Involvement of fructans in the protection of leaf meristems of grassland species during drought

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Introduction

With the increasing frequency of drought episodes due to climate change, water stress is an important factor to consider in the development of new cultivars and agricultural practices in temperate areas. In many grassland species, fructans represent a dynamic carbon pool which not only constitutes a carbon reserve but also contributes to the resistance to abiotic stresses, by stabilizing cell membranes [2]. We aim to study the involvement of fructans in the protection of leaf meristems during drought in perennial ryegrass (*Lolium perenne)*.

✓ **We hypothesized that under drought fructans migrate from the vacuole to the apoplast, allowing membrane protection.**

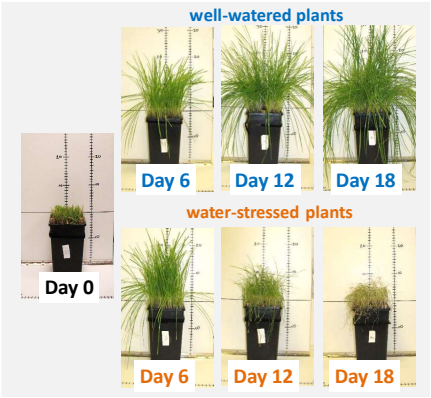

Fig. 1. Plants during the drought experiment.

Material & Methods

Plants *(L. perenne var.* 'Delika') were grown under controlled environment in pots containing sand and perlite (50:50 mixture). After 40 days, the plants were cut at 5 cm above the ground (day 0; **Fig. 1**). The well-watered plants continued to be irrigated while the irrigation was stopped for the water-stressed plants. Measurement were made according to Volaire *et al.* [6], Charrier and Améglio [1] and O'Leary *et al.* [5] on the **0-3 cm leaf bases (stubble) containing the leaf meristems and surrounding leaf sheaths of mature leaves**.

Results & Discussion

From day 6, water content and membrane stability decreased in the water-stressed plants **(Fig.2A,B)**, revealing the drought sensitivity of var. 'Delika'. Under both conditions, the fructan content followed the well-known U-shape curve **(Fig.2C)** due to mobilization and replenishment of fructan reserves after defoliation [4].

On day 12, the fructan content started to be slightly lower in water-stressed plants but the distribution of polymers was not altered **(Fig.2E, F)**. Interestingly, an increase of fructan content (DP8 to 30) was observed in the apoplastic fluid of water-stressed plants **(Fig.2H)** indicating a migration from the vacuole in response to drought, as has been shown in response to freezing [3].

As the membrane stability decreased sharply **from days 6 to 12 (Fig.2B)**, the fructans stored in the vacuoles of the older leaf sheaths may be released into the apoplast after rupture of the membranes helping to protect the plasmalemma of meristematic cells.

After day 12, the fructan content decrease in water-stressed plants in parallel with the increase of sucrose content **(Fig.2D)** revealing that severe drought affected fructan synthesis from sucrose. This strong increase in sucrose content could explain the decrease of membrane stability, as previously suggested by Volaire *et al.* [6].

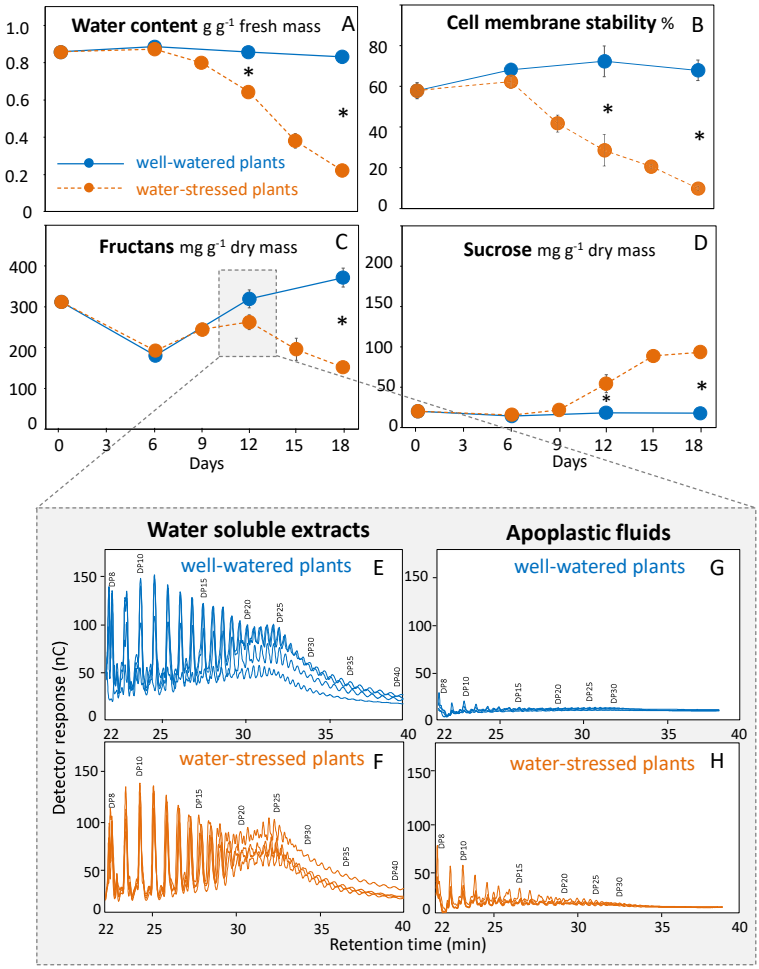

Fig. 2. Parameters measured in the base of the leaves after the start of the drought treatment (A, B, C, D, mean ± standard error, n = 4; * p<0.05, t-test, well-watered *vs* water-stressed) and HPAEC-PAD chromatograms of fructans with DP >7 in the base of the leaves from plants sampled on day 12 (E, F, G, H, four chromatograms in each panel, n=4).

Conclusion

✓ **Under drought, the fructans released from the vacuoles to the apoplast due to the rupture of leaf sheath membranes could help protect the leaf meristems by interaction with the plasmalemma.** To deepen the understanding of this cell protection mechanism, we aim to visualize the migration of fructans by immunolocalization using developing anti-fructan antibodies.

References

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We thank UMR EVA technical staff for their skilful assistance. The project ALGOEVA is co-funded by the Normandy County council and the EU in the framework of the ERDF-ESF operational programme 2014-2020.