OPTIMIZING MANAGEMENT OF SPRINKLER IRRIGATED COTTON IN A DEGREE DAY LIMITED ENVIRONMENT

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Abstract

Corn has dominated the central high plains region for years, but the crops water requirements has made it increasingly difficult to grow. Cotton has been introduced due to its lower water demand. The successful production could extend the economic life of the Ogallala in which water levels from 1950 to 2013 have decreased by an average of 4.69 meters (McGuire, V.L., 2014). The objective of this project is to investigate various management strategies in relation to irrigation use, variety selection, plant population and plant growth regulator rates on degree day limited cotton to maximize profits with efficient irrigation that produces high quality cotton. In 2021 the project consisted of 19 irrigation treatments in a randomized complete block design with plots split based on variety on the McCaull Research and Demonstration Farm near Eva, Oklahoma. Irrigation treatments will be based off estimated evapotranspiration (ET) from the Oklahoma Mesonet and from participants of TAPS. The TAPS competition hosts growers/crop consultants that compete against each other to manage their plots to reach maximum profitability and highest water use efficiency. Throughout the season growth measurements including height at first bloom (FB), two, four and six weeks past FB as well as nodes above white flower (NAWF) taken at the same time intervals were collected. Final measurements of node of first fruiting branch (NFFB), node of upper cracked boll (NUCB), node of uppermost harvestable boll (NUHB), total nodes, open and closed bolls in a were collected from 3 m row. After harvest, lint samples will be sent to the Fiber and Biopolymer Research Institute on the campus of Texas Tech University for analysis.

Introduction

Upland Cotton (*Gossypium hirsutum*) is being reintroduced into the Oklahoma Panhandle in an effort to conserve the diminishing water of the Ogallala Aquifer. Cotton requires 305-610 millimeters per hectare in comparison to corn's 610-760 millimeter requirement in this region. As water levels continue to decline cotton as an alternative crop to corn will become increasingly more important because of the potential water savings. The objective of this study was to investigate various irrigation amounts and timings on overall lint yield and lint quality. Irrigation amounts can be distributed throughout the growing season to optimize irrigation during growth stages where crop requirements increase.

Materials and Methods

In 2021 various PhytoGen cotton varieties were planted 6 May 2021 on the McCaull Research and Demonstration Farm near Eva, Oklahoma (Table 1). The treatment structure consisted of a randomized complete block design with plots split based on variety with 19 treatments replicated 3 times. Each plot consisted of two sub plots that contained two different cotton varieties. Treatment 1 served as the control with no irrigation applied. Treatments 2-7 had in season grower input to determine water application, variety selection, growth regulator amounts, and plant population. Treatments 8-19 received varied water treatments at different levels of evapotranspiration (E_t) based on data from the Oklahoma Mesonet, data from soil moisture sensors installed in the field, and from participants of the TAPS program (Table 1). The TAPS competition hosts growers/crop consultants that compete against each other to manage their plots to reach maximum profitability and highest efficiency for water, crop variety selection, seeding rates, and growth regulator applications. Throughout the growing season each participant received crop reports in order to make real time management decisions. Soil moisture probes were installed by Aqua Spy in one plot for each TAPS participant and select fixed irrigation treatments (8-19)Each subplot received varying plant populations on 76 centimeter rows. Stand counts and vigor ratings were collected during peak emergence. Throughout the season growth measurements were taken to gauge maturity and cutout. These measurements include height measurements at first bloom (FB), two, four and six weeks past FB as well as nodes above white flower (NAWF) taken at the same time intervals. End of season maturity measurements included final plant height, total nodes, node of first fruiting branch (NFFB), node of uppermost cracked boll (NUCB), node of uppermost harvestable boll (NUHB), open bolls and closed bolls in a 3 m row, and plants in a 3 m row. Stand counts were again taken at the end of season. Two rows were harvested in the 8 row plot. A subsample was pulled to be ginned and sent to the Fiber and Biopolymer Research Institute on the campus of Texas Tech University to be ginned for fiber strength, fiber length, and micronaire.

Table 1. Planting data for all treatments as well as irrigation amounts applied in 2021 with the overhead VRI sprinkler irrigation. Percentages are based on data from the Oklahoma Mesonet.

2021 Management				
Treatment #	**Variety**	**Seeding Rate (plants/ha)**	**Pix Rate (mL)**	**Irrigation Treatments**
1	PHY205	79000	1419.5	Control
2	PHY205	111200	1419.5	TAPS
3	PHY332	123500	2839	TAPS
4	PHY332	155000	2366	TAPS
5	PHY205	111200	2839	TAPS
6	PHY205	136000	1419.5	TAPS
7	PHY400	136000	3312	TAPS
8	PHY205	111200	1419.5	Constant= 90% of ET minus rainfall
9	PHY205	111200	1419.5	70% of constant
10	PHY205	111200	1419.5	40% of constant
11	PHY205	111200	1419.5	Square=constant + Bloom=70% of constant
12	PHY205	111200	1419.5	Square=constant + Bloom=70% of constant
13	PHY205	111200	1419.5	Square=constant + Bloom=0% of constant
14	PHY205	111200	1419.5	Square=70% + Bloom=40% of constant
15	PHY205	111200	1419.5	Square=70% + Bloom=0% of constant
16	PHY205	111200	1419.5	Square=40% + Bloom=constant
17	PHY205	111200	1419.5	Square=40% + Bloom=70%
18	PHY205	111200	1419.5	Low Pre-water + Square=70% + Bloom= 70%
19	PHY205	111200	1419.5	Low Pre-water + Square=70% + Bloom= 40%
Standard	PHY350	111200	1419.5	Same as prescribed treatments

Results and Discussion

All data presented is based on seed weight cotton. The final results could be greatly impacted by the micronaire. The data will ultimately be evaluated for profitability when samples are ginned and fiber analysis is returned. From previous years data we can conclude that maximum yield does not equate to highest profitability. This can be concluded in regards to water usage as well. Over irrigation will increase production cost and can have a negative impact on cotton quality. With the seed lint yield data there seems to be a correlation with yield and irrigation after plants have begun to set bolls. This relationship can be seen across most of the treatments, but is interesting to note the difference in yield of treatment 15, which received the same amount of irrigation as treatment 14 up until the end of July where irrigation ceased. This resulted in a yield difference of about 700kg/ha. This can also be seen in treatments 12 and 13 (Figure 1 and 2). As samples come back from the lab we will be able to draw more conclusions in regards to water use efficiency and profitability for each treatment. This shows that there is an efficient way to spread out water usage to achieve yields comparable to those using more water than necessary.

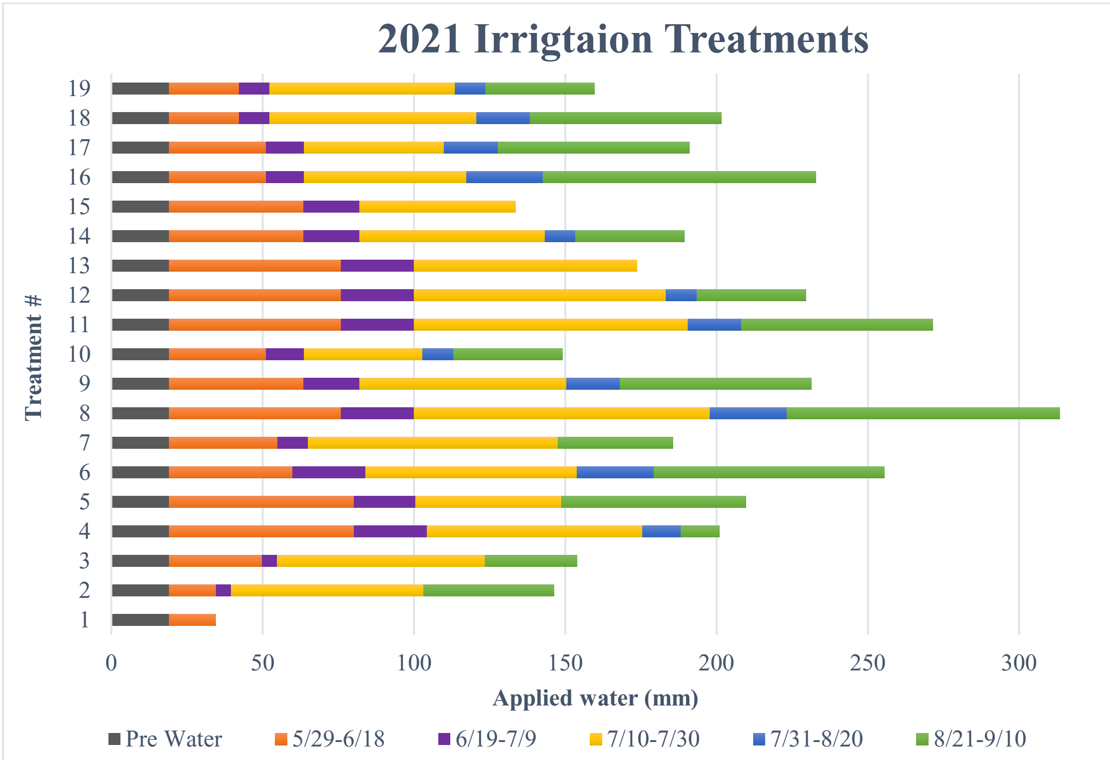

Figure 1. Irrigation applied in the 2021 season. The 2021 season began on May 26 and ended Sept. 6. Farm 1 was the check and received no irrigation but pre-water and herbicide incorporation.

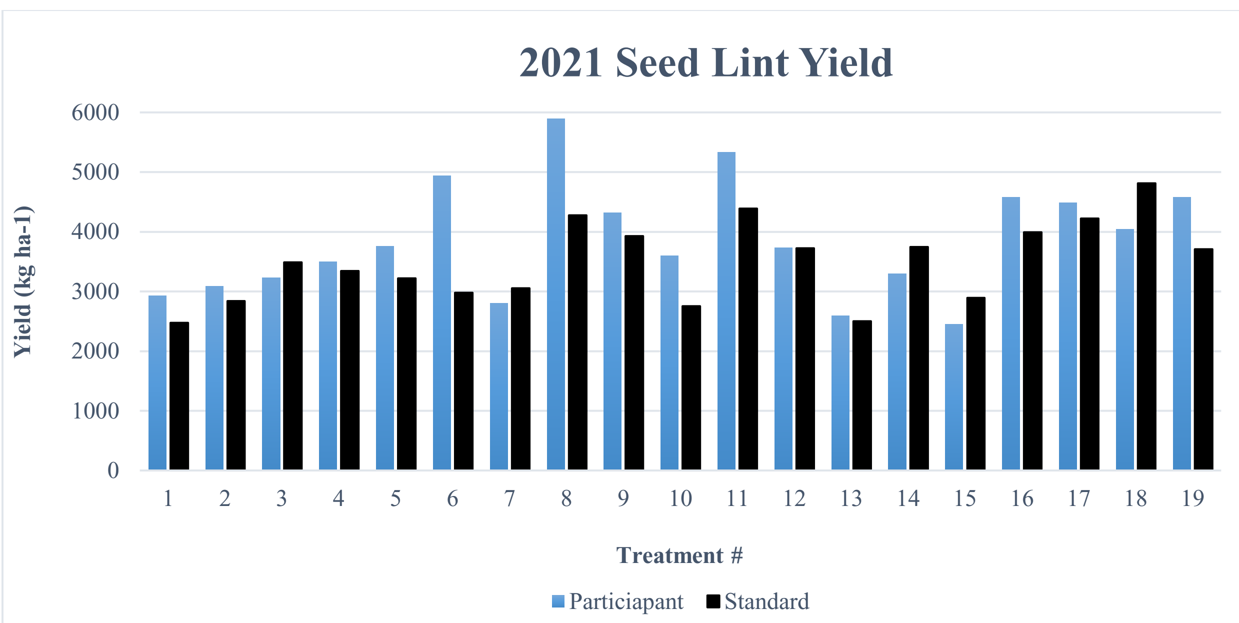

Figure 2. Seed Lint yield for each irrigation treatment for the standard and participant variety. This yield is not final as the weight as ginning can alter lint yield amounts.