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Eilish Hanson, John Ritten, Perry Miller, Amy Nagler, Selena Gerace

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CROP ENTERPRISE BUDGET

CONVENTIONAL DRYLAND SWITCHGRASS, UPPER MISSOURI RIVER BASIN

This crop budget is for a conventional dryland switchgrass operation in the Upper Missouri River Basin (UMRB). In the U.S. the UMRB encompasses most of Montana and South Dakota, portions of North Dakota and Wyoming, as well as small parts of Nebraska, Iowa, and Minnesota. Soil productivity varies across this region (Figure 1).

Switchgrass is a warm-season perennial grass native to North America which tolerates low fertility, acidic, and moderately alkaline soils across most of the United States. It has been studied extensively for its potential as a bioenergy feedstock, which could have many benefits over conventional bioenergy crops, including providing wildlife habitat, erosion control, nutrient loss avoidance, and reduced input requirements.

Limited research exists on the production practices and costs of farming switchgrass, so the operations and figures in this budget estimate production costs based on various case studies. While this budget may provide insights into the methods, practices, and inputs required for switchgrass production, its purpose is to compare costs of production with conventional crops rather than to specify actual production costs. A thorough, experimental case study would need to be conducted at various sites within the UMRB to develop comprehensive switchgrass production budgets for this region.

Because we assume switchgrass has a 10 year stand life, all figures in this budget are averaged over 10 years, even if the cost are born only in the first year or only in a couple of years of the stand life.

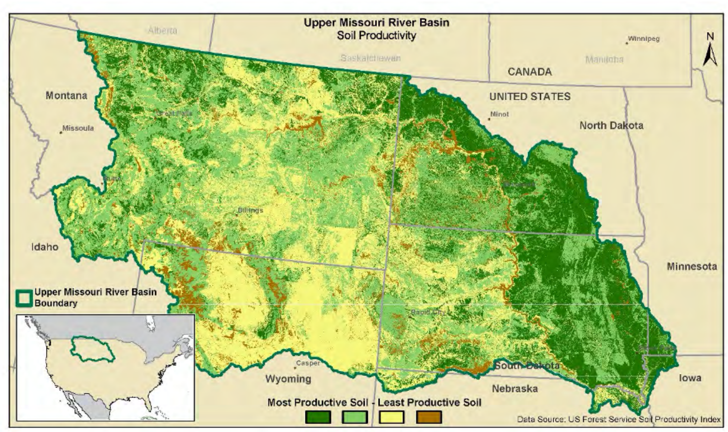

Figure 1. Soil productivity across the Upper Missouri River Basin

LAND & LABOR

This budget shows the annual cost per acre of producing switchgrass and omits fixed costs and ownership costs such as land charges, machinery investments, and depreciation. Labor is included at the rate of $25 per hour. The figures in this budget will allow producers to better understand the per-acre contribution an individual crop provides to the entire farm business based solely on the variable cost of production—those costs that vary based on output of production within a single production period.

CAPITAL

We assume a 5.5 percent rate of interest on operating capital. This rate reflects the regional operating interest on loaned

CONVENTIONAL DRYLAND SWITCHGRASS, UPPER MISSOURI RIVER BASIN, 2017

Estimated Annual Yield: 2.73 tons per acre (10-year stand without harvest in the first year)

Operating Inputs	Quantity per Acre	Unit	Cost per Unit	Cost per Acre	
Seed					$8.91
Switchgrass (PLS)	0.66	lb	$13.50	$8.91	
Fertilizer*					$33.72
Phosphorus (10-34-0)	6.33	lb	$2.80	$17.73	
Nitrogen (24-0-0)	39.96	lb	$0.40	$15.99	
Herbicides					$6.30
Glyphosate	0.14	gal	$12.69	$1.79	
Atrazine	0.11	gal	$15.00	$1.67	
2,4-D	0.19	gal	$15.00	$2.84	
Machinery					$51.04
Fertilizer Application	1	acre	$6.00	$6.00	
Herbicide Application	0.4	acre	$3.03	$1.21	
No-Till Drill Seeding	0.11	acre	$11.00	$1.21	
Mowing	0.875	acre	$14.57	$12.75	
Raking	0.875	acre	$14.00	$12.25	
Baling	0.875	acre	$11.12	$9.73	
Transporting	0.875	acre	$9.02	$7.89	
Other					$6.99
Twine	2.73	per ton harvested	$2.56	$6.99	
Production Costs					$106.97
Operating Interest	5.5%			$5.88	
Total Production Costs					$112.85
Operating Costs per Ton					$41.30

*In areas with relatively poor soil quality nitrogen fertilizer may need to be adjusted to 46-0-0 and phosphorus fertilizer may need to be adjusted to the following: 11-52-0 applied at a rate of 6.33 gal/acre and cost of $2.23/gal, for a per acre cost of $14.12. Total fertilizer cost for soils requiring this mix is $31.72/acre; resulting production input costs are $106.97/acre, total production costs $110.31/acre, and operating costs per ton $40.37/acre.

funds. It should be adjusted by individual producers to reflect the interest rate on their operating capital loans.

FIELD OPERATIONS

For this budget, we assume switchgrass has a 10-year stand life, produces a sufficient yield for annual harvesting throughout eight years of production with limited harvesting available in years one and two, and has an estimated 10-year average annual yield of 2.73 tons per acre.

We use a seeding rate of 5.6 lbs. of pure live seed (PLS) per acre in the first year, assume no-till planting, and assume ten percent of switchgrass must be reseeded during the second year of production (with no required reseeding in the remaining eight years). Based on this we estimate an annual average seeding rate for the entire 10-year lifespan of switchgrass of approximately 0.66 lbs. of PLS per acre.

Nitrogen fertilizer (24-0-0 for more productive and 46-0-0 for less productive soils) is not applied in the first or second year of establishing the switchgrass stand, but is applied at the rate of 39.97 lbs. per acre in the remaining eight years. Phosphorus fertilizer (10-34-0 for more productive, 11-52-0 for less productive soils) is applied at a rate of 29.98 lbs. per acre in the first year, half of that in the second year, and an application rate of 0.84 lbs. per dry ton harvested in the remaining eight years of production. Averaged over ten years, the budget includes an annual Phosphorus fertilizer cost for 6.33 lbs. per acre.

Herbicide treatments of Glyphosate and Atrazine are applied during the first year at a rate of 1.12 gallons per acre and 2.16 gallons per acre, respectively, and are repeated in the second year of establishment at rates of 0.28 gallons per acre and 0.54 gallons per acre, respectively. Herbicide treatment of 2,4-Dichlorophenoxyacetic acid (2,4-D) is applied twice during the remaining eight years of stand life, typically during years five and eight, at a rate of 0.95 gallons per acre.

Harvesting activities include mowing, raking, baling and transporting the biomass from switchgrass, similar to hay. These activities have associated machinery costs (e.g., repairs, fuel, etc.) and can vary depending on type of baling method. Here we assume the use of conventional hay equipment, and one annual harvest after the first killing frost.

FURTHER READING

Biermacher, Jon T., Mohua Haque, Jagadeesh Mosali, and James K. Rogers. 2017. "Economic feasibility of using switchgrass pasture to produce beef cattle gain and bioenergy feedstock." BioEnergy Research 740-749.

Bourlion, Nelly, Larry Janssen, and Michael Miller. 2014. "Economic analysis of private and public benefits of corn, switchgrass, and mixed grass systems in Eastern South Dakota." Renewable Agriculture and Food Systems 355-365.

Brandes, Elke, Alejandro Plastina, and Emily A. Heaton. 2018. "Where can switchgrass production be more profitable than corn and soybean? An integrated subfield assessment in Iowa, USA." Global Change Biology Bioenergy 473-488.

Cobuloglu, Halil Ibrahim, and I. Esra Buyuktahtakin. 2014. "A mixed-integer optimization model for the economic and environmental analysis of biomass production." Biomass and Bioenergy 8-23.

Duffy, Mike. 2008. "Estimated costs for production, storage and transportation of switchgrass." Iowa State University Extension and Outreach. https://www.extension.iastate.edu/agdm/crops/html/a1-22.html

Gouzaye, Amadou, Francis M. Epplin, Yanqi Wu, and Siva O. Makaju. 2014. "Yield and nutrient concentration response to switchgrass biomass harvest date." Agronomy Journal 793-799.

Gustafson, Cole. 2018. "Biofuel economics: Will pure switchgrass stands be required for cellulosic ethanol?" North Dakota State University Extension Agriculture Communication. https://www.ag.ndsu.edu/news/columns/biofuels-economics/biofuel-economics-will-pure-switchgrass-stands-be-required-for-cellulosic-ethanol/

Hanson, Eilish, John Ritten, Perry Miller, Amy Nagler, Selena Gerace. 2020. *B-1360.1 Is growing switchgrass economically feasible? Economic considerations for switchgrass production in the Upper Missouri River Basin*. Laramie, WY: University of Wyoming Extension. http://www.wyoextension.org/publications/

Lazarus, William, and Cole Gustafson. 2015. "Budgeting Methods for Comparing a Biomass Energy Crop to an Existing Crop." Extension. https://farm-energy.extension.org/budgeting-methods-for-comparing-a-biomass-energy-crop-to-an-existing-crop/

Mahr, Susan. 2015. "Switchgrass, Panicum virgatum." Master Gardener Program, Division of Extension. https://wimastergardener.org/article/switch-grass-panicum-virgatum/

Nagler, Amy, and Selena Gerace. 2020. *B-1360.3 First and second generation biofuels: What's the difference?* Laramie, WY: University of Wyoming Extension. http://www.wyoextension.org/publications/

North Dakota State University. 2017. "USDA grass and forbs seed prices." North Dakota Foundation Seedstocks. https://www.ag.ndsu.edu/fss/seed-prices/usda-native-grass-and-forbs-seed

Perrin, Richard, Kenneth Vogel, Marty Schmer, and Rob Mitchell. 2008. "Farm-scale production cost of switchgrass for biomass." Bioenergy Resources 91-97.

Rosen, Julia. 2018. "Vast bioenergy plantations could stave off climate change - and radically reshape the planet." Science Magazine. February 15. http://www.sciencemag.org/news/2018/02/vast-bioenergy-plantations-could-stave-climate-change-and-radically-reshape-planet

Turhollow, Anthony, and Francis Epplin. 2012. "Estimating region specific costs to produce and deliver switchgrass." Green Energy and Technology 187-204.

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Eilish Hanson, graduate student, Agricultural and Applied Economics, University of Wyoming. John Ritten, Professor, Agricultural and Applied Economics. Perry Miller, Professor, Land Resources and Environmental Sciences, Montana State University. Amy Nagler, Research Scientist, Agricultural and Applied Economics, University of Wyoming. Selena Gerace, Outreach Coordinator, Agricultural and Applied Economics, University of Wyoming.

Editor: Katie Shockley, University of Wyoming Extension

Design: Tanya Engel, University of Wyoming Extension