Choosing Between Alfalfa and Corn Silage
……..or when do you trade *Medicago* for *Maize*?

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Situation

Dairy producers in Wisconsin are increasingly asking the question, "Should I be growing and feeding more corn silage at the expense of alfalfa?" Some producers don't even bother to ask the question, they just do it! The trend toward producing more corn silage is being driven by several factors. First, Wisconsin dairy producers have suffered considerable stand loss from alfalfa winterkill during the 1990's. In some situations, this has forced producers to harvest and feed more corn silage. Many of these producers found that there was no milk production decline on these higher corn silage diets when rations were balanced accordingly. A second reason for more corn silage production is being driven by private industry. Some seed companies are placing a strong emphasis and devoting large chunks of research dollars toward developing and marketing corn hybrids for use as silage crop. Unlike a few years ago, performance data is still available for both forage yield and quality on many corn hybrids. This industry trend has prompted increased testing and research on corn silage at our public institutions. Finally, many dairy farms in Wisconsin are modernizing and rapidly increasing cow numbers. As farms get bigger, it becomes increasingly difficult to harvest large acreage of alfalfa in the window where optimum forage quality is obtained. In these situations, growing more corn for silage helps to spread both risk (growing more than one crop species to meet forage needs) and labor demands.

Determining the optimum mix of corn silage and alfalfa is not simple, nor is there a right decision that applies to every farm situation. There are a number of agronomic, nutritional, and economic factors involved. Some people would also argue that there are important environmental factors to consider related to soil erosion, pesticide applications, and fossil fuel use. This paper will try to address some of the factors that a producer or consultant may want to consider when allocating acres to alfalfa and corn silage production.

Agronomic considerations

Crop rotation is one of the most powerful agronomic tools that a crop producer has to employ. Alfalfa and corn complement each other in several unique ways and shifting forage production toward more corn silage at the expense of alfalfa often results in fewer situations where corn follows alfalfa and more corn after corn acres. Where corn does follow alfalfa, research has demonstrated a 10 to 15% yield increase compared

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to corn after corn. Additionally, higher input expenses are incurred in the form of more nitrogen and corn rootworm insecticide in the second-year corn situation.

Corn silage and alfalfa are also very different in terms of nutrient utilization. Assuming an optimum soil test level, a four ton per acre dry matter yield of alfalfa will remove the equivalent of 60 lbs. P_2O_5 and 220 lbs. of K_2O per acre. Corn grown for silage (16 to 20 tons per acre wet yield) will remove about 65 lbs. of P_2O_5 and 120 lbs. of K_2O (Kelling et al., 1997). Obviously the nitrogen requirement for corn is much greater for alfalfa, which generates its own through nitrogen fixation processes. Thus, for dairy farms with large quantities of manure to spread on crop fields, having more corn silage may be advantageous from a nitrogen standpoint but less desirable from a potassium utilization perspective.

A mix of con silage and alfalfa acres may be advantageous in terms of timeliness and labor utilization, especially where large acreage are harvested. Both crops have a relatively short time frame where they can be harvested for optimum quality but at distinctly different times during the growing season. Having a mix of both crops enables the producer to harvest each crop in a more timely manner compared to having all of one crop or the other.

A final agronomic consideration is that of risk. Depending solely on alfalfa or solely on corn silage places the producer in a position where significantly reduced yields of either can have huge economic consequences. Mother Nature has a tendency of humbling both the best management and crop genetics. If corn silage is the primary forage source, by the time severely reduced yields are known it is often late to grow an alternative forage source. Alfalfa, as the primary forage source, does offer the advantage of being able to make-up shortfalls by either growing another forage (in the case of winterkill) or making-up mid-season shortfalls by harvesting more corn for silage.

Nutritional considerations

From the standpoint of optimizing milk production, the alfalfa versus corn silage issue has raged for many years and will probably continue into the future. An analysis of the top five 1996 dairy herds in Fond du Lac County for rolling herd average indicates a wide diversity in the amount of corn silage and alfalfa haylage being fed in milking cow rations (Table 1).

Table 1. Percentage of corn silage and alfalfa haylage being fed in the milking cow diets of the top five milk producing herds in Fond du Lac County for 1996

	RHA	% Corn Silage	% Alfalfa Haylage
Farm 1	28,328	10	90
Farm 2	27,173	33	67
Farm 3	27,622	0	0
Farm 4	27,428	33	67
Farm 5	26,382	0	100

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Dhiman and Satter (1997) compared milk performance from diets containing all alfalfa haylage, one-third corn silage/two-thirds alfalfa haylage, and two-thirds corn silage/one-third alfalfa haylage at the Dairy-Forage Research Center in Prairie du Sac, Wisconsin. They found only a slight economic benefit for the one-third corn silage ration. Adding corn silage to the diet resulted in somewhat higher dry matter intakes compared to the all alfalfa haylage diet, perhaps indicating a more palatable ration. Diets containing corn silage also resulted in lower ruminal NH_3 concentrations and N excretion was reduced. Based on the results of this study, the researchers suggested feeding diets with one-third to two-thirds of the dietary forage dry matter coming from corn silage with alfalfa silage making-up the balance.

Just as they do in an agronomic sense, alfalfa and corn silage complements each other from a nutritional perspective. Although both provide the needed fiber components of milking cow rations, corn silage is high in energy whereas alfalfa is high in protein. Howard (1994) suggests that factors such as forage particle length, diet dry matter, protein degradability, dietary starch concentration, and calcium levels are important factors to consider when determining the optimum balance of alfalfa and corn silage in rations. He also points to the need of careful management when high corn silage diets are fed. These types of diets, which often include high protein supplements, will lead to an array of metabolic problems if the diet becomes overloaded with non-fiber carbohydrates (NFC).

The nutritional perspective of the alfalfa versus corn silage decision is becoming more complicated as hybrids are developed with specific plant traits that enhance their value as a nutrient source. Examples are brown mid-rib and high oil corn hybrids. Research will need to continue to quantify when, or if, these types of hybrids show additional benefits above and beyond those of standard corn hybrids and whether economic milk yields dictate major ration component shifts.

From a purely nutritional standpoint, the "right" decision will probably fall somewhere between 25% and 75% corn silage as a percent of forage dry matter. At the low end of this range, the palatability and dry matter intake benefits of corn silage would likely be realized and by not exceeding the high end, metabolic problems associated with high corn silage rations are at least manageable. A key factor to consider, however, is the ability of the individual dairy farm unit to consistently produce relatively high quality alfalfa (RFV 130 or greater). From a dairy ration perspective, it's a lot easier to back-off on alfalfa haylage when it has a nutritional value approaching firewood. However, this assessment needs to be made based on long-term performance rather than an individual year where harvested alfalfa quality was unusually bad or good.

Economic considerations

Determining the optimum allotment of crop acres to either alfalfa or corn silage with an economic analysis of each crop enterprise. That is, what is the alfalfa cost of production compared to that of the corn silage alternative? There are four key factors that "drive" a forage enterprise cost production. They are:

1. Dry matter yield per acre

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2. Stand life (for alfalfa)
3. Acreage
4. Machinery size, type, and use

The following analysis will show haw the forage enterprise analysis can be used to gauge whether a shift in alfalfa or corn silage acres is warranted on a farm **within the confines of other agronomic or nutritional factors.** Data from an actual Fond du Lac County dairy farm will be used under the farm name of "Agent Acres". The farm currently grows 190 acres of alfalfa and 110 acres of corn silage. The machinery line is largely well-used (i.e. not many recent purchases) and typical of many Wisconsin moderately-sized dairy farms. The inventory is as follows:

Tractors	**Implements**	
125 HP	Chisel plow—11ft.	Forage chopper (pull type)
105 HP	Field cultivator—18ft.	Forage wagons-4
70 HP	Rotary hoe—15ft.	Packing blade
45 HP	Cultivator—6-30"	Custom work:
	Mower-Cond—10ft.	Corn Planting
		Spraying

Agricultural Budget Calculation Software (ABCS) was used to make the enterprise analysis. This software program was developed by Gary Frank, UW-Madison Farm Management Specialist. The first step was to analyze the alfalfa enterprise with the following Agent Acres cost of production factors:

Direct	**Fixed**
Fertilizer	Land
Alfalfa Seed	Management
Silage preservation	Interest
Fuel and Lubrication	Depreciation
Repairs	Labor
Overhead	
Crop consulting	

Alfalfa establishment costs (seed, tillage, and planting operations) were prorated based on stand life. In this case, stand life includes the establishment year. A detailed analysis of costs and returns for a four-year stand life and four ton per acre yield average can be found in Attachment 1. Similar analysis for two and three-year stands were also generated. From these, a sensitivity analysis for stand life and yield was generated and presented in Table 2.

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Table 2. Effect of average dry matter yield and stand life on alfalfa production cost per ton*

Stand Life	Cost/Acre		Average Yield Over Life of Stand						
	Direct	Total	2.0	2.5	3.0	3.5	4.0	4.5	5.0
2	121	239	120	96	80	68	60	53	48
3	106	224	112	90	75	64	56	50	45
4	99	216	108	86	72	62	54	48	43

*average dry matter yield over the stand life including alfalfa harvested during the establishment year

Several observations about alfalfa production can be derived from Table 2. First, stand life alone has little impact on cost of production IF production can be maintained. For example, at the 4.0 tons per acre yield level, the difference in cost of production is only $4.00 per ton from a 2- to 3- year stand life and $2.00 per ton from a 3- to 4- year stand life. By comparison, dry matter yield has a relatively large impact on cost per ton. Between the 3.5 and 4.0 ton yield levels, for example, cost per ton decreases $8.00 per ton. This same difference is about $20.00 per ton between the 3.0 and 4.0 ton yield level. Although stand life alone has little impact on cost of alfalfa production, factors such as winterkill or poorly drained soils that shorten stand life also reduce dry matter yield and put more acres into an establishment year situation. This has the overall impact of significantly raising cost of production.

To determine where corn silage "stacks-up" against alfalfa, a similar enterprise analysis needs to be made. Production records for Agent Acres show dry matter yields of corn silage to be 6.3 tons per acre following alfalfa and 5.6 tons per acre following corn. The ABCS analysis for corn silage following alfalfa is presented in Attachment 2. A summary of costs and yields is presented in Table 3.

Table 3. "Agent Acres" corn silage production costs and measured yields

	1st-year corn	Corn after corn
Total Production Costs	$255.00	$283.00
Yield/Acre (as Fed)	18.0	16.0
Yield/Acre (d.m.)	6.3	5.6
Cost/ton (as fed)	$14.00	$18.00
Cost/ton (d.m.)	$41.00	$51.00

Now we know the cost of production for both alfalfa and corn silage enterprises on the Agent Acres farm. However, it is unfair to make a direct comparison of either tons produced per acre or cost per ton of alfalfa to that of corn silage because the two are completely different feedstuff. **The comparison must be made on a "cow value" basis**. To do this, a spreadsheet computer program called PRICER can be used. This program was developed by W.T. Howard, UW Madison Professor Emeritus of Dairy Science, to compare the maximum price that can be paid for a forage source based on the known

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price of another base forage. In this analysis we are using the program to value alfalfa against that of corn silage at a calculated cost of production. The output from this program is presented in Attachment 3 with the Agent Acres base forage (corn silage) valued at $16.00 per wet ton (average cost of production from Table3). If the value of the corn silage is compared to that of 135 RFV alfalfa (a forage quality average on the Agent Acres farm) we note that the value of the alfalfa is $83.00 per ton on a dry matter basis

The next step is to look back at Table 2 to see where the $83.00 value compares to the farm's actual cost of production. Depending on stand life, we see that this value is somewhere between a 2.5 to 3.0 tons per acre whole farm yield level. Based on historical yield records, the actual whole farm yield level for Agent Acres is about 3.5 tons of dry matter per acre and actual average stand life is 4 years (establishment year plus 3 production years). This places the actual cost of alfalfa production at around $62.00 per ton. Thus, for the Agent Acres farm it is probably more economical to derive a major portion of the forage dry matter fed from the alfalfa enterprise versus that of corn silage. However, this recommendation assumes that high alfalfa forge quality can be maintained. In some cases this may not be feasible give the limitations of current machinery inventory and labor availability.

At this point it is prudent to remind dairy producers and consultants that each farm situation can be very different. Factors such as actual yield levels for the respective forage alternatives, acres harvested, and machinery age, type and size have a large influence on cost of production. On farms where corn silage dry matter yield levels nearly triple those of alfalfa (not uncommon with soils of low pH or poor drainage and a high incidence of winterkill), corn silage will look much better than it does on the Agent Acres farm. Many diary producers make the mistake of directly comparing tons of alfalfa to tons of corn silage without any adjustment for feed value. This approach can make corn silage look unrealistically superior to alfalfa.

An alternative comparison approach using MILK91 to evaluate the alfalfa enterprise

Using the computer spreadsheet program MILK91 (developed by W.T. Howard, D. Undersander, and R. Shaver-UW Madison) offers another approach to evaluate the comparative importance of production variables inherent to the alfalfa enterprise. The spreadsheet offers the user an opportunity to input establishment and production costs (from a separate enterprise analysis), stand life, numbers of cuts, comparative feed costs, forage yields, and forage quality parameters. By changing one variable and leaving all others constant, a relative comparison can be made to evaluate the importance of each input. Such a comparison is presented in Attachment 4 for dry matter yield, stand life, and forage quality. This evaluation, like the earlier one, again shows that yield plays a much larger role in enterprise profitability than stand life. A similar corn silage analysis can be made using the MILK95 spreadsheet program developed by the same authors.

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Alfalfa stand life considerations

Optimum alfalfa stand life has long been a debated issue. Enterprise analysis shows that short alfalfa rotations are not necessarily bad IF acceptable whole farm yields can be maintained. In a crop rotation analysis done by Frank (1994) it was found that a four-year rotation of (1)establishment-(2)alfalfa-(3)alfalfa-(4) corn was usually the most profitable compared to extended or shorter duration of each crop. When determining optimum crop rotation and stand life, forage needs of both alfalfa and corn silage along with the crop acreage base must also be considered. For example, where all crop acres are needed to meet feed needs, a short alfalfa-corn rotation may leave a producer short on alfalfa haylage inventories and with too much corn grain or silage.

Often the decision of when to terminate an alfalfa stand is based solely on the condition and productivity of the stand itself. In fact, it is often the case where the simple thought of having to "pick rocks" the next spring is enough to extend the alfalfa years in rotation. However, there are some distinct advantages to maintaining short alfalfa rotations. A short alfalfa rotation forces more corn acres into a first-year situation following the legume. This fact alone adds 10 to 15 percent more corn yield compared to corn produced after corn. In addition, input costs are substantially lowered on first-year corn fields from the standpoint of less purchased nitrogen fertilizer and needing no corn rootworm insecticide. Shorter alfalfa rotations also place more of the alfalfa acres into a terminal year position where fall cutting flexibility is increased because winterkill or injury is not a factor. Usually an extra cutting can be taken from these fields in the fall and provide some exceptional quality additional forage.

Strategies to improve forage enterprise profitability

As much as we may not want to admit it, cost of production is influenced significantly by dry matter yield produced per acre. For this reason, dairy producers must make sure controllable factors don't limit yield. Use of improved varieties, maintaining soil fertility, and controlling crop pests (all the stuff us agronomists have been talking about for years) must be implemented so that maximum economic yields are obtained. Fixed costs spread over more yield always results in a lower cost per unit produced.

Machinery cost is more becoming a limiting factor to the profitability of the forage enterprise no many dairy farms. This is especially true on moderately-sized dairy operations where old equipment must be replaced. There often are not enough acres to economically justify the purchase or farm cash flow is such that it can bear the major additional expense. Several options are available and currently being employed on many Wisconsin dairy farms to lower machinery costs. A common one is to look for those bargains on well-maintained, pre-owned equipment and avoid the new equipment cost entirely. A second approach is machinery sharing between neighbors. With the right situation and personalities, sharing equipment and labor between neighboring farms can turn the profit outlook from grim to great, especially on moderately-sized dairies. Finally, there is the option of utilizing a custom harvester and letting them bear the equipment expense but spreading it out over many more acres than the individual farm unit would able to.

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Closing summary points

1.) ACTUAL farm costs and returns "drive" the most efficient use of forage resources.

2.) Whole farm yield per acre is the biggest factor impacting profitability of the alfalfa enterprise relative to other forage alternatives. Conversely, yield of the alternative forage (corn silage) is a major factor in how well it competes economically against the alfalfa enterprise.

3.) Forage quality, and to a lesser degree stand life, can significantly influence the profitability of the alfalfa enterprise.

4.) Corn silage or alfalfa is not an all or nothing decision. Both crops complement each other from a nutritional and agronomic perspective.

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