MEANS OF IDENTIFYING AND REDUCING CROP STRESS IN COTTON

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Abstract

The objective of this study was to try to determine a trigger (best time) for 1-MCP applications to cotton based on air versus canopy temperature. We believe that due to the unusual rainy season and evaporative cooling, the crop was able to maintain canopy temperatures almost always well below air temperature. Despite the fact that no statistically significant differences were found in final seedcotton yield, it is important to notice that a consistent numerical difference was found. Dryland plots that received 1-MCP applications produced more than the control plots, and the opposite occurred when plots were irrigated. This consistency may indicate a potential benefit of 1-MCP application under stress conditions.

Introduction

Cotton crops all over the US Cotton Belt and other parts of the world are constantly under some type of environmental stress. Drought and high temperature stresses are perhaps the two most common and constant stresses. Both have been implicated in causing fruit shedding in cotton. While some fruit shedding is expected during the plant reproductive stage, excessive loss of reproductive structures due to stresses will negatively affect final crop yield. Ethylene is a naturally occurring plant hormone, implicated in fruit ripening, flower opening, and abscission of vegetative and reproductive structures. More recently, compounds such as 1-methylcyclopropene (1-MCP) have been studied due to their potential benefits in helping alleviate the negative impact of stresses on final crop yield. 1-MCP is widely used in fruit and vegetable markets to delay ripening during shipping and storage. This compound is known to have approximately 10-fold higher affinity for ethylene receptors in the plant when compared to ethylene itself. By binding to these receptors, 1-MCP delays and/or diminishes ethylene effects.

Materials and Methods

The study was conducted at the Texas A&M University experimental farm in Burleson County, near College Station, Texas. A single variety (Phytogen 499 WRF) was planted under sub-surface drip irrigation on 10 April, 2012 and experimental plots were arranged in a randomized complete block design with an irrigation split, namely dryland and 80% evapotranspiration replacement, with four replications. A total of 32 plots (four rows by 32') were established and the center pair harvested with a modified 2-row John Deere 9910 spindle harvester on 9 April, 2012. Additionally, one Smartcrop^{TM} infrared thermometer (IRT sensor) was installed in each plot to monitor crop canopy temperature. Applications of 1-MCP were triggered by four treatments, defined as Control (C), Smartcrop^{TM} (S), forecasted maximum temperature of at least 3 days over 95 ºF (A95), and forecasted maximum temperature of at least 3 days over 100 ºF (A100). One SmartWeather^{TM} station was also installed in the field to capture weather information. Water potential measurements were taken between 6:00 am and 8:00 A.M. on three different occasions with a pressure bomb. Data was collected for the 3rd uppermost fully expanded leaf in three different plants for each plot to assess plant water status.

Results and Discussion

In 2012, a total of 37.4 inches of rainfall was recorded for the experimental site (Fig. 1). No significant differences (5% probability level) in plant water potential measurements were found between treatments within plots under irrigated or dryland conditions. However, significant differences (p-value 0.037) were found between irrigated and dryland plots, which may indicate an irrigation effect on plant water status.

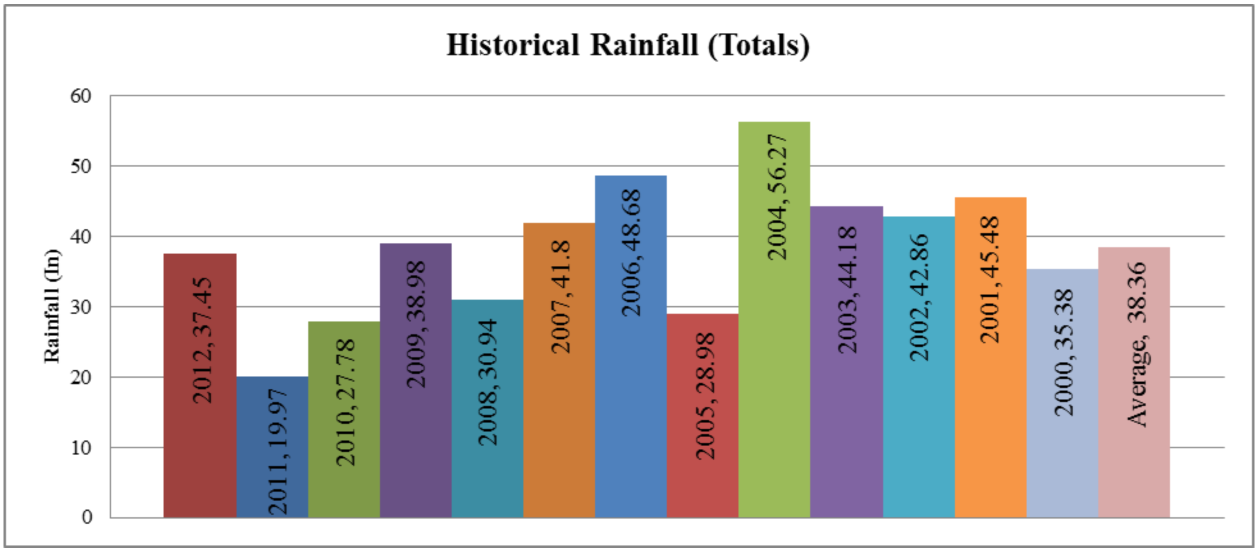

Figure 1. Historical 10-year rainfall totals for the experimental site. Please note that data for 2012 does not account for the month of December.

The majority of total daily rainfall events were around 0.1 to 0.4 inches, but were so frequent during the period studied that coupled with a few more intense events, were able to maintain soil moisture. For this particular season, rainfall was not considered a strong limiting factor for cotton growth and development. Also, due to plentiful water in the soil profile, canopy temperatures remained almost always well below air temperature. Although in some instances canopy temperatures of dryland plots were higher than those of the irrigated plots, temperatures were similar between dryland and irrigated plots across the period studied. We believe that this behavior is a result of the unusual rainy season. With plenty of water available in the soil profile, plants are able to maintain a lower canopy temperature through evaporative cooling. Black circles on figure 2 indicate 1-MCP applications based on forecasted (maximum) temperatures of 95 °F for at least three consecutive days. For simplicity, only the 95 °F treatment (A95) is shown.

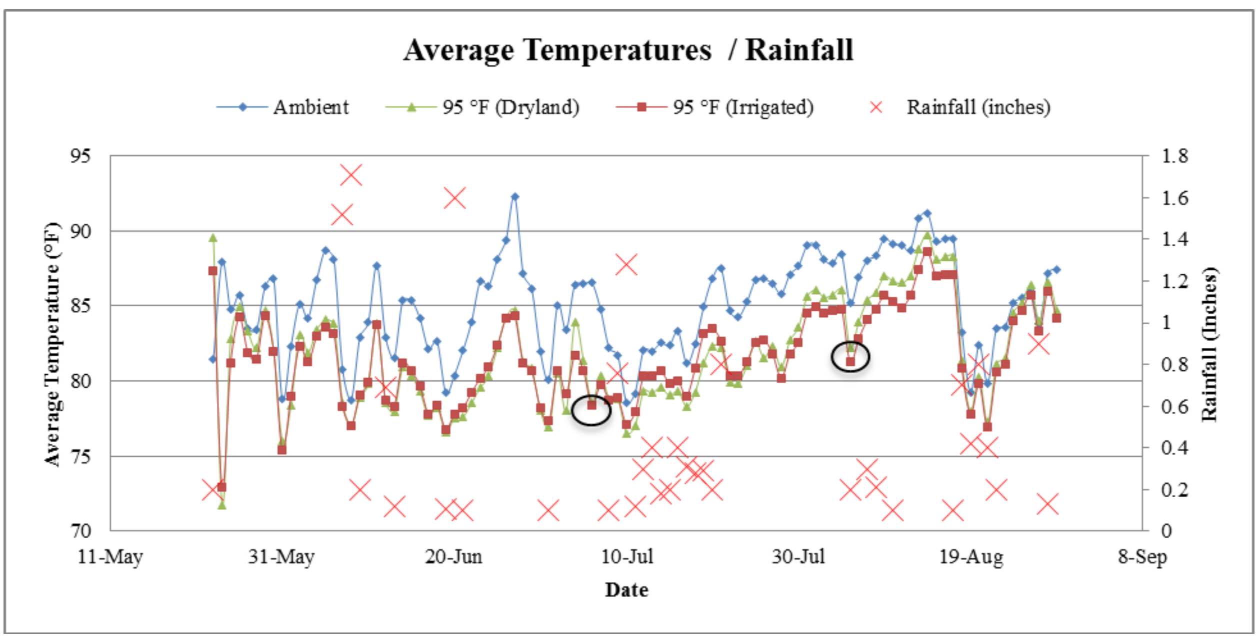

Figure 2. Graph shows average ambient temperature as well as canopy temperatures for the A95 treatment under both dryland and irrigated conditions. Daily rainfall (in inches) is shown by the red X marks for the period studied. The two black circles in the graph show dates of 1-MCP application based on the weather forecast.

Despite the fact that no significant differences were found in final seedcotton yield between treatments and the control, it is interesting to note that consistent numerical differences were found (Table 1). All plots treated with 1-MCP growing under dryland conditions had higher (numerical) yield than the control plots. Under irrigated conditions, the opposite occurred, and all plots treated with 1-MCP had lower (numerical) yield than the control plots. While no statistically significant differences were found, this data may indicate a potential benefit of 1-MCP applications to help alleviate negative impacts of drought and high temperature stresses on final cotton yield.

Table 1. Final seedcotton yield comparisons between treatments and control for dryland and irrigated plots. Yields are from 2 center rows and 4 replications for each treatment. Mean yields are presented as pounds of seedcotton per acre.

DRYLAND				**IRRIGATED**			
Treatment	Replications	Mean Yield	p-value	Treatment	Replications	Mean Yield	p-value
A100	4	4004.6	0.76	A100	4	4476.8	0.61
C	4	3935.7		C	4	4586.6	
A95	4	4027.6	0.60	A95	4	4425.8	0.48
C	4	3935.7		C	4	4586.6	
S	4	4004.6	0.74	S	4	4341.5	0.35
C	4	3935.7		C	4	4586.6	

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