

ECONOMICS OF VARIETY CHOICE—RISK ANALYSIS

William T. W. Woodward¹

ABSTRACT

When examining an enterprise budget for growing alfalfa hay, it becomes obvious that the cost of growing the crop can be high. In order to offset these high costs, it becomes important to look at yield in order to make a profit. In the state of Washington, the break-even costs for growing alfalfa hay under a 125 foot pivot irrigation system has been shown to be about \$112.00 dollars per ton when an eight ton yield is obtained. Seed costs have little impact on costs when prorated over a perennial crop like alfalfa. However, the selection of the best variety possible can have a large impact on the return of the seed investment.

Key Words: alfalfa, varieties, yield, diseases, insects, pests, economics

Introduction

Development of new varieties of alfalfa is a continuous process. Each research company develops from 10 to 200 new experimental varieties each year to constantly try to make an improvement on varieties that are currently on the market. Only a few of these will make it to market. Much of the effort has been in pest resistance, forage quality, and grazing tolerance. Many will argue that little has been done in the selection of yield per se. This may be true, but have yields been improved indirectly by selecting for the problems that affect a perennial crop like alfalfa? Even though many university yield trials continue to be run in prime locations, the evidence is strong that yield has been improved through selection for defensive traits. Variety selection is among the most important decisions that are made when it is time to establish a stand. It is a decision that a producer must live with for the life of the stand whether for three or ten years. It is an investment in the business and can provide an excellent return on investment.

Enterprise Budget

An enterprise budget for alfalfa will provide information to the owner on his returns for the production of alfalfa hay. It will allow the grower to recognize the costs for each input that is required to produce a good product. Table 1 shows itemized cost per acre for establishing alfalfa hay following wheat or barley in the Columbia Basin of Washington under center pivot irrigation. The total cost for establishment is \$245.19 of which \$53.20 is seed cost at \$2.80 per pound and a seeding rate of 19 lbs. per acre. Seed costs are about 22% of the establishment cost. Table 2 provides information on the cost per acre for production of alfalfa hay raised in the Columbia Basin under center pivot irrigation and baled into 1-ton bales. Prorated establishment costs over a four-year stand is \$75.68 of which seed costs are about \$17.00, or less than 2% of the total costs. If a grower were to decide on lower priced seed (\$1.40/lb.), he would save about 1% of the total costs or about \$8.50 per acre/year. A grower needs to increase his yield less than one tenth a ton/acre to pay for his variety of choice.

¹ W.T.W. Woodward, Washington State University Agronomist, Franklin and Benton Counties, Franklin County Courthouse, 1016 N 4th, Pasco, WA 99301-3706; Email: woodward@wsu.edu.

TABLE 1: ITEMIZED COST PER ACRE FOR ESTABLISHING ALFALFA HAY FOLLOWING WHEAT OR BARLEY IN THE COLUMBIA BASIN, CENTER PIVOT IRRIGATION.

| | | <u>PRICE OR UNIT</u> | | <u>VALUE</u> | <u>YOUR</u> |
|----------------------------|------------|----------------------|--------------|-----------------|-------------|
| | | <u>COST/UNIT</u> | | <u>OR COST</u> | <u>FARM</u> |
| | | <u>QUANTITY</u> | | | |
| <u>VARIABLE COSTS</u> | | | | \$ | \$ |
| SOIL TEST | ACRE | 0.50 | 1.00 | \$0.50 | _____ |
| NITROGEN (DRY) | LB. | 0.23 | 25.00 | \$5.75 | _____ |
| PHOSPHATE (DRY) | LB. | 0.22 | 100.00 | \$22.00 | _____ |
| BORON | LB. | 2.90 | 1.00 | \$2.90 | _____ |
| POTASH | LB. | 0.17 | 100.00 | \$17.00 | _____ |
| CUSTOM FERTILIZATION | ACRE | 6.50 | 1.00 | \$6.50 | _____ |
| RENTED CHALLENGER | HOUR | 50.00 | 0.15 | \$7.70 | _____ |
| ALFALFA SEED | LB. | 2.80 | 19.00 | \$53.20 | _____ |
| SELECT | OZ. | 1.91 | 8.00 | \$15.28 | _____ |
| CUSTOM SPRAY | ACRE | 6.50 | 1.00 | \$6.50 | _____ |
| IRRIGATION POWER* | ACRE | 40.00 | 0.20 | \$8.00 | _____ |
| IRRIGATION REPAIR* | ACRE | 20.00 | 0.20 | \$4.00 | _____ |
| IRRIGATION WATER* | ACRE | 35.00 | 0.20 | \$7.00 | _____ |
| TRACTOR REPAIR* | ACRE | 2.92 | 1.00 | \$2.92 | _____ |
| TRACTOR FUEL/LUBE | ACRE | 6.50 | 1.00 | \$6.50 | _____ |
| MACHINERY REPAIRS | ACRE | 6.39 | 1.00 | \$6.39 | _____ |
| MACHINE FUEL/LUBE | ACRE | 2.93 | 1.00 | \$2.93 | _____ |
| LABOR | HOUR | 14.50 | 1.23 | \$17.84 | _____ |
| INTEREST ON OOP. CAP. | ACRE | 2.76 | 1.00 | \$2.76 | _____ |
| OVERHEAD | ACRE | 9.78 | 1.00 | \$9.78 | _____ |
| <u>TOTAL VARIABLE COST</u> | -- | -- | -- | <u>\$205.44</u> | _____ |
| <u>FIXED COSTS</u> | -- | \$ | - | \$ | |
| TRACTOR DEPRECIATION | ACRE | 5.68 | 1.00 | \$5.68 | _____ |
| TRACTOR INTEREST | ACRE | 5.62 | 1.00 | \$5.62 | _____ |
| TRACTOR INSURANCE | ACRE | 0.37 | 1.00 | \$0.37 | _____ |
| TRACTOR TAXES | ACRE | 1.12 | 1.00 | \$1.12 | _____ |
| TRACTOR HOUSING | ACRE | 0.62 | 1.00 | \$0.62 | _____ |
| MACHINE DEPRECIATION | ACRE | 9.50 | 1.00 | \$9.50 | _____ |
| MACHINE INTEREST | ACRE | 4.96 | 1.00 | \$4.96 | _____ |
| MACHINE INSURANCE | ACRE | 0.33 | 1.00 | \$0.33 | _____ |
| MACHINE TAXES | ACRE | 0.99 | 1.00 | \$0.99 | _____ |
| MACHINE HOUSING | ACRE | 0.55 | 1.00 | \$0.55 | _____ |
| MANAGEMENT FEE* | ACRE | 50.00 | 0.20 | \$10.00 | _____ |
| TOTAL FIXED COST | | | | \$39.74 | _____ |
| <u>TOTAL COST</u> | -- | - | - | <u>\$245.19</u> | _____ |

* 20% ALLOCATED TO ALFALFA ESTABLISHMENT, 80% ALLOCATED TO THE PRECEDING CROP.

TABLE 2: ITEMIZED COST PER ACRE FOR PRODUCTION OF ALFALFA HAY
 RAISED IN THE COLUMBIA BASIN UNDER CENTER PIVOT
 IRRIGATION AND BALED INTO 1-TON BALES.

| | | <u>PRICE OR UNIT COST/UNIT</u> | | <u>VALUE</u> | <u>YOUR</u> |
|------------------------------|-------------|--------------------------------|-------------|-----------------|-------------|
| | | <u>QUANTITY</u> | | <u>OR COST</u> | <u>FARM</u> |
| <u>VARIABLE COSTS</u> | | | | \$ | |
| SOIL TEST | ACRE | \$0.50 | 1.00 | \$0.50 | _____ |
| PHOSPHATE (LIQ) | LB. | \$0.34 | 100.00 | \$34.00 | _____ |
| POTASH (LIQ) | LB. | \$0.28 | 100.00 | \$28.00 | _____ |
| ZINC (LIQ) | LB. | \$1.43 | 4.00 | \$5.72 | _____ |
| BORON (LIQ) | LB. | \$3.19 | 1.00 | \$3.19 | _____ |
| VELPAR | GAL. | \$60.92 | 0.25 | \$15.23 | _____ |
| GRAMOXONE-MAX | GAL. | \$38.82 | 0.25 | \$9.71 | _____ |
| STICKER | GAL. | \$10.94 | 0.25 | \$2.73 | _____ |
| 21-0-0-24 | LB. | \$0.20 | 3.40 | \$0.68 | _____ |
| CUSTOM GROUND APPLIC. | ACRE | \$6.50 | 1.00 | \$6.50 | _____ |
| CUSTOM SWATH | ACRE | \$15.00 | 4.00 | \$60.00 | _____ |
| CUSTOM RAKE | ACRE | \$6.00 | 4.00 | \$24.00 | _____ |
| CUSTOM BALE (1TON) | TON | \$15.00 | 8.00 | \$120.00 | _____ |
| PRESERVATIVE | TON | \$3.00 | 8.00 | \$24.00 | _____ |
| HAUL & STACK | TON | \$3.50 | 8.00 | \$28.00 | _____ |
| INSURANCE* | \$1K | \$2.00 | 0.98 | \$1.96 | _____ |
| GOPHER CONTROL | ACRE | \$2.00 | 1.00 | \$2.00 | _____ |
| IRRIGATION POWER | ACRE | \$40.00 | 1.00 | \$40.00 | _____ |
| IRRIGATION REPAIR | ACRE | \$20.00 | 1.00 | \$20.00 | _____ |
| IRRIGATION WATER | ACRE | \$35.00 | 1.00 | \$35.00 | _____ |
| MACHINERY REPAIRS | ACRE | \$0.75 | 1.00 | \$0.75 | _____ |
| MACHINE FUEL/LUBE | ACRE | \$3.73 | 1.00 | \$3.73 | _____ |
| LABOR | HOURLY | \$14.50 | 0.85 | \$12.32 | _____ |
| INTEREST ON OP. CAP. | ACRE | \$15.75 | 1.00 | \$15.75 | _____ |
| OVERHEAD | ACRE | \$24.69 | 1.00 | \$24.69 | _____ |
| <u>TOTAL VARIABLE COST</u> | | | | <u>\$518.46</u> | _____ |
| <u>FIXED COSTS</u> | | | | \$ | |
| MACHINE DEPRECIATION | ACRE | \$4.60 | 1.00 | \$4.60 | _____ |
| MACHINE INTEREST | ACRE | \$2.39 | 1.00 | \$2.39 | _____ |
| MACHINE INSURANCE | ACRE | \$0.16 | 1.00 | \$0.16 | _____ |
| MACHINE TAXES | ACRE | \$0.48 | 1.00 | \$0.48 | _____ |
| MACHINE HOUSING | ACRE | \$0.27 | 1.00 | \$0.27 | _____ |
| LAND RENT ACRE | ACRE | \$250.00 | 1.00 | \$250.00 | _____ |
| MANAGEMENT FEE | ACRE | \$50.00 | 1.00 | \$50.00 | _____ |
| PRORATED ESTAB COST** | ACRE | \$75.68 | 1.00 | \$75.68 | _____ |
| <u>TOTAL FIXED COST</u> | | | | <u>\$383.58</u> | _____ |
| <u>TOTAL COST</u> | | | | <u>\$902.04</u> | _____ |

* 8 TONS VALUED @ \$120/TON.

**\$245.19 ESTABLISHMENT COST AMORTIZED OVER 4 YEARS AT 9% INTEREST.

Alfalfa Variety Choice Factors

Alfalfa variety choice factors include: yield potential, winter hardiness, pest resistance, forage quality, and stand persistence. Some of these factors may be more important than others when incorporated in the bottom line. Should seed cost be a factor?

Yield

Yield is certainly the most important factor as it influences net profits. If the choice variety improves yield by 5%, and production costs are fixed, more than \$50 dollars net profit can be realized on each acre. That is if you can get \$120 for a ton of hay off a field that produces 8 ton. Small plot data can be used to determine yield differences in alfalfa varieties. Most universities run yield trials to obtain yield data to aid growers in the selection of the best varieties. Significant weight should be given to local tests; however, it is to the growers advantage to look at all tests that fit into his production scheme even if the data is from a nearby state. If alfalfa is being grown under irrigation, a consideration of all tests under irrigation could be of benefit.

Winter Hardiness

In colder regions winter hardiness is a primary factor. Stand declines and general health of the alfalfa plant will cost yield. Although many would argue that there is not a correlation of winter hardiness and fall dormancy, if all dormancy groups are considered, there is a clear correlation. Often the only data provided on a variety is fall dormancy. In areas prone to winterkill, a dormancy rating of 2-4 is most often used. In areas where winterkill is not a problem, classes 7-9 are used.

Pest Resistance

There are a number of insects, diseases, and nematodes that can negatively affect alfalfa. In recent years, it has become less difficult to find varieties that have resistance to most of the major economically damaging pests. A grower does not have to settle for anything less than an R classification for specific pests that affect his location. Table 3 shows yield in percent of mean for the top six varieties from a yield test run near Pasco, Washington. The location has a severe problem with Verticillium wilt (VW), a disease that infects the stand in the first year and results in clear stand declines by the end of the second year. The top five varieties began the test as average to slightly above average in yields. Variety 6 began the trial with the top yield but lost stand drastically in the following two years causing its yield to decline. Variety 6 is an example of a variety that is classified as having moderate resistance to VW while the top five were classified as having resistance or better. Even though the variety has recently been developed, it declined in yield primarily due to its susceptibility to VW. Other pests such as Phytophthora root rot, anthracnose, bacterial and Fusarium wilt along with stem and root knot nematode can cause similar yield declines. The choice variety should have resistance or better to these pests.

Table 3: Yield in % of mean for selected varieties from a 1997 seeding in Pasco, WA.

| Entry | 1998 % of mean | 1999 % of mean | 2000 % of mean | 3 yr. Percent of Mean |
|-----------|----------------|----------------|----------------|-----------------------|
| Variety 1 | 101.0% | 106.5% | 112.2% | 106.3% |
| Variety 2 | 104.8% | 105.6% | 107.8% | 106.0% |
| Variety 3 | 101.0% | 104.7% | 110.0% | 105.0% |
| Variety 4 | 101.0% | 107.5% | 106.7% | 105.0% |
| Variety 5 | 99.0% | 104.7% | 111.1% | 104.7% |
| Variety 6 | 111.5% | 98.1% | 97.8% | 102.7% |

Forage Quality

Market conditions and intended use will influence the desired level of forage quality. Alfalfa producers should know that climate, location, and harvest management have a much greater effect on forage quality than with variety selection. However, if a variety has top yield potential and the necessary pest resistance package, and in addition has been selected for forage quality, then it would be a good choice. Harvesting at proper maturity to balance forage quality with stand life is often the best choice. Harvesting very early will cause stands to decline and yield reduction. Harvesting late reduces forage quality. The market usually determines the choice. If there is no premium for top quality hay, then a grower may go to a four cut system rather than a five. This saves him the cost of an extra harvest and improves yield.

Stand Persistence

Persistence of an alfalfa stand is determined by the plants ability to withstand winterkill, harvest frequency, and a number of damaging pests. It is suggested that a grower should replace the field when the stand has less than five plants or 40 stems per square foot. In a business that requires optimum yields, a grower may decide on stand replacement based on yields obtained during the year. Even adequate stands may lose yields due to general health of the plants.

Seed Expense

Table 4 shows yield in tons and percent of mean over three years in a 1998 alfalfa seeding near Pasco, Washington. Three varieties were selected from the trial for comparison. Variety 1, 2, and 3 was considered the high, average and low yielding varieties, respectively. Table 5 shows the calculated value of hay harvested from a 125-acre field with yields based on trial results. The value of the four-year stand is

projected based on a three-year average. The dollar advantage of Variety 1 over Variety 3 was \$81,000 for hay harvested from a typical 125-acre pivot irrigation field. The advantage of Variety 2 over Variety 3 was \$42,500. Table 6 provides similar information as Table 5 with the exception for the cost of seed. \$3.00, \$2.00, and \$1.50 were considered as high, medium and low priced seed, respectively.

Table 4: Yield of selected alfalfa varieties from the 1998 seeding in Pasco, Washington

| Entry | 1999 tons | 1999 % of mean | 2000 tons | 2000 % of mean | 2001 tons | 2001 % of mean | 3-year avg. | Percent of Mean |
|-----------|-----------|----------------|-----------|----------------|-----------|----------------|-------------|-----------------|
| Variety 1 | 12.1 | 102.5% | 12.5 | 103.3% | 10.7 | 109.2% | 11.77 | 104.8% |
| Variety 2 | 12 | 101.7% | 11.7 | 96.7% | 9.3 | 94.9% | 11.00 | 98.0% |
| Variety 3 | 11.7 | 99.2% | 11.1 | 91.7% | 8.1 | 82.7% | 10.30 | 91.7% |

Table 5: Value of 125 acre field of alfalfa hay and advantage

| Entry | 3-year avg. | Dollars per acre @ \$110 | Value of 125 acre field | Value of four year stand | Advantage |
|-----------|-------------|--------------------------|-------------------------|--------------------------|-------------|
| Variety 1 | 11.77 | \$1,295.00 | \$161,875.00 | \$647,500.00 | \$81,000.00 |
| Variety 2 | 11.00 | \$1,210.00 | \$151,250.00 | \$605,000.00 | \$42,500.00 |
| Variety 3 | 10.30 | \$1,133.00 | \$141,625.00 | \$566,500.00 | |

Table 6: Variety advantage (125 acre field of alfalfa hay)

| Entry | Value of four year stand | Advantage without seed cost | Seed cost per lb. | Additional seed cost | Advantage with seed costs |
|-----------|--------------------------|-----------------------------|-------------------|----------------------|---------------------------|
| Variety 1 | \$647,500.00 | \$81,000.00 | \$3.00 | \$2,812.00 | \$78,188.00 |
| Variety 2 | \$605,000.00 | \$42,500.00 | \$2.00 | \$938.00 | \$41,562.00 |
| Variety 3 | \$566,500.00 | | \$1.50 | | |

Frequently, seed costs are assumed to be a major cost. However, when the total cost of establishing alfalfa is considered, using a modern variety could represent as much as 22 percent of the cost. When considering the total cost of production of a four-year stand, it would only represent about 2 % of the costs. The returns from selecting the right variety can be excellent.