FIELD TRIALS in Kansas have shown that bloomless lines of sorghum (Sorghum bicolor (L.) Moench) yield significantly less than the normal bloom lines (Ross 1972). Bloom, a powdery, waxy layer on sorghum plant surfaces, may improve productivity under dryland farming conditions in arid or semiarid climates by reducing transpirational losses and increasing water-use efficiency. Evidence of differences in the leaf surfaces of sorghum is shown in in vitro digestibility trials. Rumen microbes more readily penetrate the surfaces of fresh bloomless leaves than the surfaces of bloomed leaves (Hanna et al. 1974). Bloomless types were also reported more digestible than bloom types by Cummins and Dobson (1972). We grew isogenic lines of bloom and bloomless sorghum under closely controlled environmental conditions and measured net carbon dioxide and water vapor exchange to further investigate differences between the two sorghum types.

Seven lines of sorghum, three bloom and four bloomless, were planted in soil in 12.5-cm clay pots and grown in controlled-environment chambers (Environmental Growth Chambers, Model M-2)1. Two pairs (assigned nos. 1-4) were nearisogenic lines. The other three lines (nos. 5-7) consisted of a pair of closely related bloom and bloomless sorghums and a rapidly digestible bloomless line. Plants were grown at constant 30°C, about 75% relative humidity (RH), ambient CO2 concentration and 16-h illumination at 30 klx cool white fluorescent light. Plants were watered three times daily by an automatic watering system and fertilized weekly with 20-20-20 water-soluble fertilizer.

1 Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. Dep. Agric., and does not imply its approval to the exclusion of other products that might also be suitable.

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Fig. 1. Net carbon dioxide exchange (NCE) of seven lines of *Sorghum bicolor*, three normal bloom lines and four bloomless, measured 14 days after seeding. Lines 1 and 2, also 3 and 4, are near-isogenic. Lines 5 and 6 are of very similar backgrounds, but are not isogenic. Line 7 (bloomless) is the most digestible of all sorghum lines tested.

Transpiration rates on the more mature plants followed almost the same pattern as NCE. Bloomless lines 2, 4, and 6 had 20, 32, and 10%, respectively, higher rates of transpiration than their bloom counterparts (Fig. 4). The highest rate of transpiration among the older plants occurred in line 7, the line with the highest NCE rate. Overall mean transpiration rate was 26% higher (significant 1%) in bloomless than in bloom lines.

Gas exchange ratio, NCE rate/transpiration rate (Barrs 1968), was 14 and 6% higher (significant 1%) in lines having bloom than in bloomless ones on leaves 3 and 5 or 6, respectively (Fig. 5 and 6). Bloom lines 1, 3, and 5 had 14, 9, and 16%, respectively, higher gas exchange ratios than their bloomless counterparts when measured on leaf 3, 14 days after seeding, and 5, 7, and 11% when measured on leaf 5 or 6 at 23 days. We recognize that light intensities under which this experiment was conducted were considerably less than full sunlight. We submit, however, that the bloom would affect the energy budget of leaves even at full sunlight.

At 14 days, bloom was not visible. Transpiration rate and gas exchange ratio
were different, however, evidencing differences that are not readily apparent. At 23
days, both NCE and Tr rates were less in bloom lines than in bloomless lines; however,
they were unequally affected. The consequence was a higher gas exchange ratio in
the bloom lines.

We conclude that bloom and the associated cuticle characteristics act as a barrier,
thereby modifying gas exchange properties. After bloom development, which occurs relatively early in the development of sorghum plants, both NCE and Tr rates are greater in bloomless lines. Gas exchange ratio is important in sorghum production under dryland farming conditions where water availability is often a limiting factor. It is possible that the difference in yield between bloom and bloomless sor-
ghums under semiarid conditions, as reported by Ross (1972), is a result of the differences in gas exchange ratio we observed under controlled environments. Although bloom sorghum lines are reportedly less digestible than bloomless types, the yield increase associated with their higher gas exchange ratio may result in the production of more digestible forage per hectare by bloom types under dryland farming conditions in arid or semiarid regions than by bloomless lines. Conversely, under humid conditions where adequate moisture is available, maximum production of digestible dry matter may be obtained from bloomless lines because of their higher NCE rates.

Seed was obtained from A. B. Mauder, DeKalb Ag Research Inc., Lubbock, Texas, and K. F. Schertz, Texas A & M University, College Station, Tex.


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