IDT4-022 | High temperature influence on limited transpiration response at elevated vapor pressure deficitin maize

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Drought impacts nearly all crop production for at least a limited period of time across the US Corn Belt. Temperature and vapor pressure deficit (VPD) are two important environmental factors influencing stomatal conductance and transpiration under water deficit stress. A limited transpiration rate (TRlim) trait expressed under high VPD (> ~2kPa) has been shown to offer an approach to increase crop yield in water-limited areas. Previous studies at moderate temperatures (32°C and lower) identified maize (*Zea mays* L.) hybrids that express the TRlim trait. A critical question is whether the TRlim trait is also expressed by these hybrids under temperatures up to 38°C, which are relevant in environments where maize may be grown. Out of 12 maize hybrids, five failed to express the TRlim trait at 38°C, but seven hybrids had sustained expression of the trait at 38°C. The loss of expression of the TRlim response in the five hybrids was found to occur in the very narrow range of temperature increase from 36 to 38°C.The next question is how long it takes for stomatal conductance to be back at the same levels as before the high temperature (38°C) treatment? The result of a series of experiments on maize hybrids with expressing TRlim and not expressing the trait indicated that the recovery in the hybrids with expressingTRlimoccurredquickly (~ 6hrs). The genetic differences in water use among these maize hybrids could be useful in selecting hybrids that are especially well adapted for temperature conditions in a targeted production area.

IDT4-023 | Transpiration efficiency: further insights from species, sink strength, and soil comparisons

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During ID-IV we reported that TE was closely related to the capacity to restrict transpiration under high vapor pressure deficit (VPD). Experiments were undertaken to evaluate other possible factors influencing TE. Experiments across seasons varying in VPD conditions and across water regimes showed that maize had a higher TE than sorghum and pearl millet. While C4 cereals should, theoretically, have similar TE, 100 years of breeding in maize could be responsible for these differences, possibly from increased rates of carbon fixation deriving from selective pressure underincreased planting densities. These results then open an opportunity to accelerate breeding in sorghum and pearl millet by specifically targeting the possible reasons for these differences (RUE, density "resistance"). Further experimentation was undertaken in which ears and panicles were severed from the plants and showed that TE was depressed in maize and sorghum, respectively, while it was not in pearl millet, which produced many new tillers and nodal tillers. This work then raised the question of source-sink relationship in setting carbon demand and then photosynthetic activity. Finally, TE assessed in C4 cereals, grown in four different soils and two different VPD seasons, showed large TE differences among soils during the high VPD season, with a degree of species-by-soil interaction. We interpret these differences to be a consequence of different hydraulic soil properties likely affecting the transpiration response under high VPD. Results will be discussed with regard to breeding targets in "less-bred" crops (pearl millet, sorghum) and with regards to better understanding GxExM interactions.