

Severe Preharvest Drought Elevates Respiration and Storage Rot in Postharvest Sugarbeet Roots

ABBAS M. LAFTA¹, JOHN D. EIDE², MOHAMED F. R. KHAN^{1,3}, FERNANDO L. FINGER⁴, KAREN K. FUGATE².

¹Department of Plant Pathology, North Dakota State University, Fargo, North Dakota, USA. ²USDA-ARS, Edward T. Schafer Agricultural Research Center, Fargo, North Dakota, USA. ³University of Minnesota Extension Service, St. Paul, Minnesota, USA. ⁴Departamento de Agronomia, Universidade Federal de Viçosa, Viçosa, MG, Brazil.

CORRESPONDING AUTHOR(S): KAREN K. FUGATE

DOI: <https://doi.org/10.1111/jac.12718>

Abstract

Sugarbeets are largely produced without irrigation, making drought stress inevitable when rainfall is insufficient. Whether drought stress impacts root storage, however, is currently unknown. Research was conducted to determine the effect of preharvest water stress on postharvest sugarbeet root respiration rate and susceptibility to storage rots as these traits are the primary determinants for sucrose loss and quality deterioration. Greenhouse-grown plants were subjected to four levels of water deficit by discontinuing watering for 0, 7, 14 or 21 days prior to harvest. Plants receiving water-restrictive treatments displayed physiological stress by leaf epinasty, reductions in net photosynthetic rate and leaf relative water content and increases in leaf temperature, whereas the water content of roots harvested from these plants progressively decreased with the severity of the preharvest water-deficit treatment. Harvested roots from all watering treatments were stored at 10°C and 95% relative humidity for up to 12 weeks and evaluated for respiration rate and susceptibility to storage rot. Root respiration rate during storage was inversely related to root water content at harvest by second-order equations, such that respiration was not significantly affected by minor reductions in root water content but increased exponentially for roots obtained from severely drought-stressed plants with water

contents at harvest of $\leq 75\%$. Similarly, roots with water contents $\leq 75\%$ had elevated levels of electrolyte leakage, a measure of cellular membrane damage, and were more susceptible to dehydration and fungal infection during storage. In separate experiments, roots harvested from water-stressed plants were inoculated with *Botrytis cinerea* or *Penicillium vulpinum*, two causal agents for storage rots. In these experiments, preharvest water stress quantitatively increased root rot and qualitatively altered symptoms of their infection. Overall, these results demonstrate that severe preharvest drought stress is likely to significantly increase sugarbeet root storage losses caused by root respiration and storage rots and that storage losses are likely to accelerate with time in storage. However, mild-to-moderate drought conditions prior to harvest are expected to have no or minimal effect on storage losses from root respiration or storage rots.

RE-PRINT: This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs License](#), which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

Author: Lafta et al.

Publication: Journal of Agronomy and Crop Science Publisher: Wiley-VCH GmbH

Date: 25 June 2024

Copyright: ©2024 The Author(s). Journal of Agronomy and Crop Science published by Wiley-VCH GmbH.