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## Abstract

This study examines recent irrigation water use by pecan farmers in Georgia. Data on yields, total water use, and irrigation cost was collected. In total, data from 10 systems were obtained and analyzed. Data was acquired via a survey instrument that was mailed to likely participants. Yearly averages were calculated for water use, irrigation cost, and crop yield. Irrigation water use numbers were combined with rainfall data to produce total water application numbers for each year from 1999 to 2003. Our analysis showed that on the average, pecan farmers in Georgia are not supplying their trees with enough total water needed for optimum yield based on the recommended 48 inches per year.

## Status of Irrigation Water Use on Pecans in Georgia: Lesson for Growers, Extension Specialists, Extension Agents, Professional Farm Managers, and Appraisers

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## Introduction

From 1990 to 2000, Georgia was one of the fastest growing states in the nation. During that time period, state population increased by 26.4 percent. These population swells and recent drought cycles have brought water issues to the forefront of concerns facing state policy makers. As talk of a water market continues, it is important for the state's agricultural sector to understand the precise levels of water needed for maximum crop yields. Over half of Georgia's pecan crop is irrigated. Many of the irrigation systems are older and in need of improvements. Water delivery problems could be having a negative economic impact on crop yields. Insufficient water delivery can lead to reductions in yield. According to Stein, the recommended total water application for pecans is 2 inches per week from April through October, or a total of 48 inches per year (rainfall included). The principal objective of this study was to evaluate water use and crop yield data from various Georgia pecan farmers in an effort to better understand the current irrigation situation facing growers. The specific objectives were to:

1. Determine the amounts of water applied to crops by pecan growers in the state of Georgia;
2. Compare actual water application levels to recommended levels;
3. Examine the relationship between water use and yields; and
4. Illustrate the importance of documenting water use.

## Materials and Methods

In 2003, a grant from the Agricultural Commodity Commission for Pecans and the College of Agricultural and Environmental Sciences at the University of Georgia was made available to the Departments of Agricultural & Applied Economics and Biological & Agricultural Engineering. In total, 427 pecan producers were notified of the project and asked to voluntarily participate. Of those contacted, 33 pecan producers were willing to participate in the study. In August of 2003, a survey questionnaire was distributed to the 33 pecan growers throughout southern Georgia who expressed interest in participating in the project. The survey was designed to obtain detailed information about acreage, crop age, water use, total yield, and operating costs.

By October of 2003, only 15 of 33 surveys had been returned. A follow-up letter was mailed to all participating farmers. The letter encouraged participation and re-emphasized the importance of the project. A similar letter was mailed in February of 2004. Of the 33 respondents who assured us their full cooperation, only fifteen completed the survey. Five completed surveys were unusable due to insufficient records. Ten surveys were usable. Due to the limited number of respondents, it was impossible for us to carry out any econometric analysis. Consequently, descriptive statistics were utilized for data analysis. The yield data collected from each grower was calculated in terms of pounds per acre whereas the water use data was calculated in terms of inches applied per year via irrigation. Irrigation cost per year was calculated for each farmer. These numbers were totaled and averaged for each year from 1998 to 2003. Lastly, rainfall data was obtained from [www.georgiaweather.net](http://www.georgiaweather.net). Yearly rainfall data from April 1 through October 31 was acquired and examined.

## Results and Discussions

Total acreage of the ten systems observed in the study was 1,330.3. The average amount of land per farmer was 133 acres. The maximum yield reported was 1,217.4 pounds per acre in 2003 and the lowest was 769.6 pounds per acre in 1998. The average yield over the 6 years from 1998 to 2003 was 1029.4 pounds per acre. This number falls in line with McEachern, et al., assertion that commercial pecan production starts at 1,000 pounds per acre. Water use data was calculated as gross inches applied per year via irrigation. From the available data, we observed a high level of water use in 2001 when on average slightly less than 20 inches were applied. The lowest occurred in 2000 when slightly more than 10 inches were applied on average. Over the five years that water data was available, the average yearly irrigation application level was 15.5 inches per year. The average rainfall from 1999 to 2003 (April 1 through October 31) was 22.9 inches.

The average irrigation application for our survey participants from 1999 to 2003 was a mere 15.5 inches. The average rainfall from 1999 to 2003 (April through October) was 22.9 inches. Adding average irrigation to average rainfall equals 38.4 inches of total water application per year. This number is almost a full 10 inches shy of the recommended 48 inches (Stein). Only two of the 10 farmers who completed the

questionnaire were applying the recommended water levels to their trees in at least one of the five years the study examined. These results compare favorably with that of Harrison and Thomas, which demonstrated that over half of the monitored pecan system owners were under-watering by 20 to 29 percent. Improved irrigation systems, more rigorous documentation of water use, and adherence to recommended water application levels could lead to an increase in the efficiency of Georgia's pecan crops.

Irrigation cost is a measure of total operating costs including: labor, repairs, electricity, energy, gas, and other accessories. From the accessible data, we observed a high mark in irrigation cost in the year 2002. That year farmers spent an average of about \$64 per acre to irrigate their pecan crops. This finding is consistent with the study of Fonsah, et al., at the University of Georgia. The low mark occurred in 1998 when farmers only spent about \$46 per acre per year on irrigation. The average irrigation cost for the five years from 1998 to 2002 was \$56.1 per acre per year.

The six year average yield analysis for the study participants depicts that there was no difference in the 1999 and 2000 yield per acre. There after, yields started trending downward until 2002 when yields escalated to almost 1,200 pounds (Figure 1). However, these results were based on the limited total number of respondents to our survey not the total number of Georgia pecan growers.

Interestingly, a comparison of average water use and average yield showed that there is a correlation. Average yield was slightly above 600 pounds per acre when no water was used in 1998 and the highest yield of over 1,200 pounds per acre was reported when water use was also at its peak at about 50 inches per acre per year (Figure 1). Bear in mind that "water stress affects nut size, quality, number of viviparous nuts (nuts which germinate while still in the shuck), number of sticktights (nuts which fail to develop and open), as well as the following year's crop" (Stein).

To provide an idea of actual statewide pecan yield trends, Figure 2 shows total utilized production of pecans in Georgia from 1998 through 2003. Clearly, there are differences between our study results and actual statewide figures. For example, the

encompassing statewide data shows greater fluctuation from year to year. However, the low yield years from both graphs are 1998 and 2002. This indicates that our study-generated yield data is at least partially correlated with actual statewide figures even though the statewide data vividly depicts the alternate-bearing pecan production trend.

However, using the actual average water use data from our respondents, the trend showed a perfect correlation with the actual statewide utilized production. Although this is non-scientific, it can be expected that if all pecan growers used adequate water, the 1999 to 2001 yields would have probably been higher and maintained a similar trend as the study participants.

Further, we compared the average total water application and average irrigation cost (Figure 3). It is important to keep in mind that Total Water Application is comprised of both gross irrigation and rainfall data for each year. There seems to be little connection between water use and irrigation cost. As the graphs of the data collected from study participants (Figure 3) illustrate, in years 2002 and 2000 the cost of irrigation were at their peak and relative peak respectively even though water use in the same time period was declining. The graph further shows that water use was at its peak in 2003 (Figure 3).

This may partially explain the meager connection between water application and yield on a year by year basis. Furthermore, the alternate-bearing production and yield nature of pecan crops could influence these results. Even so, sparse data and inexact measurement techniques provide ample reason to believe that the results from this study are atypical.

The individual yields for each grower across the six years from 1998 through 2003 showed that most yields hovered around the 1,000 lbs per acre mark. However, there were exceptions to this assertion as in 1998 when one grower produced 1,466 lbs per acre and in 2000; another grower had a yield of over 2,000 lbs per acre. These irregular yields force us to consider if irregular watering practices including alternate-bearing may have been a contributing factor.

Furthermore, there were differences in the individual grower irrigation water use from 1998 to 2003. For instance, one of the

growers provided water use information for only three years, 2001, 2002, and 2003 respectively. Fortunately, several growers were able to supply water use data for five of the six years. A grower whose data exhibited irregular yields per acre was one of the participants who actually supplied better water use data. He applied 11 inches of water via irrigation in both 1999 and 2000. In 2001 and 2002, he applied 24 inches via irrigation and in 2003, he applied 27.2 inches.

### Implications for Extension Specialists, Extension Agents, Growers, Professional Farm Managers, and Appraisers

This study was limited by a small amount of functional data. When the project was in its initial stages, 10 percent of 427 growers agreed to participate as volunteers since the results of the study were of crucial importance to both the individual growers and the pecan industry as a whole. In actuality, only 2.3 percent of the 427 growers ended up supplying useful data. As a result, it was impossible to conduct any meaningful statistical or econometric analysis. The following is a quote from a farmer who initially volunteered for the study but later declined to participate:

*"After reviewing the survey questions, I don't think my input would be of much value since I only have drip (micro jet) irrigation. Also, the questions directed to just drip irrigation will require quite a lot of time to answer and unfortunately I do not have that much spare time. Sorry."*

### Lessons to Learn by Extension Specialists, Extension Agents, Growers, Professional Farm Managers, and Appraisers.

Successful agricultural production is a function of several factors. Record keeping and management is a vital aspect of that process. Without it, it would be difficult for any grower/farmer or professional farm manager or appraiser to determine whether their business was profitable or whether they were adopting standard operating procedure in their multifaceted day to day operations. Other lessons to be drawn are: (1) some farmers do not keep records of any kind, (2) some farmers keep records, and (3) some farmers keep fragmented records.

When farmers fail to keep records, it becomes difficult for extension specialists, agents and professional farm managers and appraisers to render quality services when required to do so.

Of 427 pecan growers in Georgia, only 7.7 percent were willing to participate in this study even though participation was to their advantage. These same growers require specialists, agents, and professional farm managers and appraisers to provide quality information to them when needed. How can this be achieved if they are not willing to assist? From an empirical and non-scientific perspective, the reason why the number of growers willing to participate in this study so low could partially be attributed to the fact that they: (1) are not keeping records, (2) did not want to be bothered, (3) did not have the time to spare, or (4) were simply unsure whether their records were good enough.

### Conclusion and Recommendations

The study shows that average irrigation application for pecans in Georgia from 1999 to 2003 was 15.5 inches. The average rainfall from 1999 to 2003 was 22.9 inches. Accordingly, a total of 38.4 inches of water was applied in the pecan orchards. This quantity of water applied is 10 inches shy of the recommended 48 inches (Stein). These results compare favorably with results from a 1997 study by Harrison and Thomas. That study found that over half of the monitored pecan systems were under-watering by 20 to 29 percent.

Although these conclusions are based on limited observations, the notion that farmers in Georgia need to document water use is an important point. Thorough records of monthly water use will allow farmers to establish relationships between irrigation applications and crop yields. Detailed records could also aid farmers in lobbying for augmented water rights as those rights become increasingly scarce. Sustainable pecan production is a function of several factors such as pest and disease control, fertility application, weed control and irrigation. A change in any of these parameters may have an adverse impact on productivity, yield, quality and profitability. To maximize yield and profit margin, it is imperative that growers adhere to these recommendations and continually adopt good agricultural practices.

### Limitation of Study

Due to insufficient data, it was impossible to carry out any meaningful statistical or econometric analysis to substantiate this study. However, the information gathered with the limited data is indeed vital to the Georgia pecan industry at large and to

specialists, agents, growers, professional farm managers and appraisers in particular. Undoubtedly, this study can serve as a basis for future studies. Hopefully, growers will realize that they must keep accurate records so that specialists may provide them with the information they need to be successful in their day to day farming practices and activities.

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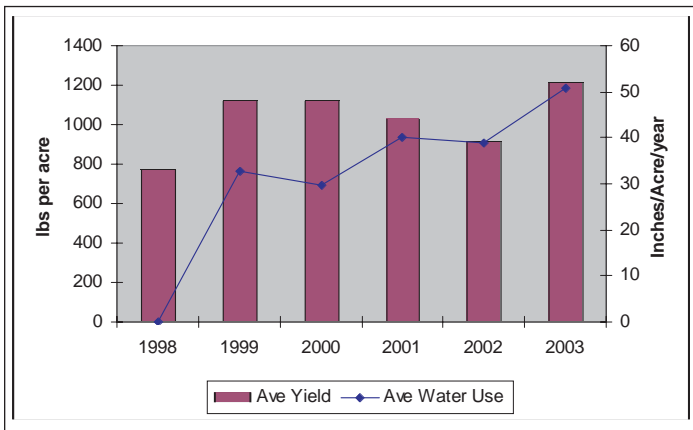
### Acknowledgments

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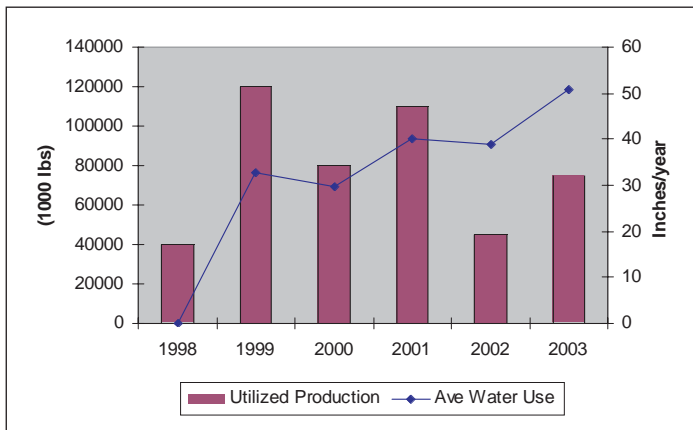
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Figure 1. Six Years Average Crop Yield and Average Water Use For the Study Participants in Georgia: 1998 - 2003



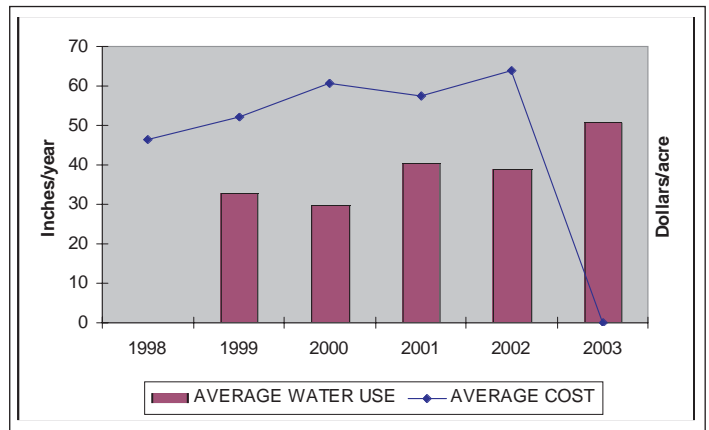
Source: Survey results 2004

Figure 2. A Comparison of Statewide Pecan Production and Average Water Use of Study Participants in Georgia: 1998 - 2003



Source: [www.nass.usda.gov](http://www.nass.usda.gov)

Figure 3. Average Total Water Application and Irrigation Cost for Study Participants, 1998-2003



Source: Survey results 2004