

## Physiological changes of leaves on early reproductive branch caused by changing the ratio of source to sink in cotton

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### Abstract

The harmonious relationship between source and sink can be a key factor to the high yield and quality of cotton. Changing the ratio of source/sink by cutting off the buds or leaves on reproductive branches could affect the relationship of source and sink with different levels. The results of this experiment showed that changing source/sink ratios significantly affected the content of chlorophyll, dissoluble protein and starch of leaves on the lower reproductive branches. Cutting off buds could enhance the content of dissoluble protein (during July 20 – August 9), and starch (during July 9 – August 1) of the leaves. While cutting off leaves led to rapid decrease of chlorophyll and reduced the content of dissoluble protein of the leaves at the same time.

### Media Summary

Changing the ratio of source/sink by cutting off buds or leaves on the lower reproductive branches resulted in significant changes of chlorophyll, dissoluble protein and starch of leaves on the lower reproductive branches.

### Keywords

Sink-Source - physiological characteristics-ratio of source to sink-cotton

### Introduction

The source-sink theory about crops was initiated with cotton (Ji and Yu 2000). Sink is the growing center, while source is the organs that provide nutrition for sink. In cotton, leaves and bolls constitute the source-sink system. The leaf-boll relationship is the main part of source-sink theory, which directly determines the yield and quality (Bhardwajs 1975; Li and Wang 1998; Li 1992; Zhuang. 1992). Many studies on the relationships between source and sink in cotton had been done in recent years (Chen et al. 1996, 2000, 2002; Zhuang. 1992; Ji and Yu 2000 ). Compared with grain crops, the reproductive organs of cotton distribute dispersedly and their structure is more complicated (Chen et al. 1996). For example, the 'bolls-leaves systems' of cotton can be divided into different levels. These include "boll and the leaf at the same node of reproductive branch", "bolls and leaves at the same reproductive branch", "bolls and leaves at the same plant". Previous studies on these systems mostly focus on the level of "bolls and leaves at the same plant" (Chen et al. 1996, 2000, 2002; Zhuang. 1992; Ji and Yu 2000). This experiment was designed to study the effects on physiological characteristics of leaves on early reproductive branch by cutting off the early buds or some leaves on the same reproductive branch of cotton.

### Materials and methods

The experiment was carried out in the field at the Agricultural University of Hebei (39°N) in 2002 and 2003. With the treatments of cutting off some buds or leaves on the lower reproductive branches at the early flowering, the effects of changing source/sink ratios on physiological characteristics of boll-leaf system were studied. Utilizing BT-transgenic hybrid cotton CCRI29 variety as material, the trimming experiment was made by three treatments: A) cutting off leaves of other nodes on the same reproductive branch (one leaf support two bolls) at 8d after anthesis; B) cutting off buds of other nodes on the same reproductive branch (two or three leaves support one boll) at 8d after anthesis; and C) normal trimming management as the same with large field cotton production. Concurrently, different levels of N-fertilizer

were applied in the trimming experiment:(1) high-N: applied 375.0 kg?hm<sup>-2</sup>N in all; (2) middle-N: applied 187.5 kg?hm<sup>-2</sup>N in all; (3) no N applied. The row width?plant spacing was 75cm?25cm. Planting density is 5.24?10<sup>4</sup> plants?hm<sup>-2</sup>.

The contents of chlorophyll, soluble protein and starch was extracted and determined using the methods as described by Bai et al (2001).

## Results

Changes of source/sink ratios affected the content of chlorophyll, dissoluble protein and starch of leaf on the lower reproductive branch (Fig.1, Fig.2, Fig.3). Removing leaves at the leaf growth prophase (before Aug.1) resulted in the highest chlorophyll content of leaves. In leaves growth anaphase (after Aug.1), cutting off buds boosted the chlorophyll accumulation in leaves, which in turn extended leaf function period. However, removing leaves led to rapid decrease of the chlorophyll content, (these leaves showed the signs of early ageing), and also reduced the content of dissoluble protein of the leaves.

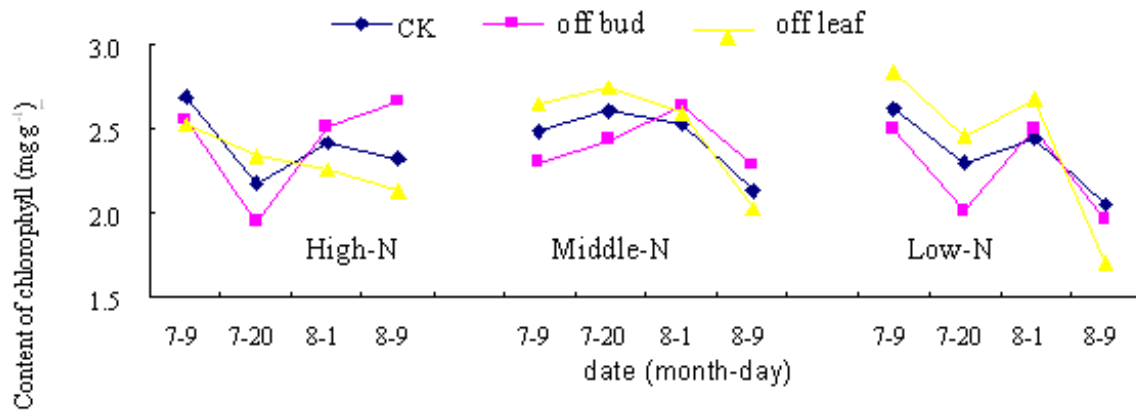


Fig.1 Effect on content of chlorophyll in leaves on early fruit branch by changing the ratio of source to sink

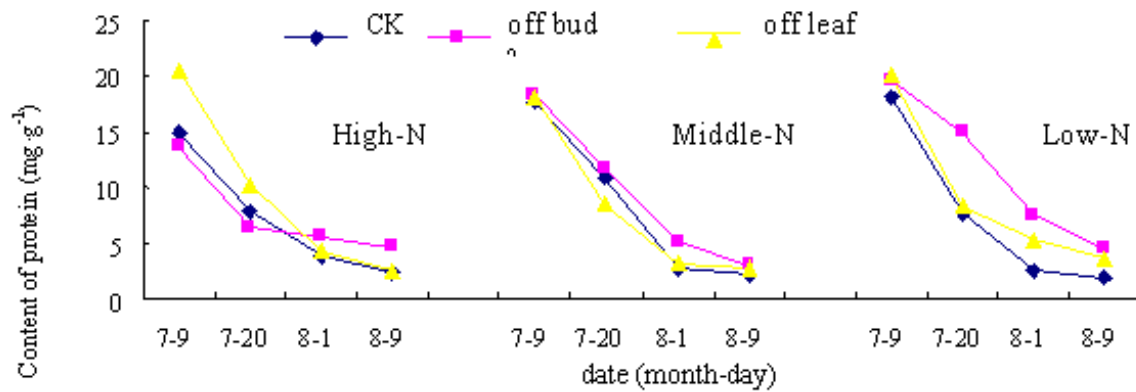
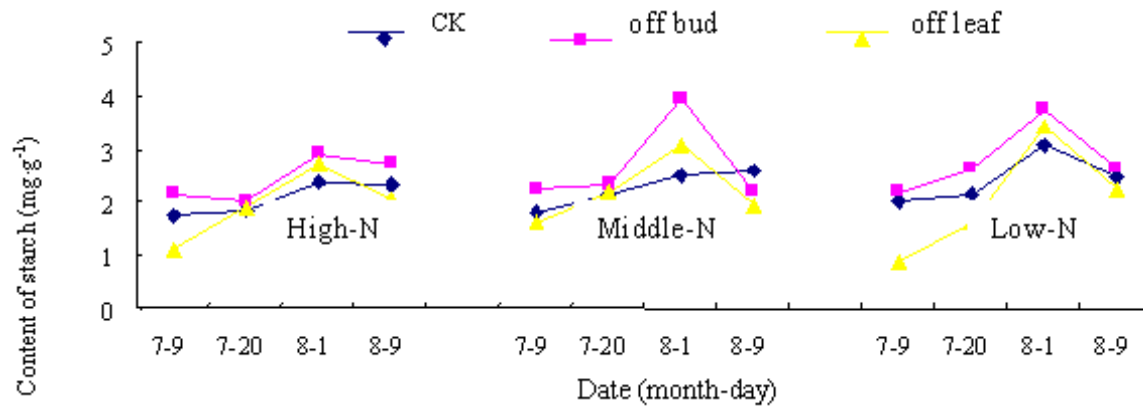


Fig.2 Effect on content of protein in leaves on early fruit branch by changing the ratio of source to sink



**Fig.3** Effect on content of starch in leaves on early fruit branch by changing the ratio of source to sink

Compared with CK, removing buds enhanced the content of dissolvable protein (during July 20 – August 9), and starch (during July 9 – August 1) of leaves on the lower reproductive branches, which can maintain more active physiological function of the leaves. All of these changes could contribute to the increase of boll weight.

## Discussion

The harmonious relationship between source and sink is very important to the high yield and quality of cotton (Chen et al. 2002; Ji and Yu 2000). Many methods can be exploited to regulate the ratio of vegetative and reproductive growth in the research and production of cotton in order to enhance this harmonious relation. In this study, with the method of cutting off the early buds or leaves on early reproductive branches, the different ratio of source and sink were achieved. The results showed that the changes of source/sink ratios significantly affected the content of chlorophyll, dissolvable protein and starch of leaves on the lower reproductive branch. Generally, the increased ratio of source/sink improved the physiological status of leaves on reproductive branches, which led to increase weight of seed cotton per boll and the prevented the early ageing of cotton plant. In this experiment, both the weights of boll-shell and seed cotton were significantly enhanced with the treatment of cutting off early buds. This also demonstrated that there must be the transportation of nutrition from the leaf without boll on the same node to the boll on the neighbor node of the same branch.

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