2006 Beltwide Cotton Conferences, San Antonio, Texas - January 3 - 6, 2006

EVALUATION OF A 15-INCH SPINDLE HARVESTER IN VARIOUS ROW PATTERNS; THREE YEARS PROGRESS

Michael Herbert Willcutt and Eugene P. Columbus
MSUES Ag. & Bio. Engineering
Mississippi State, MS
Normie W. Buehring, Robert R. Dobbs and M.P. Harrison
North Mississippi Research and Extension Center
Verona, MS

Abstract

Cotton was produced in eight different row configurations ranging in width from 15-inch solid and skip row to 38 inch solid and skip row configurations at the Northeast Mississippi Research and Extension Center, Verona, MS, and at a private farm in Falkner, MS in 2003 and at the North Mississippi Research and Extension Center, Verona, MS, and at private farms in Falkner, MS, and Clarksdale, MS in 2004 and 2005.

A John Deere PRO 12 VRS spindle picker row unit (In-line head) was mounted on a single row picker chassis (John Deere Model 122, one row cotton harvester mounted on a gear drive JD 4020 tractor) in 2003-2004 and two row units were mounted on a John Deere 9960 chassis in 2005. The harvester was operated in the plots, operation was observed for any problems that might be associated with the harvester row unit, yields and losses measured, samples ginned and lint sampled for AFIS and HVI quality determinations.

Total harvest losses were greater in the 15-inch row configurations at Falkner and Verona in 2004 and 2005 (Hill locations) with variation in loss amounts by location and year. Ground losses were influenced by pre harvest weather events at Verona and Falkner and Hurricane Rita in 2005 at Clarksdale where ground losses were estimated at 25% to 30%. In 2004 ground losses ranged from a location average low of 2.6% at Clarksdale where no rainfall occurred between boll opening and harvest to 7.9% at Verona following a heavy rain on September 19 and 9.6% at Falkner, where plots were exposed to several heavy rain events during October.

No meaningful fiber quality (HVI) differences were found between treatments in 2003, 2004 or 2005. In 2004 and 2005 all treatments produced essentially equal fiber qualities from a textile mill and market standpoint for each location as measured by HVI; however, color, strength and length were influenced by location and pre harvest weathering.

The harvest simulation model, XLCOTSIM, was used to predict the impact of row spacing and machine performance on net revenue after harvest costs were deducted. Three year average yields for the Hill and two year average yield for the Delta plots, fiber quality, harvest losses, and estimates of machinery costs were used in the model for each row pattern. Narrow row treatments produced the greater net revenue after harvest cost with the 15-inch solid producing \$411/ac, 2 X 2skip rows producing \$405/ac and the 38 row producing a net revenue of \$356/ac for the Hill locations. Net revenue after harvest expenses decreased as row width increased for the Hill locations for all years. The Clarksdale location where yield differences were not as great, resulted in a higher net revenue after harvest costs for the 38 inch solid production system.

Introduction

Efficient cotton production for improved net returns is essential for cotton growers to maintain a competitive advantage in a global market. Ultra narrow row (UNR) cotton and skip-row cotton production systems (Parvin et al. 2000, 2002b) have been used as means for improving profitability. UNR cotton has shown equal or higher yields (Atwell 1996; Buehring et al. 2001; Nichols et al. 2002; Shurley et al. 2002) and net returns (Parvin et al. 2002a; Shurley et al. 2002) than conventional wide rows. However, the 3 to 5¢/lb discount for the fiber's negative spinning quality (mainly neps and trash); the inability to operate the finger strippers under high humidity or dampness in the rain belt; and the increased trash content have offset these advantages. The increased trash content in the material taken to the gin reduces processing capacity (Brashears 1968; Mayfield 1999; and Anthony et al. 1999 and 2000). Although HVI fiber quality analysis have shown no differences between spindle picker and finger stripper cotton, finger stripper cotton had increased neps (Anthony et al. 1999 and 2000; Willcutt et al. 2001).

Researchers at Tempe, AZ, constructed a prototype harvester and described it as, "A method of harvesting stalk-like plants wherein the plants are retained in substantially their upright growing position comprising the steps of conveying the plants together, intertwining the tops of the plant, cutting the stalks of some of the converged intertwined plants and feeding the intertwined cut and uncut plants through a harvester" (Kappelman, et al., 1972). California researchers (Kempner, et al. 1975) modified and tested a brush stripper for harvesting twin rows. Seed cotton losses ranged from 2.7% to 8.0%; however, they experienced many of the problems associated with stripper cotton harvesters including failure to operate satisfactorily in high humidity, stalks being pulled from the soil and lack of cleaner capacity.

John Deere has recently developed, tested and introduced a prototype and subsequently a production spindle picker unit (PRO 12 VRS) for 15-inch row production systems (Deutsch, et al., 2001). Their row unit employs a cutting device consisting of rotary knives operating against a stationary section to shear stalks approximately 2 to 6 inches above the soil. The un-harvested plants are moved in a vertical orientation into the adjacent uncut row where both cut and uncut plants are passed through the picking unit. Rotating finger wheels are employed to move stalks into the uncut row and assist the stalks in moving between the first and second picking drums of an inline picking unit. This design offers the potential to offset some of the limitations of the UNR system; namely, a harvester that can operate in a wider range of plant and weather conditions than a finger or brush stripper yet produce lint qualities expected from a spindle picker.

The objective of this study was to determine the performance of this spindle picker unit and the effect it has on lint yield and quality harvested from UNR and skip row patterns.

Materials and Methods

Studies were initiated in 2003 on a Marietta silt loam and Falaya sandy loam soil at Verona and Falkner, MS, respectively. In 2004, a third location was added at Clarksdale on a Dubbs very fine sandy loam soil. The studies were conducted as randomized complete block designs with four replications. Plot size was 20 ft by 120 ft with row patterns (treatments) as shown in Figure 1. Deltapine DP449BG/RR cotton cultivar was planted no-till into a spring prepared stale seedbed. Buehring provided a complete description of the agronomic production practices and plant characteristics that may be found in companion papers for this conference (Buehring et al., 2004, 2005, 2006).

The cotton was defoliated when the percent open bolls reached approximately 50% to 60% and harvested at Verona on 10/22/03, 9/27/04 and 10/5/05; at Falkner on 10/29/03, 11/8/04 and 10/12/05 and Clarksdale on 10/05/04 and 10/03/05.

All cotton plots were harvested with a John Deere Pro 12 VRS 15-inch row spindle picker unit mounted on a single row picker using a John Deere 4020 as the power unit for 2003 and 2004 and a modified John Deere 9960 with two Pro 12 VRS 15-inch row units for 2005. Figure 2 is a drawing of the header excerpted from the Deere advertising brochure. Adequate rows were harvested to produce a 60+ lb of seed cotton for ginning purposes and to determine lint yield and quality from each plot.

Harvest losses were determined by gleaning seed cotton from the stalks, then removing any dropped seed cotton from the ground from three 10 ft sections of the harvested rows in each plot. Large sticks, burs and leaves were removed by hand from the loss samples and individual samples weighed and dried. The dried seed cotton loss samples were then weighed and combined into one sample from each location and an average turnout determined by ginning. The seed cotton loss per treatment was then multiplied by the average turnout percent for the loss sample and expressed as a lint loss per acre. Percent harvest loss was determined as total lint loss per acre divided by the harvested lint yield per acre at 6% moisture multiplied by 100.

The seed cotton from the harvested plots was stored until November 3, 2003, November 8, 2004 and October 30, 2005 then ginned in the Mini-gin at Mississippi State University (a state of the art, 12 inch wide gin machinery, arranged in a recommended ginning sequence equivalent to a commercial gin) and the USDA Cotton Ginning Lab at Stoneville, MS in 2005 to determine lint yield. Lint moisture determinations were made on all samples before and after ginning and the yield was adjusted to 6% moisture for all plots before data analysis. Three lint sub-samples were taken from each sample in 2003 and 2004 and sent to Cotton Incorporated for HVI and AFIS analysis to determine fiber properties. In 2005, only one AFIS sample per sample was collected for analysis. Data were analyzed using Analysis of Variance and Duncan's New Multiple Range (SAS). A lint value of $0.52/lb based on

Memphis spot cotton prices for December 5, 2005 was determined. The average color grade used was 31-3. A seed value of $80 per ton was determined for Memphis area spot quotes for December 5, 2005.

The harvest simulation model, XLCOTSIM (Chen, et. al, 1992 and To and Willcutt, 2002) was used to simulate a season long harvesting operation. The simulation calculated costs, timing of the harvester and handling system machinery components while adjusting for quality and yield due to weather conditions for the Mid South. This model was used to compare projected season long harvest yield, costs and revenues from a farm sized, full season operation.

The average lint yields for all Hill tests in 2003, 2004 and 2005 and Delta in 2004 and 2005, lint values and the cost variables for a commercially available John Deere spindle picker configured to harvest the different treatment row patterns were used as input information into the XLCOTSIM harvest simulation model. Harvester performance rate for each treatment was determined by using a synchronized speed of 3.6 mph for the harvester multiplied by the width of the harvester swath and dividing by 10 to arrive at harvested acres per hour. This equates to about 85% field efficiency for the picker. XLCOTSIM harvest simulation accounts for harvester unloading, turning and waiting times and further reduces field efficiency appropriate to the handling system used. Acreage for each treatment simulation was chosen so that the model indicated completion of the simulated harvest an average of 30 days and approximately 218 to 222 hours total for the harvest for each treatment when the model was run for ten replications. An average weather scenario was chosen for all runs. In the event the model did not indicate "harvest completed" within the prescribed time, acreage was adjusted until all 10 replications were completed by the model.

Harvester retail price was determined from John Deere's most common picker options by a Deere representative and reduced by 10% (Spurlock, Stan R., 2006). A JD four or six row chassis was used for the model harvester in all treatments, equipped with four-wheel drive guide axle and PRO 12 VRS picking units. Each harvester system included the picker, one boll buggy priced at $20,000 and one module builder priced at $24,000 with two tractors and four laborers including the harvester operator for cost comparisons. Total harvest system costs and net revenue after deducting harvest system costs from gross lint and seed revenue were computed.

Results and Discussion

The wet soil conditions in May 2003 delayed planting at both locations until the last days of May. Above normal rainfall throughout the growing season resulted in above average plant and fruit growth. However, late August cloudy, rainy weather resulted in the top-crop fruit shed at both locations. The cool weather in late September and early October also resulted in a loss of harvestable bolls in the upper most fruiting branches due to a lack of maturity at the time of defoliation. Although no replanting was necessary in 2004, wet soil conditions at Verona and Clarksdale did result in stunting of plant growth and therefore irregular plant heights in the early growing season. Late season rainfall delayed maturity and harvest at the Falkner location. In 2005, lack of rainfall during the growing season and pre harvest Hurricane Rita at Clarksdale reduced yields form normally expected and caused an estimated ground loss in the 25% to 30% range. Similarly, the Verona location experienced adverse conditions that resulted in the plants fruited close to the ground and short stalks. However, the Falkner location experienced almost ideal growing and harvest conditions and first fruit was initiated between nodes 7 and 9, thus approximately 12 inches above the ground.

The PRO 12 VRS picking units performed very well; however, the combination of the growing conditions and adjustments to the picking row unit resulted in the cut row stalks bunching at intervals, thus slug feeding the picking unit to a minor degree in 2003. The compressor door tension springs were tightened to near maximum in an attempt to better clean the stalks. In 2004, choke-ups to the picking unit were noted in harvesting the higher yielding plots, which occurred as a result of inadequate conveying air to the picking unit and could have made ground losses more excessive. The change to the modified John Deere 9960 picker in 2005 with two JD PRO 12 VRS row units mounted on the right side of the chassis eliminated problems experienced with conveying air in previous years (Figure 3). Plugging the fan ports for the other unused two rows directed a greater amount of air to the operating row units. Ground losses may have been worsened by the excessive amount of conveying air for the Verona location in 2005 as some minor amount of seed cotton was blown out of the duct entrance to the basket and sacking attachment as a result of back pressure on the entrance. Cut stalks posed no problems in the picking units in 2004 or 2005. Row spacing adjustment was accomplished by rolling the picking unit on the tool bar. The ducts were aligned with the aid of a swivel on the back of the picking unit. This allowed the upper duct to remain permanently fixed and tilting of the lower duct section from side to side as the row unit was moved (Figure 4). The picking units handled a wider range of plant conditions that would probably have impeded the operation of a finger stripper.

An analysis of the moisture sample data indicated that both seed cotton and lint moistures were not significantly different between treatments for a given location. Lint moisture at the feed control of the gin ranged between 4% and 7% over all locations and years. All lint yields were adjusted to 6% moisture before calculating turnout and losses. Slight but significantly different levels in turnout were noted for the Verona location in 2005 with the higher turnouts found for the narrower row treatments. This may be a reflection of crop maturity.

Yields are provided in Table 1 for the Hill location and Table 2 for the Delta location for all years. A discussion of statistical differences in yields is included in the companion papers by Buehring, et al. (2004, 2005 and 2006). The Hill locations tended to decrease in yield as row width increased. The yields for the 15-inch solid, 30-inch solid and 38-inch solid treatments at the Clarksdale location in 2004 and 2005 were equal. This is consistent with previous research results from Ultra Narrow Row Cotton (UNRC) trials by other researchers that demonstrated that soils better suited for UNRC are those that are marginally suited for cotton production and that yield differences due to row spacing are less apparent in highly productive soils better suited for cotton production. Yields for Hill locations for three years and Delta for two years were averaged and used for input into the XLCOTSIM model.

Harvest losses are provided in Tables 3a and 3b and graphically as a percent loss in Figures 5a, 5b, 5c, 5d and 5e. Bolls were slow to open and dry at the Falkner location in 2003 and 2004, making spindle picking appear to have higher than normal losses. Losses were greater for the Verona and Falkner locations in 2005 for all 15-inch row configurations. Stalk losses were higher than normally expected because of the low fruiting positions on flat planted drills, preventing the picking unit to harvest lower bolls, particularly at the Verona location in 2005. At Clarksdale in 2004, stalk losses were equal for all treatments. All cotton bolls at the Clarksdale location were open and fully fluffed as compared to the top crop at Falkner and Verona locations exhibiting partially opened and hard locked bolls in 2004.

Ground losses were influenced by pre harvest weather events and the maturity of the crop by treatment when these weather events occurred. Higher yielding treatments showed greater ground losses partially due to inadequate conveying air on the picking unit during the 2004 harvest. In 2004 ground losses ranged from a location average low of 2.6% at Clarksdale where no rainfall occurred between boll opening and harvest to 7.9% at Verona following a heavy rain on September 19 and 9.6% at Falkner, where plots were exposed to several heavy rain events during October. The 15-inch solid treatments were higher in ground losses for all Hill locations and years. In 2005, heavy rains and winds from Hurricane Rita resulted in estimated ground losses of 25% to 30% at Clarksdale and an attempt at harvest loss measurements was abandoned. Losses were extremely high at Verona due to low boll set, short plant height, lower yields and flat planted fields. Losses at Falkner in 2005 were lower than the other locations due to ideal pre harvest weather, taller stalks with lowest fruit set beginning between nodes 7 and 9 and higher yields.

HVI data are presented in Table 4 and 5 for all locations for 2004 and 2005 respectively. Although statistical differences were detected in several of the quality variables, these differences are meaningless for the textile mill and in the market loan values. In 2004 and 2005, the Hill locations tended to decrease in micronaire (MIC) for an increase in row width and length (UHM) increased slightly as row width increased. Similarly, strength (STR) tended to increase slightly with an increase in row width. An analysis of AFIS data for both 2004 and 2005 was unavailable for this report.

XLCOTSIM model input variables are listed in Table 6 and include example inputs for the 15-inch solid production system. Lint price, seed price, interest rate, permanent and temporary labor rates and diesel fuel cost were held constant for all treatments. Lint yield was used for each treatment respectively. A four row chassis and four row units were used in the simulation for the Hill locations. A four row or six row chassis and row units was used for the Delta location simulation depending on the maximum width of the harvester matching typical planter systems. Picker parameters are also listed in Table 7 for the Hill locations and Table 8 for the Delta location along with the model prediction of harvest system cost and net revenue after deducting harvest system costs. The Hill location 15-inch treatments ranged from $411/ac, $393/acand $405/ac in net revenue for the solid 15 inch, 15 inch 2X1 and 15 inch 2X2 skip row treatments with total system costs from $175, $126 and $98, to per acre respectively. All the 15-inch row treatments produced greater net revenue than the 38 inch row treatments with net revenues of $55, $37 and $49 per acre more than conventional row patterns. The 30-inch solid treatment (treatment 4) produced a net revenue after harvest system cost of $10 more than the 38 inch conventional treatment. Simulated acreage harvested ranged from 750 acres per machine system for the solid 15-inch row and solid 30-inch rows to 1400 acres for the 15-inch row 2x2 skip, treatment 3. It should be noted that model output for the season long simulation never reached harvested yield for the plots. By design, the plot yields harvested were considered to be at the top of the yield curve or maximum yield for the treatments; thus, the season long yields will always be lower than the plot yields.

Net revenues for the 15 inch treatments were $52, $27 and $47 for the solid 15 inch, 15 inch 2 X 1 skip and 15 inch 2 X 2 skip respectively; lower than the 38 inch conventional treatment for the Delta location. No statistical analysis of the simulation runs was conducted. Spurlock, et al., 2006 provided an analysis of total production system costs and returns for the treatments included in these tests using average yields and total production system inputs. His results support the findings above and show that the 15 inch 2X2 and 15 inch 2X1 production systems produced higher net revenue than wider row systems for the Hill locations.

Conclusions

All 15-inch row patterns produced greater yields than did wider row patterns for the Hill locations for two out of three years. The Delta location with better cotton soils produced equal yields for 15 inch, 30 inch and 38 inch row spacing. XLCOTSIM predictions of harvest system costs and net revenues suggested that 15-inch row production systems would have been more profitable than conventional systems for the Hill locations provided that pre-harvest production costs were equal. The Hill location 15-inch treatments ranged from $411/ac, $393/acand $405/ac in net revenue for the solid 15 inch, 15 inch 2X1 and 15 inch 2X2 skip row treatments with total system costs from $175, $126 and $98, to per acre respectively. All the 15-inch row treatments produced greater net revenue than the 38 inch row treatments with net revenues of $55, $37 and $49 per acre more than conventional row patterns.

Acknowledgement

This project's completion was possible only with close cooperation of a dedicated team of scientists, staff and sponsors. The authors gratefully acknowledge the funding support provided by Cotton Incorporated in core and state funds and harvester row units, planter and financial support provided by John Deere and Company. The authors also acknowledge Keith Morton Farms, Incorporated and Cliff Heaton of Heaton Farms in their support of the research through provision of locations for plots, time and interest in the experiment.

References

Anthony, W.S., W.D. Mayfield, and T.D. Valco. 2000. Results of 1999 ginning studies of ultra narrow cotton. Proceedings 2000 Beltwide Cotton Conference.

Anthony, W.S., William D. Mayfield, and Thomas D. Valco. 1999. Results of 1998 ginning studies of ultra narrow row cotton. Proceedings 1999 Beltwide Cotton Conference.

Atwell, S.D. 1996. Influence of ultra narrow row on cotton growth and development. Proceedings 1996 Beltwide Cotton Conference. 1187-89.

Brashears, A.P., I.W. Kirk, and E.B. Hudspeth, Jr. 1968. Effects of row spacing and population on double row cotton. Texas Agr. Exp. Station MP872.

Buehring, N. W., M.P. Harrison, R.R. Dobbs, M.H. Willcutt, E.P. Columbus, T.C. Needham and J.B. Phelps. 2004. Spindle Picker 15-Inch Row Pattern Influence on Lint Yield and Plant Characteristics: One Year's Progress. Proceedings 2004 Beltwide Cotton Conference.

Buehring, N. W., M.P. Harrison, R.R. Dobbs, M.H. Willcutt, E.P. Columbus, T.C. Needham and J.B. Phelps. 2005. Lint Yield and Plant Characteristics as Influenced by Spindle Picker Narrow and Wide Row Patterns. Proceedings 2005 Beltwide Cotton Conference.

Buehring, N. W., M.P. Harrison, R.R. Dobbs, M.H. Willcutt, E.P. Columbus, T.C. Needham, J.B. Phelps and Ann F. Ruscoe. 2006. Yield and Plant Characteristics as Influenced by Spindle Picker Narrow and Wide Row Patterns Three Years Progress Report. Proceedings 2006 Beltwide Cotton Conference.

Buehring, N.W., M.H. Willcutt, G.R. Nice, and R.R. Dobbs. 2001. UNR cotton response to seeding rates. 2000 North Mississippi Research and Extension Center Annual Report. Mississippi Agricultural and Forestry Experiment Station Information Bulletin 375. 125-127.

Chen, L.H. and H. Willcutt. 1992. Cotton Harvesting System With Module Builder, Boll Buggy and Trailer. Proceedings 1992 Beltwide Cotton Conference.

Deutsch, Timothy A. and Howard C. Hadley. September 25, 2001. Narrow Row Crop Harvester with Lateral Conveying of Cut Row; U.S. Patent Number 6,293,078 B1, Assigned to Deere & Company, Moline IL.

Kappelman, Benjamin O. and Martin I. Vance. August 22, 1972. Device for Harvesting Randomly Grown Plants; US Patent Number 3,685,263.

Kempner, R. A., R. G. Curley, C. R. Brooks and V. T. Walhood. February 18, 1975. A brush Type Stripper for Double-Row Cotton. Proceedings, Western Cotton Production Conference.

Mayfield, William. 1999. Overview of ultra narrow row cotton situation from a ginner's perspective. Proceedings 1999 Beltwide Cotton Conference. 414-416.

Nichols, S.P., C.E. Snipes, and M.A. Jones. 2002. Evaluation of varieties and plant population in ultra narrow cotton in Mississippi. Proceedings Beltwide Cotton Conference. CD-Rom.

Parvin, D.W., F.T. Cooke, and Jo Stephens. 2000. Estimated costs, yields, and returns associated with 8-row solid and 12-row skip-row cotton production systems: a case study Department of Agric. Eco. Miss. Agric. & Forestry Expt. Station, Mississippi Cooperative Extension Service, Mississippi State University Staff Report 2000-2003.

Parvin, D.W., Judson Gentry, F.T. Cooke, and S.W. Martin. 2002a. Three years experience with ultra narrow row cotton production in Mississippi, 1999-2001. Proceedings 2002 Beltwide Cotton Conference. CD-Rom.

Parvin, D.W., J.W. Burkhalter, F.T. Cooke, and S.W. Martin. 2002b. Three years experience with skip-row cotton production in Mississippi, 1999-2001. Proceedings 2002 Beltwide Cotton Conference. CD-Rom.

Spurlock, Stan R., M.H. Willcutt and N.W. Buehring. 2006. Costs and Returns of Alternate Spindle Picker Systems. Proceedings of the 2006 Beltwide Cotton Conferences, San Antonio, TX.

Shurley, Don W., Michael J. Bader, Craig W. Bednarz, Steve M. Brown, Glen Harris, and Phillip M. Roberts. 2002. Economic assessment of ultra narrow row cotton production in Georgia. Proceedings 2002 Beltwide Cotton Conference. CD-Rom.

To, S. D. Filip, M. Herbert Willcutt. 2002. XLCOTSIM, a cotton harvesting system simulator. Proceedings 2002 Beltwide Cotton Conference. CD-Rom.

Willcutt, M.H., Eugene Columbus, Thomas D. Valco, and Patrick Gerard. 2001. Cotton lint qualities as affected by harvester type in 10 and 30-inch production systems. Proceedings 2001 Beltwide Cotton Conference.

Table 1: Lint yield on a land basis as influenced by row pattern on a Marietta silt loam soil, Verona, MS, Falaya silt loam soil, Falkner, MS in 2003-2005.

Yield (lb/ac)													
	Verona						Falkner						Hill Avg
Treatments	2005		2004		2003		2005		2004		2003		
1: 15-in solid	675	b	1043	a	1196	a	1482	a	1304	a	995	a	1116
2: 15-in 2 X 1 skip	758	ab	967	abc	1106	ab	1426	abc	1236	ab	932	ab	1071
3: 15-in 2 X 2 skip	737	ab	923	abcd	1039	bc	1347	cd	1159	bc	886	b	1015
4: 30-in solid	758	ab	987	ab	1038	bc	1456	ab	1230	abc	949	ab	1070
5: 30-in 2 X 1 skip	724	ab	844	cde	813	d	1371	bcd	1110	bc	801	c	944
6: 60-in solid	683	b	759	e	902	cd	1285	d	969	de	714	d	885
7: 38-in solid	827	a	855	bcde	922	cd	1413	abc	1092	cd	907	b	1003
8: 38-in 2 X 1 skip	669	b	796	de	810	d	1192	e	924	e	751	cd	857

Means followed by same letter do not significantly differ (P=.05, LSD)
Lint yield adjusted to 6% moisture.

Table 2: Lint yield on a land basis as influenced by row pattern on a Dubbs very fine sandy loam soil, Clarksdale, MS, 2004-2005.

Yield (lb/ac)					
	Clarksdale				Delta Avg.
Treatments	2005		2004		
1: 15-in solid	1035	a	1355	ab	1195
2: 15-in 2 X 1 skip	977	b	1311	ab	1144
3: 15-in 2 X 2 skip	995	ab	1261	bcd	1128
4: 30-in solid	972	ab	1397	ab	1185
5: 30-in 2 X 1 skip	1004	ab	1168	cd	1086
6: 60-in solid	886	b	1149	d	1018
7: 38-in solid	1030	a	1358	ab	1194
8: 38-in 2 X 1 skip	843	b	1273	bcd	1058
Grand Mean	967.8		1284		1126

Means followed by same letter do not significantly differ (P=.05, LSD)

Table 3a: Average Stalk and Ground Loss on a land basis as influenced by row pattern on a Marietta silt loam soil, Verona, MS.

	2005						**2004**						**2003**	
Treatments	**Stalk Loss (lb/ac)**		**Ground Loss (lb/ac)**		**Total Loss (lb/ac)**		**Stalk Loss (lb/ac)**		**Ground Loss (lb/ac)**		**Total Loss (lb/ac)**		**Total Loss (lb/ac)**	
1: 15-in solid	38	ab	61	a	99	a	25	a	130	a	155	a	40	b
2: 15-in 2 X 1 skip	35	b	48	bc	83	a	25	a	132	a	157	a	38	b
3: 15-in 2 X 2 skip	49	a	42	c	91	a	33	a	92	b	125	ab	42	b
4: 30-in solid	34	b	54	ab	88	a	16	b	77	bc	93	bc	42	b
5: 30-in 2 X 1 skip	34	b	23	d	57	b	12	b	48	cd	60	cd	37	b
6: 60-in solid	36	b	22	d	57	b	9	b	33	d	42	d	63	a
7: 38-in solid	38	ab	27	d	65	b	12	b	51	cd	63	cd	38	b
8: 38-in 2 X 1 skip	28	b	21	d	49	b	10	b	30	d	40	d	32	b
Grand Mean	80		37		117		18		74		92		42	

Means followed by same letter do not significantly differ (P=.05, LSD)

Table 3b: Average Stalk and Ground Loss on a land basis as influenced by row pattern on a Falaya silt loam soil, Falkner, MS.

	2005						**2004**						**2003**	
Treatments	**Stalk Loss (lb/ac)**		**Ground Loss (lb/ac)**		**Total Loss (lb/ac)**		**Stalk Loss (lb/ac)**		**Ground Loss (lb/ac)**		**Total Loss (lb/ac)**		**Total Loss (lb/ac)**	
1: 15-in solid	37	b	93	a	130	ab	43	a	157	a	200	a	104	
2: 15-in 2 X 1 skip	62	a	86	ab	148	a	23	ab	117	bc	140	bc	91	
3: 15-in 2 X 2 skip	50	ab	67	b	117	b	29	ab	130	ab	159	b	125	
4: 30-in solid	38	b	41	c	79	c	21	b	114	bc	135	bc	117	
5: 30-in 2 X 1 skip	41	b	36	c	77	c	19	b	94	cd	113	bc	87	
6: 60-in solid	47	ab	32	c	79	c	19	b	83	d	102	bc	110	
7: 38-in solid	37	b	36	c	73	c	26	ab	89	cd	115	bc	118	
8: 38-in 2 X 1 skip	50	ab	26	c	76	c	31	ab	89	cd	120	bc	88	
Grand Mean	45		52		98		26		109		136		106	

Means followed by same letter do not significantly differ (P=.05, LSD)

Table 4: HVI Fiber Properties by Treatment from 2004 Locations.

Verona, MS

Trt No.	Treatment Name	MIC		UHM		UI		STR		ELO		Rd		+b		AREA %		SFC %	
1	15" solid	4.06	abc	1.06	c	81.88	a	29.77	c	5.39	a	77.99	ab	7.62	a	0.68	ab	11.27	a
2	15" 2X1 skip	4.27	a	1.07	bc	81.83	a	29.63	c	5.36	a	77.60	bc	7.75	a	0.72	ab	11.22	a
3	15" 2X2 skip	3.92	c	1.08	b	82.33	a	29.89	bc	5.43	a	76.87	c	7.84	a	1.00	a	11.05	ab
4	30" solid	3.99	bc	1.07	bc	82.12	a	29.61	c	5.41	a	77.98	ab	7.71	a	0.60	b	11.48	a
5	30" 2X1 skip	4.00	bc	1.10	a	82.03	a	30.52	ab	4.88	b	78.46	a	7.76	a	0.77	ab	10.81	ab
6	60" solid	3.97	bc	1.10	a	81.72	a	30.67	a	4.89	b	77.72	ab	7.80	a	0.84	ab	10.88	ab
7	38" solid	4.19	ab	1.08	bc	81.98	a	29.76	c	5.16	ab	77.87	ab	7.72	a	0.59	b	11.14	ab
8	38" 2X1 skip	4.16	abc	1.10	a	82.31	a	30.95	a	4.79	b	77.98	ab	7.67	a	0.68	ab	10.43	b
Grand Mean		4.07		1.08		82.03		30.10		5.16		77.81		7.73		0.74		11.03	

Ripley, MS

Trt No.	Treatment Name	MIC		UHM		UI		STR		ELO		Rd		+b		AREA %		SFC %	
1	15" solid	4.18	a	1.05	b	81.59	a	27.28	ab	6.47	a	69.17	a	7.85	b	1.02	b	12.42	ab
2	15" 2X1 skip	4.16	a	1.06	b	81.48	a	27.68	a	6.34	ab	69.05	a	7.98	ab	1.16	b	12.38	b
3	15" 2X2 skip	4.22	a	1.05	b	81.58	a	27.52	a	6.20	ab	68.65	a	7.95	ab	1.29	ab	12.58	ab
4	30" solid	4.16	a	1.05	b	81.33	ab	26.93	b	6.18	ab	68.69	a	7.93	ab	1.06	b	12.76	ab
5	30" 2X1 skip	4.15	ab	1.06	ab	81.35	ab	27.27	ab	6.15	b	68.00	a	7.96	ab	1.33	ab	12.23	b
6	60" solid	4.12	ab	1.06	ab	81.18	ab	27.15	ab	6.16	b	68.22	a	8.26	a	1.03	b	12.66	ab
7	38" solid	3.97	b	1.06	b	80.70	b	27.33	ab	6.16	b	68.33	a	8.13	ab	1.30	ab	13.16	a
8	38" 2X1 skip	3.78	c	1.07	a	80.90	ab	27.48	ab	6.07	b	68.35	a	8.26	a	1.64	a	12.62	ab
Grand Mean		4.09		1.06		81.26		27.33		6.22		68.56		8.04		1.23		12.60	

Clarksdale, MS

Trt No.	Treatment Name	MIC		UHM		UI		STR		ELO		Rd		+b		AREA %		SFC %	
1	15" solid	4.15	ab	1.09	d	81.82	a	30.11	b	4.85	a	80.43	ab	7.62	cd	0.25	ab	11.22	a
2	15" 2X1 skip	4.19	a	1.10	cd	81.88	a	30.46	b	4.61	ab	80.09	ab	7.86	ab	0.28	ab	11.12	a
3	15" 2X2 skip	4.21	a	1.12	b	81.87	a	30.57	ab	4.57	ab	79.50	b	7.73	bc	0.38	a	10.81	a
4	30" solid	4.21	a	1.11	bc	81.68	a	30.20	b	4.73	ab	81.03	a	7.58	d	0.29	ab	11.13	a
5	30" 2X1 skip	4.02	b	1.11	bc	81.51	a	30.85	ab	4.54	ab	81.27	a	7.74	bc	0.21	b	11.27	a
6	60" solid	3.83	c	1.12	b	81.76	a	30.80	ab	4.63	ab	80.36	ab	7.84	ab	0.25	ab	11.15	a
7	38" solid	4.16	a	1.11	bc	81.64	a	30.30	b	4.68	ab	80.89	a	7.72	bc	0.20	b	11.36	a
8	38" 2X1 skip	3.86	c	1.13	a	81.73	a	31.24	a	4.41	b	80.44	ab	7.93	a	0.24	ab	10.77	a
Grand Mean		4.08		1.11		81.74		30.57		4.63		80.50		7.75		0.26		11.10	

Means followed by same letter do not significantly differ (P=.05, LSD)

2006 Beltwide Cotton Conferences, San Antonio, Texas - January 3 - 6, 2006

Table 5: HVI Fiber Properties by Treatment from 2005 Locations.

Verona, MS

Trt No.	Treatment Name	MIC		UHM		UI		STR		ELO		Rd		+b		AREA %		SFC %	
1	15" solid	4.5	a	1.03	a	79.38		28.1	b	4.82		78.4		7.27		0.242	d	11.49	a
2	15" 2X1 skip	4.33	ab	1.03	ab	77.95		29.48	a	4.68		78.5		7.2		0.467	bc	11.43	a
3	15" 2X2 skip	4.15	b	1.07	abc	79.33		29.6	a	4.98		78.2		7.15		0.492	abc	10.01	ab
4	30" solid	4.16	b	1.09	c	80.23		29.23	a	4.98		78.4		7.29		0.442	c	8.98	ab
5	30" 2X1 skip	4.13	b	1.09	c	79		30.27	a	4.81		78.3		7.22		0.567	abc	8.18	b
6	60" solid	4.13	b	1.09	c	80.04		29.6	a	4.84		78.2		7.08		0.617	abc	8.99	ab
7	38" solid	4.32	ab	1.08	bc	80.52		29.86	a	4.83		78.6		7.12		0.492	abc	8.59	b
8	38" 2X1 skip	4.18	b	1.06	abc	78.87		30.07	a	4.84		78.2		7.08		0.583	abc	9.77	ab
Grand Mean		4.24		1.07		79.41		29.53		4.85		78.33		7.17		0.49		9.68	

Ripley, MS

Trt No.	Treatment Name	MIC		UHM		UI		STR		ELO		Rd		+b		AREA %		SFC %	
1	15" solid	4.51	a	1.08	a	80.88	ab	29.64	bcd	5.75	ab	78.9	ab	7.04	b	0.43	bc	9.04	
2	15" 2X1 skip	4.47	a	1.09	a	80.91	ab	29.33	d	5.72	ab	77.8	bc	7.08	b	0.49	bc	8.58	
3	15" 2X2 skip	4.43	a	1.09	a	80.88	ab	29.85	abcd	5.66	ab	77.9	bc	7.03	b	0.53	ab	8.9	
4	30" solid	4.45	a	1.09	a	80.49	b	29.45	cd	5.65	ab	79.3	a	7.23	ab	0.35	c	8.98	
5	30" 2X1 skip	4.43	ab	1.1	a	80.66	ab	30.11	abc	5.55	b	78.5	abc	7.08	b	0.49	bc	9.35	
6	60" solid	4.44	a	1.1	a	80.79	ab	29.7	bcd	5.6	b	78.9	ab	7.14	b	0.48	bc	9.04	
7	38" solid	4.41	ab	1.1	a	80.52	b	30.23	ab	5.91	a	78.5	abc	7.19	b	0.52	ab	8.79	
8	38" 2X1 skip	4.29	b	1.12	b	81.23	a	30.39	a	5.75	ab	77.4	c	7.46	a	0.67	a	8.23	
Grand Mean		4.42		1.1		80.79		29.84		5.7		78.4		7.16		0.49		8.86	

Clarksdale, MS

Trt No.	Treatment Name	MIC		UHM		UI		STR		ELO		Rd		+b		AREA %		SFC %	
1	15" solid	4.74	a	1.1		79.43		30.18		4.66		73.6	a	8.63	a	0.35		8.48	
2	15" 2X1 skip	4.74	a	1.07		78.75		29.73		4.31		74.7	bc	8.27	ab	0.38		9.44	
3	15" 2X2 skip	4.93	ab	1.1		79.73		30.22		4.61		74.7	bc	8.4	ab	0.36		9.1	
4	30" solid	5.01	b	1.1		80.35		29.73		4.61		74.8	bc	8.18	b	0.36		8.95	
5	30" 2X1 skip	4.87	ab	1.07		79.7		29.94		4.3		73.9	ab	8.38	ab	0.33		9.19	
6	60" solid	4.97	b	1.1		80.16		29.68		4.42		75.1	c	8.09	b	0.3		8.9	
7	38" solid	4.89	ab	1.1		80.12		29.92		4.47		75.7	c	8.02	b	0.3		8.48	
8	38" 2X1 skip	5	b	1.08		78.68		30		4.61		75.2	c	8.01	b	0.36		9.74	
Grand Mean		4.89		1.08		79.61		29.92		4.5		74.71		8.25		0.34			

Means followed by same letter do not significantly differ (P=.05, LSD)

Table 6: Example XLCOTSIM Input Values Treatment 1: Solid 15 Inch Rows

RUN

1116	**Expected Average Lint Yield (lb/acre)**		
$ 0.52	**Lint Price ($)/Lb**		
$ 80.00	**Seed Price ($)/ ton**		
7.50%	**Interest rate (%)**		
$ 10.00	**Permanent labor Rate ($/hr)**		
$ 7.50	**Temporary labor Rate ($/hr)**		
$ 1.50	**Diesel fuel cost ($/gal.)**		
300	**area of maturity group 1 (acres)**		
1000	**area of maturity group 2 (acres)**		
200	**area of maturity group 3 (acres)**		
97%	**% of yield harvested in first picking**		
0%	**% of yield harvested in 2nd picking**		
	Attributes of Pickers	**JD 4 Row PRO 12 VRS**	**JD 4 Row PRO 12 VRS**
	Field capacity (ac/hr)	3.6	3.6
	Basket capacity (lb)	8500	8500
	Purchase Price ($)	$310,266	$310,266
	Leasing cost for Leased picker ($/hr)	$ -	$ -
	Fuel Consumption (gal/hr)	14	14
	Second Harvest Field capacity (ac/hr)	0	0
	Second Harvest Percent of Acreage Harvested	0.00%	0
	Leased or Owned (L/O)	O	o
	Included in Simulation (Y/N)	y	y
	Attributes of boll Buggies	**Buggy #1**	**Buggy #2**
	CAPACITY (lb)	10000	10000
	Purchase Price ($)	$ 20,000	$ 20,000
	Included in Simulation (Y/N)	y	y
	Attributes of Module Builders	**Builder #1**	**Builder #2**
	Capacity (lb)	20000	20000
	Purchase Price ($)	$ 24,000	$ 24,000
	Included in Simulation (Y/N)	y	y
	Attributes of of Trailers	**Trailer#1**	**Trailer #2**
	Capacity (lb)	12000	12000
	Purchase Price ($)	$ 3,600	$ 3,600
	Turnaround time (hr)	1.5	
	Included in Simulation (Y/N)	n	N
1	**Weather Scenario, 1=good 2= moderate, 3=bad**		
10	**Number of replications to run this model**		
9/16	**Initial Harvest date (mm/dd)**		
Y	**Preemption option , Y/N**		
n	**Include second harvest?**		
9/4	**The date considered day-1 of harvest season**		
$ 15.74	**Tractor fixed cost for boll buggy and module builder operations ($/hr) See MSU crop budget**		
$ 8.92	**Tractor direct cost ($/hr) for boll buggy and module builder operations See MSU crop budget**		

RUN

Table 7: XLCOTSIM results using a four row chassis with PRO 12 VRS units and average yields from all Hill locations, 2003-2005.

Treatments	Yield (lb/ac)	Acres/Group	Total Acres / Machine	Performance Rate (Ac/Hr)	Harvest Cost ($/Ac)	Net Revenue ($/Ac)	Harvester Cost
1: 15-in solid	1116	150,500,100	750	3.6	$175	$411	$310,266
2: 15-in 2 X 1 skip	1071	200,775,150	1125	5.4	$126	$393	$344,187
3: 15-in 2 X 2 skip	1015	325,875,200	1400	7.2	$98	$405	$344,867
4: 30-in solid	1070	150,500,100	750	3.6	$171	$366	$301,094
5: 30-in 2 X 1 skip	944	200,700,150	1050	5.4	$117	$357	$307,560
6: 60-in solid	886	300,875,200	1375	7.2	$90	$353	$308,385
7: 38-in solid	1003	200,600,125	925	4.6	$134	$356	$301,894
8: 38-in 2 X 1 skip	857	300,800,200	1300	6.8	$94	$344	$309,641

Table 8: XLCOTSIM results using a four row chassis with PRO 12 VRS unitsand average yields from Delta location, 2003-2005.

Treatments	Yield (lb/ac)	Acres/Group	Total Acres / Machine	Performance Rate (Ac/Hr)	Harvest Cost ($/Ac)	# Units	Net Revenue ($/Ac)	Harvester Cost
1: 15-in solid	1195	300,700,100	1100	5.4	$140	6	$441	$384,687
2: 15-in 2 X 1 skip	1144	450,950,200	1600	8.1	$97	6	$466	$389,867
3: 15-in 2 X 2 skip	1128	350,850,200	1400	7.2	$98	4	$446	$344,867
4: 30-in solid	1184	300,700,100	1100	5.4	$137	6	$443	$370,922
5: 30-in 2 X 1 skip	1086	450,950,200	1600	8.1	$94	6	$439	$373,403
6: 60-in solid	1018	350,850,200	1400	7.2	$90	4	$418	$308,385
7: 38-in solid	1194	300,800,200	1300	6.8	$111	6	$493	$371,603
8: 38-in 2 X 1 skip	1058	300,800,200	1500	6.8	$96	4	$430	$309,641

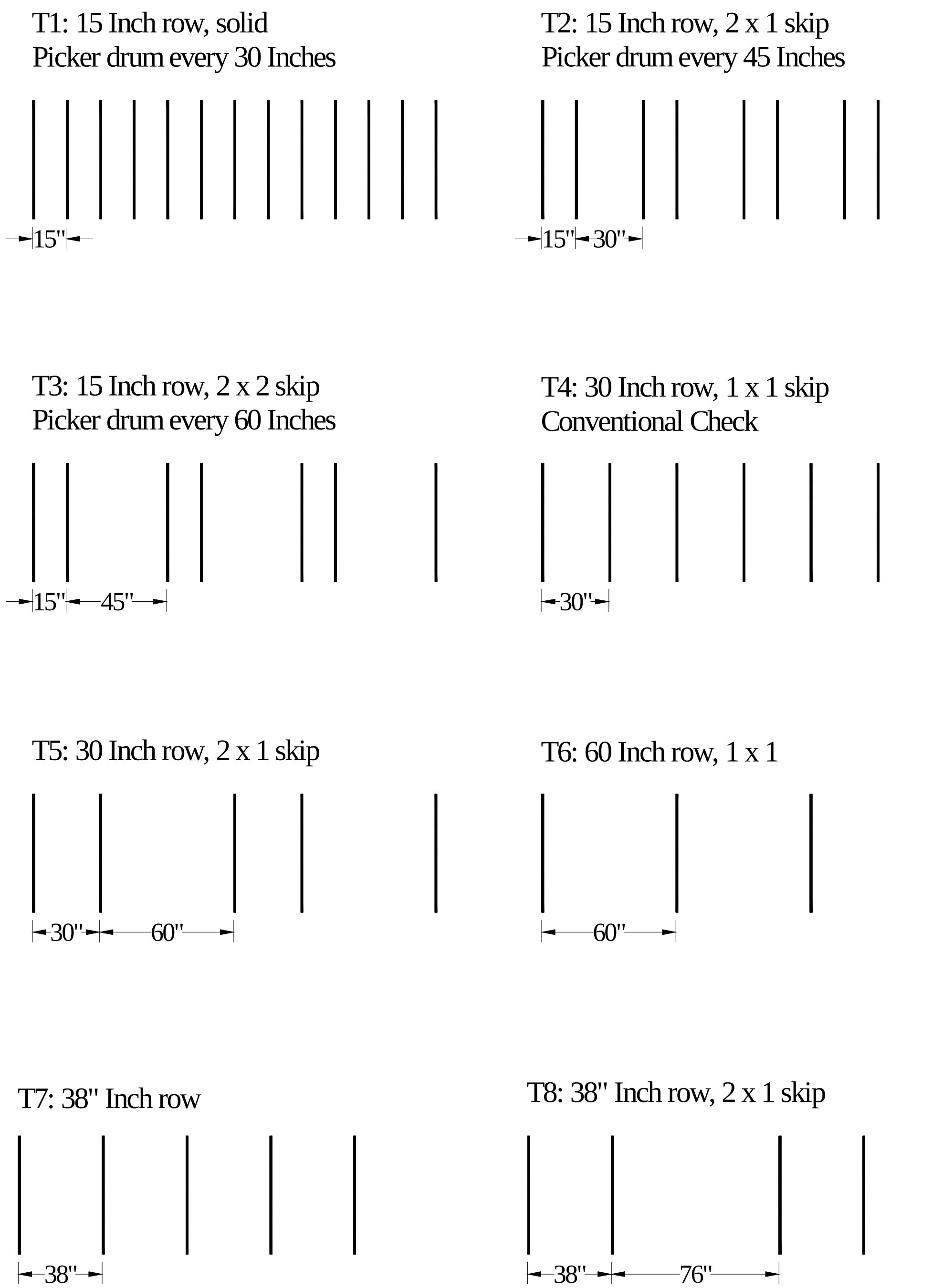

Figure 1: Row Patterns Tested

Figure 2: John Deere, Pro 12, 15-inch spindle picker row unit.

Figure 3: John Deere 9960 modified plot harvester set to harvest 15-inch 2X2 skip row.


Figure 4: Swivel on back of picking unit for positioning row units.

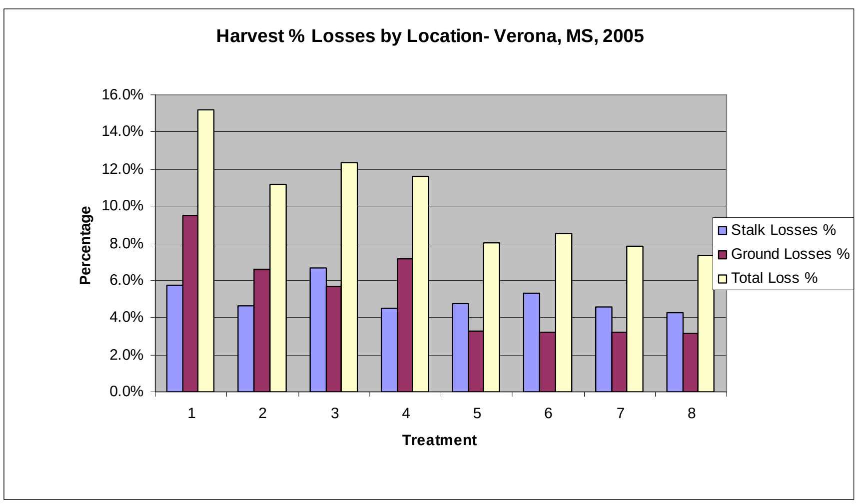

Figure 5a: % Harvest Losses at Verona, 2005

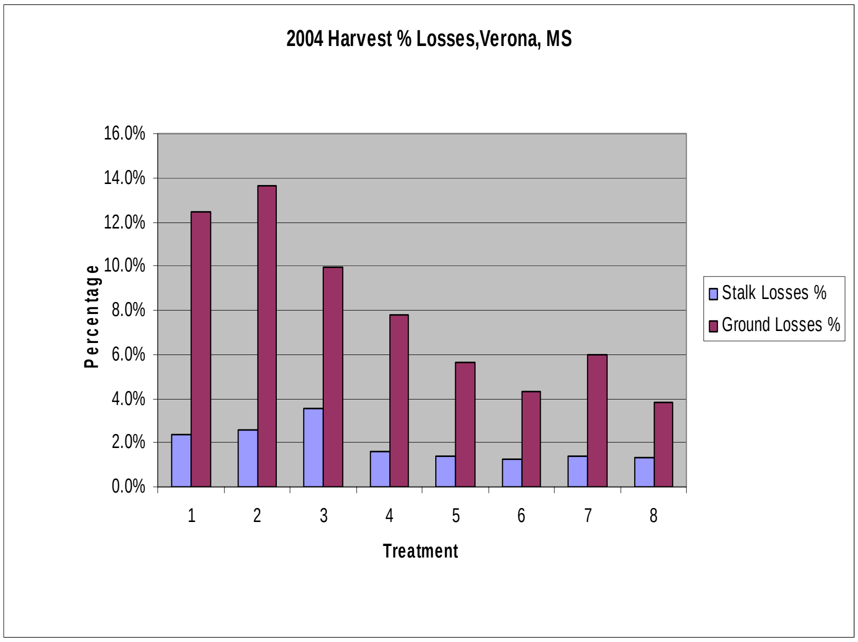

Figure 5b: % Harvest Losses at Verona, 2004.

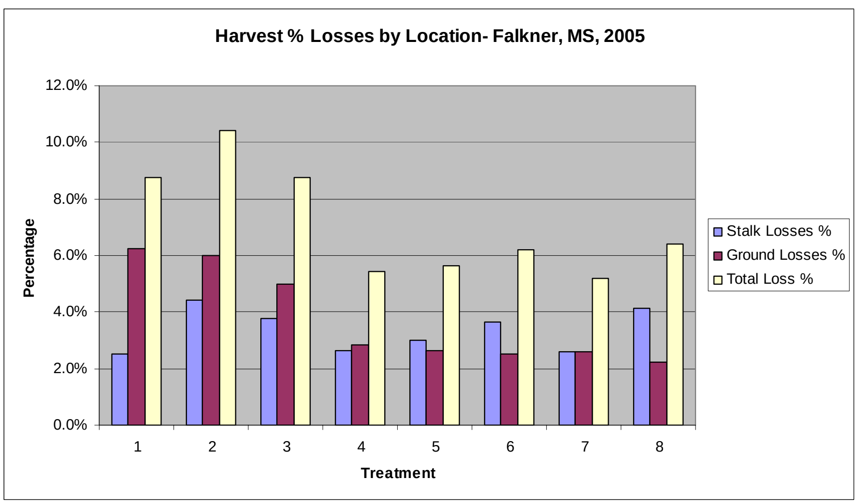

Figure 5c: % Harvest Losses at Falkner, 2005.

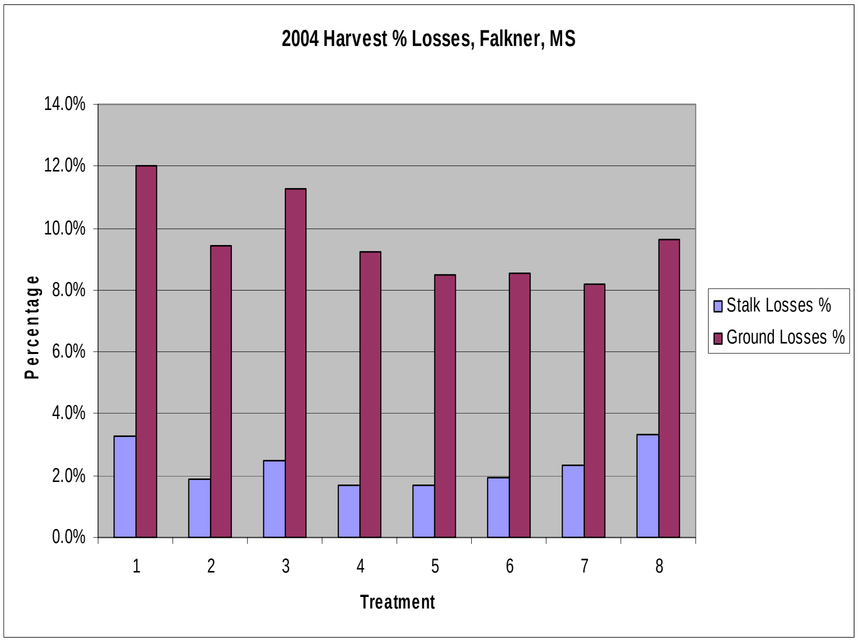

Figure 5d: % Harvest Losses at Falkner, 2004.

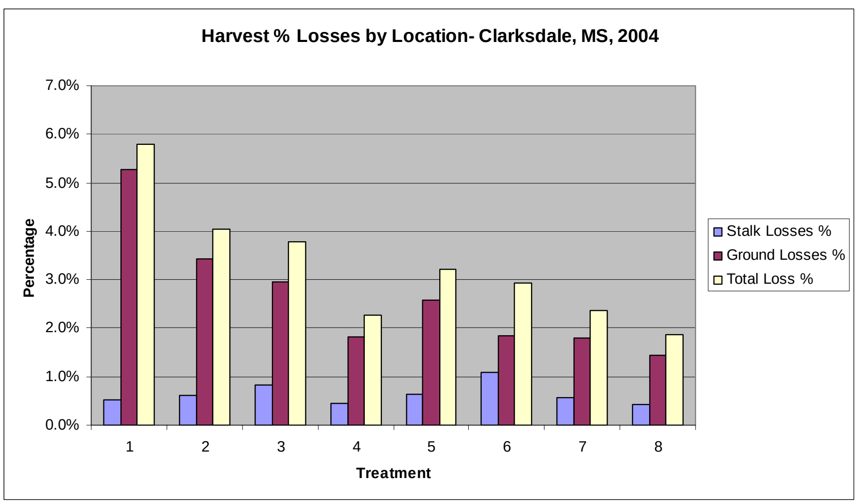

Figure 5e: % Harvest Losses at Clarksdale, 2004.