



# Economics of Producing Alfalfa

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Alfalfa growers make a variety of management decisions that affect profitability, including site selection and preparation, seed variety selection, fertility program, insect and weed control, harvest method and timing, and target market and timing. Only a limited amount of research addresses some of the interrelated aspects of alfalfa management. This extension fact sheet summarizes specific research on several aspects of alfalfa production at Oklahoma State University (OSU) and discusses its economic implications for alfalfa growers.

## Profit, Returns, Costs

The primary objective of growers when planting alfalfa is to earn a profit. Profit is simply total revenue (sales) minus total costs (expenses). Many aspects of production and marketing combine to affect both total revenue and total costs. Since alfalfa is a perennial crop, total costs are divided into establishment costs and annual operating costs. Establishment costs are incurred the year a new stand is established but can be averaged over the life of the stand. Annual operating costs occur each production year.

Many management practices affect both revenue, either price received or yield, and costs, either establishment costs or annual costs. Price often depends on quality, which in turn is affected by establishment practices, such as seedbed preparation, and annual production practices, such as fertilization, weed and insect control, and harvest method. Yield, another revenue component, is affected by establishment practices such as seedbed preparation, seed selection, and fertilization; and annual production practices such as fertilization, weed and insect control, and harvest method.

Annualized establishment costs depend on stand life, which in turn depends on establishment practices such as seedbed preparation, seed selection, and fertilization, and annual production practices such as fertilization, weed and insect control, and harvest method.

Therefore, establishment and annual production practices are both very important. Both affect profitability by contributing jointly to returns — i.e., yield and quality — and costs.

## Seedbed Preparation

OSU researchers studied four types of seedbed preparation at three locations in Oklahoma (Huhnke, Stritzke, and Solie 1993). Chemical weed control was used at each site. Results depended somewhat on the research plot location. However, approximate tillage and chemical costs per acre for each seedbed preparation method were: moldboard plow, \$35; chisel plow, \$28; offset disk, \$22; and light disking with herbicide, \$21 to \$48, depending on weed pressure. Weed pressure was affected by weed control practices in the preceding crop. Tillage method results showed no effect on first-year plant counts or yields. Poor weed control at one location resulted in a higher weed component in the harvested forage than at the other locations. The higher weed content of the forage reduces its value, especially for dairy markets (for marketing and pricing implications, see a companion Extension Facts WF-569, Marketing and Pricing Alfalfa Hay).

Tillage with a moldboard plow reduced the population of cool-season weeds, which could have several positive effects. It may result in higher alfalfa quality for buyers, reduced use and cost for chemical weed control in the established stand, and a longer stand life. Light disking caused a noticeably rougher field surface than deeper tillage methods.

## Seed Variety

Improved varieties of alfalfa seed cost more than common alfalfa (or variety unknown), but research shows they can provide a greater return. For example, consider common alfalfa at 20 lbs. of seed per acre and \$1.50/lb., for a cost of \$30 per acre, compared with improved varieties at 20 lbs. per acre and \$3.00/lb., for a total seed cost of \$60 per acre. Dowdy (1988) found that over a five-year period improved varieties yielded one ton per acre per year more on average than Oklahoma common. Using five-year average prices, the higher yield difference improved net returns by about \$50 per acre per year, accounting both for higher seed cost and higher harvesting costs (Ward et al. 1990). Note that this research was conducted on irrigated plots. The same results may not have been found under non-irrigated conditions.

Insect and weed control costs in the same study were also less for the improved varieties. Quality was higher without weeds and grasses in the harvested alfalfa and without leaf damage from insects. In addition, nearly the entire stand of Oklahoma common had died by the end of the sixth growing season. Thus, improved varieties contributed to increased stand longevity by at least one year. In addition, fewer pounds of seed per acre of improved varieties are typically required than for common alfalfa, reducing somewhat the total dollar outlay for improved varieties at planting time.

## Weed Control

As noted above, weed control increased average yields in the same study (Dowdy 1988; Ward et al. 1990) by about 0.6 tons per acre per year. Most significant gains occurred after the third year. Weed control was not cost-effective for the first three years but led to increased returns the final two years of the study. Weed interference was not serious enough in the early years of the stand to economically justify application of herbicides. The degree to which weeds are controlled in the preceding crop will affect the need for weed control in the newly established alfalfa stand and for the subsequent year or two. The alfalfa site also can affect weed growth, especially depending on rainfall or whether alfalfa is grown under dryland or irrigated conditions.

Weed control in the OSU research also contributed to increased alfalfa quality and a longer stand life. Estimated net returns from weed control were over \$9 per acre per year for the five years. However, estimated returns were \$43 per acre per year for the final two years. These returns do not include the added benefit from marketing higher quality alfalfa, which could be as much as \$10-20/ton.

## Insect Control

Insect control is imperative and is required sometimes simply to save the stand and preserve within-season yields. However, research also confirms its importance over a longer time period (Dowdy 1988; Ward et al. 1990) where returns from insecticide applications increased as the alfalfa stand aged. The greatest difference in returns was likely due to relatively low alfalfa weevil populations in two years of the five-year study. Thus, within-year weather and growing conditions significantly affect insect populations and research results. Potential savings through reduced use of insecticides are dependent on insect infestation levels (i.e. damage potential) regardless of alfalfa stand age.

For the five years of the OSU study, average yields increased about 0.5 tons per acre per year due to insect control. In addition, insect control contributed to improved alfalfa quality and longer stand life. Estimated net returns from insect control were \$30 per acre per year for the five years. As with weed control, returns from insect control increased for the final two years of the study, to more than \$65 per acre per year. Insect damage reduces both yields and alfalfa quality (Berberet and McNew 1986). Note that returns mentioned here do not include the added benefit from marketing higher quality alfalfa.

## Fertilization and Liming

OSU researchers have assessed the importance of phosphorus fertility methods and rates in alfalfa production (Mullen et al. 2000). Alfalfa plots that received 600 lbs. of phosphorus over six years were compared with check plots without a phosphorus fertilizer application. Both the timing of fertilizer application and method of application varied. Application rates included: (1) 600 lbs. per acre at preplanting; (2) 100 lbs. per acre at preplanting and 100 lbs. per acre applied annually thereafter; and (3) 200 lbs. per acre at preplanting and 200 lbs. per acre applied every two years thereafter. For the 200- and 600-lb. rates, phosphorus in the form of ammonium phosphate was applied by knife injection as well as broadcast as diammonium phosphate.

Results showed a significant yield response to the application of phosphate fertilizer. In the first year, there was a marked increase in yields associated with increasing rates of phosphorus. The 600 lbs. per acre preplant application produced the highest alfalfa yields in year one due to high plant density of the young stand. However, by the sixth year, highest yields were associated with the 200 lbs. per acre rate applied every two years, followed by the annual application of 100 lbs. per acre. The lowest yields came from the check plots, which had no phosphorus application. When compared with smaller and more frequent applications of phosphorus, availability of phosphorus to the plant decreased from the large application at preplanting and the resulting first-year yields to the sixth-year yields.

Increased alfalfa yields in total for the six years compared with the check plots were: (1) 100 lbs. per acre per year, +3.4 tons; (2) 200 lbs. per acre every two years, +4.2 tons; (3) 600 lbs. per acre applied at preplanting, +4.7 tons; (4) 200 lbs. per acre every two years (knife application), +5.8 tons; and (5) 600 lbs. per acre at preplant (knife application), +6.8 tons. Economic results are contingent on considering several factors, including cost of money associated with purchasing fertilizer (large initial cost vs. smaller, more frequent costs), application rates (single application vs. more frequent applications), and harvest costs (higher costs associated with higher yields). Smaller rates and more frequent applications proved most economical. The annual economic returns in excess of the check plots were: (1) 100 lbs. per acre per year, +\$15.88 per acre; (2) 200 lbs. per acre applied every two years, +\$23.41 per acre; (3) 600 lbs. per acre at preplanting, \$22.45 per acre; (4) 200 lbs. per acre every two years (knife application), +\$43.28 per acre; and (5) 600 lbs. per acre at preplant (knife application), +\$48.49 per acre.

This research clearly shows the importance of proper phosphorus levels for high alfalfa yields. Proper fertility also results in healthier, hardier plants, making them more resistant to weed and insect infestations and thereby contributing to longer stand life. Note again that this research was conducted on irrigated plots. The same results may not have been found under non-irrigated conditions.

## Harvest Management

Research has addressed various aspects of harvest management. One study evaluated alternative end-of-season management practices (Dowdy 1988; Ward et al. 1990).

Alternatives included a late-fall cutting, winter grazing, and not harvesting late-season alfalfa. Winter grazing produced the highest returns each year and for the five-year period. Removal of fall alfalfa growth by grazing reduced stress on alfalfa plants resulting from insect and weed infestations. This management practice increased yields and improved alfalfa quality, both of which contributed to enhanced returns. Estimated returns (not considering costs and returns from cattle grazing) were \$27 per acre per year compared with the other two harvesting options. Removal of fall growth by late-fall harvesting was not cost effective. Returns from harvesting small late-season yields did not offset harvest costs.

Other harvest management research considered alternative machinery implements for harvesting alfalfa, with emphasis on evaluating the costs of different balers (Huhnke 1999). Assuming 80 acres of alfalfa and five cuttings per year, estimated costs per acre for harvesting with a mower-conditioner, wheel rake, and one of the following balers were as follows: small rectangular baler, \$19.94; large square baler, \$32.83; and round baler, \$18.97. Small rectangular bales increase marketing flexibility since they are used by nearly all groups of buyers (dairy producers, horse raisers, cattle producers, and feedlots). Large square bales enable targeting larger dairies (Ward, Huhnke, and Cuperus 1995) and reduce the time and cost of moving bales to the side of the field for storage or shipping. Round bale cost was relatively low, but round bales are often price discounted as much as \$15/ton, especially by dairy producers (Ward 2000). Round bale harvesting is most cost-effective when harvesting lower quality alfalfa targeted for beef cattle or cattle feedlots. At 200 acres of alfalfa, the difference in cost per acre for large square bales and small rectangular bales reduced to \$3.30 compared with \$12.89 for the 80-acre example. Thus, larger acreage reduces per acre harvesting costs significantly for larger and most costly equipment.

The target market for alfalfa and amount of alfalfa acreage will affect the choice of harvesting equipment (Ward 2000). Also important is the size of equipment necessary to harvest in a timely manner.

## Stand Life

Using a sample budget for an alfalfa enterprise, and excluding capital costs for land, buildings, and equipment, establishment costs represent over 35% of first-year production costs. However, if the stand survives eight years and establishment costs are averaged over the eight-year period, establishment costs represent only 7% of the total costs for the eight years of production (assuming constant annual costs). As noted previously, stand life is dependent on many factors, so extending the productive stand life to as many years as economically possible requires long-run planning combined with timely execution of annual management practices. Sometimes, what appears as a cost savings by not following a recommended management practice results in a lower plant population, less vigorous plants, lower yields, poorer quality alfalfa, and a reduction in stand life. Therefore, not following recommended practices may be more costly in the long run than the associated short-term expenses.

Stand life is especially important to profitability of the alfalfa enterprise, but at some time the stand needs to be

replaced with an interim crop and later reestablished. The yield pattern of an alfalfa stand over several years is difficult to estimate due to weather and other factors. However, generally the stand is most productive in the early-to-mid years and declines in later years. One approach is to allocate all establishment costs to the first crop year. Then total costs each year (establishment plus operating costs in year one and just operating costs in subsequent years) are divided by each year's yield to determine the marginal or added cost per ton for maintaining alfalfa another year. Marginal or added costs are by far the highest the first year due to the establishment costs. Then the added cost of maintaining the alfalfa stand declines and remains relatively low during the higher-yielding years. Finally, as annual yields decrease in later years of the stand and annual weed and insect control costs increase, marginal costs increase.

Growers should track their yield pattern and costs and note when yields are decreasing and marginal costs are increasing. At some point, marginal costs increase above the expected marginal or added revenue from each ton of alfalfa sold. Marginal or added revenue per ton is simply the expected selling price. To be profitable, the added revenue from maintaining the alfalfa stand one more year must equal or exceed the added cost of maintaining the stand one more year. Consequently, whenever expected marginal revenue (expected sale price for the year) exceeds expected marginal costs (annual operating costs), the stand should be maintained for another year. However, when expected marginal revenue drops below expected marginal cost, the stand should be taken out of production.

## Conclusions

Several factors affect alfalfa costs and returns, and therefore profit. Most production practices are interrelated and thus affect both costs and returns. "Saving" money by not following recommended production practices must be considered carefully. Such presumed "savings" may result in larger long-run expenditures and may also result in lost income from smaller yields, lower quality, or reduced stand life.

Several tools are available for alfalfa producers from OSU to assist in making economical management decisions. Producers are encouraged to visit the Oklahoma Alfalfa Production Calendar web site, either directly or through their county extension office, at: <http://www.agr.okstate.edu/alfalfa/pageone/alfa-cal.htm>.

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