



CORN STOVER HARVEST



IOWA STATE UNIVERSITY
Extension and Outreach

Economics of Harvesting and Transporting Corn Stover

Corn stover is an abundant source of winter feed and bedding for beef cows and other livestock in Iowa. It is also in demand as a feedstock for the production of biofuels and other products. However, corn stover is a relatively bulky commodity with a low value to weight ratio, so the costs of harvesting it and transporting it to the site where it will be used must be carefully considered.

Operations

As many as four operations can be involved in taking corn stover from the open field to its final destination:

- Windrowing
- Baling
- Collecting and handling
- Transporting

Which operations are performed depends on the particular system employed, which in turn depends on the end use of the stover, the distance it must be moved, and the type of equipment owned by the producer. Details about stover harvesting systems can be found in another fact sheet in this series, "Corn Stover Harvesting Machinery." The total cost of harvesting and transporting stover should be compared to its selling price or implied value as a feed or bedding substitute or as biofuel feedstock. The fact sheet "Estimating a Value for Corn Stover" looks at the potential market value for harvested stover in different uses.

Windrowing

When stover will be used for livestock feed or bedding the amount of foreign material (mostly dirt and rocks) is not of great concern. The combine spreaders can be



disengaged and the stalks, cobs and husks allowed to drop directly behind the combine. One pass with a bar rake or wheel rake will leave a windrow that can be picked up by a baler. Estimated costs for windrowing corn stover with a hydraulically powered rake are shown in Table 1. All estimated machinery costs in this fact sheet assume that the tractor or machine is purchased for 95% of its list price and is owned for 10 years, interest rates are 5.5% annually, diesel fuel costs \$3.50 per gallon, and labor is valued at \$15 per hour. Implements are assumed to be used 10 hours per day for 25 days each year, or 250 hours annually.

Table 1. Estimated costs for raking stalks, \$ per acre

Description	Tractor	Rake
Size of implement	125 hp	27 feet
New list price	\$125,000	\$35,000
Assumed purchase price	\$118,750	\$31,500
Annual use	400 hours	3,000 acres
Fuel consumption	5.5 gal/hr	
Field capacity		10 ac/hr
Cost summary, \$ per acre	Tractor	Rake
Depreciation, interest	\$3.24	\$2.14
Repairs	\$.35	\$.86
Fuel and lubrication	\$2.21	
Labor	\$1.65	
Total	\$7.45	\$3.00
Total cost for operation	\$10.45 per acre	

If the material is destined for use as ethanol feedstock, raking it off the ground will usually collect too much foreign material. A stalk chopper or shredder that is set to avoid ground contact can be used to break down stalk material and leave it in a windrow. Table 2 summarizes estimated costs for a stalk chopper/windrower. Another alternative is to collect the stover material directly from the back of the combine and feed it into a baler being pulled in tandem, eliminating the need for a separate operation to collect the material.

Table 2. Estimated costs for chopping stalks

Description	Tractor	Chopper
Size of implement	200 hp	27 feet
New list price	\$200,000	\$30,000
Assumed purchase price	\$190,000	\$27,000
Annual use	400 hours	2,500 acres
Fuel consumption	8.8 gal/hr	
Field capacity		10 ac/hr
Cost summary, \$ per acre	Tractor	Rake
Depreciation, interest	\$5.39	\$1.83
Repairs	\$.56	\$.94
Fuel and lubrication	\$3.54	
Labor	\$1.65	
Total	\$11.14	\$2.77
Total cost for operation	\$13.91	

Baling

Corn stover can be harvested as large round bales, large square (or rectangular) bales, or small square (rectangular) bales. Since most producers want to handle stover bales mechanically, small bales are seldom used. Round balers are generally less expensive than large square balers. Some producers already own them for making hay and straw bales. Table 3 summarizes estimated costs for a large round baler.

Table 3. Estimated costs for a large round baler

Description	Tractor	Baler
Size of implement	165 hp	60"x72"
New list price	\$165,000	\$45,000
Assumed purchase price	\$152,000	\$42,750
Annual use	400 hours	2,250 acres
Fuel consumption	7.3 gal/hr	
Field capacity		9 ac/hr
Cost summary, \$ per acre	Tractor	Rake
Depreciation, interest	\$4.61	\$3.06
Repairs	\$.50	\$4.06
Fuel and lubrication	\$3.25	
Twine and wrap		\$6.00
Labor	\$1.83	
Total	\$10.19	\$13.12
Total cost for operation	\$23.31	
Total cost per bale (4/ac)	\$5.83	

Round bales are not as easily transported as large square bales and are not as dense, so square bales are preferred for use as ethanol feedstock or when bales will be hauled longer distances. Table 4 summarizes estimated costs for a large square baler.

Table 4. Estimated costs for a large square baler

Description	Tractor	Baler
Size of implement	250 hp	3'x4'x8'
New list price	\$250,000	\$106,550
Assumed purchase price	\$237,500	\$101,223
Annual use	400 hours	3,500 acres
Fuel consumption	11 gal/hr	
Field capacity		14 ac/hr
Cost summary, \$ per acre	Tractor	Baler
Depreciation, interest	\$4.81	\$4.65
Repairs	\$.50	\$1.56
Fuel and lubrication	\$3.16	
Twine		\$2.00
Labor	\$1.18	
Total	\$9.65	\$8.21
Total cost for operation	\$17.86	
Total cost per bale (4/ac)	\$4.46	



Collecting and Handling

Several methods are available for collecting stover bales and either moving them directly to a storage site or loading them onto a truck, wagon or trailer. A detailed description can be found in the fact sheet "Productivity of Corn Stover Bale Handling Systems." A simple bale fork mounted on a tractor can be used to spear bales one at a time and move them a short distance or load them onto a wagon. Table 5 shows estimated costs for moving large round bales a short distance with a bale fork.

Table 5. Estimated costs for a bale fork

Description	Tractor	Bale Fork
Size of implement	75 hp	1 bale
New list price	\$50,000	\$500
Assumed purchase price	\$47,500	\$475
Annual use	400 hours	500 acres
Fuel consumption	3.3 gal/hr	
Field capacity		5 ac/hr
Cost summary, \$ per acre	Tractor	Collector
Depreciation, interest	\$2.88	\$.16
Repairs	\$.27	\$.02
Fuel and lubrication	\$2.66	
Labor	\$3.30	
Total	\$9.11	\$.18
Total cost for operation	\$9.29	
Total cost per bale (4/ac)	\$2.32	

A faster system utilizes a self-propelled telehandler with a fork or squeeze loader that can handle multiple bales at one time. Several companies offer bale wagons that can be pulled behind a tractor and accumulate a stack of square bales directly from the ground. Table 6 shows estimated costs for a typical bale wagon collector.

Table 6. Estimated costs for a 12-bale collector

Description	Tractor	Collector
Size of implement	200 hp	12 bales
New list price	\$200,000	\$80,000
Assumed purchase price	\$190,000	\$76,000
Annual use	400 hours	5,000 acres
Fuel consumption	8.8 gal/hr	
Field capacity		20 ac/hr
Cost summary, \$ per acre	Tractor	Collector
Depreciation, interest	\$2.70	\$2.44
Repairs	\$.28	\$1.10
Fuel and lubrication	\$1.77	
Labor	\$.83	
Total	\$5.57	\$3.54
Total cost for operation	\$9.11	
Total cost per bale (4/ac)	\$2.28	



Transporting

When bales are to be moved to a collection point or point of sale some distance from the farm, they will usually be loaded onto a flatbed trailer or truck bed. The fact sheet "Transporting Biomass on Iowa Roadways" provides more details about several hauling systems. A study published in 2009 estimated costs for transporting large square bales with a flatbed semi-trailer truck at about \$.40 per dry ton per loaded mile for a 20-mile haul (Hess, et al). Spreading fixed costs for the truck over a 100-mile distance lowered the cost per mile to just over \$.20 per dry ton. This converts to about \$.10 to \$.20 per bale per loaded mile. The most recent Iowa farm custom rate survey reported an average hauling charge of \$.25 per bale per loaded mile for large square bales. The average rate reported for hauling round bales was \$.19 per bale per loaded mile. Compared to the 2009 study, current custom rates reflect higher fuel costs and a profit margin for the hauler.

Custom Rates

Table 7 summarizes custom rates for similar operations as reported in the 2013 Iowa Farm Custom Rate Survey. Rates for raking, moving bales and hauling bales include operations for hay as well as corn stover.

Table 7. Reported custom rates for corn stover harvest

\$ per acre	Average	Range
Chopping stalks	\$11.40	\$5.00-\$18.00
Raking	\$6.25	\$2.50-\$10.00
\$ per bale		
Baling, without net wrap	\$11.70	\$10.00-\$14.00
Baling, with net wrap	\$13.00	\$10.00-\$17.50
Moving round bales	\$2.85	\$1.50-\$4.00
Moving square bales	\$3.55	\$2.00-\$5.00
\$ per bale per loaded mi.		
Hauling round bales	\$.19	\$.07-.27
Hauling square bales	\$.25	\$.13-\$.40

Source: Iowa Farm Custom Rate Survey, 2013, ISU Ag Decision Maker information file A3-10.

Total Costs

The total costs for harvesting and transporting corn stover bales for two different systems are summarized in Table 8. The first system reflects large round bales to be used for livestock feed or bedding. It includes raking stover into windrows and moving bales to a truck with a bale fork. The second system represents stover production for biofuel feedstock, and includes chopping clean stover into a windrow and collecting large, square bales with a bale collector to move to a truck.

These are calculated costs based on the assumption that the producer owns all the necessary equipment. ISU Ag Decision Maker decision file A3-29, "Machinery Cost Calculator," can be used to estimate similar costs using alternative input values (see www.extension.iastate.edu/agdm/).

Table 8. Total costs for two stover harvesting systems

\$ per acre	Livestock (round)	Biofuel (square)
Windrowing	\$10.45	\$13.91
Baling	\$23.31	\$17.86
Collecting bales	\$9.29	\$9.11
Hauling bales (25 miles)	\$19.00	\$25.00
Total cost per acre	\$62.05	\$65.88
Total per bale (4 / acre)	\$15.51	\$16.47
Total cost per ton (.6 t. / bale)	\$25.85	\$27.45

Table 9 summarizes the same systems using average reported custom rates from Table 7. For both systems a harvest rate of four bales per acre is assumed.

Table 9. Total costs for two stover harvesting systems (custom)

\$ per acre	Livestock (round)	Biofuel (square)
Windrowing	\$6.25	\$11.40
Baling (4 bales/acre)	\$52.00	\$46.80
Collecting bales (4 /acre)	\$11.40	\$14.20
Hauling bales (25 miles)	\$19.00	\$25.00
Total cost per acre	\$88.65	\$97.40
Total per bale (4 / acre)	\$22.16	\$24.35
Total cost per ton (.6 t. / bale)	\$36.93	\$40.58

Summary

Any given system may include only some of these operations, or other operations that were not listed. Some operators may be willing to ignore fixed costs for machinery that they already own and which will be used a small number of additional hours for harvesting or transporting stover, such as a utility tractor. Other producers may consider only cash costs, which may not include a return to their own labor. In addition, other costs such for the replacement of nutrients removed during stover harvest need to be taken into account. Each producer needs to focus on the costs that are relevant to his or her own system and decision-making situation when evaluating the profitability of producing and marketing corn stover.

References

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