Fertilizing Perennial Grass Hay and Pasture

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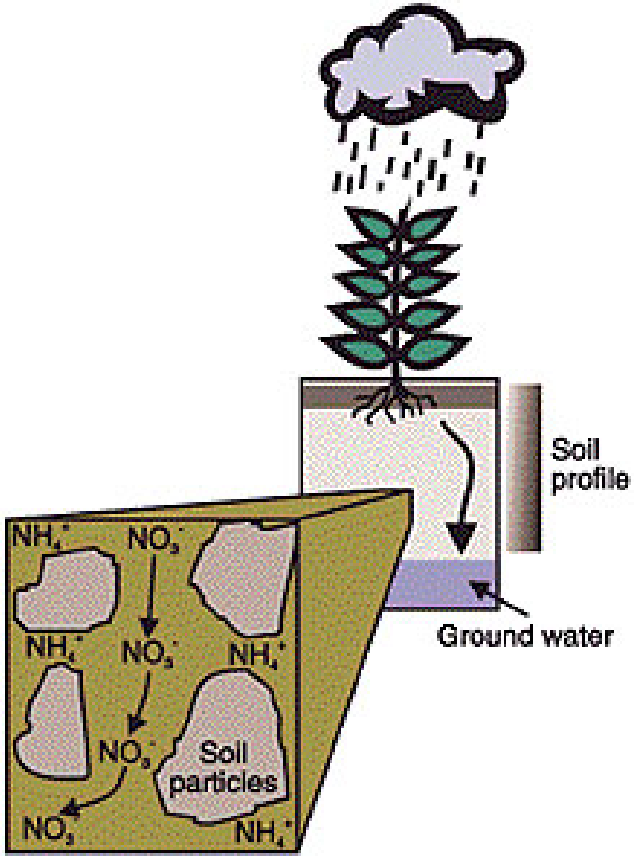
Benefits of Fertilization of Perennial Grasses

- Increases yield
- Increases protein and forage quality
- Maximize value of other inputs (irrigation, weed control, harvest costs, etc)

Disadvantages of Fertilization

- Cost of fertilizer and fertilizer application
- Potential for nitrate accumulation in the forage (nitrogen fertilizer)
- Potential for nutrient leaching and runoff



How do I know if my grass field needs fertilizer?

- Soil testing is the most common and easiest to interpret method
- Collect 15 to 20 samples, mix in a bucket, and send to the lab
- Collect soil from 1-8 inch or 1-12 inch depth; 12-24 inch sample can give you an indication if nutrients leached below root zone
- Send to lab for analysis

Other methods of determining nutrient status of grass field

- Grass tissue testing- most accurate but grass sample must be collected at the proper growth stage for nutrient analysis
- Needed if a sulfur or micronutrient deficiency is suspected

Phosphorus

Table III. Phosphorus recommendations for dryland and irrigated grasslands.

Relative Index Value	*Soil Test Value*				
	Bray or Mehlich II, III	*Olsen*	*Dryland*	*Irrig. Cool Season grasses*	*Legume Mix Irrig.*
	---------- ppm ----------		---------- lb P_2O_5 /acre ----------		
Very Low	0-5	0-3	40	60	90
Low	6-15	4-10	20	40	60
Medium	16-25	10-17	10	20	30
High	>25	>17	0	0	0

- Phosphorus- grasses are very good at obtaining phosphorus- only need to apply P fertilizer if soil is deficient
- Grass yield will likely not increase if Olsen-P is at or above 10 ppm; Don’t fertilize with P if Olsen-P is greater than 20 ppm

Potassium

Table IV. Potassium recommendations for irrigated pastures.

		K_2O to Apply	
Soil Test Value	*Relative Index Value*	*Grass*	*Grass-Legume*
ppm K		pounds per acre	
4 - 40	Very low	90	120
41 - 75	Low	60	80
75 - 124	Medium	30	40
125 - 150	High	0	0
> 150	Very high	0	0

- Most soils have plenty of potassium for grass production as NE CA soils are naturally high in potassium. The only time I've observed a K deficiency in grass is a sandy field with a long history of alfalfa.

Sulfur

- Grasses only require 3.1 lbs S per ton of grass hay; less than 20 lbs S per acre per year.
- Soil testing is not accurate for diagnosing a S deficiency, but if your soil test comes back with greater than 5 to 10 ppm S you don’t need to apply S fertilizer
- Sulfur often provides a soil quality benefit if your soils are high in pH or you have a salinity/sodium problem. The amount of sulfur needed depends on soil pH, soil EC, and SAR values
- Don’t over apply sulfur!!!! Many growers have over applied sulfur on sandy soils decreasing their soil pH below 6.5. 30 to 40 lbs S per acre is plenty on sandy soils.

Micronutrients

- Grasses need less than 10 lbs per acre per year.
- Iron is sometimes a problem but often related to waterlogged soils and/or alkaline soils.
- Tissue testing is needed to confirm a micronutrient deficiency

Nitrogen

- Most limiting nutrient for grass production
- Most soils quickly become deficient in nitrogen if not fertilized annually
- In hay fields, nitrogen fertilizer is often needed for each cutting to maximize yield. In pastures, manure and urine return nutrients back to the soil but not at a 1:1 ratio
- The nitrogen cycle is a leaky system. Nitrogen is constantly being lost to leaching, denitrification, volatilization, and excess accumulation by plants

Previous Research on N Fertilization

- Spring is most important time to fertilize. Often best to apply shortly before 1st irrigation.
- Split fertilizer applications are more efficient than single lump-sum applications

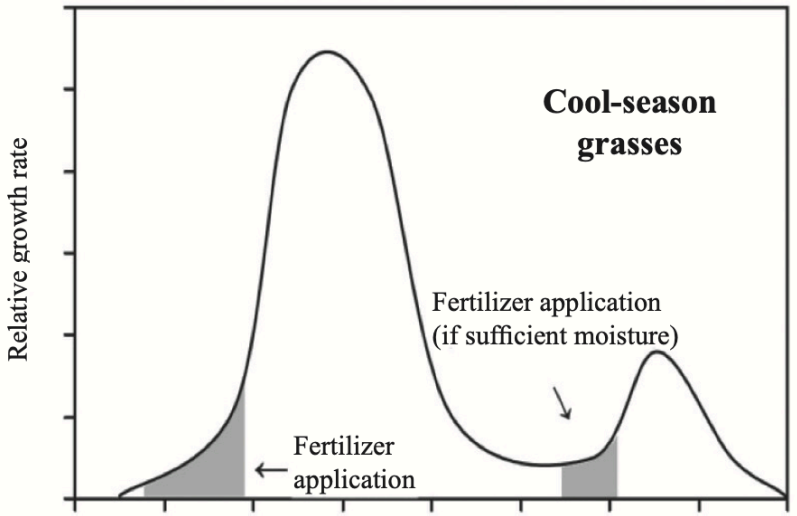
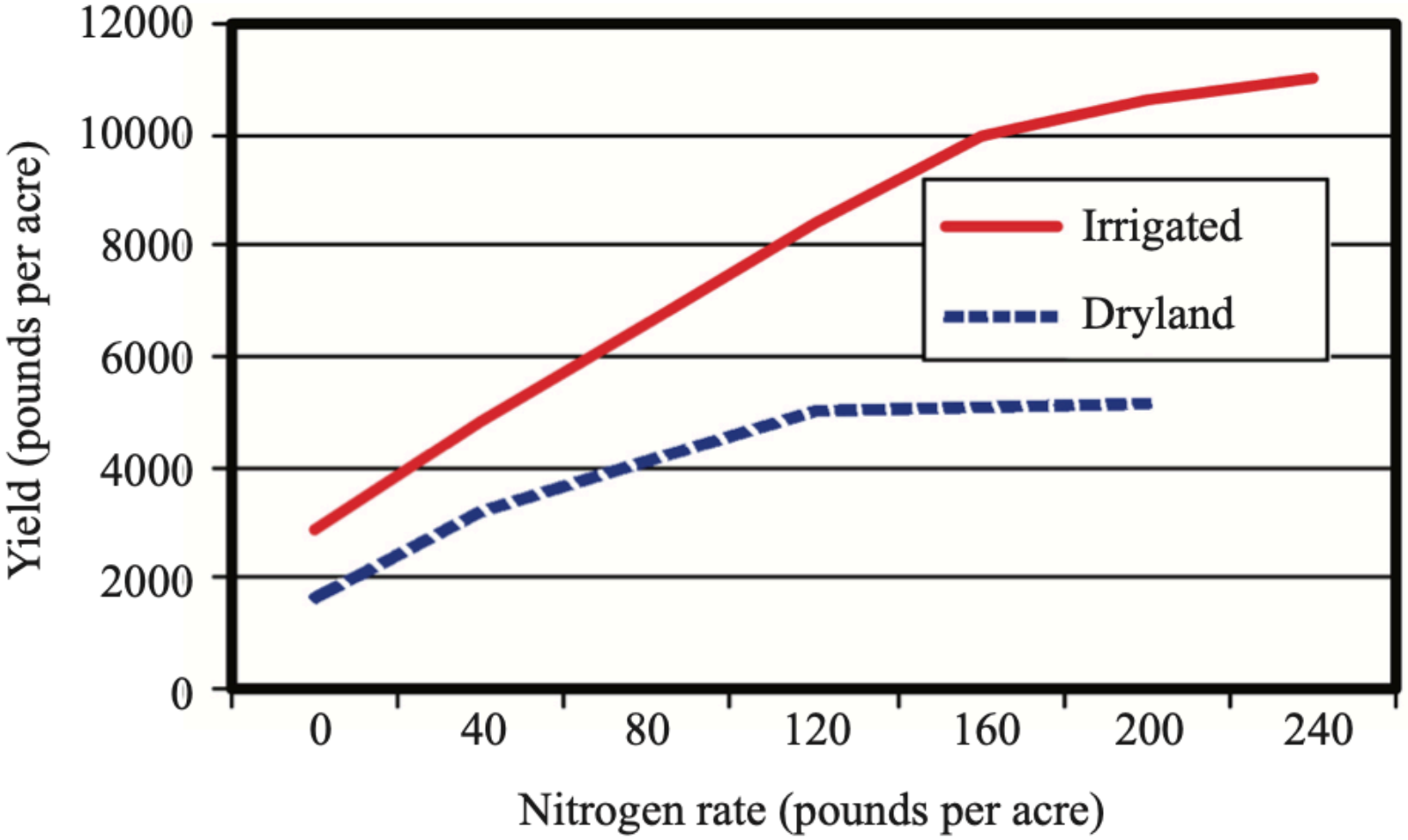


Figure 1. Apply fertilizer just prior to periods of rapid growth.

How much nitrogen fertilizer to apply?

- Depends on soil test
  - less than 10 ppm nitrate= empty; little excess nitrogen
  - Each additional 10 ppm nitrate = 50 lbs of available nitrogen in soil
  - Test soil shortly before application; nitrate levels change quickly in soil

Cool-season grass response to nitrogen fertilizer



Grass/Alfalfa or Grass/Clover Mixes

Table II. Nitrogen recommendations for grass/legume mixtures.

	Yield or stocking potential of the site[1]			
	4 tons/ac	*5 tons/ac*	*6 tons/ac*	*7-8+ tons/ac*
	1,400 lbs of grazing animal/ac	*1,750 lbs of grazing animal/ac*	*2,100 lbs of grazing animal/ac*	*2,450+ lbs of grazing animal/ac*
Stand composition	lb N / acre			
100% grass	100	120	180	240
80% grass, 20% legume	80	100	150	200
60% grass, 40% legume	60	80	120	160
40% grass, 60% legume	20	40	60	80
> 60% legume	0	0	0	0

[1]Grazing management and associated harvest efficiency will impact the stocking potential.

Intermountain Fertilizer Trial

- Investigators: Rob Wilson, Steve Orloff, Dan Marcum, & Don Lancaster
- Started in 2005 to examine nitrogen fertilization of grass hay under current management conditions
- Sites were located at 6 orchardgrass sites and 2 tall fescue sites throughout N. California

Intermountain Fertilizer Trial

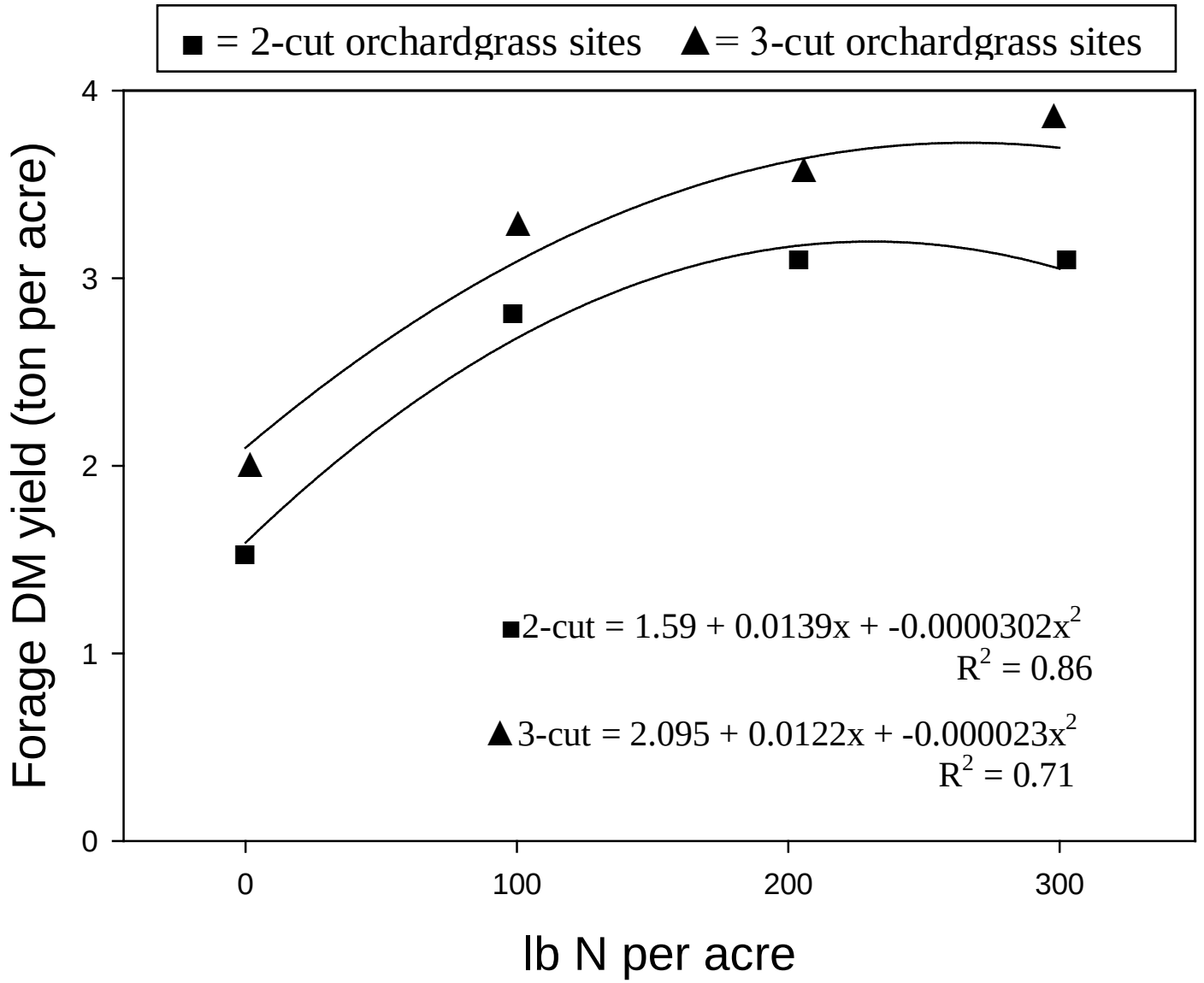
- The experiment evaluated the effects of nitrogen on:
  - Yield
  - Forage quality
  - Nitrate concentrations in the soil

Intermountain Fertilizer Trial

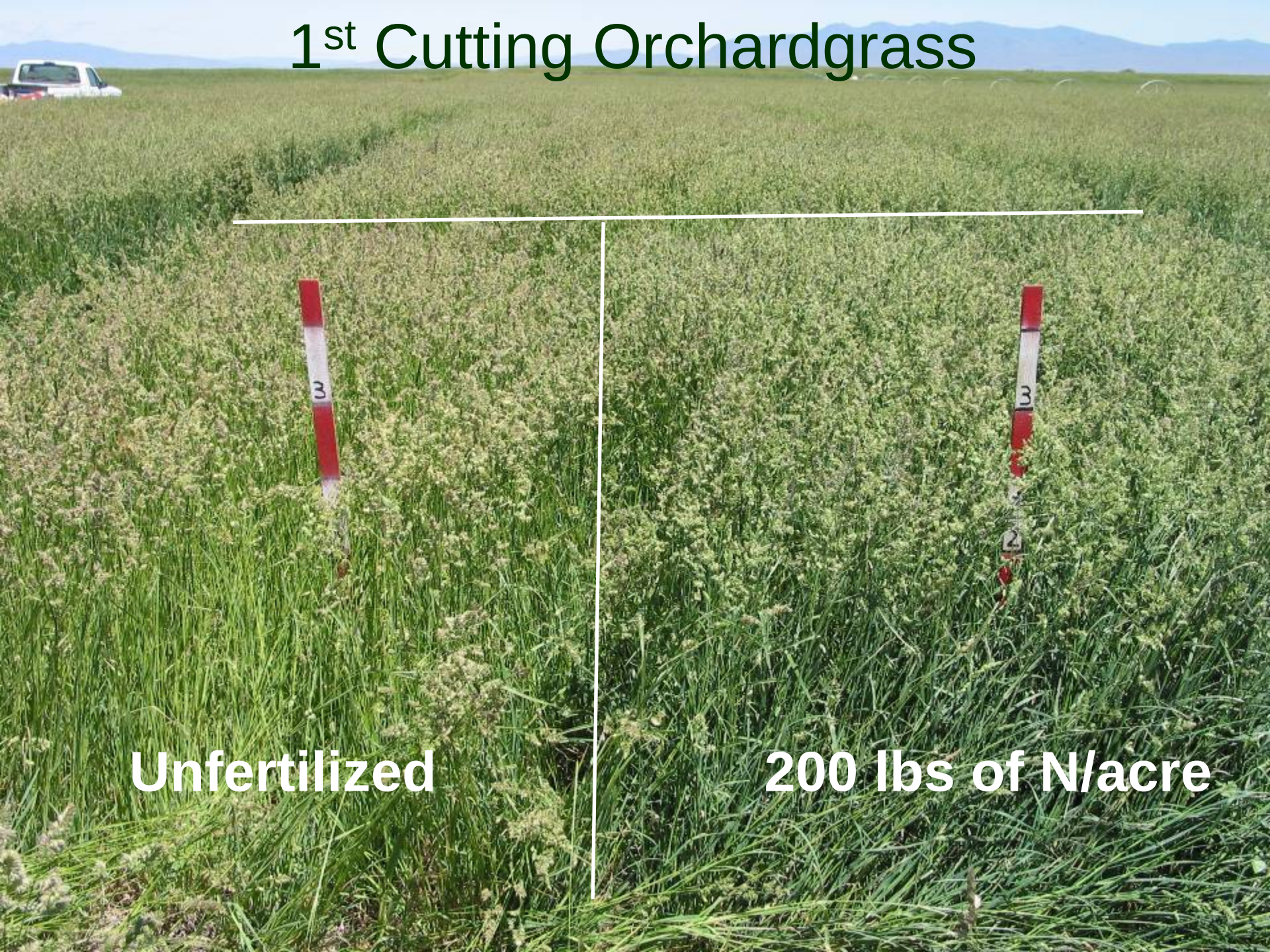
- Nitrogen fertilizer (Urea) treatments were applied:
  - In early spring at grass green-up
  - 1 to 2 days before the 1st irrigation after each cutting
- Yield and forage quality were measured at each cutting
- Soil moisture and irrigation was monitored through the growing season

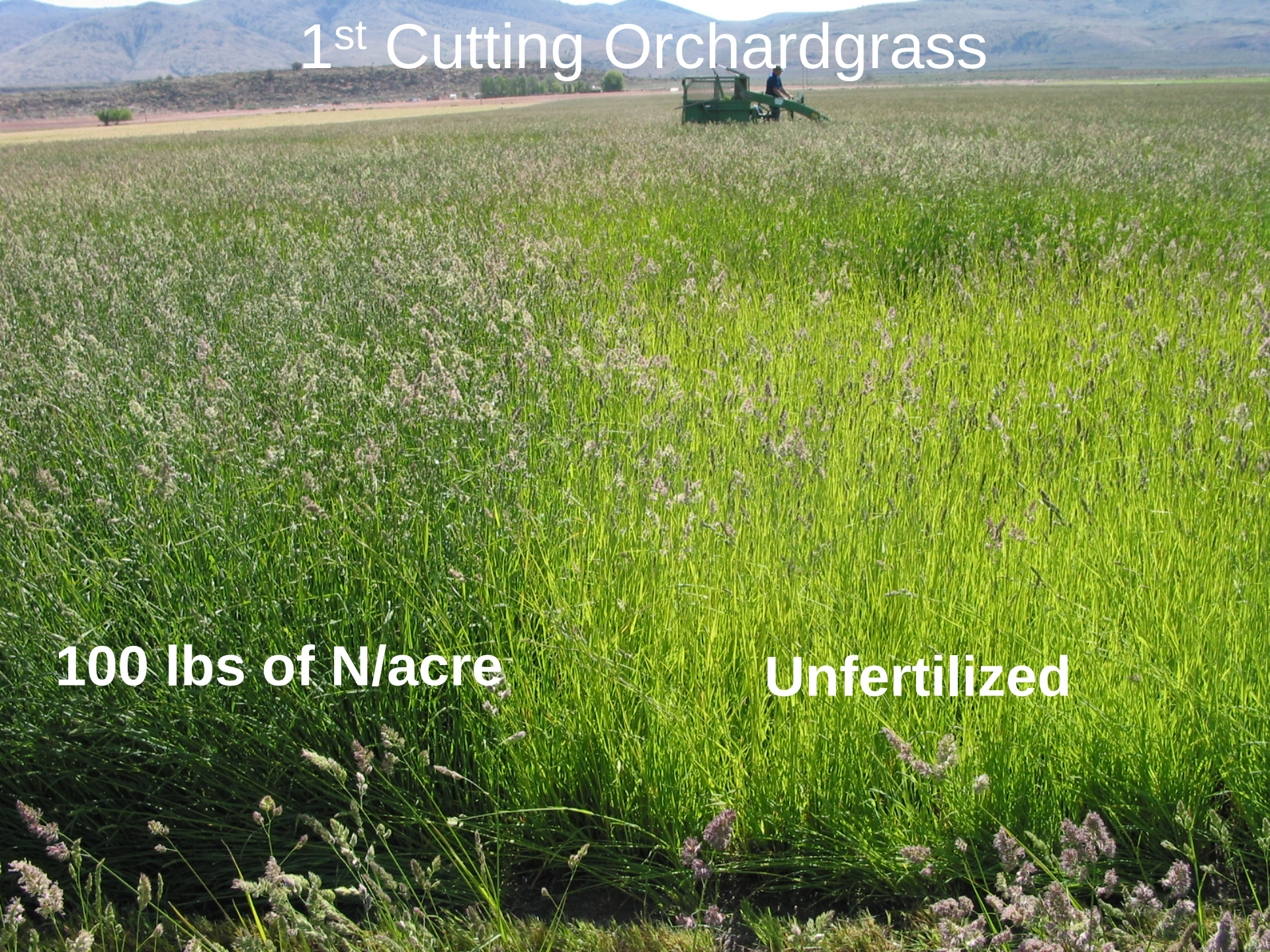
Results

Orchardgrass 1st Cutting Yield

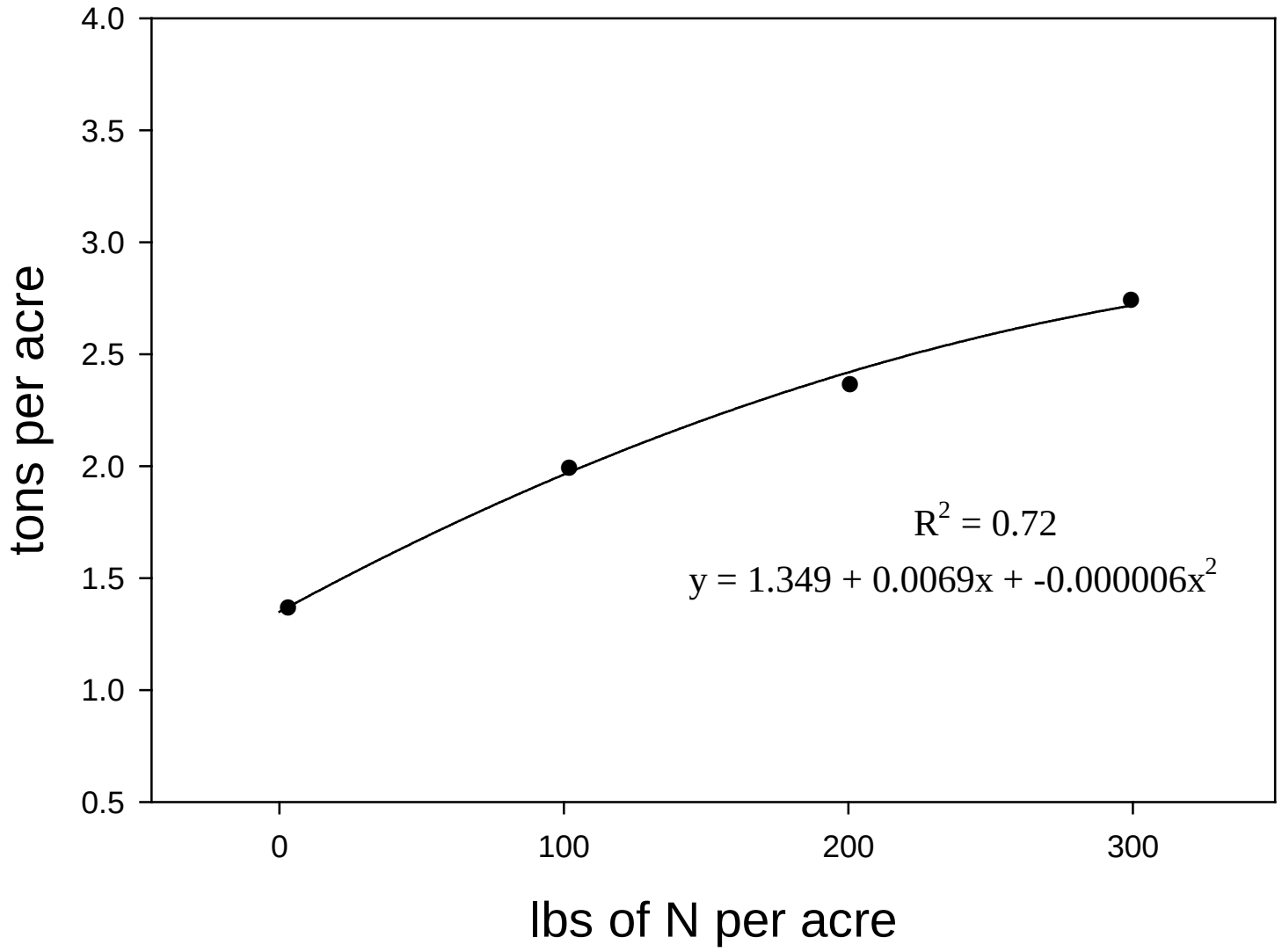


1st Cutting Orchardgrass



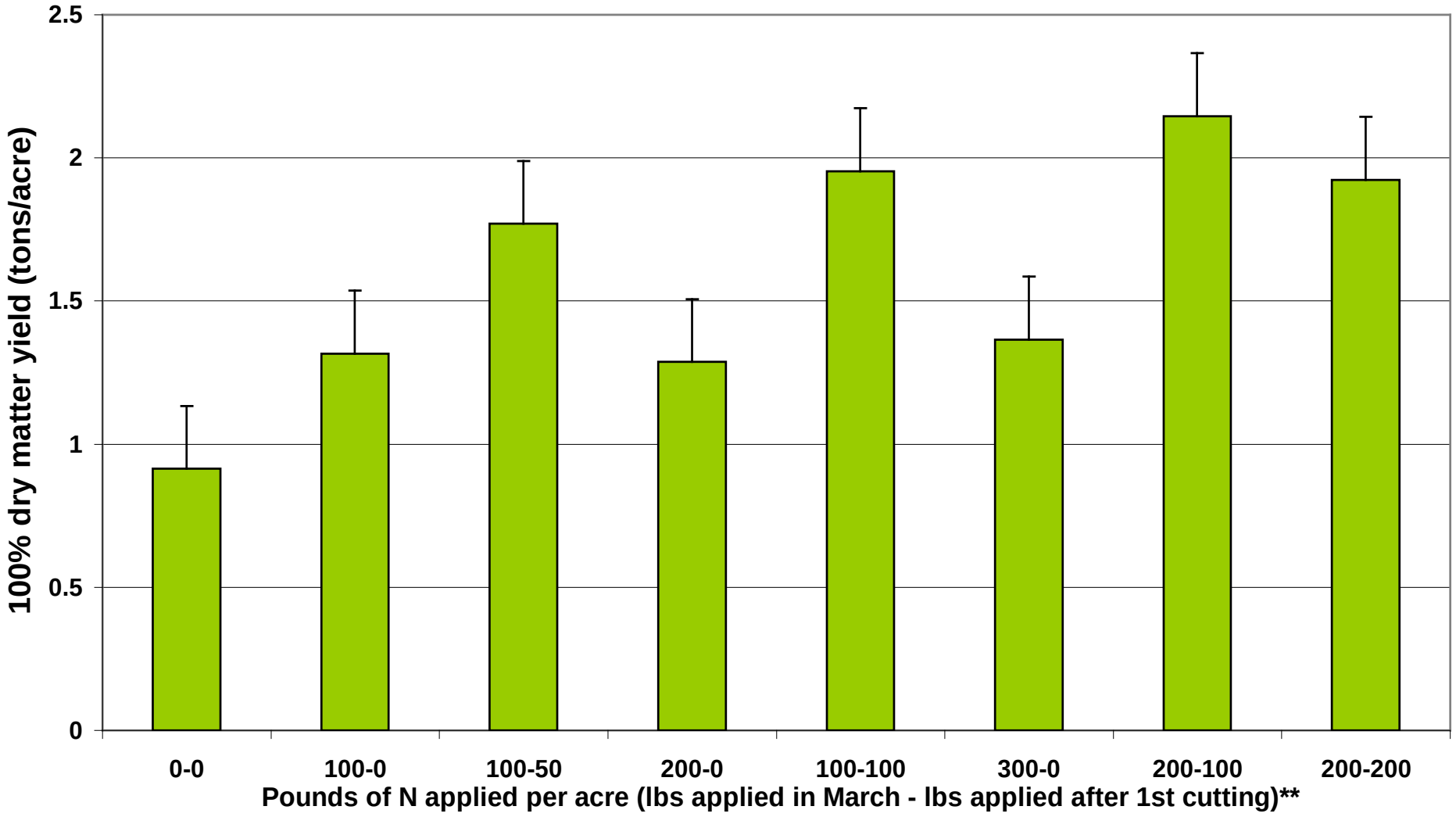

1st Cutting Orchardgrass
100 lbs of N/acre
Unfertilized

Tall Fescue 1st Cutting Yield



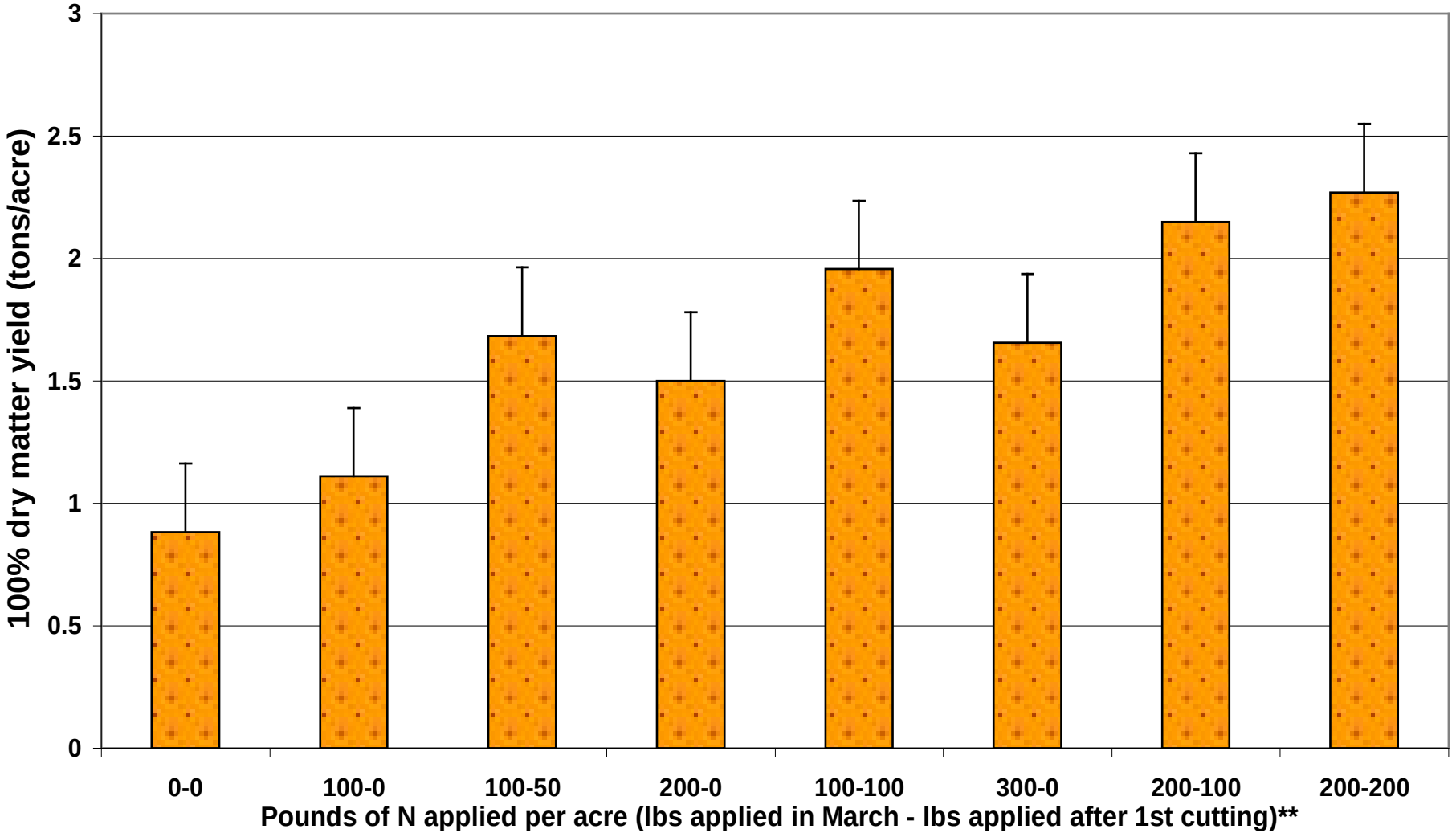
1st Cutting Tall Fescue in Susanville

The Effect of Nitrogen Fertilization on 2nd Cutting Orchardgrass Yield at Three-Cut Sites



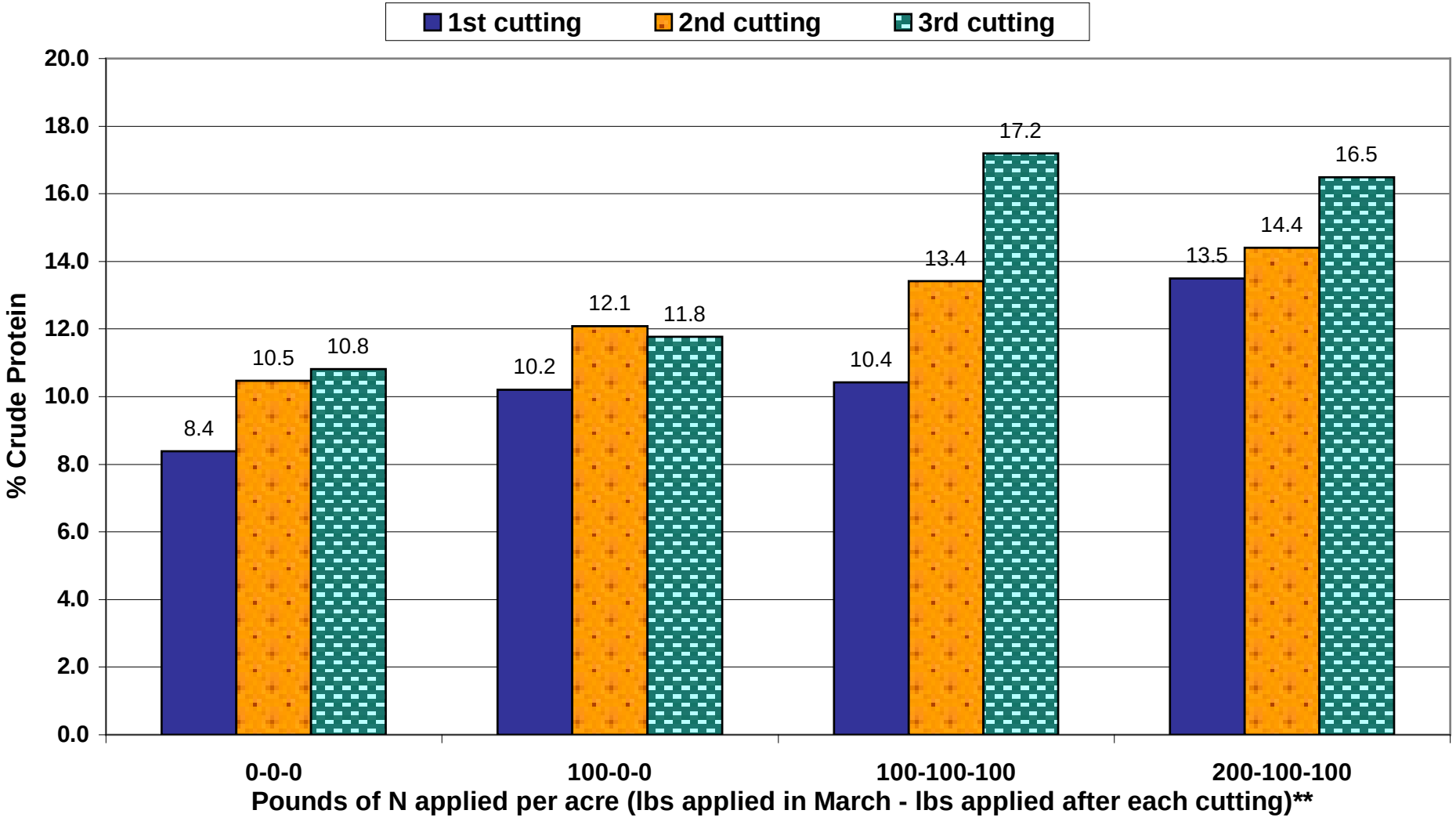
**Split nitrogen fertilization treatments consisted of applying urea in March at the time of grass greenup, at the first irrigation after 1st cutting, and at the first irrigation after the 2nd cutting.

The Effect of Nitrogen Fertilization on 2nd Cutting Orchardgrass Yield at Drought-Stressed Two-Cut Sites



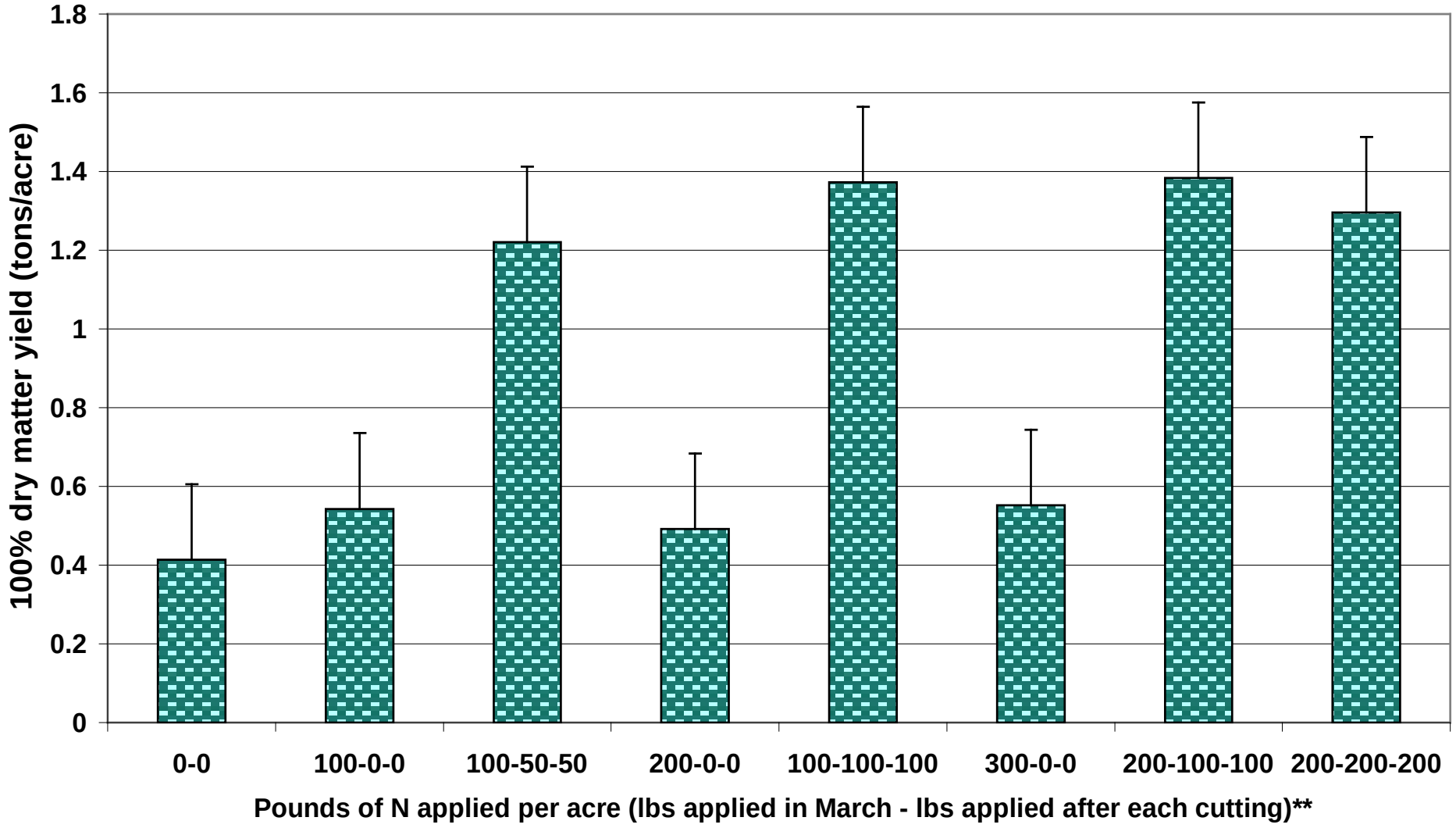
**Split nitrogen fertilization treatments consisted of applying urea in March at the time of grass greenup, at the first irrigation after 1st cutting, and at the first irrigation after the 2nd cutting.

The Effect of Nitrogen Fertilization on Orchardgrass Protein Averaged Across All Sites



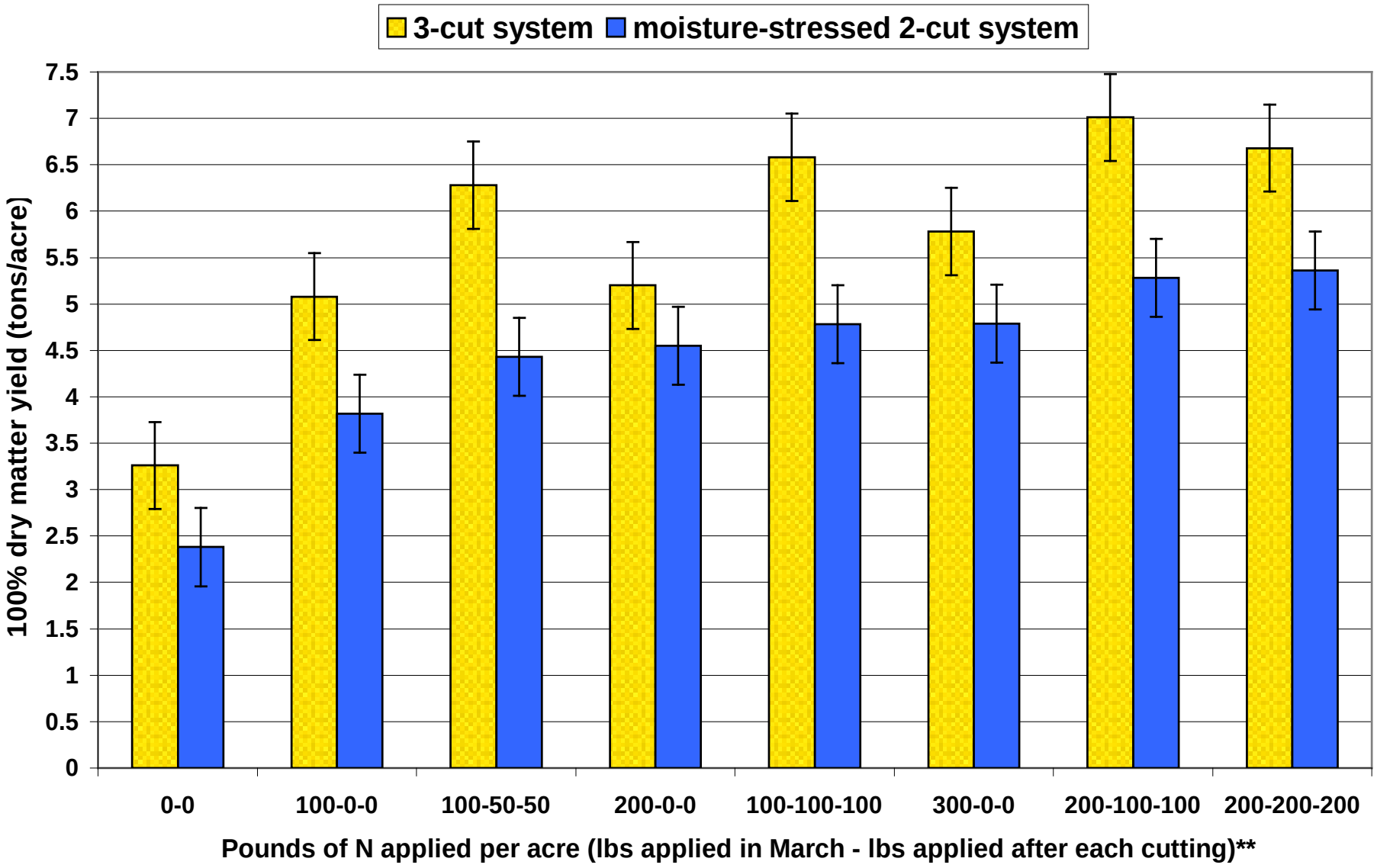
**Split nitrogen fertilization treatments consisted of applying urea in March at the time of grass greenup, at the first irrigation after 1st cutting, and at the first irrigation after the 2nd cutting.

The Effect of Nitrogen Fertilization on 3rd-Cutting Orchardgrass Yield at Three-cut sites



**Split nitrogen fertilization treatments consisted of applying urea in March at the time of grass greenup, at the first irrigation after 1st cutting, and at the first irrigation after the 2nd cutting.

The Effect of Nitrogen Fertilization on Total (season-long) Orchardgrass Yield



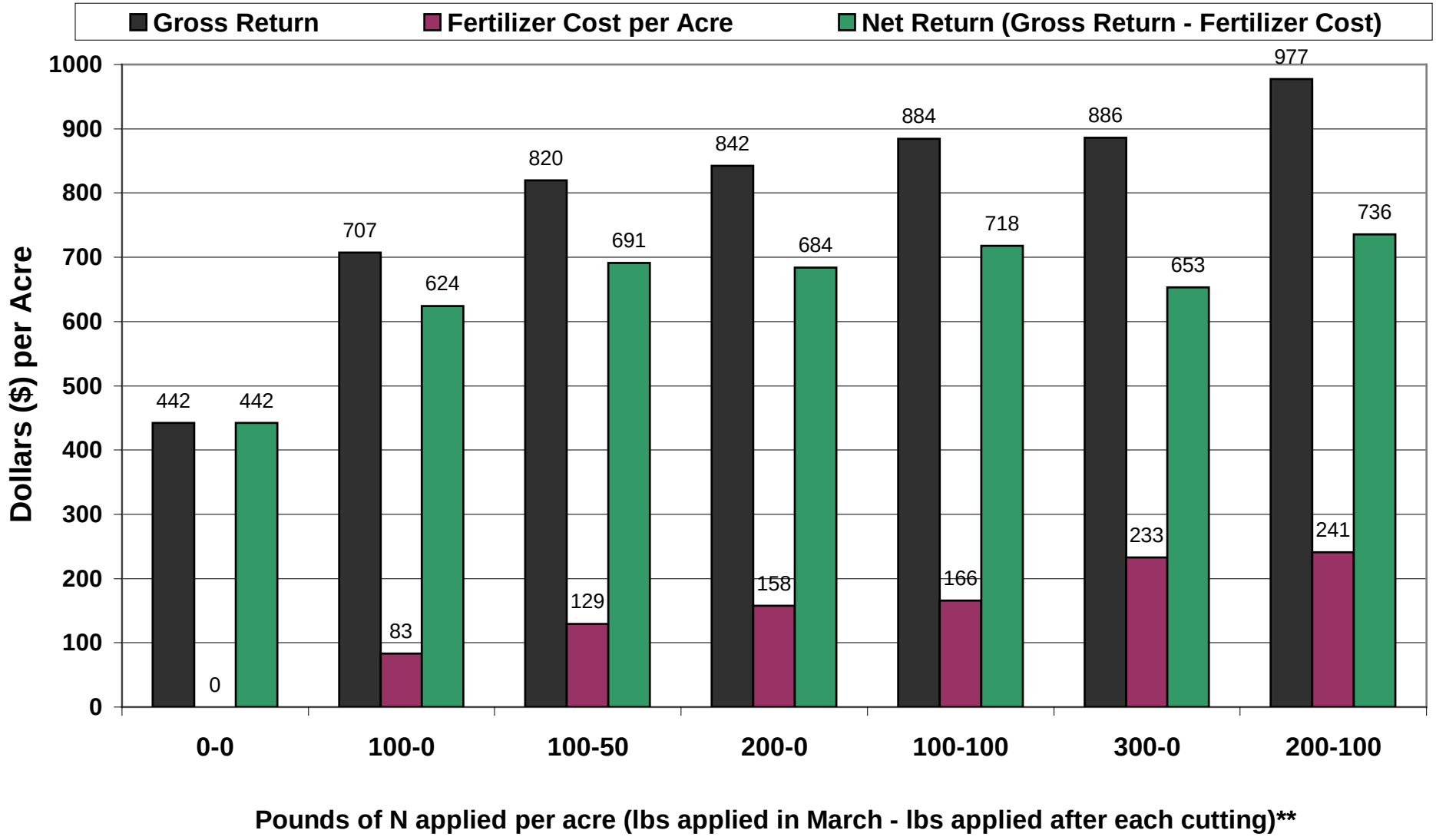
**Split nitrogen fertilization treatments consisted of applying urea in March at the time of grass greenup, at the first irrigation after 1st cutting, and at the first irrigation after the 2nd cutting.

Does the Yield Increase from N Fertilization Pay for the Fertilizer?

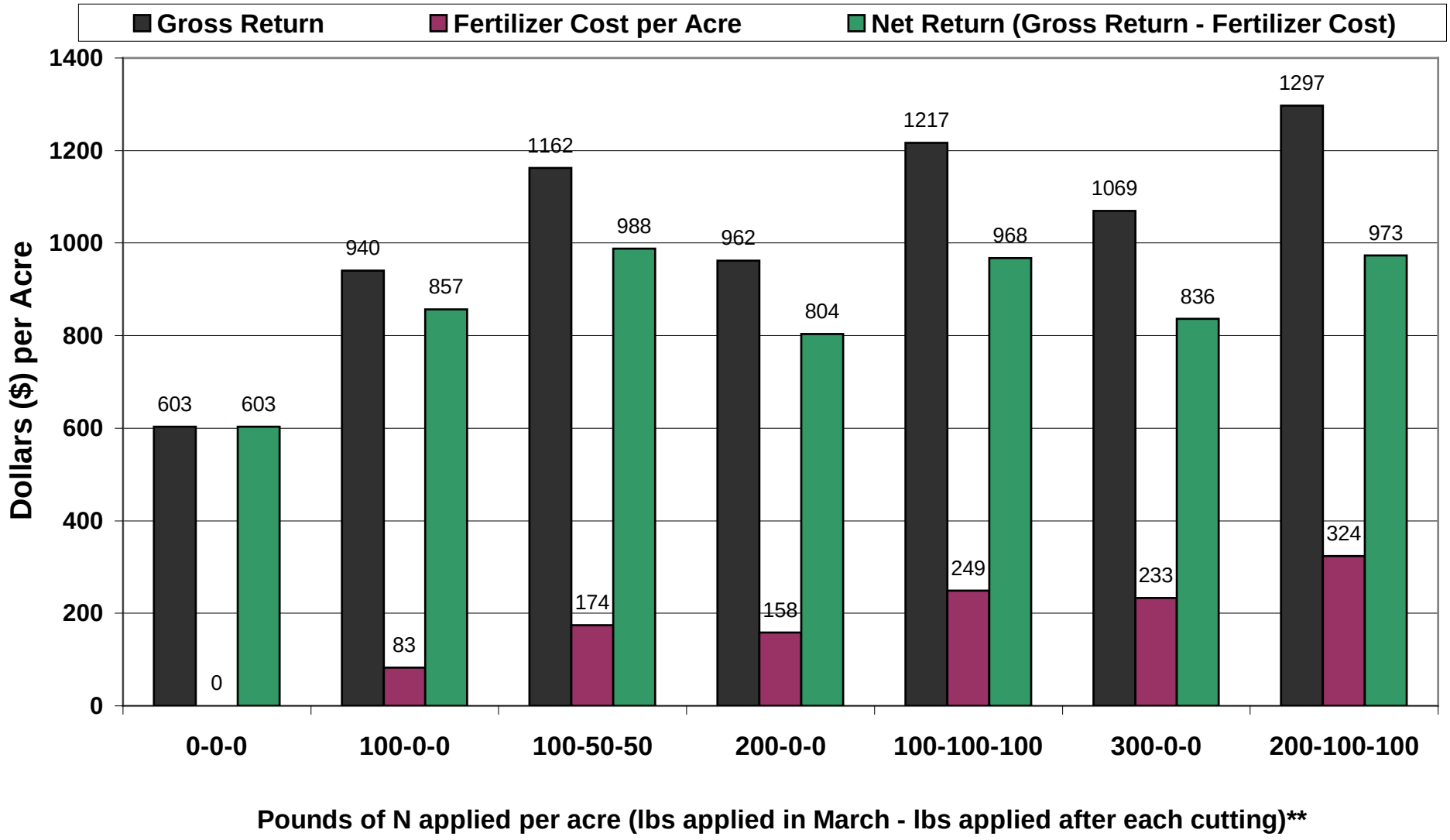
Nitrogen Fertilizer Costs

- Urea 46-0-0 = $445/ton or $0.48 lb of N
- Ammonium Sulfate 21-0-0-24= $300/ton or $0.71lb of N
- UAN 32 solution 32-0-0 or 3.55lb N/gal = $2.35/gal or $0.66lb of N
- $8.50 per acre air-flow spreading cost

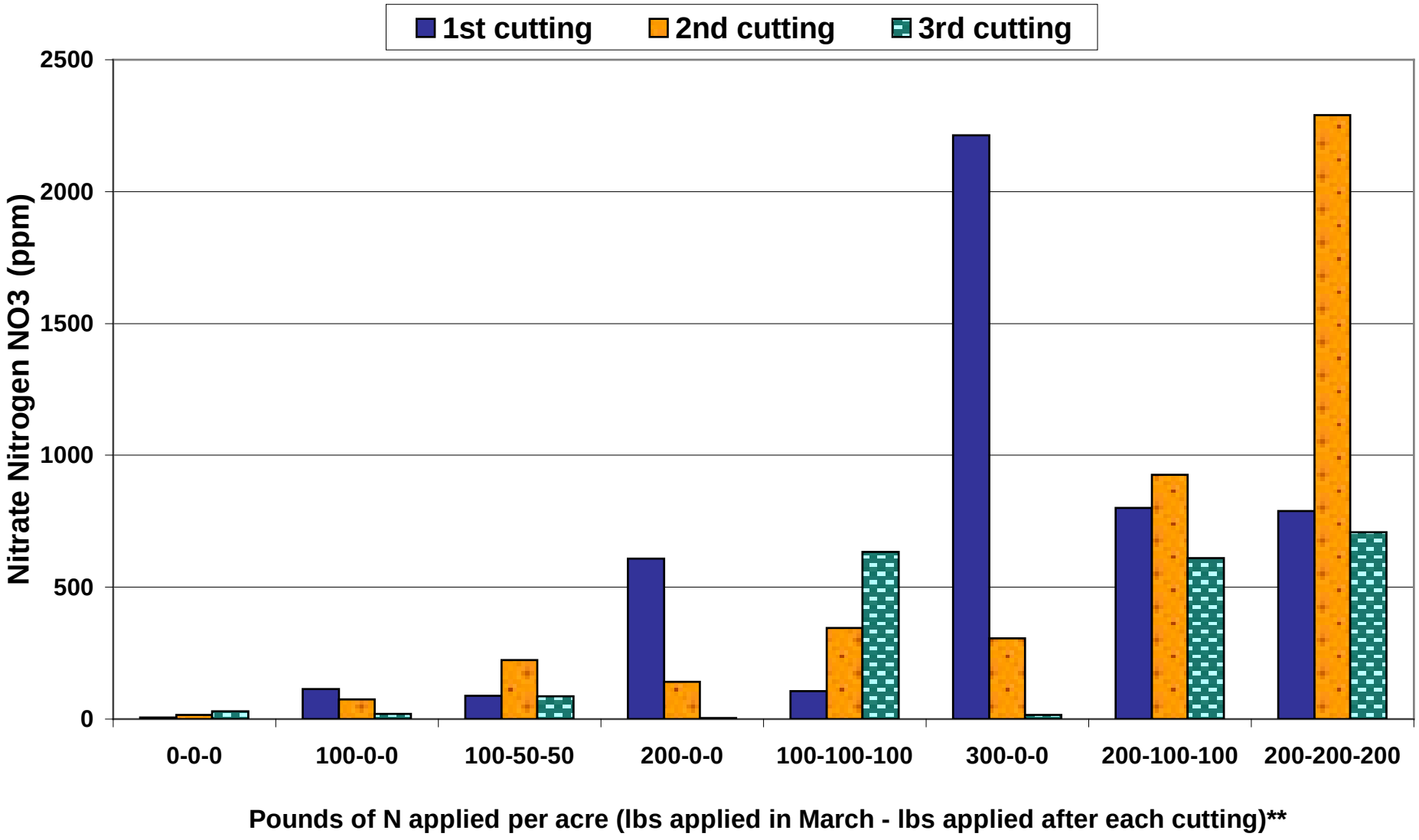
The Effect of Nitrogen Fertilization on Orchardgrass Net Return ($185 per ton hay) minus fertilizer cost ($0.75 per lb of N + $8 per acre spreading cost) for a Moisture-stressed 2-Cut System



The Effect of Nitrogen Fertilization on Orchardgrass Net Return ($185 per ton hay) minus fertilizer cost ($0.75 per lb of N + $8 per acre spreading cost) for a Three-Cut System



The Effect of Nitrogen Fertilization on Orchardgrass Nitrate Levels Averaged Across All Sites *(1000 ppm is the maximum accepted level in most grass hays)*



Summary

- It pays to apply N fertilizer to grass hay and grass pasture in all irrigated scenarios
- Proper irrigation is critical to maximizing yield and fertilizer efficiency!!!!!!!!
- It’s worth looking at price differences between fertilizers and spending the extra effort to water incorporate the fertilizer into the soil shortly after application

- Conservative Rate Guidelines for Irrigated Grass Hay
  - Apply between 100 to 150 lbs/ac of N at grass greenup in early spring (March-April)
    - 220 to 320 lbs of urea/acre
    - 475 to 714 lbs of ammonium sulfate/acre
  - Apply 75 lbs/ac of N after 1st cutting
    - 160 lbs of urea/acre
    - 360lbs of ammonium sulfate/acre
  - Apply 50 lbs/ac of N after 2nd cutting
    - 110 lbs of urea/acre
    - 240 lbs of ammonium sulfate/acre
  - Total N per season = 225 to 275 lb of N per acre

Nitrogen Recommendation for Irrigated Pasture

- Depends on grass species make-up, water availability, and irrigation uniformity
- Most grass pastures will benefit from 80 to 100 lbs of N applied in spring. Not worth the expense of putting on less than 50 lbs N per acre.
- Productive grass pastures can produce 5 to 8 tons of forage per acre with proper irrigation and nitrogen fertilization.

Questions?