THE HISTORY OF COTTON PHYSIOLOGY

Jack Mauney
Cotton Physiologist
Scottsdale, AZ

This will not be an exhaustive examination of all that has happened in this discipline or at this Conference. Instead, it will be a series of anecdotes which I believe can instruct us about the folly of becoming dogmatic in our views about what seems 'obvious.' The take-home message of this essay is "Listen to the cotton plant." The cotton physiological system is unique, as is that of all species. We are at risk when we assume that some historical belief about it, or a transfer of data from another crop, will surely tell us how it will behave. The history of the study of cotton physiology is replete with instances of our traveling down wrong paths for decades because we were not sufficiently sensitive to its uniqueness.

First, let us look at the record of productivity by this crop in the United States. From 1900 to 1940 the yield per acre hovered in the neighborhood of 200 pounds of lint per acre. Since the yield of long term unfertilized field plots is at this level, those early yields were probably due largely to limitations of nitrogen in the soil. The nation produced 10 - 15 million bales of cotton annually in those years, but it took 40 million acres of the land to do it. In the 1940's the national yield per acre began a steady increase, and by 1960 had reached the 500 pound per acre plateau.

The word "plateau" is appropriate because the phrase "Yield Plateau" was used frequently from 1960 to 1980 to express the frustration of the industry about the stagnation of yields during those decades. In 1980 yields began to increase once more and by 1987 were at the 700 pound per acre level where we remain today. Have we reached another "plateau"?

It can be argued that the research focus on the morphological and physiological system of the cotton production system enabled this spectacular increase in productivity, over three fold, during the 50 years of the Cotton Physiology Conference. The modern tools for management; genetic traits, pest protection, chemical growth regulators, nutrient and water supply, are grounded in the widespread understanding of the basic biology that growers must deal with to successfully culture this wonderful plant.

The names of our cotton physiology forebears are widely recognized outside the cotton fraternity. Cook, King, Eaton, Ergle, Addicott, Carns, Hall, Mason, Tharp, were substantial scientists. At the turn of the century O.F. Cook was the definition of cotton research. His publications are about all there is in the literature. He described the cotton plant and its flowering habit as having close similarities to that of the coffee plant with which he was familiar. In his description, there are two branch buds at the base of each leaf, an 'axillary' and an 'extra-axillary' bud. He viewed the 'axillary' (dominant) bud as the one which produced vegetative branches, and the 'extra-axillary' as the source of fruiting branches.

That description was repeated in all summaries of cotton literature including the seminal paper in the 1951 Annual Review of Plant Physiology by Frank Eaton, "Physiology of the Cotton Plant". Unfortunately it is inaccurate. In 1960 I had to rename those axillaries as 'first axillary' (dominant), and 'second axillary' to avoid name confusion. The first axillary is the source of both vegetative and fruiting branches. When branching is vigorous, the second axillary may also be either vegetative or fruiting. Understanding branching has been fundamental to understanding plant mapping and boll loading which now commands so much of our attention.

Frank Eaton, together with David Ergle, taught us much about the efficiency of the cotton production system. Their data sets, recorded from 1930 to 1950, are so thorough that they can be referred to today to determine if modern culivars are more or less efficient in carbohydrate allocation that were the cultivars of old.

In the early years of the Cotton Physiology Conference (1947-55) the gathering met with the Southern Agricultural Workers Conference and was known as the Cotton Defoliation Conference. Hardy Tharp and those who were trying to make defoliation into a science saw the need to exchange data. One to two dozen papers were the extent of those meetings. In 1954 the National Cotton Council initiated the Beltwide Cotton Production and Research Conferences. With some changes in name the conference has florished and will present 130 papers and posters at the 1997 conference.

The emphasis on cotton leaf abscision led to a seminal event in plant phyisiology. In 1963 Harry Carns, in the UCLA cotton laboratory of Fred Addicott, identified the structure of a compound from cotton bolls which retarded abscision in a bioassay. They named it 'abscisin II' and that name gained precedence over 'dormin' which had been isolated in another laboratory. After some controversy the name Abscisic Acid, ABA, was assigned to that structure, and the rest is history.

In the early 1970's cotton physiology became focused on the possibility that the cotton production system could be mathematically simulated in computer models. Herb Stapleton's SYMCOT and Donald Baker's GOSSYM led us into the age of the computer. Unfortunately, the full benefit of that dream still alludes us. But the focus on the

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factors of production which can limit productivity have lead to plant mapping and real-time management discision aids which have fine tuned the production system.

The decision to hold a series of Cotton Physiology Symposia in 1979, ‘80, and ‘81 was a major step in the history of this Conference. It not only enabled the publication of Volume I of Cotton Physiology, but more importantly it brought to light some little recognized facts about this plant that were lying dormant in the literature. One such fact was that the first boll on each fruiting branch accounts for the majority of yield each season. Reports from as early as 1940 had made this observation But the observation was not widely recognized in this country. The realization that the plant architecture plays a role in the quality and volume of the crop has lead modern growers to use plant mapping and growth regulators to push the productive potential of the plant to its limits.

The Physiology Conference has had its share of controversy. In 1976 I announced to the conference that I believed that a major cause for square shedding prior to mid-season heavy boll loading was not high temperatures but insect damage. I believed that there was evidence that plant bugs were a major source of this damage. Subsequent research proved this belief to be correct. But serious arguments took place as to the wisdom of insecticidal control of these pests. Those arguments continue today. However, the realization that weather was not reponsible for much of early square shedding set the industry on a course of emphasis upon earliness which, I believe, resulted in the surge in productivity which took place in the 1980’s.

The cotton fiber is one of the purest sources of cellulose found in the plant kingdom. It’s size and rapid growth have made it a ready subject for the study of cellulose biochemistry. Therefore, much research in that arena has been reported outside the confines of the Physiology Conference. Our Physiology Symposia enabled this conference to bring that body of data to the attention of cotton biochemists.

Emphasis upon nutrients has always been a feature of cotton physiologists. Eaton examined the relationship of nitrogen and productivity. Howard Joham made a career of studying all the major and minor elements. While nitrogen was the focus the the early decades of the Conference, potassium has become the center of interest today. This is probably because of the intersection of soil depletion and crop demands. As the productivity of this crop has increased, the demands on the supply of potassium have come to exceed depleted soil resources.

And that is the story of the continuing need to assess and research the physiological capabilties and limitations of this wonderful crop. We find relief for one limitation and move to another level where everything may have to be re-examined. Listen to the cotton plant. It makes for a wonderful conversation.