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Cooperative Extension South Dakota State University

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# Fertilizing Pasture and Hayland



Cooperative Extension Service  
South Dakota State University  
U.S. Department of Agriculture

# Fertilizing Pasture and Hayland

By Edward J. Williamson and Earl P. Adams, Extension agronomists—soils; Paul L. Carson, associate professor, plant science department; and Ron Gelderman, manager, soil testing laboratory, Agricultural Experiment Station.

The production of South Dakota's 28 million acres of grazing land and 4½ million acres of hayland provides much of the feed for livestock enterprises. Certain areas of this grassland acreage could be improved considerably by proper use of fertilizer. It is estimated that only 5% of the tame hay and pasture area now is being fertilized, compared to fertilizer use on 23% of the corn acreage.

Frequently overlooked is the fact that five tons of quality alfalfa is equivalent in feed value to about 113 bushels of corn, 104 bushels of wheat, or 223 bushels of oats. Equivalent amounts of good grass forage compare favorably to alfalfa in total digestible nutrients (T.D.N.).

Proper fertilization is a key factor in producing high quality livestock feed. Important increases in forage yield and protein content from fertilizer use have been demonstrated by research in South Dakota and neighboring states. Forage yields have nearly doubled with ample nitrogen applications on cool-season grasses, while protein content increased 2 to 3%. Likewise, research has shown alfalfa yield increases of nearly a ton from fertilizer use, particularly from fertilizers containing phosphorus. Research has not consistently proved any particular advantage to spring or fall fertilizer application as far as its effect on yield or protein content is concerned; however, there is some evidence that fall fertilization helps to reduce alfalfa winter-kill. Fall fertilization also hastens growth for early grazing.

Grasses differ from legumes in their nutrient needs and, as a result, recommended fertilization practices differ. Both grasses and legumes require all the essential plant food elements for most favorable growth. Basically, grasses, particularly the cool-season species, respond to nitrogen; whereas, legumes respond primarily to phosphorus and, in some cases, potassium. Soil testing is a reliable guide in determining the best rates of fertilizer to use.

Fertilizing is not a substitute for adequate moisture and proper management, however plants use available water more effectively when high soil fertility exists. Fertilization should be considered in conjunction with other pasture or range improvement practices such as grazing systems, mechanical treatment, interseeding of more productive grasses and legumes, and weed control. Fertilization also can be profitably used with weed control on hayland.

## FERTILIZING FOR FORAGE PRODUCTION

Fertilizing for forage production is handled in the same manner on grazing land as on hayland containing the same plant species. However, fertilizer practices vary depending on whether the crop is a grass, a legume, or a grass-legume mixture.

### Fertilizing Established Grasses

Grasses, unlike legumes, do not have the capacity for fixation of atmospheric nitrogen to supply their growth needs. For this reason, nitrogen fertilizer use on grass will usually return profitable yield increases. Phosphorus or potassium fertilizer, however, seldom returns profitable yield increases unless soil levels, as indicated by a soil test, are low.

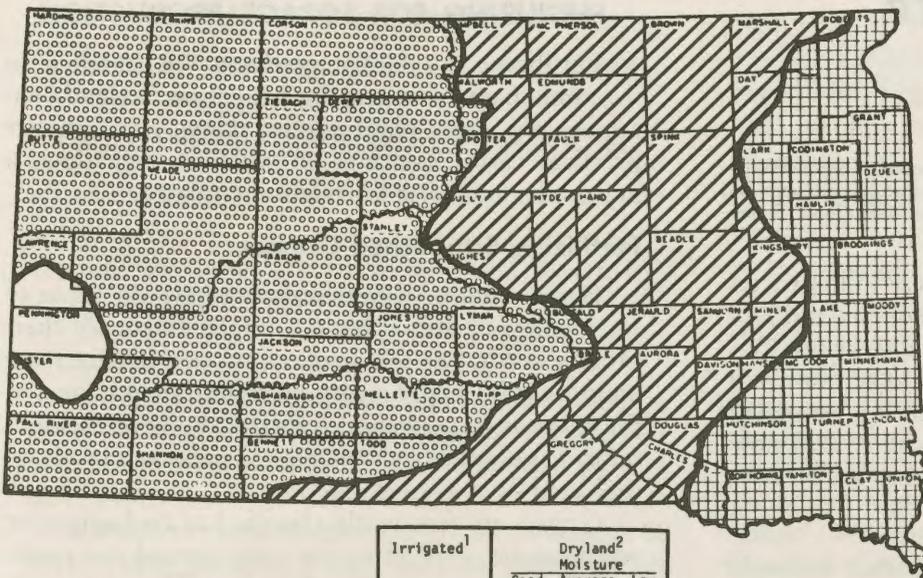
Grasses are frequently classified as cool-season or warm-season, depending on what part of the growing season major growth takes place. The more common cool-season species include smooth brome grass, intermediate wheatgrass, crested wheatgrass, western wheatgrass, reed canarygrass, creeping foxtail, Russian wildrye, green needlegrass and bluegrass. Warm-season grasses include switchgrass, Indian grass, the bluestems, the grama grasses, buffalo grass and others. The major growth of cool-season grasses is in the early and late parts of the growing season when moisture is less likely to be limiting and mineralization or release of soil nitrogen is slower. These two factors usually make nitrogen fertilization of cool-season grasses more profitable (see Table 1).

Table 1. Effect of Nitrogen on Cool-Season Grass

County	Grass	Yield—Lbs/Acre		
		Rate: Lbs N/Acre (Ammonium Nitrate)		
		0	60-70	120-140
Brookings	Brome grass .....	1804	3959	5577
	Creeping Foxtail ..	710	1840	3940
Harding	Crested Wheat ...	1476	3363	3714
	Corson	Crested Wheat ...	1183	2839
Campbell	Crested Wheat ...	2503	4465	5130
	Tall Wheat .....	1702	3562	4845
Faulk	Native .....	1775	3696	4670
Hanson	Reed Canary ....	856	2873	3748
	Mean .....	1501	3325	4426

Research indicates warm-season grasses do not respond as much as cool-season species to commercial fertilizers; however, any productive species must have a certain minimum amount of plant food. Some improved strains of warm-season grasses have shown profitable responses (see Table 2). The magnitude of the response may be influenced by time of application. Some species would increase in abundance with certain dates of application. For example, an early spring application of fertilizer on a mixture of warm- and cool-season grasses encourages the growth of the cool-season species. Continued use of the fertilizer at this time may allow the cool-season species to dominate the mixture. Although research work

Figure 1. Nitrogen\* (lbs. N/A) recommendations for dryland and irrigated grass stands.



<sup>1</sup>The 160-pound rate should be a split application for hay, half of it early in the spring the other half immediately after the 1st cutting. For pasture, the second half should be applied immediately after the spring growth has been grazed.

<sup>2</sup>The levels good, average and low refer primarily to soil conditions influencing available moisture. Examples are given which are not all-inclusive.

**Good**—when more water is available for the growth of grasses than found in normal well-drained soils of the area. Such sites are sub-irrigated areas, somewhat poorly-drained areas, poorly-drained areas, bottom lands that are not gravel or sand, where water spreading systems are used, etc.

**Average**—the well-drained upland soils in the area.

**Low**—soils that have less available water present than those found in the well-drained uplands soils. Such sites are soils with steep slopes that permit runoff and excessively drained soils (sands and gravels, etc.).

\*For areas sub-irrigated or with a water spreading system, increase the dryland (good moisture) rate of nitrogen application by 50%. Black Hills area (shown in white at left edge of map)—use same fertilizer recommendations as the eastern South Dakota area.

is lacking, it appears that fertilizing at a later date to coincide with the optimum growth of the warm-season species would benefit these plants.

Table 2. Effect of Nitrogen on Warm-Season Grass (switchgrass) Brookings County, 1975

Rate Lbs N/Acre	Yield—Lbs/Acre	
	Ammonium Nitrate	Urea
0	2898	2898
35	3557	3492
70	4467	4235
140	5371	5468
Mean	4073	4023

“Sod-bound” conditions can occur in older grass stands where few or no legumes are included, or where manure or nitrogen fertilizer has not been applied. Proper nitrogen fertilizer use can prevent and correct such conditions. Tearing-up old sod apparently gives no permanent correction of the problem, although it may promote vigorous temporary growth. A combination of both may be desirable.

Recommended fertilizer rates for cool-season grasses in the state vary from 40 to 100 pounds per acre of actual nitrogen, depending on available moisture (rainfall, runoff and sub-irrigation) and productivity of the existing grasses during the growing season. Good stands of cool-season grasses, such as smooth brome grass or intermediate wheatgrass, in the eastern quarter of South Dakota should receive up to 100 pounds of actual nitrogen per acre. The fertilizer rates should be reduced to 30 to 50% on pastures containing less productive grasses such as blue-

grass and the predominant cool-season native species. Little if any response differences have been noted from either late fall or early spring application; normally little or no nitrogen will be lost from such applications. Occasionally, however, losses occur on sloping land where fertilizer has been spread on frozen soil or snow, or when rains or thawing result in heavy surface-water runoff.

A 50- to 75-pound rate per acre of actual nitrogen should be applied in the east central section of the state for the more productive grasses such as smooth brome grass, intermediate and crested wheat grasses.

In the western half of the state where forage yields are restricted even more by limited rainfall, a 40- to 50-pound rate per acre of nitrogen should be applied. Not all of this area will show a profitable response to this level of nitrogen. However, situations most likely to return a profitable response when fertilizer is used include rangeland and cropland that has been reestablished to introduced grasses and native mid or tall grasses situated on favorable moisture sites. Phosphorus and potassium should be used for established grass where soil tests indicate low soil levels of these elements (see Table 3).

Table 3. Phosphorus and Potassium

Soil Test	Fertilizer—Lbs./A.			
	P <sub>2</sub> O <sub>5</sub>	or P	K <sub>2</sub> O	or K
Very Low	30	13	80	66
Low	20	9	60	50
Medium	0	0	45	37
High	0	0	0	0

**Fertilizing Interseedings:** Interseeding is seeding a legume or more productive grass into the permanent grassland with a minimum amount of tillage. If fertilizer is needed, a broadcast application normally will stimulate the existing grass sod, resulting in severe competition with the new seedlings. Therefore, broadcast applications of fertilizer generally should be deferred until after the interseeded species have become established.

The value of using a starter fertilizer for interseeding has not been adequately demonstrated. A soil test may reveal that native grasslands are low in either nitrogen or phosphorus or both. If phosphorus is deficient and a legume is being interseeded, it is important that the phosphorus be applied, but it should be placed in a band immediately below or to one side of the seed. If equipment is not available for band application, it usually is best to defer fertilization until after the seedlings are well established.

**Fertilizing and Weed Control:** Weeds present in grasslands are stimulated by fertilization and should be controlled either by clipping or spraying for optimum forage production. A failure to control broadleaf weeds when fertilizer is added actually may reduce forage yields. Investigations show that recommended applications of fertilizer, proper mowing, and regulated grazing will keep weeds under control.

### Fertilizing Established Legumes

Legumes have the capacity of extracting atmospheric nitrogen and fixing it in the soil, and thus furnishing their own nitrogen needs for growth. However, to assure symbiotic nitrogen fixation, seed inoculation is recommended with nitrogen-fixing bacteria specific for that legume.

Legumes are heavy users of phosphorus and potassium. Fertilizer application rates for these two elements on established legume stands should be based on soil test results (as listed in Table 4). Apply the fertilizer by top-dressing either in the fall or as early as possible in the spring. If application is not

possible in the spring because of wet ground, top-dress after removal of the first crop of hay.

### FERTILIZING ESTABLISHED GRASS-LEGUME MIXTURES

Fertilizing established stands of grass-legume mixture is important. Applying phosphorus and potassium fertilizer to mixed stands frequently increases legume vigor and growth more than that of the grass. More legume growth, however, permits greater nitrogen fixation by the legume, thus assuring more available nitrogen for increased growth and vigor of the grass. This effect is more likely to occur where the forage stand consists of more than 35% legumes. Fertilizer application rates correspond to those in Table 4 and vary from 40 to 60 pounds of phosphorus ( $P_2O_5$ ) and 45 to 80 pounds of potassium ( $K_2O$ ), depending on soil tests.

Where mixed legume-grass stands contain predominantly grass vegetation, maximum forage yields will be obtained by applying fertilizer containing nitrogen. The fertilizer nitrogen rates under these conditions vary from 40 pounds in areas where limited rainfall may restrict yield, to 100 pounds in extreme eastern South Dakota (as found in Fig. 1). Eventual loss of the limited number of legume plants in such a stand may be expected where straight nitrogen is used. If legume plants are to be kept in the stand, some phosphorus and potassium should be applied with nitrogen fertilizer.

### Fertilizing Irrigated Forage

Irrigation can provide substantially greater forage yields, therefore a correspondingly greater amount of plant food is required. The ratios of nutrient demands of irrigated plants differ little from those grown under dryland conditions.

Phosphorus and potassium application rates for both established alfalfa and grass stands under irrigation should be increased 50 to 100%, depending upon the yield potential, over those recommended for the dryland condition. For example, a recommendation for established dryland alfalfa forage, calling for 0+60+45 would be increased to a minimum of 0+90+60 if the same field is to be irrigated.

Nitrogen application rates for established irrigated grass to be harvested for forage should be increased to 160 pounds of actual nitrogen per acre (see Fig. 1). This 160-pound rate should be a split application for hay, half of it in early spring and the other half immediately after the first cutting. For pasture, the second half should be applied immediately after the spring growth has been grazed.

**Table 4. Recommended Dryland Fertilizer Rates for Established Legume Stands and New Seedlings in Hay and Pasture.\***

Soil Test	Fertilizer (Pounds per Acre)			
	$P_2O_5$ or P		$K_2O$ or K	
Very Low .....	60	26	80	66
Low .....	60	26	60	50
Medium .....	40	18	45	37
High .....	0	0	0	0

\* (a) On established stands, apply fertilizer every other year unless yields exceed 3 tons per acre, then apply fertilizer every year.

(b) For new seedlings, apply nitrogen at one-fourth the phosphorus application rate, regardless of the soil test for organic matter (nitrogen availability).

## FERTILIZING NEW SEEDINGS

**New Legume Seedings:** The stand, seedling vigor and eventual yield of a legume can be improved by using fertilizer at seeding time. This practice can mean the difference between a good stand and essentially no stand where soil fertility levels are very low.

The application of starter fertilizer at seeding time can be done either with a fertilizer attachment on the seeding equipment, or broadcasting before preparation of the seedbed.

Fertilizer rates at seeding time mainly should be based on the available plant nutrients in soil. Soil tests are an effective way to determine these existing soil fertility levels.

Fertilizers containing nitrogen and phosphate in 1-to-4 ratios (11-48-0; 8-32-0) are well suited for use as a starter. Table 4 shows fertilizer rates to be used at seeding time depending on soil test level. For example, a soil testing **very low** in phosphorus and **medium** in potassium would require a fertilizer application rate of 60 pounds of phosphorus ( $P_2O_5$ ) and 45 pounds of potassium ( $K_2O$ ) per acre for a new legume seeding, with the nitrogen application being one-fourth the rate of phosphorus, or 15 pounds of nitrogen (N).

**New Grass Seedings:** Proper fertilization also improves grass seedling vigor and stands. Use of starter fertilizer at the suggested rate (See Table 4) is a recommended practice for new grass seedings providing weeds can be properly controlled by either herbicide or clipping. Starter fertilizer can be applied with an attachment on the seeding equipment or by broadcasting. New grass and legume seedlings initially have about the same nutrient needs. Recommended fertilizer rates and application methods for

new grass seedings are the same as those for new seeding of legumes (see Table 4).

**New Grass-Legume Seedings:** The same fertilizer rates are recommended for new seedings of mixed stands as used in pure legume and grass stands.

## FERTILIZING SEED PRODUCTION

Proper fertilization can increase seed production of legumes and grasses. Fertilizer rates for established legume seed fields are the same as those for forage production (See Table 4).

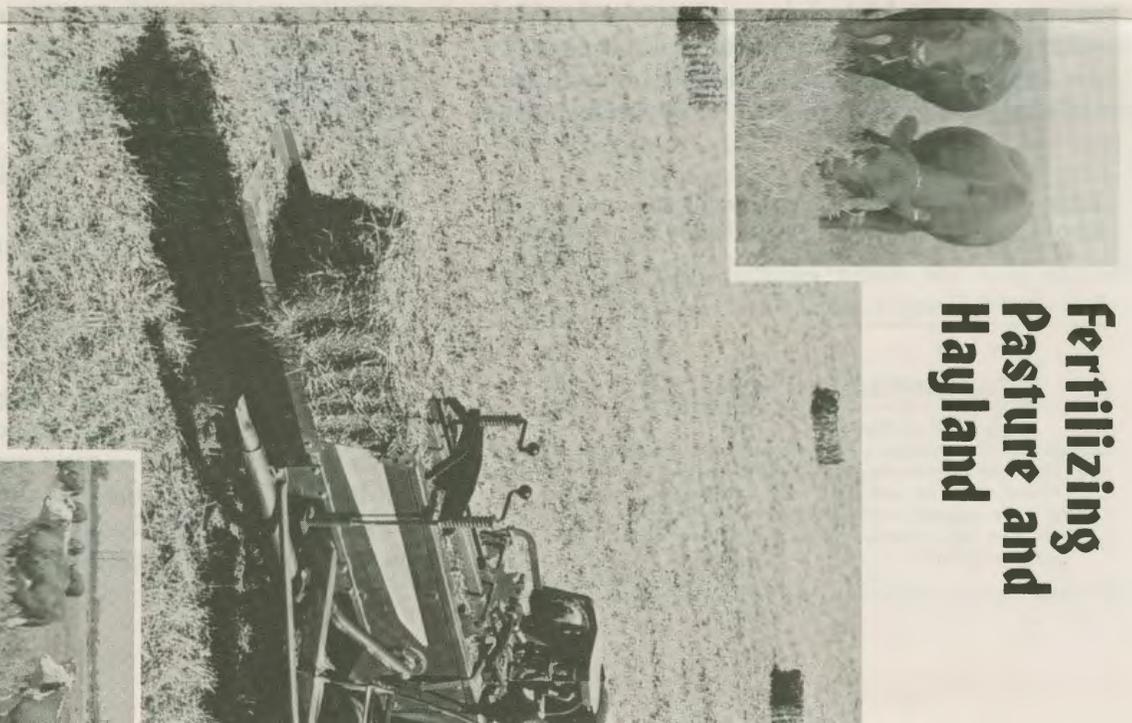
Fertilizer, especially nitrogen, can help increase grass seed production. Fertilizer should be applied at the rates of 40 pounds actual nitrogen per acre in lower rainfall areas of South Dakota and up to 100 pounds in higher rainfall areas. Best results are obtained from application in late September or early October of the year before seed harvest. Additional phosphorus, and in some cases potassium, also may be needed for top seed production on fields suspected of having unusually low fertility. Phosphorus and potassium may be applied at the same time with nitrogen as a mixed fertilizer at rates shown in Table 3, based on soil tests.

### Fact Sheets for Additional Information

- Cool-Season Grasses for Early Spring and Fall.
- Cool-Season Grasses for May and June.
- Warm-Season Grasses for July and August.
- Grasses for Special Purposes.
- Grazing Management Based on How Grasses Grow.
- Interseeding and Modified Renovation
- Alternative Pasture and Forage Systems
- Alfalfa Management
- Chemical Weed Control in Pasture, Range and Hayland.

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