References

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Hybrid Sorghum Response to Soil Moisture Stress

W. C. Hofmann, A. K. Dobrenz, and M. K. O'Neill

Physiological responses of six sorghum hybrids and their respective parental lines were evaluated under high and low soil moisture conditions at Tucson, Arizona in 1980 and 1981. Apparent photosynthesis, transpiration, diffusive resistance and temperature differential (ambient temperature minus leaf temperature) were measured at weekly intervals. Transpiration, diffusive resistance and temperature differential measurements were made with a Licor LI-1600 steady state porometer. Simultaneous measurements of apparent photosynthesis were made with the technique developed by Clegg, Sullivan, and Eastin (1978). A small plexiglas chamber was sealed over a section of leaf blade. Gas was sampled from the chamber with two syringes pulled at a 30- or 60-second interval. The CO_2 concentrations in the syringes were measured with an infrared gas analyzer.

Mean physiological responses under both high and low soil moisture conditions for the four hybrids and their respective parental lines showed relatively consistent hybrid vigor in 1980 (Fig. 1). Hybrid 4 exhibited heterosis for all four physiological responses under both irrigation levels. It had higher rates of apparent photosynthesis and transpiration and a greater temperature differential. Diffusive resistance was lower in hybrid 4 compared to its parents. Hybrid 1 showed heterosis for all four physiological characteristics under adequate moisture conditions. Hybrids 2 and 3 displayed extremely variable results, except for apparent photosynthesis.

Due to the superior responses of hybrids 1 and 4, they were again evaluated in 1981. Hybrids 1 and 4 were assigned codes 5 and 8, respectively, in 1981. Hybrids 6 and 7 with their parental lines were two new germplasm sources. Seasonal mean responses in 1981 revealed fewer heterotic responses (Fig. 2).

Hybrids 5 and 8, the superior hybrids in 1980, displayed heterosis for apparent photosynthesis only under dry soil moisture conditions. Hybrid 8 (hybrid 4 in 1980) again showed heterosis for transpiration, diffusive resistance and temperature differential under both soil moisture conditions. Hybrids 5, 6, and 7 failed to display consistant hybrid vigor.

The comparison of mean responses from two irrigation treatments gives some indication of genetic stability, but fails to resolve response characteristics across a wide range of environmental conditions. The regression analysis technique of Finlay and Wilkenson (1963) is a better approach for the identification of genotypes which are adapted to a wide range of environmental conditions. The regression compares the response of an individual genotype to the response of all genotypes being appraised.

Evaluted with this technique, hybrid 4 showed heterosis for all four physiological characteristics across all environmental conditions. When this hybrid is compared to the three other 1980 hybrids, the stability and superiority is evident (Fig. 3).

A comparison of the four hybrids in 1981 indicates that hybrids 6 and 8 are better adapted to a wide range of environmental conditions (Fig. 4). Hybrid 6 was the most stable for diffusive resistance, transpiration and apparent photosynthesis. Hybrid 8 had a slight advantage in temperature differential. A potential disadvantage for hybrid 6 is its relatively low correlation coefficient (R). Eberhart and Russel (1966) consider this to be an indication of low stability.

Hybrid 4, which displayed superior physiological responses in 1980, had numerically the greatest yields under low soil moixture conditions and statistically higher yields in the high moisture plots. There were no observed differences for yield in 1981.

Evaluations of physiological responses of sorghum germplasm across diverse environmental can help in the identification of stable and drought-resistant material. This information could prove valuable to the plant scientist in the development of superior cultivars.

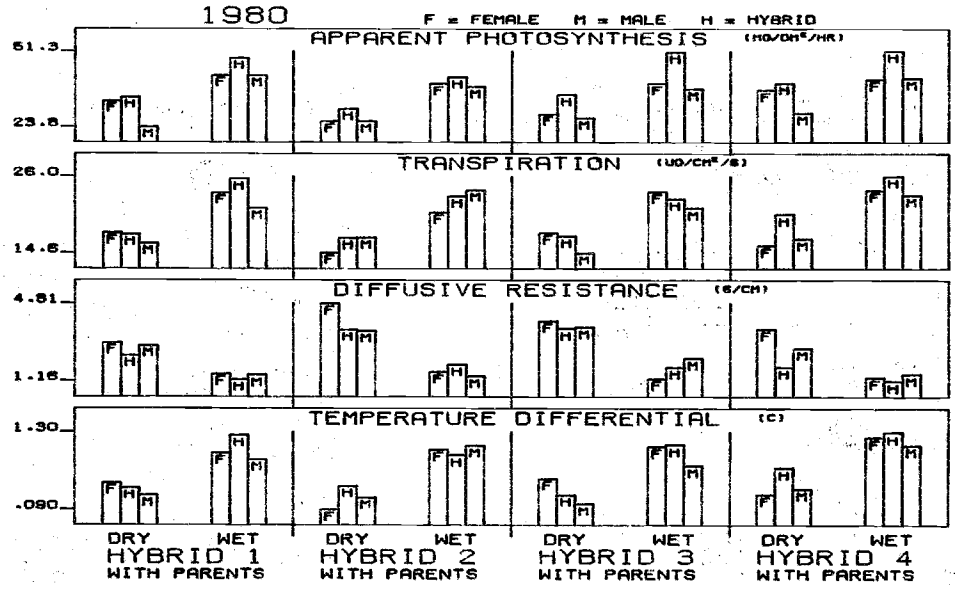

Figure 1. Seasonal mean responses for apparent photosynthesis, transpiration, diffusive resistance and temperatures differential for four hybrids and their respective parents grown under dry and wet moisture conditions in 1980.

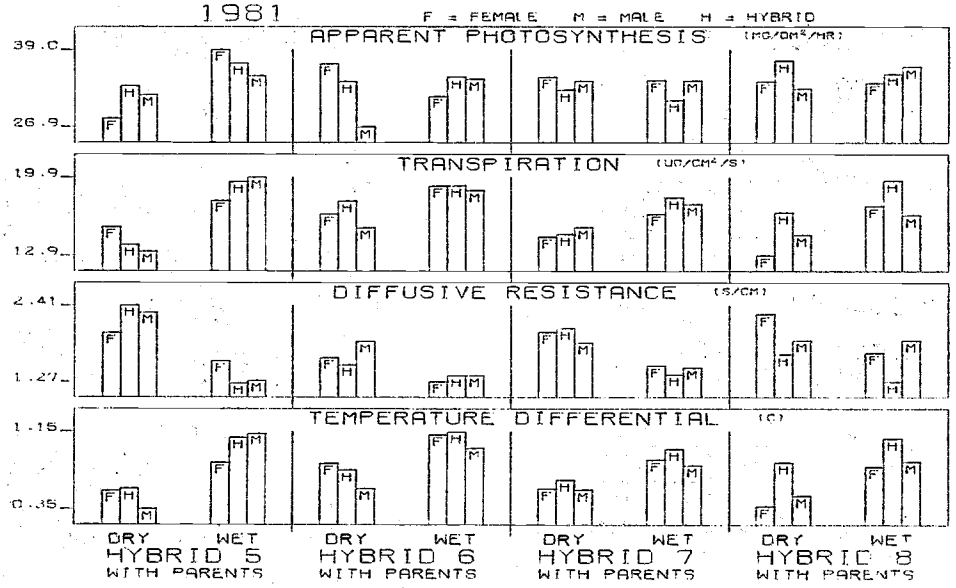

Figure 2. Seasonal mean responses for apparent photosynthesis, transpiration, diffusive resistance and temperatures differential for four hybrids and their respective parents grown under dry and wet moisture conditions in 1981.

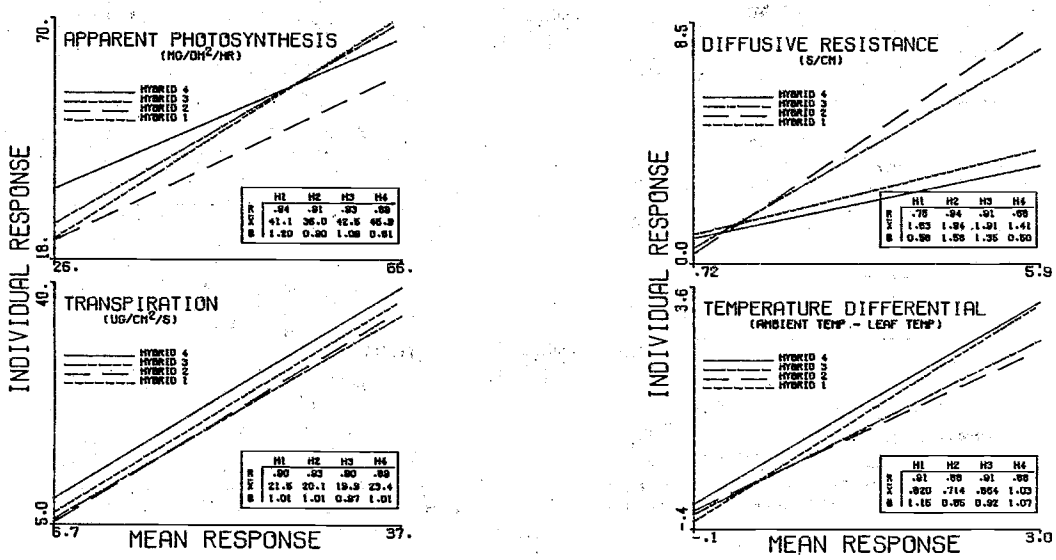

Figure 3. Finlay and Williamson regressions with correlation coefficient (R), mean ($\bar{X}$), and slope (B) for apparent photosynthesis, transpiration, diffusive resistance and temperature differential for the four hybrids in 1980.

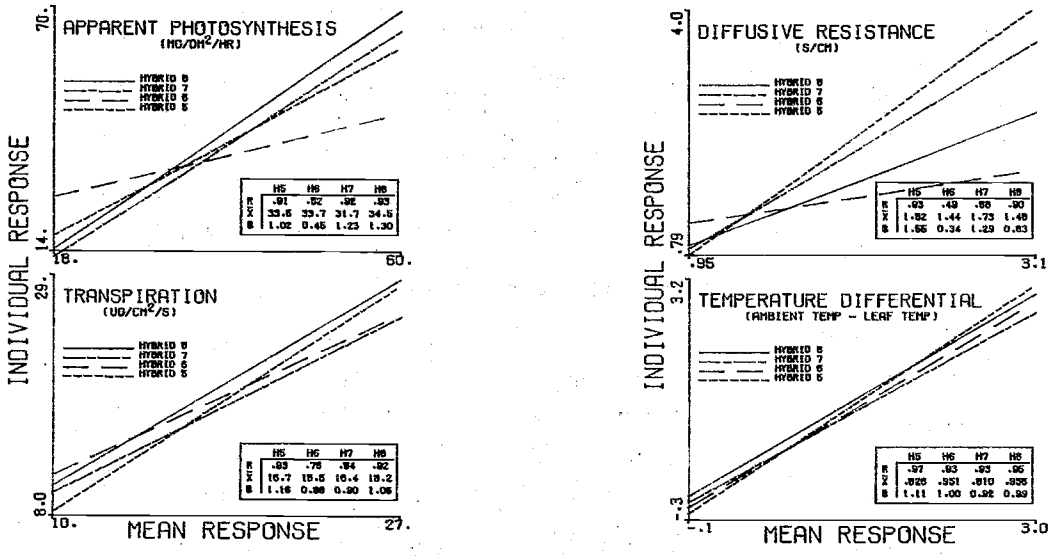

Figure 4. Finlay and Williamson regression with correlation coefficient (R), mean ($\bar{X}$), and slope (B) for apparent photosynthesis, transpiration, diffusive resistance and temperature differential for the four hybrids in 1980.

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Yuma County Sorghum Variety Test

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Elevation: 450

Crop History:

Planted: July 9, 1981
Harvested: December 21, 1981
Seeding Rate: 18 lbs/acre
Previous Crop: Wheat
Insecticide: None
Weed Control: None
Fertilizer: 125 lbs N/acre as NH_3 were injected prior to planting. Two additional applications of 40 lbs N/acre, each, were made in the irrigation water.

Irrigation: An estimated 36 acre inches/acre of Colorado river water were applied to the plots.

Plot Size: 14 X 820 feet

Entry	Yield (lbs/plot)[1/] Rep 1	Rep 2	Rep 3	Rep 4	Ave. Yield (lbs)	Ht (in)	Bu Wt (lbs)	Harvest Moisture %	Yield (lbs/A)[2/]
WAC 715	1647	1399	1463	1325	1458	78	58	12.0	5532a
WAC 701G	1355	1455	1448	1496	1438	62	58	12.5	5456a
Funks G522DR	1398	1348	1432	1365	1386	54	57	12.2	5259ab
DeKalb DK 64	1601	1249	1279	1217	1337	67	61	13.0	5073abc
Advance 82	1392	1298	1345	1189	1306	67	58	12.9	4955abc
NK Brand 26/0	1092	1472	1285	--	1283	64	59	12.5	4868abc
DeKalb DK 57	1392	1368	1171	1129	1265	58	60	13.6	4799abc
Asgrow Double TX	1192	1250	1232	1261	1234	65	57	11.5	4682abc
NK Brand 2778	1223	1161	1279	1186	1212	60	58	12.6	4599abc
Advance 80	1188	1338	1285	1013	1206	51	56	11.7	4576abc
Acco R1029A	1123	1228	1447	1027	1206	53	56	12.0	4576abc
Asgrow Coral	1161	1364	1171	1001	1174	59	59	12.5	4455abc
Funks G623GBR	1429	974	1171	963	1134	57	57	12.2	4303 bc
Acco GR1138	1172	1170	1033	988	1091	58	58	11.9	4140 c

1/All yields adjusted to 10% moisture.
2/Yields followed by the same letter are not significantly different at the .05 level by the Student-Newman-Keuls' Test.