From: mohan gowda
To: bill payne; Dr.Bill Rooney
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Subject: ASA-poster
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Attachments: ASA09.ppt

Dear all,
Here is my poster for ASA meeting-09. I am planing to get printed by Thursday. Please let me know your suggestions.

Thanks
Mohan

Genetic Variability for Gas Exchange Rates and Transpiration Ratio related to Pre-flower Drought Tolerance in Sorghum

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Abstract

There is an increasing need to improve crop water-use efficiency (WUE) (i.e., the ratio of whole-plant biomass to cumulative transpiration) due to decreased water availability and increased food and energy demands throughout the world. In previous studies, the preflowering transpiration ratio A:E [CO_2 assimilation rate (A) divided by transpiration rate (E)] of sorghum leaves was correlated with WUE. The present greenhouse study was conducted to examine preflower A:E in a recombinant inbred line population of sorghum (*Sorghum bicolor* L. Moench) lines. A total of 71 lines and two parents (Tx 430 and Tx 7078) were evaluated for in terms of A:E's relationship to WUE. Parents had been selected with contrasting A:E based on previous studies. The experimental design was a Randomized Complete Block with replications, genotype and water regime (40 and 80 per cent of field capacity) as experimental factors. Genotype, water regime and their interaction had a significant effect on A, E and A:E. Regression of A on E showed a greater genetic variability among the inbred lines than among parents for transpiration ratio (A:E). Average A:E was 3.07 mmol CO_2 mol^{-1} for Tx430 and 2.80 for Tx 7078. Heritability estimates for A:E , A and E were 0.33, 0.14 and 0.08 respectively. These results provide further evidence that there is genetic variability among genotypes for gas exchange rates at pre-flowering in sorghum with heritability values that suggest scope for improved WUE and productivity.

Introduction

➢There is an increasing need to improve crop water-use efficiency (WUE) (i.e., the ratio of whole-plant biomass to cumulative transpiration) due to decreasing water availability and increased food and energy demands throughout the world (Balota et al., 2008).

➢Sorghum [*Sorghum bicolor* (L.) Moenth] is the world's fifth most important grain crop based on tonnage, after maize, wheat, rice, and barley (www.fao.org), and provides staple food for millions of people in semi-arid tropics of Africa and Asia.

➢In 2008, sorghum was produced on approximately 39.36 million hectares with an average yield of 1.57 metric tons per hectare worldwide (http://www.fas.usda.gov). Currently, it is the 2nd most important source of grain-based ethanol production in US after maize.

➢Balota et al. (2008) examined four sorghum parental inbred lines and 12 of their hybrids for transpiration ratio under water limited and well watered conditions at Bushland, TX. They found that average A:E over both water conditions was 3.10 mmol CO_2 mol^{-1} H_20 for 'Tx430' and 2.91 for 'Tx7078'. These two genotypes also had the highest 'A'. They concluded that there is genetic variation for pre-flower 'A',' E', ' A:E', and WUE in sorghum genotypes.

➢Increasing the transpiration efficiency of the crops, defined as the biomass produced per unit water transpired through plants, might be an important option to increase the water productivity (Condon et al., 2004).

Objectives

Phenotypic screening for transpiration efficiency (A:E) in recombinant inbred line population of sorghum (*Sorghum bicolor* L. Moench) under controlled conditions.

Methodology

➢Experiment was conducted at Texas AgriLife Research and Extension Station, (35°11' N lat; 102°06' W long; 1170 m elevation) Bushland, TX.

➢A total of 71 inbred sorghum [*Sorghum bicolor* (L.) Moenth] lines and two parents (Tx430 and Tx7078) were obtained from Dr.William L. Rooney (sorghum breeding and foundation seed center, Texas A&M University, College Station, TX).

➢Parents were selected with contrasting transpiration efficiency (CO_2 assimilation rate (A): transpiration rate (E)) based on previous studies (Balota et al., 2008).

➢The experimental design was a Randomized Completely Block, with genotype (71 inbred lines and the parents) and water regime (40 and 80 per cent of field capacity) as experimental factors, and four replications.

Fig. 1: View of the experimental layout in greenhouse at TAES,Bushland, TX.

Fig. 2: Measuring the 'A' and 'E' using LICOR-6400

Fig. 3: Root washing using 1-mm sieve

Parameters measured:

➢CO_2 assimilation rate (A), Transpiration (E) and Vapor Pressure Deficit (vpd) using Li-Cor 6400
➢Temperature and Relative Humidity using Hobometer
➢Cumulative transpiration (measured everyday starting from 16 days after planting (DAP) to 35 DAP.
➢At harvest (35 DAP) the following were determined;
  ➢Shoot and root biomass to calculate total WUE

➢**Data analysis:** Genotype effect on A, E, and A:E was assessed with ANOVA from the GLM procedure of SYSTAT 10.2 (2002, SYSTAT Software Inc., Richmond, CA) using plant as the experimental unit. Factorial ANOVA of SYSTAT was used to asses water and genotype effects on A, E, A:E, biomass, water use and WUE.

Results and Discussion

➢Genotype, water regime and their interaction had a significant effect on A, E and A:E (Table. 1).

Table 1. Mean squares and probability levels (*P*) from combined ANOVAs for CO_2 assimilation rate (A), transpiration rate (E), and transpiration ratio (A:E) on a sorghum [*Sorghum bicolor* (L.) Moench] using 71 recombinant inbred lines and two parents (Tx430 and Tx7078) under two environments (water regimes), and with four replications.

Source	df	A μmol CO_2 m^{-2} s^{-1}		E mmol H_2O m^{-2} s^{-1}		A:E mmol CO_2 mol^{-1} H_2O	
		Mean square	*P*	Mean square	*p*	Mean square	*P*
Water regime	1	20645.1	0.000	796.978	0.000	51.18	0.000
Entry	72	141.83	0.000	3.419	0.000	1.487	0.000
Water regime*Entry	72	107.142	0.000	2.384	0.001	1.575	0.000
Error	1642	50.327		1.475		0.792	

➢Regression of A on E showed a greater genetic variability among the inbred lines than among parents for transpiration ratio (A:E) (Fig. 1) . Average A:E was 3.07 mmol CO_2 mol^{-1} for Tx430 and 2.80 for Tx 7078.

➢Heritability estimates for A:E , A and E were 0.33, 0.14 and 0.08 respectively.

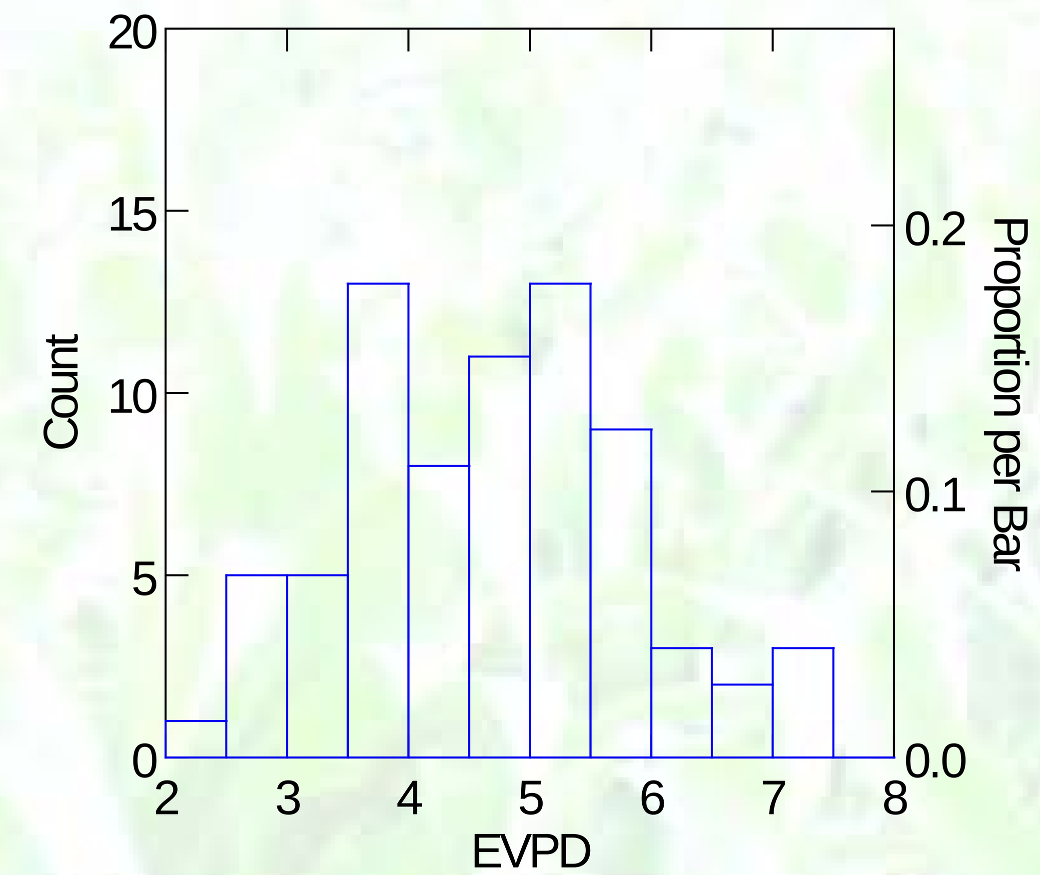

Fig. 4: Density slope graph obtained by regressing CO_2 assimilation rate (A) vs. transpiration rate (E) corrected with vapour pressure deficit (vpd) in 71 recombinant inbred lines and two parents.

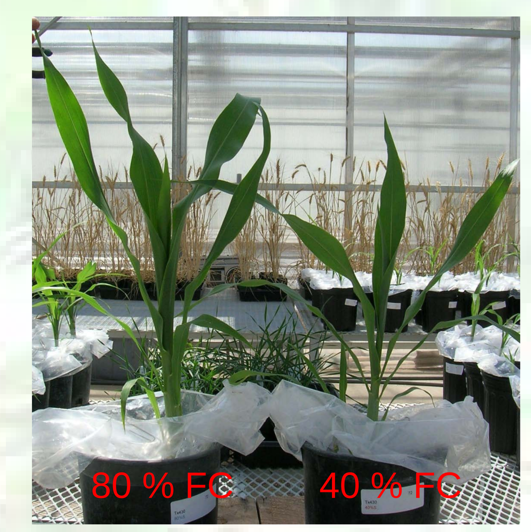

Fig. 5: Genotype 'Tx 430' at 30 days after planting

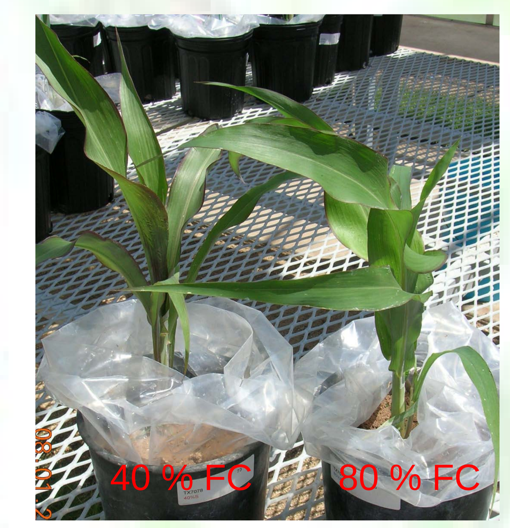

Fig. 3: Fig. 5: Genotype 'Tx 7078' at 30 days after planting

Conclusions

These results provide further evidence that there is genetic variability among genotypes for gas exchange rates at pre-flowering in sorghum with heritability values that suggest scope for improved WUE and productivity.

References

Balota, M. W. A. Payne, W.L. Rooney, and D. Rosenow, 2008. Gas Exchange and Transpiration Ratio in Sorghum. Crop Sci., 48:2361-2371.

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Acknowledgement

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