White Clover & Bluegrass

Most clover-bluegrass pastures are grown in the mountains at elevations above 2000 ft. The most prevalent fertility problem is low P. When P_2O_5 and K_2O are recommended, apply full amounts either in early spring or fall. Although response to P often exceeds that to lime, most mountain pastures are quite acid and benefit from liming.

A balanced clover-grass stand does not need N, and the N supplied by the clover does not promote excessive competition by the grass. However, a N application of 50–60 lb/acre can be used to shift peak production to an earlier period: apply in early August for fall growth, March for early spring growth. When applying N early, keep grass grazed to 8 inches or less to protect clover.

Cool-Season Perennial Grasses

The N rates for cool-season grasses—such as fescue, bluegrass, orchardgrass and timothy—range from 100 to 200 lb/acre to allow adjustment for soil type, geographic region and level of production desired for hay and grazing. For tall fescue hay, apply 200 lb/acre on sandy soils and 160 lb/acre on fine-textured soils. On tall fescue pastures for grazing, NCDA&CS recommends 150 lb/acre on sandy soils and 120 on fine-textured soils.

The timing of a N application is important for best results. Apply half the N in mid-February–March and half in mid-August–September. Mid-August is best for western piedmont and mountain pastures. September is best for eastern piedmont and coastal plain pastures.

Warm-Season Annual Grasses

For millet, crabgrass, Sudan grass and Sudan-sorghum hybrids, the NCDA&CS recommends applying N at a rate of approximately 50–70 lb/acre/yr at or before seeding. Apply the remainder in increments of 40–60 lb/acre after each cutting or grazing period. For more information, refer to the earlier section on **RYE N Rates**.

Warm-Season Perennial Grasses

When establishing common and/or hybrid bermuda or bahia on sandy soils where K leaches, apply only half the K_2O before sprigging or seeding and the remainder at midseason. When plants start to grow, apply N at 30–40 lb/acre over the row and then another 30–60 lb/acre when runners appear (6–8 weeks after planting).

To maintain an established bermuda pasture on sandy soils, make split applications of K_2O that coincide with N treatments (3–4 applications per year, depending on the extent of grazing or the number of cuttings). Adequate K is essential to reduce leaf spot, safeguard against winter kill, and optimize yield and quality. Submit soil samples in late summer to find out if K will be needed in the fall.

N rates for hybrid bermudagrass hay vary based on soil type: 220 lb/acre for sandy soils, 175 lb/acre for fine- and medium-textured soils. Apply 50–60 lb/acre in April and the rest in equal amounts in June and mid-July or after each cutting. For more information, refer to the section on **RYE N Rates**.

Grazing: Nitrogen Rate Reduction

When pastures are grazed, nutrients are recycled. In open-grazing systems, total N rates may be reduced by 25%. Under controlled grazing, a more uniform distribution of animal waste occurs and total N rates may be reduced by 50%.

North Carolina Department of Agriculture and Consumer Services

Steve Troxler, Commissioner of Agriculture

NCDA&CS Agronomic Division

Colleen M. Hudak-Wise, Ph.D., Director

www.ncagr.gov/agronomi/

(919) 733-2655

Mailing Address
1040 Mail Service Center
Raleigh NC 27699-1040

Physical Address / Location
4300 Reedy Creek Road
Raleigh NC 27607-6465

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NOTE 12: Fertilization of Forage & Pasture Crops

Production of quality forage requires a balanced pH and nutrient regime. Soil testing is the best way to determine lime and fertilizer requirements. Submit soil samples from established pastures, hay meadows and silage fields every one to three years to meet yield goals and animal nutritional requirements.

Lime

Lime is recommended to neutralize soil acidity. When possible, till lime into the soil. On no-till sites or established fields, surface applications are beneficial; however, do not apply more than 1.0 ton/acre at one time.

If recommendations exceed 1.0 ton/acre, apply the excess in 1.0-ton/acre increments every 6–9 months until the full rate is applied. Lime rates depend on the current and target soil pH for the specified crop or soil class. The target pH for forage crops depends on soil class: 6.0–6.5 for mineral (MIN) soils, 5.5 for mineral-organic soils and 5.0 for organic soils.

There are two types of agricultural lime. Calcitic lime is calcium carbonate ($CaCO_3$). Dolomitic lime is a mixture of calcium and magnesium carbonates [$CaMg(CO_3)_2$] and contains a minimum of 120 lb of Mg per ton. Dolomitic lime is an economical source of Mg and reduces the risk of grass tetany in livestock.

Another potential source is lime-stabilized sludge containing calcitic lime. If used, monitor soil Mg levels. When Mg is needed, 25–30 lb per acre are adequate.

For establishment of perennial grasses, NCDA&CS recommends enough lime to raise the pH to 6.5 on MIN soils. This initial application, which is tilled into the soil, fosters a pH that allows for a longer production period before additional lime is needed. After establishment, a target pH of 6.0 is appropriate for forage production on MIN soils.

Phosphorus (P), Potassium (K) & Sulfur (S)

Soil testing accurately predicts phosphate (P_2O_5) and potash (K_2O) needs. The following are general guidelines for fertilizing forage crops at planting and

after establishment. Specific nutrient suggestions are given later by crop.

Prior to establishing any forage, refer to current soil recommendations for P_2O_5 and K_2O rates. If P_2O_5 is needed, till it into the plow layer prior to planting, if practical, since its movement in soil is limited. Incorporation is especially critical when P-I values are medium or low (< 50), especially on perennial crops that are to be productive for several seasons. When P-I values are high and less P_2O_5 is recommended, incorporation is not as critical. Commonly available sources of P are triple superphosphate (0-46-0), superphosphate (0-20-0) and diammonium phosphate (18-46-0).

For established crops, apply P_2O_5 before plants begin new growth. P_2O_5 applied just before rainfall should be incorporated, otherwise runoff is likely. To maximize economic return and avoid excessive accumulation in soil, apply P_2O_5 only if recommended. Special considerations related to P use may apply in river basins designated as Nutrient Sensitive Waters.

When K_2O is recommended for new plantings, you can apply the full rate and incorporate it with P_2O_5 on medium and fine-textured soils. K may leach on sandy soils that have low water-holding and cation exchange capacities (CEC), especially in seasons with excessive rainfall. Split applications may increase use efficiency. On such sites, apply half the recommended rate at planting. Apply the rest at midseason of new growth or split it into two equal applications during the growing season.

For crops established on medium- or fine-textured soils, apply all of the K_2O just before new growth begins. On sands, apply half at the start of the growing season and the rest at midseason. Alternatively, apply K_2O in equal applications after each cutting or at each nitrogen (N) application, depending on the crop. Commonly available sources of K are muriate of potash (0-0-60), potassium sulfate (0-0-50) and potassium magnesium sulfate (0-0-22).

Sulfur (S) is usually present in adequate amounts in medium- and fine-textured soils. Like K, it may leach on sandy soils. The soil test report gives a S recommendation whenever S-I < 25. On crops receiving N applications, apply any recommended S when N is first applied. Since S leaches readily, it may be adequate at the time of the report but be limiting later during the season. Plant tissue analysis can be used in-season to test for sufficiency. To ensure hay quality, forage testing is also suggested.

Realistic Yield Expectation (RYE) N Rates

N rates for annual and perennial grasses are available based on yield expectations by soil type. These rates are required for waste and nutrient management plans in some North Carolina river basins. Rates using the RYE approach are available online at www.soil.ncsu.edu/nmp/yields/.

Table 1 provides guidelines for estimating yield based on general N rates. A given N rate does not guarantee a specific yield due to other limiting factors, such as pH, P, K, rainfall and management.

Animal Waste as a Nutrient Source

Soil application of poultry and animal wastes provides nutrients such as N, P_2O_5, K_2O and S. Use of livestock wastes reduces the need for commercial fertilizers and disposal of waste products. Waste products should be analyzed for nutrient content prior to application. The NCDA&CS Agronomic Division provides a waste analysis service that helps determine suitable applications rates.

Always use a current soil test report as a guide in animal and poultry waste management plans. On farms governed by water quality or waste regulations, base N and P_2O_5 rates on nutrient management guidelines. Off-site movement of both N and P can negatively affect water quality. Also, excess N from manure causes overabundant vegetative growth, which promotes plant disease and causes nitrate poisoning in livestock.

Animal wastes may contain high levels of micronutrients (zinc and copper) so soil levels should be monitored.

Table 1. Dry yield (tons/acre) of forage based on nitrogen application (from Green JT 1994, personal communication) *

	Nitrogen Rates (lb/acre)	
Forage Crop	100	200
Hybrid Bermuda, Gamagrass	2.5–3.0	4.0–5.0
Common Bermuda, Bahia	1.8–2.3	3.0–3.8
Fescue, Orchardgrass, Timothy, Prairiegrass	2.0–2.5	3.5–4.0
Ryegrass (winter annual)	1.5–2.0	3.0–3.5
Small Grain (silage)	1.5–2.0	N/A
Sorghum-Sudan, Millet, Crabgrass	2.0–2.5	3.5–4.5
Sorghum (silage)	3.0–4.0	5.0–7.0
Switchgrass	2.0–4.0	3.0–4.5

* This table is a guide to help select N rates best suited to your soil and management conditions. N rates of 250 lb per acre will increase perennial grass yields on highly productive soils with adequate moisture and intensive management. For more information, see N.C. Agric. Res. Serv. Tech. Bull. 305, *Production and utilization of pastures and forages in N.C.*

Alfalfa

Alfalfa is very sensitive to acid soils. It requires a soil pH of at least 6.5 for optimum growth. Adequate Ca levels are also essential for high yields. Lime not only neutralizes soil acidity but also provides essential Ca and Mg.

Molybdenum (Mo) is a micronutrient essential for symbiotic N fixation (nodulation); it is more available as soil pH increases. For soils inherently low in Mo, a rate of 0.25–0.5 lb per acre is suggested.

When seeding legume forage crops, use an inoculant containing Mo. On established fields, a foliar application of 3.0 ounces of Mo in 25 gallons of water per acre will correct a deficiency. Apply foliar Mo in spring before new shoots are 2–3 inches high.

Alfalfa also requires high levels of boron (B). Since most soils are low in B, broadcast 3.0 lb/acre for establishment and 2.0 lb/acre/yr for maintenance. NCDA&CS does not analyze soil for Mo and B but can analyze levels in plant tissue. If nutritional problems develop during the growing season, submit both soil and plant samples to help diagnose the cause.

Alfalfa requires high soil P and K (P-I, K-I > 50) to sustain yields. The K removed from the soil by the crop must be replenished with fertilizers. Where K may leach, apply half the recommended K_2O in March. Apply the remainder in June after the second cutting. If leaching is not a concern, apply all the K_2O in fall, in early spring or in split applications.

Clover-Grass Mixtures

Well-balanced clover-grass mixtures that contain tall fescue, orchardgrass, prairiegrass or timothy do not need N. Application promotes competition between clover and grasses that favors grass. However, if the clover stand is less than 25% and re-establishment of clover is not desired, apply fertilizers as recommended for pure grass stands. Refer to the section **Cool-Season Perennial Grasses** for fertilizer and lime recommendations.