

Chapter 5. Crop Production

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Table of Contents

Introduction.....	96
Agronomic crops.....	96
Barley	96
Buckwheat.....	97
Corn, field	97
Corn, popcorn	98
Cotton.....	99
Oats	99
Peanuts	100
Rapeseed (canola)	100
Rye	101
Sorghum, grain (milo).....	101
Sorghum, sweet.....	102
Soybean.....	102
Sugar beet.....	103
Sunflower	103
Tobacco, burley.....	104
Tobacco, dark-fired.....	104
Tobacco, flue-cured	104
Tobacco, sun-cured.....	105
Wheat, winter.....	105
Nitrogen uptake and fertilization for corn and small grains	106
Corn.....	106
Small grains	107
Forage, hay, and cover crops	109
Alfalfa	109
Alsike clover	110
Austrian winter pea and field pea	110
Bermudagrass.....	111
Birdsfoot trefoil.....	111
Bluegrass, Kentucky	112
Bromegrass, smooth.....	112
Caucasian bluestem.....	112
Comfrey, Quaker (Russian comfrey).....	113

Crimson clover.....	113
Crownvetch.....	114
Eastern gamagrass.....	114
Fescue, sheep's	114
Fescue, tall	115
Lespedeza bicolor	116
Lespedeza, Korean and Kobe	116
Lespedeza, Sericea.....	116
Matua prairiegrass.....	117
Millet, foxtail	117
Millet, pearl.....	118
Orchardgrass	118
Red clover	119
Redtop.....	119
Reed canarygrass	120
Ryegrass, annual and perennial.....	120
Sorghum, forage.....	121
Sudangrass and sorghum-sudangrass hybrid	121
Sweet clover.....	121
Switchgrass	122
Tall meadow oatgrass	122
Timothy.....	123
Vetch, hairy.....	123
White clover, common.....	123
White clover, ladino.....	124
Links to information on turfgrass, fruit, and vegetable production	125
References cited.....	126
References for additional information	126

Introduction

The following lists of agronomic, forage, hay, and cover crop descriptions are condensed from Part I of the Virginia Tech Agronomy Handbook (Brann et al., 2000), with some modifications based on recommendations from the University of Delaware. **These are meant to be a general guide only.** For specific fertilizer recommendations and planting/harvest dates for your area, or more details on a particular crop, please consult your state Cooperative Extension Service, or see:

- Penn State Agronomy Guide: <http://agguide.agronomy.psu.edu/>
- Virginia Tech Agronomy Handbook: <http://www.ext.vt.edu/pubs/agronomy/>

Other useful regional websites include:

- Agronomic Crop Nutrient Recommendations Based on Soil Test and Yield Goal (Maryland Cooperative Extension): <http://www.agnr.umd.edu/MCE/Publications/PDFs/SFM1.pdf>
 - Maryland Cropping Systems Research and Extension page: <http://www.nrsl.umd.edu/extension/crops/>
 - University of Delaware Cooperative Extension Agronomy page: <http://ag.udel.edu/extension/agnr/agronomy.htm>
 - West Virginia University Extension Service Field Crops page: <http://www.wvu.edu/%7Eagexten/flcprps/index.htm>
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Agronomic crops

Barley

Barley (*Hordeum vulgare*) is an annual whose grain is used primarily for animal feed. Barley is also used for silage and in mixtures with other small grains for cover crops and winter grazing and has limited use in human food.

- **Fertilization:** For N, see “Nitrogen uptake and fertilization for corn and small grains” section. Apply P and K according to soil test recommendations. These applications should be large enough to supply nutrients to the succeeding crop if the small grain will be double-cropped. Split applications of K are preferred on soils with high leaching potential.
- **Nutrients of Special Interest:** Sulfur deficiencies can occur on coarse-textured soils with low organic matter contents. The entire S requirement should not be applied at planting due to loss potential. Apply 10 to 15 lbs

S/A to S deficient soils with the first N application in late winter/early spring. Determine S tissue content at Zadoks' growth state 30, and if the N:S ratio is greater than 15:1; apply recommended S with the growth stage 30 N application.

- **Soil pH Range:** 6.0-6.5. Barley is very sensitive to low pH and very sensitive to low available Mn levels on sandy soils if the pH is too high.
 - **Approximate Planting Date:** About 2 weeks before first average frost in fall.
 - **Harvesting:**
 - Grain: Combine when fully ripe and 12-14% moisture.
 - Silage: Cut in the soft dough stage or boot stage depending on forage requirements.
 - **Approximate Harvest Dates:** Grain: June 1-June 20; Silage: May 1-June 1
-

Buckwheat

Buckwheat (*Fagopyrum esculentum*) is an annual plant whose grain is used as livestock feed, particularly poultry feed, or is ground into flour. It is a good honey and green manure crop.

- **Fertilization:** 20-30 lbs N/A. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.5-6.0
 - **Approximate Planting Date:** Latter part of May to middle of July. Seeds do not set well in warm weather. Likes cool, moist climate. No-till can work well.
 - **Harvesting:** Combine grain when the maximum numbers of seeds are mature and plants have lost most of their leaves. Drying may be necessary for safe storage.
 - **Approximate Harvest Date:** Early to mid-September.
-

Corn, field

Field corn or maize (*Zea mays*) is an annual whose grain is used for livestock or poultry feed, human food products, and silage.

- **Fertilization:** For N, see following section: "Nitrogen uptake and fertilization for corn and small grains." Apply P and K according to soil test recommendations. For silage, increase the amount of P applied by 1/3, and double the amount of K.

- **Nutrients of Special Interest:** In coarse-textured Coastal Plain soils with low organic matter, sulfur deficiency can occur upon leaching of sulfate into the finer textured subsoil. Rates of 20-50 lbs S/A are sufficient for high corn yields where conditions favor S deficiency.
- **Soil pH Range:** 5.8-6.2
- **Approximate Planting Dates:** Full-season corn should be planted one week before to one week after average date of last killing frost in spring. Corn will germinate at 50° F, but growth rate is slow until temperatures reach 60° F. Double-crop corn can be planted up to July 1.
- **Harvesting:**
 - Silage: Harvest at hard dough stage when kernels are dented, a black layer has formed at their bases, and lower leaves and husks are turning brown. Dry matter content should be 35-42%.
 - Grain: Corn is mature at 30-35% moisture. A black layer of cells is formed at the base of the kernel at maturity. If corn is harvested with a picker and cribbed, the moisture content should be no more than 20%. The optimum moisture for field shelling is between 18% and 26%. It should be dried to 13% moisture before storage.
- **Approximate Harvest Dates:** Silage: August - October; Grain: September -November.

Note: If growing **reduced-tillage or no-till corn**, an annual cover such as small grain, permanent sod, or mulch from a previous crop, is important for success. Herbicides are used to kill existing vegetation and reduce weed competition throughout the season. A specially designed planter is used to plant the corn in the mulch with no soil preparation.

Corn, popcorn Popcorn (*Zea mays everta*) is similar to field corn but is used for confection and meal.

- **Fertilization:** Same as field corn.
- **Soil pH Range:** Same as field corn.
- **Approximate Planting Date:** 1-2 weeks after date of last killing frost.
- **Approximate Harvest Date:** Shuck from standing stalks after it is thoroughly ripe. Maximum popping expansion is reached when kernel moisture is about 13-14%.

Cotton

Cotton (*Gossypium hirsutum*) is an annual grown primarily for fiber; seed used for stock feed, fertilizer and oil. It is adapted to the eastern shore and southeastern area of Virginia.

- **Fertilization:** 50-70 lbs N/A. Apply P and K according to soil test recommendations. Sidedress with 25-75 lbs N/A.
 - **Nutrients of Special Interest:** Cotton is very sensitive to deficiencies of N, K, S, and B. These nutrients can be removed by leaching rains in coarse-textured soils. Recommended rates of N, K, S, and B are based on long-term field trials over a wide range of conditions. Split applications may be required to improve fertilizer efficiency, and to ensure adequate availability throughout the growing season on soils subject to leaching,
 - **Soil pH Range:** 5.8- 6.5. The optimum pH for cotton ranges from 6.2 to 6.5. Of the crops grown in the East, cotton is among the most sensitive to soil acidity. Marked growth and yield increases have repeatedly occurred when lime was applied to acidic soils. When soil pH drops below 5.5, aluminum and manganese limit early plant growth, resulting in fewer and smaller bolls with poor lint quality.
 - **Approximate Planting Dates:** After soil begins to warm, usually about April 5-May 1.
 - **Approximate Harvest Dates:** Mid to late fall.
-

Oats

Oat (*Avena sativa*) is an annual used for grain, hay, and grazing. Oat is an excellent rotational crop for wheat or barley because it is not susceptible to the same range of diseases.

- **Fertilization:** 20 lbs of N/A in the fall. Apply P and K according to soil test recommendations. Topdress with 60-80 lbs of N/A in February or early March. These rates assume no carry over N from the previous crop.
- **Soil pH Range:** 6.0-6.5
- **Approximate Planting Dates:**
 - Winter oats: Fall and midwinter. Not recommended west of the Blue Ridge.
 - Spring oats: March-April. Not recommended for the Coastal Plain. Although they can be grown there, this usually results in lower yields than winter oat crops.

- **Harvesting:**
 - Hay: Cut in boot to early dough stage.
 - Seed: Combine when fully ripe at 10-15% moisture.
 - **Approximate Harvest Dates:**
 - Winter oats: Late June to early July.
 - Spring oats: Early to mid July.
-

Peanuts

Peanut (*Arachis hypogaea*) is an annual legume plant used for food for humans and livestock. Peanut cross-inoculates with lespedezas, cowpeas, and kudzu. The best quality peanuts are produced on well drained, light, sandy soils.

- **Fertilization:** Direct fertilization is not recommended. Increase the fertilizer application to the crop that precedes peanuts in rotation by 50-100 lbs P₂O₅ and 10-60 lbs K₂O, depending on soil test levels. Apply 900 lbs gypsum broadcast or 600 lbs banded over the row as plants begin to bloom.
 - **Soil pH Range:** 5.8-6.5
 - **Approximate Planting Date:** April 20-May 10. Soil temperature should be at least 65° F for three consecutive days.
 - **Harvesting:** Dig when approximately 70% of the shells turn brown on the inside (usually 130-170 days after planting).
 - **Approximate Harvest Date:** September 15-November 1.
-

Rapeseed (canola)

Rapeseed, or canola, (*Brassica napus*) is a cool season annual in the mustard family that reaches a height of 3-6' at maturity. Winter and spring varieties are available. It is used for an oil crop and for pasture. It is usually ready for grazing about 8 weeks after seeding.

- **Fertilization:** 60-80 lbs N/A. Apply P and K according to soil test recommendations.
- **Nutrients of Special Interest:** Rapeseed is very responsive to sulfur fertilization. Sulfur deficiencies can reduce both yield and crop quality.
- **Soil pH Range:** 5.2-6.2
- **Approximate Planting Date:** February and March, or August and September. Fall planting is recommended for canola oil crop.

- **Approximate Harvest Dates:** Harvest for oil when the seeds have dried to 15% moisture or less (9-12% preferable).
-

Rye

Rye (*Secale cereale*) is an annual, and is the most winter-hardy of small grains. Rye performs better on low productivity soils than wheat, oats, or barley. It is used for cover crop, grain, silage, and winter and spring pasture conditions.

- **Fertilization:** For N, see “Nitrogen uptake and fertilization for corn and small grains” section. Apply P and K in fall, according to soil test recommendations. If the small grain will be double-cropped, these applications should be large enough to supply nutrients to the succeeding crop. Split applications of K are recommended on soils with high leaching potential.
 - **Nutrients of Special Interest:** Sulfur deficiencies can occur on coarse-textured soils with low organic matter contents. Apply 10 to 15 lbs S/A to S deficient soils with the first N application in late winter/early spring. Determine S tissue content at Zadoks’ growth state 30, and if the N: S ratio is greater than 15:1; apply recommended S with the growth stage 30 N application.
 - **Soil pH Range:** 5.8-6.2
 - **Soil Adaptation:** Any well drained soil.
 - **Approximate Planting Date:** Plant 2 weeks before to 4 weeks after first killing frost.
 - **Harvesting:**
 - Grain: Combine when fully ripe at 10-15% moisture. Rye ripens slowly and the seed is easily damaged during harvesting.
 - Silage: Harvest at the boot stage.
 - Pasture: Earlier fall planting allows some late fall grazing. Stock heavily and rotationally to maintain leafy growth.
 - **Approximate Harvest Dates:** Grain: Mid-June - July; Silage: April - May.
-

Sorghum, grain (milo)

Grain sorghum, or milo, (*Sorghum bicolor*) is the same genus and species as forage sorghum. Shorter plant types that produce lighter colored grain have been bred. Milo will recover from high temperature and drought more easily than corn. It is used for grain and silage.

- **Fertilization:** Apply 0-25 lbs N/A following a good soybean crop or winter

legume cover crop and no more than 50 to 75 lbs N/A if following a previous grass (corn or milo) crop. Uses approximately the same amount of P and K that would be applied to corn when grown under comparable conditions.

- **Soil pH Range:** 5.8-6.2
 - **Approximate Planting Date:** 1-2 weeks after corn, when soil temperatures are at least 65° F and expected to rise. Early-medium maturing hybrids can be planted following small grain harvest.
 - **Harvesting:**
 - Grain: Harvest grain with combine when seed is mature and shells easily from the head.
 - Silage: Chop for silage when the grain is in the dough stage.
-

Sorghum, sweet Sweet sorghum (*Sorghum bicolor* var *saccharum*) is similar in appearance to forage sorghum and is used for syrup.

- **Fertilization:** 30-50 lbs N/A. Apply P and K according to soil test recommendations. Sidedress N to provide a total of no more than 70 lbs N/A when plants are 25-35 days old.
 - **Soil pH Range:** 5.8-6.2
 - **Approximate Planting Date:** 2-4 weeks after corn at 3-5 lbs in rows 30-36 inches apart. Plant 1 to 1 ½ inches deep.
 - **Harvesting:** When seeds are in hard-dough stage.
 - **Approximate Harvest Date:** September 1-October 1.
-

Soybean Soybean (*Glycine max*) is an annual legume that is used for seed, hay, and silage. Soybean should be rotated with non-legume crops.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations. Little or no yield response to added P can be expected from soybeans grown on soils testing high in P. If soil tests show a low, or sometimes a medium P level, P application will usually increase yields. Yield response to added K when soil test levels are medium or above is rare so direct K application may not always be needed. Potassium application may be split on coarse-textured soils to improve efficiency.
- **Nutrients of Special Interest:** Soybeans need 20 to 25 lbs/A of S for top

yields. Some S is present in organic matter and a sizeable quantity (1 to 15 lbs/A) is supplied through rainfall. Soil testing or plant analysis should be used to determine whether supplemental S additions are needed.

- **Soil pH Range:** 5.8-6.5
 - **Approximate Planting Date:** Up to two weeks after corn planting time for the area for full-season beans, or generally after June 15 if double-cropped with small grain. Requires soybean inoculum where soybeans are not grown regularly. Yield declines rapidly if planted later due to lack of time to develop adequate growth.
 - **Harvesting:**
 - Hay and silage: Harvest when lower leaves begin to turn yellow and pods are about half-filled.
 - Seed: Harvest when leaves have fallen, pods are brown and dry, and seed moisture is 10-15%.
 - **Approximate Harvest Dates:** Hay: August-October; Seed: September-December 1.
-

Sugar beet

Sugar beets (*Beta vulgaris*) are a biennial crop used for sugar production and livestock feed.

- **Fertilization:** 40 lbs N/A. Apply P and K according to soil test recommendations. An additional 40 lbs N/A will be needed 4-6 weeks later. Use a borated fertilizer.
 - **Soil pH Range:** 6.0-6.5
 - **Approximate Planting Date:** Late winter or early spring.
 - **Approximate Harvest Dates:** October-December.
-

Sunflower

Sunflower (*Helianthus annuus*) is a tall annual used for oil crop, bird feed, and snack food.

- **Fertilization:** 100 lbs of N/A. Apply P and K according to soil test recommendations.
- **Soil pH Range:** 5.8-6.0
- **Approximate Planting Date:** Tolerates freezing temperatures better than most crops. Can plant 2-3 weeks prior to last killing frost. Because of early

maturity, planting can continue until August 1 in southeastern Piedmont and southern Coastal Plain.

- **Approximate Harvest Date:** 110-120 days are required from planting to harvest. The seeds are mature when the backs of flower heads turn yellow.
-

Tobacco, burley

Burley tobacco (*Nicotiana tabacum*) is grown from transplants that are usually produced in greenhouses. It is used primarily for cigarette blends, with a small amount used in pipe and chewing tobacco products.

- **Fertilization:** 175-200 lbs of N/A. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** When checked in the spring, a pH of 5.8-6.2 is preferred. If the pH drops to 4.9 during the season, there is a danger of manganese toxicity.
 - **Approximate Planting Date:** Transplant mid-May to early June.
 - **Approximate Harvest Date:** Mid-August to October 1.
-

Tobacco, dark-fired

Dark fired tobacco (*Nicotiana tabacum*) is primarily exported for the manufacture of smoking tobacco, chewing tobacco, and cigars. Domestically, it is used for dry snuff.

- **Fertilization:** 135 lbs N/A. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.6-6.0
 - **Approximate Planting Date:** May 1-June 1.
 - **Approximate Harvest Date:** August 15-September 1.
-

Tobacco, flue-cured

Flue-cured tobacco (*Nicotiana tabacum*) is an annual grown from transplants, which are usually produced in greenhouses. It is primarily used in cigarettes.

- **Fertilization:** 50-80 lbs N/A. If necessary to topdress, use nitrate source of N. Apply P and K according to soil test recommendations. Use materials low in chlorine (less than 2%). Preplant fertilizer rates should not exceed 40 lbs of N and 120 lbs K₂O per acre. Additional N and K₂O can be applied as a side application to obtain the total amount of nutrients desired.

- **Soil pH Range:** 5.5-6.0
 - **Approximate Planting Date:** Transplant from April 25-May 20.
 - **Approximate Harvest Date:** Typically three harvests or primings as leaves ripen. Harvest period may last 8-12 weeks, beginning as early as mid-July and ending as late as October.
-

Tobacco, sun-cured

Sun-cured tobacco (*Nicotiana tabacum*) has smaller plants than flue cured and is primarily exported for making smoking and chewing tobacco. A small portion is used domestically for plug chewing tobacco.

- **Fertilization:** 125 lbs N/A. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.6-6.0
 - **Approximate Planting Date:** May 1 - June 1
 - **Approximate Harvest Date:** August to early September.
-

Wheat, winter

Winter wheat (*Triticum aestivum*) is an annual used for grain, grazing, and cover crops.

- **Fertilization:** For N, see “Nitrogen uptake and fertilization for corn and small grains” section. Apply P and K in fall according to soil test recommendations. These applications should be large enough to supply nutrients to the succeeding crop if the small grain will be double cropped. Split applications of K are recommended on soils with high leaching potential.
- **Nutrients of Special Interest:** Sulfur deficiencies can occur on coarse-textured soils with low organic matter content. Apply 10 to 15 lbs S/A to S deficient soils with the first N application in late winter/early spring. Determine S tissue content at Zadoks’ growth stage 30, and if the N: S ratio is greater than 15:1; apply the recommended amount of S with the growth stage 30 N application.
- **Soil pH Range:** 5.8-6.2
- **Approximate Planting Date:** After the Hessian fly-free date (or approximately one week before to one week after the first killing frost).
- **Approximate Harvest Dates:** Mid-June to July

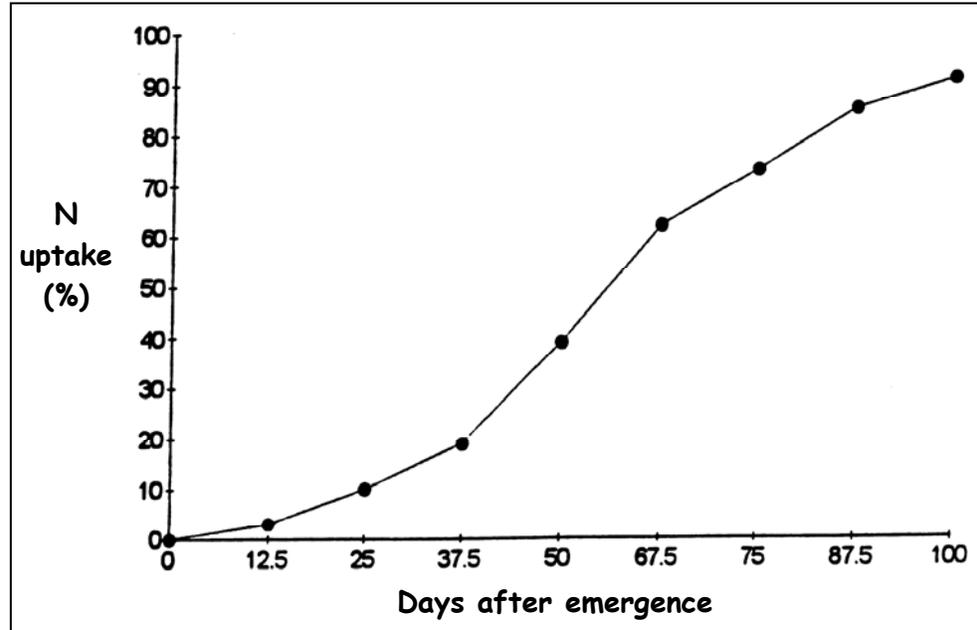
Nitrogen uptake and fertilization for corn and small grains

Corn

- **N Uptake:** Efficient fertility management of corn is critical to water quality because corn has among the highest N requirements of all crops (125-150 lbs/A). During the first 25 days after emergence, corn will utilize only 10% of its total N requirements (Figure 5.1). If the entire portion of N is applied at planting, the portion that is not utilized immediately can be lost through leaching, surface runoff, soil erosion, and denitrification.
- **N Application:** By applying approximately 30 lb/A of N at planting, and delaying the larger application until the corn is 12 to 18 inches tall, a greater portion of the applied N will be used by the crop and less will be lost to surface water and groundwater. On fine textured soils, applying the sidedress N shortly after the 12 inch stage is suggested so that rainfall will position the N in the corn rooting area in time for the maximum crop N demand. Thus, on a farm with contrasting soil textures, one should begin sidedressing soils with the most clay, followed by sandier soils. By efficiently applying N in split applications, corn can generally be grown on approximately 1 lb of N per bushel of expected yield.

For most efficient use, N applied at planting time should be banded 2 inches beside and 2 inches below the row at the rate of 20-40 lbs/A. Alternatively, if N must be broadcast at planting due to the lack of a starter fertilizer attachment, 50-70 lbs, or no more than 50% of the total crop needs, should be applied at planting. This is particularly important on environmentally sensitive sites such as soils with a high leaching index. The use of low N, high P banded fertilizers should be avoided since not enough N will be concentrated near the young corn plant for optimum growth. Banded fertilizer grades that achieve application rates of 30-0-0, 30-15-0, or 30-30-0 lbs/A N-P₂O₅-K₂O are recommended depending on the P soil test results.

Figure 5.1. Nitrogen uptake by corn.



Small grains

- **N Uptake:** Small grain crops (wheat, barley, and rye) use relatively small amounts of N in the fall. Most uptake begins in late winter at the time of jointing (Figure 5.2).
- **N Application:**
 - At-Planting Application: When using conventional tillage, broadcast and incorporate up to 30 lbs N/A during land preparation for planting. If no-till is used, broadcast up to 30 lbs N/A shortly after planting.
 - Midwinter Application: In the southern portion of the Chesapeake Bay Region (i.e., Virginia) and on very sandy soils, a midwinter (December-January) N application may be needed if the crop is developing slowly.

Three conditions should be met before this application is made. These are:

- There have been two or more rainfall events of 2 inches or more each during the October-December period.
- There are less than three *tillers* (a tiller is a shoot with three leaves/collars visible) per plant and the crop has a pale green color.
- The long range weather outlook indicates there may be several days during December and January in which maximum temperature will exceed 50° F.

If these conditions are met, apply 30 lbs N/A.

- Late Winter Applications: (February - Early March): Research on N management in small grain production continues to show advantages to dividing this application between Zadoks' growth stage 25 and at Zadoks' growth stage 30 (Figure 5.3). Topdress with 30-50 lbs of N in February if the stand is thin or shows obvious nitrogen deficiency. Additional nitrogen should be applied in late March (40-80 lbs).

Figure 5.2. Nitrogen uptake by winter wheat

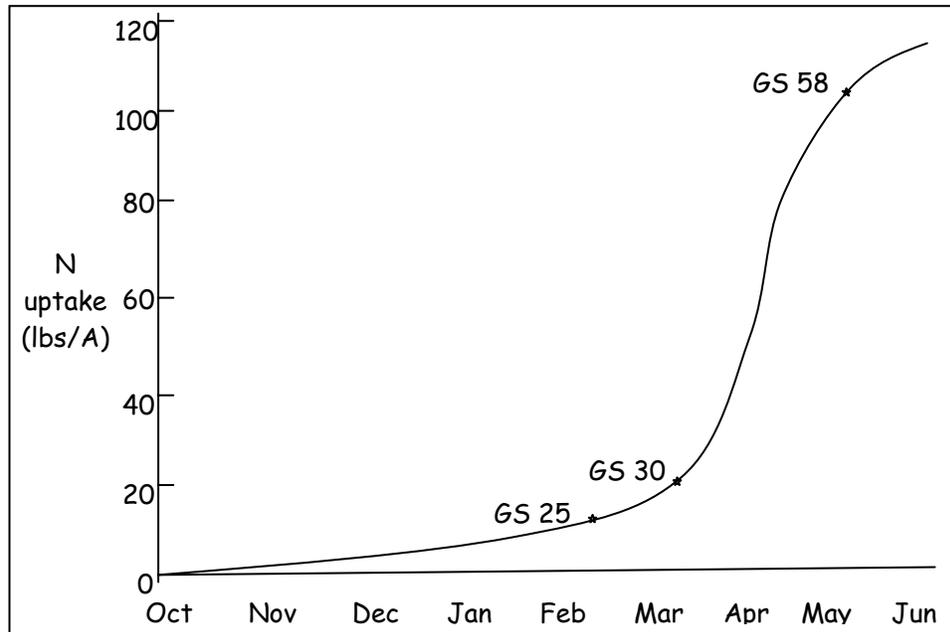
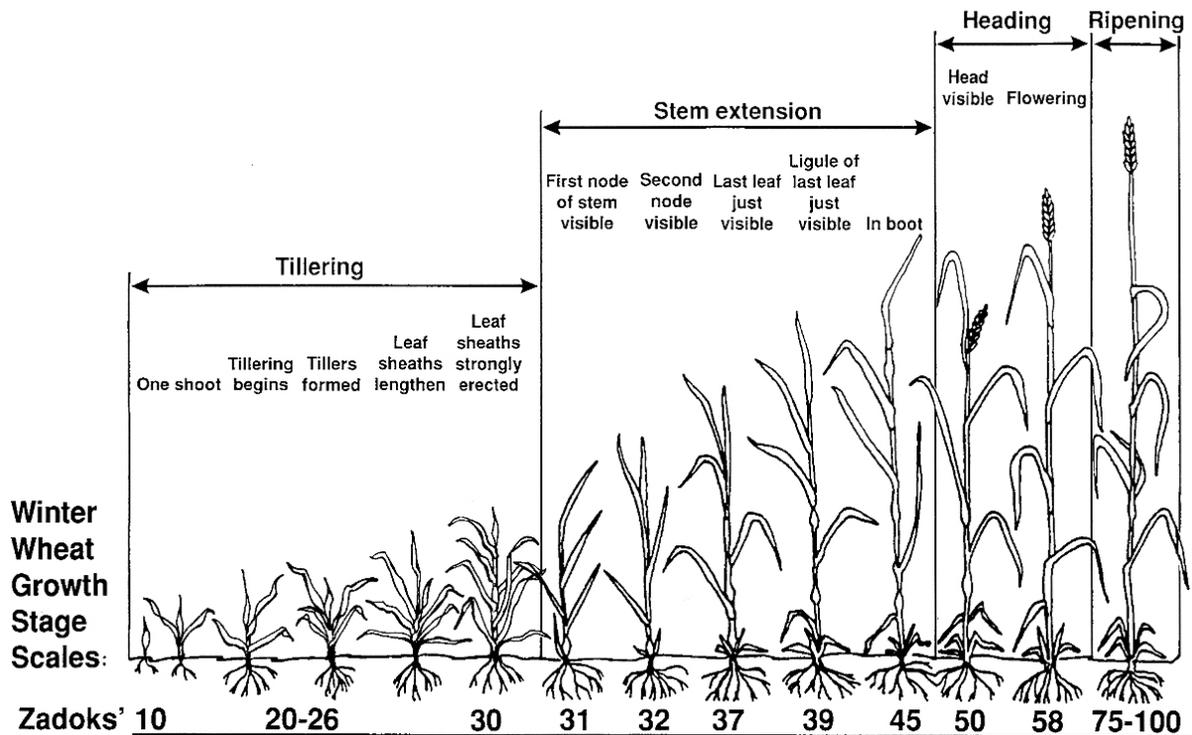


Figure 5.3. Zadoks' growth stages of winter wheat (adapted from Alley et al, 1993).



Forage, hay, and cover crops

Alfalfa

Alfalfa (*Medicago sativa*) is a perennial used for hay, pasture, and silage. Inoculation is essential. The inoculant is a live bacterial spore and should be handled to ensure that it remains live. Alfalfa cross-inoculates with sweet and bur clover. Lime-coated preinoculated seed can be used but be certain that the seed is not more than 9 to 12 months old at the time of planting, and that it has been stored correctly.

- **Fertilization:** At seeding, use 20-30 lbs N/A. Apply P and K according to soil test recommendations. Fertilizer should be split-applied, with about half applied after the first or second cutting and the second half applied after the August or early September cutting. Fertilizing during the late-summer or early fall helps plants survive the winter and make a vigorous early start next spring. Lower levels of fertilizer are required for pasture.
- **Nutrients of Special Interest:** Use borate fertilizers at a rate of 2 lbs B/A in split applications with P and K. Alfalfa may respond to S application in some instances.

- **Soil pH Range:** 6.8-7.0. If the pH is 6.0 or below, apply lime at least 6 months before the alfalfa is seeded and retest the soil prior to actually seeding the crop so additional lime can be added if the soil pH has not risen adequately.
- **Approximate Planting Dates:** 30-60 days before first killing frost in fall or 30 days before last killing frost in spring.
- **Harvesting:**
 - Hay or silage: Harvest at late bud to 1/4 bloom, except first cutting. First cutting should be made in bud stage or when orchardgrass begins to head. Alfalfa may be cut 3-5 times/year at 30-40 day intervals, depending upon location and average rainfall. Make last cutting 3-4 weeks before average date of first killing frost in fall or in time to allow 6-8 inches of regrowth. Allow at least one harvest to reach 1/10 bloom to help persistence.
 - Pasture: Use grazing-tolerant varieties under continuous stocking. Hay-type varieties should be rotationally stocked with 1-7 day grazing periods and 25-40 day rest periods. Avoid bloat by seeding with grass, turning cattle into new paddock only after forage is dry (no dew), and not allowing cattle to get too hungry prior to turn in.

Alsike clover

Alsike clover (*Trifolium hybridum*) is a perennial used for hay and pasture but it does not sufficiently recover after the first cutting for a second hay crop. Inoculation of alsike clover is important for establishment. It cross-inoculates with red, crimson, ladino, and white clover. Alsike is more tolerant of a high water table and/or acid soils than some clovers. Avoid using for grazing horses since the crop can cause photosensitivity in some horses.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations.
- **Soil pH Range:** 5.8-6.5
- **Approximate Planting Date:** 30-60 days before last killing frost in spring, or 30-45 days before first killing frost in fall.
- **Approximate Harvest Dates:** June, at 1/2 to full bloom, or when about 3/4 of the heads are ripe. Handle as other clover.

Austrian winter pea and field pea

Austrian winter pea and field peas (*Pisum sativum*) are winter annuals used for forage or cover crops. They cross-inoculate with garden peas and vetch.

- **Fertilizer:** Apply no N. Apply P and K according to soil test recommendations.

- **Soil pH Range:** 6.0-6.5
 - **Approximate Planting Dates:** Fall: September to mid-October; Spring: March-April.
 - **Harvesting:**
 - Silage: When barley or other small grain is in soft dough.
 - Hay: When in full bloom. Difficult to cure for hay.
 - Seed: When pods begin to turn brown.
-

Bermudagrass Bermudagrass (*Cynodon dactylon*) is a perennial warm-season grass used for pasture, hay, silage, and turf. Bermudagrass produces most of its biomass during June, July, and August and achieves the greatest forage potential in the southern Piedmont and southern Coastal Plain. It is propagated by sprigs (rhizome and stolon pieces) and seed.

- **Fertilization:** Apply 70 lbs N/A at planting. Apply 175-300 lbs N/A for hay and lower N rates when used as pasture. Apply P and K according to soil test recommendations.
 - **Approximate Planting Dates:** April-June.
 - **Harvesting:**
 - Hay: Cut when 8-12 inches tall before heading, or every 35-45 days.
 - Pasture: Can be continuously stocked if grazed no shorter than 2-3 inches. Rotational stocking is preferred; turn in at 6-8 inches; move cattle at 2-3 inches. Minimize seed production to maintain quality and growth rate. Do not graze during establishment year; cut for hay instead.
-

Birdsfoot trefoil Birdsfoot trefoil (*Lotus cornicalatus*) is a fine-stemmed perennial legume adapted to higher elevations in Virginia and western Maryland and to northern areas of the Mid-Atlantic region. Birdsfoot trefoil is a short-lived perennial that can reseed and is used for hay or pasture. Inoculation is essential since trefoil does not cross-inoculate with other legumes.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations.
- **Soil pH Range:** 5.8-6.5
- **Approximate Planting Dates:** March-April or August-September. Should be sown with a grass such as orchardgrass or Kentucky bluegrass.

- **Harvesting:** Harvest for hay when in bloom. Avoid clipping close if extremely dry.
-

**Bluegrass,
Kentucky**

Kentucky bluegrass (*Poa pratensis*) is a low-growing, sod-forming, perennial grass that spreads by underground rhizomes. It is used for permanent pasture and lawns and requires several years to become well established. Kentucky bluegrass provides good early grazing, goes dormant in summer, and revives in fall to again furnish good grazing.

- **Fertilization:** If seeded with white clover, 20 lbs N/A at seeding. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 6.0-6.5
 - **Approximate Planting Dates:** Late summer or early spring.
-

**Bromegrass,
smooth**

Smooth bromegrass (*Bromus inermis*) is a sod-forming, perennial grass that spreads by underground rhizomes. It is drought-tolerant, and is used for hay and pasture. Historically, smooth bromegrass is not well adapted to some areas of the Mid-Atlantic because of diseases, although newer varieties may be more disease-resistant.

- **Fertilization:** 100-200 lbs N/A. Lower N rates are required when used as pasture in split applications. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.8–6.7
 - **Approximate Planting Dates:** Early spring, or in fall. Companion crops are still used but recent research indicates that they can set back stand establishment. If planted early, fall-seeded bromegrass should not need a small grain companion crop to establish as fall weed competition should be minimal.
 - **Approximate Harvest Dates:** Early bloom stage. Do not graze or cut during stem elongation.
-

**Caucasian
bluestem**

Caucasian bluestem (*Bothriochloa caucasica*) is a warm-season, long-lived, perennial bunch grass that is used primarily for pasture, although it can be used for hay. Caucasian bluestem does not do well on extremely sandy soils or wet soils.

- **Fertilization:** Apply 60-120 lbs N/A in split applications. Apply P and K

according to soil test recommendations.

- **Soil pH Range:** 5.5-6.2
 - **Approximate Planting Date:** After soil temperature reaches 65° F in late May or early June.
 - **Harvesting:**
 - Hay: Harvest in boot stage.
 - Pasture: Maintain in vegetative stage. Loses palatability after seedhead emergence. Tolerates close grazing. Rotational stocking best.
-

**Comfrey,
Quaker
(Russian
comfrey)**

Quaker comfrey (*Symphytum peregrinum*), also called Russian comfrey, is a perennial used for green manure or as forage.

- **Fertilization:** 60 lbs N/A. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 6.0-6.5
 - **Approximate Planting Date:** Fall or early spring. Root cuttings in rows 3 feet apart in prepared seedbed.
 - **Harvesting:** Cut to a 2 inch stubble when leaves reach a length of 18-24 inches.
-

Crimson clover

Crimson clover (*Trifolium incarnatum*) is an annual legume used for green manure, hay, cover crop, and pasture crop. Inoculation is important. Crimson clover will cross-inoculate with red, alsike, ladino, and white clovers. It is best suited to the southern Coastal Plain and southeastern Piedmont. When seed is allowed to mature and the crop is cut for horse feed, or when horses are allowed to graze the mature crop, the seed capsules enclosing each seed can act as an irritant to the eyes and nasal passages of horses.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations.
- **Soil pH Range:** 5.8-6.5
- **Approximate Planting Date:** In the fall, 30-60 days before frost. Plant 20-30 lbs hulled seed alone; 15 lbs in mixtures.
- **Harvesting:** Cut for hay when most advanced heads are beginning to show faded flowers at base.

- **Approximate Harvest Dates:** Hay: May 15-June 1; Seed: June 15-July 1.
For green manure, spray or till 20-30 days before planting succeeding crop.
-

Crownvetch

Crownvetch (*Coronilla varia*) is a perennial with creeping underground roots that is used primarily for erosion control, and stabilization. It has limited potential for pasture and hay use because of limited regrowth after defoliation. Inoculation is important and a specific inoculum is required.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.5-6.5
 - **Approximate Planting Date:** Late winter or early spring at 5-10 lbs scarified seed.
-

Eastern gamagrass

Eastern gamagrass (*Tripsacum dactyloides*) is a warm season perennial bunch grass that is used primarily for grazing, but is also used for hay, silage, erosion control, and wildlife. It grows in fertile bottomland, swamps, and along stream banks. Seed dormancy is high, so special treatment is needed before planting.

- **Fertilization:** Apply 100-150 lbs N/A/Yr in split applications. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.8-6.5
 - **Approximate Planting Date:** Plant wet, chilled seed after the soil temperature reaches 60 to 65° F. Alternatively, dormant seed can be sown in November-December.
 - **Harvesting:**
 - Hay and silage: Harvest 2-3 times per year in vegetative to early head stages. Can harvest to 5 inches stubble.
 - Pasture: Use rotational stocking; turn in at 18-24 inches, graze to 8 inches residual.
-

Fescue, sheep's

Sheep's fescue (*Festuca ovina*) is a long-lived bunch grass which forms dense turf. It is used in pastures but is seldom seeded. (Commercial seed comes from Europe.) Sheep's fescue does better than most grasses on sandy soils.

- **Fertilization:** 40-60 lbs N/A. Apply P and K according to soil test

recommendations.

- **Soil pH Range:** 5.0-6.2.
 - **Approximate Planting Dates:** August or early fall is best, but may be sown in spring.
-

Fescue, tall

Tall fescue [*Festuca arundinacea* (syn *Lolium arundinaceum*)] is a long-lived, tufted, deep-rooted perennial grass which produces most of its biomass in early spring and late fall. Tall fescue is used for pasture, hay, and turf, and is also widely used for winter grazing. Most existing tall fescue stands are *endophyte-infected*, which means they are contaminated with a fungal endophyte that improves the heat and drought tolerance of the plant, but induces fescue toxicosis in cattle. *Endophyte-free* varieties are less hardy than endophyte-infected tall fescue and require more careful management. *Endophyte-enhanced* varieties are infected with a special endophyte fungus that does not produce the toxin that causes animal problems but still improves heat and drought tolerance.

- **Fertilization:**
 - Establishment: 40 lbs N/A.
 - Pasture topdressing: For winter grazing, apply 60-75 lbs N/A in mid-August.
 - Hay topdressing: 120-200 lbs N/A.
 - Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.6-6.2
 - **Approximate Planting Dates:** Early fall or spring.
 - **Harvesting:**
 - Hay: First cut when heads begin to emerge. Stems and seedheads of endophyte-infected fescue are highly toxic, especially to pregnant mares, and can significantly reduce animal gains during the heat and droughts in summer. To prevent endophyte-free fields or endophyte-enhanced fields from becoming infected, mow fields and surrounding areas to prevent seed formation in any endophyte-infected fescue plants that may be present.
 - Seed: When field takes on yellowish-brown cast and heads droop.
 - Pasture: Tolerant of continuous stocking. With rotational stocking, turn in at 8 inches; remove cattle at 2-3 inches. Keep vegetative to reduce potential problems with endophyte.
-

**Lespedeza
bicolor**

Lespedeza bicolor (*Lespedeza bicolor*) is a bushy perennial shrub that is used primarily as food for game birds and for erosion control. It is not adapted to high altitudes because the seed will not ripen in short season areas, and it is not adapted to wet areas.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.5-6.2.
 - **Approximate Planting Date:** In spring after frost.
-

**Lespedeza,
Korean and
Kobe**

Korean (*Lespedeza stipulacea* Maxim) and Kobe (*Lespedeza striata* var Kobe) lespedezas are warm-season reseeding annual legumes used for hay, pasture, and wildlife cover that are tolerant of acidity and low soil P. They are killed by frost and furnish poor winter cover. Seed in mixtures with grasses or other legumes; or, if seeded alone, use winter cover crop. They may not reseed above 2,500' elevation. Korean is adapted to all areas of Mid-Atlantic, and Kobe is adapted to southeastern sections of Virginia. They cross-inoculate with perennial lespedezas, peanuts, and cowpeas.

- **Fertilization:** At seeding, apply no N. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.5-6.2
 - **Approximate Planting Date:** February and March.
 - **Harvesting:**
 - Hay: Early bloom stage
 - Seed: Combine in fall when ripe
 - **Approximate Harvest Dates:** Hay: August 1-September 1; Seed: September 15-November 1
-

**Lespedeza,
Sericea**

Sericea lespedeza (*Lespedeza cuneata*) is a warm-season, drought tolerant perennial with a growth habit similar to alfalfa. It is used for erosion control, hay, pasture, and cover for wildlife, and is very tolerant of acid soil and low fertility. Sericea cross-inoculates with annual lespedezas, cowpeas, and peanuts.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations.

- **Soil pH Range:** 5.0-6.2.
 - **Approximate Planting Date:**
 - Unhulled seed: Late fall or early spring.
 - Scarified seed: March or April.
 - **Harvesting:**
 - Hay: When plants are about 15-24 inches tall. High tannin levels drop when harvested for hay, improving palatability and digestibility.
 - Seed: Direct combined. Second growth produces seed more uniformly and is easier to thresh than first crop, but the yield of the first crop is usually higher.
 - Pasture: Begin grazing at 8-10 inches. Do not graze lower than 4 inches.
 - **Approximate Harvest Dates:** Hay: June - July; Seed: August – September.
-

Matua prairiegrass

Matua prairie grass (*Bromus willdenowii*) is a cool-season, short-lived perennial grass used for hay, greenchop, or silage. It can be used for dairy or beef pastures under rotational stocking management, but is not suited for continuous grazing.

- **Fertilization:** Apply 40 lbs N/A at seeding. For high level of production, apply 50-60 lbs N/A following mechanical harvest or 30-40 lbs N/A following each grazing. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 6.0-7.0.
 - **Approximate Planting Date:** May be seeded in the fall or spring when the soil temperatures are at least 55° F. No-till or conventional planting methods may be used.
 - **Harvesting:** Mechanical harvest for hay or grazing should begin at the boot stage for best quality, yield, and longevity. A regrowth/rest period of 30-42 days depending on the season is essential. One regrowth per year must be allowed to set seed to maintain the stand.
-

Millet, foxtail

Foxtail millet (*Setaria italica*) is an annual that is used for supplemental pasture and hay crop, for a nurse crop for late spring and for early summer forage seedings. It is necessary to smother the crop prior to late summer no-till forage seedings. Foxtail millet has lower yield and regrowth than pearl millet.

- **Fertilization:** Apply 60-80 lbs N/A. Apply P and K according to soil test

recommendations.

- **Soil pH Range:** 5.8-6.2
 - **Approximate Planting Date:** May 1-July 1.
 - **Harvesting:** Cut for hay at seedhead emergence. Do not feed to horses.
-

Millet, pearl

Pearl millet (*Pennisetum glaucum*) is an annual that is used for supplemental pasture, hay crop, and green chop. It regrows after cutting and grazing.

- **Fertilization:** Apply 60-80 lbs N/A. Apply P and K according to soil test recommendations at seeding. Apply 40-60 lbs N/A after each cutting.
 - **Soil pH Range:** 5.5-6.5
 - **Approximate Planting Date:** May 1-July 1.
 - **Harvesting:**
 - Hay: Cut when heads begin to emerge from boot or at 30-40 inches.
 - Pasture: Requires high stocking rate, preferably with rotational stocking.
 - **Approximate First Harvest Date:** Early to mid-July.
-

Orchardgrass

Orchardgrass (*Dactylis glomerata*) is a long-lived, deep-rooted perennial bunch grass used for pasture, hay, and silage.

- **Fertilization:**
 - Establishment: When seeded alone: 40-50 lbs N/A.
 - Maintenance (hay): 120-200 lbs N/A split 50:50 between early spring and after first cutting.
 - When seeded with clover: Reduce N rate to 20 lbs/A. No N is needed for maintenance where there is more than 35% clover.
 - Apply P and K according to soil test recommendations.
- **Soil pH Range:** 5.8-6.2
- **Approximate Planting Date:** In the Coastal Plain, seed after the first good rain in September up to October 15, or during February or early March. In the Piedmont, Ridge and Valley, and Appalachian Plateau, seed after the first good rain in August up to September 15, or from March to mid-April.

- **Harvesting:**
 - Hay and silage: Cut in boot to early head stage.
 - Pasture: Do not graze below 3 inches. Rotational stocking with 1-4 day grazing periods is best.
 - **Approximate First Harvest Dates:** Hay: May - June; Seed: June - July.
-

Red clover

Red clover (*Trifolium pratense*) is a short-lived perennial that often behaves as a biennial. Used for hay, pasture, silage, and commercial seed production. Inoculation is important. Red clover cross-inoculates with alsike, crimson, ladino, and white clovers.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations. Lower amounts needed when used as pasture.
 - **Soil pH Range:** 5.8-6.5
 - **Approximate Planting Date:** 45 days before last killing frost in spring, or 30 days before first killing frost in fall.
 - **Harvesting:**
 - Hay: 1/4-1/3-bloom stage. Early harvesting for hay favors good seed yield by second crop.
 - Seed: Cut with combine when heads have turned brown, flowers and stalks are deep yellow, and seeds have begun to show a distinct violet color. Will shatter badly if cut later.
 - **Approximate First Harvest Dates:** Hay: June; Seed: August-September.
-

Redtop

Redtop (*Agrostis alba*), also known as creeping bentgrass or redtop bent, is a perennial that produces numerous stems from a well-developed base. Used primarily for erosion control and soil stabilization.

- **Fertilization:** Apply 40-60 lbs N/A/Yr. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.8-6.2
 - **Approximate Planting Date:** August and September. May be seeded in spring.
 - **Harvesting:** For hay, shortly before full bloom.
-

**Reed
canarygrass**

Reed canarygrass (*Phalaris arundinacea*) is a tall, coarse, sod-forming perennial cool-season grass which is used for hay, pasture, silage, and conservation cover in wet areas and in areas irrigated for disposal of liquid wastes. It tolerates wet soils, yet is more drought-tolerant than many other cool-season plants.

• **Fertilization:**

- Establishment: 50 lbs N/A.
- Maintenance (pasture): 0-60 lbs N/A.
- Maintenance (hay): 20-200 lbs N split 50:50 between early spring and after first cutting.
- When seeded with clover: N rate should be reduced to 20 lbs or less. For maintenance where there is more than 35% clover, no nitrogen is needed. If the stand becomes non-competitive with weeds or other species, increase the N rate to strengthen the grass's competitiveness.
- Apply P and K according to soil test recommendations.

• **Soil pH Range:** 5.8-6.2

• **Approximate Planting Date:** Early fall (requires a full six weeks before first frost) or spring. Often slow to establish.

• **Harvesting:** First cut when heads begin to emerge.

• **Approximate Harvest Dates:** Hay: May - June.

**Ryegrass,
annual and
perennial**

Annual (or Italian) ryegrass (*Lolium multiflorum*) is a bunchgrass that is used for hay and pasture, especially as a supplementary pasture mixed with crimson clover and/or small grain. It tolerates close, continuous stocking. It is also used for a green manure, winter turf, and over-seeding bermudagrass. Perennial (or English) ryegrass (*Lolium perenne*) is similar to annual ryegrass in use and adaptability. Special varieties are adapted for turf purposes. Perennial ryegrass is also used for pasture, where it is high yielding during the first year, but has decreased yields in subsequent years due to poor persistence.

• **Fertilization:** For pasture, 20 lbs N/A and 50-70 lbs N topdressed in spring. Apply P and K according to soil test recommendations.

• **Soil pH Range:** 5.8-6.2

• **Approximate Planting Date:** August 15 to November 15. Use the earlier seeding date for Northern Piedmont and west of the Blue Ridge, including WV and PA.

**Sorghum,
forage**

Forage sorghum (*Sorghum bicolor*) is an annual very similar to corn in the vegetative stage that is used for silage, hay, grazing.

- **Fertilization:** Apply 60-80 lbs N/A. Apply P and K according to soil test recommendations.
 - **Approximate Planting Date:** 1-2 weeks after corn. Soil needs to be warm (at least 60° F).
 - **Harvesting:**
 - For hay or wilted silage: Cut no later than early head emergence.
 - For direct ensiling: Cut in dough stage.
-

**Sudangrass and
sorghum-
sudangrass
hybrid**

Sudangrass (*Sorghum sudanense*) and sorghum-sudangrass hybrid are annuals that are used for hay, silage, and supplemental pasture.

- **Fertilization:** Apply 60-80 lbs N/A plus 40-60 lbs N after each cutting. Apply P and K according to soil test recommendations.
- **Soil pH Range:** 5.8-6.2
- **Approximate Planting Date:** Two weeks after corn.
- **Harvesting:**
 - Hay: Cut just as heads emerge.
 - Silage: Cut when grain is in dough stage, or as heads emerge and wilt.
 - Do not graze or harvest for green chop until plants are 24 to 30 inches tall to reduce danger of prussic acid poisoning.
- **Approximate Harvest Dates:** July (both hay and silage).

Note: Johnsongrass (*Sorghum halepense*) is a coarse, tall-growing perennial grass of the sorghum group that spreads by seed and strong underground stems. It was used as hay and pasture in some of the southern states, but is considered a serious pest in crop fields in most of the eastern U.S. Johnsongrass is considered a **noxious weed** in many states and is prohibited as a seed contaminant. It is also against the law to seed this plant. It spreads easily from seed when abandoned or when roadside stands are allowed to mature.

Sweet clover

Sweet clover [*Melilotus alba* (white flowered); *Melilotus officinalis* (yellow flowered)] is an erect biennial that is used for pasture, hay, and green manure. Inoculation is important, and the sweet clovers cross-inoculate with alfalfa and bur clover.

- **Fertilization:** Apply no N. Apply P and K according to soil test

recommendations.

- **Soil pH Range:** 6.5-7.0
 - **Approximate Planting Date:** February, using unhulled seed. Use scarified seed in late March or April. Plant in grain with drill in February or March, or sow on frozen ground.
 - **Harvesting:** For hay, cut in bud stage before any bloom appears.
 - **Approximate Harvest Dates:** Hay, May 10-June 1
-

Switchgrass

Switchgrass (*Panicum virgatum*) is a native, warm-season, sod-forming, perennial tall grass that is used for summer pasture or hay. Switchgrass will not persist under close or frequent grazing.

- **Fertilization:** Generally has a low fertility requirement. At establishment, apply P and K according to soil test recommendations. Apply 40-60 lbs N/A annually if legumes are not present.
 - **Soil pH Range:** 5.5-6.5
 - **Approximate Planting Date:** May 15-July 15 using 6-8 lbs pure live seed.
 - **Harvesting:**
 - Hay: Cut prior to seed head emergence.
 - Pasture: Begin grazing when 18 to 24 inches tall. Do not graze below 8 inches.
 - **Approximate First Harvest Dates:** July 15- August 1.
-

Tall meadow oatgrass

Tall meadow oatgrass (*Arrhenatherum elatius*) is a perennial bunchgrass that is used for hay and pasture. Tall meadow oatgrass makes early spring growth but very little aftermath growth.

- **Fertilization:** Apply 40-60 lbs N/A. Apply P and K according to soil test recommendations.
- **Soil pH Range:** 5.8-6.2
- **Approximate Planting Date:** Late summer or fall using 15-20 lbs alone or 10-12 lbs in mixtures.
- **Harvesting:** For hay, cut at early heading stage.

- **Approximate Harvest Dates:** Hay, May 15 – June 1
-

Timothy

Timothy (*Phleum pratense*) is a perennial, cool-season, semi-bunch grass. It is primarily used for hay, and is best adapted to the northern United States, but does fairly well in northern Piedmont, Ridge and Valley, and the Appalachian Plateau. Timothy makes very little regrowth after spring cutting when compared to orchardgrass or tall fescue. It is usually seeded in mixtures with clovers or alfalfa.

- **Fertilization:** Apply 40-60 lbs N/A. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.8-6.2
 - **Approximate Planting Date:** Spring or fall.
 - **Approximate Harvest Dates:** Hay: June 1-July 1
-

Vetch, hairy

Hairy vetch (*Vicia villosa*; sometimes called winter vetch) is an annual semi-vining legume with 3-5' long stem. Used for hay, pasture and winter cover. Because of the hardness of the seed and its size, it often becomes a weed in small grain crops that follow. Inoculation is important. Vetch cross-inoculates with garden peas and field peas.

- **Fertilization:** Apply no N. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 6.0-6.5
 - **Approximate Planting Date:** August 1 - November 1.
 - **Harvesting:**
 - Hay: When seeds in lower half of the plants are half developed.
 - Seed: Cut when first pods are well developed.
 - **Approximate Harvest Dates:** Hay: May 1-June 1.
-

White clover, common

Common white clover (*Trifolium repens*) is a low growing, short-lived, perennial legume that is used for pastures and tolerates close, continuous grazing. White clover cross-inoculates with alsike, crimson, ladino, and red clover.

- **Fertilization:** With bluegrass or other cool-season grasses at seeding, apply 0-20 lbs N/A. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 5.8-6.5
 - **Approximate Planting Date:** 45 days before last killing frost in spring or 30 days before first killing frost in fall.
-

**White clover,
ladino**

Ladino white clover (*Trifolium repens latum*) is a giant variety of white clover resembling white clover in every respect except size. It is used primarily for pasture with tall growing grasses such as orchardgrass. It is less persistent and grazing-tolerant than white clover. Inoculation is important. Ladino cross-inoculates with alsike, crimson, ladino, and red clover

- **Fertilization:** Alone at seeding or topdressing, apply no N. Apply P and K according to soil test recommendations.
 - **Soil pH Range:** 6.0-6.5.
 - **Approximate Planting Date:** 30-60 days before the average date of the first killing frost in fall or 30-45 days before the average date of the last killing frost in spring. Fall seedings are preferred.
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Links to information on turfgrass, fruit, and vegetable production

Information on **turfgrass** production can be found in:

- The Virginia Tech Agronomy Handbook, Part III, available at <http://www.ext.vt.edu/pubs/agronomy/part3.pdf>

Information on **vegetable** and **fruit** production can be found in:

- Nutrient Management for Tree Fruits and Small Fruits, available at <http://www.agnr.umd.edu/users/agron/nutrient/Pubs/NM-5.pdf>
 - The Maryland Commercial Vegetable Production Recommendations, available at: <http://www.agnr.umd.edu/MCE/Publications/Publication.cfm?ID=674&cat=C>
 - The Pennsylvania Tree Fruit Production Guide, available at: <http://tfpg.cas.psu.edu/default.htm>
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