NebGuide

University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

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Fertilizing Grass Pastures and Hayland

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Proper fertilization is an important component of managing pastures and haylands.

Production from many Nebraska pastures and haylands is low. Given the variety of forage species and soil and terrain conditions, managing pastures and haylands requires viewing these resources as a system that includes the animals foraging on them.

Research shows that fertilizing, weed control, and rotational grazing increases production from pastures, resulting in greater livestock production. Fertilizing and controlling weeds on haylands also increases production.

Important factors to consider when evaluating the economics of fertilization include the cost of fertilizer, value of hay or pasture, plant type and response to fertilizer, and risk. Risk can be associated with things such as changes in hay value, timing and amount of rainfall, and the year to year variability in the yield response to the fertilizer. As would be expected, low hay or pasture prices results in low levels of economic success, and high fertilizer prices result in less chance of breaking even.

When fertilizing pastures, grazing management that results in livestock efficiently consuming most of the extra forage growth is needed. Fertilization usually isn't economical if one pasture is continuously grazed throughout the season, because this wastes much of the additional growth. If additional forage can be purchased or pasture rented at a lower cost than fertilizer, these alternatives may be better choices.

Nitrogen

Nitrogen (N) increases both grass yield and protein content. It also improves the vigor of grass plants, which can thicken stands and reduce weed invasion. When adequate soil moisture is present, economical rates of nitrogen more than double forage production.

Fertilization with nitrogen is most economical where weeds have been controlled, and where additional grass growth is needed and utilized by livestock. Nebraska research has shown that when nitrogen is applied to grass pastures at recommended rates, one pound of fertilizer nitrogen can produce one additional pound of calf or yearling gain.

Nitrogen fertilizer applied just prior to the period of most rapid grass growth ensures that the applied nitrogen is available to the plants and produces the most pounds of additional grass growth per pound of nitrogen applied. For cool season grasses, such as smooth brome and wheatgrasses, maximum growth occurs in mid to late spring *(Figure 1)*. These grasses grow very little in July and August, even when moisture is

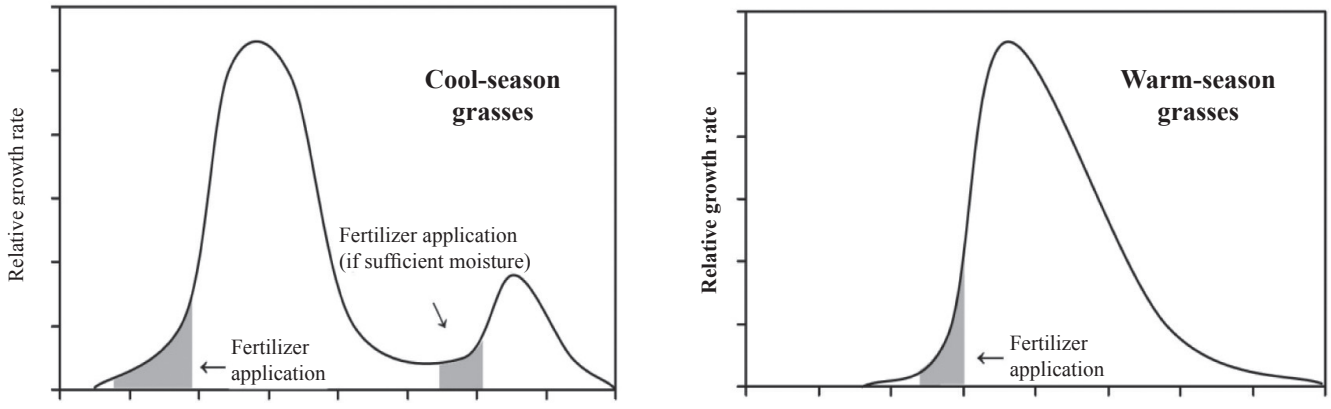

Figure 1. Apply fertilizer just prior to periods of rapid growth.

plentiful. A small amount of growth takes place in late August and September if soil moisture is adequate and temperatures are favorable. Fall growth, however, is only a small portion of the total growth for the entire growing season.

Nitrogen can be applied in either spring or late summer on cool season grasses. The risk of losing applied nitrogen by either leaching or run-off is reduced if it is applied in early spring. Early spring applications also produce the most pounds of additional grass growth per pound of nitrogen applied. Therefore, spring applications usually are preferred.

If livestock are unlikely to efficiently consume all the extra spring grass growth produced by applied nitrogen, it may be wiser economically to reduce the amount of nitrogen applied or harvest excess growth as hay from some pastures. Another option is to only fertilize some pastures in early spring and wait until mid-May to fertilize those remaining. Apply fertilizer in mid-May only when soil moisture is sufficient for grasses to use the applied nitrogen efficiently. This will encourage cool season grasses to produce more growth during summer when these grasses normally grow very slowly.

Split applications of nitrogen for production of cool season grasses under dryland conditions are useful only when more than 100 pounds of nitrogen per acre are to be applied during the growing season and good growing conditions are anticipated during September and October. For irrigated pastures, where annual rates can range from 150 to 250 pounds, split applications are recommended. Generally, split applications would be about 60 percent of the total annual amount in spring and early summer, 15 percent in midsummer, and 25 percent in late summer and fall. Application can be planned to promote growth for periods of grazing forage need, but the greatest yield response and most efficient use of nitrogen are observed from spring applications and the growth during May.

Apply fertilizer in mid to late May to pastures and haylands containing warm season grasses, such as switchgrass and the bluestems. Do not fertilize warm season grasses in early spring. This will reduce fertilizer losses and avoid stimulating growth of cool season weeds. Begin application in mid-May in southern Nebraska and delay until late May in the northern portion of the state. Do not apply more nitrogen than the warm season grasses are expected to use during the year the fertilizer is applied. Carryover nitrogen often stimulates invasion by cool season weeds.

Some pastures and haylands contain a mixture of both cool and warm season grasses. Time the application of fertilizer to stimulate growth of the most desired type of grass. Fertilizing these pastures with nitrogen in early spring often stimulates the cool season grasses, which then may crowd out any warm season grasses present. To maintain warm season grasses in such a mixture, fertilize in late May. It also may be necessary to apply herbicides to suppress the cool season grasses. See the *Guide to Weed Management in Nebraska* (*http://www.ianrpubs.unl.edu/sendIt/ec130.pdf*) for herbicide suggestions.

Liquid and dry forms of nitrogen fertilizer are equally effective for increasing pasture production when certain precautions are taken. Do not apply urea nitrogen to pasture or haylands on calcareous soils when air temperatures are above 85°F. Nitrogen losses due to ammonia volatilization can be high under these conditions. Since urea supplies more than half the nitrogen in liquid solution nitrogen fertilizers, use similar care with their use. Application before predicted rain of at least 0.4 inches will minimize the chance of volatilization losses.

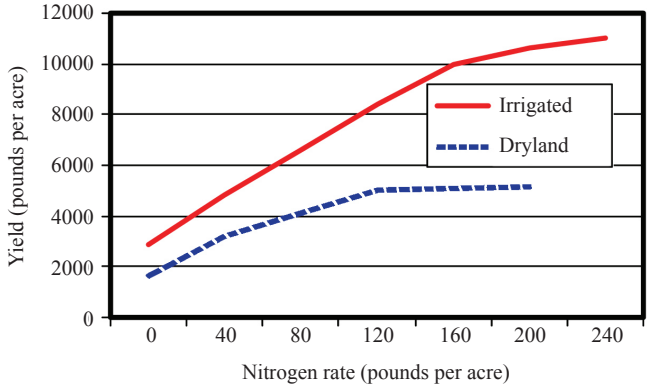

Figure 2. Typical grass yield response to nitrogen fertilizer (irrigated is statewide; dryland is for eastern Nebraska).

As the nitrogen application rate increases, the amount of added yield from pasture and hayland per pound of added nitrogen decreases *(Figure 2)*.

Nitrogen applications to dryland pastures and haylands depend on soil moisture conditions and rainfall. If other factors are not limiting, grassland can use a large amount of nitrogen. *Figure 3* shows Nebraska and the rainfall regions used for making the nitrogen recommendations listed in *Table I*. The higher rates listed for each zone are expected to produce approximately one pound of additional calf or yearling gain for every pound of nitrogen applied when there is a full profile of subsoil moisture at the start of the growing season. The lower rates listed are the minimum amounts recommended for average weather conditions and good grazing management situations. Fertilizing upland, native range in Zones III and IV generally is not economical, especially where soils are sandy. Therefore, apply the recommended rates of nitrogen only to sub-irrigated sites in these zones.

Table 1. Nitrogen recommendations for dryland pastures and haylands in Nebraska.

	*Pounds of nitrogen to apply per acre**			
	Cool-season grasses		*Warm-season grasses*	
Zone	*Pasture*	*Hayland*	*Pasture*	*Hayland*
I	80-120	100-150	60-90	75-100
II	50-80	60-90	40-75	50-80
III	40-60	50-75	25-50	40-60
IV	20-40	30-60	20-40	30-50

*Use the higher rate when a full profile of subsoil moisture is present.

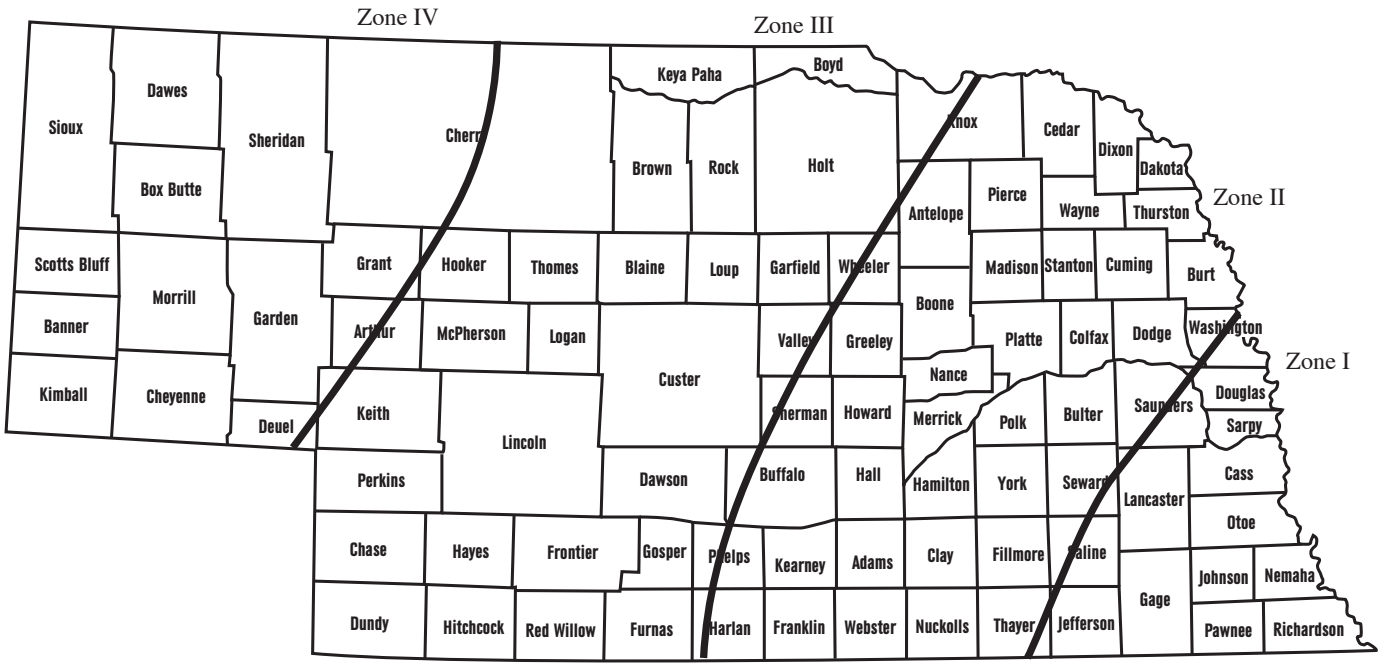

Figure 3. Nitrogen fertilizer zones for dryland pastures and haylands.

Some pastures and haylands contain legumes. Legumes with an adequate population of nitrogen-fixing rhizobia will obtain all of their nitrogen needs. Nitrogen benefits to the associated grasses will vary depending on the amount of legume in the mixture. Nitrogen applications may tend to increase grass stands at the expense of the legumes. *Table II* shows recommended nitrogen rates based on production goals and legume percentage with the higher production goals applicable to irrigated cool-season grasses used for hay or pasture. For irrigated grass at the higher nitrogen rates, split applications are commonly used. The spring application, before rapid growth, is still considered to be the most efficient and about 40 to 60 percent of the total rate should be applied at that time.

Phosphorus

Phosphorus (P) fertilizer also is needed on many pastures in Nebraska. Research in eastern and northeastern Nebraska and on sub-irrigated hay meadows shows that the combination of nitrogen and phosphorus frequently produces higher yields than the application of either nutrient alone.

Phosphorus recommendations are based on the availability of phosphorus in the soil as measured by a soil test. Phosphorus recommendations for grasslands are listed in *Table III*. If legumes make up one-fourth or more of the stand, apply 50 percent more phosphate than for grass alone. Phosphate fertilizers can be applied with the nitrogen in either spring or fall.

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.

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

Repeated applications of phosphate fertilizers may increase the level of available phosphorus in the soil. When soil phosphorus levels are in the high range, phosphate application can be eliminated until soil test levels fall below the high range. When grasslands are used as haylands, soil sample more frequently. Phosphorus may need to be applied more often, since nutrient removal will be greater than on grazed land.

Potassium

Potassium (K) recommendations for irrigated pastures and haylands are given in *Table IV.* As with phosphorus, the increased potassium rates for an irrigated grass-legume mix is to keep the legume in a competitive environment with the grass. Research results in eastern Nebraska have shown that pastures generally do not respond to potassium fertilization due to relatively high natural levels in the soil.

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

Sulfur

Irrigated, sandy, low organic matter sites may need sulfur (S), especially if legumes are a significant part of the pasture or hayland. Sulfur should not be needed where irrigation water contains more than 6 parts per million sulfate sulfur. When needed, apply sulfur at 30 to 40 pounds per year or at 100 pounds before seeding, and then once every three years.

Resources

"Effect of Precipitation and Long Term Nitrogen Fertilization on Nitrogen Uptake, Crude Protein Content and Yield of Bromegrass Forage" by W. L. Colville, L. Chesin, and D.P. McGill, available in *Agronomy Journal* 55:215-218.

Switchgrass, Big Bluestem, and Indiangrass for Grazing and Hay (G1908) by R. Mitchell and B. Anderson, available through Extension offices and online at *www.ianrpubs.unl.edu/sendIt/g1908.pdf.*

Common Grasses of Nebraska (EC170) by J. Stubbendick and K.L. Kottas, available through Extension offices and online at *www.ianrpubs.unl.edu/sendIt/ec170.html*.

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