Selection For Delayed Leaf Senescence To Improve Drought Resistance In Sorghum

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Sorghum breeders have selected for a delay in leaf senescence during grain filling in water-stressed sorghum hybrids to improve yield and stand ability under conditions of limiting moisture, but have also noted the influence of grain sink on leaf area duration. This project aims to identify the interactive effects of drought adaptive traits and grain sink capacity on the rate of leaf senescence (leaf area duration) during grain filling.

Methods

The study involved the use of a rain-out shelter. Top-cross hybrids formed from three female and five male commercial lines (provided by Pacific Seeds), TX610 and E57 were grown with adequate irrigation until flowering and then either continued irrigation (control) or no irrigation (or rain) to black layer formation. Total dry matter (TDM) and its distribution to the head and grain was measured at flowering and maturity. Leaf area index, leaf number, dawn leaf water potential, osmotic potential and relative water content were measured much week after flowering. Osmotic adjustment was also determined

Results and discussion

Relative leaf area (the proportion of maximum leaf area index at anthesis) declined linearly with time, only in the stress treatment, and at significantly different rates among the entries. Leaf area duration was correlated with the change in total above ground plant dry matter during grain filling (GS3) ($r^{=}0.70$) and grain yield ($r^{=}0.66$) the stress treatment, but unrelated to yield in the irrigated treatment ($r^{=}0.21$). Most (78%) of the variation in the $r4_2$te of leaf senescence was explained by variation in drought tolerance ($r^{=}0.61$) and drought avoidance ($r=0.85$), which were characterised by the rate of loss of dawn leaf water potential (days MPa) and as the relative leaf area maintained with the declining leaf water potential (percent leaf area loss MPa), respectively. Regression statistics also suggest that 67% of the observed differences in drought tolerance were explained by variation in osmotic adjustment and the source sink relationship (measured as the number of grains per unit of leaf area index). The form of the relationship is such that a small sink with respect to source and a large osmotic adjustment will enable the plant to tolerate (i.e. reduce leaf loss) low leaf water potential. Similarly, 54 percent of the differences in drought avoidance was associated with variation in osmotic adjustment and stomatal conductance, such that large osmotic adjustment and lower conductance minimised the reduction in dawn leaf water potential.

This study indicates that leaf senescence is an integrative trait of drought tolerance and avoidance and is associated with enhanced TDM and grain yield under stress. However, it is also influenced by the relative sizes of grain sink to current source supply. The more direct and positive role of osmotic adjustment to the maintenance of leaf area is implicated.

1. Ludlow, M.M., Chu, A.C.P., Clements, R.J. and Kerslake, R.G. 1983. Aust. J. Plant Physiol. 10 119-30.