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IDEAL IRRIGATION DEFICIT FOR MID-SOUTH COTTON BASED ON SOIL TYPE

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Introduction

Irrigated cotton yields in Missouri are approximately 285 pounds of lint higher per acre then are dryland yields. Additionally, within the subset of Missouri irrigation users, those irrigators who actually utilize an irrigation-scheduling program will increase this yield differential another 100 pounds, versus irrigators who do not employ any scheduling tool. These data come from annual irrigation surveys for the period, 2000-2003.

An essential part of irrigation scheduling, is to know the ideal deficit point at which irrigation must be re-applied to obtain highest yields. The focus of this study was to test various deficit amounts on several soil types to empirically determine the optimum deficit.

It is interesting to note that there is a dichotomy between the western US and the mid-South in regards irrigation amount-timing. Often in the west, the concept of irrigation amount-timing is thought of in terms of *interval*, specifically, days between irrigation events. In the mid-South the focus is on the amount (commonly termed *deficit*), in units of inches applied per irrigation. Probably on of the reasons for this dichotomy is that under western conditions cotton farmers can go longer between irrigations (with associated higher application amounts). In the mid-South where rains are more frequent and hardpans more problematic, the interval (and, thus, also, the a applied amount) is smaller.

Methods

The tests were conducted at the University of Missouri Delta Center near Portageville, MO. As discussed, the main purpose of the test was to identify the ideal deficit for various combinations of SOIL TYPE x IRRIGATION METHOD. The tested irrigation deficit amounts were:

- 0.75 inches
- 1.00 inches
- 1.50 inches
- 2.50 inches
- 3.00 inches

The soil types tested included a “sandy” and a “silty” soil. The irrigation systems tested were pivot and furrow. A test was not done on sandy under furrow irrigation, as this does not regularly occur in the region. Each treatment was replicated at least three times. Overall irrigation amounts between treatments in the various tests remained similar, since the smaller deficits were watered more often. Irrigation on all treatments was determined based on the computer program, ***Arkansas Scheduler***. The ***Arkansas Scheduler*** uses daily maximum temperature to estimate a form of reference evapotranspiration. These data along with rainfall amounts were gathered from one of the automatic weather stations maintained by the Commercial Agricultural Program of the University of Missouri, which were located within half a mile of the test blocks. The computer program was run several times per week, and irrigated as needed based on the desired deficit amount for each test.

Flood irrigation was done a field having a length of 1200 feet. The smaller application amounts were possible since every other water furrow was used, and cut-back irrigation (high initial furrow flow rate until water reached ¾ of the way to the end of the field, after which flow was cut-back to avoid runoff).

The pivot irrigation was done using a small three-tower pivot field that covered approximately 23 acres. One third of this field was planted in cotton for this test. Row width was 2.5 feet and laid out in concentric circles. However, this particular field had several sand blows, which are sandy areas created in the New Madrid earthquake of the early 19^{th} Century. In 2001 the field was mapped using a Veris EC monitoring device linked to a data logger and GPS system. This allowed variations in soil texture to be delineated and mapped out, which allowed yield results be collected from different soil texture groups. Data values were in apparent EM and ranged from 0 to 25. Thus, separate yield data on sprinkler/silt and sprinkler/sand could be collected from beneath this pivot by differentially harvesting areas.

An aerial map of the field (Fig. 1) was located and visually used to compare the photo of the field against the Veris results. It is seen in Figure 2.

The cotton had been planted in a circular fashion, with plots being wedge-shaped arcs of the circle approximately 8° of the complete circle. The area beneath the first pivot span was not utilized, due to the small arc length. The outer rows of the experimental units were about 60 feet long. The pivot had an automatic control panel that allowed the pivot circle to be broke into segments as fine as one degree. The panel was programmed to apply the appropriate depth on the appropriate blocks. The cotton was picked by cutting an alley between segments prior to harvest. In each complete pass of parallel, circular rows, 15 blocks were harvested (5 treatments X 3 reps). Five complete passes were made in 2002 and four in 2003. A soil texture map was used to classify each data point as sandy or silt. The number of reps that were sand or silt depended on the amount of sand or silt areas in the four or five passes. Areas that had regions that were part sand (EM <5) and part silt (EM>5), were not used. Dryland yields were collected from sandy and silt areas outside the pivot circle.

Yield was taken by picking two adjacent rows with a picker. Weighing the collected sample and calculating the corresponding area determined seed cotton yield.

Results

The results showing seed cotton yields from the various parts of the test are shown in tables 1-3.

In the surface irrigation test, the yield down the field was determined by breaking the field into five units of about 200 feet each, after leaving out buffer areas at the top and bottom of the field. Results are seen in figure 3.

Table 1. Cotton lint yields from silt/sprinkler.

	0.75 inch	**1.0 inch**	**1.5 inch**	**2.0 inch**	**3.0 inch**
2001	1293.1	1345.6	1419.8	1354.1	1234.1
2002	1008.0	884.0	1173.0	1000.0	1060.0
2003	983.5	958.1	965.8	832.8	786.8
Avg	1094.9	1062.6	1186.2	1062.3	1027.0

Table 2. Cotton lint yields from sand/sprinkler.

	0.75 inch	**1.0 inch**	**1.5 inch**	**2.0 inch**	**3.0 inch**
2001	1527.2	1338.4	1282.9	1396.8	1259.3
2002	1210.0	1136.0	1267.0	1036.0	977.0
2003	1058.1	1148.0	728.3	600.2	477.7
Avg	1265.1	1207.5	1092.7	1011.0	904.7

Table 3. Cotton lint yields from silt/furrow.

	0.75 inch	**1.0 inch**	**1.5 inch**	**2.0 inch**	**3.0 inch**
2002	1007.7	891.2	906.4	997.6	708.6
2003	983.5	958.1	965.8	832.8	786.8
Avg	995.6	924.7	936.1	915.0	748.7

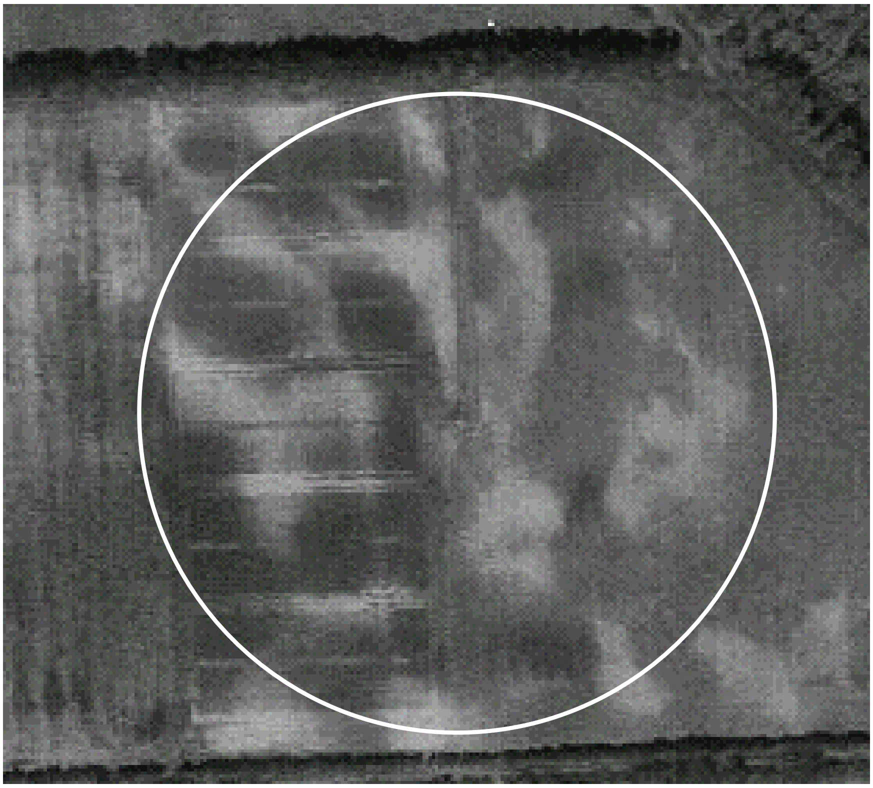

Figure 1. Aerial view of center pivot field used at the University of Missouri's Marsh Farm.

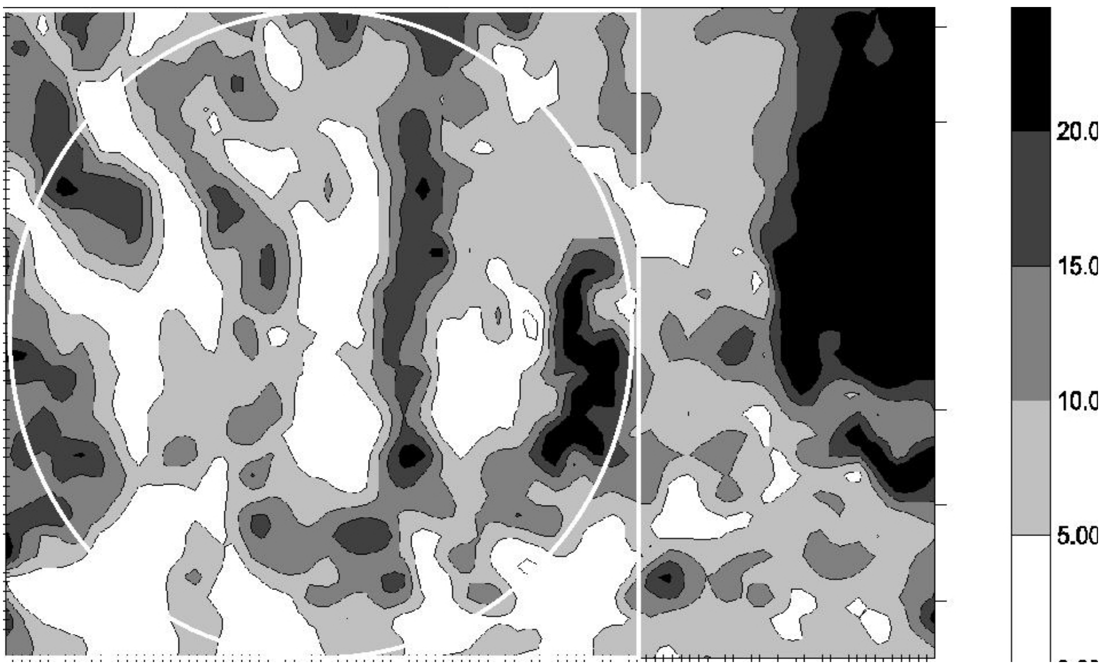

Figure 2. Map of center pivot field used at the University of Missouri's Marsh Farm using values from a Veris deep EM machine. EM values at right. EM values from 0-5 were considered as sand; values greater then 5 were considered as silty. Note that the shapes in the EM map closely follow the outlines in the aerail view in Figure 1. Cotton plots were in the northwestern third of the pivot (outside two spans only). White indicates heavier “sandy” areas, while darker colors represent the "silty" areas of the field.

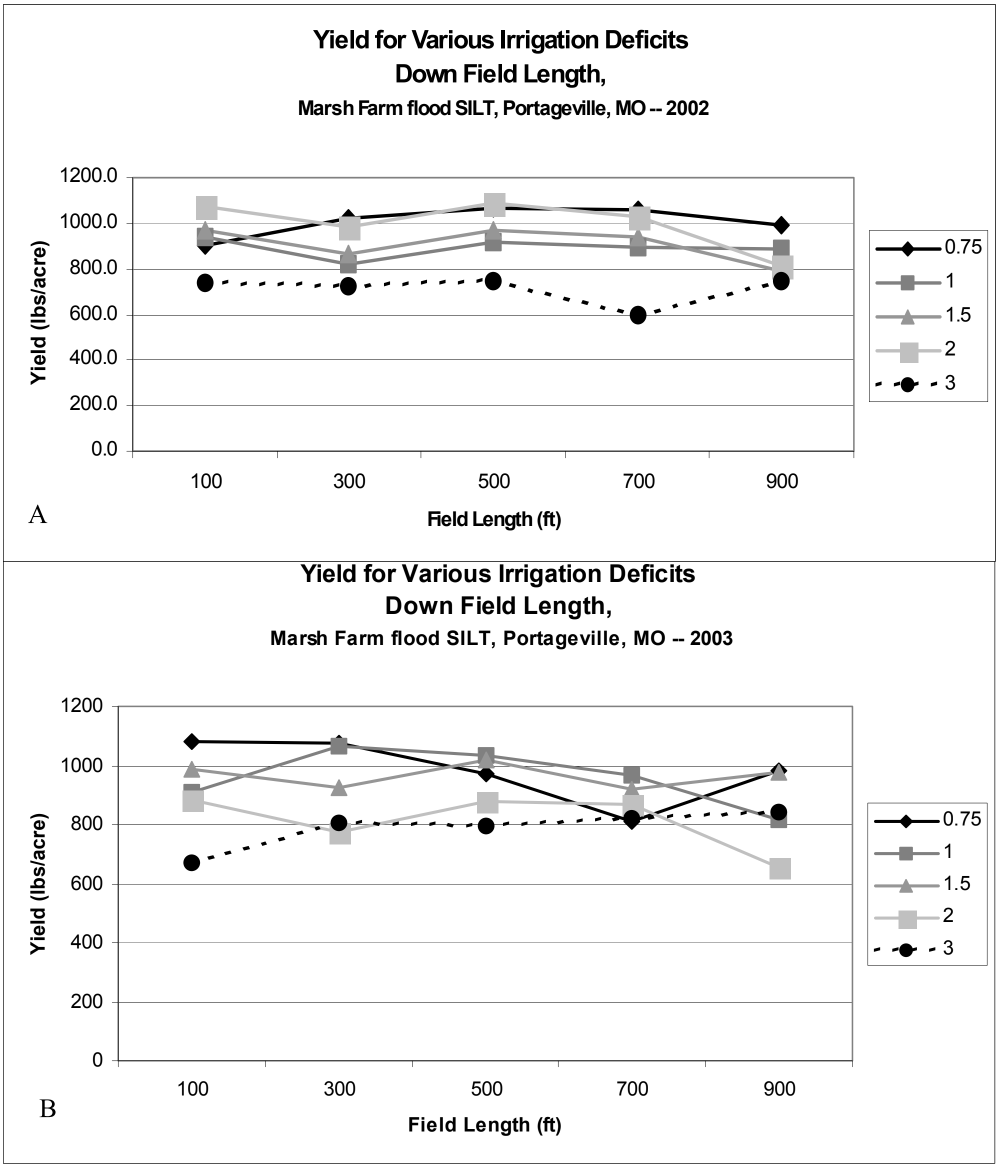

Figure 3. Yield down the field for 2002 (A) and 2003 (B) furrow-irrigated, silt field.