RADIATION USE EFFICIENCY OF OKRA AND NORMAL LEAF COTTON ISOLINES

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Abstract

Solar radiation is the main energy input for crop growth. Accumulation of dry mater depends on the effectiveness of the crop to utilize the intercepted radiation (radiation use efficiency). Variation in leaf shape of cotton has been associated with differences in light interception and dry matter production. In this study okra- and normal-leaf cotton isolines were tested for differences in radiation use efficiency. The two isolines significantly differed in light interception and dry matter partitioning, but no statistically significant differences were observed for lint yield. Radiation use efficiency of the okra-leaf isoline was significantly higher than that of the normal leaf.

Introduction

Crop growth (accumulation of dry matter) depends mainly on the amount of intercepted radiation and the time allowed for growth (Sinclair and Muchow, 1999). The effectiveness of a crop to convert intercepted radiation to dry matter is called radiation use efficiency (RUE), and is defined as the amount of dry matter produced (g) per unit of radiation intercepted (MJ) by the crop canopy. Monteith (1977) described this correlation as linear.

Leaf shapes of cotton (*Gossypium hirsutum*) range from highly divided leaves (okra leaf) to normal leaf shape (Meredith, 1984). The variation in leaf shape results in differences in canopy architecture and light interception characteristics (Wells and Meredith, 1986). Heitholt et al. (1992) described higher yields of okra leaf isolines for a given amount of intercepted radiation, indicating that the okra leaf types utilized intercepted radiation more efficiently than the normal-leaf types. However, no values of radiation use efficiency are reported comparing cotton isolines.

Material and Methods

Cotton okra- and normal-leaf isolines of cultivar FM832 (provided by Dr. W.R. Meredith) were planted in Marianna, AR in a randomized complete block design with 10 blocks. Plot size was 15 m by 4 rows.

Measurements were recorded between pinhead square stage and three weeks after flowering and included the fraction of radiation intercepted by the crop canopy (weekly) and dry matter and partitioning (every 10-15 days). Yield components and lint yield were determined by 1 m^2 hand-picked samples and mechanical harvest. For the regression analysis and analysis of variance JMP 6 software was used. Means were separated at α=0.005.

Results

Significantly higher amount of radiation was intercepted by the normal-leaf isoline (Table 1). This was attributed to significantly larger fraction of light interception at all three growth stages measured compared to the okra-leaf isoline (Fig. 1).

Table 1. Radiation use efficiency, daily productivity and intercepted radiation of the two cotton isolines.

Isolines	Intercepted Radiation	Productivity	RUE
	$MJ\cdot m^{-2}$	$g\cdot m^{-2}\cdot day^{-1}$	$g\cdot MJ^{-1}$
Normal-leaf	273.95	14.21	1.672
Okra-leaf	246.45	15.79	2.488
P value	0.043	0.333	0.020

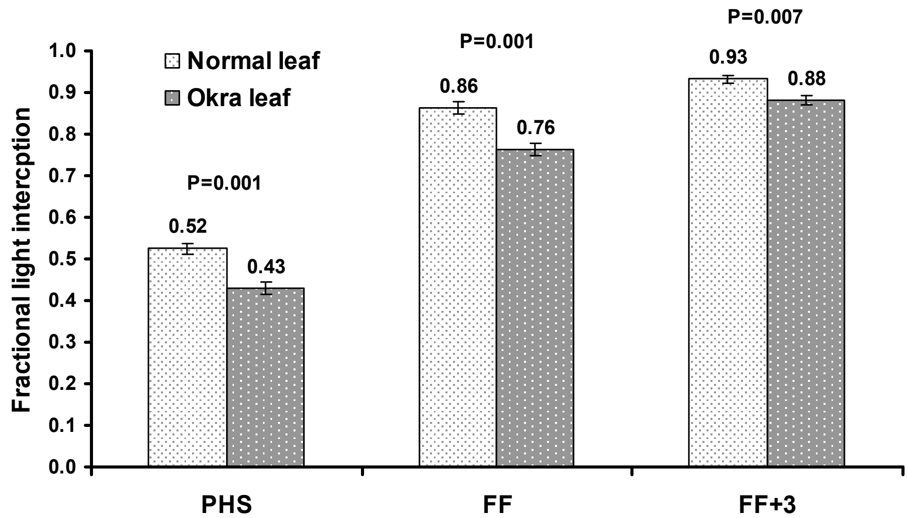

Fig. 1. Fractional light interception by the crop canopy at pinhead square (PHS), first flower (FF), and three weeks after first flower (FF+3). P values and ± 1 std. error bars are shown.

While the daily dry matter productivity did not statistically differ between the two isolines, the okra-leaf isoline had significantly higher radiation use efficiency (Table 1). In addition, at three weeks after flowering, the okra-leaf isoline partitioned a smaller percentage of dry matter to leaves and stems and a larger percentage to fruit (Fig. 2).

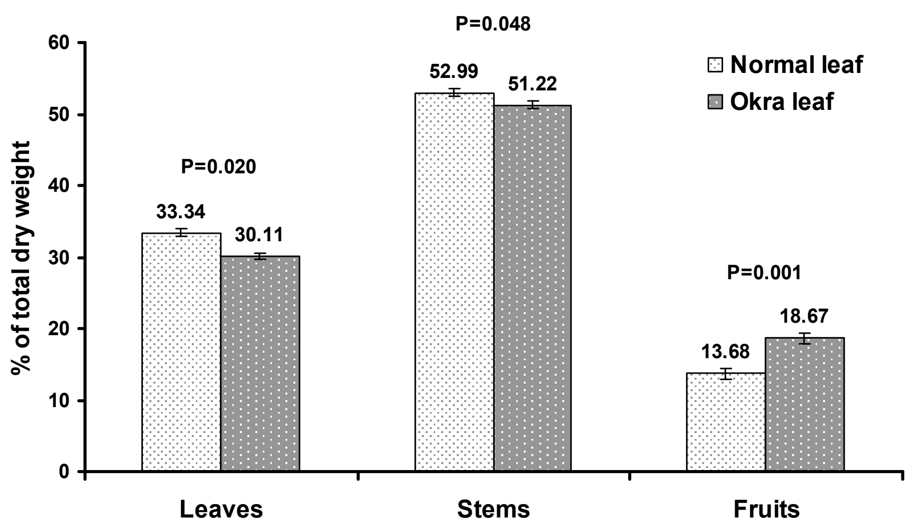

Fig. 2. Dry matter partitioning at three weeks after first flower. P values and ± 1 std. error bars are shown.

No statistically significant differences were observed between the two isolines for lint yield, gin turnout and number of bolls (Table 2). However, a larger boll size was observed for the okra-leaf isoline.

Table 2. Lint yield and yield components of the two cotton isolines.

Isolines	Lint Yield	Gin turnout	Bolls	Boll Weight
	kg/ha	%	#/ha	g/boll
Normal-leaf	1360.92	39.17	676,296	5.185
Okra-leaf	1382.89	39.72	642,252	5.446
P value	0.704	0.399	0.251	0.030

References

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