SPATIAL TURNOUT ON STRIPPER HARVESTED COTTON

Wesley M. Porter
Crop and Soil Sciences Department, University of Georgia
Tifton, GA
Randal K. Taylor
Biosystems and Agricultural Engineering Department, Oklahoma State University
Stillwater, OK
John D. Wanjura
USDA-ARS Cotton Production and Processing Research Unit
Lubbock, TX
Randal K. Boman
Shane Osborne
Oklahoma State University, Southwest REC
Altus, OK
Hossain Navid
Visiting Scholar, Biosystems and Agricultural Engineering Department, Oklahoma State University
Stillwater, OK

Abstract

The main goal of this study was to document the spatial turnout of stripper harvested cotton across a production cotton field. The data provided an insight into the variability of lint turnout from stripper harvested cotton and its potential effects on predicting yield. A production field near Canute, OK was selected and cotton was harvested from this field using a 6-row cotton stripper. Three 1100 ft long transects were harvested from the production field. Weight samples for yield determination were collected every 100 ft. An approximate 25-lb subsample was collected from each of the yield samples. Lint turnout was collected from each of the 33 samples. There were no significant correlations with lint turnout and yield. Lint turnout was not variable and ranged from 30% in lower yielding cotton to 37% in higher yielding cotton. A correlation was found between lint turnout and both lint yield and seed cotton yield for the lower yield transect. In higher yielding cotton it does not appear that lint turnout is correlated to either seed cotton or lint yield. However, since there is a correlation present between seed cotton yield, lint yield, and lint turnout in lower yielding cotton then more spatial turnout work should be performed on lower yielding cotton stands to determine the sources of the correlation.

Introduction

Unlike picker harvesters, which use spindles to remove seed cotton from open bolls, stripper harvesters use brushes and bats to indiscriminately remove seed cotton, bolls, leaves, and other plant parts from the stem of the plant. Stripper harvested bur cotton contained 27.8% total trash compared to 4.6% for spindle picked seed cotton (Kerby et al., 1986; Baker et al., 1994; Faulkner et al. 2011a). Garner et al. (1970) reported that spindle picked cotton ginned an average of 24% faster than stripped cotton due to much lower content of foreign matter. The harvesting efficiency, or the amount of crop material removed during harvest, with a picker is lower than that with a stripper harvester. Field losses are lower than those from pickers and under ideal harvesting conditions; a stripper can harvest 99% of the cotton on the plant compared to 95-98% with a picker and in some instances the picker will have harvest losses approaching 20% (Hughs et al. 2008).

Stripper harvesting is predominately confined to the Southern Plains of the US due to several factors including: low humidity levels during harvest, tight boll conformations and compact plant structures adapted to withstand harsh weather during the harvest season, and reduced yield potential due to limited rainfall and irrigation capacity. Cotton strippers typically cost about one-third the price of cotton pickers and have harvesting efficiencies in the range of 95 – 99% making them ideal for lower yielding cotton conditions (Faulkner et al., 20011b; Williford et al., 1994). In 2010, approximately 50% of the total number of cotton bales produced in the U.S. came from Texas and Oklahoma (USDA, 2011). Approximately 70-75% of the cotton harvested in these two states was harvested with stripper harvesters. Over one quarter of the cotton harvested in the U.S. in 2010 was harvested with cotton strippers (USDA, 2011).

Thus, stripper harvesting is not going to disappear from the Southern High Plains and is a viable and cheaper alternative option to picker harvesters. However, the higher trash levels can present specific challenges during harvest, transport, and ginning. The foreign matter levels can be variable and can result in producers getting variable lint turnout from the gin for the modules that they deliver. The variability in lint turnout at the gin can make it very difficult to accurately estimate lint yield. If the variability truly exists, as producers believe it does, then this study can aid in determining correlations to the variability.

The main objective of this study was to document the spatial turnout of stripper harvested cotton across a production cotton field. The secondary objective was to determine the variability of lint turnout of the harvested cotton and its potential effects on predicting yield.

Materials and Methods

Cotton was harvested on December 3, 2013 near Canute, OK to determine spatial yield and turnout variability. The cotton variety, Delta Pine 0935, was grown in a dryland environment on 40-in. wide rows. Three transects, approximately 1100 feet in length, were segmented into 100 feet increments except the last segment where the length final length was slightly shorter due to field shape. The harvested transects were parallel and approximately 200 feet apart (Figure 1). A 6-row John Deere 7460 cotton stripper was used to harvest the crop.

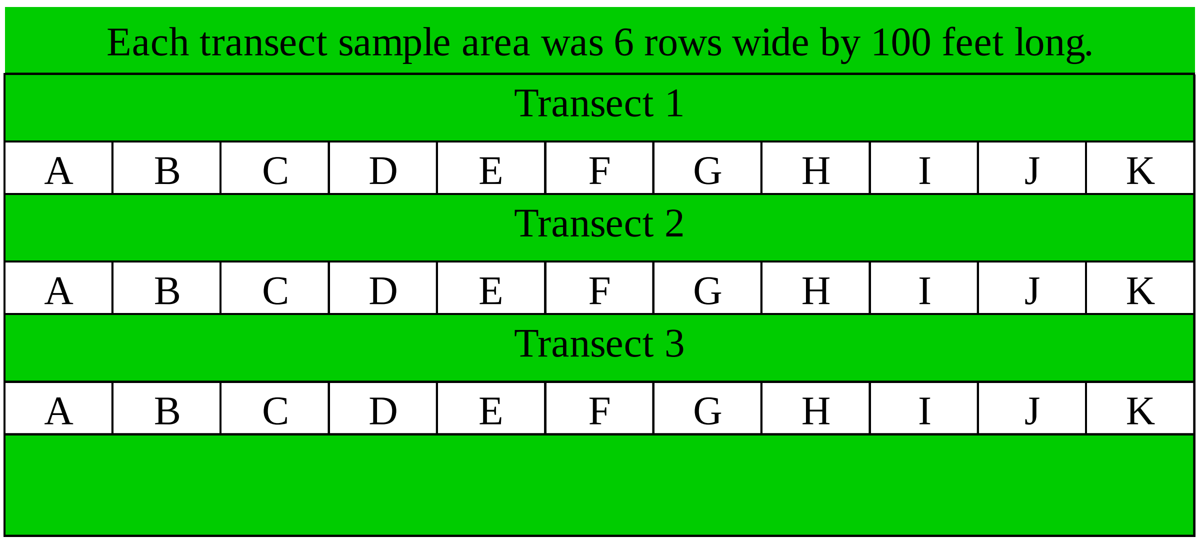

Figure 1. Field map of transects and sampling areas, not to scale.

The stripper harvested each segment and unloaded into a boll buggy where the bur cotton was caught in a 10 by 12 plastic tarp. The tarp containing the cotton was weighed by suspending it from four 50 lb load cells (Figure 2). The load cells were connected to a summing junction (Interface Advanced Force Measurement Model JB104SS Scottsdale, AZ) and the resulting value was displayed on a digital readout (Interface Display and Signal Conditioner Model 9820-000-1). The display also supplied power to the load cells. After a weight was recorded, approximately 25 lbs was bagged for ginning.


Figure 2. The sample collection system, located inside of the boll buggy.

Each of the harvesting samples was processed through an extractor-feeder (C-95, Continental Gin Company-Moss Gordin, Birmingham, AL), 16-saw gin stand (Model 610, Continental Gin Company, Birmingham, AL), and one stage of saw-type lint cleaning (Model 620, Continental Gin Company, Birmingham, AL). After ginning all the cleaned lint from a harvesting sample was weighed (Electroscale Model LC2424) to obtain lint turnout. Lint turnout was calculated by dividing the clean lint weight by the total sample weight and multiplying by 100. The trash collected from the extractor-feeder and seeds from the gin stand were collected and weighed on the same scale. The seed and trash weights were used to aid in ensuring that the total sample weight was accounted for in the final lint turnout analysis. Percent trash was calculated by dividing the trash weight collected from the extractor feeder by the total sample weight. One subsample of cotton lint after the lint cleaner from each harvesting sample was collected and sent to the Texas Tech University, Fiber and Biopolymer Research Institute in Lubbock, TX for the HVI Breeder's Test (Uster Technologies HVI 1000).

Bur cotton yield was determined by dividing the mass harvested in the 2000 ft^2 area (20 ft x 100 ft). The lint turnout for that sample was used to calculate a lint yield. Simple summary statistics were used to determine variation in yield and lint turnout. Correlation analysis was also conducted between yield and lint turnout.

Results and Discussion

Overall seed cotton yield was variable throughout each of the harvest transects. Average seed cotton yield was 1890 lb/ac, 1960 lb/ac, and 1500 lb/ac for transects one, two and three respectively. Transect three also had more spatial variability than the other two transects.

Figure 3 represents the seed cotton yield and lint turnout from transect one. Except for the first sample ginned, the lint turnout was very consistent. There was a problem with the first gin lot that caused an exaggerated high lint turnout.

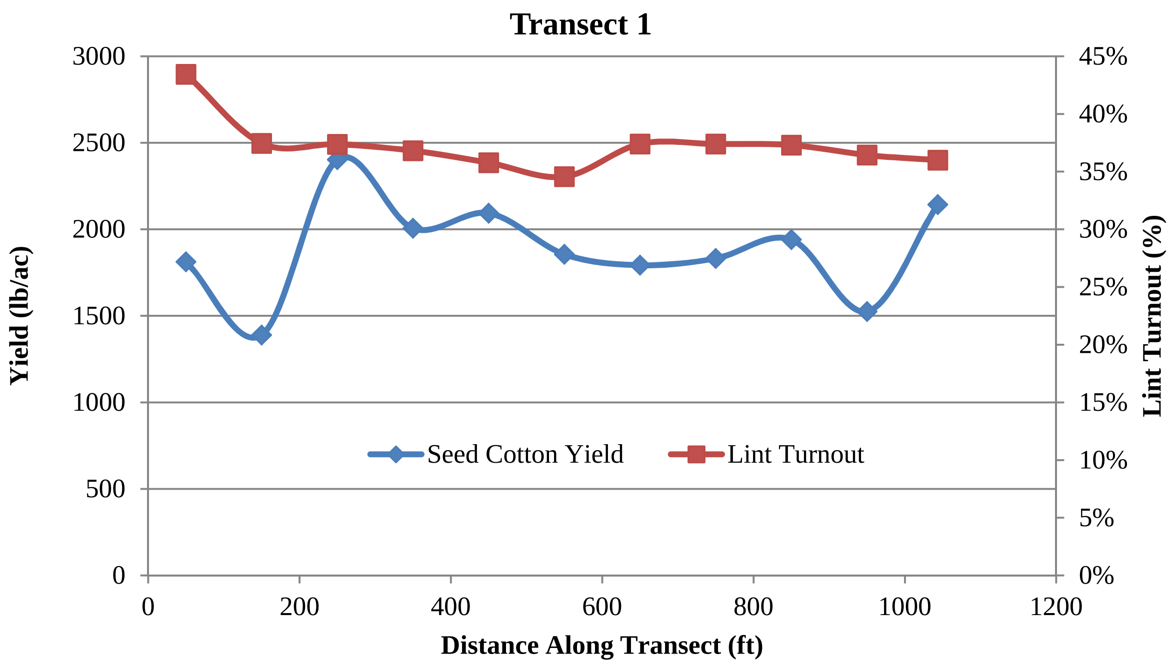

Figure 3. Seed cotton yield and lint turnout as a function of distance along transect 1.

As can be viewed in Figure 3, the variability observed in seed cotton yield was not present in lint turnout. There was a -0.130 correlation between seed cotton yield and lint turnout. The correlation between lint yield and lint turnout was slightly higher at 0.259; however, since lint turnout was used to calculate lint yield, there should be a higher correlation.

Similar results can be observed in Figure 4. Again lint turnout had very little spatial variability across transect two. Seed cotton yield in transcript two had a negative relationship with lint turnout, but still not a strong correlation. In this case seed cotton yield has a -0.298 correlation with lint turnout while lint yield only has a correlation of -0.135 with lint turnout.

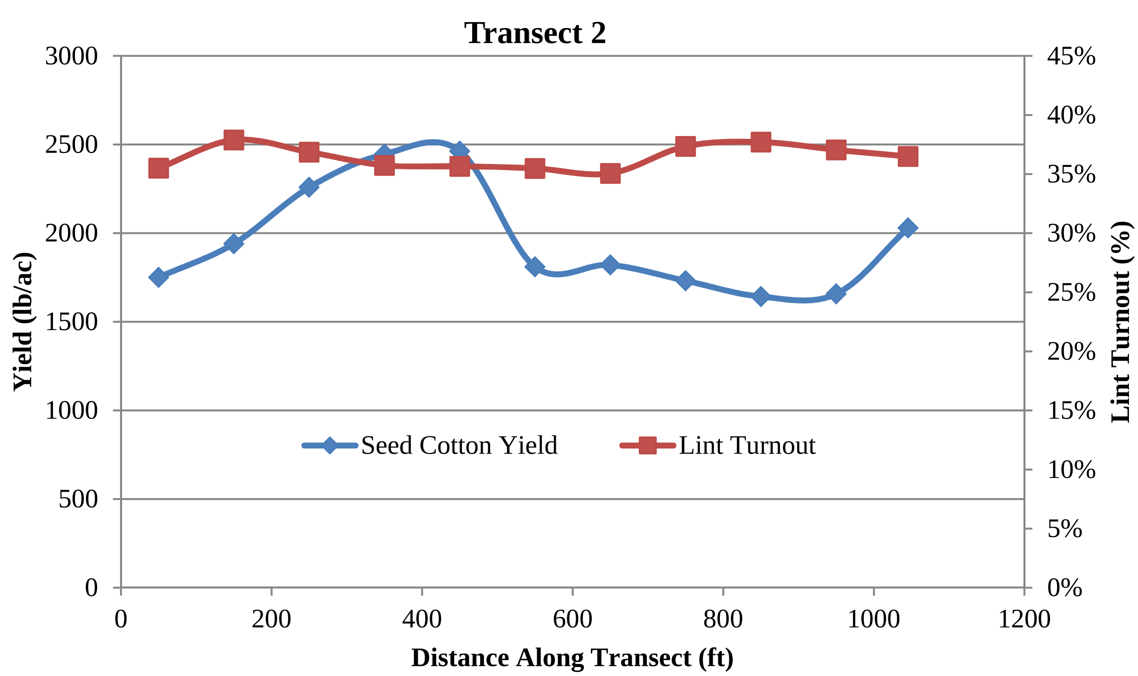

Figure 4. Seed cotton yield and lint turnout as a function of distance along transect 2.

Compared to transects one and two, transect three has a much lower average yield. However, the first two transects do not have strong correlations between lint turnout and yield. Transect three had the highest correlations with seed cotton yield having a 0.50 correlation with lint turnout and lint yield having a 0.70 correlation with lint turnout (Figure 5). There is not enough data to fully verify but it seems that lower yielding cotton could potentially produce higher correlations between lint turnout and yield.

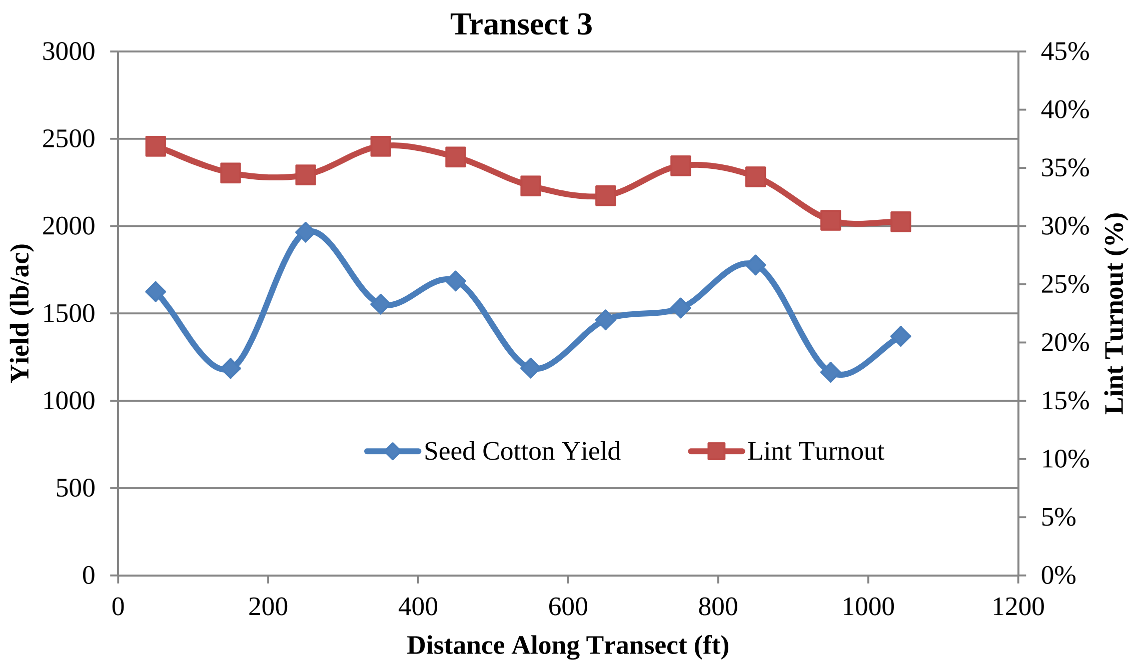

Figure 4. Seed cotton yield and lint turnout as a function of distance along transect 2.

Based on the data from this study, a further study performed in very low yielding cotton could determine if the data collected from transect three is valid and representative of all lower yielding cotton or just a situation unique to this particular field. There is not enough low yielding data in this study to draw firm conclusions about the relationship between low yielding stripper harvested cotton and variability in lint turnout.

Summary and Conclusions

Lint turnout did not have a high correlation with either seed cotton or lint yield. For higher yielding seed cotton, yield did not affect lint turnout at the gin level. Thus, the variability discovered in this study is not enough to prevent accurate yield prediction. Based on the weak correlations between the higher yielding transects and both seed cotton and lint yield there is no justification for trying to determine variable lint turnout as the cotton is harvested. This study determined correlations between seed cotton and lint yields and lint turnout. Since the lower yielding transect had stronger correlations with lint turnout, more work should be performed on very low yielding cotton to determine if spatial turnout variability increases with decreasing yield. A future study should also investigate the types of foreign matter that are causing the increasing levels of spatial turnout variability as the yield decreases.

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