PHYSIOLOGY TODAY

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Effect of Cold Weather on Yield and Quality

Kater Hake, Tom Kerby & Will McCarty

Cold weather, anytime from April to harvest, is rough on cotton. When cold or wet weather hits early, as it did in the West last year and the Mid-South this year, harvest is delayed, often into adverse fall weather. Cold weather late, during boll development, such as the Mid-South and Southeast states are experiencing this year, raises concerns about reduced yield and lower quality. Premature crop termination can also be a problem with cold weather because cotton needs every warm day it can get in the spring and the fall to mature the crop.

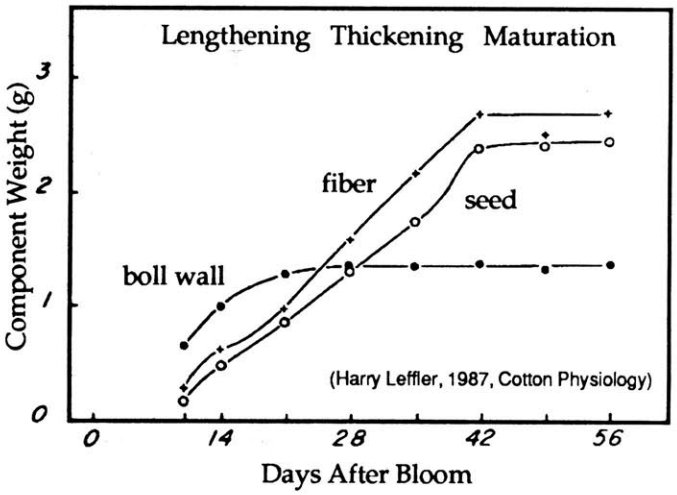
Growers with late fields must juggle two major factors in determining when to defoliate: the yield and quality loss from early defoliation versus the risk of loss from wet weather. Early defoliation or premature crop termination halts lint and seed development which has a predictable effect on yield and quality. An understanding of the effect of cold weather and premature crop termination on yield and quality will help growers manage late developing fields and decide the optimum time to defoliate cotton.

Causes of Premature Crop Termination

After a defoliant is applied the lint and seed will continue to develop for approximately one week, while desiccation halts boll development within a couple of days. Surprisingly we do not understand the limits of temperature and leaf activity under which bolls will continue to mature. Unpublished data from Tom Kerby and Ted Wilson indicate that bolls will develop at temperatures down to 45°F, although at a snail's pace and with reduced quality. Besides defoliation, many other factors halt further boll development. Vascular wilts such as Fusarium or Verticillium, severe potassium deficiency and severe mite damage can halt boll development.

Boll Development

The cotton plant regulates its fruit load by shedding squares and young bolls. This "thinning", although potentially detrimental to yield, lessens the impact of early stress on quality. Only stresses during the last stage of boll development, such as premature crop termination or cold weather, are detrimental to quality. The following figure shows boll weight development from bloom to open boll.



The boll wall stops growing early during boll development while fiber accumulates weight both during the lengthening and thickening stages. The seed continues to accumulate weight after lint reaches its maximum weight. This differential rate of seed and lint development is the reason that immature bolls usually show a slightly higher lint percent or turnout than mature bolls. And also results in planting seed vigor being the most sensitive quality component decreased by premature crop termination or cold pre-harvest weather. Following a cool fall growers will want to select planting seed carefully.

Also In This Issue

Lint Development

The greatest economic impact of premature crop termination and cold weather is not on seed but on lint. The primary effect on lint is on thickening rather than lengthening. Since fibers elongate before they thicken, staple length is minimally influenced by premature crop termination or cold pre-harvest weather. Additionally, fiber lengthening can occur at colder temperatures because the optimum temperature for lengthening is 10°F colder than for fiber thickening.

Once fibers reach their final length they thicken with daily rings of cellulose. Unlike a tree that grows outward by depositing new rings on the outside of the previous year's growth, cotton fibers deposit new daily rings inward. The daily rings alternate in direction as they fill in the hollow part of the fiber or lumen. When the lint is mature, the lumen is a small hollow core. The last stage of boll development starts with the formation of the abscission zone between the burs. Drying then causes strands in the boll wall or carpel to tighten and subsequently bend backwards opening the boll. As the boll opens, the lint dries and crimps due to collapse of the lumen and constriction in alternating layers of cellulose. Crimping of the lint causes it to fluff and intertwine allowing it to be spun into yarn. Boll drying can occur without leaves on the plant and under cold temperatures.

Quality Effect

Cutting short the deposition of growth rings has several important quality implications. The most apparent effect is reduced maturity. With reduced maturity fibers, will be lighter and the 50 grain (3.2g) micronaire sample will therefore be composed of many more fibers. Thus air movement through the chamber will be reduced causing a low micronaire reading. Individual fiber strength is also decreased with premature boll termination. This can cause greater fiber breakage, decreased length uniformity and increased short fiber content, especially if cotton is ginned too dry or excessively cleaned. Fiber strength as measured by HVI may not be decreased because when the fiber weighs less, more fibers are included in the strength reading.

Immature fibers have also been implicated in nep formation and reduced dyeability, problems that show up in the textile mill and reduce the desirability of cotton. Even when late-set bolls are allowed to mature, low micronaire is anticipated because the colder the night temperature during boll filling, the lower the micronaire. For example, Arizona with its high night temperatures can experience very high micronaire. Hot day temperatures will not compensate for this cold night time effect. Cool temperatures do not generally reduce HVI fiber strength.

Yield and Dollar Loss

For growers, premature crop termination will affect gross returns primarily due to yield loss and bale penalties from low micronaire. Yield loss due to interruption of boll development can be estimated from micronaire. For every tenth point decrease in micronaire, below normal for a particular variety, yield is decreased approximately 2.5%. A half point drop in micronaire from 4 to 3.5 would be associated with a 12.5 % decrease in yield. Low micronaire is also penalized heavily in the marketplace. The following table shows the percent of the U.S. crop with mike below 3.5, the average spot market penalty for low mike and the states most severely affected. This yield and quality loss may be slight compared to the dollar loss if the delayed harvest exposes the lint to soggy weather.

Micronaire Penalties, Percent of U.S. Crop and Average Cents Off per Pound of Lint

	1988	1987	1986	1985	1985
Percent of Crop below 3.5 Mike	9.9	16.5	15.9	10.2	23.2
Avg. Cents Off per Lb.	2.33	2.13	2.01	2.29	2.44
Regions Affected	NM,TX MS,AZ	NM,TX, OK,GA	NM,TX, OK	NM,TX, OK	TX,NM, OK,SC

(Jess Barr, National Cotton Council, Economic Services)

The next table shows the yield and quality loss from premature crop termination in the San Joaquin Valley. In location 1, Verticillium wilt terminated the crop in mid-August, decreasing yield, micronaire, and length uniformity of the susceptible variety, SJ-2. Lint strength and length were not affected, while lint percent increased in SJ-2 with heavy wilt. In location 2, the crop was not terminated prematurely. Yields and quality are typical for

these two varieties under favorable growing conditions. As an example of the relationship between micronaire and yield, we could predict the yield of SJ-2 in location 1, based on the yield difference between varieties in location 2 (no micronaire differences) and the micronaire difference in location 1. Our estimate of the SJ-2 yield in location 1 would be 1265 lbs, within 2 % of the actual yield.

Premature Crop Termination Hurts Yield and Quality						
	Yield	Mike	Length Unif.	Strength HVI	Length HVI	Lint %
Location 1 - Heavy Verticillium Wilt						
SJ-2	1284	3.45	81	29.5	1.18	39.2
GC-510	1521	3.9	82.5	29.5	1.17	40.6
Location 2 - Low Verticillium Wilt						
SJ-2	1225	4.4	82	28.5	1.14	37.3
GC-510	1297	4.4	82	29.5	1.15	40.1

(Dick Bassett, 1988, Acala Cotton Board)

Mississippi cotton yields during the last decade demonstrate the sensitivity of micronaire to adverse weather and premature crop termination. The following table displays the yield and quality for the cotton harvested in Mississippi. During the years of 1979 and 1984, statewide micronaire averages dropped precipitously but yield, strength and staple length were normal.

Mississippi Cotton Yields and Quality - 1979 - 1988				
Year	Yield	Mike	Strength	Staple
78	561	47	NA	34.4
79	657	41	NA	34.4
80	488	47	23.9	34.8
81	626	43	24	34.5
82	853	44	25.3	35.5
83	640	44	25	34.8
84	767	40	24	35.4
85	764	43	24.4	34.9
86	571	44	25	34.2
87	829	41	26.6	34.7
88	736	43	24.8	35.1

(USDA-AMS Cotton Division)

Management Options

The decision of when to defoliate late fields rests with the balancing of the dollar loss from premature crop termination versus the risk of adverse fall weather. Attempting to defoliate immature cotton during cool weather is more difficult than defoliating mature cotton and will require full label rates and multiple applications. When we plant cotton late, we want to avoid genetically low micronaire or late maturing varieties. Short season cultural practices (early fruit protection, PIX, PREP, and moderate N levels) are appropriate with late cotton. Whether to shoot for a once-over-harvest will be influenced by the marketing strategy. Growers that custom market their cotton and are building a quality reputation may want to double pick to avoid mixing in late maturing, low quality bolls with the first pick.

With the increased emphasis on quality in the marketplace, understanding fiber development and the effect of management on quality will be even more critical. This newsletter, although focused on cotton physiology, will attempt to cover the economic and quality implications of physiological topics.

Introduction to the NCC - CPEP

Andy Jordan

The National Cotton Council initiated the Cotton Physiology Education Program, to assist growers in understanding the plant and utilizing that knowledge for improved production practices. This program is funded by The Cotton Foundation for three years. Kater Hake manages the program and develops information such as this first newsletter. He joins the National Cotton Council after nine years as a Cotton Farm Advisor in the San Joaquin Valley. Kater is completing a Doctorate in Plant Physiology from the University of California at Riverside.

Other planned components of the Cotton Physiology Education Program include Beltwide and regional seminars, plant mapping kits and interpretive guides, radio and video programs and technical bulletins on pertinent cotton physiology topics. We are working closely with Extension Specialists and growers and consultants to make this program

as useful as possible. If you have any topics that need to be covered, or wish to provide input for this program, give Kater a call at our office in Memphis, 901-274-9030.

Beltwide Cotton Conferences

Jim Brown

The Beltwide Cotton Conferences are the annual focus for meetings on production and marketing information and research developments, nationwide. These conferences have grown to 2,500 participants and are well-attended by growers. The 1990 conferences will be held in Las Vegas beginning on Wednesday morning, Jan. 10, with a grower oriented Physiology Seminar on "Causes of Square and Boll Shed", and on "Plant Mapping". The Production Conference will start Wednesday afternoon and continue through Thursday. Friday and Saturday will be devoted to technical sessions on topics such as Plant Nutrition/Fertilization, Entomology, Weed Control, Marketing, Quality and Plant Disease among others.

Room rates at the Riviera for these conferences are $48 per night single or double. Registration, which includes a complete copy of the proceedings, is $50. For further information contact Debbie Richter of the National Cotton Council at 901-274-9030.

The Cotton Physiology Education Program is supported by a grant from The Cotton Foundation, and brought to you as a program of the Technical Services Department, National Cotton Council.

The National Cotton Council (NCC) is the central organization representing all seven sectors of the U.S. cotton industry: producers, ginners, warehousemen, merchants, cottonseed crushers, cooperatives and manufacturers. A majority of elected delegates from each sector must approve all NCC policies, thus assuring unity of purpose and action.

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