

Stomatal Resistance, Leaf Temperature, and Chlorophyll Content of Sorghum Hybrids Varying in Maturity

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INTRODUCTION

It is well known that hybrids of the same crop have different maturities. Reasons for varying maturity are poorly understood. Essentially no experiments have been done comparing the physiological characteristics of hybrids varying in maturity. Therefore, we grew two grain sorghum hybrids varying in maturity and measured stomatal resistance, leaf temperature, and chlorophyll content to see if they differed between the two hybrids. We also measured growth (height, number of tillers, and weight.)

Our hypothesis was that early maturing hybrids might grow faster than later maturing hybrids. Early maturing hybrids may have a lower stomatal resistance, because of their faster, earlier growth. Stomatal resistance is the reciprocal of stomatal conductance. Stomatal conductance and growth are directly related. The more open the stomata, the faster can be the rate of growth.

MATERIALS AND METHODS

The experimental plants were two DeKalb hybrids of sorghum [*Sorghum bicolor* (L.) Moench] varying in maturity:

DKS 36-16: Medium-early maturity

DKS 44-20: Medium maturity

The experiment was done in a greenhouse at Kansas State University. Plants grew in 48 pots (23 cm diameter; 21.5 cm tall) filled with a silt-loam soil obtained from a local nursery (Britts Garden Acres, Manhattan, KS). On 3 Feb. 2011, seeds of DKS 36-16 were planted in 24 pots and seeds of DKS 44-20 were planted in 24 pots (Fig. 1). The experiment was designed to see the effects of pre-flowering and post-flowering drought on the plants. However, the plants developed slowly in the soil, which turned out to be a poor medium for growth. The soil crusted and cracked (Fig. 2), causing the soil surface in each pot to dry out and the soil in the bottom half of each pot to remain wet, as determined by a soil moisture meter (Fig. 3). Therefore, differential watering of the plants was abandoned, and all pots were well watered during the experiment.

Plant height was measured 46 and 60 days after planting using a ruler. Stomatal resistance and leaf temperature were measured 55 days after planting using a diffusion porometer (Model SC-1, Decagon Devices, Pullman, WA). Chlorophyll content was measured 119 days after planting with a Konica Minolta (Osaka, Japan), SPAD chlorophyll meter. Plants were harvested 152 and 153 days after planting.

The experiment was set up as a randomized, complete block with four blocks. Because all plants were under well-watered conditions, there were 24 plants of each hybrid for each measurement (n = 24). In the following tables with plant data, means and standard errors are shown.



Fig. 1. Overview of the pots at planting Terri Branden (L) and Kalai Pidanar (R)



Fig. 2. Soil that crusted and cracked



Fig. 3. Soil moisture meter

RESULTS AND DISCUSSION

SOIL

Table 1 shows the textural analysis of the soil. The high variability in silt, sand, and clay showed that the soil was poorly mixed. It was probably a mixture of different types of soils. It could not be categorized taxonomically (M.D. Ransom, Kansas State University, personal communication).

Table 1. Textural analysis of the greenhouse soil

| Textural class | Percent (mean \pm SD) |
|----------------|-------------------------|
| Sand | 33 \pm 19 |
| Silt | 51 \pm 16 |
| Clay | 16 \pm 3 |

GROWTH

Height of the two hybrids did not differ significantly (Table 2). Number of tillers, fresh weight, and dry weight of the two hybrids did not differ significantly (Table 3). There was a tendency for the medium-maturing hybrid to produce more tillers and to have more tillers per plant, when tillers appeared, than the medium-early maturing hybrid. The medium-maturing hybrid went into boot stage before the medium-early hybrid (Fig. 4) and had more panicles at harvest (three) than the medium-early hybrid (one).

Table 2. Height of two sorghum hybrids varying in maturity

| Days after planting | DKS 36-16 Medium-early | DKS 44-20 Medium |
|---------------------|---------------------------|---------------------|
| | cm | |
| 46 | 28.5 \pm 0.7 | 29.4 \pm 0.7 |
| 60 | 47.0 \pm 1.9 | 46.0 \pm 2.1 |

RESULTS AND DISCUSSION (continued)

Table 3. Tillers, fresh weight, and dry weight at harvest of two sorghum hybrids varying in maturity

| Growth characteristic | DKS 36-16 Medium-early | DKS 44-20 Medium |
|--------------------------------|---------------------------|---------------------|
| Tillers, number on 24 plants | 27 | 29 |
| Tillers, range (tillers/plant) | 1-5 | 3-5 |
| Fresh weight/plant, g | 9.8 \pm 1.2 | 11.5 \pm 1.7 |
| Dry weight/plant, g | 5.8 \pm 0.6 | 6.3 \pm 0.8 |



Fig. 4. The medium-maturing hybrid (orange label). It went into boot stage before the medium-early hybrid.

PHYSIOLOGICAL MEASUREMENTS

Stomatal resistance, leaf temperature, and chlorophyll content did not differ between the two hybrids (Table 4). There was a tendency for the medium-maturing hybrid to have a slightly higher stomatal resistance than the medium-early maturing hybrid. Also, the medium-maturing hybrid tended to have a warmer leaf temperature compared to the medium-early maturing hybrid, which agreed with the slightly higher stomatal resistance of the medium-maturing hybrid.

Table 4. Physiological characteristics of two sorghum hybrids varying in maturity

| Physiological characteristic | DKS 36-16 Medium-early | DKS 44-20 Medium |
|---------------------------------|---------------------------|---------------------|
| Stomatal resistance, s/m | 929 \pm 118 | 936 \pm 127 |
| Leaf temperature, °C | 24.8 \pm 0.3 | 25.0 \pm 0.2 |
| Chlorophyll content, SPAD units | 42.6 \pm 1.5 | 43.0 \pm 2.2 |

Frank et al. (2012) studied 18 corn (*Zea mays* L.) hybrids varying in maturity from 98 to 118 days. Under dryland conditions in western Kansas, they found a linear, inverse relation between ear population and tiller population. That is, later maturing hybrids produced more tillers than early maturing hybrids, and many of these tillers were barren. The tendency for a higher number of tillers to appear on the medium-maturing sorghum hybrid compared to the medium-early hybrid agrees with the data of Frank et al. (2012).

When the two sorghum hybrids are grown in the field in western Kansas, the medium-maturing hybrid yields more seeds per panicle than the medium-early maturing hybrid (Pidaran, 2012).

CONCLUSION

The hypothesis of the experiment could not be validated, because the plants did not grow well in the greenhouse soil, which crusted and cracked. Number of tillers, fresh weight, and dry weight of the two hybrids varying in maturity did not differ. Stomatal resistance, leaf temperature, and chlorophyll content of the two hybrids varying in maturity did not differ. Future research will need to be done to determine if hybrids varying in maturity have different physiological characteristics. The experiments need to be done under both well-watered and dry conditions.

REFERENCES

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