Cost of Producing Switchgrass for Biomass Feedstock

Andrew P. Griffith, Francis M. Epplin, and Daren D. Redfearn[1]

Switchgrass can be successfully established using either conventional tillage or no-till methods (a) if weeds are controlled and (b) if appropriate seeding equipment is available and properly calibrated and used. The purpose of this paper is to present switchgrass establishment enterprise budgets for conventional tillage and no-till and to present a maintenance budget for established stands of switchgrass to be harvested for biomass feedstock. As of this writing, no market for mature switchgrass biomass exists in Oklahoma. Rather than compute an estimate of the expected net returns per acre, the maintenance budget is used to compute the breakeven price for biomass.

As noted on the establishment tab, the general recipe for switchgrass establishment is as follows:

1. Clean-till in fall before spring planting.
2. Apply lime, P, and K based on soil test.
3. Clean-till in late winter and roller pack to firm the seedbed.
4. Wait for rainfall to germinate annual weeds.
5. Apply glyphosate within three days of planting to control weeds.
6. Without additional tillage, plant switchgrass ¼ to ½ inch deep in April.
7. Evaluate establishment two to three weeks post planting.
8. Apply labeled herbicides based on weed population or mow broadleaf weeds.
9. Burn stands the following spring.
10. Evaluate establishment.
11. Fertilize with 50 pounds N per acre at spring green up.

Weed control is an important factor in switchgrass establishment. Herbicides may be used to control most broadleaf weeds in stands of young switchgrass. However, grassy weeds can be more problematic. Weed competition can be greatly reduced by either spraying (with glyphosate) or tilling switchgrass fields in the fall and again in the spring prior to the spring planting.

Table 1 includes a listing of the field operations budgeted for switchgrass establishment with conventional tillage. Table 2 includes the switchgrass established with conventional tillage budget. Table 3 includes a listing of the field operations budgeted for no-till switchgrass establishment. Table 4 includes the no-till establishment budget. Table 5 includes the maintenance budget.

Both establishment budgets include a mowing operation designed to clip weeds that extend over the top of the switchgrass. If weed pressure is minimal, this operation would not be necessary. However, if weeds are excessive, this mowing activity should be conducted before

[1] Departments of Agricultural Economics and Plant and Soil Sciences, Oklahoma State University, Stillwater. August 2010.

the weeds start to canopy the switchgrass. Clipping the weeds at the top of the switchgrass is designed to ensure that sunlight can reach the young switchgrass plants.

Estimated establishment costs are from $155 (no-till) to $189 (conventional tillage) per acre. These costs include a land charge of $45 per acre. Stands of established switchgrass are expected to thrive for at least ten years. The establishment costs are amortized over ten years at 7%. This estimated amortized cost of establishment is $22/acre/ year for no-till and $27/acre/year for conventional tillage. The $27/acre/year charge is included on the maintenance budget (Table 5).

Swathing is modeled as a per acre cost while baling and hauling cost depend on yield. The budget represented in Table 5 assumes that biomass is baled into rectangular solid bales (4x4x8, 1500 lbs), loaded, and transported from the field by a tractor trailer truck. Costs per acre and costs per dry ton are computed for yields of 2, 4, and 6 tons per acre. The estimated breakeven costs are $47/ton for 6 dry tons/acre yield and $88/ton for a 2 dry tons/acre yield. These breakeven costs would be $40/ton of 15% moisture material for the high yield and $75/ton of 15% moisture material for the low yield.

Table 1. Field operations budgeted for switchgrass establishment with conventional tillage.

Month	Operation	Description
For establishment in cropland harvested in the fall or in pastureland		
Sept-Oct	Test soil	
	Chisel Plow	if needed, apply P_2O_5, K_2O and lime
	Disk	
Apr	Disk	
	Cultipack	prepare firm seedbed
	Plant	¼ to ½ inch deep
	Spray	glyphosate burndown prior to planting if weeds have emerged after the April disking
May-Jun	Spray	broadleaf herbicide
Jun-Jul	Rotary mower	clip over the top of the switchgrass if grassy weeds have canopied
For establishment in winter wheat field that was grazed out or harvested for hay in April		
Sept-Oct	Test soil	If needed, apply P_2O_5, K_2O and lime prior to seeding wheat
Apr	Disk	1 time
	Cultipack	prepare firm seedbed
	Plant	¼ to ½ inch deep
	Spray	glyphosate burndown prior to planting if weeds have emerged after the April disking
May-Jun	Spray	broadleaf herbicide
Jun-Jul	Rotary mower	clip over the top of the switchgrass if grassy weeds have canopied

Table 2. Conventional tillage switchgrass establishment budget

Item	Unit of Measure	Price per unit	Quantity	Value
Costs				
Land Rental	acre	$ 45.00	1	45.00
Switchgrass Seed	lbs PLS	$ 6.00	5	30.00
DAP (18-46-0)[a]	lbs.	$ 0.27	43	11.74
Fertilizer Application	acre	$ 4.14	1	4.14
Chisel Plow	acre	$ 11.00	1	11.00
Disking	acre	$ 10.00	3	30.00
Cultipacking (firming seedbed)	acre	$ 9.00	1	9.00
Seeding	acre	$ 13.40	1	13.40
Rotary mower	acre	$ 3.50	1	3.50
Herbicide (glyphosate)	oz	$ 0.23	18	4.14
Herbicide (broadleaf, post emerge)	acre	$ 4.50	1	4.50
Herbicide Application	acre	$ 4.94	2	9.88
Annual Operating Capital	$	$ 0.07	176.30	12.34
Total "Cash" Costs	acre			**$ 189**
Establishment amortized over 10 years	annual	$ 189	7%	**$26.86**

[a] If soil test values of phosphorus are sufficient, no P_2O_5 is recommended. The budgeted DAP application includes 8 lbs of N and 20 lbs of P_2O_5.

Table 3. Field operations budgeted for switchgrass establishment with no-till methods.

Month	Operation	Description
For establishment in cropland harvested in the fall or in pastureland		
Sept-Oct	Spray	glyphosate for burndown
	Test soil	if needed, apply P_2O_5 and K_2O. If pH is
	Fertilize	below 5.0, lime should be applied and preferably incorporated before establishment.
Apr	Spray	glyphosate for burndown
	Plant	¼ to ½ inch deep
	Spray	glyphosate burndown prior to planting if weeds have emerged since the April spraying
May-Jun	Spray	broadleaf herbicide
Jun-Jul	Rotary mower	clip over the top of the switchgrass if grassy weeds have canopied
For establishment in winter wheat field that was grazed out or harvested for hay in April		
Sept-Oct	Test soil	If needed, apply P_2O_5, K_2O and lime prior to seeding wheat
Apr	Spray	glyphosate burndown
	Plant	¼ to ½ inch deep
	Spray	glyphosate burndown prior to planting if weeds have emerged since the April spraying
May-Jun	Spray	broadleaf herbicide
Jun-Jul	Rotary mower	clip over the top of the switchgrass if grassy weeds have canopied

Table 4. No-Till switchgrass establishment budget

Item	Unit of Measure	Price per unit	Quantity	Value
Costs				
Land Rental	acre	$ 45.00	1	45.00
Switchgrass Seed	lbs PLS	$ 6.00	5	30.00
DAP (18-46-0)[a]	lbs.	$ 0.27	43	11.74
Fertilizer Application	acre	$ 4.14	1	4.14
Herbicide (glyphosate)	oz	$ 0.23	54	12.42
Herbicide (broadleaf, post emerge)	acre	$ 4.50	1	4.50
Herbicide Application	acre	$ 4.94	4	19.76
Seeding	acre	$ 13.40	1	13.40
Rotary mower	acre	$ 3.50	1	3.50
Annual Operating Capital	$	$ 0.07	144.46	10.11
Total "Cash" Costs	acre			**$ 155**
Establishment amortized over 10 years	annual	$ 155	7%	**$22.01**

[a] If soil test values of phosphorus are sufficient, no P_2O_5 is recommended. The budgeted DAP application includes 8 lbs of N and 20 lbs of P_2O_5.

Table 5. Maintenance budget for established stands of switchgrass to be harvested for biomass feedstock

Item	Unit of Measure	Price per unit	Quantity	Value		
Costs						
Establishment amortized over 10 years	acre	$ 26.83	1	26.83		
Land Rental	acre	$ 45.00	1	45.00		
Urea (46-0-0)[abc]	lbs.	$ 0.20	92	18.34		
DAP (18-46-0) [ac]	lbs.	$ 0.27	43	11.74		
Potassium [a]	lbs.	$ 0.26	0	0.00		
Fertilizer Application	acre	$ 4.14	1	4.14		
Swathing [d]	acre	$ 13.15	1	13.15		
				Yield (tons dry matter/acre)		
				2	4	6
Baling (4x4x8, 1500 lbs)	bale	$ 14.60	variable	38.93	77.87	116.80
Hauling[e]	bale	$ 4.50	variable	12.00	24.00	36.00
Annual Operating Capital	$	7.00%		5.96	7.88	9.52
Total "Cash" Costs	acre			**$ 176**	**$ 233**	**$ 282**

Harvested Yield (tons/ac @ 15% moisture)	DM Yield (tons/ac)	Breakeven Price (dry ton)
2.3	2	**$ 88**
4.7	4	**$ 58**
7.1	6	**$ 47**

[a] Fertilizer is assumed to be applied in February or March.

[b] The price of urea ($0.20/lb) is presented in the budget. This translates into a price of $0.43/lb of actual nitrogen.

[c] If soil test values of phosphorus are sufficient, no P_2O_5 is recommended. The budgeted DAP application includes 8 lbs of N and 20 lbs of P_2O_5. The budget reflects the cost of 42 lbs of N from urea and 8 lbs of N from DAP to achieve the level of 50 lbs of actual N/acre.

[d] Harvest is budgeted to occur in October or November.

[e] Haul distance is assumed to be no more than 30 miles.