IN FIELD TIME IN MOTION COMPARISONS OF CONVENTIONAL, JOHN DEERE 7760 AND CASE 625 MODULE EXPRESS COTTON PICKERS

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Abstract

This paper should be viewed as a summary of preliminary results for the purpose of establishing machinery parameters for an economic evaluation that will be conducted at a later time for three different harvesting systems. At no time were all three harvesters operated in the same field. Six "example fields" were chosen based on logistics and necessities of data management for the study presented in this paper. Field performance data from the actual harvester is included along with "predicted" calculations of what the other harvesters might be expected to achieve in this field for the same actual turning time row length and field geometry that was harvested. Down time was eliminated from the analysis; therefore, the actual field efficiencies and capacities reported will be lower than in actual harvesting operations. A more complete annual report for this project will be available at a later date from Cotton Incorporated.

A half a million data points from three different harvester systems were collected over 28 days from a total of 14 different farm operations and 29 fields. Package and load weights were determined to be 3.74 bales/round module, 6.5 bales/half module and 16 bales/conventional module when adjusting to 480 lb net weight/bale for the John Deere 7760, Case IH 625 ME and conventional pickers, respectively. Truck loads were found to be 14.96 bales, 13 bales and 16 bales per load for the John Deere 7760, Case IH 625 ME and conventional pickers, respectively. When speeds were held constant at 4 mph and compared (without down time other than unloading and turning), the Case IH 625 ME achieved 7.5 ac/hr at 81% time on the row harvesting, compared to the JD 7760 which achieved 8.2 ac/hr at 89% efficiency when averaged over all six fields. The conventional picker attained 7.5 ac/hr at 81% field efficiency averaged over all six fields. Based on these average field capacity values, the JD 7760's ability to unload without needing time to get to a position to unload or stopping contributed to about a 9.4% increase in field capacity above the Case IH 625 ME and conventional machines when all were operated at a constant speed of 4 mph. When the John Deere 7760 was compared to the Case IH 625 ME for first gear picking, the added speed increase and the advantage of the unloading system amounted to 12.5% to 16.5% increase in field capacity (5% due to the speed increase) depending on the field characteristics and yield. Speed on the row had the second greatest effect on field capacity in comparison to the unloading system. Decreasing row length from 2538 ft to 1274 ft decreased field efficiency by approximately 3.2% (conventional), 4.2% (JD 7760) and 3.2% (Case IH 625 ME) depending on speed and unloading system and was 83.1% vs. 79.9%; 91.5% vs. 87.3%; 83% vs. 79.8% for the Case IH 625 ME, JD 7760, and conventional harvesters and longer rows vs. shorter rows respectively (first gear operation).

Introduction

Cotton harvesting represents perhaps the largest single cost item in cotton production today and certainly the largest capital investment other than land (MSU Cotton Planning Budgets 2007). Establishing accurate crop budgets can only be accomplished by having accurate information on the performance and efficiency of these machines. Published information on the new harvesters that unload the seed cotton from the harvester as a package was previously nonexistent.

The dynamics of cotton harvesting has changed drastically during the sixty plus years since mechanized harvesting began. Early pickers harvested only one row per pass and held approximately half bale quantities of seed cotton in self unloading baskets. These machines operated at approximately 2 miles per hour and could usually be expected to spend about 60 percent of the day picking in the row (Renoll 1979). These machines unloaded the harvested cotton into trailers capable of hauling two to four bales and were somewhat limited by the unloading height of the harvester.

Two row machines were introduced and perfected in the 1950's. Along with the increased harvesting capacity provided by harvesting multiple rows came increased basket capacity such that the machine could remain on the row harvesting approximately the same percentage of time as the single row harvesters. The additional harvesting capacity being introduced during the 1960's as a greater portion of the United States cotton crop was mechanically harvested severely taxed the handling and ginning capacities at that time to the point where gins had to increase their hourly capacity. Additional trailers were purchased and became temporary storage devices when gins could not keep up with the harvesting capacities that growers were achieving. Trailers became larger and required more labor to handle cotton from the harvester to the gin.

The demand for a better handling system gave rise to the Arkansas Cotton Caddy and the cotton ricker in the late 1960's, and cotton module builder and boll buggy in the early 1970's. The cotton module builder and boll buggy provided an unlimited volume of seed cotton to be harvested and stored on the turn row until the gins could process the cotton. The module builder and boll buggy were adopted by growers in the Mid South only after the introduction and acceptance of the four row harvesters in the early 1980's. These systems, while superior to the trailers in handling and storage of seed cotton from the harvesters, were labor and machinery intensive. The recommendations of one module builder and boll buggy for every six rows of harvesting capacity became the industry standard (Willcutt, et.al.1989). Chen and Willcutt (1992) collected time and motion data for two and four row harvesters utilizing the module builder and boll buggy handling and storage system and developed the harvest simulation model "COTSIM" (Chen et.al.) to be able to optimize the harvesting machinery system through equipment selection. This data showed harvesters operating on the row between 60 and 75 percent of the harvest day. This model was later adapted to "XLCOTSIM" (To and Willcutt 2002) as computer software became more advanced.

American Society for Agricultural and Biological Engineering (ASABE) Standards published in 2003 (ASABE D497.4 February 2003) currently lists field efficiencies in the 60-75% range. These data are perhaps outdated even for four row and six row conventional basket pickers that are properly supported with a module builder and boll buggy.

The introduction of six row harvesters further taxed the handling systems; however, labor to support the harvesters was soon recognized as the dominant factor and created a need for revision of the current harvesting machinery system. Each six row harvester required a picker operator, boll buggy and module builder operators and support labor for cleaning the cotton spilled while unloading the harvester and applying tarps to the completed modules. Many larger growers are forced to find additional labor for harvesting and this labor is often unskilled and not dependable.

The harvesters evaluated in this study offer the latest technology and automated systems to package seed cotton on the harvester, thus eliminating most of the labor and handling and storage machinery in previous systems. These systems also offer greater productivity (field capacity) in increased speed on the row, seed cotton carrying capacity and faster unloading without dependence on supporting labor and equipment. The two new harvester systems incorporate different concepts of forming and handling a package of seed cotton which offers improved efficiencies over the conventional basket-type picker with a module builder and boll buggy system. However, no independent data that establishes field capacity and field efficiency values have been available prior to this study.

In order to understand the difficulty of sorting and understanding the data derived from this study, several other historical relationships should be pointed out. Renoll (1979) studied the relationships of machine size and the optimum turn row width on turning efficiency. He stated that for large machines like harvesting equipment, the optimum turn row width should be twice the machine length in order to make a semicircular turn without backing. Backing during a turn usually increases the turn time by more than double due to a slower reverse speed and the operator simultaneously performing the functions of steering and operating controls to raise and lower the headers of a cotton picker. A machine operating in larger fields with longer row lengths is more efficient than for the same machine operating in smaller fields and shorter row lengths. Irregular shaped fields where not all rows end such that turning immediately back onto adjacent rows is possible results in increased turn row travel and thus lower field efficiency. As the operating speed of a field machine increases, field efficiency decreases, yet field capacity increases primarily because the time spent on the row is less in proportion to turning, unloading and down time. These relationships are well documented in research, extension and industry publications (i.e., Hanna (2001); Renoll (1979); Siemens (1999)).

Objectives

The objectives of this study were to establish the field operating efficiencies and capacities of the two new harvester systems and compare these performance measures to the conventional six row basket-type picker system. These data will provide more accurate information for published field performance data for cotton harvesters and economic data derived from these measurements. More importantly, this study provides one portion of the total evaluation upon which growers may base decisions when considering to keep basket-type pickers and related support equipment or adopt a new harvesting system to their operation. In the future, these data will also serve as a basis for developing a decision aid model in the form of a new generation of "XLCOTSIM" that could allow growers to input field maps, expected yield and harvester cost data then simulate harvest timing and cost of harvest for the total farm operation.

Materials and Methods

The understanding of field machinery performance is critical to determining the capabilities of a machine to properly match that machine to the particular operation. Several definitions are hereby restated to promote this understanding. Theoretical field capacity (TFC) is defined as the maximum possible field capacity of a machine operating at 100% of its width for a given speed performing the function that the machine was designed to accomplish (Renoll (1979); and Hanna (2001)) and can be expressed as:

TFC (ac/hr) = width (ft) X Speed (mph) X 5280 (ft/mile) / 43560 (ft^2/ac).

This capacity cannot be sustained for long periods of time. Secondary functions such as unloading cotton from the harvester, turning at row ends, down time due to breakdowns, servicing and operator personal time reduce the time the machine is performing its primary designed function of harvesting cotton. An Effective Field Capacity (FC) can be calculated by dividing the acres harvested during a period (usually an hour or day) by the hours spent harvesting those acres. Effective Field Efficiency (FE) is the ratio of effective field capacity to theoretical field capacity. Another way to determine effective machine efficiency is to proportion out the different harvesting operations (i.e. turning, unloading, downtime, etc.) and to calculate the percentage of the time that operation was performed. Thus, for a cotton harvester:

Field efficiency (FE) = hours spent on the row harvesting / total hours spent harvesting.

In order to better understand the field efficiency values obtained, it is often helpful to see the amount of time spent in performing these different harvesting operations.

Effective field capacity can then be determined by multiplying theoretical field capacity by the determined field efficiency.

FC (ac/hr) = TFC X FE or FE (%) = FC / TFC.

The field operations timing during this study were accomplished by using a global positioning system (GPS) unit producing the position of the harvester every second during the day. This data was recorded on a laptop computer using a special software that incorporated notes made by the computer operator as to each status change of the harvester. A standardized shorthand notation was employed such that rapidly changing harvester status could be documented with minimal human error during the data collection sessions. For example, when the harvester transitioned from an in-the-row picking status to turning, then to positioning-to-unload, then to unloading, all within a 10 to 15 seconds time frame, the computer operator was able to keep the data current by making one key stroke to create a time stamp for the transition and a one to four character code for the notation. An example of the computer screen setup and shorthand notations are shown in Figure 1.

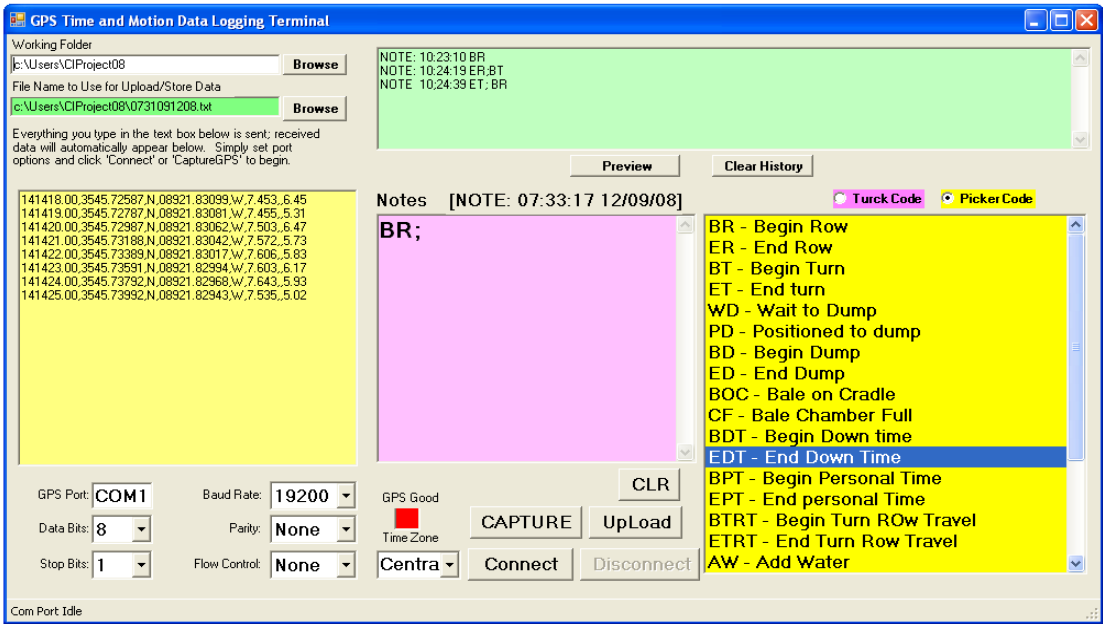

Figure 1: Computer Screen with Data Logging Software in Operation; Left Window is GPS Data, Center is "Notes" Window, Right Window is "Notes Codes", Top Window is Saved Data

These data were logged into the computer, labeled and saved as files including the information of date, farm, harvester and field being monitored. Once the field operations concluded, the data files were post-processed in a spreadsheet that included a manual cleaning pre-processing which corrected any operator related discrepancies such as by making sure that every "beginning" tag had an "end" tag. The "conditioned" spread-sheet data was then processed by programming routines to generate condensed data for the percentages of times spent on the row harvesting, turning, unloading, down time due to various reasons and the total time the operation was observed. The processed data was then imported into ArcMap software (ESRI) for visualization of the harvester path and subsequent analysis. This resulted in a total of approximately 0.5 million data points, with each data point representing a specific harvest operation for that particular location in the field. When times for each of the monitored functions were added and compared to the actual time from the beginning to end of day, the total error was $\leq$ less than 1.5% of the time not accounted for using the Excel spreadsheet analysis.

During this study in 2008, data were obtained for a total of 29 full harvest days of operation on ten farms utilizing 13 different machines. These machines included three Case IH 625 ME pickers (15 ft X 8 ft X 8 ft rectangular ½ modules), one Case 610 Cotton Express (conventional basket with module builder and boll buggy) and 9 John Deere 7760 Round Module harvesters (one machine operated both in MO and west TN). The pickers observed were operated in the Delta areas of Mississippi County, Arkansas; Coahoma County Mississippi; Stoddard and Dunklin Counties of Missouri and the rolling hills of western Tennessee. In addition, gin records for each of the 28 fields were obtained such that yield, quality, package size and load weights could be determined. These data can be compared to data obtained in 2006 for conventional basket picker systems and 2007 for limited data for the new concepts harvesters and conventional harvesters (Willcutt, 2008).

Results and Discussion

Field parameters can have a major impact on harvester efficiency and capacity. During the span of this study, 13 different harvesters were observed in 28 fields with different shapes and sizes ranging from 12.8 acres to 150 acres, with varying row lengths ranging from 376 ft to 2600 ft and yields ranging from 932 lb/ac to 1341 lb/ac (Table 1). In addition, the harvesting speed was chosen by the operator, manager or owner and was influenced in some degree by the row length, yield and field obstructions. Harvester speeds ranged from 3.8 mph to 5.1 mph. It was not always apparent why a speed of operation was chosen.

Unloading Times

An average unloading time was determined for each of the harvester systems from the data. This value was used in our simulation model to predict the time to unload the total number of modules harvested in a field. An average unloading time of 0.30 minutes for each John Deere 7760 round module was determined by taking all times required to change out new rolls of wrap in the field and dividing these times by 22 round module wraps per roll. Approximately 40 percent of all times to change out a new roll of wrap included either personal time or time to clean the machine and were eliminated from the average. Time to change out a new roll of wrap in the field ranged from 3.6 minutes to 9.5 minutes for an average of 6.3 minutes to change a roll of 22 wraps. There were no instances observed where adequate wrap was not carried on the machine for a day's operation. Therefore, any additional time to load rolls of wrap onto the picker prior to beginning harvest operations for the day were not considered in the analysis.

The unloading sequence for the Case IH 625 ME picker was divided into three segments. The position to unload segment was determined from the time the harvester left the row until the harvester stopped at the unloading site. The unloading segment included the time for any addition compaction, raising the picker basket, extending the unloading ramp and the actual unloading of the ½ module. The final segment, begin turn row travel, was determined from the time the harvester left the unloading site until it entered the row and resumed picking.

This unloading sequence includes a portion of a turn before the ½ module was unloaded and another portion of a turn before getting back into the row. The actual unloading sequence was adjusted for the turns that would have been necessary without unloading. These adjusted unloading times ranged from 1.35 minutes, where little or no additional compacting occurred once the harvester stopped at the unloading site, to 4.81 minutes, where some additional compacting took place The unloading time of 1.35 minutes/unloading was achieved by a highly skilled operator and was consistent throughout the day of operation. Based on 112 unloading sequences, the average time for the Case IH 625 ME to unload a ½ module was determined to be 2.54 minutes.

The conventional unloading times were determined from the one conventional harvester system observed in 2008 and those observed in the 2006 and 2007 field activities. Each of these systems included one boll buggy and one module builder, two tractors and associated labor per harvester. These systems were operated such that the picker stopped on the row signaling the boll buggy operator in the close vicinity that unloading was required. The boll buggy was then pulled alongside the picker for unloading. This was found to be the most efficient way of unloading basket pickers. The average unloading time was determined to be 2.59 minutes per unloading operation (Willcutt, 2008).

Truck load weights were based on the actual number of modules from a field and the average weight of those modules. If a field had less than enough modules for a full truck load, the fraction of a load was used to indicate truck loads. This is the equivalent of assuming that another field in the close vicinity would have modules that would complete the load. Average load sizes for all fields and harvesters involved in the 2008 study are reported in Table 1. The resulting truck load weights indicate smaller loads for the Case IH ½ modules. The average half module from the Case IH 625 ME was 6.5 bales (480 lb standard bale). The average John Deere 7760 round module was 3.74 bales (480 lb/bale standard bale), determined from 764 round modules. Farm averages for the John Deere 7760 ranged from 2.95 bales/round module to 4.16 bales/round module and 5.95 to 8.02 bales/½ module for the Case IH 625 ME (Table 1). The round modules from the JD 7760 were more uniform in size (lint weight) than the Case IH ½ modules. Much of the variation in size of the Case IH ½ modules can be attributed to decisions made by the operator due to field conditions. Almost all operators chose to make smaller loads than possible in order to unload at the field turn row. This involved operator decisions based on yield monitor indications of the harvester's seed cotton holding capacity, field to gin hauling distance, yield, row length, need for extra turning and experience.

Table 1: Summary of Farms and Fields in Time In Motion Study

		Acreage	Lint (lb)	Yield (lb lint /ac)	# Packages	# Loads	Load Size (lb lint)	# Bales	Bales/Load	Bales/Package @ 480 lb/bale
Farm	Field									
John Deere 7760										
1	1	148.6	199256	1341	110	27.25	7312	403	15.23	3.77
1	2	36.3	44132	1216	23	5.5	8024	91	16.72	4.00
1	3	66.7	77030	1155	44	11	7003	159	14.59	3.65
1	4	24.4	29654	1215	17	4.25	6977	64	14.54	3.63
1	5	149.0	196837	1321	111	28	7030	407	14.65	3.69
1	6	27.5	30333	1103	17	4.25	7137	63	14.87	3.72
1	7	37.2	47316	1272	27	7	6759	148	14.08	3.65
2	1	90.0	107842	1198	54	13.5	7988	224	16.64	4.16
3	1	76.6	82168	1073	47	11.75	6993	168	14.57	3.64
3	2	79.2	101135	1277	57	14.25	7097	210	14.79	3.70
3	3	51.7	48161	932	34	8.5	5666	100	11.80	2.95
4	1	135.4	68643		37	9.25	7421	140	15.46	3.87
		135.4	131998	975				270		
4	2	305.8	305935	1000	156	39	7844	613	16.34	4.09
		1150.0	1019653	887				2076		
4	3	350.0	236169		130	32.5	7267	485	15.14	3.78
		350.0	495132	1415				1015		
						Average Round Module (480 lb bales)				3.74
Case IH 625 ME										
5	1	134.6	162688	1209	57	28.5	5708	331	11.89	5.95
5	2	157.4	207989	1322	70	35	5943	420	12.38	6.19
6	1	77.6	80818	1041	23	11.5	7028		14.64	7.32
6	2	21.4	11551	540	3	1.5	7701		16.04	8.02
6	3	40.5	39114	967	11	5.5	7112		14.82	7.41
7	1	100.0	99701	997	29	14.5	6876	203	14.32	7.16
7	2	40.0	42756	1069	13	6.5	6578	87	13.70	6.85
8	1	65.5	64985	992	21	10.5	6189	133	12.89	6.45
8	2	22.0	18086	822	6	3	6029	38	12.56	6.28
8	3	21.3	19367	909	6	3	6456	29	13.45	6.72
			747055		239					68.35
						Average Half Module (480 lb bales)				6.51
Conventional 2008										
6	1	55.4	57622	1041	7	7	8232		17.15	17.15
6	2	10.0	9713	967	1	4	2428		5.06	20.24
6	3	56.6	30579	540	4	1	30579		63.71	15.93
					Average Conventional Module (480 lb bales)					17.77

Down Time

The most subjective portion of this study was how to deal with down time in our analysis. Both manufacturers' harvesters experienced some level of down time during the days observed. Machine reliability is best determined as a season(s) long accounting of the amount of and number of times the machine was unavailable to and could not be successfully operated. This study was not designed to determine season long instances of machine failure. Furthermore, the manufacturers continue to improve and correct design influenced flaws and likely will eliminate most if not all in later model harvesters.

Similarly, maintenance, servicing and cleaning down time was not considered as a major factor in this study. In nearly every situation observed, greasing of the harvester occurred when the machine's monitor flashed that enough hours had elapsed to require greasing, regardless of whether the operator expected to harvest for another 30 minutes or several hours. Some consideration should be made by the manufacturers for greasing "on the go" in several smaller applications of grease, rather than a 6 or 8 hour interval. Cleaning of cameras for viewing the machine's operation, cleaning sensors and cotton chambers were also related more to operator preference and start of the day servicing routines than a specific need or failure to operate.

Row unit and conveyor chokes occurred on the row in most instances. Time of day and the resulting cotton moisture, servicing techniques, make of machine and operator habits all influenced the frequency and duration of this portion of the down time. Row unit chokes occurred more frequently early and late in the harvest day, immediately after greasing and when cleaning techniques were not thorough prior to entering the field in the mornings. Down time was subtracted from the total time spent harvesting in order to minimize the down time effects and more accurately compare the seed cotton handling systems of the three harvesters.

Systems Comparisons

Due to the complexity of analyzing the data and time constraints, simulated field efficiency and capacity comparisons of the three harvesting systems from only 6 of the 28 fields are presented in this paper. Fields selected for this initial comparison were fields that the entire field was picked or fields that we had data for an entire day of picking. These six fields ranged in size from approximately 13 to 150 acres.

In all the following comparisons, the total time in the field is the sum of the predicted time required to pick the field, the time to turn and the predicted time required to unload all the cotton from the harvesters studied. The predicted time required to pick the field was determined by dividing the estimated picking travel distance by the speed of the harvester. The turning time used for all analyses were determined from the actual turning time accomplished by the operator for that particular field. While some may argue that one make or model can turn faster than another, field studies from the 2007 harvest season indicated that the operator can have more influence on turning time than the machine itself. Based on this observation, turning times were considered to be the same for all three harvester systems for a given field..

The predicted time required to unload all the cotton for a particular field from each of the harvesters studied was determined by first estimating the number of times the harvester had to unload and then multiplying this value by the average time to unload. The total number of unloads for a given field was calculated by multiplying the average yield by the number of acres harvested and then dividing this value by the average unload size (i.e. 3125 lbs for the Case IH 625 ME, 1795 lbs for the JD 7760 and 3200 lbs for the conventional basket-type picker). As previously stated, the average time to unload was determined to be 2.54 min/unload for Case IH 625 ME, 0.3 min/unload for the JD 7760 and 2.6 min/unload for the conventional basket-type picker.

The time the harvester spent on the row harvesting cotton divided by the total time spent harvesting is the field efficiency for that harvester and field. Field efficiencies and harvester capacities, along with theoretical field capacity (picker is 100% efficient without turning, unloading, or down time) and the actual values achieved by the operator and harvester that harvested that field are presented in Tables 2-6.

Harvester system comparisons are possible only by holding variables of speed, field row length, shape and size, turning time, and yield constant. Since picking speed varies by make and model, several variations were chosen including manufacturers' advertised first and second picking speeds and machines at equal speeds of 4 miles per hour (determined by the slowest machine). Some older conventional basket pickers have advertised first and second speeds of only 3.6 mph and 3.8 mph when equipped with powered hydraulic steering axle assist.

Influence of Field Characteristics on Predicted Field Efficiency and Field Capacity

Field characteristics such as size, shape and row length were found to have an influence on field efficiency and thus field capacity. The effect of row length and field size and shape on field efficiency can be seen in Table 2 by comparing the same operator and harvester from two different areas of the same field (Figure 2). Field efficiency was found to be 77.6% for the short rows, 94.4% for the long rows but averaged only 88.2% for the total field observed. Similarly, field capacity was 8.2 ac/hr for the short rows, 10.1 ac/hr for the long rows and 9.5 ac/hr for the total field. Theoretical field capacity for the 4.6 mph average harvest speed is 10.6 ac/hr. Table 3 shows field efficiency and capacity values for a small 13. 1 acre triangular shaped field with an average row length of 739 feet (Figure 3). Running the simulation model at the advertised 1st gear picking speed, the predicted field efficiency values obtained for the three harvesters studied were 77.3% for the Case IH 625 ME, 82.9% for the John Deere 7760 and 77.2% for the conventional picker. These field efficiency values can be contrasted to the larger field shown in Table 4.

Table 2: Effect of Long Rows VS. Short Rows on Field Efficiency (Figure 2)

Field Location	Acres	Total Time (hrs)	Field Efficiency (%)	Field Capacity (ac/hr)
West	6.2	0.73	77.6	8.2
East	12.6	1.25	94.4	10.1
Total Field	18.8	1.98	88.2	9.5
Avg. Speed (mph)	4.6			10.6

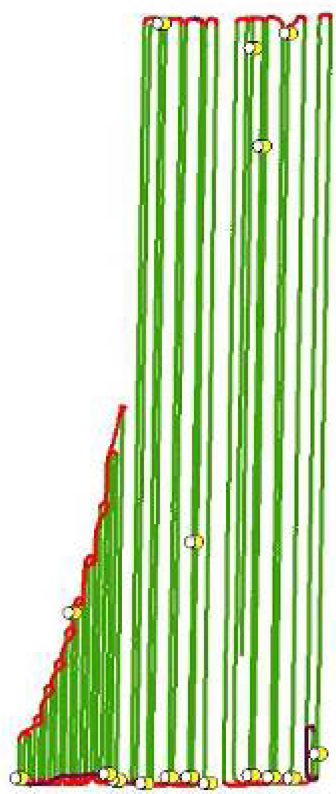

Figure 2: ArcMap Generated Image of Field 5; Field Section Showing two pickers in long rows on right compared to only one picker in short rows (Table 2).

Table 3: Small Field, 13.1 Acres, Yield of 992 lb/ac, 749 ft Avg. Row length, 40 Turns Totaling 14.4 minutes

Picker	Speed (mph)	Load Size (lb lint /load)	# Loads	Time/ Unload (min)	Total Loads	Picking Time (min)	Total Time (min)	Field Efficiencies (%) Picking	Turning	Unloading	Field Capacity (ac/hr) Predicted	Theoretical
Advertised First Speed												
CIH 625 ME	4	3125	4.09	2.50	10	83.9	108.6	77.3	13.3	9.4	7.1	9.2
JD 7760	4.2	1795	7.12	0.30	2	80.0	96.5	82.9	14.9	2.2	8.0	9.7
Conventional	4	3200	4.00	2.59	10	83.9	108.7	77.2	13.2	9.5	7.1	9.2
Conventional 2	3.6	3200	4.00	2.59	10	93.3	118.0	79.0	12.2	8.8	6.6	8.3
Actual	3.9	3094	4.00	3.14	9	86.1	109.2	78.9	13.2	7.9	7.1	9.0
Advertised Second Speed												
CIH 625 ME	4.8	3125	4.09	2.50	10	70.0	94.6	74.0	15.2	10.8	8.2	11.1
JD 7760	5	1795	7.12	0.30	2	67.2	83.7	80.2	17.2	2.6	9.2	11.5
Conventional	4.8	3200	4.00	2.59	10	70.0	94.7	73.9	15.2	10.9	8.2	11.1
Conventional 2	3.8	3200	4.00	2.59	10	88.4	113.1	78.1	12.7	9.1	6.8	8.8
Actual	3.9	3094	4.00	3.14	9	86.1	109.2	78.9	13.2	7.9	7.1	9.0
Constant Speed												
CIH 625 ME	4	3125	4.09	2.50	10	83.9	108.6	77.3	13.3	9.4	7.1	9.2
JD 7760	4	1795	7.12	0.30	2	83.9	100.5	83.5	14.3	2.1	7.7	9.2
Conventional	4	3200	4.00	2.59	10	83.9	108.7	77.2	13.2	9.5	7.1	9.2
Conventional 2	3.8	3200	4.00	2.59	10	88.4	113.1	78.1	12.7	9.1	6.8	8.8
Actual	3.9	3094	4.00	3.14	9	86.1	109.2	78.9	13.2	7.9	7.1	9.0

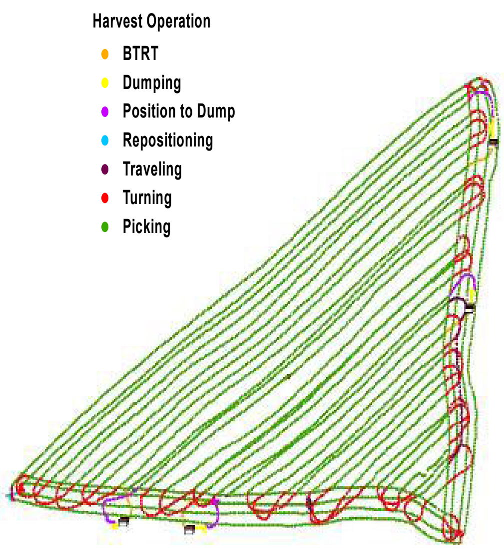

Figure 3: ArcMap Generated Image of Field1; Small Triangular Field, 13.1 Acres, Yield of 992 lb/ac, 749 ft Avg. Row length, 78 Turns Totaling 14.4 minutes (Table 3).

Table 4 shows the results from a more rectangular 49.4 acre field with an average row length of 2021 feet. This field was harvested with the same machine as the field shown in Table 3 and had the same average yield of 992 lbs. lint per acre. Predicted field efficiency values in this field for the three harvesters studied were 84.1%, 91.1% and 84.0% for the Case IH 625 ME, JD 7760 and conventional harvesters, respectively, for first gear operation. Comparing these two fields, increasing the average row length from 749 to 2059 feet increased the field efficiency (picking) values by 6.8% (77.3% to 84.1%) for the Case IH 625 ME and conventional picker and 8.0% (83.5% to 91.5%) for the JD 7760.

Table 4: JL Big Field, 49.4 Acres, Yield of 992 lb/ac, 2059 ft Avg. Row length, 56 Turns Totaling 21.6 minutes

Picker	Speed (mph)	Load Size (lb lint /load)	# Loads	Time/ Unload (min)	Total Loads	Picking Time (min)	Total Time (min)	Field Efficiencies (%)			Field Capacity (ac/hr)	
								Picking	Turning	Unloading	Predicted	Theoretical
Advertised First Speed												
CIH 625 ME	4	3125	15.67	2.50	39	321.6	382.3	84.1	5.6	10.2	7.7	9.2
JD 7760	4.2	1795	27.28	0.30	8	306.2	336.0	91.1	6.4	2.4	8.8	9.7
Conventional	4	3200	15.30	2.59	40	321.6	382.8	84.0	5.6	10.4	7.7	9.2
Conventional 2	3.6	3200	15.30	2.59	40	357.3	418.5	85.4	5.2	9.5	7.1	8.3
Actual	3.9	3094	16.00	2.59	42	329.8	392.9	83.9	5.5	10.6	7.5	9.0
Advertised Second Speed												
CIH 625 ME	4.8	3125	15.67	2.50	39	268.0	328.7	81.5	6.6	11.9	9.0	11.1
JD 7760	5	1795	27.28	0.30	8	257.2	287.0	89.6	7.5	2.9	10.3	11.5
Conventional	4.8	3200	15.30	2.59	40	268.0	329.2	81.4	6.6	12.0	9.0	11.1
Conventional 2	3.8	3200	15.30	2.59	40	338.5	399.7	84.7	5.4	9.9	7.4	8.8
Actual	3.9	3094	16.00	2.59	42	329.8	392.9	83.9	5.5	10.6	7.5	9.0
Constant Speed												
CIH 625 ME	4	3125	15.67	2.50	39	321.6	382.3	84.1	5.6	10.2	7.7	9.2
JD 7760	4	1795	27.28	0.30	8	321.6	351.3	91.5	6.1	2.3	8.4	9.2
Conventional	4	3200	15.30	2.59	40	321.6	382.8	84.0	5.6	10.4	7.7	9.2
Conventional 2	3.8	3200	15.30	2.59	40	338.5	399.7	84.7	5.4	9.9	7.4	8.8
Actual	3.9	3094	16.00	2.59	42	329.8	392.9	83.9	5.5	10.6	7.5	9.0

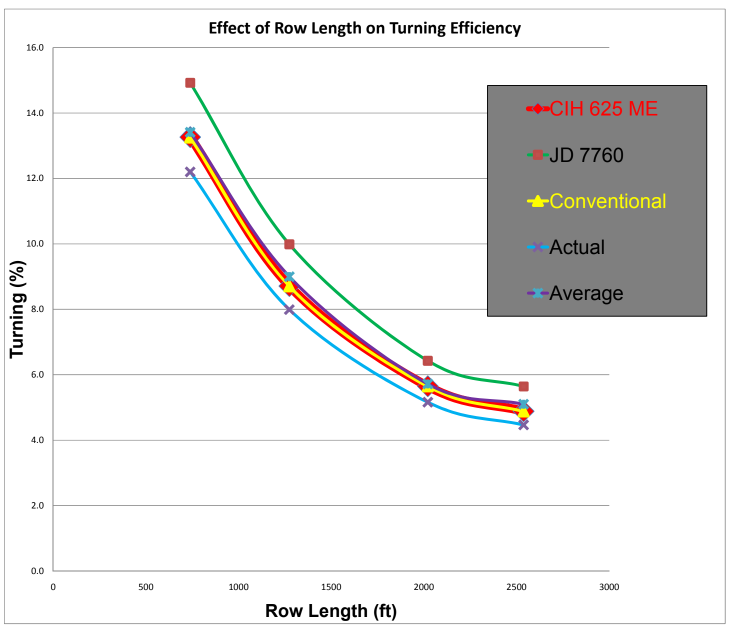

Figure 4: Effect of Row Length on Turning Efficiency for First Gear Picking.

A more direct comparison of the effect of row length on field efficiency can be seen in Tables 5 (Figure 5) and 6a. These two fields were normalized to the same yield (1209 lb/ac) and the average row length of the field shown in Table 5 is approximately twice the row length of the field in Table 6a.

As shown in Table 5 and 6a for 1st gear picking speed, decreasing the row length from 2538 ft to 1274 ft resulted in a decrease in field efficiency by approximately 3.2% for the Case IH 625, 4.2% for the JD 7760 and 3.2% for the conventional picker. This observed decrease in field efficiency between these two fields is due to the relationship between row length and turning efficiency. As shown in Figure 5, as row length increases, the percentage of time spent turning decreases and thus field efficiency increases.

Table 5: Large Field, 81.6 acres, Yield of 1209 lb/ac, One Harvester, Row Length of 2538 ft, 76 Turns, Totaling 32.2 Minutes.

Picker	Speed (mph)	Load Size (lb lint /load)	# Loads	Time/ Unload (min)	Total Loads	Picking Time (min)	Total Time (min)	Field Efficiencies (%)			Field Capacity (ac/hr)	
								Picking	Turning	Unloading	Predicted	Theoretical
	Advertised First Speed											
CIH 625 ME	4	3125	31.57	2.50	79	547.9	659.0	83.1	4.9	12.0	7.7	9.2
JD 7760	4.2	1795	54.96	0.30	16	521.8	570.5	91.5	5.6	2.9	8.8	9.7
Conventional	4	3200	30.83	2.59	80	547.9	660.0	83.0	4.9	12.1	7.6	9.2
Conventional 2	3.6	3200	30.83	2.59	80	608.8	720.8	84.5	4.5	11.1	7.0	8.3
Actual	4.4	2854	35.00	1.36	48	498.1	577.9	86.2	5.6	8.2	8.7	10.1
Advertised Second Speed												
CIH 625 ME	4.8	3125	31.57	2.50	79	456.6	567.7	80.4	5.7	13.9	8.9	11.1
JD 7760	5	1795	54.96	0.30	16	438.3	487.0	90.0	6.6	3.4	10.4	11.5
Conventional	4.8	3200	30.83	2.59	80	456.6	568.6	80.3	5.7	14.0	8.9	11.1
Conventional 2	3.8	3200	30.83	2.59	80	576.7	688.8	83.7	4.7	11.6	7.3	8.8
Actual	4.4	2854	35.00	1.36	48	498.1	577.9	86.2	5.6	8.2	8.7	10.1
Constant Speed												
CIH 625 ME	4	3125	31.57	2.50	79	547.9	659.0	83.1	4.9	12.0	7.7	9.2
JD 7760	4	1795	54.96	0.30	16	547.9	596.6	91.8	5.4	2.8	8.5	9.2
Conventional	4	3200	30.83	2.59	80	547.9	660.0	83.0	4.9	12.1	7.6	9.2
Conventional 2	3.8	3200	30.83	2.59	80	576.7	688.8	83.7	4.7	11.6	7.3	8.8
Actual	4.4	2854	35.00	1.36	48	498.1	577.9	86.2	5.6	8.2	8.7	10.1

Figure 5: ArcMap Generated Image of Field 2; Large Field, 82 acres, Yield of 1209 lb/ac, One Harvester, Row Length of 2468 ft, 77 Turns, Totaling 32.1 Minutes (Table 5).

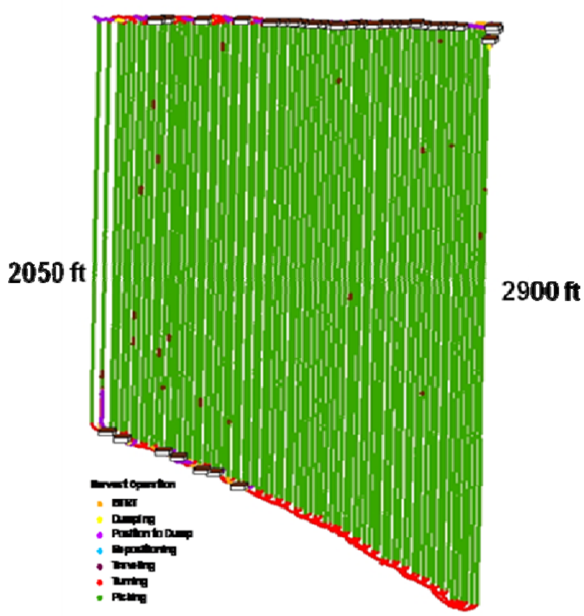

Table 6a: Large Field 47.8 ac, Yield of 1209 lb/ac, 1274 ft Row Length, 90 Turns Totaling 35.5 Minutes

Picker	Speed (mph)	Load Size (lb lint /load)	# Loads	Time/ Unload (min)	Total Loads	Picking Time (min)	Total Time (min)	Field Efficiencies (%)			Field Capacity (ac/hr)	
								Picking	Turning	Unloading	Predicted	Theoretical
Advertised First Speed												
CIH 625 ME	4.0	3125	18.49	2.50	46	325.7	407.5	79.9	8.7	11.3	7.4	9.2
JD 7760	4.2	1795	32.20	0.30	10	310.2	355.4	87.3	10.0	2.7	8.4	9.7
Conventional	4.0	3200	18.06	2.59	47	325.7	408.0	79.8	8.7	11.5	7.4	9.2
Conventional 2	3.6	3200	18.06	2.59	47	361.9	444.2	81.5	8.0	10.5	6.8	8.3
Actual	4.1	1417	33.00	0.30	10	317.8	363.2	87.5	9.8	2.7	8.3	9.4
Advertised Second Speed												
CIH 625 ME	4.8	3125	18.49	2.50	46	271.5	353.2	76.9	10.1	13.1	8.5	11.1
JD 7760	5.0	1795	32.20	0.30	10	260.6	305.8	85.2	11.6	3.2	9.8	11.5
Conventional	4.8	3200	18.06	2.59	47	271.5	353.7	76.7	10.0	13.2	8.5	11.1
Conventional 2	3.8	3200	18.06	2.59	47	342.9	425.2	80.6	8.3	11.0	7.1	8.8
Actual	4.1	1417	33.00	0.30	10	317.8	363.2	87.5	9.8	2.7	8.3	9.4
Constant Speed												
CIH 625 ME	4.0	3125	18.49	2.50	46	325.7	407.5	79.9	8.7	11.3	7.4	9.2
JD 7760	4.0	1795	32.20	0.30	10	325.7	370.9	87.8	9.6	2.6	8.1	9.2
Conventional	4.0	3200	18.06	2.59	47	325.7	408.0	79.8	8.7	11.5	7.4	9.2
Conventional 2	3.8	3200	18.06	2.59	47	342.9	425.2	80.6	8.3	11.0	7.1	8.8
Actual	4.1	1417	33.00	0.30	10	317.8	363.2	87.5	9.8	2.7	8.3	9.4

Influence of Unloading Systems on Field Efficiency and Capacity

The differences associated with the seed cotton unloading systems of the three harvesters can only be compared with all machines operating at the same speed. When speeds were held constant at 4 mph for the field represented in Table 5 (Figure 5), the Case IH 625 ME achieved a predicted field capacity of 7.7 ac/hr at 83.1% field efficiency and the JD 7760 8.5 ac/hr at 91.8% field efficiency. The conventional picker achieved a predicted field capacity of 7.6 ac/hr at 83% field efficiency in this field. Based on these values, the JD 7760's ability to unload without spending time to position to unload or stopping translates to an increase of 8.7% in field efficiency over the Case IH 625 ME and conventional machine in this field. When speeds were held constant at 4 mph and compared for the 13 acre field (Table 3 and Figure 3), the predicted field capacities and efficiencies for the three harvesters were 7.1 ac/hr at 77.3% for the Case IH 625 ME, 7.7 ac/hr at 83.5% for the JD 7760 and 7.1 ac/hr at 77.2% field efficiency. The results for this field translate to an increase of 6.2% in field efficiency for the JD 7760 over the other two harvesters. We observed this same trend in the other four simulated fields. Depending on the field characteristics (field shape, field size, row length and yield), the JD 7760's ability to unload without spending time to position to unload or stopping amounts to an increase of 6 to 10% in field efficiency above the Case IH 625 ME and conventional machine when all were operated at a constant speed of 4 mph. This corresponds to an increase in field capacity of 0.6 to 0.9 ac/hr. The 10% increase in field efficiency was predicted from a 147 ac field with an average row length of 2300 ft and 2 ¾ bale/ac yield.

Influence of Picking Speed on Predicted Field Efficiency and Field Capacity

Field efficiency and capacity values were predicted at the advertised first and second gear picking speeds (1st gear: 4.0 mph Case IH 625, 4.2 mph JD 7760, 4.0 mph conventional; 2nd gear: 4.8 mph Case IH 625, 5.0 mph JD 7760, 4.0 mph conventional) for all fields to determine what effects picking speed have on field efficiency and capacity. When picking at the advertised first gear speed in the field shown in Figure 5 and Table 5, the predicted field efficiencies and capacities for the Case IH 625 ME, JD 7760 and conventional picker were 7.7 ac/hr at 83.1%, 8.8 ac/hr at 91.5% and 7.6 ac/hr at 83.0%, respectively. As expected, when speeds were increased to the advertised second picking speed for all pickers, field efficiency values decreased while field capacities increased. At the advertised 2nd gear picking speed, the predicted field capacity values obtained from the 1st gear picking speed increased by 1.2, 1.6 and 1.3 ac/hr for the Case IH 625 ME, JD 7760 and conventional pickers. Across all the 6 fields simulated, changing picking speeds resulted in a 1.1 to 1.3 ac/hr increase in field capacity for the Case IH 625 ME and conventional and a 1.2 to 1.6 ac/hr increase for the JD 7760.

Comparing all three machines in this field at the advertised 1st gear picking speed, the JD 7760 can harvest approximately 1.1 acres more per hour than the Case IH 625 and conventional picker. Part of this increased field capacity is due to the 0.2 mph difference in speed and the other part is due to the differences in the unloading systems. When we held speed constant at 4.0 mph for all the pickers in this field, the predicted field capacity for the JD 7760 was 0.8 ac/hr higher than the predicted field capacity for the Case IH 625 ME and conventional picker. Thus, the ability of the JD 7760 to operate at 0.2 mph faster in the row increased the field capacity about 0.3 ac/hr in this field. Similar increases in predicted field capacity were observed across all the fields simulated. The range was 0.3 to 0.4 ac/hr depending on characteristics of the field and yield.

When operating in 2nd gear (4.8 mph for the Case IH 625 ME and conventional and 5.0 mph for the JD 7760) in this field, the predicted field capacity for the Case IH 625 increased 1.2 ac/hr, the JD 7760 1.6 ac/hr and the conventional 1.3 ac/hr over 1st gear picking speed. Comparing all three machines at these speeds in this particular field, the JD 7760 has about a 1.5 ac/hr advantage over the Case IH 625 ME and conventional picker. This is an increase of 0.4 ac/hr over first gear. We observed a 0.1 to 0.4 ac/hr increase in field capacity from first to second gear with the larger increases coming from the fields with higher yields for all the six fields simulated.

Influence of Yield on Predicted Field Efficiency and Field Capacity

The impact of yield on the different unloading systems can be seen by comparing data for the same field for two different yields (Tables 6a and 6b). When picking at the advertised 1st gear speed, increasing the yield from approximately 2 to 2.5 bales per acre in this field resulted in a decrease in field efficiency of 2.2%, 0.5% and 2.2% and a resulting decrease in field capacities of 0.2 ac/hr, 0.1 ac/hr and 0.2 ac/hr for the Case IH 625 ME, JD 7760 and conventional harvesters, respectively. As can be seen from these results, the field efficiency and capacity values predicted for the Case IH 625 ME and conventional picker were affected more as yield increased than the JD 7760. These observed differences can be attributed to the differences in the unloading systems.

Table 6b: Large Field 47.8 ac, Yield of 932 lb/ac, 1274 ft Row Length, 90 Turns Totaling 35.5 Minutes

Picker	Speed (mph)	Load Size (lb Lint/ load)	# Loads	Time/ Unload (min)	Total Loads	Picking Time (min)	Total Time (min)	Field Efficiencies (%)			Field Capacity (ac/hr)	
								Picking	Turning	Unloading	Predicted	Theoretical
	Advertised First Speed											
CIH 625 ME	4.0	3125	14.3	2.50	35.64	325.74	396.88	82.1	8.9	9.0	7.6	9.2
JD 7760	4.2	1795	24.8	0.30	7.45	310.23	353.18	87.8	10.1	2.1	8.5	9.7
Conventional	4.0	3200	13.9	2.59	36.06	325.74	397.30	82.0	8.9	9.1	7.6	9.2
Conventional 2	3.6	3200	13.9	2.59	36.06	361.94	433.50	83.5	8.2	8.3	6.9	8.3
Actual	4.1	1417	33.0	0.3	9.9	317.80	363.20	87.5	9.8	2.7	8.3	9.4
	Advertised Second Speed											
CIH 625 ME	4.8	3125	14.3	2.50	35.64	271.45	342.59	79.2	10.4	10.4	8.8	11.1
JD 7760	5.0	1795	24.8	0.30	7.45	260.60	303.54	85.9	11.7	2.5	9.9	11.5
Conventional	4.8	3200	13.9	2.59	36.06	271.45	343.01	79.1	10.3	10.5	8.7	11.1
Conventional 2	3.8	3200	13.9	2.59	36.06	342.89	414.45	82.7	8.6	8.7	7.2	8.8
Actual	4.1	1417	33.0	0.3	9.9	317.80	363.20	87.5	9.8	2.7	8.3	9.4
	Constant Speed											
CIH 625 ME	4.8	3125	14.3	2.50	35.64	325.74	396.88	82.1	8.9	9.0	7.6	9.2
JD 7760	5.0	1795	24.8	0.30	7.45	325.74	368.69	88.4	9.6	2.0	8.1	9.2
Conventional	4.8	3200	13.9	2.59	36.06	325.74	397.30	82.0	8.9	9.1	7.6	9.2
Conventional 2	3.8	3200	13.9	2.59	36.06	342.89	414.45	82.7	8.6	8.7	7.2	8.8
Actual	4.1	1417	33.0	0.3	9.90	317.80	363.20	87.5	9.8	2.7	8.3	9.4

Influence of Operator on Predicted Field Efficiency and Field Capacity

Not all the differences in field capacities that were observed between the Case IH 625 ME and the JD 7760 can be attributed solely to the differences in the unloading systems. The decisions made by the operators of the Case 625 ME's did have some influence on the values obtained. As previously stated, the average time to unload a Case 625 ME ½ module was 2.5 minutes. Reducing this average time to unload can increase field capacity. As shown in Table 5, the field capacity values predicted for the two machines picking in 2nd gear (i.e. 4.8 mph for the Case 625 ME and 5.0 mph for the JD 7760) were 8.9 ac/hr for the Case 625 ME and 10.4 ac/hr for the JD 7760. The 8.9 ac/hr field capacity was predicted using the average time to unload of 2.5 min/unload. This field was harvested with a Case 625 ME, however, the operator picking this field had the shortest average unloading time (1.35 min/unload) of all the operators that were observed. This was a highly skilled operator who was very consistent with his unloading times throughout the entire day. Substituting his actual average unloading time into our simulation model increases the predicted field capacity to 9.5 ac/hr. This clearly shows that operators who consistently unload faster than the 2.5 minutes used in our analysis will have higher field capacities than would be predicted from our simulation model.

Summary of Field Efficiency and Field Capacity Values Across all Fields

All fields were included in an average over acres for all harvesters operating at 4 mph, in advertised first gear and advertised second gear speeds the results presented in Table 7 were obtained. When all fields were considered with all harvester speeds at 4 mph, the field capacity difference of 0.7 ac/hr (7.5 ac/hr for the Case IH 625 ME and 8.2 ac/hr for the JD 7760) in favor of the JD 7760 amounts to 9.4% advantage to unloading on the go over the Case IH 625 ME and conventional harvesters.

Table 7: Performance Variables Averages Over Six Fields

	4 MPH All Speeds Constant				Field Capacity	Field Capacity Increase (%)	Advertised 1st Gear			Field Capacity	Field Capacity Increase (%)	Advertised Second Gear			Field Capacity	Field Capacity Increase (%)
	Field	Field Efficiencies (%)					Field Efficiencies (%)					Field Efficiencies (%)				
Picker	Acres	Picking	Turning	Unloading	(ac/hr)	JD Over CIH	Picking	Turning	Unloading	(ac/hr)	JD Over CIH	Picking	Turning	Unloading	(ac/hr)	JD Over CIH
CIH 625 ME	12.9	77.3	13.3	9.4	7.1	8.1	77.3	13.3	9.4	7.1	12.5	74.0	15.2	10.8	8.2	13.0
CIH 625 ME	49.4	84.1	5.6	10.2	7.7	8.8	84.1	5.6	10.2	7.7	13.8	81.5	6.6	11.9	9.0	14.5
CIH 625 ME	81.6	83.1	4.9	12.0	7.7	10.5	83.1	4.9	12.0	7.7	15.5	80.4	5.7	13.9	8.9	16.6
CIH 625 ME	47.8	79.9	8.7	11.3	7.4	9.9	79.9	8.7	11.3	7.4	14.7	76.9	10.1	13.1	8.5	15.5
CIH 625 ME	47.8	82.1	8.9	9.0	7.6	7.6	82.1	8.9	9.0	7.6	12.4	79.2	10.4	10.4	8.8	12.9
CIH 625 ME	61.3	80.6	6.3	13.1	7.4	11.5	80.6	6.3	13.1	7.4	16.5	77.6	7.3	15.1	8.6	17.7
Average	50.1	81.2	8.0	10.8	7.5	9.4	81.2	8.0	10.8	7.5	14.2	78.3	9.2	12.5	8.7	15.0
JD 7760	12.9	83.5	14.3	2.1	7.7		82.9	14.9	2.2	8.0		80.2	17.2	2.6	9.2	
JD 7760	49.4	91.5	6.1	2.3	8.4		91.1	6.4	2.4	8.8		89.6	7.5	2.9	10.3	
JD 7760	81.6	91.8	5.4	2.8	8.5		91.5	5.6	2.9	8.8		90.0	6.6	3.4	10.4	
JD 7760	47.8	87.8	9.6	2.6	8.1		87.3	10.0	2.7	8.4		85.2	11.6	3.2	9.8	
JD 7760	47.8	88.4	9.6	2.0	8.1		87.8	10.1	2.1	8.5		85.9	11.7	2.5	9.9	
JD 7760	61.3	89.9	7.0	3.0	8.3		89.5	7.3	3.2	8.7		87.7	8.5	3.7	10.1	
Average	50.1	88.8	8.7	2.5	8.2		88.3	9.1	2.6	8.5		86.4	10.5	3.0	10.0	
						JD Over Conv.					JD Over Conv					JD Over Conv 1
Conv.	12.9	77.2	13.2	9.5	7.1	8.2	77.2	13.2	9.5	7.1	12.7	73.9	15.2	10.9	8.2	13.2
Conv.	49.4	84.0	5.6	10.4	7.7	9.0	84.0	5.6	10.4	7.7	13.9	81.4	6.6	12.0	9.0	14.7
Conv.	81.6	83.0	4.9	12.1	7.6	10.6	83.0	4.9	12.1	7.6	15.7	80.3	5.7	14.0	8.9	16.8
Conv.	47.8	79.8	8.7	11.5	7.4	10.0	79.8	8.7	11.5	7.4	14.8	76.7	10.0	13.2	8.5	15.7
Conv.	47.8	82.0	8.9	9.1	7.6	7.8	82.0	8.9	9.1	7.6	12.5	79.1	10.3	10.5	8.7	13.0
Conv.	61.3	80.5	6.3	13.2	7.4	11.7	80.5	6.3	13.2	7.4	16.7	77.5	7.2	15.3	8.6	17.9
Average	50.1	81.1	7.9	11.0	7.5	9.5	81.1	7.9	11.0	7.5	14.4	78.2	9.2	12.7	8.6	15.2

The additional 0.2 mph of the JD 7760 increased average field capacity to 8.5 ac/hr for a total increase in field capacity of 14.2% over the Case IH 625 ME and 14.4% over the conventional harvesters. The difference in the systems at 4.0 mph and 4.2 mph can therefore be allocated about 9% for the unloading system and 5% for the speed increase. Further analysis of all the fields will be forthcoming.

Conclusions

Three different harvester systems were observed for operation in a total of 14 different operations and 29 fields and logged requiring 28 man days and 0.5 million points of recorded data. Package and load weights were determined to be 3.74 bales/round module, 6.5 bales/half module and 16 bales/ conventional module when adjusting to 480 lb net weight/bale for the John Deere 7760, Case IH 625 ME and conventional pickers respectively. Truck loads were found to be 14.96 bales, 13 bales and 16 bales per load for the John Deere 7760, Case IH 625 ME and conventional pickers, respectively. When speeds were held constant at 4 mph, the average field capacity and field efficiency values obtained over the six fields were 7.5 ac/hr at 81% for the Case IH 625 ME and conventional picker and 8.2 ac/hr at 89% for the JD 7760. Based on these values, the JD 7760's ability to unload without spending time to position to unload or stopping amounts to about a 10.7% advantage in field capacity above the Case IH 625 ME and conventional machines when all were operated at a constant speed of 4 mph and turning times were equal. When the John Deere 7760 was compared to the Case IH 625 ME for first gear picking, the added speed increase and the advantage of the unloading system amounted to 12.5% to 16.5% greater actual field capacity (5% due to the speed increase). Speed on the row, picking had the second greatest effect on field capacity in comparison to the unloading system Decreasing the row length from 2538 ft to 1274 ft decreased field efficiency approximately 3.2% Case IH 625 ME, 4.2% JD 7760 and 3.2% Case IH 625 ME. Yield was also found to have a greater influence on field efficiency and capacity values predicted for the Case IH 625 ME and conventional picker than the JD 7760. These observed differences can be attributed to the differences in the unloading systems..

This report should be viewed as a report of preliminary results for the purpose of establishing machinery parameters for an economic evaluation of the three harvesting systems to be conducted at a later time. At no time were all three harvesters operated in the same field. Six "example fields" were chosen for this report out of the necessity to manage the data. Data from the actual harvester for the field is included along with a "normalized" calculation of what the other harvesters might be expected to achieve, based on the actual turning time for the field, the row length and field geometry that was harvested. Down time was eliminated from the analysis; therefore, the actual field efficiencies and capacities reported in this paper will be lower in actual operations. A more complete annual report for this project will be available at a later date from Cotton Incorporated.

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