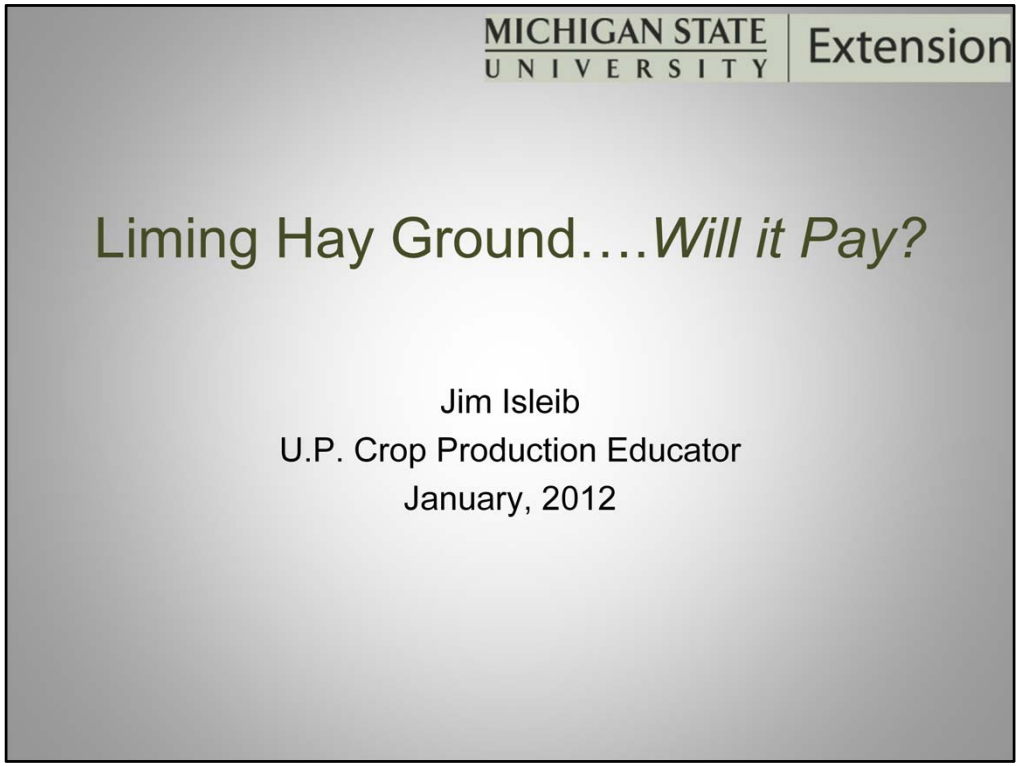
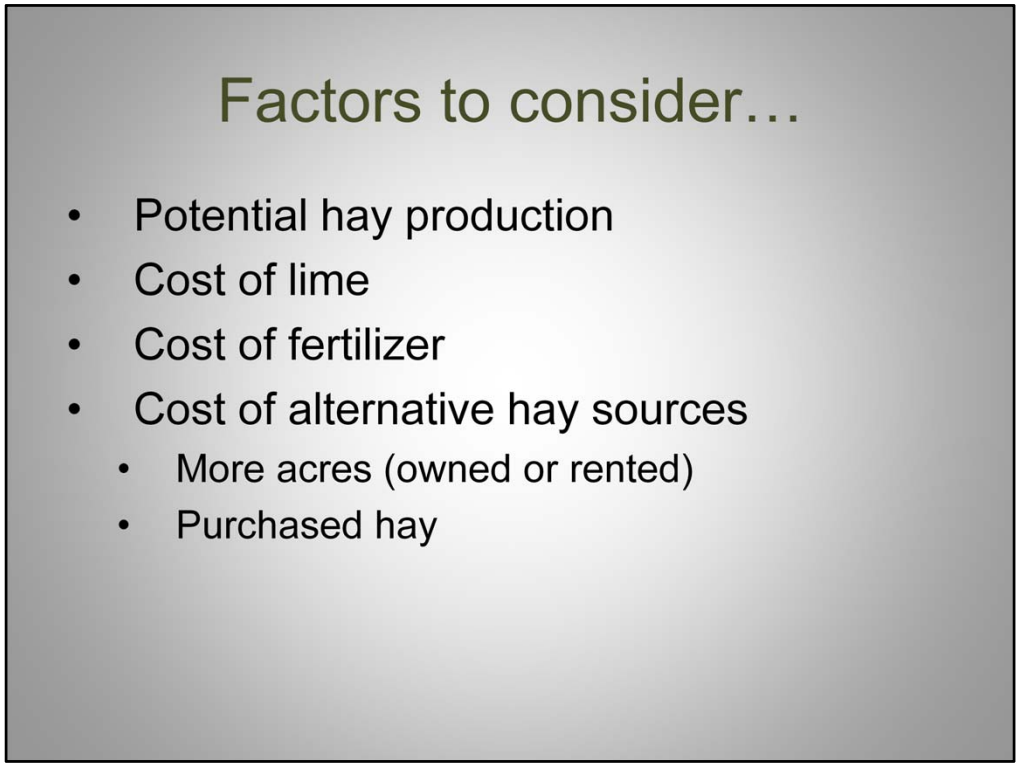


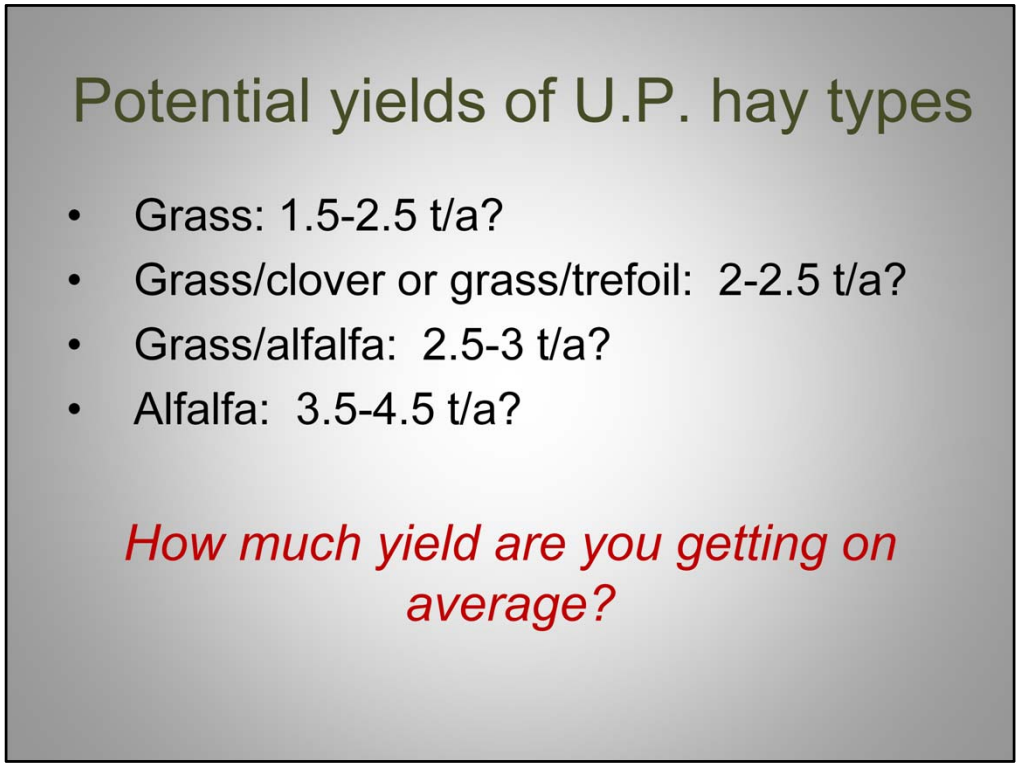
Liming agricultural land in the Upper Peninsula of Michigan is becoming more challenging with increasing costs of transportation and fewer lime vendors in the region.

This presentation provides one method of thinking through the process of liming hay ground with an emphasis on economics. The value of increased hay production resulting from lime application should equal or exceed the cost of the lime application.



Some assumptions are needed to think through the process, including:

- An estimate of potential hay production IF fields are limed and fertilized adequately
- Cost of liming materials, including cost at the point of purchase, loading, transportation and spreading
- Cost of typical fertilizers used in hay production
- Cost of hay from alternative sources including hay produced on additional acres, and purchased hay. This will be used to compare with the cost of producing MORE hay on existing acres with lime applied.



These estimates of average potential yields on different types of hay in the U.P. are based on farmer feedback over many years.

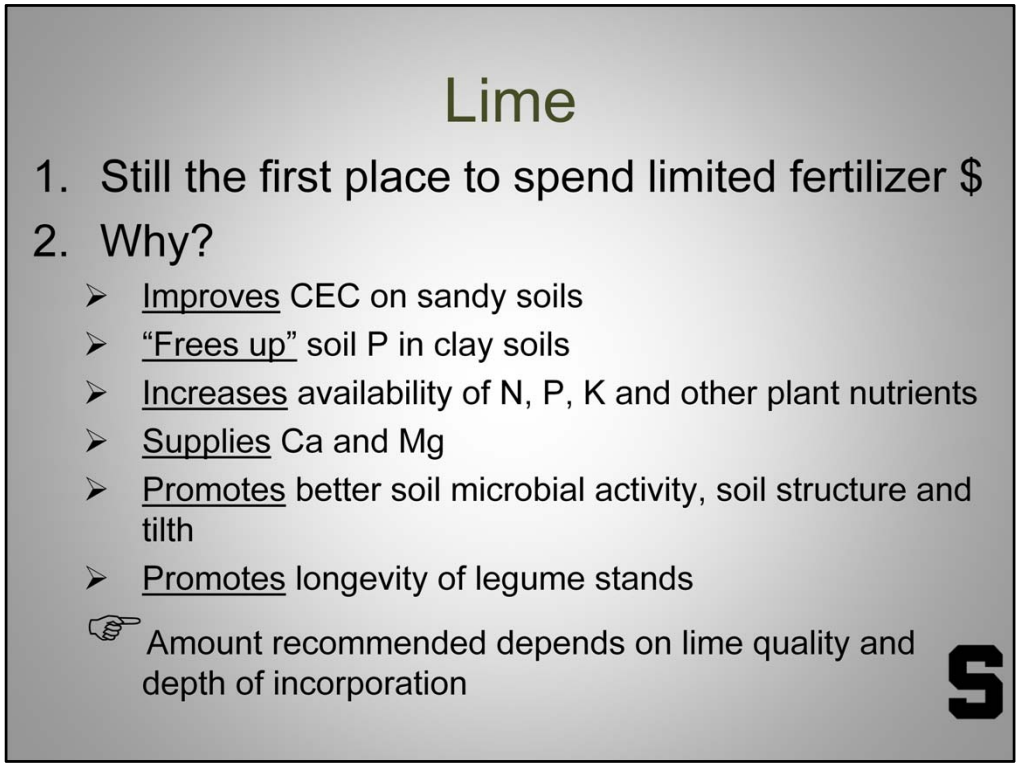
Most experienced farmers have a good idea how much their hay fields yield.

The answer to the first question is usually 'yes'.

The answer to the second question isn't so easy. It depends on how deficient soil fertility has been and what the actual yield potential could be under ideal conditions. It also depends on the growing conditions of each year.

How do you know?...

- Maybe a gut feeling
- Maybe an educated guess based on experience
- Maybe an educated guess based on what you know about soils, fertility and plant performance.

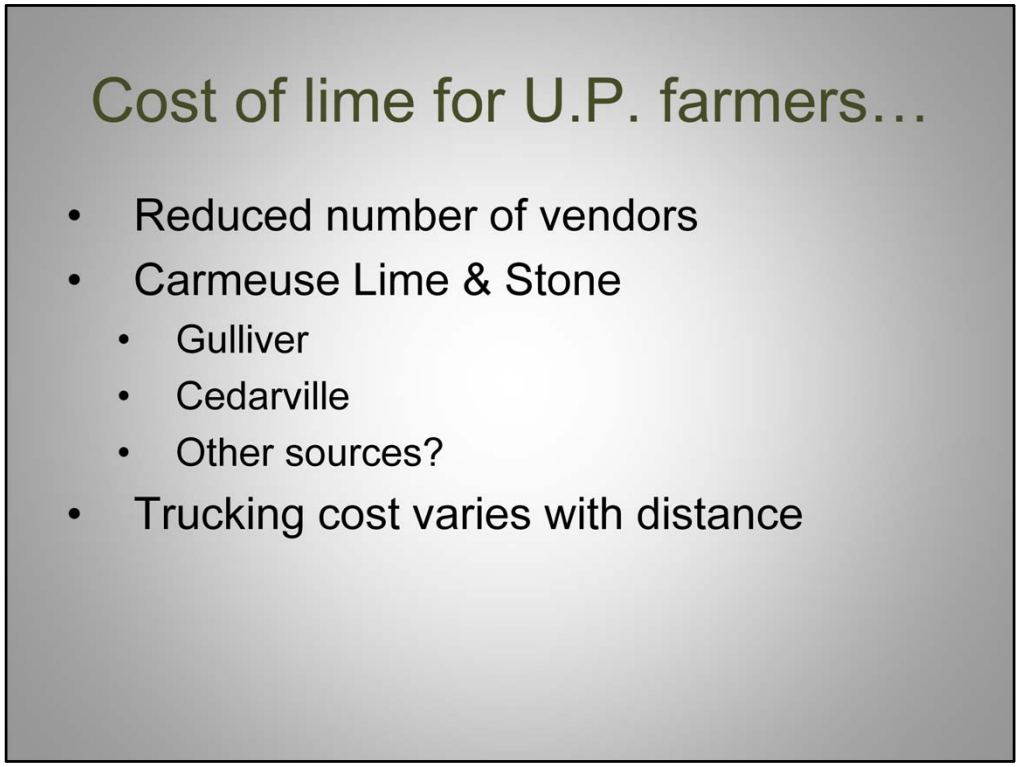


Soil pH impacts the availability of plant nutrients. That means if soil pH is too low, plants can't extract certain nutrients efficiently, like phosphorus, calcium and magnesium, even if they are present. Correcting low soil pH allows plants to take in more of these nutrients without adding additional fertilizers. Of course, if plant nutrient levels are inadequate, fertilizer should be applied.

Lime also improves soil chemistry on sandy soils by increasing cation exchange capacity (CED), allowing sandy soils to retain certain plant nutrients more effectively.

Lime supplies calcium and magnesium, promotes soil microbial activity and helps legumes live longer.

The quality of ag lime has a big impact on its effectiveness. Quality of ag lime is influenced by fineness of grind (finer is better) and purity of lime (compared to pure calcium carbonate). Application rate and degree of mixing with the soil also have a big impact on liming results.



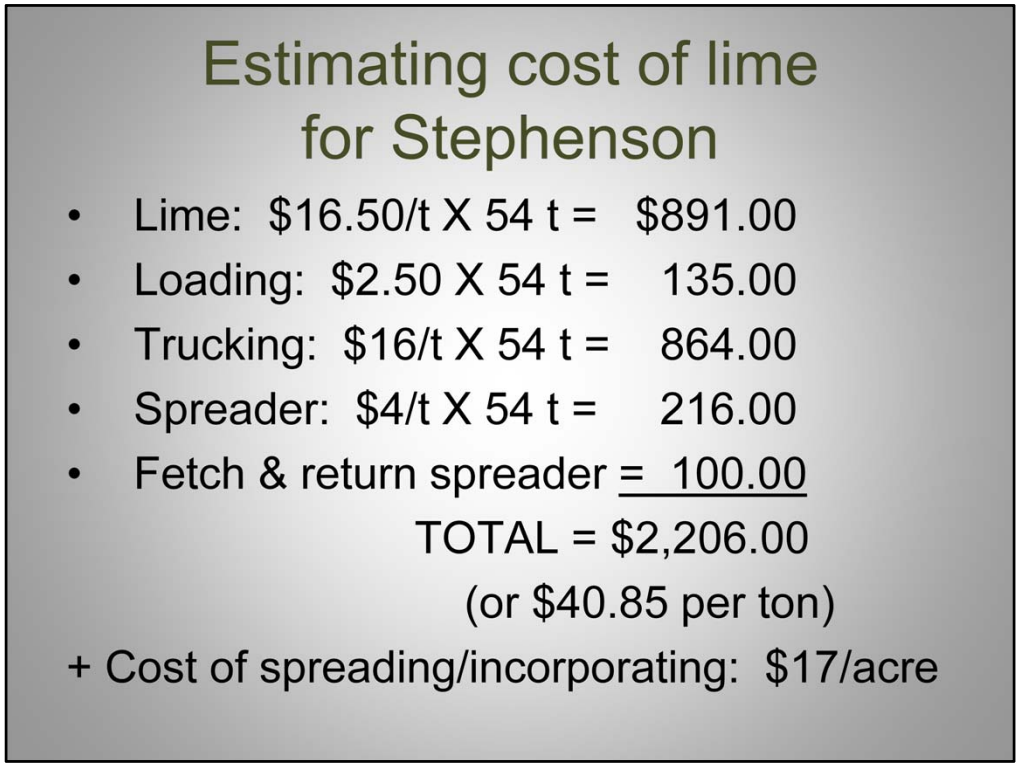
The number of commercial suppliers of ag lime serving the U.P. has decreased in recent years. The main local lime supplier is Carmeuse Lime and Stone with facilities in Cedarville (Mackinaw County) and Gulliver (Schoolcraft County). There are also suppliers in Antigo WI (Servco FS) and Green Bay WI (Great Lakes Calcium).

For the purpose of this example, we will be using lime from Gulliver delivered to Stephenson, MI (Menominee Co).

Transportation costs will vary depending on source of lime and delivery location.

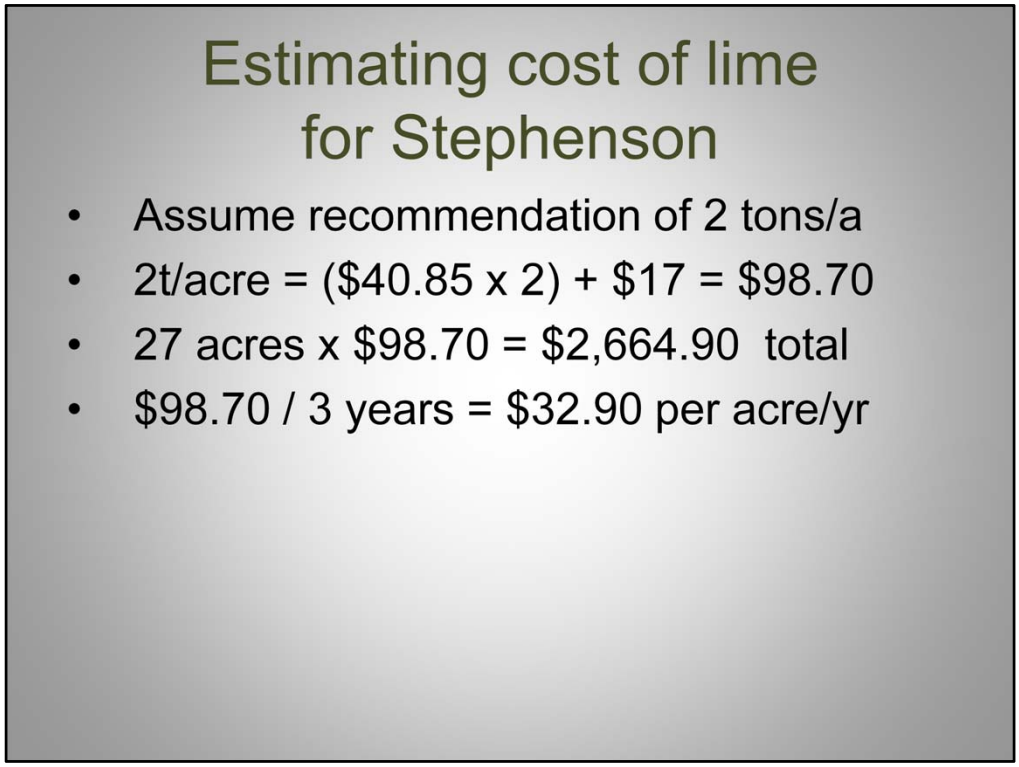
These cost estimates are based on discussions with U.P. lime vendors in December 2011. You should develop your own costs by contacting vendors and truckers.

One option for renting a lime spreader is through Great Lakes Agri Service of Gladstone, MI. There may be other options.



This cost estimate is based on a full, 54 ton truckload of ag lime delivered from Gulliver to Stephenson and spread with a rented lime spreader from Gladstone.

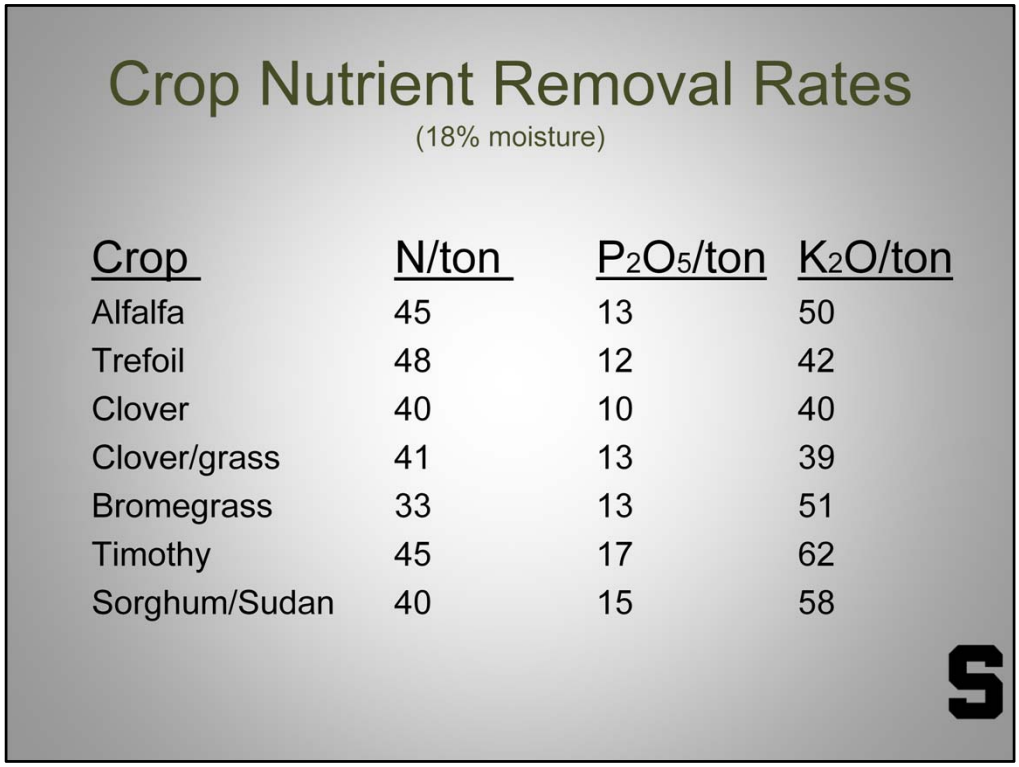
The per-ton cost of application and incorporation are figured separately from the per-ton cost of the lime and the lime spreader rental.



Assumptions:

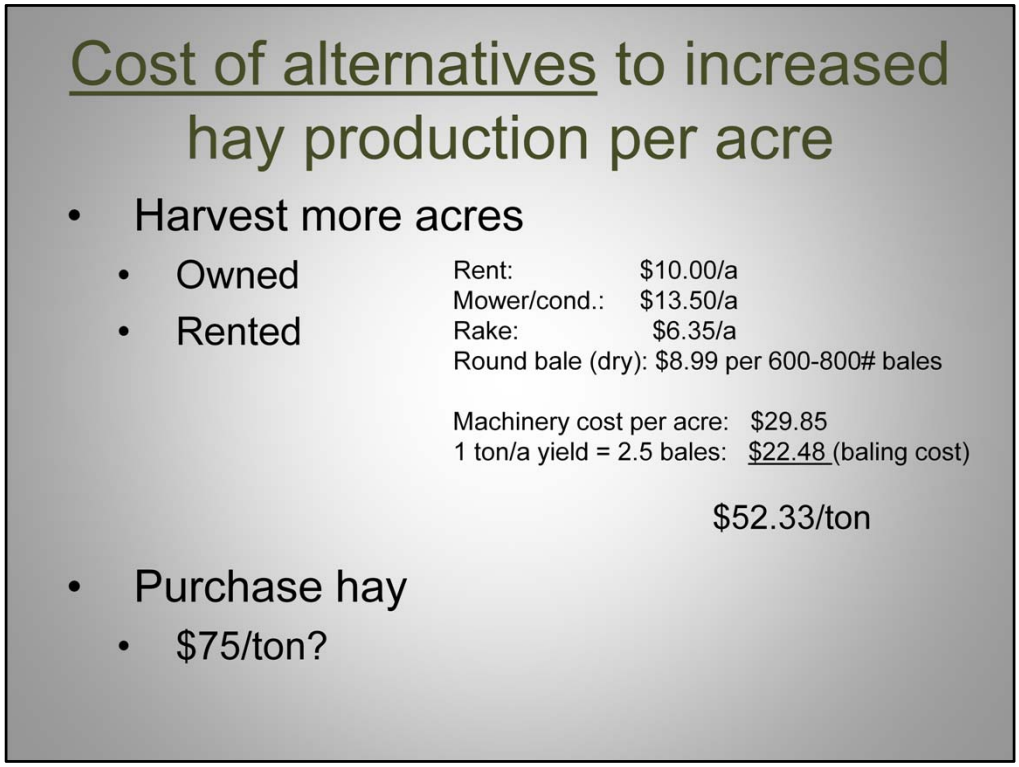
- 2 tons per acre lime recommended by soil test
- The 54-ton load of lime can cover 27 acres
- The lime application will be fully effective for 3 years, and the cost will be spread over a 3-year period.

In order to compare the cost/benefit of lime application to the potential cost of fertilizer, some assumptions about fertilizer prices are needed. These costs are based on U.P. bulk fertilizer prices checked in December 2011.



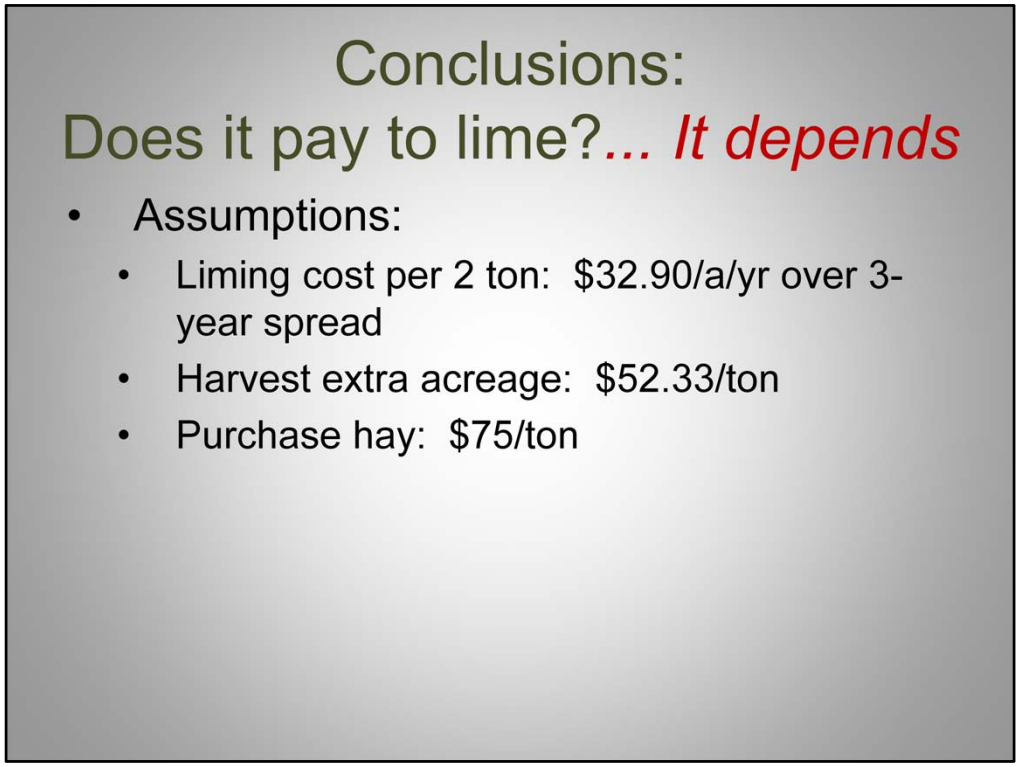
These forage species remove nitrogen, phosphorus and potassium at the rates shown base on MSU Extension publication “Nutrient Recommendations for Field Crops in Michigan” publication E2904

We will use this information to estimate the cost of producing more hay by using more fertilizer. This will be compared to liming.

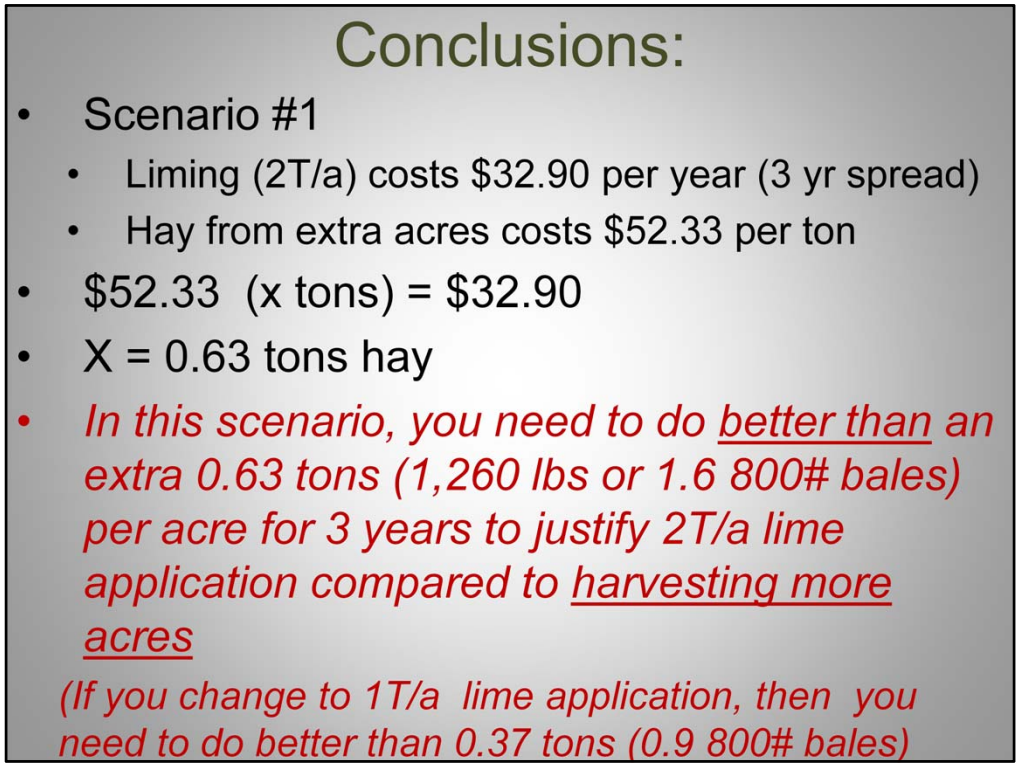


Now we need to estimate how much it will cost to secure additional hay by other alternatives, not including liming. These alternatives include:

1. Producing additional hay on additional acreage, either owned or rented. Selected costs are shown.
2. Purchasing hay



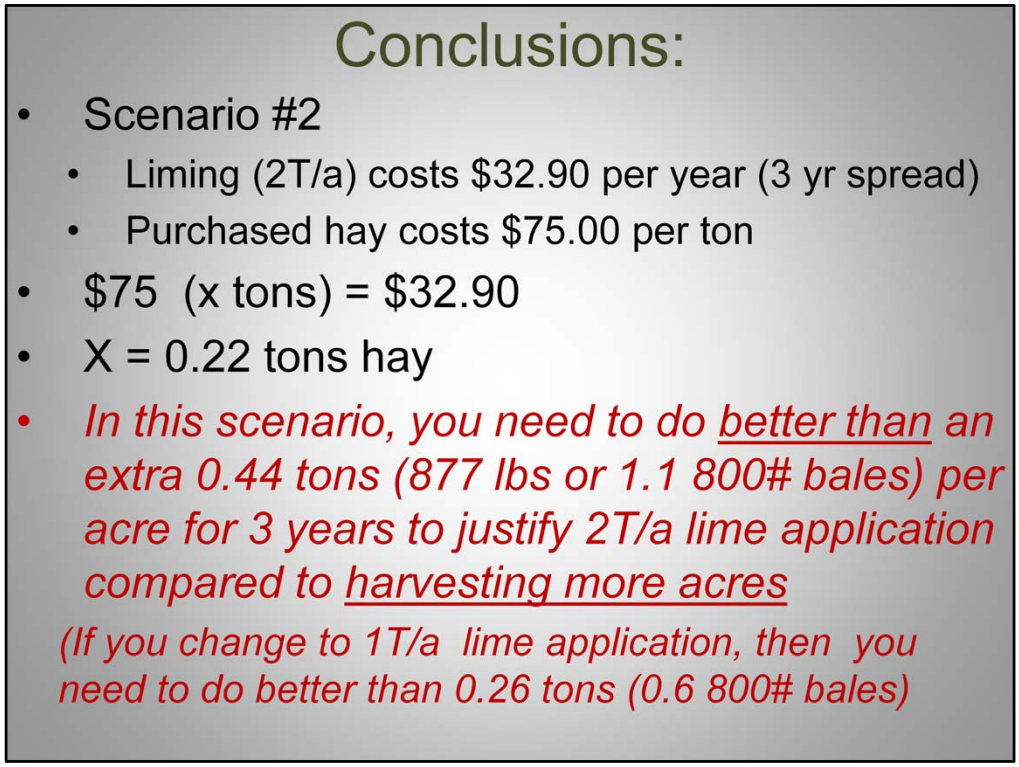
We will use our cost estimates and assumptions to determine if it pays to lime hay ground.



First, we'll compare liming hay ground with making hay on extra, low-producing acres.

With 'extra' hay valued at $52.33 and the cost of liming at $32.90 annually, hay production on the limed ground needs to INCREASE a minimum of 0.63 tons per acre to break even. Of course, there are many additional factors, including time constraints and harvest efficiency, that may need to be considered.

If the liming rate is reduced from 2 tons per acre to 1 ton per acre, then the amount of production increase needed to 'break even' with harvesting extra acres drops to 0.37 tons per acre.

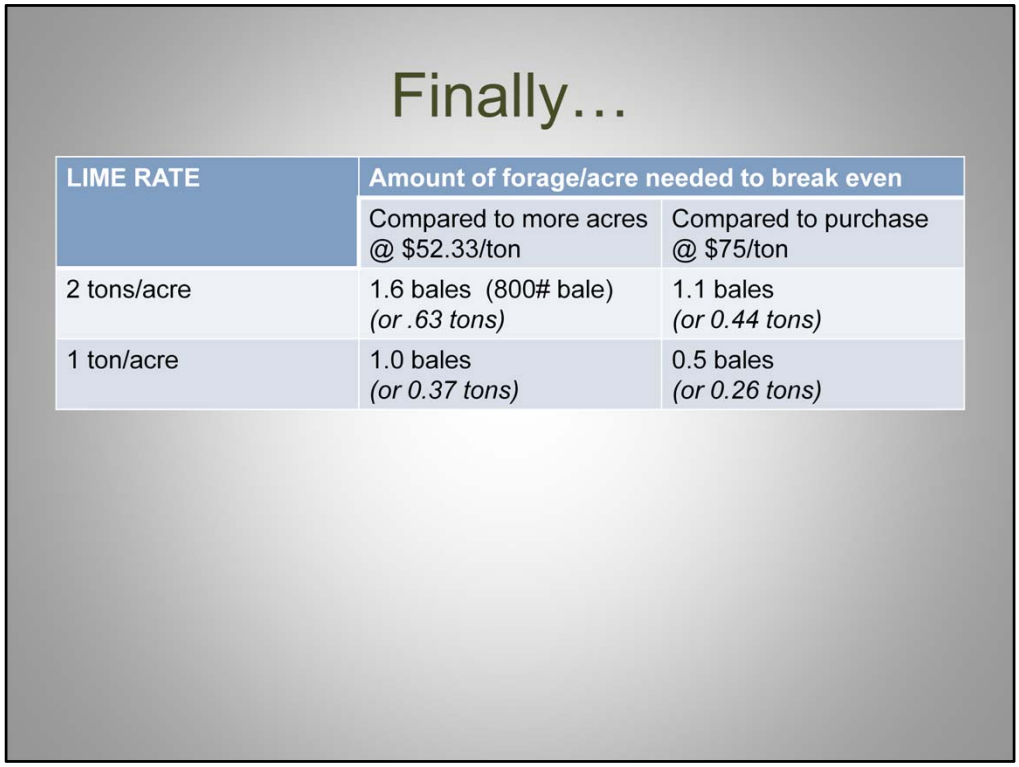


In this second scenario, we'll compare liming hay ground to increase production with PURCHASING additional hay at $60.00 per ton.

With 'purchased' hay valued at $75.00 and the cost of liming at $32.90 annually, hay production on the limed ground needs to INCREASE a minimum of 0.44 tons per acre to break even.

If the liming rate is reduced from 2 tons per acre to 1 ton per acre, then the amount of production increase needed to 'break even' with harvesting extra acres drops to 0.26 tons per acre.

So in this example, if the alternative to liming is purchasing hay, then it is easier to reach the 'break-even' level of improved yield.



This table summarizes the two scenarios discussed. Break-even increases in hay production are expressed as 800 lbs round bales.

It appears that the increase in hay production needed to equal the cost of liming as presented in the example is very high, maybe not reasonable.

There are other factors to consider:

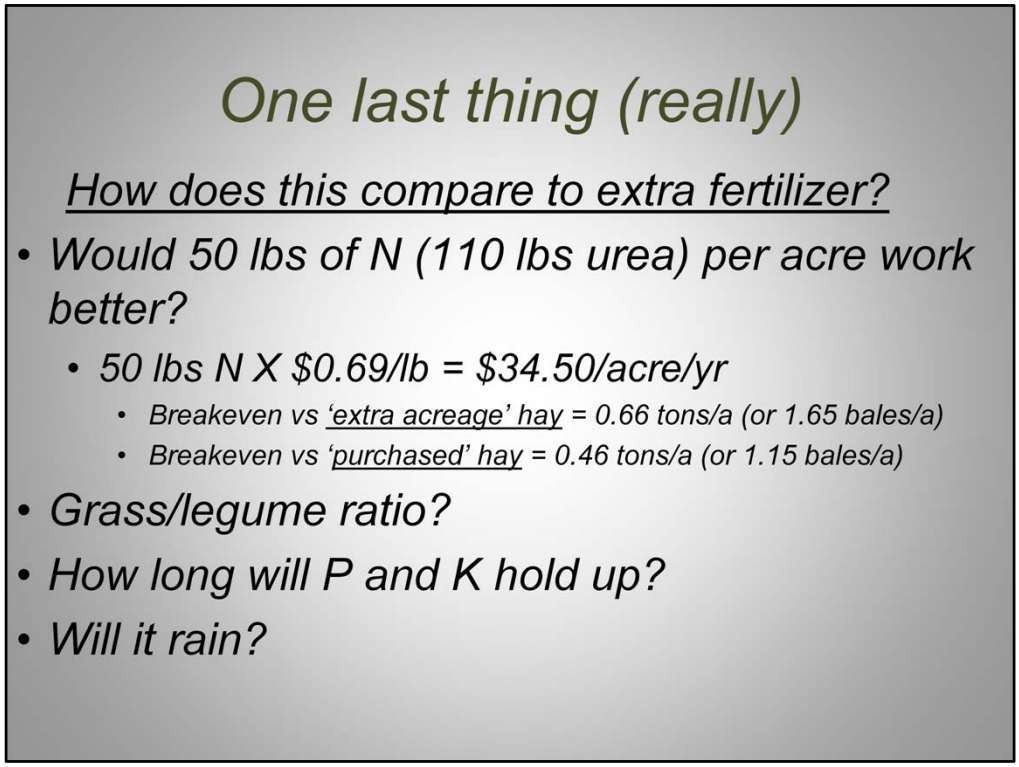
- How do the example costs and assumptions compare with your experience?
- What are the costs of <u>your</u> alternative sources of hay?

Lets say…you can get lime delivered (not spread) for $30 or $20 per ton

and go through the same process…spread cost over 3 years, compare to same alternative forage costs:

LIME RATE and cost delivered	Amount of forage/acre needed to break even	
	Compared to more acres @ $52.33/ton	Compared to purchase @ $75/ton
2 tons/acre @ $40.85	1.6 bales (800# bale) *(or .63 tons)*	1.1 bales *(or 0.44 tons)*
2 tons/acre @ $30	1.2 bales *(or .49 tons)*	0.9 bales *(or .34 tons)*
2 tons/acre @ $20	0.9 bales *(or.36 tons)*	0.6 bales *(or .25 tons)*
1 ton/acre @ $40.85	1.0 bales *(or 0.37 tons)*	0.6 bales *(or 0.26 tons)*
1 ton/acre @ $30	0.8 bales *(or 0.30 tons)*	0.5 bales *(or .21 tons)*
1 ton/acre @ $20	0.6 bales *(or .24 tons)*	0.4 bales *(or .16 tons)*

If the cost of lime is lower than the original assumptions, then the increase in yield needed to break even becomes more easily attainable, as shown in the chart.



Nitrogen availability is lowered when soil pH is very low, however soils with moderate acidity are not as badly affected. On grassy hay fields, nitrogen application is likely to improve hay production significantly.

Using the same sort of thought process, we can compare the cost of applying 50 lbs of nitrogen per acre (110 lbs of urea fertilizer per acre) to the estimated costs of hay from alternative sources.

0.66 tons of hay per acre (1.65 800# bales per acre) of resulting yield increase would be needed to break even with making hay on extra, low-yielding acres.

0.46 tons of hay (1.15 800# bales per acre) of resulting yield increase would be needed to break even with purchasing hay.

A few other things to consider with this scenario:

- How much legume is present in the hay stand? The more legumes present, the less yield impact nitrogen fertilizer is likely to have.
- Is there adequate phosphorus and potassium available to support the projected yield increase based on nitrogen fertilizer?
- Will growing conditions, especially water availability, support the projected yield increase based on nitrogen fertilizer?

These ideas are meant to stimulate your thinking about the feasibility of liming low pH soils to increase hay yields. It is important to go through this, or a similar, exercise with your own realistic cost estimates and assumptions.