Source and sink characteristics of various genotypes with different boll weight in cotton

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Abstract

Some physiological characteristics of both source and sink of different boll-weight genotypes of cotton were studied. It showed that genotype have different characteristics for both sink and source. Compared to small-boll genotypes, large-boll genotypes had more soluble sugar in the boll-shell and have higher starch content before 35th day of boll development. Further, leaves of the large-boll genotypes on main stem were also found to have more soluble sugar at most of the different developmental stages, which might indicate the better photosynthesis capacity of such genotypes.

Media Summary

Compared to small-boll genotypes, large-boll genotypes of cotton had higher starch content in seed, more soluble sugar in leaves of main stems and lower weight ratio of boll-shell to boll. .

Keywords

Sink-Source - physiological characteristics-boll weight genotype-cotton

Introduction

The source-sink theory about crops is studied in this paper with cotton (Ji and Yu 2000). Sink is the growing center, while source is the organs that can provide nutrition for sink. In cotton, leaves and bolls constitute the source-sink system. The leaf-boll's relationship is the main part of source-sink theory, which directly determines the yield and quality (Bhardwajsn. 1975; Li and Wang 1998; Li.1992; Zhuang.1992). Boll weight is a factor to cotton yield and a characteristic of different genotypes of cotton (Chen et al. 2002; Davidonis et al. 1996; Singh.1983). Also, it is an obvious measure of a cotton sink's quality. In this study five genotypes were selected to represent large, middle and small boll-weight genotypes respectively. The study was designed to investigate the relationship between source and sink with different boll-weight genotypes

Materials and methods

The experiment was carried out in the field located at Agricultural University of Hebei (39?N) in 2002 and 2003. Genotypes with five different boll-weights were selected. They are A1 (Sanjiangbadahua, 2.51g (seed cotton per boll)), A2 (Cehengdamianhua, 3.98g), A3 (Xinmian33B, 4.62g), A4 (Zhongmiansuo29, 5.61g) and A5 (Sumian9108, 7.49g). The density was 52500 plant/hm^2, which were sown on April 20. Each plot was 10m long and 12m wide. The soil fertility was good. The field management was similar to that of normal high yield cotton.

The bolls on the first and third node of the lower (first and second), middle (6th and 7th) and upper (11th and 12th) reproductive branches were tagged at flowering and the tagged bolls were sampled 15 days after flowering and then once every10 days until the 55th day.

Starch in seed and soluble sugar in boll-shell and leaves were extracted with vitriol anthracene-ketone method, and their contents were determined with 723-spectrophotometer.

Results

1. Differences of the content of starch in cottonseed between different boll-weight genotypes

The starch content in large-boll genotypes (A3, A4, A5) was higher than that of small-boll genotypes (A1, A2) before 35th day of boll development (Fig.1). The boll on the third node had the same trend of differences between the boll-weight genotypes with that on the first node.

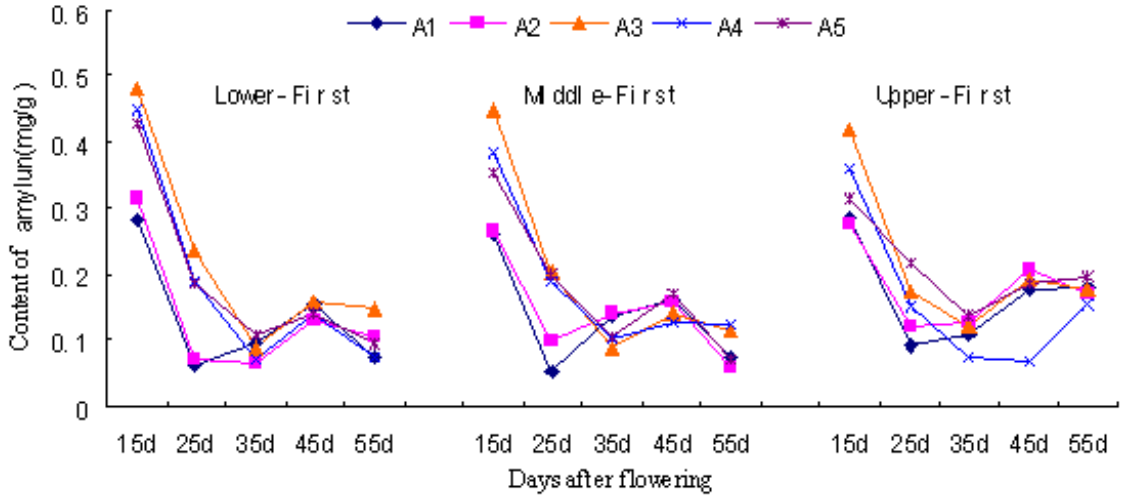

Fig.1 Changes of the starch content in cottonseeds of different spatial position of boll with different genotypes.

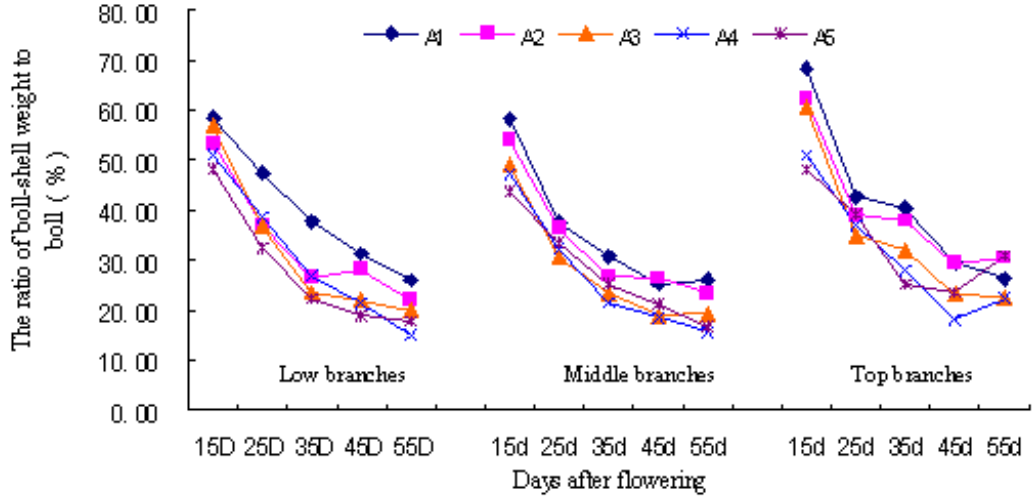

Fig.2 Changes of the ratio of the weight of boll-shell to boll on different branch levels for genotypes with different boll-weights.

2. Differences of the ratio of weight of boll-shell to the boll between different boll-weight genotypes

Fig.2 showed that genotypes with small-bolls have higher ratios of boll-shell's weight compared to those with large-bolls on every different spatial position and every development stage of bolls. Usually, the higher of the ratio of boll-shell's weight, the lower the harvest index.

3. Differences of the soluble sugar content in leaves of main stems of genotypes with different boll-weights

Soluble sugar content in leaves of main stem of large-boll genotypes was higher than that of small-boll genotypes in most of the time of cotton development (Fig.3). The soluble sugar content in these leaves declined rapidly after the onset of flowering for all of the genotypes.

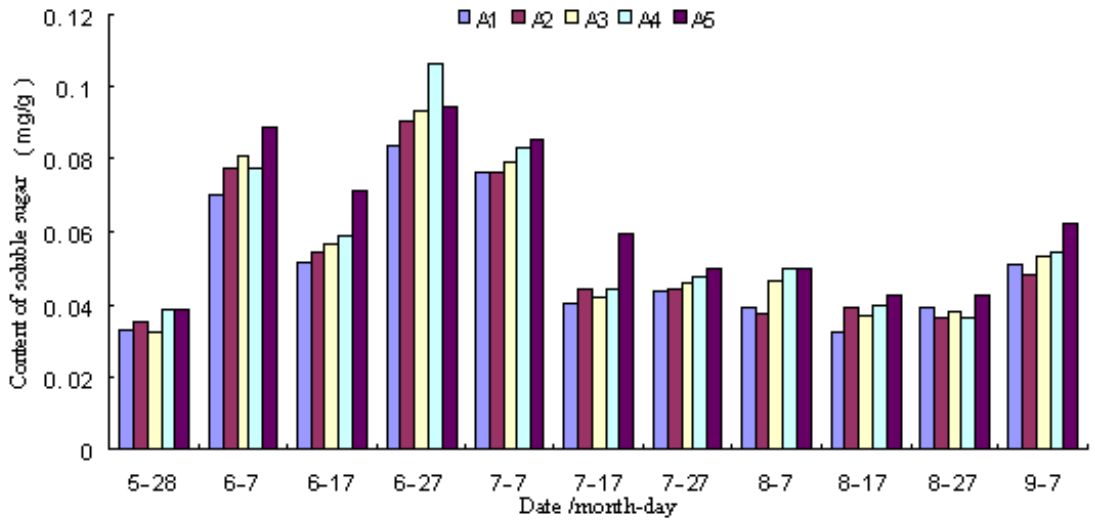

Fig.3 Changes of soluble sugar content from leaves of main stems of genotypes with different boll-weights

Discussion

Cotton genotypes with large-bolls of cotton showed higher starch content in seed than that of genotypes with small-bolls in the early stage of boll development. This indicated that there was more soluble sugar transported into the large-boll and then changed into starch. That is also meant more nutrition was available for fiber cell development in large–boll genotypes. This is very important to the increase of boll-weight, because the boll size is determined in the early stage of boll development (Chen et al. 1996, 2000).

In addition to the difference of starch content in seed between genotypes with different boll-weights, following facts might also contribute to boll development of the large-boll genotypes: (1) Genotypes with large-boll showed a low ratio of boll-shell weight to boll; (2) their soluble sugar content is higher in the boll-shell at the early stage of boll development, indicating that these boll-shells have a stronger capability to gain nutrition from the source which in turn was favorable to boll development ; (3) the higher content of soluble sugar in leaves of main stems of large-boll genotypes, an indication of better nutrition status, might also benefit its boll development.

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