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SYSTEMS ANALYSIS OF GINNING SEASONS AND SEED COTTON TRANSPORT

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Abstract

Cotton production continues to remain steady in Texas. Gin facilities have decreased in number through the decades. Fewer gins mean longer distances to haul seed cotton modules from field to gin. Transport of modules is limited to certain roads due to axle weight restrictions of module trucks. A study of alternative transport systems to include semi-tractor trailers is underway at Texas A&M University. Fewer gins also mean more bales to throughput per facility and longer ginning seasons or increased ginning rate. Efficiencies of operation will be essential for gin owners to continue making profits. A second study of three practical scenarios for a new seed cotton handling, storage and ginning system that would result in extended ginning seasons and reductions in production costs is underway at Texas A&M University.

Introduction

The cotton industry like many industries has found more efficient production and processing approaches through the years. Ginning efficiencies worth noting are the gin universal density press, the module feeder, air quality control systems (while not a ginning efficiency, a requirement by federal, state and local governments), and various expensive items now commonly used in the seed cotton and lint cleaning and ginning process. It is through these progressive yet expensive items, however, that gins not able to afford changes have been forced out of business.

In Texas alone, gin numbers since 1960 have plummeted from close to 1,400 to less than 280 active gins in the 2003 ginning season (figure 1). Most gin numbers for cotton producing states in the U.S. have followed similar declining trends. Regression analysis (R^2 value 0.98) from 1983 to 2003 indicates that as the declining trend continues into the future at the same rate of gin closures, by 2018, gins in Texas become nonexistent. Of course this will not happen. From figure 1 it is evident that Texas production numbers are remaining steady and even increasing slightly at around 5 million bales. Therefore, one can assume that the rate of declining gin numbers will level off in the very near future in order to continue accommodating the stable production amounts.

Seed Cotton Transport

Modules are being transported farther distances as gin numbers decline. Transporting modules along the Dwight D. Eisenhower System of Interstate and Defense Highways (Interstate System) now becomes crucial. Currently, however, seed cotton module transportation trucks with a load of cotton exceed the federal tandem-axle weight limit of 34,000 pounds. Therefore, drivers must not use the Interstate System when hauling a module. Fines for doing so are hefty. For those gins located near Interstate System roads, owners have experienced large fuel and maintenance costs because they are forced to take a longer return route from the field. The smaller Farm-to-Market, county or state roads may not be as direct a route compared to Interstate System highways. On a long-distance haul this is most certainly true. Costs could be reduced significantly by establishing a different transportation method that would keep axle weight within requirements to allow the use of the Interstate System.

Data were gathered from USDA – National Agricultural Statistics Service: Cotton Ginnings – Annual Reports, Texas Cotton Ginners' Association Ginners' Red Books, US Department of Commerce – Bureau of the Census – Cotton Production in the United States and Cotton Ginnings in the United States. These data were analyzed using the mapping software ArcView 8.3. Estimates were made of module transportation distances from field to gin. Figures 2a-b and 3a-b track the movement of cotton production and gin location by county in Texas from 1960 to 2002. There were 179 counties where cotton was produced across Texas in 1960. There were 1,427 gins in 156 counties across Texas in 1960, as represented by the circles in Figure 3a. Large numbers of gins were needed as trailers typically were not moved great distances down roads. As modules came into use for longer seed cotton storage periods, transport of modules became easier and faster than trailers. Figure 3b illustrates that only 286 gins in 81 counties handled the production in 2002. And in 2002, fewer counties, only 127, produced 500,000 bales of cotton more than in 1960. Average distances that seed cotton was transported from field to gin increased from only two or three miles in 1960, to now 10 to 30 miles in 2002 and 2003. Gin managers and trade association leaders have indicated that the longest distances modules have been transported from field to gin reaches 100, 200 and even 250 miles.

The farthest distance a truck will haul modules will continue to increase. It is possible that areas traditionally producing cotton will not have access to a gin nearby. Producers will be forced to grow other crops when the cost of transporting modules prevents cotton from being competitive. For example, a seed cotton module will typically be 32 feet long, 8 feet wide and 8 to 10 feet tall. The volume of a module of seed cotton will range from 2,000 to 2,600 ft^3. According to Wilkes (1974), the

density of the seed cotton in a module can range from less than 10 to 14 pounds per cubic foot (lb/ft^3). An average module will contain 20,000 lbs of seed cotton. The equivalent number of picked 500 pound bales would be 13, or 10 bales of stripped cotton. To move 30,000 bales of stripped cotton 100 miles in module form would require 3,000 round trips with a module truck. Can cotton be transported long distances with more effectively and economically?

It is hypothesized that semi-tractor trailers (STT) may be used to move modules long distances more economically than module trucks. Advantages of STT are that more weight can be moved per trip and the STT can travel on the Interstate System because the module weight is distributed over more axles. Can we load and unload modules into STT without loosing the ability to preserve lint and seed quality for long-term storage?

One alternative system to investigate is a flatbed STT combined with a loading and unloading device. A module loader used in Australia, for example, picks up a 40 foot module and straddles a flatbed STT to load the truck (figure 4). A second alternative system is an enclosed van STT with a live bottom. Gin managers have experimented with live bottom vans, specifically backing a module truck up to a van with a live bottom, unloading straight into the van and reversing the operation at the destination. These experiments included working with a half module. A 54 foot van will accept one 32 foot module with 22 feet to spare. Building a module with a divider in the middle of the module builder, allows the module to be split into two 16 foot sections. The half module was loaded with little effect on module form and stability. Would we have to reconfigure the module at the long-term storage site to preserve lint and seed quality?

If we were to adopt a system whereby modules were moved from the farm to the long-term storage location with STT how quickly could the cotton be moved from the turn-row? What system would be used to prioritize which modules were to be moved?

Continuing with the previous example of moving 30,000 bales in module form, we assume the physical configuration of STT would allow for loading 1.5 modules per trip. To move the 30,000 bales with STT at 1.5 modules per trip would only require 2,000 round trips, one-third less number of round trips.

Ginning Season

Remember the trend of declining gin facilities in Texas (figure 1). Efficiencies of operation continue to be important for gins to survive, let alone profit. In figure 2 the average number of 500 pound bales ginned per facilities has increased from 3,100 bales in the time period from 1960 to 1975, when trailers were used to 11,300 bales in the time period from 1990 to 1999. Just since 2000 the average number ginned was 14,700 bales. Seeing that Texas gins are fewer and fewer while production remains constant, how will the ginning industry physically gin all of the cotton? Two options exist: expand individual ginning rate by increasing bales ginned per hour or extend the ginning season by more days, weeks or months.

It has been suggested that a 10-hour day, 4 days-per-week schedule with a longer ginning season of 6 to 9 months may provide significant cost breaks to gin owners/cooperators compared to “24 hour ginning” for 1 to 2 months. Advantages to an extended gin season include the following:

- The ginning rate could remain the same and prevent costly machinery expansion.
- Fewer employees since only one shift would be working.
- Less over-time charges due to a 40-hour work week schedule.
- Possible reduced environmental compliance costs.
- Possible reduced bale storage charges.
- Possible reduction in energy costs if gin operation during off-peak hours.

An extended ginning season raises many questions and provides challenges to address. One important topic to consider is the cotton marketing process. If cotton is stored in module form for 6 to 9 months, how does the producer sell the lint and seed? How can the quality of the lint be determined in module form? Another important challenge is preserving the quality of the seed cotton. Research on module system improvement is on-going at the Department of Biological and Agricultural Engineering at Texas A&M University. A summary of activities related to the module research can be found in the papers, “Viscoelastic Properties of Seed Cotton and their Impact on Module Shape and Density,” authored by Robert G. Hardin, Stephen W. Searcy and Shay L. Simpson in the Cotton Engineering-Systems Conference, and “Performance of Module Covers in Resisting Moisture Penetration,” authored by Shay L. Simpson and Stephen W. Searcy in the Cotton Ginning Conference both found in the 2004 Beltwide Production Conference Proceedings.

Future Work

Specific research goals for an engineering systems analysis of ginning seasons and seed cotton transport at Texas A&M University are to:

1. Formulate a minimum of three practical scenarios for a new seed cotton handling, storage and ginning system that would result in extended ginning seasons and reductions in production costs. The issues addressed would include (1) the optimum gin size (ginning rate) (2) optimum ginning season, (3) maximize energy savings (operating off-peak), (4) maximize labor savings, (5) minimize insurance costs, and (6) minimize gin equipment maintenance costs. The evaluations will be made using Monte Carlo simulations; and
2. Formulate a feasible, module transport system that could be implemented at a Texas location with the gin service area expanded to 100 and 150 miles.
    a. Study use of semi-tractor trailers (STT), or other system, for moving seed cotton modules from the farm to long-term storage locations near a gin with simulations.
    b. Develop a method of loading and unloading seed cotton modules into STT, or other system, and demonstrate the feasibility of this method on model systems.

Acknowledgement

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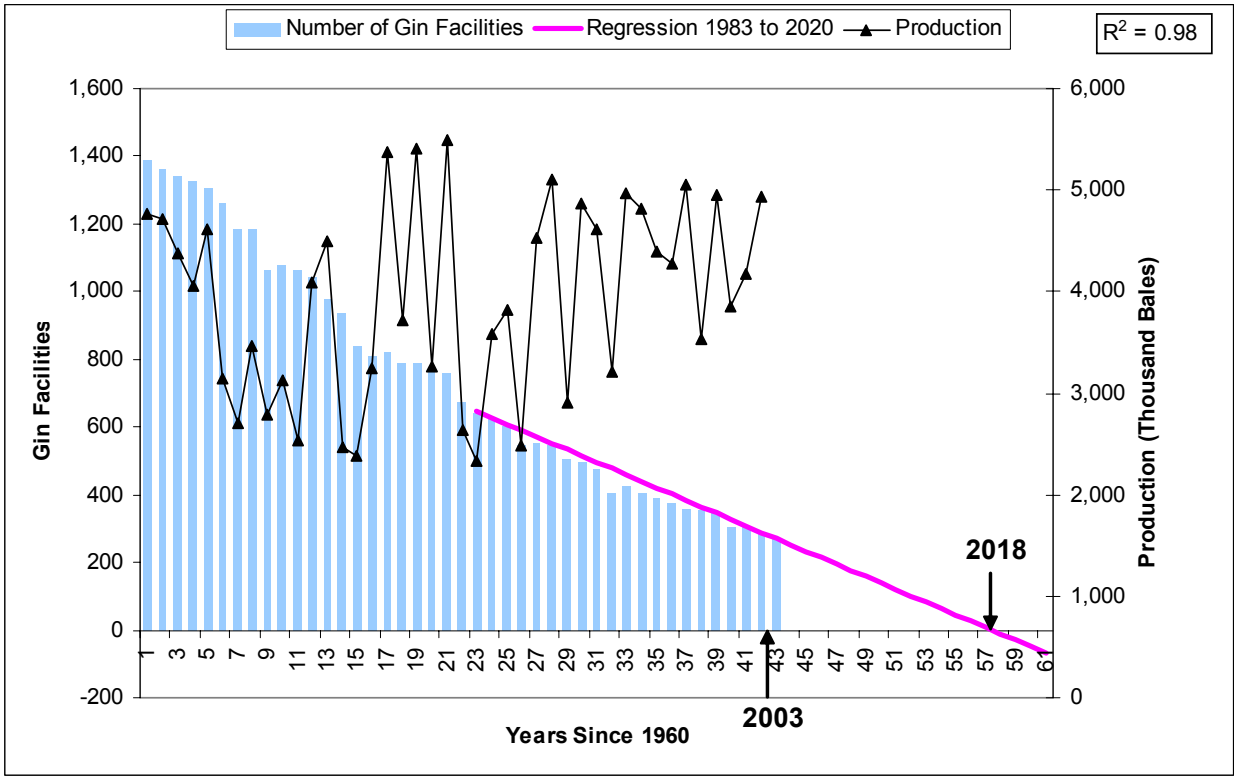

Figure 1: Gin facility numbers and production in thousand bales from 1961 through 2003, with regression of gin facilities from 1983 to 2003 and continuing to 2020.

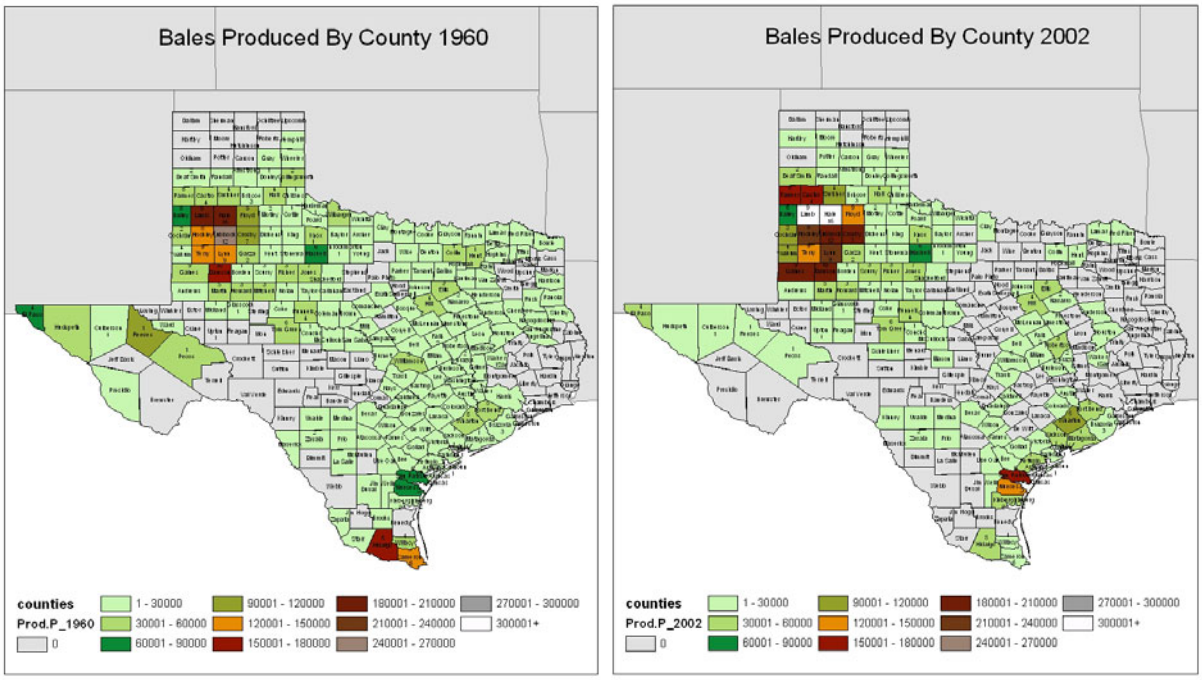

Figure 2: Production in bales by county in Texas in a) 1960 and b) 2002.

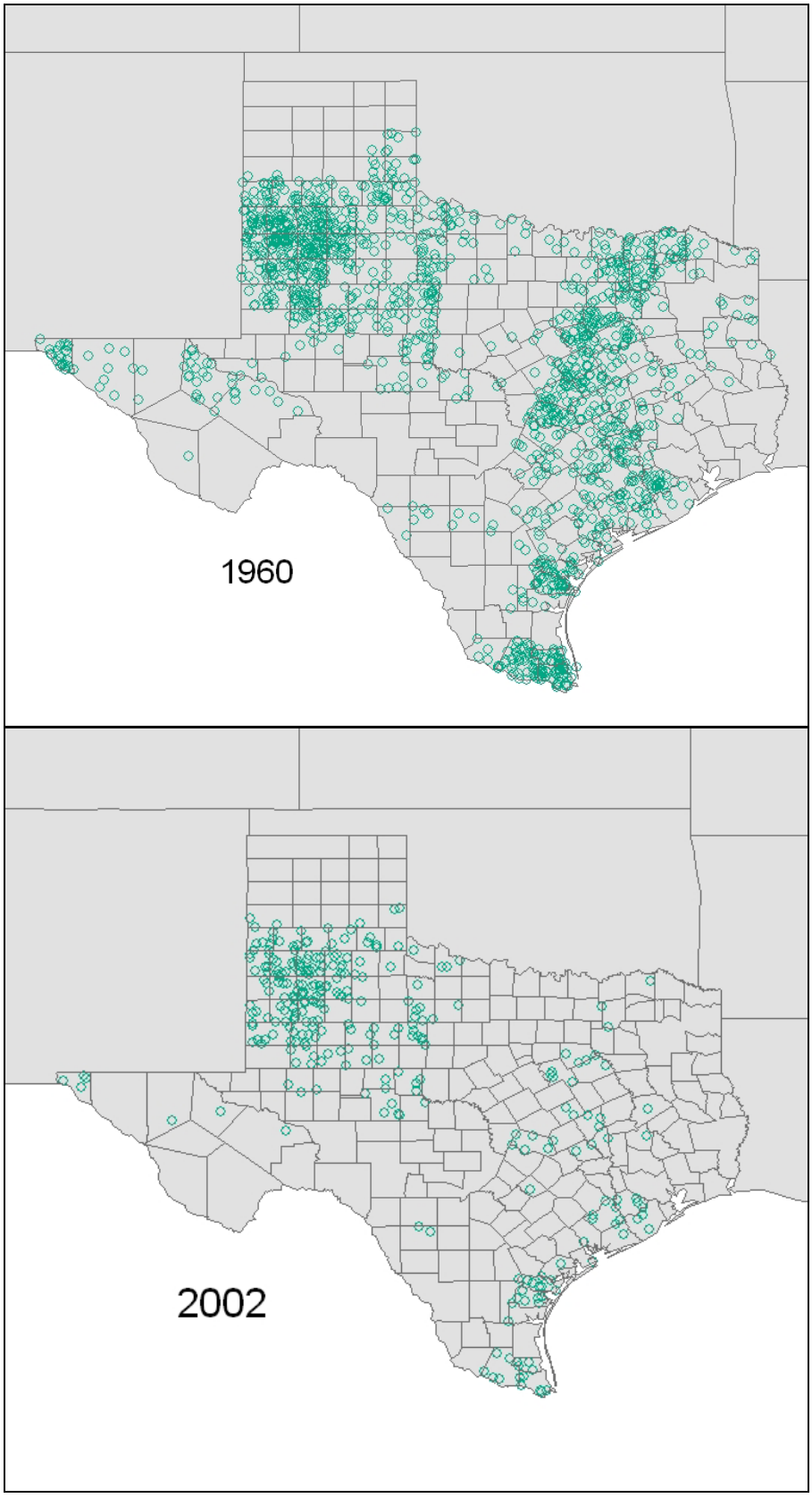

Figure 3: Gin facility location by county in Texas in a) 1960 and b) 2002.

Figure 4: Module loader system used in Australia. Provided by © The State of Queensland Department of Natural Resources 2000.

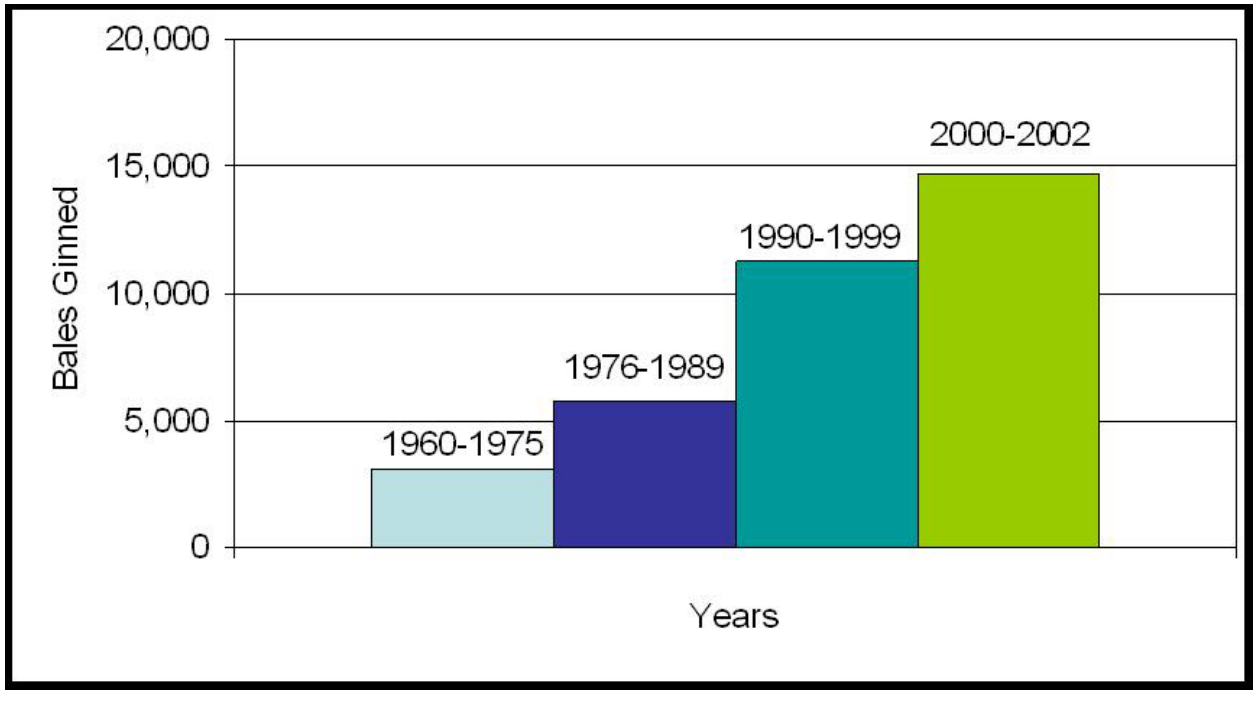

Figure 5. Average number of 500 pound bales ginned at gin facilities from 1960 to 2002.