Alfalfa Yield and Quality Relationships Within Individual Harvests

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Our improving knowledge of the relationship between alfalfa *yield* and alfalfa *quality* has greatly influenced when farmers harvest the crop.

Consider this timeline of how alfalfa harvest management has evolved through the years.

Time frame	Farmer's goal	No. harvests	Growth stage at harvest
1920-1950	Persistence, yield	1 – 2	Full flower
1950-1960	Nutrient yield*, persistence	3	First flower
1970's	Nutrient yield*	4	First flower
1980's	Nutrient concentration**	4	Bud

Sheaffer, 1990

* Total amount of nutrients harvested

** Favorable percentage of nutrients in the plant

We know that:

When we give the plant more time to grow before harvesting . . .

. . . yield increases,

. . . but at the expense of feed quality.

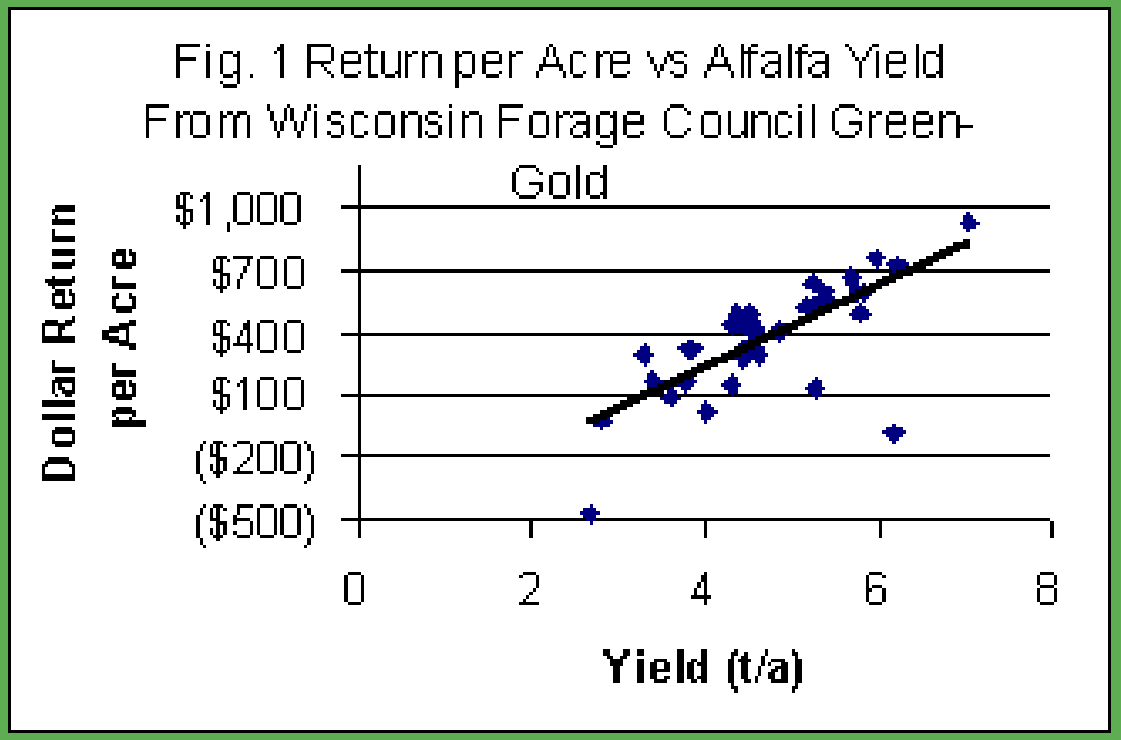
When we cut the plant early . . .

. . . we capture a higher quality feed;

. . . but this is at the expense of total yield.

This previous study clearly shows . . .

. . . you get a greater monetary return (based on crop value) per acre of alfalfa with higher yields.

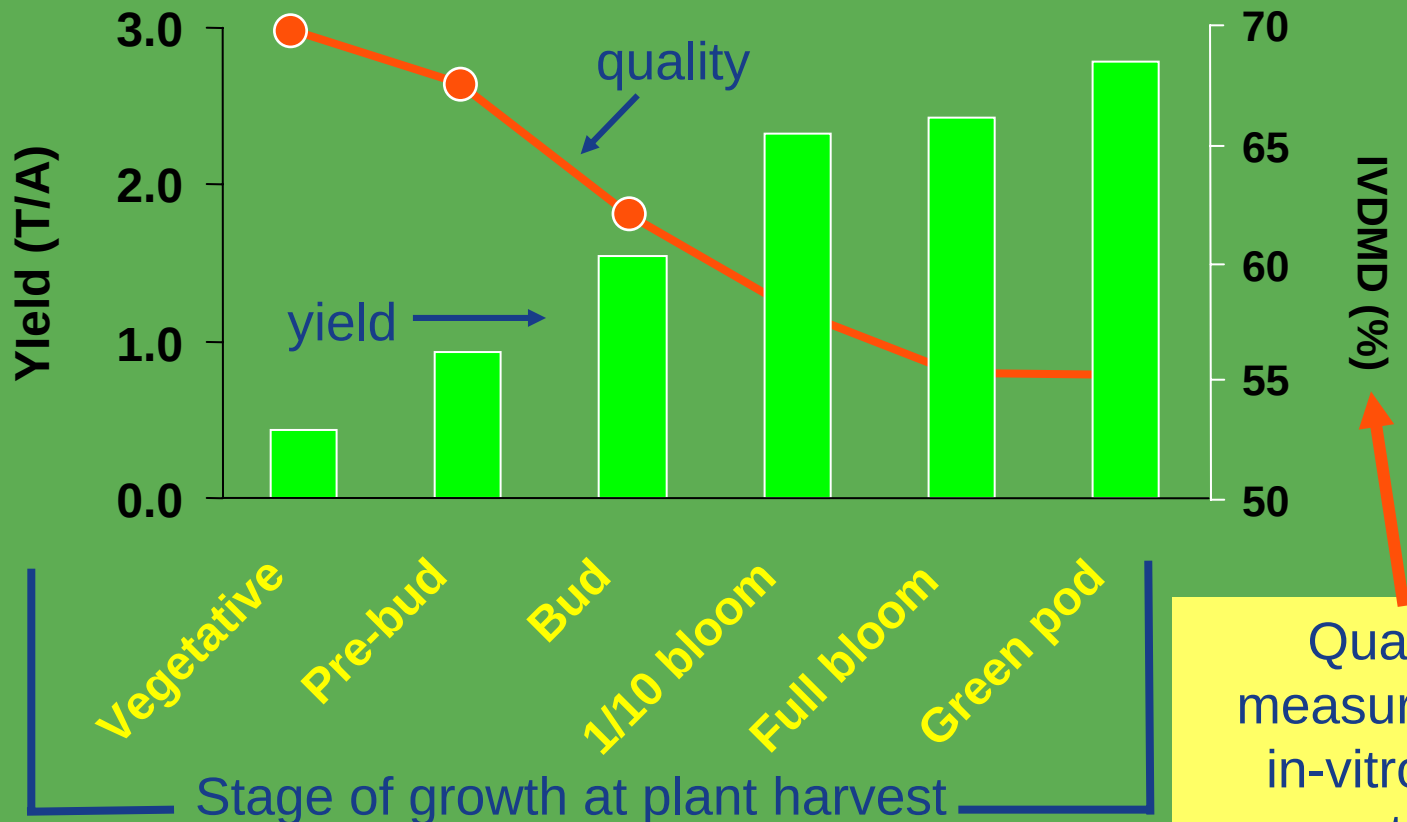


Undersander, 2001

But yield and quality are opposed:

As yield increases (green bars) . . .

. . . quality declines (orange line).



Smith, 1960

Quality measured as in-vitro dry matter digestibility (**IVDMD**)

Previous studies on the trade-off between yield and quality looked at the crop on an annual basis.

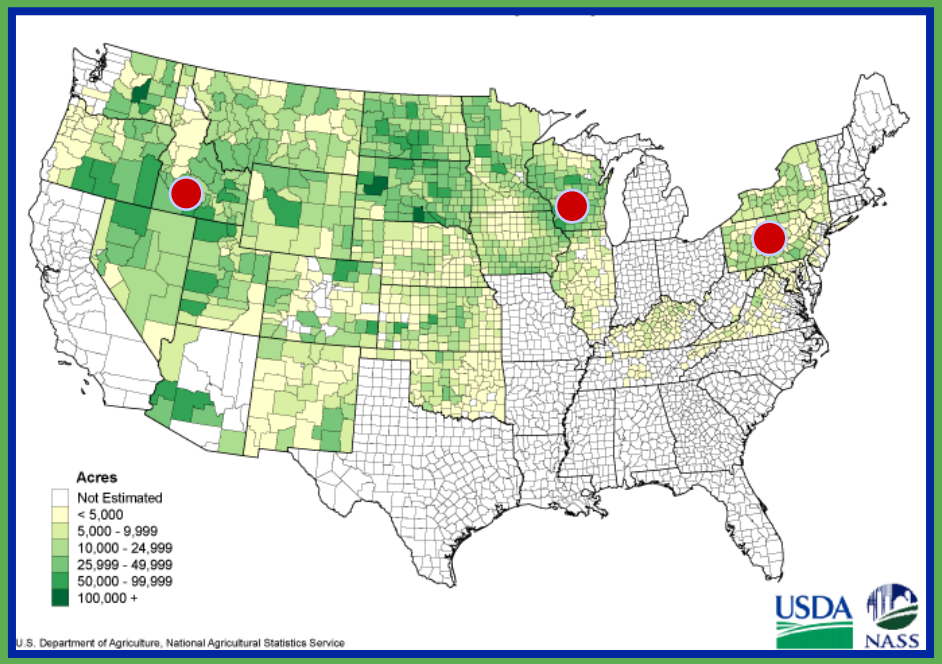
We conducted a study to find out:

1. **What is the trade-off between yield and quality *during the growing season*? Does it vary from one cutting to the next?**

We conducted a study to find out:

2. When does harvest management have the greatest impact on potential milk production?

Study conducted at 3 locations:



South Central Idaho

Study conducted on 2005 crop.

Central Pennsylvania

South Central Wisconsin

We planted 3 different varieties at each location.

Variety	Source	Advertised traits
Affinity+Z	ABI	disease resistance, fall dormancy 4, full season, fast recovery, traffic tolerance
Standfast	CalWest	lodging resistance, fall dormancy 4/5, fast recovery (reach late bud 3 - 5 days faster)
WL-346	WL Research	insect/disease resistance, fall dormancy 4, fast recovery

We set up a detailed cropping schedule at each location with:

4 harvest periods

- **Spring**
- **Early Summer**
- **Late Summer**
- **Fall**

And five cuts for each harvest period (each cut 5 days later than the first).

Cutting dates for each harvest period

Spring

May 11 May 16 May 21 May 26 May 31

Early summer

Jun 18 Jun 23 Jun 28 Jul 3 Jul 8

Late summer

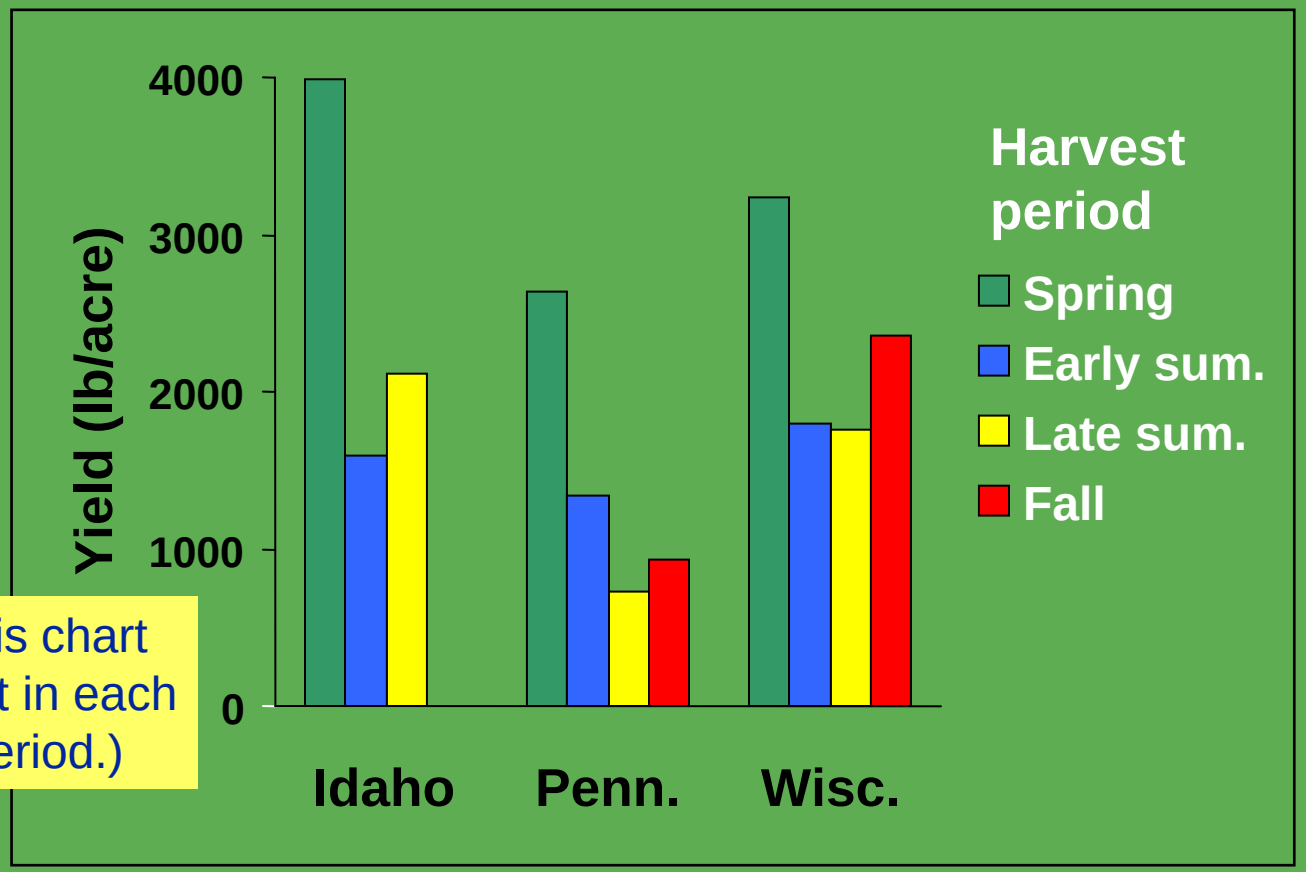
Aug 4 Aug 9 Aug 14 Aug 19 Aug 24

Fall

Sep 12 Sep 17 Sep 22 Sep 27 Oct 2

The results:

Yield was highest for the Spring harvest period in all 3 locations.



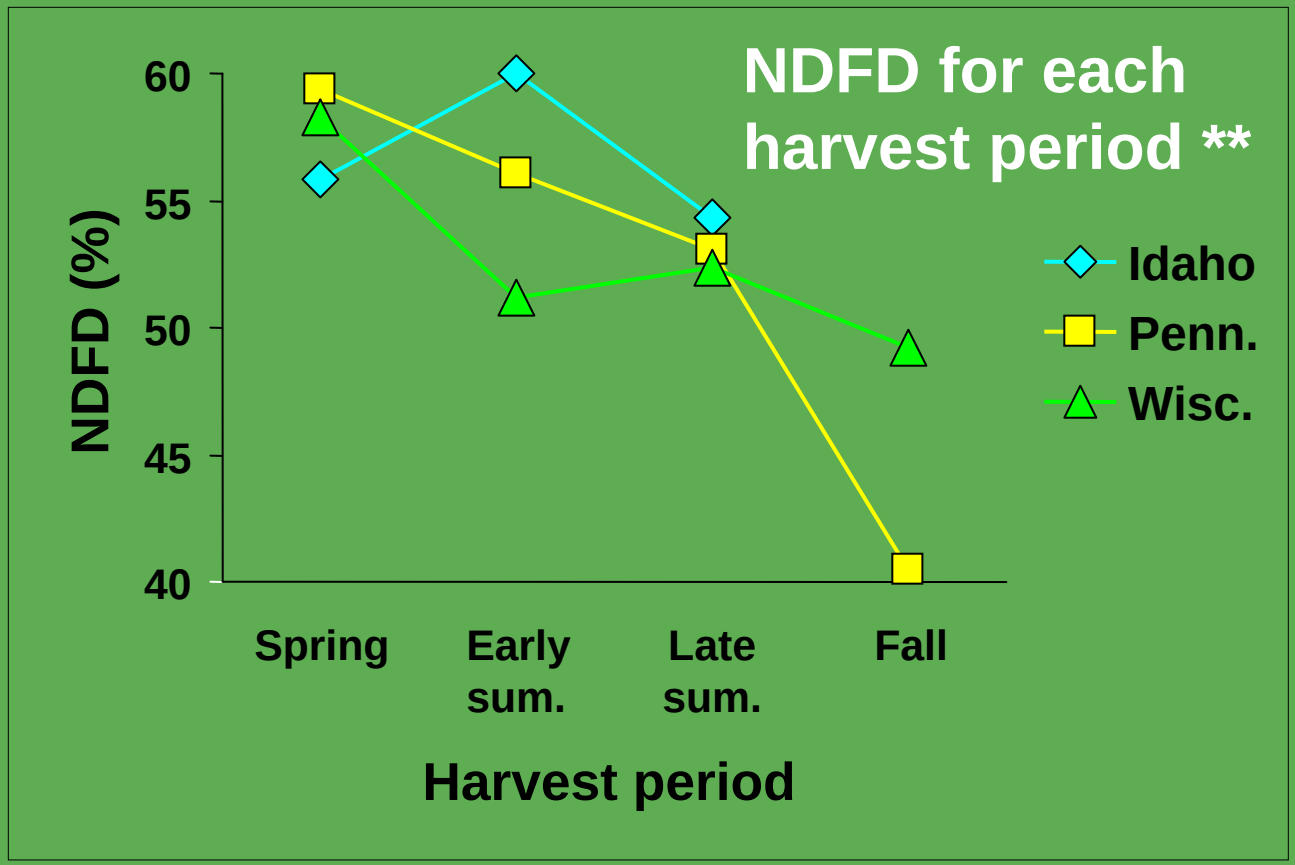
(Yield in this chart is for first cut in each harvest period.)

* No differences found among varieties

The results:

Quality* was highest for the Spring harvest period for 2 of the 3 locations.

*Quality measured as Neutral Detergent Fiber Digestibility (NDFD) – the portion of the total NDF that is actually digested.



**No differences found among varieties

The results:

In Idaho, forage production was dependent on and maximized under irrigation beginning in early summer.

In Pennsylvania and Wisconsin, the greatest rate of DM production occurred in the spring or early summer due to optimum temperatures and moisture.

Rate of DM production after vegetative stage

Harvest period	lb forage grown per day		
	ID	PA	WI
Spring	120	290	130
Early summer	180	60	250
Late summer	180	100	90
Fall	-	40	-20

The results:

At all three locations, forage quality declined most rapidly in the early summer.

In Pennsylvania and Wisconsin, the decline in forage quality is slowest in late summer.

Rate of NDFD decline after vegetative stage

Harvest period	% NDFD change per day		
	ID	PA	WI
Spring	- 0.3	- 0.2	- 0.4
Early summer	- 0.6	- 0.7	- 0.6
Late summer	- 0.5	- 0.2	- 0.1
Fall	-	- 0.4	- 0.4

The results:

Another way to express the results is by using an index (Milk 2000) that combines forage yield and quality into a single term to estimate milk production.

Results are seen in the next 4 slides.

UW Extension

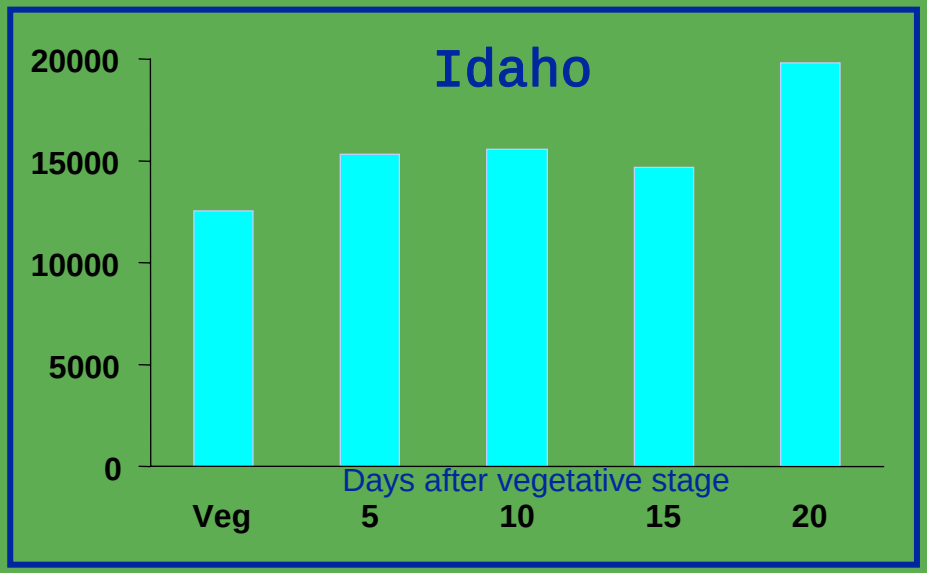
Milk2000

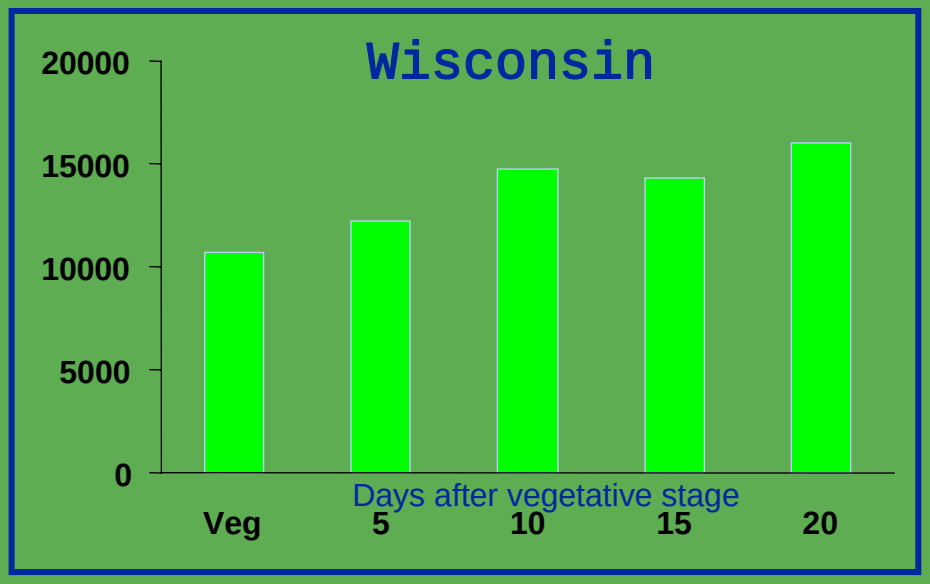
The results:

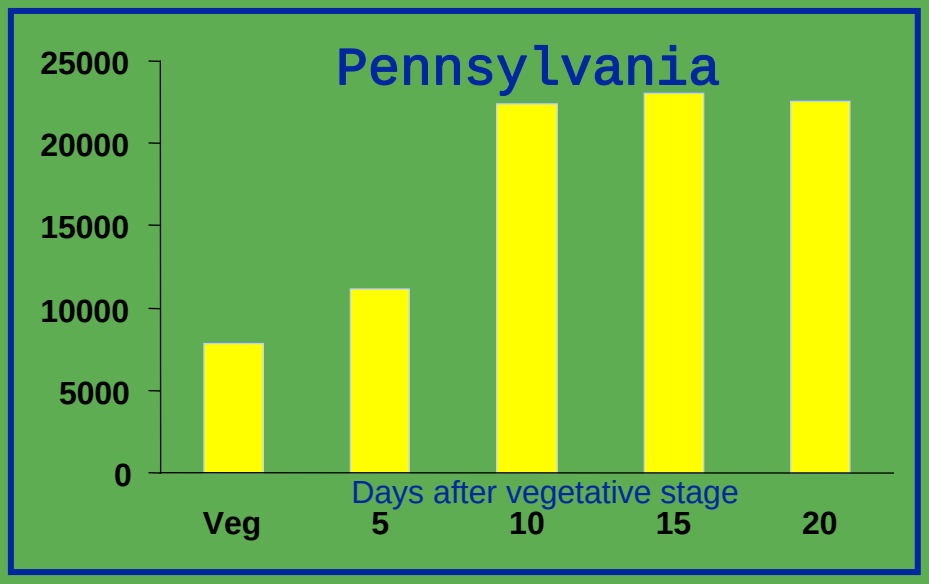
Spring harvest

Lbs. milk / acre vs. alfalfa maturity

Milk per acre plateaus approximately 10 days after vegetative stage.







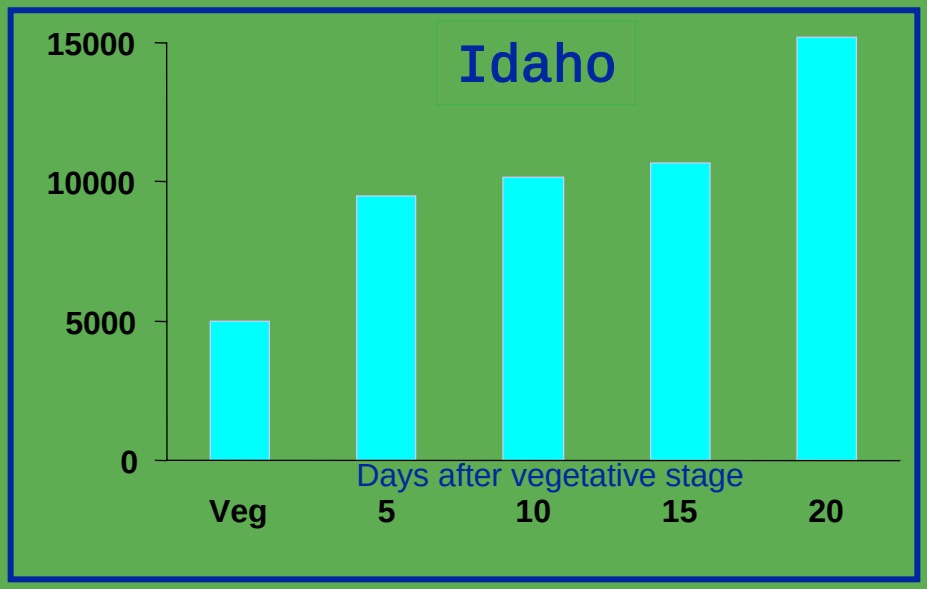
The results:

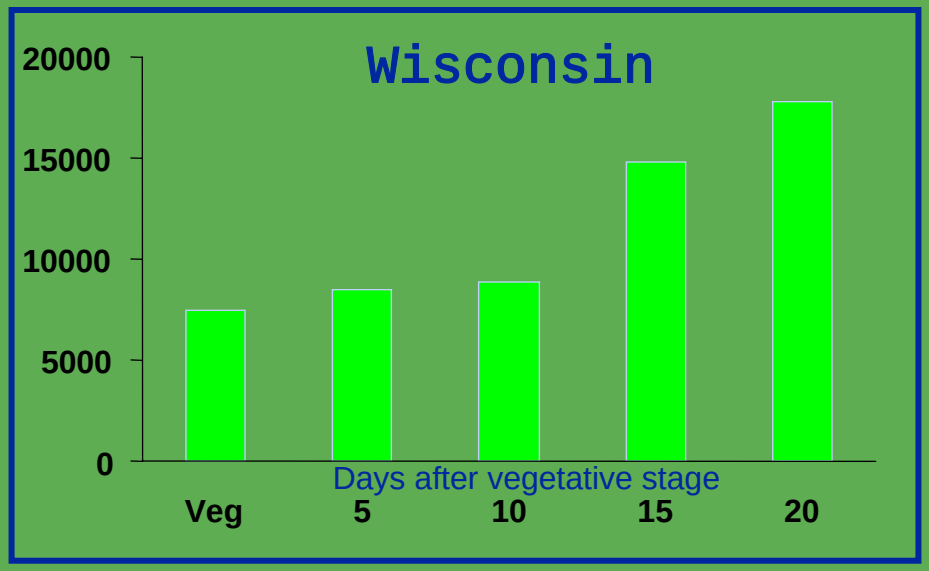
Early summer harvest

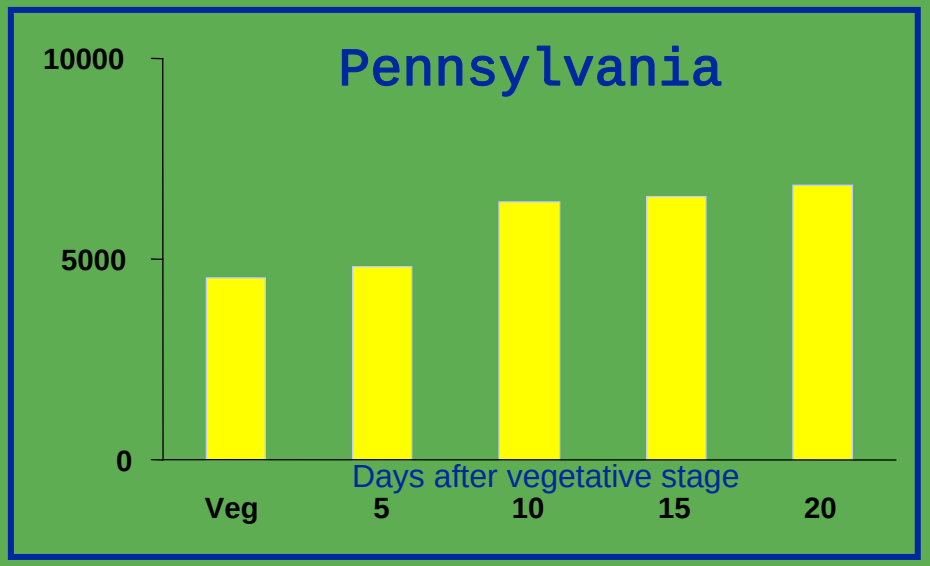
Lbs. milk / acre vs. alfalfa maturity

Milk/acre plateaus after 10 days, similar to spring harvest, in PA.

Environments in ID and WI result in milk/acre increase due to increase in DM yield of crop.





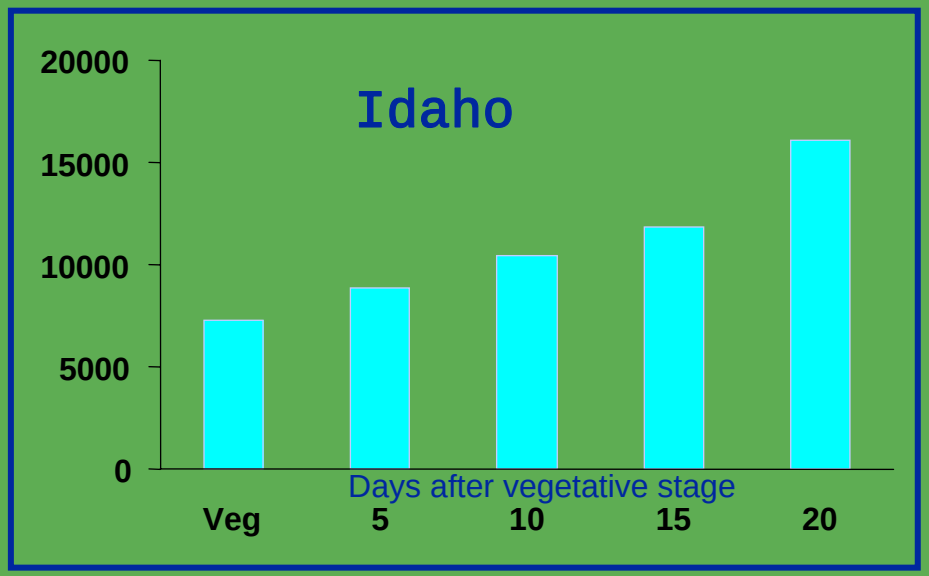


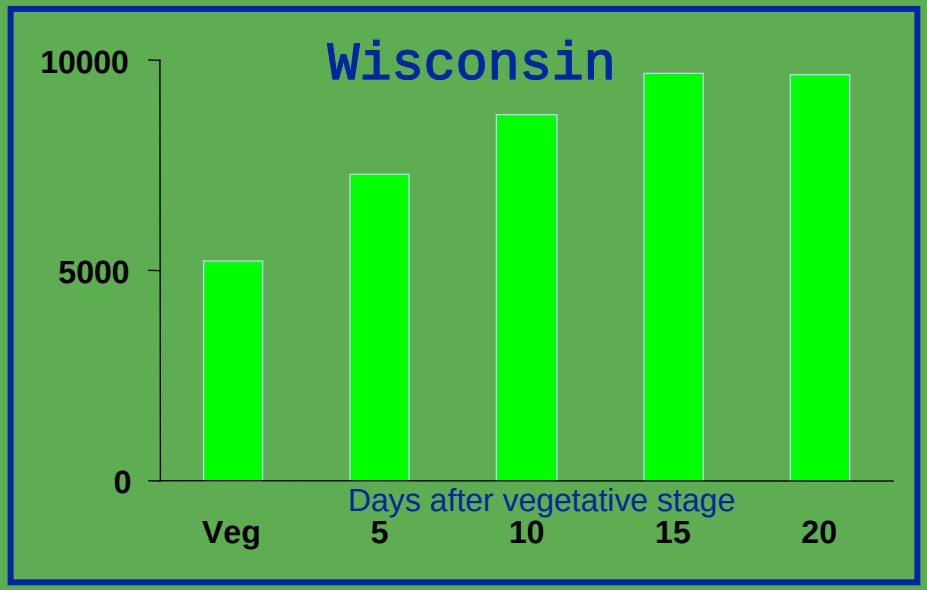
The results:

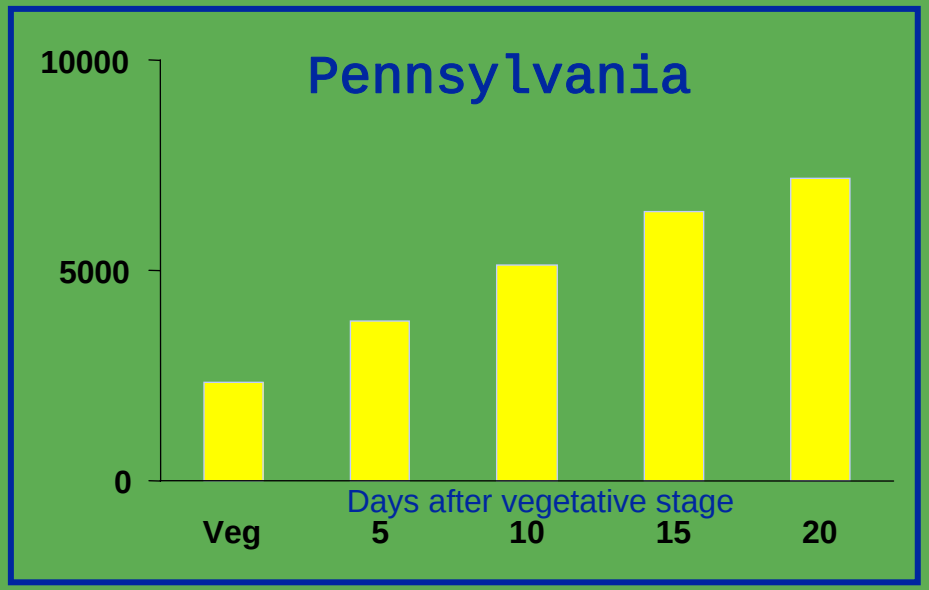
Late summer harvest

Lbs. milk / acre vs. alfalfa maturity

During this harvest, potential milk production continues to increase because DM is increasing while forage quality does not decline as rapidly as in early summer.







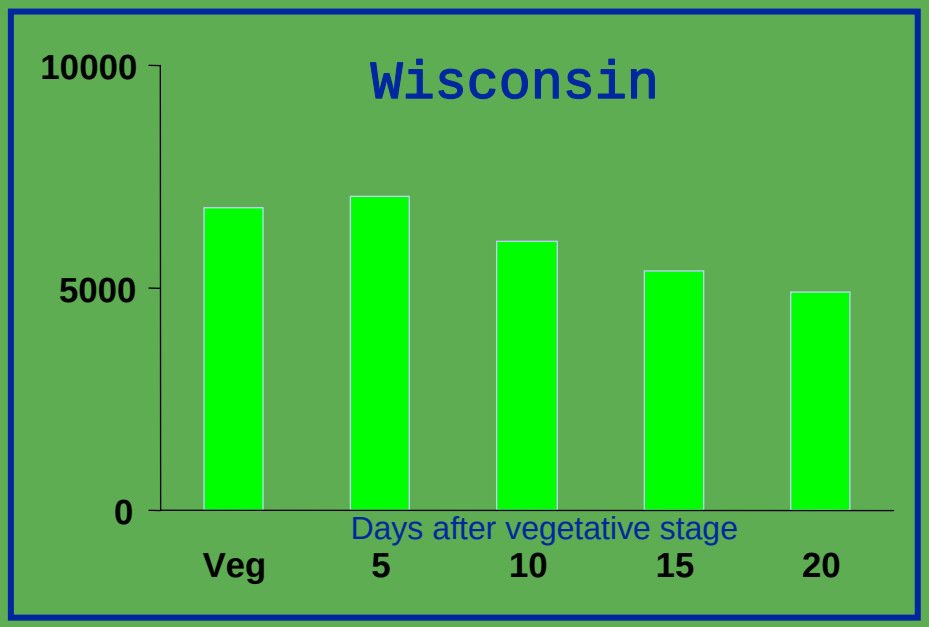
The results:

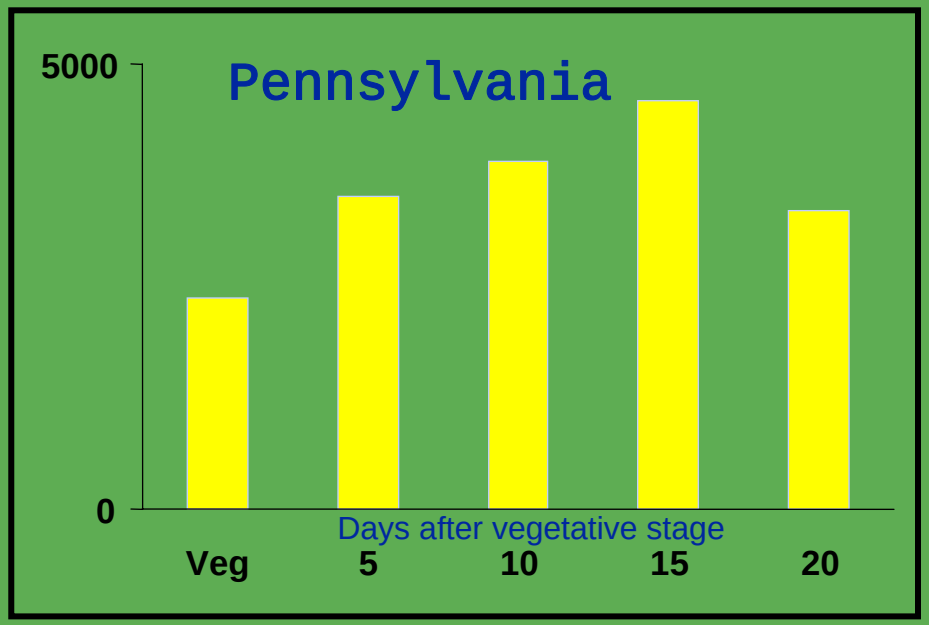
Fall harvest

Lbs. milk / acre vs. alfalfa maturity

There was no fourth harvest in Idaho.

Potential milk production of alfalfa harvested in the fall is less predictable due to the relatively rapid decline in quality and the inconsistent effects of weather on yield.





Summary

1) Forage yield and quality are usually highest in the spring.
2) Under conventional management (no irrigation), forage yield increases and forage quality declines most rapidly as alfalfa matures during the spring and early summer.

Summary

3) Harvesting within 10 days after vegetative stage in the spring and early summer provides optimum milk production and dairy quality hay.
4) Harvest in late summer can be delayed because digestibility declines more slowly than in the spring and early summer.

This material courtesy of:

U.S. Dairy Forage Research Center

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