FERTILIZER guide

FG 63
Reprinted January 2000

Pastures

Western Oregon and Western Washington

J. Hart, G. Pirelli, L. Cannon, and S. Fransen

In western Oregon and Washington, forage shortages typically occur in late fall and early spring. In contrast, an excess supply may exist in late spring. By fertilizing in early fall and late winter, you can increase forage supply in deficient times. To reduce production in times of excess, reduce or eliminate late spring fertilization.

A single fertilization program will not fit all pastures. Determine which combination of grazing management, fertilization, and irrigation fits your resources and environment. Use a soil test and an assessment of forage supply and forage species to determine fertilizer need.

If suitable species are not present, fertilization will not compensate. In this case, consider renovating the pasture.

New Seedings

Match the pasture species to site conditions and livestock needs when renovating a pasture. Cows prefer grasses over legumes and graze perennial ryegrass before tall fescue. Sheep graze selectively, preferring clover and grass mixtures with short, lush feed to tall, coarse plants.

Horses are selective grazers, eating a wide range of plants. The horse digestive system cannot handle large amounts of legumes. Small and frequent amounts of forage are best. Horses avoid grazing near their own manure and urine; therefore, managing grazing on horse pastures is difficult.

Cool season forages such as tall fescue, perennial ryegrass, orchardgrass, subclover, and white clover are suited for our climate.

After choosing the appropriate forage species and planting method, use a soil test as the basis for fertilization. EC 628, *How to Take a Soil Sample . . . and Why*, contains instructions for obtaining a soil sample.

For a preplant soil test, obtain samples from the tillage depth, generally the surface to 6 inches. If you use a minimum tillage method of planting, you may wish to divide the sample into two parts: the top 2 inches and the lower 4 inches.

Analyze the soil sample for the following:
- pH
- Lime requirement (SMP or LR)
- Phosphorus (P)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)

Soil pH indicates whether lime is needed, and the SMP buffer or lime requirement (LR) test estimates the amount of lime needed. Estimate the rate of lime application from the following SMP buffer table.

Table 1.—Lime application rates for grass or white clover-grass pastures.

If the SMP buffer test for lime is:	Apply this amount of lime (t/a):
under 5.5	4–5
5.5–5.8	3–4
5.8–6.1	2–3
6.1–6.5	1–2
over 6.5	0–1

If soil pH is below 5.5, incorporate lime for stand establishment and longevity. Mix lime into the seedbed before seeding to allow time for lime to neutralize soil acidity.

Exceptions to Table 1 are subclover seedings and pastures on coastal county bottomland soils. For new subclover seedings where the pH of the top 2 to 3 inches of soil is 5.5 or lower, mix 1 to 2 t lime/a into the surface 2 inches of soil before seeding. Using lime-pelleted seed also can improve seedling establishment on acidic soils.

If your pasture is on coastal county bottomland soils, apply a maximum of 2 t lime/a if the soil pH is below 5.5.

Additional information about lime requirement and the SMP buffer is in FG 52, *Fertilizer and Lime Materials*.

Nitrogen fertilization usually is necessary to establish grass forages in western Oregon and Washington. Broadcast 20 to 40 lb N/a at planting, or band this amount 1 to 2 inches below the seed. When P or K is needed, N can be banded with these nutrients. The total N plus K_2O in the band should not exceed 100 lb/a. *Do not include B in band applications because this concentration of B can be toxic to seedlings.*

Working P into the top 2 inches of the soil during seedbed preparation is more effective than broadcasting after seeding. The most effective P application method is banding.

If you band P, place the band 1 to 2 inches to the side or below the seed. Some soil should separate seed from fertilizer. Phosphorus fertilization rates are given in Table 2.

In new clover or clover and grass seedings, broadcast K and work it into the seedbed anytime before seeding. See Table 3 for fertilization rates based on a soil test.

John Hart, Extension soil scientist; Gene Pirelli, Extension agent, Polk County; Lynn Cannon, Extension agent emeritus, Coos County; Oregon State University; and Steve Fransen, Washington State University. Reviewed by western Oregon county Extension agents.

OREGON STATE UNIVERSITY
EXTENSION SERVICE

If soil test K is below 125 ppm, band an additional 20 lb K_2O/a at the time of planting. At least 1 inch of soil should separate the seed and fertilizer. Potassium can be banded with N and P. Potassium fertilization at planting will not meet the need for K in subsequent years.

Inoculate legume seed immediately before planting to ensure an adequate supply of nitrogen-fixing bacteria. Use fresh, effective live culture of the correct rhizobial strain.

Established Pastures

Manage fertilization and grazing jointly in established pastures. Although growth rates are influenced by temperature, moisture, solar radiation, and soil fertility, grazing management has a profound impact on pasture production.

New Zealand sheep producers use plant growth phases in ryegrass pastures to manage pasture growth, grazing, and fertilizer applications. Phase I (lag phase), Phase II (vegetative phase), and Phase III (maturity) describe the stages of growth and the impact on grazing and dry matter production.

Grass-clover pastures in Phase II provide high-quality feed. The goal is to graze before excess forage is produced (Phase III) and to supply fertilizer for rapid regrowth after grazing.

Figure 1 is an example of how this works with a perennial ryegrass pasture grazed by sheep or cattle. In Phase I (3/4 inch, 550 lb of dry matter), the plants grow very slowly because they lack sufficient leaf area for photosynthesis.

Phase II (3/4 to 4 1/4 inches high, 550 to 1,900 lb of dry matter/a) growth is desired in pastures. Plants grow most rapidly and efficiently in this stage. Their leaf area is great enough for efficient use of sunlight.

Growth slows in Phase III (greater than 4 1/4 inches), as lower leaves become shaded and die, and the plant moves toward maturity and seed production.

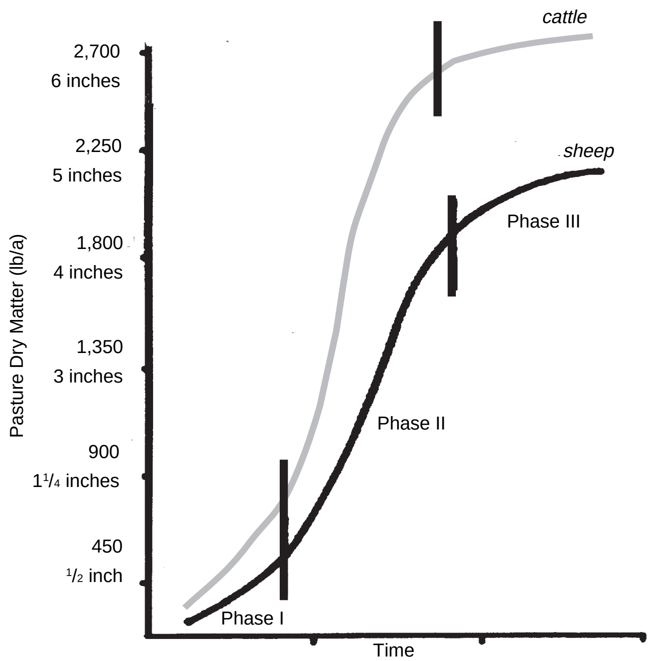

Figure 1.—Rate of perennial ryegrass pasture regrowth following grazing. For other grasses, multiply height by 2.

The grey line represents Phases I, II, and III if the pasture were managed for cattle. Cattle do not graze as closely as sheep, so the growth curve is based on higher initial and residual dry matter amounts. Other grass species such as orchardgrass and tall fescue have similar growth phases, but the grass heights listed for perennial ryegrass should be multiplied by two.

Fertilization of established pastures should be based on a soil test and the amount of forage needed. Obtain soil samples the year after establishment and every 2 to 3 years thereafter. Obtain samples from the top 3 inches of established pastures.

Nitrogen (N)

N fertilization should be based on moisture and temperature, which control pasture growth. Time N applications to crop and forage production needs. Avoid the following:

- *N applications in November and December*. N applied to cold, wet soils in winter can be leached beyond the root zone before slow-growing plants can use the fertilizer.
- *Late winter or early spring N application to saturated soils.* Soils that are too wet to drive on with a tractor may be too wet for plant growth. The plants may be yellow due to lack of oxygen from wet conditions and not lack of fertilizer. Wait for conditions conducive to plant growth before applying fertilizer.

See Figure 2 for an application schedule.

Fall

Assume the growing season begins with the fall rains. If sufficient rain falls in September to initiate growth, apply 40 to 60 lb N/a for the fall growing season (September and October). Do not apply N if adequate rain does not fall until late October or if the air temperature drops to or below freezing in October.

Many growers apply fertilizer to dry soil and note that the granules disappear before any rain. They fear volatile N loss. Nitrogen fertilizers, especially ammonium nitrate, often disappear overnight. Usually, this N has dissolved in dew and has moved onto the surface soil.

Winter

In cold conditions, pastures will not grow enough to use fertilizer. Forages in southwest coastal sites generally grow throughout winter, while conditions in the northern Willamette Valley allow only occasional winter growth.

For warm winters in the south coastal counties, apply 50 to 60 lb N/a in January or February (in addition to fall N application). Apply 50 to 60 lb N/a in the Willamette Valley or other cooler areas when a temperature of 40 to 45°F is maintained in the surface 2 inches.

Another method to estimate nitrogen demand is to monitor air temperature, then change the air temperature into heat units. A heat unit is the average of the high and low temperature for the day (in centigrade) and is a way to measure heat accumulation over time.

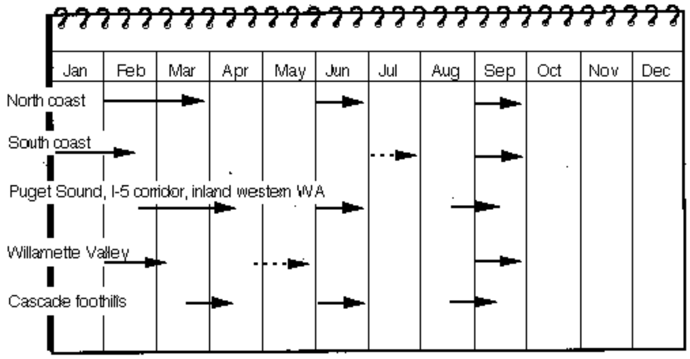

Figure 2.—Pasture nitrogen application calendar. Apply 50 to 60 lb N/a each time a solid arrow appears for your region. Additional applications for irrigated pastures are indicated by dotted lines. See nitrogen section in text for an explanation.

Table 4 shows a sample calculation of heat units. The process is as follows:

1. Beginning January 1, add together each day's maximum temperature and minimum temperature, and divide this total by 2. The result is the day's average temperature (column 4).
2. If this average temperature is in Fahrenheit, convert it to centigrade (column 5). To convert to centigrade, subtract 32 from the Fahrenheit temperature and then multiply by 0.556. For example:

   42°F - 32 = 10

   10 x 0.556 = 5.6°C

   The centigrade average temperature is the number of heat units accumulated for that day. (If the average temperature is below freezing, give it a heat unit value of zero.)
3. To find the number of heat units that have accumulated since January 1, add together the heat units for each day (column 6).

Apply nitrogen when 200 heat units are accumulated or soon thereafter. The 30-year average for accumulation of 200 heat units is January 30 to February 14 in the Willamette Valley. Foothill temperatures and pasture growth typically lag 2 to 3 weeks behind the Willamette Valley.

Spring

Intensively grazed pastures that are expected to produce a high level of forage through June should receive a second application of nitrogen. Apply nitrogen only if moisture is sufficient for additional growth after mid-May. Apply summer N in July on irrigated coastal pastures.

Phosphorus (P)

Adequate P fertilization is particularly important for clover. Estimate the need for P fertilization with a soil test.

Table 2.—Phosphorus application rates for pastures.

If the Bray soil test for P is (ppm)	Apply this amount of phosphate (P_2O_5) (lb/a)
0–15	60–100
15–30	0–60
over 30	0

Apply P on established pastures in the fall or spring before growth begins. When using ammonium phosphate materials, do not over-apply N to supply adequate P.

Moderate rates of N and P (40 to 60 lb/a) applied together sometimes have a synergistic effect on plant growth. Fall applications of N and P from ammonium phosphate materials on south coastal Oregon pastures produced more forage than individual applications of either N or P.

Potassium (K)

An adequate level of available K is essential for optimal growth of clover-grass pastures. Potassium is particularly important for clover. Grass competes vigorously with clover for K. High-producing pastures can rapidly deplete soil test K. Test soil every 2 years to determine available K levels.

Potassium deficiency is indicated by light-colored spots around the margins of clover leaves and yellow to brown coloring of grass leaf tips. Growth responses to K fertilizer often can be obtained before deficiency symptoms are seen.

Table 3.—Potassium application rates for pastures.

If the soil test for K is (ppm)	Apply this amount of potash (K_2O) (lb/a)
0–125	100–150
125–200	70–100
over 200	None—Watch soil tests for K depletion

We suggest split applications of K for established, high-yielding irrigated pastures, with the first application in late

Table 4.—Sample heat unit calculation.

Day	Max Temp. (°F)	Min Temp. (°F)	Average Temp (°F) (Max T + Min T)/2	Average Temp. (°C) = Daily Heat Units	Cumulative Heat Units
Jan 1	47	37	42	5.6	5.6
Jan 2	46	32	39	3.9	9.5
Jan 3	45	36	40	4.7	14.2

heat unit = (Max T + Min T)/2. Convert temperatures to centigrade to determine heat units. The equation to convert Fahrenheit to centigrade is: (°F - 32) x 0.556.

spring to avoid tetany and the second in midsummer. For other pasture types, apply K in the fall or spring.

Sulfur (S)

Plants absorb S as sulfate. Most fertilizer materials (ammonium sulfate, gypsum, sulpomag) supply S as sulfate.

Soil sulfate, which increases in the fall, is decreased by leaching in November and December and use by microorganisms in the spring. Thus, we recommend late winter or spring applications unless there is a severe deficiency, which may require additional fall or spring applications.

You can meet pasture S requirements by applying 20 to 30 lb S/a annually as sulfate or by applying 30 to 40 lb S/a as sulfate every other year.

Boron (B)

Clover-grass pastures need adequate B. Clovers have a higher B requirement than grasses. Too much B can be highly toxic to plants; therefore, do not exceed suggested rates of B application. Distribute B evenly over the field. *Never band B-containing fertilizer materials.*

If the soil test for B is below 0.7 ppm, we suggest an application of 2 to 3 lb B/a. Mix thoroughly when applying B with other fertilizers. Spring applications are preferred. Apply B in the fall only when B is critically low.

Lime, Calcium (Ca), and Magnesium (Mg)

Soils west of the Cascades are naturally acidic. Lime applications overcome soil acidity, allowing for increased grass and legume growth. Determine the need for lime by soil pH or a calcium (Ca) soil test. The amount of lime required to raise soil pH is determined by the SMP buffer or lime requirement (LR) test. Additional information is available in FG 52, *Fertilizer and Lime Materials*.

Grass pastures have a moderate tolerance to soil acidity. We suggest a lime application if the soil pH is below 5.4 or the Ca soil test is below 5 meq Ca/100 g of soil. For acidic soils low in Mg (less than 0.8 meq Mg/100 g of soil), use 1 t/a of dolomitic lime as an Mg source. Dolomitic lime and ground limestone have about the same ability to neutralize soil acidity. Liming rate is based on 100-score lime.

Subclover is an annual, reseeding itself each year. We recommend lime on subclover pastures where soil pH in the surface 2 to 3 inches of soil is below 5.5. Broadcast 1 t lime/a on established stands.

Clovers other than subclover are more responsive to liming than grasses. We recommend a 1–2 t/a lime application when soil pH is below 5.8. Broadcasting lime on established pastures is not as effective as mixing lime with the soil at planting, but is the only alternative on established pastures.

Pasture yield responses to Mg have not been observed in western Oregon and Washington. We suggest trial applications of a soluble Mg fertilizer where soil test levels are below 0.8 meq/100 g soil.

Incidence of grass tetany, however, may make Mg applications desirable. If tetany is a problem, do not apply K fertilizer until after the tetany period, since K reduces plant Mg and can induce tetany.

For More Information

OSU Extension publications

To order copies of the following publications, send the publication's complete title and series number to:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119

Gardner, E.H., and J. Hart. *How to take a soil sample. . . and why*, EC 628 (Revised 1995). No charge

Hart, J. *Fertilizer and lime materials,* FG 52, (Reprinted 1998). No charge

Hart, J. *A List of Analytical Laboratories Serving Oregon*, EM 8677 (reprinted 1999). No charge

Other publications

Controlled Grazing Systems, Farm Production and Practice 681, New Zealand Ministry of Agriculture and Fisheries, P.O. Box 2526 (Wellington, New Zealand, 1983).

Dawson, M.D., and W.S. McGuire. *Recycling nitrogen and sulfur in grass-clover pastures,* Agricultural Experiment Station Bulletin 610 (Oregon State University, Corvallis, 1972).

Jackson, T.L., H.H. Rampton, and J. McDermid. *The effect of lime and phosphorus on the yield and phosphorus content of legumes in western Oregon,* Agricultural Experiment Station Technical Bulletin 83 (Oregon State University, Corvallis, 1964).

Kilgour, R., and C. Dalton. *Livestock behavior, a practical guide*. Mathuen Publications (New Zealand, 1942).

McCarthy, M.J. *Some effects of sulfur fertilization on the nutrient value of subclover-grass forage.* M.S. thesis (Oregon State University, Corvallis, 1976).

Rogers, J. *The Effect of Topdressed Lime Upon Pasture Production and Quality.* M.S. thesis (Oregon State University, 1996).

Suggested P, K, Mg, B, and lime applications are based on soil test methods used in the Central Analytical Laboratory, OSU, Corvallis, OR. This fertilizer guide is based on experiments and field trials conducted by Lynn Cannon, M.D. Dawson, E. Hugh Gardner, John Hart, T.L. Jackson, W.S. McGuire, and Gene Pirelli, Agricultural Experiment Station and Extension Service, Oregon State University. This guide replaces FG 1, *Irrigated Clover-Grass Pastures (W. Ore.)*; FG 4, *Subclover-Grass Pasture (W. Ore.)*; FG 16, *Perennial Grass Pasture (W. Ore.)*; FG 58, *Irrigated Clover-Grass Pastures (SW Ore.)*; and FG 63, *Subclover-Grass Pastures (W. Ore.)*.

Revised April 1996. Reprinted January 2000.