MF, van Herwaarden AF, Chapman SC (2009) Grain number and grain weight in wheat lines contrasting for stem water soluble carbohydrate concentration. *F Crop Res* 112:43–54. doi: 10.1016/j.fcr.2009.02.006
- Rivera-Amado C, Trujillo-Negrellos E, Molero G, et al (2019) Optimizing dry-matter partitioning for increased spike growth, grain number and harvest index in spring wheat. *F Crop Res*. doi: 10.1016/j.fcr.2019.04.016
- Yemm EW, Willis AJ (1954) The estimation of carbohydrates in plant extracts by anthrone. *Biochem J* 57:508–514