

Texas High Plains 2011 Cotton Irrigation Termination

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Texas High Plains cotton producers have had a very difficult year to say the least. The season started with difficulty establishing irrigated stands in most areas and near complete failure in dryland fields. After establishment, stands ranged from very poor or “skippy” to excellent. Since establishment, persistent hot dry winds and high daily temperatures (high’s and low’s) have been very detrimental to irrigated crop development despite virtually non-stop irrigation applications. Most cotton producers have done an excellent job, under the circumstances, maintaining established irrigated fields under all irrigation practices (sub-surface drip, LEPA and LESA center pivot, and furrow irrigation). However, with little to no rainfall, their efforts have resulted in a crop that now is fast approaching, or in some cases, has reached cutout (nodes above white flower (NAWF)=5).

Currently producers are faced with the difficult decision of how much longer they should continue irrigation, or whether or not they should continue irrigating a crop that may or may not produce enough lint to pay for the input costs (mainly irrigation) that have already been incurred. The decision to terminate irrigation is dependent upon the condition and developmental level of the cotton crop in question. In 2011 I have observed three different levels of development. The first level includes those fields that are near normal in development, or those that entered first bloom at 8-10 NAWF and now are approaching cutout. The second level is described as cotton crops that came into bloom at 6-7 NAWF and are now at or beyond cutout. Finally, the third level includes fields that entered bloom at 5 NAWF or less or are just now beginning to bloom and are at cutout.

Although scarce, there are some “pockets” of fields that would be considered as level one in my opinion (~10% to 20% of the High Plains irrigated cotton crops). When considering these first level fields, producers should refer to “normal” practices when determining irrigation termination. However, with the current conditions (continued hot and dry), adjustments may need to be made to insure that the last effective boll be allowed to fully develop. Using normal irrigation management decision keys should suffice for those crops contained in the first level with extreme care taken in determining residual soil moisture content. It is worth noting that irrigation termination under normal conditions considers moisture reserves and this year little to no reserves will be available.

Second level fields can be broken down into two categories. First, if the terminal is still active and the crop has just now reached cutout, producers may consider adjusting their countdown to irrigation termination to assure retention of their last harvestable bolls. However, if the terminal

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has little or no activity and the crop has reached hard cutout (NAWF<5), consider the current bloom as the last effective and start the countdown to termination immediately. Based upon what I have observed, approximately 60-70% of the High Plains irrigated cotton falls in this category.

Cotton fields in the third level comprise 20-30% of the Texas High Plains irrigated crop this year. Fields in this level have entered bloom at cutout (NAWF<5), or have been significantly delayed and just begun to bloom. At this point these fields have either set all the bolls they can or, if just entering bloom, may have a significantly reduced yield potential. Producers whose fields are in these two situations may wish to consult their insurance provider to assess the yield potential of the crop. If the plants have set all the harvestable bolls they can and have essentially reached full maturity, accurate boll counts could be taken to indicate overall yield potential. Special consideration should be given to the fact that mature boll size could be reduced by up to 50% of normal in these fields.

Regardless of the level of development of an individual producer's field, it may be advisable to terminate/begin reducing irrigation as soon as possible to reduce further input costs as well as give the irrigation systems in the Texas High Plains a well deserved "rest". To assist in the decision making process for those producers with crops that have higher yield potential (level 1), the following is an excerpt from a 2008 edition of Texas AgriLife Extension "Focus on South Plains Agriculture" concerning irrigation termination developed by Dr. Randy Boman.

Irrigation Termination

The 2008 growing season has resulted in exorbitant irrigation expenses for many producers. Some fields are now entering cutout. In any given field, the last irrigation will be dependent on seasonal conditions, soil type and the irrigation system being utilized. Ideally, the last irrigation should provide just enough plant available moisture to retain and mature all the bolls that have a reasonable chance of producing lint of acceptable quality under normal growing conditions. Based on historical long term seasonal conditions at Lubbock, blooms set on August 10 have a 100 percent probability of producing a **fully mature cotton boll** whereas blooms set on August 15 and 25 and September 1, respectively, have only 71, 29 and 14 percent respectively, chance of reaching maturity. More recently, with the warmer growing seasons experienced in some years, and especially in the southern counties in the High Plains, these final bloom dates have been pushed somewhat later into August. Normally a boll will be retained once it reaches 10 -14 days after bloom. The goal is to avoid excessive moisture stress at least until the final bloom to be taken to the gin becomes about a 10-14 day old boll. This will reduce the likelihood of small bolls shedding due to water stress. After that, late bolls can handle more stress. For a boll set on August 10th, excessive moisture stress should be avoided at least through the end of the month, unless rainfall can offset irrigation requirement. Approaching the boll opening stage of cotton, the crop coefficient decreases from about 1.0 at first open boll to about 0.8 at 30 percent open bolls and it decreases rapidly after that. If reference ET is averaging 0.25 inches per day, and the crop coefficient is 1.0, then at first open boll the crop ET is 0.25 inches/day (0.25 x 1.0) or 1.75 inches per week. As the crop approaches boll opening phase, if reference ET is averaging 0.25 inches per day, the crop will use about 1.4 inches per week (0.25 x 0.8 x 7 days). A rod probe, soil water

monitoring equipment, or other tools may be useful to determine the amount of moisture remaining in profiles in fields.

Irrigation System Suggestions

In the High Plains, furrow irrigation applications that bring soil moisture levels to near field capacity should be terminated by mid-August. There is considerable management utility in using deficit irrigation with center pivots and SDI to apply small amounts of water extended into early September as needed to minimize fruit shed. Because of highly controlled irrigation amounts in center pivot or SDI, producers may need to "weanoff" high yielding fields and not terminate completely at that time. With center pivots and SDI, low amounts of irrigation can be applied if the cotton is severely stressed after initial termination. If the amount of wilting is unsuitable for the boll load, then the pivot can be passed over the field or drip applications may be made to apply additional water. These amounts could be as small as 0.75 to 1 inch per week depending upon profile moisture and crop conditions. Table 1 contains irrigation deficit replacement values based on irrigation capacity.

Table 1. Limited cotton irrigation for a 1/4 mile center pivot on 120 acres.

GPM for Circle	GPM per acre	LEPA Inches per day limit (at 95% efficiency)	Percent deficit replacement (at 0.24 inches per day water use)	LEPA Inches per week limit (at 95% efficiency)	Spray Inches per week limit (at 85% efficiency)
180	1.5	0.07	32	0.53	0.48
240	2.0	0.10	42	0.70	0.63
300	2.5	0.12	50	0.84	0.79
360	3.0	0.15	63	1.05	0.94
420	3.5	0.17	71	1.19	1.10
480	4.0	0.20	83	1.40	1.26
540	4.5	0.23	96	1.61	1.42
600	5.0	0.25	104	1.75	1.55

In many years the value of continued center pivot irrigation and SDI after bolls begin to open is probably questionable, unless extremely high temperatures and high ET are encountered and the field has a depleted moisture profile and a late boll load. Generally, we observe about 2-5 percent boll opening per day once bolls begin to open. This implies that if the last irrigation is made at a few percent open bolls, then it should take about 10 days to reach 30-60 percent open bolls. Research projects addressing these issues are underway. Preliminary results of a 2007 project indicate that untimely early irrigation termination significantly reduces yields. Water holding capacity of various High Plains soil types are included in Table 2.

Table 2. Average available water holding capacities for typical High Plains soils.

Soil series	Dominant texture	Available water holding capacity, inches/foot
Amarillo fine sandy loam	sandy clay loam	1.8
Amarillo loamy fine sand	sandy clay loam	1.7
Arvana fine sandy loam	sandy clay loam	1.8
Brownfield fine sand	sandy clay loam	1.4
Portales fine sandy loam	sandy clay loam	1.6
Acuff loam	sandy clay loam	1.9
Olton loam	clay loam	2.0
Estacado clay loam	clay loam	1.6
Pullman clay loam	clay	1.8
Miles fine sandy loam	sandy clay loam	1.8
Ulysses clay loam	clay loam	1.6
Mansker loam	clay loam	1.8
Lofton clay loam	clay	1.9

Data from High Plains Underground Water Conservation District No. 1 and USDA-NRCS.

Using Plant Mapping/COTMAN

When using the COTMAN program funded by Cotton Incorporated and developed by the University of Arkansas, various investigators across the Cotton Belt have noted that irrigation termination at about 400-600 DD60 heat units past cutout (here defined as Nodes Above White Flower or NAWF = 5 on a steep decline) has been reasonable in some areas. One low yielding trial (about a bale/acre) conducted by Extension IPM agents at the AGCARES facility at Lamesa in 2003 indicated 600 DD60s optimized yield and net returns from LEPA irrigation. A SDI project conducted on 1100 lb per acre cotton in the St. Lawrence area indicated that **untimely early** termination based on heat units past cutout resulted in yield losses. **However, it was concluded that few benefits were noted by extending SDI irrigation past 500 HU after NAWF = 5.** Most of the project reports published in the Beltwide Cotton Conference Proceedings and other publications lacked information on soil profile moisture status in the trials at the time the irrigation was terminated. We suggest producers use this only as a guide.