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ENERGY CROP PRODUCTION COSTS AND BREAKEVEN PRICES UNDER MINNESOTA CONDITIONS

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APPLIED
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Energy Crop Production Costs and Breakeven Prices under Minnesota Conditions

The next generation of biofuels and bioenergy is expected to be heavily dependent on energy crops that are not grown at present and crop residues that are not presently collected. Many economic feasibility studies of biomass conversion facilities are underway that depend critically on biomass feedstock costs. The key variables in these feedstock costs are the costs of growing, harvesting, and transporting these crops and the breakeven prices that induce crop producers to shift agricultural land from current uses to these new crops.

This information will be used in a model for delineating biomass fuelsheds for evaluating conversion facilities under consideration for different Minnesota locations. This report presents a set of crop enterprise budget projections that are intended to help answer the current policy question of what prices typical farm operators would need to be paid for corn stover and for three widely-discussed energy crops – 1) grassland with higher fertilization and other inputs, 2) grassland with lower fertilization and other inputs, and 3) the short-rotation woody crop of hybrid poplar. A fourth budget is also presented for willow, another woody crop grown in New York which might be desirable because it would be ready for harvest in fewer years than poplar but which has not yet been grown experimentally as an energy crop under Minnesota conditions. Breakeven prices are calculated as the per-ton price that would be needed to bid land away from four current land uses to grow each of these four energy crops. The current land uses are intensive pasture plus three grain crops: corn grain, soybeans, and wheat. Corn stover was also analyzed. The stover breakeven price is calculated as the difference in cost between a corn grain budget with the additional machinery and labor costs and the fertilizer nutrient replacement needed to collect the corn stover for energy use, compared with a corn grain budget without stover removal.

Many other reports have been published on production costs for these crops. This analysis is somewhat unique, however, in that it compares all four of the crops in a consistent, discounted-cash-flow format and with assumptions that reflect Minnesota growing conditions and the current economic environment. Yields, input rates, and prices are spelled out and provided in a spreadsheet for ease of updating and modification to fit specific situations.

Projected crop enterprise budgets for the food and feed crops have not been done on a systematic statewide basis for Minnesota since the “What to Grow” budgets were discontinued in 1992. The FINBIN crop enterprise summaries have been a satisfactory substitute for budgets for some purposes, but have drawbacks for some uses [Center for Farm Financial Management, University of Minnesota, 2007]. Two drawbacks of the FINBIN summaries when addressing the energy crop policy question are that: 1) the prices and costs are not current because there is roughly a two-year lag between the transactions that they are based on, and the year for which the projections are needed, and 2) they lack detail including per-acre quantities and per-unit prices on various inputs of interest such as seed, fertilizer, chemicals, and machinery costs. The budgets

presented here address those two issues by using projected 2009 prices and costs, and including explicit per-acre quantities and per-unit prices for those major cost categories.

Stand Life, Field Operations, Harvest Frequency, Transportation, and Competing Feed and Food Crops

Assumptions common to all of the energy crops are discussed first, followed by discussions of yield, price, and input cost assumptions for each of the four energy crops along with corn stover. Budgets are also included for three feed and food crops (corn grain, soybeans, and wheat) for the purpose of calculating energy crop breakeven prices that would compete with (provide a net return per acre equal to) each of those crops. Land is assumed to be cash-rented, so a rental expense is included in all of the budgets.

Discounted Cash Flow Model, Stand life, Production Activity Timing, and Transportation Costs

The main economic criterion used to compare the energy crops is the breakeven cost per dry ton that equalizes the discounted cash flows over the life of the stand. The cash flows are discounted using a "real" or inflation-adjusted discount rate of six percent. The overall stand life ranges from 10 years for the high-fertilization grassland to 23 years for the willow (top panel of Table 2). The stand life is divided into an establishment period and a mature stand duration, plus one additional year for stump removal in the case of the woody crops. The New York willow planting was delayed until the second year to allow for site preparation and vegetation removal. The other crops were assumed to be planted during the first year, although some site preparation such as application of a burndown herbicide is required for those crops as well. The grassland crops are harvested during the later years of the establishment period when the yield increases to the point where the crop value covers the cost of harvesting. More detailed tables later in the report list the input quantities and prices for the first three years of each crop, when site preparation and planting take place, and for a typical harvest year. The cash flows for all years are also shown in later tables.

The yields are compared in the middle panel of Table 2. The mature stands of high-fertilization grassland and the poplar yields are both 4 tons of dry matter per acre, although the 4 ton poplar yield is an average dry matter accumulation rate over the entire 16-year growing period so the average yield over the entire 17-year stand life is 3.8 tons when the stump removal year is included compared to only 3.0 tons for the grassland. The woody crops have a higher moisture content when harvested – 50 percent compared to 10 percent for the grasses.

A cost for transporting the energy crops to a processing plant is included for comparability with the grain crop budgets, which include trucking and marketing costs. The energy crop transportation assumptions are from a Minnesota switchgrass analysis and from the New York willow data, with the on-road diesel fuel price updated to $4.00 per gallon [Tiffany et al., 2006; SUNY College of Environmental Science and Forestry, 2008]. The bottom panel of Table 2 shows the transportation assumptions. The New York model lists a maximum load weight of 35 tons. However, the maximum load

weight for Minnesota is reported to be around 23 tons, depending on the design and weight of the trailer [Fruin and Fortowsky, 2004]. The 25-mile one-way hauling distance and 50 miles-per-hour speed is from the New York data. The New York model also included a one-mile haul on a field road at a slower speed, but that additional distance has little impact on total cost so was omitted here for simplicity. The 45-minute loading time is from Tiffany. The willow harvester blows the material first into a side-dump trailer which is then dumped into the truck, which only takes 5 minutes. They assume a 15-minute unloading time compared to 8 minutes in Tiffany's data. The $0.50-mile non-fuel truck cost is from the New York data. The dry matter per load is lower for the woody crops than for the grass crops because of the higher moisture content and the truck weight limit. Tiffany reports a truck fuel consumption rate of 8 miles per gallon compared with 7 miles per gallon in the New York data. That difference may be due to various factors, but for the purpose of this analysis is assumed to be due to the 5-ton heavier load so 7 miles per gallon is used for the woody crops. The total transportation cost is $5.99/ton for the grasses, $8.05 for the poplar and $6.95 for the willow.

Farm Machinery Costs

Machinery costs for all of the budgets are based on the October, 2008 extension publication, "Machinery Cost Estimates" [Lazarus, 2008]. The costs are based on prices of new machinery as of early 2008, a diesel fuel price of $3.50/gallon for non-road use and $4.00 for on-road use, and labor costs of $13.50/hour for unskilled labor and $17.00/hour for skilled labor, including wages and fringe benefits. Fertilizer application and herbicide spraying were assumed to be done by custom operators in the grassland and food/feed crop budgets, at $10/acre for fertilizer application and $7/acre/trip for herbicide application. Costs for the specialized machinery used for hybrid poplar and willow were taken from the previous studies of these crops as cited below.

The grassland crops and corn stover are assumed to be baled with a round baler. The round baler performance assumptions are based largely on performance rates reported by a Minnesota custom operator who spoke at a November 2007 workshop at the West Central Research and Outreach Center [Woodford, 2007; Petrolia, 2006] [Petrolia, 2006; Woodford, 2007]. Harvesting equipment annual usage is assumed to be 100 hours for the baler and stalk shredder, and 80 hours for the rake and swather.

The custom operator listed several cost parameters for round baling: average tons baled/hour of 22.5 for corn stover and 15 for native grasses, corn stover removed/acre of 5,300 lbs (2.65 tons), and average bale weights of 1,400 to 1,700 pounds for native grass bales and 1,250 pounds for corn stover. Bale dimensions are 5 feet wide by 6 feet diameter, which results in a 10 foot wide truck load when the bales are loaded two abreast. This width is wider than the normal legal limit for a truck, but can be used in rural areas when a wide-load permit is obtained from the state.

A round baler needs to stop while the bale is wrapped with mesh or twine, and ejected. The impact of this stopped time on the field efficiency (time actually operating divided by time in the field) of a round baler was estimated under the assumption that it would

otherwise operate at 80% field efficiency aside from that stopping time. Schechinger-Hettenhaus advocate equipping round balers with mesh wrap rather than twine because the mesh needs to be wrapped only three times compared to 20 times or so for twine [Schechinger and Hettenhaus, 2004]. This reduces the stopped time for wrapping. The John Deere website states that their balers with mesh can wrap and eject a bale in as little as 20 seconds. The custom operator reports using mesh wrap at four wraps/bale on corn stover, and 2.5 to 3 wraps for hay and straw. He feels that the 20-second estimate is accurate. At 4.2 bales/acre and 20 seconds/bale of stopping time means total stopped time is 1.4 minutes/acre out of the total 7.1 minutes/bale. Time in the field other than when wrapping and ejecting then works out to be 5.7 minutes/acre or 10.6 acres/hour of moving time. If we assume that the baler is operating at 80% field efficiency other than when wrapping and ejecting, adding that extra time brings the field efficiency to 64%.

The custom operator shreds and rakes the stover before baling, with dual 16 foot wheel rakes that can span 20 to 32 feet depending on the setting with 28 feet being typical. He aims for a field speed of 5 mph, but a coverage rate of 10.6 acres/hour, a 28 foot swath, and 80% field efficiency, actually calculates out at 3.9 miles per hour.

These calculations were modified to reflect a corn stover removal of 2 tons/acre rather than the custom operator's estimated 2.65 tons. A swath of 30 feet and speed of 4.3 mph would fit this yield.

A grassland scenario with a 4 ton/acre yield and a bale weight of 1,500 pounds works out to a swath width of 14 feet and a speed of 3.1 mph. A 2 ton/acre grassland scenario with a 15 tons/hour baling rate and his a 1500 lb. bale weight works out to a swath width of 20 feet and a speed of 4.4 mph.

Costs for an Inland 2500 bale mover and a Deere 3220 telescoping bale handler are based on data from Petrolia [Petrolia, 2006]. The purchase prices of these machines were adjusted for inflation using the change in the Producer Price Index for farm machinery, from the annual 2005 number to the March 2008 number.

Costs for the self-propelled forage harvester used for the willow were taken from Lazarus. The actual willow harvester had a prototype head whose manufacturing cost is unknown at this time. For the purpose of this analysis that specialty head is assumed to be $16,000 based on the price of a four-row forage harvester corn head. Costs for poplar and willow production activities involving machines not in the Lazarus machinery database were taken directly from Berguson or the New York willow model.

One issue with the two woody crops is removal of the stumps or stock at the end of the stand life. The willow data includes a $300 charge for this operation. Hybrid poplar stump removal costs are uncertain because little removal has been done to date. The current thinking in Minnesota is that if the poplar stumps are actually removed, the cost could run as much as the $300 willow number [Levar, 2008]. The poplar stumps are larger but fewer than the willow stock since the willow is a smaller, shrub-like plant.

Willow roots create a mat which can be more difficult for earthmoving equipment to grapple and move than a poplar tree stump would be. If the land is to be replanted to an agricultural crop, the stumps would need to be removed. If it is planted back to a woody crop like poplar, a cheaper approach would be to leave the stumps alone, disk between them, and replant the new seedlings between them. The Berguson data includes $11/acre for stump disking. If the stumps are not removed, however, the carbon they contain can tie up with the nitrogen in the soil and create a nitrogen deficiency in the new crop. Additional nitrogen fertilizer would be required in that case, which is estimated at an additional $50/acre are current fertilizer prices for a total of $71 for the disking operation and fertilizer. This analysis takes a conservative approach of using the $300/acre stump removal cost for both the poplar and the willow crops, with the recognition that the cost may be lower depending on the choice of a following crop.

Labor costs for the energy crops were taken from several sources. Machinery labor was taken from the Lazarus database for the operations in that list. For the operations from Berguson or the New York data, a portion of the total operation cost was allocated to labor based on the relative cost shares for similar operations in the Lazarus database. One additional hour per acre per year was added to reflect non-machine-related activities, based on labor disappearance numbers for FINBIN intensive pasture summary.

Land rent, crop insurance, and miscellaneous expenses for corn, soybeans, and wheat are from 2007 FINBIN state and regional crop enterprise cost and return data collected under the MnSCU Farm Business Management Program and the Southwestern Minnesota Farm Business Farm Management Association. One year's inflation was added to those 2007 averages using the Bureau of Labor Statistics producer price index and the USDA-NASS index of prices paid by farmers. Land rent for the energy crops varies depending on the competing land use they are being compared to. The energy crop budgets presented below include a $40/acre land rental charge which is based on the FINBIN average rent for intensive pasture.

The breakeven energy crop prices shown in the energy crop columns of Table 1 are calculated based on this $40 rental rate. The energy crop breakeven prices shown in the corn, soybeans and wheat columns are recalculated using the FINBIN average rental rates for those feed/food crops, and also cover the net returns above all costs that are shown for those crops. The net returns are positive for corn and soybeans, so including them increases the energy breakeven prices. Wheat has a slightly negative net return, so it reduces the energy crop breakeven prices shown.

The budgets are summarized in Table 3. The following tables show the detailed quantities, prices, and per-acre costs and returns for the first three years and for a harvest year for each energy crop, and a cash flow summary for all years. Tables 14-16 show the detail for the corn, soybeans, and wheat budgets.

High-Fertilization Grassland

The high-fertilization grassland budget is based on data for switchgrass, but the name "high-fertilization grassland" is intended to reflect the fact that the budget could also fit several other grasses and mixes that are under consideration as energy crops. The budget is based mainly on recent switchgrass demonstration plot data from Nebraska and the Dakotas, and on information from University of Minnesota agronomists [Sheaffer, 2008; Perrin et al.; Perrin et al., 2008]. This budget considers a ten-year period (years 0 – 9), with the land treated with a burndown herbicide in year 0 and then planted in year 1. The yield is assumed to ramp up to 2 tons of dry matter per acre in year 2. The stand reaches its full 4-ton yield potential in the year 3 and remains at that yield until year 9, with a single annual harvest. Perrin (Bioenergy Research article, page 2, bottom of second column) reported that out of ten sites, half of one site was abandoned after two failed seeding attempts [Perrin et al.]. One other site suffered a failed establishment the first year, and a third required partial re-seeding. Based on this report and similar stand failures in Minnesota plots, the budget includes seed and planting machinery and labor costs to reseed thirty percent of the crop in the second year and five percent in the third year after the initial planting. Another five percent is assumed to be abandoned and planted to another crop. The only cost included for the abandoned acreage is land rent on an additional 0.05 acre in the first year.

The seed cost is based on a seeding rate of seven pounds per acre of switchgrass at a cost of $3.50/lb., based on a price quoted by a Minnesota native grass seed producer in October, 2008.

The grassland crops are not fertilized in the seeding year, to minimize weed growth. The high-fertilization grassland is fertilized with 40 pounds of nitrogen in year 2, the year after planting. It is fertilized with 60 pounds of N, 20 pounds of P_2O_5, and 30 pounds of K_2O based on U of M recommendations for pasture.

Low-Fertilization Grassland

This budget is similar in structure to the high-fertilization version, but assumes a more diverse species mix, lower yield, lower (but not zero) rates of fertilizer, and a longer 20-year stand life. The seed cost is based on a 15-species mix currently recommended for Conservation Reserve Program land in Minnesota. The yield is assumed to ramp up over five years, with 1 ton harvested in the fourth year and 1.5 tons in the fifth year. The stand reaches its full yield potential in the fourth year and averages 2 tons of dry matter per acre in years six through 20, again with a single annual harvest.

The low-fertilization grassland is fertilized with 10 pounds of nitrogen in year 2, 20 pounds in year 3, and 30 pounds in year 4. It is fertilized with 60 pounds of N and 5 pounds each of P_2O_5, and K_2O in years 5 – 19 based on U of M recommendations for pasture.

Hybrid Poplar

The hybrid poplar budget is based on information from University of Minnesota foresters that was compiled for a previous economic impact analysis of poplar utilization for oriented-strand board manufacturing [Berguson, 2007; Lazarus and Tiffany, 2007]. The

trees are assumed to be harvested in year 8 and then coppiced (allowed to grow back from the stumps) and harvested again in year 16, after which replanting would be required. An average annual growth of 4 bone-dry tons is assumed over the 16 years, meaning that 32 tons is removed in each harvest. The harvest is done with a feller-buncher and skidder, which are equipment designed for lumbering.

Poplar planting chemical costs are $108/acre, which is higher than for the other energy crops. The annualized average chemical cost over the 17-year stand life is only $9/acre, however, which is still low compared to the grain crops.

Willow

Willow has been discussed as a potential energy crop for the northeastern U.S., but has not yet been fully evaluated under Minnesota conditions [SUNY College of Environmental Science and Forestry, 2008; Abrahamson et al., 2002]. Based on experience in New York State, three advantages of willow over poplar are that: 1) harvest begins in year 5 rather than year 8; 2) harvest is done with a modified agricultural forest harvester rather than slower and more expensive lumbering equipment; and 3) slightly higher yields. This alternative is included principally as an indication of the potential value of increasing research on this species.

Corn Stover

The corn stover is assumed to be collected by shredding, raking, and round baling. Two recent reports mention stover removal rates of 1.5 tons and 2.65 tons per acre, while other reports indicate that the amount of stover that can be removed without undue risk of soil erosion varies widely by soil erosiveness and other locational factors. [Schechinger and Hettenhaus, 2004] [Woodford, 2007]. Given this variability, a rate of 2 tons is assumed in this analysis.

Fertilizer rates are increased in the corn grain budget to replace the phosphorus (P) and potassium (K) removed in the stover. Nitrogen is not replaced because the following crop is assumed to be soybeans, which fixes its own nitrogen. The amount of P and K needed is based on Iowa State recommendations, which are consistent with a 1978 research report [Larson et al., 1978; Sawyer et al., 2002].

No extra payment to the crop producer is included in the stover cost calculations beyond the fertilizer replacement and machinery costs, because of the lack of information at this point about how large the payment would need to be.

Potentially Competing Grain Crops

One issue addressed in the analysis is the breakeven energy crop price that would induce crop producers to shift from conventional feed and food crops to each of the energy crops examined. The conventional crops considered are corn grain, soybeans, and wheat. Budgets are presented for each of these crops that are based on the average of Minnesota state average yields reported by the USDA National Agricultural Statistics Service for the most recent five years, 2002-06. The crops are valued based on futures prices reported by the Chicago Board of Trade in late October, 2008 for the

contracts closest to harvest time for the 2009 crop – December for corn, November for soybeans, and July for wheat, adjusted for basis. The cash prices arrived at via this method are corn - $4.00/bushel, soybeans - $9.25/bushel, and wheat - $6.50/bushel.

Other revenue sources considered for these crops are government payments and miscellaneous income. Government payments include direct payments, counter-cyclical payments, and loan deficiency payments. These were calculated based on USDA Farm Service Agency formulas for representative counties, with base yield assumed to be the same as the budget yield. Miscellaneous income is taken from the crop enterprise summary for all cash-rented fields in the FINBIN database.

The corn fertilization rates consider credits from a previous soybean crop. Seeding rates and chemical applications are based on University of Minnesota Extension recommendations and/or judgments of Extension staff about typical producer practices in Minnesota. Fertilizer rates are based on 2007 FINBIN per-acre average expenses, NASS estimates of prices paid for fertilizer, Extension recommendations, and average P and K soil test levels from a commercial laboratory. The corn and soybean seed prices are thought to be typical of a biotech hybrid, but the corn variety would not be rootworm resistant. Wheat seed prices are assumed to be $5/bushel over the market price for wheat. Seeding rates per acre are corn - 34,000 kernels, soybeans – one bushel, and wheat - 113 pounds. Fertilizer prices are from a Minnesota cooperative. Nitrogen prices are based on NH_3. P_2O_5 prices are based on an 18-46-0 price with the N priced as NH_3. K_2O prices are based on 0-0-60. Chemical prices are estimated retail prices from a variety of sources.

The FINBIN hired labor expense plus operator labor and management opportunity cost is the number included in the budget totals, unless harvesting corn stover in which case the machinery labor for the stover harvesting is added in. FINBIN includes a labor disappearance estimate of hours per acre that is based on estimated total labor hours provided annually by the operators and hired workers. This total is allocated across the crop and livestock enterprises on the farm. This procedure usually results in an estimate of hours per acre that is several times higher than the hours required to carry out the machinery operations required for the crop. For example, the machinery operations for corn grain require 0.40 hours/acre but the FINBIN estimate of labor disappearance is 2.42 hours/acre, which is six times the machinery operation amount. The difference is probably due to time required for planning, marketing the crop, maintenance of the machinery and buildings, arranging financing, and other non-machinery-related tasks. Stover harvesting labor is added to the FINBIN totals because stover harvesting would not normally be included on the FINBIN farms so the FINBIN labor disappearance estimates would not include labor for stover collection.

Land rent, hauling and trucking, crop drying fuel, crop insurance, and miscellaneous crop expenses are taken from 2007 FINBIN state crop enterprise cost and return summaries of data collected under the MnSCU Farm Business Management Program and the Southwestern Minnesota Farm Business Farm Management Association. One year's inflation was added to those 2007 averages based on price indices reported in

USDA Agricultural Prices publications or in the Department of Commerce Producer Price Index. The percentage adjustments are shown in Table 1.

Summary

Production costs and breakeven prices were calculated for four widely-discussed energy crops plus corn stover. The energy crop breakeven prices were calculated under two different assumptions about land costs and the opportunity costs of not utilizing the land for some other competing land use. One assumption is that the competing land use is pasture whose rental rate is $40/acre, and assuming that the tenant renting the pasture would just breakeven. The other assumption is that the energy crops would need to compete with grain crops on land renting for $82 to $150/acre, and would need to provide a return to the farm operator's labor, management, and risk equal to returns currently provided by corn grain, soybeans, and wheat in Minnesota.

Corn stover would be the cheapest of the energy biomass sources considered, at $50/ton to cover the additional machinery costs to shred, rake, bale, and transport 25 miles to a processing plant. Aside from stover, a grassland crop under high fertilization with a 4-ton yield has the lowest cost at $77/ton of dry matter. A grassland crop under low fertilization with a 2-ton yield but a longer stand life has the highest cost at $110/ton. Hybrid poplar comes in at $81/ton. Willow is at an early stage of development in Minnesota, but it would be the cheapest energy crop at $72/ton if it turns out to provide a 5-ton yield with a 23-year stand life.

Table 1. Prices Used in the Crop Enterprise Budgets

Crops					
Corn	$4.00	bushel			
Soybeans	$9.25	bushel			
Wheat	$6.50	bushel			
Seed and seedlings					Crop(s) used on
Corn	$ 250.00	bag			
Soybeans	$40.00	bushel			
Wheat	$11.50	bushel			
Sunburst switch grass	$3.50	lb			grassland – high fertilization
Native grass mix for CRP, 15 species	$8.24	lb			grassland – low fertilization
Poplar seedlings (with planting labor)	$0.150	each			poplar
Willow seedlings	$0.103	each			willow
Fertilizer					
NH_3	$850	ton	$ 0.52	lb	corn, soybeans
P_2O_5 as DAP, 18-46-0, N netted out as NH3	$900	ton	$ 0.78	lb	all
K_2O	$ 800	ton	$ 0.67	lb	all
Chemicals					
Glyphosate 4.5L	$50.00	gal	$ 0.39	oz	corn, soybeans, poplar
Ammonium sulfate	$6.50	gal	$ 1.63	qt	corn , soybeans
Axial	$ 160.00	gal	$20.00	pt	wheat
Headline	$ 335.00	gal	$ 2.62	oz	wheat
Prosario	$2.33	oz			wheat
Penncap	$1.00	oz			wheat
Sureguard	$6.69	oz			poplar
Insecticide	$15.00	acre			poplar
Land rent	2007 FINBIN + 37% (based on USDA Ag Prices U.S. September indices)				
Diesel fuel, non-road	$3.50	gal			all
Diesel fuel, non-road	$4.00	gal			energy crops
Round bale mesh wrap	$250.00	roll			grassland, corn stover

Reference to commercial products and trade names is made with the understanding that no discrimination is intended and no endorsement by the University of Minnesota is implied.

Table 2. Assumptions Made for the Energy Crops[a]

	Grassland, high fertilization	Grassland, low fertilization	Hybrid poplar	Willow
Stand Life and Production Activities				
Establishment period (first year - last year):	0 - 2	0 - 4	0 - 6	0 - 4
Mature stand duration (first year - last year):	3 - 9	5 - 19	7 - 15	5 - 25
Plant in year:	1	1	0	1
Fertilize in year:	2-9	2-19	3, 5, 9, 11	1, 5, 9, 13, 17
Spray in year:	0	0	0-1	1-2
Mow in year:			1-3, 7	1
Cultivate in year:			0-2	
Harvest in year:	2-9	2-19	7, 15	5, 9, 13, 17, 21
Stump removal in year:			16	22
Overall stand life including stump removal	10 years	20 years	17 years	23 years
Yields				
Yield/year during mature stand, tons dry matter	4.0	2.0	4.0	4.6
Yield/year average over stand life including stump removal, tons dry matter	3.0	1.7	3.8	4.0
Moisture content (%)	10%	10%	50%	50%
Yield/year during mature stand, tons as harvested	4.4	2.2	8.0	9.2
Yield/year average over stand life including stump removal, tons as harvested	3.3	1.8	7.5	8.0
Transportation of Crop to Processing				
Tons/load as harvested	18	18	23	23
Tons/load dry matter	16.2	16.2	11.5	11.5
Transport distance to processing plant (miles)	25	25	25	25
Waiting time to load (minutes)	45	45	45	5
Waiting time to unload (minutes)	8	8	8	15
Gas mileage of trucks (miles per gallon)	8	8	7	7
Diesel fuel cost ($/gallon)	$4.00	$4.00	$ 4.00	$4.00
Non-fuel expenses for truck ($ per mile)	$0.50	$0.50	$ 0.50	$0.50
Driving Speed (miles per hour)	50	50	50	50
Labor cost/hour (total for 1 driver and 1/4 loader)	$ 25	$25	$25	$25
Total expense/mile	$1.94	$1.94	$ 2.01	$1.74
Fuel expense/ton dry matter	$1.54	$1.54	$ 2.29	$2.29
Non-fuel expense/ton dry matter	$1.54	$1.54	$ 2.00	$2.00
Fuel plus nonfuel (not labor)/ton dry matter	$3.09	$3.09	$ 4.29	$4.29
Labor expense/ton dry matter	$2.91	$2.91	$ 3.77	$2.67
Total expense/ton dry matter	$5.99	$5.99	$ 8.05	$6.95

[a]The years are numbered with the first year denoted as year 0.

Table 3. Summary of Energy and Grain Crop Estimated Per Acre Costs and Returns

	Corn Grain, No Stover Collection	Corn Grain with Stover Collection	Soybeans	Wheat	Corn Stover, Added Cost	Grassland, high fertilization	Grassland, low fertilization	Hybrid poplar	Willow
Crop yield per acre	158	158	39	50					
Crop price per bu.	$ 4.00	$ 4.00	$ 9.25	$ 6.50					
Stover or grass yield per acre		2.0			2.0	3.0	1.7	3.8	4.0
Stover or grass price/ton	$ -	$ 60	$ -	$ -	$ 60	$ 60	$ 60	$ 60	$ 60
Crop revenue per acre	$ 631	$ 631	$ 361	$ 322		(Annualized over stand life)			
Stover or grass revenue	$ -	$ 120	$ -	$ -	$ 120	$ 157	$ 83	$ 177	$ 198
Gov't payments	38	38	15	22					
Miscellaneous income	15	15	6	7					
Gross return per acre	$ 684	$ 804	$ 381	$ 351	$ 120	$ 157	$ 83	$ 177	$ 198
Fertilizer & lime (lbs N-P2O5-K2, tons lime)	(140-40-45, 0)	(140-50-95, 0)	(0-20-0, 0)	(115-0-35, 0)		- - - (varies by year) - - -			
Preharvest machinery	$ 50	$ 50	$ 40	$ 59	$ -	$ 7	$ 6	$ 31	$ 27
Seed (for grasses, amortized stand establishment)	116	116	50	22	$ -	4	7	10	41
Fertilizer & lime	134	175	16	83	$ 41	56	32	16	16
Crop chemicals	22	22	24	38	$ -	2	1	9	-
Crop insurance	20	20	15	13	$ -				
Miscellaneous	11	10	8	6	$ (1)	8	8	8	8
Harvest machinery	60	114	37	26	$ 54	50	31	60	63
Labor & mgmt	43	47	31	26	$ 4	32	24	58	36
Total Cost/A w/o Rent or Interest	$ 456	$ 554	$ 220	$ 271	$ 99	$ 159	$ 110	$ 193	$ 190
Rent	150	150	132	82	$ -	38	38	38	38
Interest on preharvest var. costs	13	15	6	8	$ 2	4	4	7	8
Total Cost/A	$ 619	$ 720	$ 357	$ 361	$ 100	201	152	237	236
Net Return/A	$ 64	$ 84	$ 24	$ (11)		$ (43)	$ (69)	$ (61)	$ (38)
Total cost per bushel or per ton	$ 3.59	$ 3.47	$ 8.64	$ 6.71		$ 67	$ 92	$ 63	$ 59
Corn stover breakeven price/ton					$ 50				
Grassland, high fertilization, breakeven price/ton	$ 150	$ 157	$ 124	$ 90		$ 77			
Grassland, low fertilization, breakeven price/ton	247	262	198	135			$ 110		
Hybrid poplar, breakeven price/ton	143	150	121	92				$ 81	
Willow, breakeven price/ton	128	134	108	81					$ 72
Fuel, gallons/A	4.11	5.33	3.47	3.02		2.54	1.55	16.00	4.93
Fuel expense, $/A	$ 15.84	$ 20.53	$ 13.35	$ 11.62		$ 8.72	$ 5.29	$ 50.32	$ 16.54
Labor & management hours/acre	2.42	2.68	1.79	1.34		2.99	1.92	2.95	1.34
Labor & management $/acre	$ 42.62	$ 46.57	$ 31.15	$ 25.50		$ 32.02	$ 23.75	$ 58.35	$ 35.96

Table 4. Projected Costs for Grassland with High Fertilization, Establishment Period						
				Year: 0	1	2
Yield per acre grown (tons DM)				-	0.4	2
Yield per acre harvested (tons DM)						2
Value per ton						$ 60.00
Total product return per acre						$ 120.00
Expenses:						
Preharvest machinery, owned:						
Prairie Grass Drill (Twinned) , 21 Ft	105 MFWD				$ 14.43	$ 4.12
Custom hired operations:						
Spray				$ 7.35	$ 2.10	$ 0.35
Apply fertilizer, dry N, P and K						$ 5.00
Fertilizer expenses:	Units applied	Price				
Nitrogen, lbs.	40	$ 0.71				$ 28.26
Seed expenses:						
Sunburst switch grass	7	$ 3.50			$ 25.73	$ 7.35
Weed control:						
Glyphosate, 4.5L, oz/A	22	$ 50.00		$ 9.02	$ 2.58	$ 0.43
Ammonium sulfate, qt/A	1.5	$ 6.50		$ 2.56	$ 0.73	$ 0.04
Miscellaneous		$ 9.00		$ 9.00	$ 9.00	$ 9.00
Land rent				$ 42.00	$ 42.00	$ 40.00
Interest on preharvest variable costs, within-year:				$ 4.20	$ 5.79	$ 5.67
Harvest machinery:	Tractor HP					
Grain Swather, Self-Prop 21 Ft	None					$ 11.04
Rd Baler/Wrap Switchgr 4 T yld, 14 Ft	105 MFWD					$ 24.38
Mesh wrap						$ 5.26
Roadsiding						$ 7.34
Transportation, 25 miles						$ 6.18
Labor & management				$ 17.53	$ 18.16	$ 32.11
Total cost per acre				$ 88.55	$ 116.75	$ 190.87

Table 5. Projected Costs and Returns for Grassland with High Fertilization at a $60/ton Price, Mature Stand					
Data item	Units	Price	Fixed	Variable	Total
Total product return per acre (tons)	4.0	$ 60.00			$ 240
Expenses:					
Custom hired operations:					
Apply fertilizer, dry P and K				$ 5.00	
Fertilizer:					
Nitrogen, lbs.	60	$ 0.71		$ 42.39	
P2O5, lbs.	20	$ 0.78		$ 15.60	
K2O, lbs.	30	$ 0.67		$ 20.10	
Total fertilizer				$ 78.09	$ 78
Harvest machinery:					
Grain Swather, Self-Prop 21 Ft	None		$ 4.20	$ 6.85	
Rd Baler/Wrap Switchgr 4 T yld, 14 F	105 MFWD		$ 6.64	$ 17.74	
Mesh wrap				$ 10.51	
Roadsiding				$ 14.67	
Crop transportation to processing				$ 12.36	
Total harvest machinery			$ 10.84	$ 62.12	$ 73
Labor & management	Hours	Labor Rate			
Machinery operation	1.53	16.01		$ 24.56	
Other labor & management	1.00	16.01	$ 16.01	$ -	
Total labor & management	2.53	32.03	16.01	24.56	$ 41
Land rent					$ 40
Interest on preharvest variable costs, within-year:					$ 3
Miscellaneous					$ 9
Total cost per acre, after establishment			$ 75.86	$ 148.59	$ 249
Net Present Values and Annualized Costs and Returns/Acre					
Establishment period, years:	3				
Mature stand life, years:	7				
Overall stand life, years:	10				
Overall Stand Life Values	Net Present Value	Annualized @ 6% over a stand life of 10 years			
Preharvest machinery inc. machinery labor, not other labor & mgmt):			$53	$7	
Seed			$29	$4	
Fertilizer & lime			$390	$50	
Crop chemicals			$14	$2	
Miscellaneous, inc. crop insurance			$66	$8	
Land rent			$298	$38	
Interest on operating expenses			$30	$4	
Harvest machinery			$387	$50	
Labor & management			$250	$32	
Total cost per acre			$1,517	$195	
Gross return per acre			$1,226	$157	
Net return per acre			($292)	($37)	
Fuel, $/acre total avg over stand	$ 9.79	simple avg			
Fuel price, $/gallon	$ 3.50				
Lub cost, % of fuel	10%				
Fuel gallons/acre	2.54	gallons			
Fuel, $/acre total avg over stand	$8.72	annualized			
Labor&management hours/acre	2.99	simple avg			
Labor&management $/acre	$32.02	annualized			

Table 6. Cash Flow Summary by Year, Grassland with High Fertilization at a $60/ton Price											
	Year: 0	1	2	3	4	5	6	7	8	9
Preharvest machinery (w/o labo	$ 7	$ 17	$ 9	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5
Seed	-	26	7	-	-	-	-	-	-	-
Fertilizer & lime	-	-	28	78	78	78	78	78	78	78
Crop chemicals	12	3	0	-	-	-	-	-	-	-
Miscellaneous, inc. crop insuran	9	9	9	9	9	9	9	9	9	9
Land rent	42	42	40	40	40	40	40	40	40	40
Interest on operating expenses	4	6	6	3	3	3	3	3	3	3
Harvest	-	-	54	73	73	73	73	73	73	73
Labor & management	18	18	32	41	41	41	41	41	41	41
Total cost per acre	$ 92	$ 121	$ 187	$ 249	$ 249	$ 249	$ 249	$ 249	$ 249	$ 249
Gross return per acre	$ -	$ -	$ 120	$ 240	$ 240	$ 240	$ 240	$ 240	$ 240	$ 240
Net return per acre	$ (92)	$ (121)	$ (67)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)

Table 7. Cash Flow Summary by Year, Grassland with Low Fertilization at a $60/ton Price											
	Year: 0	1	2	3	4	5	6	7	8	9
Preharvest machinery (w/o labor):	$ 7	$ 17	$ 9	$ 6	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5
Seed	-	74	21	4	-	-	-	-	-	-
Fertilizer & lime	-	-	7	14	21	50	50	50	50	50
Crop chemicals	12	3	1	-	-	-	-	-	-	-
Miscellaneous, inc. crop insurance	9	9	9	9	9	9	9	9	9	9
Land rent	42	42	40	40	40	40	40	40	40	40
Interest on operating expenses	4	9	5	4	5	3	3	3	3	3
Harvest machinery	-	-	28	32	37	42	42	42	42	42
Labor & management	17	18	22	24	26	27	27	27	27	27
Total cost per acre	$ 91	$ 170	$ 143	$ 133	$ 142	$ 176	$ 176	$ 176	$ 176	$ 176
Gross return per acre	$ -	$ -	$ 30	$ 60	$ 90	$ 120	$ 120	$ 120	$ 120	$ 120
Net return per acre	$ (91)	$ (170)	$ (113)	$ (73)	$ (52)	$ (56)	$ (56)	$ (56)	$ (56)	$ (56)
	Year: 10	11	12	13	14	15	16	17	18	19
Preharvest machinery (w/o labor):	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5
Seed	-	-	-	-	-	-	-	-	-	-
Fertilizer & lime	50	50	50	50	50	50	50	50	50	50
Crop chemicals	-	-	-	-	-	-	-	-	-	-
Miscellaneous, inc. crop insurance	9	9	9	9	9	9	9	9	9	9
Land rent	40	40	40	40	40	40	40	40	40	40
Interest on operating expenses	3	3	3	3	3	3	3	3	3	3
Harvest machinery	42	42	42	42	42	42	42	42	42	42
Labor & management	27	27	27	27	27	27	27	27	27	27
Total cost per acre	$ 176	$ 176	$ 176	$ 176	$ 176	$ 176	$ 176	$ 176	$ 176	$ 176
Gross return per acre	$ 120	$ 120	$ 120	$ 120	$ 120	$ 120	$ 120	$ 120	$ 120	$ 120
Net return per acre	$ (56)	$ (56)	$ (56)	$ (56)	$ (56)	$ (56)	$ (56)	$ (56)	$ (56)	$ (56)

Table 8. Projected Costs for Hybrid Poplar, First Three Years					
			Year: 0	1	2
Expenses:					
Preharvest machinery, owned:	Tractor HP				
Chisel Plow 37 Ft	310 4WD (270 PTO)		$ 7.94		$ -
Tandem Disk H.D. 30 Ft Fold	360 4WD (313 PTO)		$ 9.65		
Field Cultivator 47 Ft	260 4WD (226 PTO)		$ 4.95		
Custom hired operations:					
Spray			$ 2.75	$ 2.75	
Field marking			$ 4.59		
Gyro mower				$ 8.88	$ 8.88
Row cultivation			$ 74.68	$ 74.68	$ 37.34
	Units Applied	Price			
Seedlings (with planting labor)	681	$ 0.150	$ 102.15	$ 20.40	
Weed control:					
Glyphosate	28	$ 0.39	$ 10.92		
Sureguard	10	$ 6.69	$ 66.90		
Insecticide	2	$ 15.00	$ 30.00		
Miscellaneous		$ 9.00	$ 9.00	$ 9.00	$ 9.00
Land rent	Intensive Pasture	All	$ 40.00	$ 40.00	$ 40.00
Interest on preharvest variable costs, within-year:			$ 21.81	$ 9.34	$ 5.71
Labor & management (not inc. planting)			$ 60.73	$ 61.12	$ 40.16
Total cost per acre			$ 457.09	$ 249.42	$ 152.83

Table 9. Projected Costs and Returns for Hybrid Poplar at a $60/ton Price, Harvest Year (Year 7 or 15)					
Data item	Units	Price	Fixed	Variable	Total
Total product return per acre (tons)	32.0	$ 60.00			$ 1,920
Expenses:					
Harvest machinery:					
Feller/buncher				$ 132.88	
Skidder				$ 416.56	
Crop transportation to processing				$ 98.88	
Total harvest machinery					$ 648
Labor & management	Hours	Labor Rate			
Machinery operation	21.54	16.00		$ 344.64	
Other labor & management	1.00	16.00	$ 16.00	$ -	
Total labor & management	22.54	32.00	$ 16.00	344.64	$ 361
Land rent					$ 40
Interest on preharvest variable costs:					$ 3
Miscellaneous					$ 9
Total cost per acre, after establishment			$ 65.00	$ 651.69	$ 1,061
Net Present Values and Annualized Costs and Returns/Acre					
Overall stand life, years:	16				
Overall Stand Life Values	Net Present Value	Annualized @ 6% over a stand life of 16 years			
Preharvest machinery inc. machinery labor, not other labor & mgmt):			$230	$21	
Seed			$115	$11	
Fertilizer & lime			$180	$17	
Crop chemicals			$140	$13	
Miscellaneous, inc. crop insurance			$91	$8	
Land rent			$404	$38	
Interest on operating expenses			$121	$11	
Harvest machinery			$677	$63	
Labor & management			$565	$53	
Total cost per acre			$2,522	$235	
Gross return per acre			$1,960	$183	
Net return per acre			($562)	($52)	
Fuel, $/acre total avg over stand	$ 61.59	simple avg			
Fuel price, $/gallon	$ 3.50				
Lub cost, % of fuel	10%				
Fuel gallons/acre	16.00	gallons			
Fuel, $/acre total avg over stand	$ 50.32	annualized			
Labor&management hours/acre	3.0	simple avg			
Labor&management $/acre	$ 58.35	annualized			

Table 10. Cash Flow Summary by Year, Hybrid Poplar at a $60/ton Price											
		Year: 0	1	2	3	4	5	6	7		
Preharvest machinery (w/o labor):		$ 105	$ 86	$ 46	$ 10	$ -	$ -	$ 1	$ 9		
Seed		$ 102	$ 20	$ -	$ -	$ -	$ -	$ -	$ -		
Fertilizer & lime		$ -	$ -	$ -	$ 71	$ -	$ 71	$ -	$ -		
Crop chemicals		$ 108	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Miscellaneous, inc. crop insurance		$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9		
Land rent		$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40		
Interest on operating expenses		$ 22	$ 9	$ 6	$ 8	$ 3	$ 7	$ 3	$ 3		
Harvest machinery		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 648		
Labor & management		$ 61	$ 61	$ 40	$ 21	$ 16	$ 16	$ 17	$ 365		
Total cost per acre		$ 446	$ 226	$ 141	$ 159	$ 68	$ 143	$ 70	$ 1,075		
Gross return per acre		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,920		
Net return per acre		$ (446)	$ (226)	$ (141)	$ (159)	$ (68)	$ (143)	$ (70)	$ 845		
		Year: 8	9	10	11	12	13	14	15	16	
Preharvest machinery (w/o labor):		$ -	$ 1	$ -	$ 1	$ -	$ -	$ -	$ -	$ 300	
Seed		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Fertilizer & lime		$ -	$ 71	$ -	$ 71	$ -	$ -	$ -	$ -	$ -	
Crop chemicals		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Miscellaneous, inc. crop insurance		$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	
Land rent		$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	
Interest on operating expenses		$ 3	$ 7	$ 3	$ 7	$ 3	$ 3	$ 3	$ 3	$ 21	
Harvest machinery		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 648	$ -	
Labor & management		$ 16	$ 17	$ 16	$ 17	$ 16	$ 16	$ 16	$ 361	$ 63	
Total cost per acre		$ 68	$ 145	$ 68	$ 145	$ 68	$ 68	$ 68	$ 1,061	$ 433	
Gross return per acre		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,920	$ -	
Net return per acre		$ (68)	$ (145)	$ (68)	$ (145)	$ (68)	$ (68)	$ (68)	$ 859	$ (433)	

Table 11. Projected Costs for Willow, First Three Years					
			Year: 0	1	2
Expenses:					
Preharvest machinery, owned:	Tractor HP				
Chisel Plow 37 Ft	310 4WD (270 PTO)			$ 7.94	
Tandem Disk H.D. 30 Ft Fold	360 4WD (313 PTO)			$ 9.65	
Field Cultivator 47 Ft	260 4WD (226 PTO)			$ 4.95	
Custom hired operations:					
Veg removal, con herb, kill cover			$ 100.00		
Planting				$ 75.00	
Preemerge herbicide				$ 45.00	
mech/chem weeding				$ 15.00	$ 15.00
Cut back				$ 20.00	
Apply fertilizer				$ 1.22	
Fertilizer expenses	Units applied	Price			
Nitrogen, lbs.	100	$ 0.71		$ 70.65	
		Price			
Seedlings, $/A	5,800	$ 0.103		$ 596.00	
Miscellaneous		$ 9.00	$ 9.00	$ 9.00	$ 9.00
Land rent			$ 40.00	$ 40.00	$ 40.00
Interest on preharvest variable costs, within-year:			$ 10.52	$ 58.30	$ 5.04
Labor & management			$ 72.54	$ 19.82	$ 16.34
Total cost per acre			$ 232.06	$ 972.53	$ 85.38

Table 12. Projected Costs and Returns for Willow at a $60/ton Price, Harvest Year (Year 5, 9, 13, 17, or 21)					
Data item	Units	Price	Fixed	Variable	Total
Total product return per acre (tons)	18.4	$ 60.00			$ 1,104.00
Expenses:					
Harvest machinery:					
570 HP Self-Propelled Harvester w/Willow Head			$ 43.83	$ 98.63	
Harvester transport				$ 26.30	
Blower tractor				$ 48.21	
Crop transportation to processing				$ 56.86	
Tractors & wagons (3) for infield transport				$ 75.99	
Total harvest machinery			$ 43.83	$ 305.98	$ 349.82
Labor & management	Hours	Labor Rate			
Machinery operation	5.36	16.34		$ 87.63	
Other labor & management	1.00	16.34	$ 16.34	$ -	
Total labor & management	6.36	32.67	16.34	87.63	$ 103.97
Land rent					$ 40.00
Interest on preharvest variable costs					$ 3.37
Miscellaneous			$ 9.00		$ 9.00
Total cost per acre, after establishment			$ 109.17	$ 309.36	$ 506.16
Net Present Values and Annualized Costs and Returns/Acre					
Overall stand life, years:	22				
Overall Stand Life Values	Net Present Value	Annualized @ 6% over a stand life of 22 years			
Preharvest machinery inc. machinery labor, not other labor & mgmt):			$ 347	$27	
Seed			$ 530	$41	
Fertilizer & lime			$ 208	$16	
Crop chemicals			$ -	$0	
Miscellaneous, inc. crop insurance			$ 111	$8	
Land rent			$ 492	$38	
Interest on operating expenses			$ 101	$8	
Harvest machinery			$ 816	$63	
Labor & management			$ 469	$36	
Total cost per acre			$ 3,075	$236	
Gross return per acre			$ 2,576	$198	
Net return per acre			$ (499)	($38)	
Fuel, $/acre total avg over stand	$ 18.98	simple avg			
Fuel price, $/gallon	$ 3.50				
Lub cost, % of fuel	10%				
Fuel gallons/acre	4.93	gallons			
Fuel, $/acre total avg over stand	$16.54	annualized			
Labor&management hours/acre	1.34	simple avg			
Labor&management $/acre	$35.96	annualized			

Table 13. Cash Flow Summary by Year, Willow at a $60/ton Price													
	Year: 0	1	2	3	4	5	6	7	8	8	10	
Preharvest machinery (w/o labor):	$ 100	$ 179	$ 15	$ -	$ -	$ 1	$ -	$ -	$ -	$ 1	$ -	
Seed	$ -	$ 596	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Fertilizer & lime	$ -	$ 71	$ -	$ -	$ -	$ 71	$ -	$ -	$ -	$ 71	$ -	
Crop chemicals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Miscellaneous, inc. crop insurance	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	
Land rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	
Interest on operating expenses	$ 9	$ 54	$ 4	$ 3	$ 3	$ 7	$ 3	$ 3	$ 3	$ 7	$ 3	
Harvest machinery	$ -	$ -	$ -	$ -	$ -	$ 350	$ -	$ -	$ -	$ 350	$ -	
Labor & management	$ 26	$ 73	$ 20	$ 16	$ 16	$ 105	$ 16	$ 16	$ 16	$ 105	$ 16	
Total cost per acre	$ 184	$ 1,021	$ 88	$ 68	$ 68	$ 583	$ 68	$ 68	$ 68	$ 583	$ 68	
Gross return per acre	$ -	$ -	$ -	$ -	$ -	$ 1,104	$ -	$ -	$ -	$ 1,104	$ -	
Net return per acre	$ (184)	$ (1,021)	$ (88)	$ (68)	$ (68)	$ 521	$ (68)	$ (68)	$ (68)	$ 521	$ (68)	
	Year: 11	12	13	14	15	16	17	18	19	20	21	$ 22
Preharvest machinery (w/o labor):	$ -	$ -	$ 1	$ -	$ -	$ -	$ 1	$ -	$ -	$ -	$ -	$ 300
Seed	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fertilizer & lime	$ -	$ -	$ 71	$ -	$ -	$ -	$ 71	$ -	$ -	$ -	$ -	$ -
Crop chemicals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous, inc. crop insurance	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9
Land rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
Interest on operating expenses	$ 3	$ 3	$ 7	$ 3	$ 3	$ 3	$ 7	$ 3	$ 3	$ 3	$ 3	$ 21
Harvest machinery	$ -	$ -	$ 350	$ -	$ -	$ -	$ 350	$ -	$ -	$ -	$ 350	$ -
Labor & management	$ 16	$ 16	$ 105	$ 16	$ 16	$ 16	$ 105	$ 16	$ 16	$ 16	$ 104	$ 16
Total cost per acre	$ 68	$ 68	$ 583	$ 68	$ 68	$ 68	$ 583	$ 68	$ 68	$ 68	$ 506	$ 386
Gross return per acre	$ -	$ -	$ 1,104	$ -	$ -	$ -	$ 1,104	$ -	$ -	$ -	$ 1,104	$ -
Net return per acre	$ (68)	$ (68)	$ 521	$ (68)	$ (68)	$ (68)	$ 521	$ (68)	$ (68)	$ (68)	$ 598	$ (386)

Table 14. Projected 2009 Crop Enterprise Budget, Corn Following Soybeans, No Stover Collection, Minnesota					
Data item	Units	Price	Fixed	Variable	Total
Total product return per acre (bu.)					
Total product return per acre (bu.)	***158***	***$4.00***			$ 631.20
Government payments (vary with price & yield)					***$ 37.56***
Miscellaneous income per acre					***$ 14.94***
Gross return per acre					$ 683.70
Direct expenses:					
Preharvest machinery inc. labor:					
Owned machinery	Tractor HP				
Chisel Plow 37 Ft	***310 4WD (270 PTO)***		***$ 2.26***	***$ 5.68***	
Field Cultivator 60 Ft	***310 4WD (270 PTO)***		***$ 1.22***	***$ 4.74***	
Row Crop Planter 16 Row-30, 40 Ft	***130 MFWD***		***$ 3.54***	***$ 8.45***	
Row Cultivator 16 Row-30, 40 Ft	***200 MFWD***		***$ 1.07***	***$ 5.81***	
Total preharvest machinery owned					$ 32.78
Custom hired operations:					
Apply fertilizer, NH3 and dry P and K				***$ 10.00***	
Spray				***$ 7.00***	
Total preharvest machinery (owned & custom)					$ 49.78
			Application units/purchase unit		
Seed	***34,000.00***	***250.00***	***80,000.00***	$ 106.25	
Roundup Ready seed fee				***$ 10.00***	
Total seed					$ 116.25
Fertilizer for crop:			1		
Nitrogen, lbs.	***140***	***$ 0.52***		$ 72.80	
P2O5 (dry), lbs.	***40***	***$ 0.78***		$ 31.20	
K2O, lbs.	***45***	***$ 0.67***		$ 30.15	
Lime	***-***	***$ -***		$ -	
Total fertilizer & lime					$ 134.15
Crop chemicals:					
	Rate applied	Purchase price	application units/purchase unit		
Glyphosate, 4.5L, oz/A, 1" weeds	***22***	***$ 50.00***	***128***	***$ 8.59***	
Ammonium sulfate, qt/A, 1" weeds	***1.5***	***$ 6.50***	***4***	***$ 2.44***	
Glyphosate, 4.5L, oz/A, 4" regro	***22***	***$ 50.00***	***128***	***$ 8.59***	
Ammonium sulfate, qt/A, 4" regro	***1.5***	***$ 6.50***	***4***	***$ 2.44***	
Total crop chemicals					$ 22.06
Crop insurance				***$ 20.22***	$ 20.22
Miscellaneous			***$ 9.65***	***$ 0.91***	$ 10.56
Land rent:			***$ 150.41***		$ 150.41
Interest on preharvest variable costs:				***$ 13.41***	$ 13.41
Harvest machinery (inc. labor):					
Owned machinery	Tractor HP				
Combine Corn Hd 8 Row-30, 20 Ft			***$ 8.42***	***$ 42.12***	
Hauling and trucking - Crop				***$ 1.06***	
Drying, crop			$ -	***$ 8.27***	
Total harvest machinery					$ 59.88
Overhead expenses:					
Labor & management	Hours	Labor Rate			
Total labor & management	***2.42***	***17.61***		$ 42.62	$ 42.62
Total cost per acre			$ 176.58	$ 442.76	$ 619.34
Net return per acre					***$ 64.36***
Total cost per bushel					$ 3.59

Table 15. Projected 2009 Crop Enterprise Budget, Soybeans, Minnesota					
Data item	Units	Price	Fixed	Variable	Total
Total product return per acre (bu.)					
Total product return per acre (bu.)	***39***	***$9.25***			$ 360.75
Government payments (vary with price & yield)					***$ 14.59***
Miscellaneous income per acre					***$ 5.95***
Gross return per acre					$ 381.29
Direct expenses:					
Preharvest machinery inc. labor:					
Owned machinery	Tractor HP				
Chisel Plow 37 Ft	***310 4WD (270 PTO)***		***$ 2.26***	***$ 5.68***	
Field Cultivator 60 Ft	***310 4WD (270 PTO)***		***$ 1.22***	***$ 4.74***	
Row Crop Planter 16 Row-30, 40 Ft	***130 MFWD***		***$ 3.54***	***$ 8.45***	
Total preharvest machinery owned					$ 25.90
Custom hired operations:					
Apply fertilizer, NH3 and dry P and K				***$ -***	
Spray				***$ 14.00***	
Total preharvest machinery (owned & custom)					$ 39.90
			Application units/purchase unit		
Seed	***1.00***	***40.00***	***1.00***	$ 40.00	
Roundup Ready seed fee				***$ 10.00***	
Total seed					$ 50.00
Fertilizer for crop:			3		
Nitrogen, lbs.	***-***	***$ 0.52***		$ -	
P2O5 (dry), lbs.	***20***	***$ 0.78***		$ 15.60	
K2O, lbs.	***-***	***$ 0.67***		$ -	
Lime	***-***	***$ -***		$ -	
Total fertilizer & lime					$ 15.60
Crop chemicals:					
	Rate applied	Purchase price	application units/purchase unit		
Glyphosate, 4L, qt/A, 4" Weeds	***24***	***$ 50.00***	***128***	***$ 9.38***	
Ammonium sulfate, qt/A, 4" Weeds	***1.5***	***$ 6.50***	***4***	***$ 2.44***	
Glyphosate, 4L, qt/A, Canopy	***24***	***$ 50.00***	***128***	***$ 9.38***	
Ammonium sulfate, qt/A, Canopy	***1.5***	***$ 6.50***	***4***	***$ 2.44***	
Total crop chemicals					$ 23.63
Crop insurance				***$ 15.06***	$ 15.06
Miscellaneous			***$ 7.20***	***$ 0.62***	$ 7.82
Land rent:			***$ 131.87***		$ 131.87
Interest on preharvest variable costs:				***$ 5.51***	$ 5.51
Harvest machinery (inc. labor):					
Owned machinery	Tractor HP				
Combine Soybean Hd 25 Ft			***$ 5.06***	***$ 31.83***	
Hauling and trucking - Crop				***$ -***	
Drying, crop			$ -	***$ -***	
Total harvest machinery					$ 36.89
Overhead expenses:					
Labor & management	Hours	Labor Rate			
Total labor & management	***1.79***	***17.40***		$ 31.15	$ 31.15
Total cost per acre			$ 151.15	$ 206.27	$ 357.43
Net return per acre					***$ 23.86***
Total cost per bushel					$ 8.64

Table 16. Projected 2009 Crop Enterprise Budget, Wheat, Minnesota					
Data item	Units	Price	Fixed	Variable	Total
Total product return per acre (bu.)					
Total product return per acre (bu.)	***50***	***$6.50***			$ 322.40
Stover (tons as harvested)	-	$ -			***$ -***
Government payments (vary with price & yield)					***$ 21.92***
Miscellaneous income per acre					$ 6.51
Gross return per acre					$ 350.83
Direct expenses:					
Preharvest machinery inc. labor:					
Owned machinery	***Tractor HP***				
Chisel Plow 37 Ft	***310 4WD (270 PTO)***		***$ 2.26***	***$ 5.68***	
Field Cultivator 60 Ft	***310 4WD (270 PTO)***		***$ 1.22***	***$ 4.74***	
Presswheel Drill 30 Ft	***160 MFWD***		***$ 3.14***	***$ 10.82***	
Total preharvest machinery owned					$ 27.86
Custom hired operations:					
Apply fertilizer, NH3 and dry P and K				***$ 10.00***	
Spray				***$ 21.00***	
Total preharvest machinery (owned & custom)					$ 58.86
			Application units/purchase unit		
Seed	***1.88***	***11.50***	***1.00***	$ 21.66	
Roundup Ready seed fee				***$ -***	
Total seed					$ 21.66
Fertilizer for crop:			2		
Nitrogen, lbs.	***115***	***$ 0.52***		$ 59.80	
K2O, lbs.	***35***	***$ 0.67***		$ 23.45	
Total fertilizer & lime					$ 83.25
Crop chemicals:					
	Rate applied	Purchase price	application units/purchase unit		
Axial, OZ/A	***16.4***	***$ 103.00***	***128***	***$ 13.20***	
Headline, OZ/A	***3***	***$ 335.00***	***128***	***$ 7.85***	
Prosario, OZ/A	***6***	***$ 2.33***	***1***	***$ 14.00***	
Penncap, OZ/A	***2.5***	***$ 1.00***	***1***	***$ 2.50***	
Total crop chemicals					$ 37.55
Crop insurance				***$ 12.59***	$ 12.59
Miscellaneous			$ 6.09	$ -	$ 6.09
Land rent:			$ 81.68		$ 81.68
Interest on preharvest variable costs:				***$ 8.29***	$ 8.29
Harvest machinery (inc. labor):					
Owned machinery	Tractor HP				
Combine Grain Head 30 Ft			$ 3.71	$ 22.27	
Hauling - Crop				$ -	
Drying, crop			***$ -***		
Total harvest machinery					$ 25.99
Overhead expenses:					
Labor & management	Hours	Labor Rate			
Total labor & management	1.34	$ 19.03		$ 25.50	$ 25.50
Total cost per acre			$ 98.10	$ 263.35	$ 361.46
Net return per acre					***$ (10.62)***
Total cost per bushel					$ 6.71

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