EXTENSION

AGEC-337

What is the Economic Cost of a Bale of Hay?

September 2024

Introduction

Summertime in Oklahoma is hay baling season. Native grasses are typically baled in late June to mid-July. Bermudagrass is usually harvest in June through September and sometimes left stockpiled (uncut) for fall grazing. While market prices of hay are published by USDA AMS (see https://www.ams.usda.gov/market-news/hay-reports), less is published about the economic cost of putting up a bale of hay. Producers often omit the opportunity cost of nutrients taken up by forages and the opportunity of owned land. If these economic costs are not considered, producers might be selling hay at an economic loss.

Nitrogen

Bermudagrass hay with 12% protein is 1.9% nitrogen (0.12 × 0.16 = 0.019.) (Coover undated). Nitrogen fertilizer is usually not applied to native grasses , but bermudagrass hay meadows are fertilized at least annually. Even if no nitrogen is lost due to volatilization or other plant uses (e.g., root growth), a ton of bermudagrass needs at least 32 pounds of N. However, Oklahoma State University reports more than this minimum is necessary to reach yield goals. Oklahoma Cooperative Extension Service recommends 50 pounds of N per ton of bermudagrass after the first ton of production. So, assuming a 3-ton goal, 100 pounds of N are recommended (Redfearn et al., 2016). With urea (46-0-0) prices at $525 per ton (applied), N costs $0.57 per pound which equates to $57 for a 3-ton yield goal or $19 per ton for bermudagrass hay.

Phosphurus

Native hay typically is 0.18% phosphorus, or 3.6 pounds of phosphorus per ton of native hay (Beck et al., 2021). Bermudagrass hay is typically 0.24% phosphorus, or 4.8 pounds of phosphorus per ton of bermudagrass hay (Beck et al. 2021). Many soils in Oklahoma have low levels of phosphorus. Continued haying without applying P_2O_5 further depletes phosphorus levels, affecting yield and potentially altering plant species present. So, there is an implicit value (or an opportunity cost) of phosphorus removed by haying.

Diammonium phosphate (DAP) is commonly used as a source of phosphorus. DAP contains 18% N and 46% phosphate (P_2O_5). To find the pounds of phosphate needed to replace the pounds of the phosphorus taken up by hay, the pounds of phosphorus are divided by 0.43. For example, a ton of native hay with 0.18% phosphorus has 3.6 pounds of P. To replace 3.6 pounds of P using P_2O_5, 8.37 pounds of P_2O_5 is required. Since DAP is 46% P_2O_5, 18.2 pounds of DAP is needed per ton of hay to replace P taken off. Similarly, a ton of bermudagrass is 0.24% P. So, to replace the P taken off in bermudagrass hay (per ton), 24.3 pounds (0.0024 × 2000 / 0.43 / 0.46) of DAP is needed. A worksheet is provided in Table 1 to assist with calculating phosphorus and potassium removal costs.

To calculate the cost of P replacement on native grass, the price of DAP (applied) is multiplied by the pounds needed. At a price of $810 per ton for DAP (applied), 24.3 pounds of DAP costs $9.84 per ton of native hay.

1 Native hay with 7% protein contains 1.12% nitrogen as protein is 16% nitrogen. (0.07 × 0.16 = 0.0112).

Since DAP contains 18% N and bermudagrass requires N application, we assign the N the same value as if it was supplied with urea, $0.57 per pound of N. A pound of DAP then has $0.10 worth of N ($0.57 × 0.18). At $810 per ton (applied), or $0.405 per pound, for DAP, the cost of phosphate from DAP is $0.663 per pound. Converting to cost per pound of P, divide the cost of phosphate by 0.43 to get $1.54 per pound P as supplied by DAP. Then, 24.3 pounds of P as supplied by DAP (net of N value) costs $37.42 per ton of bermudagrass hay.

Potassium

Both native grass hay and bermudagrass hay are about 0.15% potassium (K) (Coover undated). Much of Oklahoma has soils with K levels above sufficiency. However, in soils with low levels of potassium, there is an opportunity cost to potassium removal via hay production. One ton of hay has 30 pounds of potassium. Potash (0-0-60), which is 60% K_2O, is currently about $515 per ton (applied). To convert one ton of K_2O to pounds of K, divide 2000 by 1.2046 which is 1660.3 pounds. Since potash is 60% K_2O, multiply 1660.3 by 0.6 to get 996.2 pounds of K in one ton of potash. Last, divide the cost of a ton of potash, $515, by 996.2 to get $0.52 as the cost of a pound of potassium as supplied by potash. Since native grass and bermudagrass hay have 30 pounds of K per ton, each ton of hay removes $15.60 worth of potassium.

Table 1. Calculations for Phosphorus and Potassium Removal and Cost.

Percent Phosphorus	_____ % × _____ lb (bale weight) = _____ lb P removal **(A)**
Price of 18-46-0	$_____ per ton / 395.6 = $_____ per pound of P removal **(B)**
A_____x B_____= $_____ per bale of P removal	
Percent Potassium	_____ % × _____ lb (bale weight) = _____ lb K removal **(C)**
Price of 0-0-60	$_____ per ton / 996.18 = $_____ per pound of K removal **(D)**
C_____x D_____= $_____ per bale of K removal	

Land Charge

For rented land, the per acre land rent is used to calculate land cost. For owned land, the rental rate represents the opportunity cost of land—that is the value of the next best use for owned land. Land rental rates vary across Oklahoma. For our purposes, we use $20 per acre for the land rental rate. Oklahoma State University reports pasture rental rates from producer surveys (Sahs 2021). The last survey was conducted for 2020-2021.

Pesticides

Pesticides are generally not used on prairie hay unless noxious weeds are present or selling weed-free hay. Pesticides are more commonly used on bermudagrass hay for weed control. Also, fall armyworms can be a problem in both native hay and bermudagrass hay meadows but usually are not present in relevant numbers until after native hay has been cut. Bermudagrass grass may need to be treated for armyworms and several pesticides are labeled for use in Oklahoma (see CR-7193). Harvesting bermudagrass may be the most economical means of controlling a fall armyworm infestation.

Harvest and Hauling Expense

To capture the opportunity cost of hay harvest, custom rates are used. The latest custom rate survey from Oklahoma Cooperative Extension Service has a median cost of $25 per bale for a five-foot wide bale for all harvest activities (Sahs, 2022). The median cost for hauling 5-foot width bales is $5 per bale.

Cost Summary

The costs described above are compiled in Table 2 for both prairie (native) hay and bermudagrass hay.

Table 2. Prairie and Bermudagrass Hay Production Costs.

	PRAIRIE HAY			BERMUDAGRASS HAY		
		Cost per bale	Cost per ton		Cost per bale	Cost per ton
Yield (tons/ac)	1.1			3.0		
Bale Weight (#)	1400			1400		
NUTRIENTS						
Nitrogen	1.12%			1.60%	$ 12.78	$ 18.26
Phosphorus	0.18%	$ 5.16	$ 7.37	0.24%	$ 6.88	$ 9.83
Potassium	0.15%	$ 0.00	$ 0.00	0.15%	$ 0.00	$ 0.00
Land Rent	$ 20 / ac	$ 12.73	$ 18.18	$ 20 / ac	$ 4.67	$ 6.67
Pesticides	$ 0 / ac	$ 0.00	$ 0.00	$ 12 / ac	$ 2.80	$ 4.00
Harvest Cost		$ 28.00	$ 40.00		$ 28.00	$ 40.00
Hauling		$ 5.00	$ 7.14		$ 5.00	$ 7.14
Total Cost		**$ 50.89**	**$ 72.70**		**$ 60.13**	**$ 85.90**

Hay Prices

The costs of hay production need to be compared with prices received for hay (please see the USDA Agricultural Marketing Service reports prices from recent hay sales). Historical prices from USDA National Agricultural Statistics are summarized for the past 20 years in Table 3. Note, the hay prices reported in Table 3 are an average of prairie and bermudagrass hay prices. This means that prairie hay prices were lower than the averages report and bermudagrass hay prices were higher than the reported values. If a producer's economic cost of production often exceeds market price, it may be advisable to purchase hay instead of continuing to bale hay.

Table 3. Nominal Historical Oklahoma Hay Prices (Excluding Alfalfa)*.

YEAR	$ / ton	$ / 1400# Bale
2023	$ 107.00	$ 74.90
2022	$ 112.00	$ 78.40
2021	$ 113.00	$ 79.10
2020	$ 101.00	$ 70.70
2019	$ 100.00	$ 70.00
2018	$ 94.00	$ 65.80
2017	$ 80.00	$ 56.00
2016	$ 78.00	$ 54.60
2015	$ 79.00	$ 55.30
2014	$ 85.00	$ 59.50

2013	$ 95.00	$ 66.50
2012	$ 116.00	$ 81.20
2011	$ 108.00	$ 75.60
2010	$ 74.00	$ 51.80
2009	$ 76.00	$ 53.20
2008	$ 76.00	$ 53.20
2007	$ 71.00	$ 49.70
2006	$ 88.00	$ 61.60
2005	$ 56.00	$ 39.20
2004	$ 46.50	$ 32.55
*Source: USDA National Agricultural Statistics Service (2024).		

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Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President for Agricultural Programs and has been prepared and distributed at a cost of 20 cents per copy.

AGEC-337-5