

**Reserve Starch in Pima Cotton Plants as
Influenced by Boll Load**

K. E. Fry, Plant Physiologist
USDA-ARS, Cotton Research Center, Phoenix, AZ

Summary

Starch levels in stem and root bark of cotton plants decreased when boll loads increased.

During the summer of 1983 and 1984, early-short and late-tall Pima genotypes were grown at Maricopa Agricultural Center experimental farm. Plant tissues including upper and lower stem wood and bark, tap root wood and bark, leaves, and petioles were fixed in hot alcohol, dried and ground. In this manner, the enzymatic breakdown of starch was stopped in these tissues at the time of sampling.

In 1985 the tissue analysis for starch fixed in the various plant tissues was started. To measure the reserve starch levels in the powdered plant tissue, a starch-iodine-complex color was developed in perchloric acid extracts. The method required a means to weigh 20-100 milligram samples, a colorimeter to measure color intensity, and simple glassware. A laboratory worker was able to measure starch in about 35 samples each day with a CV of about 5 percent.

Results

There were three levels of storage starch found in the cotton plant. The largest concentration of starch was located in the tap root bark. It varied from 2% to 15% of starch per dry weight of tissue. Starch levels of 0.1% to 2% were found in stem bark. Starch levels in wood tissue were usually lower than the bark tissue of the same stem or root region and sometimes approached zero. The lowest starch levels were found in the petioles which were usually below 0.1%. Leaf starch was highly variable within the day (0.5% to 5%), and for that reason, leaves were not used in a study of reserve carbohydrate. Hypocotyl tissue contained starch levels consistent with those of stem tissue and not the higher levels found in roots. In plants grown at the higher elevations of Safford, Arizona the starch levels in stem and root tissue were higher than in plants at lower elevations at Maricopa Agricultural Center. Cooler night temperatures at the high elevations may have been the cause.

During the midseason when bolls were growing, starch level in stem and root tissue was lower than during early season (before bolls) and late season (bolls matured) as shown in the Table 1.

In roots of short-early genotypes, starch levels were low (2-3%) during boll set and growth (July 7-August 19) and then gradually increased to 7-8% as more bolls matured (August 19-September 21). In the tall-late genotypes, root starch was generally higher than in short-early plants during boll growth.

During the early summer of 1984 before the bolls had set, the starch levels in stems and roots were relatively high and decreased as the boll density increased. The bolls have been considered to be strong carbohydrate sinks for carbohydrates produced daily and released from storage. Conclusions from these data are: (1) boll loads tend to draw down carbohydrate reserves; (2) the starch-level changes in root and stem bark could be used as seasonal indicators of the carbohydrate balance in the cotton field.

Table 1. Starch percentages in early-short Pima cotton plant tissues during the growing seasons as related to plant height and bolls per plant.

	1983					1984		
	7 JUL	19 AUG	30 AUG	7 SEP	21 SEP	8 JUN	26 JUN	8 AUG
UPPER STEM (Wood and bark)	0.60	0.64	.32	1.14	1.12	1.03	0.34	0.41
ROOT BARK	2.11	3.05	5.25	6.51	7.65	--	5.40	3.51
PETIOLES	--	--	--	0.05	0.05	0.40	0.05	0.01
PLANT HEIGHT (CM)*	39	90	99	--	108	18	50	108
GREEN BOLLS/PLANT (#)	11	15	15	--	14	0	4	16

* Bolls larger than 8 mm diameter but not mature.