Seed abortion of maize under water deficit is linked to a developmental process and not to carbon deprivation

Vincent Oury, Duyên D. Prodhomme, Yves Y. Gibon, Francois F. Tardieu, Olivier Turc

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V. Oury[1], D Prodhomme[2], Y Gibon[2], F. Tardieu[1], O. Turc[1]
1 INRA, UMR759, Laboratoire d'Ecophysiologie des Plantes sous Stress Environnementaux, Montpellier, France
2 INRA UMR 1332 Biologie du Fruit et Pathologie Bordeaux France
Email olivier.turc@supagro.inra.fr

Seed abortion is a major cause of yield loss under water deficit in maize, thereby causing a high sensitivity of maize yield to droughts occurring at flowering time. It is usually believed that drought-induced seed abortion is linked to sugar deprivation because sugar feeding can relieve part of the effect of water deficit. However, the experiments that evidenced this effect involved very severe deficit, not compatible with those sensed by most plants in the field. In our experiments, a field-compatible water deficit (predawn leaf water potential of -0.4 MPa) caused 30 to 50% abortion, involving ovules located near the ear tip. Sucrose and hexose concentrations were unaffected or slightly increased by water deficit in ovules located either in the base or in the tip of ears, at four dates around silking. Activities of major enzymes, measured in the young ovules, were essentially unaffected, with a slight increase and decrease in SPS and invertase activities, respectively, under water deficit. It is therefore unlikely that tip abortion in moderate water deficit is linked to sugar deprivation. We propose an alternative mechanism based on the gradient of development within the ear. Silks are initiated with a base-tip gradient of age, so the first silks to emerge are the oldest, located at the base of the ear. Our current research strongly suggests that abortion in water deficit is related to the timing of silk emergence. The latter is delayed under water deficit, so a longer period of time elapses from the first to the last silk emergence. This developmental process would explain both phenotypic variations with water deficit within a given genotype, and the difference in sensitivity between genotypes.