HOW TO MAKE YOUR ALFALFA MORE PROFITABLE

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Introduction

As a perennial plant, alfalfa can be expected to continue to live and produce for an indefinite period of time. Why then do stands need to be replanted every few years? Is modern seed available today, weakened and unable to live up to the perennial label? What about yield? How does your stand measure up? Are you barely making the state average, or struggling to even meet this modest yield level?

The first harvest each spring can produce over 40% of the yield in a single growing season. Why is a stand slower growing in the spring than you would like it to be, and producing less tonnage? Do insects and other diseases eat your profits from this queen of forages? How can you spend less and get more? Managing all inputs, the soil, seed selection, planting, pests, harvesting, fertilizing, all with simple but careful attention to important details, will bring big dividends.

First the Seed

In my position as product manager with a commercial seed company I hear many times during the year that the seed just wasn't vigorous enough, or lacked hardiness, or didn't have good pest resistance. "That's why my stand died or yielded a lot less than my neighbors' alfalfa."

The health and productivity of an alfalfa stand is less than 10% attributed to the seed. This means you, the grower, have in excess of 90% of the influence on how a stand of alfalfa grows, produces, and survives. Genetical differences certainly are greater when comparing varieties developed more than 10 years apart. As with any modern advancements, the newer models are faster growing, higher yielding, and more able to survive harsh winters, more frequent harvests, and other stresses.

The choice of seed is extremely important in making sure an adapted variety is planted and good yield potential is available. Seed cost most often is a resistance factor in planting newer, higher priced varieties, but this is misplaced caution. Comparative costs for Vernal and any modern variety that has been released in the last 10 years show this to be false economics.

The yield difference is well documented for Vernal, which is now 42 years old and still planted on many acres. Newer varieties produce over 20% more than Vernal, which means at least half a ton of extra hay can be gained every year through seed selection alone. This translates into dramatic net savings from planting a newer variety.

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Table 1. Seed cost of two alfalfa varieties and yield differences showing economic advantage from newer products.

	Seed			Hay		
	$/lb	lb/A	$/A	T/A	$/T	Adv. $/A
Vernal	0.90	15	13.50	6.00	90.00	
Proprietary	3.50	15	52.50	6.50	90.00	+45.00

Assuming a $90/ton hay price, this shows that in the first full production year, with a modest 6 ton hay yield, the seed of a newer proprietary alfalfa is really going to cost about half that of Vernal ($52.50-$45.00 = $7.50), because of the additional hay yield. Looking over a three or four year life of stand, this savings grows to where it actually costs the grower to plant lower-performing seed. A five-year stand of proprietary alfalfa is likely to return in excess of $220/acre over that produced from Vernal, or any other older variety. Make sure alfalfa seed is selected on yield data and pest resistance, rather than price.

Where the Seed is Planted

Well drained soil with a pH of at least 6.5. Golden rules, so often broken they are like a thief with ready access to a farmer's bank account. A pH of 6.8 is ideal, particularly for nodule development and subsequent nitrogen fixation. Considerable research has been done showing how lime, added after a stand has been established, can still benefit long-term productivity. However successful this may be, applying lime on mature stands does not equal the positive effects of incorporating it into the soil before seeding. Stand establishment, early yield, and long-term stand survival are negatively impacted by planting alfalfa on soils with less than ideal pH levels.

A free draining soil is nearly as important for stand longevity and good forage yield. Poorly drained soils are most likely to shorten stand life by stunting or killing the plants through oxygen starvation, or infestation by wet-soil pathogens such as *Phytophthora, Pythium, Aphanomyces, Rhizoctonia, or Fusarium.* Alfalfa roots require well aerated soils and without excess moisture pathogens don't thrive nearly as well.

Alfalfa planted in crop rotations provides the greatest value through nitrogen credits to the following crop. Fall plowing of the crown and roots has been shown to contribute the equivalent of 60 pounds of nitrogen to the following crop. If fall growth is also plowed down, over 100 pounds of nitrogen is returned to the soil (Groya & Sheaffer, 1985). Crop rotations makes alfalfa just that much more profitable by maximizing the benefits of this nitrogen, with the added bonus of decreased disease and pest pressures often encountered when replanting back to alfalfa in the same field.

How the Seed is Planted and How Much to Plant

Investing in machinery can be expensive and often not very cost effective unless used regularly over a large acreage. There are essentially three methods to seed alfalfa — broadcast, cultipacker, or band seeding. All except broadcasting requires some type of equipment, although N-gauge seeders have been the most popular, albeit unreliable, choice of equipment for broadcasting seed. Each method has drawbacks and limitations to establishing a good alfalfa stand, if not used properly.

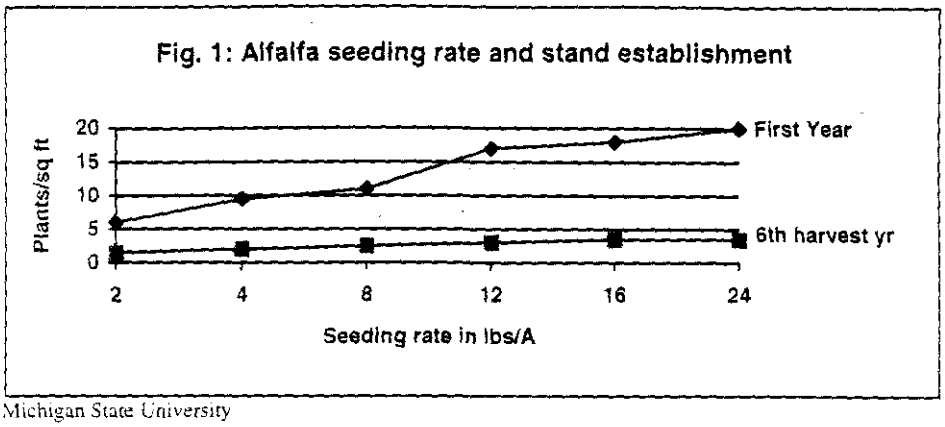
Broadcasting seed on the surface is the lowest-cost method of planting but also the least successful in reliably establishing a stand. Uneven germination through unequal distribution of the seed, and poor soil contact with the seed make this the least desirable method to establish a stand. Seed to soil contact can be increased somewhat by harrowing after seeding bit a much better stand can be gained by cultipacking.

A cultipacker also broadcasts the seed on the surface, but with two very distinct advantages. First the seed is evenly distributed and dropped on the soil between two cultipackers. The first firms the seedbed and the second presses the seed into the soil. This method produces the most consistent stands across operators, soil types, and all other conditions.

Band seeding requires the use of a drill fitted with a small-legume seed box. Disk coulters cut a slit in the soil, allowing fertilizer to be placed about two inches deep. Alfalfa seed is distributed in rows on the soil surface above the fertilizer. Packer wheels follow, pressing the seed into the soil with four times more pressure than is available from a Brillion-type cultipacker. The combination of excellent seed-to-soil contact and fertilizer for early root development, help produce the best possible stand of all seeding methods. However, band seeding requires much more careful management in equipment settings and operation to obtain the 10% greater seed germination from this method. The most regular cause of failure with this seeding method in obtaining a good stand is from the seed being placed too deep in the soil.

In selecting a seeding rate the old adage of, more is better, does not help produce the best or most cost efficient stand. Too often farmers complain about the high cost of seed and then proceed to plant far more than is necessary to obtain a good stand. One pound of alfalfa contains approximately 225,000 seeds. Spread over one acre this will place 5 seeds per square foot. A 10 pound seeding rate will place 50 seeds per square foot.

In a Michigan State University study (Fig.1), which is also supported by several others, yields increased in the seeding year with higher seeding rates, up to 8 lb/acre. However, rates above 12 lb/acre did not increase yields, or long-term stand density. These stand density numbers correlate well with trials conducted in Wisconsin where 60 seeds/square foot (12 lb/A) were seeded. Thirty five of these (almost 60%) germinated, and a year later after one winter, 20 plants/square foot remained in the stand (Undersander, et al).



Michigan State University

Averaged data for the 7-year period of the Michigan State study show that the 12- and 16-lb rates continued over time to produce higher yields, with 4.9 and 5.0 tons/acre, respectively, than lower seeding rates. No increase in yield or long-term stand density was obtained from the 24 lb/A seeding rate. The only advantage in seeding at higher rates is to compensate for a less-than-well prepared seedbed. With extra care in preparing the ground, savings in seed costs from $15 to $20/acre can easily be achieved. Remember that right depth placement of the seed, in the right soil type, in a well prepared seedbed, are crucial keys to producing an adequate stand.

Recommendations for short-term stands of 2-4 years are to seed at 8-12 lbs/acre. Long-term stands exceeding 5 years should be seeded at 12-15 lbs/acre. Rates higher than this do not help increase long-term stand density or yields.

Companion Crops, Herbicides, & Weed Control

A nurse crop is a curse crop. Only two key reasons warrant a nurse crop, which can decrease stand establishment and reduce yield of quality forage. Alfalfa grown in areas prone to wind or water erosion are often best seeded with a nurse crop. However, careful management of the companion crop is essential to avoid suppressing alfalfa seedlings along with the weeds. What prevents weeds from growing, works the same on alfalfa.

Secondly, a well managed companion crop can also provide high-tonnage forage for use in cattle operations, particularly as feed for young animals. Many of the small grains work well when seeded as a companion with alfalfa, but an oat crop has been shown to be the least competitive or likely to lodge. For best results, no more than one bushel per acre of oats should be used when seeded with alfalfa. These must be removed at the early boot stage, as oatlege or silage, to allow alfalfa seedlings to grow and develop. Anything beyond this time turns it into a curse crop

Clear seeding means planting alfalfa without a companion crop. However, weeds must be controlled for successful stand establishment and several herbicides are available to control both broadleaf and grassy weeds. Eptam, Balan, and Poast all provide excellent annual grass control and 2,4-DB will control broadleaf weeds. Feed quality and financial returns are far greater when weeds are chemically controlled, versus no control at all. In table 2, the short-term value of seeding alfalfa with an oat crop is shown to be only

marginally better than no control at all, with Balan and Poast herbicide treatments returning the best value. Growers should expect $12-14/acre in costs when using a herbicide to control weeds in a new alfalfa seeding. This can be easily regained if quality forages is the main goal, rather than just tonnage of feed.

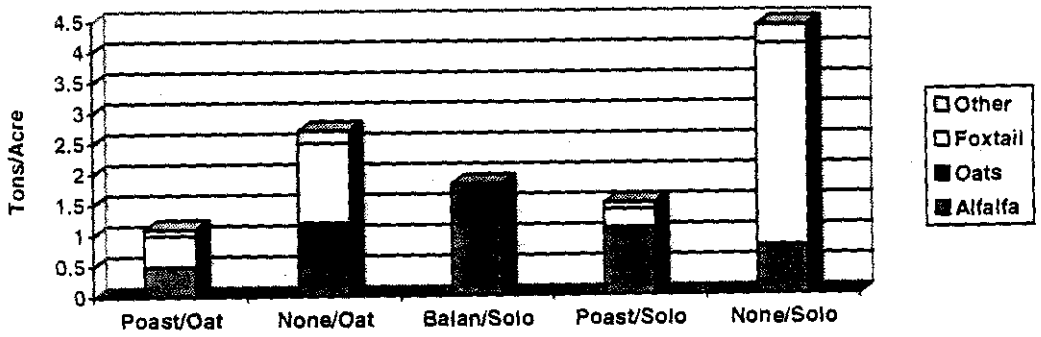
Table 2. Forage quality and feeding value of forage harvested from alfalfa in the stand establishment year.

Treatment	CP%	RFV	$FV/T	NEL
Poast- Solo	17.35	140.4	87.22	0.62
Balan- Solo	16.30	131.5	81.76	0.58
Poast- Oats	14.75	101.7	74.50	0.52
None- Oats	13.53	98.9	73.31	0.55
None- Solo	12.13	95.5	69.21	0.54

FV = feed value (corn @ $2.38/bu, soymeal @ $8.00/cwt)
University of Minnesota.

Alfalfa productivity and profitability are greatly increased by using a herbicide to control weeds during the establishment phase. Yield of pure alfalfa (Fig. 2) was highest when a preplant herbicide (Baytan) was used, but overall forage yield was greater with no weed control at all, but much of this was low quality foxtail grasses with little feeding value.

Fig. 2: Yield of alfalfa and other forages when using various weed control methods at seeding



University of Minnesota

Weed control is essential as annual grasses and other weeds become so pervasive the stand is short lived and eventually crowded out by these plants. Figure 2 shows where almost 2 tons/acre of pure alfalfa was produced in the seeding year by using a preplant herbicide. Other trials have shown that over 3 tons/acre of alfalfa hay can be produced in the seeding year. The added bonus to this is a thriving stand, free of weeds, when clear seeding with a herbicide to control weeds. Forage tonnage when seeding with an oat nurse crop can easily exceed 4 tons/acre. Pure alfalfa yield in the seeding year most often does not exceed 1 ton/acre, mainly because of oat regrowth after the first harvest.

Seeding management must be according to forage production goals along with good conservation practices to avoid soil erosion. Whatever method of seeding and weed control is used, knowing production goals will provide an added tool to make your alfalfa more profitable.

Does Alfalfa Need Fertilizer?

Not many farmers would consider planting corn without adding at least nitrogen and, most often, other fertilizer as well. Yet a large proportion of growers never add any fertilizer to an alfalfa stand. As a legume, nitrogen is not needed but other nutrients are just as important to alfalfa as they are to producing a good yielding corn crop. Phosphorus (phosphate fertilizer) is extremely important for early root development and potassium (potash fertilizer) provides essential nutrients for strong plant health and good winterhardiness.

The most profitable fertilizer rates for alfalfa are based on, 1) projected yields and, 2) the current nutrient status of the soil. Yield goals are important for determining fertilizer needs and, as a high-value crop, it is better to be optimistic in these to maximize ideal weather and moisture conditions. A soil test must be taken to determine what nutrients the soil can supply. Soil type, along with field history and location, as well as state recommendations make a difference in what fertilizer a stand of alfalfa will require. Table 3 shows average soil test results between course and fine textured soils, with amounts of phosphate fertilizer that should be added to reach certain yield goals from alfalfa.

Table 3. Phosphorus suggestions for alfalfa based on soil tests.

Yld Goal T/A	Phosphorus Soil Test (ppm)					
	0-5	6-10	11-15	16-20	21-25	25+
	$P_2O_{5\ (phosphate)}$ to apply (lbs/A)					
<3	70	50	30	0	0	0
4	85	65	40	20	0	0
5	100	80	55	30	0	0
6	115	95	70	45	20	0
7	130	110	85	60	30	0
>8	150	125	100	75	50	0

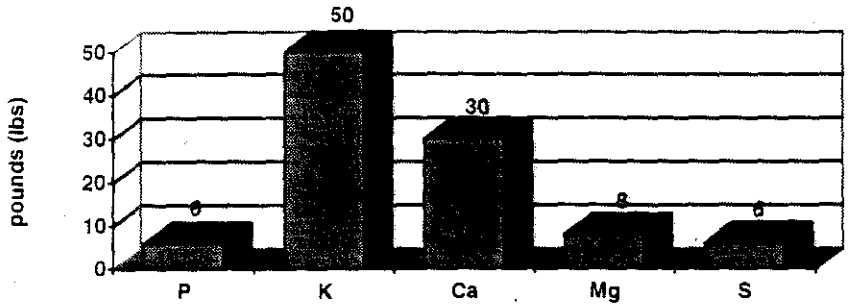
University of Minnesota

A good rule of thumb to remember is, for every ton of hay taken from an alfalfa field, 6 pounds of phosphorus and 50 pounds of potassium are removed from the soil. While it might be easy to keep adding what the crop removes, this is not recommended as fertilizer may be underapplied, thus restricting yields, or overapplied and wasting money. TAKE A SOIL TEST and know you are making your alfalfa more profitable.

Under high phosphorus soil conditions, phosphate fertlizer applied at seeding is generally adequate for the life of the stand. For maximum productivity potash should be

applied annually. The most practical time to do this is immediately following either the first or second harvest. At this time the ground will be drier, helping avoid compaction from application equipment, and giving adequate time for plant nutrient uptake before the winter.

Fig. 3: Soil nutrient removal by one ton of alfalfa hay



Purdue University

Table 4. Potash suggestions for alfalfa production on average soil types.

Yield Goal	Potassium Soil Test (ppm)				
	0-40	41-80	80-120	121-160	160+
T/A	---------- K_2O to apply (lbs/A) ----------				
<3	140	85	45	0	0
4	185	135	85	35	0
5	230	175	130	80	0
6	275	225	175	125	0
7	320	260	200	140	0
>7	365	295	225	155	0

University of Minnesota

When growing alfalfa most emphasis is placed on P and K nutrient needs but this crop also removes 30 lbs of Calcium (Ca) per ton of hay harvested. With the soil pH at ideal levels this element is rarely limiting and yields are nearly always increased from soils where the pH is optimum, as shown in table 5.

Table 5. The effect of soil pH on the forage yield of alfalfa.

pH range	Yield T/A
5.2 - 5.4	1.15
5.5 - 5.7	2.33
5.8 - 6.0	2.90
6.1 - 6.3	3.18
6.4 - 6.6	3.47
6.7 - 6.9	3.62
7.0 - 7.2	3.65

University of Wisconsin

Although alfalfa removes calcium as well as magnesium from the soil, lime is not added for the purpose of replacing these nutrients. These additional benefits from lime are generally considered secondary and include:

- increase availability of other nutrients, especially phosphorus
- reduces toxicity from manganese and aluminum
- a more ideal environment for nitrogen fixing bacteria populations to increase

Lime is also extremely important for increasing stand longevity through better plant health and creating more vigorous stands that help crowd out weeds. Potassium is the main key to improving winter survival and forage yields.

Harvesting

Harvest management of alfalfa is perhaps the most crucial of all factors in making alfalfa more profitable. How often and when the crop is harvested impacts not only the quality of the forage produced, but how much is harvested and how long the stand will continue producing at peak levels. Carbohydrate levels, more easily understood as sugars or energy, in the roots is the single most important and controllable aspect to increasing alfalfa longevity, as well as maximizing forage production.

All living plants require energy for growth. Some take in food as it is required, such as grasses and other fibrous rooted plants. Alfalfa stores energy in its large taproot and draws on this for regrowth after cutting, and for survival during the winter. The fast regrowth from alfalfa is due largely to this stored energy being so readily available, but it has to be replaced on a regular basis for continued plant health. Most problems with the lack of survival of a stand, reduced yields, and susceptibility to winterkill, stem from the depletion of root reserves. Insufficient carbohydrate root reserves has a fatal effect on alfalfa.

Carbohydrate root reserves are at peak levels when alfalfa is in full bloom. Energy from the sun is taken in through the leaves and translocated to the roots. When a cutting is made alfalfa uses energy from its roots to produce the first regrowth. About 25% of the total root reserves are used in producing the first 6-8 inches of regrowth, after which the process reverses when enough leaf area is available to intercept energy from the sun. As the alfalfa plant grows and matures between cuttings root reserves are replenished and fully restored again at full bloom.

Under intensive management, harvests are usually made in the early-bud growth stage, which means root reserves are only about 90% replenished between cuttings. If four harvests are made throughout the growing season this would theoretically reduce root reserves down to about 60% of maximum. A healthy alfalfa plant consumes about 50% of its root reserves just to stay alive during the winter. Much like a bear who hibernates fat but comes out thin in the spring, so the alfalfa plant hibernates in its own way, using energy in the roots to remain alive.

With reduced root reserves from intensive harvesting, and half of the total available required for overwintering, spring growth is the first to be affected by the energy shortage. Reduced yields in the spring, from a less vigorous stand are signs of root-reserve deficit. Spring growth, like all other regrowth periods, requires at least 25% of the root reserves to produce good top growth. If an alfalfa stand goes into the winter with only 60% of maximum reserves, due to intensive harvesting, little remains for spring growth after overwintering requirements are met. Weakened plants do not produce well and are much more susceptible to diseases.

The good news is that alfalfa can be managed intensively for maximum yields and forage quality, and still persist as a productive stand for many years. Research shows that by taking just one harvest in each growing season at a more mature stage of at least 10% bloom, but preferably nearer 25%, root reserves are restored. This higher maturity harvest is better in either the second or third cut, rather than the first because of the need to begin harvesting as early as possible in the season. Just one harvest made at a more mature stage in each growing season is adequate to restore root reserves sufficiently to enable alfalfa to function at peak levels.

The fall harvest period is also very critical for maintaining root reserves at the highest level possible. The time known as the "critical fall harvest period" is defined as 6 weeks before the first killing frost usually occurs. At this time of year it takes about 6 weeks for alfalfa to replenish root reserves after the previous harvest. From the preceding explanation it is easy to see how harvesting only 3 or 4 weeks, or less, before the first killing frost can put alfalfa in a low-energy situation for the following spring. Root reserves will be lower going into the winter and may even cause spring growth to be less vigorous. Intensive harvesting without deliberate replacement of the carbohydrate root reserves in alfalfa can shorten productive stand life to as little as two years. Careful management can have stands still producing hay at 6 and 7 tons/acre after 11 years of intensive harvesting (Tesar, 1978).

Knowing how to provide the ideal conditions for the queen of forages will bring lasting and profitable income from a single seeding. Following simple management guidelines will certainly make your alfalfa much more profitable than you ever imagined possible. Consider the extra value of extending the life of a stand by 3 or 4 years, to double what you have been getting. This would mean a large decrease in those input cost and more profit from your alfalfa.

Profit Making Guidelines for your Alfalfa

1. Select a variety *adapted* to your area with proven yield and disease resistances.
2. Prepare the soil — *optimum pH, well drained.*
3. Seed on a *firm* seedbed — do not place seed more than one half inch deep.
4. Seed at recommended rate for cropping system — don't use excess seed.

5. *Control weeds* — herbicide or companion crop, but manage carefully.

6. *Feed alfalfa* — Phosphate for root development, Potash for yield & winterhardiness.

7. Harvest for *maximum quality, yield, and stand longevity* — replenish root reserves.

8. Scout fields regularly for pests and diseases.

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