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A Guide to Successful

Wildlife Food Plots

Blending Science with Common Sense

Craig A. Harper

THE UNIVERSITY of TENNESSEE
INSTITUTE of AGRICULTURE

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Wildlife Food Plots

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The University of Tennessee

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Foreword

We are both former Extension wildlife specialists who, during our professional careers, have worked a great deal with private landowners and managers, particularly in the Southeastern United States. We have written and collaborated with professional wildlife colleagues and agronomy and soil scientists on numerous publications concerning wildlife food plots. With that background, we are in mutual agreement that this book is the most comprehensive publication on wildlife food plots we have seen.

Considerable disagreement exists among wildlife biologists and managers about the benefits of food plots in wildlife management, and there is admittedly some justification for this difference of opinion. And, as Dr. Harper clearly points out, wildlife food plots are not holistic habitat management. However, throughout much of the Southeastern U.S., and in some other regions of the nation, food plots provide a major contribution to increased carrying capacity for some wildlife species. In addition, there are benefits to other game and non-game wildlife from the appropriate juxtaposition, establishment and management of food plots.

It is likely that every state within the Southeast has one or more publications about wildlife food plots. The majority of this information is based on field research, professional experience and demonstrations, some possibly limited, and some more extensive. However, some of these publications may be based on past research, and have not kept pace with more recent findings. Such is the nature of publications – new information is continually being published from the latest research findings.

Unfortunately, some landowners base their management strategy on what they read in outdoor/sporting magazines, sporting goods catalogs or pseudo-scientific management guides. Some of this information is based more on marketing than research, and such marketing is often made without research to back up the claims. There is no silver bullet in wildlife management, and as Dr. Harper points out, habitat management is the principal tool for managing most wildlife species.

The facts and accompanying recommendations provided in this publication are based on years of quality research and experience. The author has drawn on past and recent research – both his research and that of professional colleagues with whom he has collaborated. This exemplary body of information should benefit both practicing biologists and private land managers. It is written to provide technical guidance and practical information for wildlife management beyond planting and managing food plots. The sections on initial considerations, soil fertility and amendments, planting for different species and other sections are presented in logical order. The inclusion of information about old-field management, woods road management, wildlife openings and other habitat management information, along with some aptly placed suggestions for population management as it applies to habitat, assist the reader in understanding the value of wise stewardship and management. The inclusion of numerous tables, plant lists and other pertinent material in the indices adds useful information for the landowner and manager to review before making an investment in habitat management.

The increased interest by landowners and managers in investing time and resources into improved wildlife habitat management makes this publication especially relevant today. It is also important in the wake of

continued political efforts to make baiting and feeding of wildlife legal in several Southeastern states where it is now prohibited. Unfortunately, in their attempt to justify efforts to make baiting and feeding of wildlife legal, proponents often state there is no difference between planting food plots and baiting or feeding wildlife. However, the great majority of professional wildlife biologists disagree, and point out that baiting and feeding increase disease risks, habituation and dependent behavior.

This publication provides an important addition to the considerable base of research information already available. Landowners and managers constantly seek the best results for their investment in managing habitat for the public trust wildlife resources on their land. It is an honor and privilege for us to provide this foreword. One of the most enjoyable rewards from our extensive careers as wildlife professionals, educators, land managers and administrators is the increased interest we observe among private landowners willing to invest both time and resources to enhance wildlife management on their lands.

We are confident this publication will become a well-used and often-referenced addition to the libraries of professional wildlife biologists, educators, private landowners and land managers actively involved and interested in wildlife habitat enhancement.

James L Byford, Dean
College of Agriculture and Applied Sciences
University of Tennessee–Martin

James E. Miller
Professor Emeritus
Mississippi State University

Preface

As the Extension Wildlife Specialist at the University of Tennessee, I get more calls, e-mails and requests for presentations concerning food plots than any other issue. This demand, coupled with my personal interests, led me to begin looking at food plots in an experimental manner. Several years ago, as a wildlife technician, and later graduate student, I began questioning dogma and started looking at various plants and methods for planting and managing food plots with scrutiny. In 1999, my graduate students and I started what would eventually become a series of demonstration and research food plots across Tennessee. Initially, our main focus was to investigate preference of various forages by white-tailed deer. But we learned much more. We documented changes in forage selectivity with regard to deer density and other available foods, we noted susceptibility and resistance to grazing, compatibility of various forages in mixtures and how best to manage these forages for extended use and efficiency.

In 2004, I wrote an Extension publication, ***Growing and Managing Successful Food Plots for Wildlife in the Mid-South***, which contained much of the information we had collected. It proved to be quite popular and nearly 10,000 copies were distributed within two years. However, as the printed copies dwindled, I realized we had collected a lot of data since the last printing and the publication needed revision. As I revised the manuscript, I included additional information we had learned and coupled that with up-to-date information gathered by others as well. I also tried to expand the recommendations to cover the entire South, not just the Mid-South region. Indeed, much of the information and recommendations provided are also pertinent for states further north as well. As a result, I think there is a lot of useful information in this book, but it is not perfect – no book or manual is. If you find something within these pages you feel is incorrect, or needs revision, please let me know. My students and I keep an open mind and we continue to learn more every day. That is what science is all about.

Some of the information in this book goes against dogma and recent popular opinion. I believe that shows change is needed. I believe some of the plantings and practices implemented today represent "what we've always done" (especially true among some governmental agencies) as well as the latest fads (driven by marketing and advertisements). Unfortunately, there are some plantings and practices used today that are not based on experimentation or biological evidence, but on what might seem "obvious" or what will sell the most. My objective for this book is to give wildlife enthusiasts and managers detailed information needed to grow and manage high-quality food plots and incorporate them into a sound wildlife management plan. The recommendations within are research-based, but they are coupled with real-world knowledge (that is, "common sense") that I think will help you, as land managers and hunters, when determining objectives and evaluating program success.

In the scientific community, there are many who disdain food plots. They refer to food plots as "Bubba Biology." I understand and agree with some of their contentions that food plots are not holistic habitat management and other management practices are needed. (That is why I think you will find more information related to the importance and need for other habitat management practices in this book than any other publication concerning food plots you

have ever read.) However, the undisputable, scientifically proven, biological fact remains that agriculture (especially when combined with other habitat management practices) can provide nutrition beyond what is "naturally" available, yet in a manner that is "natural" (planted and growing, as opposed to feeders), and enable wildlife populations to respond in a positive manner (increased survival, weights, reproduction, antler growth, etc.). Food plots represent agriculture, only with a twist. Planting food plots is quite simply "farming for wildlife."

The interest surrounding food plots today is remarkable and there is a tremendous demand for additional information. To me, this is refreshing because it means more people want to work with the land. And if more people want to work with the land, as opposed to developing it, then hopefully we can conserve more acres for future generations (of wildlife and people). And if food plots can be the catalyst to help get people involved with holistic habitat management, then I'm glad to be a part of it.

Craig A. Harper
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Introduction

Planting food plots is by far the most popular habitat management practice among landowners wanting to enhance wildlife habitat. Indeed, planting food plots is an excellent way to improve available nutrition and increase the nutritional carrying capacity of a property for wildlife. Research has shown quality food plots can provide more than 10 times the amount of digestible energy and protein available in recently regenerated forests or within properly managed mature forests. Food plots not only provide nutritional benefits, but also can increase and enhance hunting and wildlife viewing opportunities. Planting and managing food plots also provides recreational activity, and the satisfaction of working with the land often exceeds the value of hunting and wildlife viewing for many people.

Food plots can positively influence wildlife in many ways, including daily movements, home range size, weight, reproduction (timing and recruitment), survival (adults, broods and fawns), hatchability (percentage of eggs that hatch), lactation rate and antler development. The potential benefits of food plots, however, should not overshadow other management practices. Before getting started with a food plot program, it is critical to understand how food plots should be used to augment the quantity and quality of naturally occurring foods, not take the place of them. Establishing food plots is only one habitat-management practice, and food is only one component of habitat. Food *attracts* wildlife, but cover *holds* them. When habitat improvement is needed, other management practices must be considered as well. That includes managing forests with the appropriate regeneration methods, thinning them when ready and burning the understory when and where appropriate. Early-successional plant communities (such as old-fields) should also be managed by burning, disking and using selective herbicides when needed. Hard- and soft- mast-bearing trees and shrubs may need planting to provide additional food and cover. Native-grass buffers and/or fallow borders should be established around crop fields, and at least 30 percent of pasture and hayfield acreage should consist of native grasses. Food plots alone cannot replace the value of these practices.

The most important consideration when managing habitat for wildlife is providing and maintaining the appropriate successional stages and cover types for the desired wildlife species. Until this is accomplished, the overall impact of a food plot program will be minimal. That being said, *when incorporated into a well-designed habitat management plan*, quality food plots can help wildlife grow and develop to previously unattainable levels. The desired habitat types and the appropriate proportion and distribution of those types for several wildlife species are described in the pages that follow.

Figs. 1.1 and 1.2 *Food plots do not replace other habitat management practices, but complement them. Well-managed forests and fields provide quality cover as well as an abundance of forage and seed. The mixed hardwood stand above was thinned four years previously and has been burned twice. The field below is burned every other year to maintain quality early-successional habitat.*

Initial Considerations

When managing wildlife habitat, it is essential to identify factors limiting population growth and health. Food is not always a limiting factor. In fact, on many properties, quality cover is more often a limiting factor than food for several wildlife species. Nonetheless, where food is a limiting factor, attention should be given to making sure adequate nutrition is available throughout the year, not just during the hunting season. And in the case of white-tailed deer, the astute wildlife manager often realizes additional food may not be the answer. Population *reduction* may be what is really needed!

Before planting, there are many factors to consider. One is how much work is required to establish and maintain a quality food plot. Food-plot management usually involves liming, fertilizing, applying herbicides and insecticides, mowing, plowing, sub-soiling, disking and rotational planting. If you do it right, it is an involved process that takes time and effort. If you aren't prepared to put in the time, effort and money, you really shouldn't bother getting started.

Determine your objectives

The first thing you should do before getting started with a food plot program is define your objectives. *Why* are you planting a food plot? Do you intend to improve available nutrition for wildlife and increase the nutritional capacity on your property? Or, are you merely trying to attract wildlife for easier hunting or viewing opportunities? Are you "targeting" only white-tailed deer, or are wild turkeys, bobwhite quail, mourning doves and/or other species also a major interest? Answers to these questions influence not only what should be planted, but how plots are managed as well. After you have determined your objectives, realistic opportunities and limitations should be identified.

How much does it cost?

Food plots can be expensive, with equipment being the biggest investment. Small plots can be planted with ATVs and associated implements. However, some operations, such as sub-soiling, deep tillage and breaking sod in heavy clay, cannot be done with a 4-wheeler. Plows, sub-soilers, disc harrows, cultipackers, drills (or planters), spreaders, sprayers and rotary mowers vary greatly in price, but they are all necessary if a wide variety of food plots are to be planted and managed properly.

Throughout the eastern U.S., most soils need liming and fertilizing before plant growth is optimum. It is not unusual for fertilizer costs to exceed $200 or more per acre. Liming is by far most economical when a lime truck is contracted from a local agriculture supply dealer. Most dealers have a minimum order (5–10 tons) for delivery, so it is economical to lime all areas needed at once. At $20–25 per ton (depending on the dealer), 5–10 tons will cost $100–250 (delivered and spread). Compared to bagged lime, this is a tremendous savings. A 50-pound bag of pulverized dolomitic lime costs about $2 per bag ($80 per ton). A 40-pound bag of pelletized lime costs about $3 per bag ($150 per ton). After purchase, bagged lime has to be spread, so there is additional cost for fuel and labor. Bagged lime, especially pelletized lime, is largely a waste of money unless applied to small acreage plots. Bulk aglime can be purchased by agricultural supply dealers also; however, "lime buggies" must be rented to spread the lime, which takes considerable time, fuel and additional effort.

Chris Wolkonowski

Fig. 2.1 *Food plots may be expensive, but the benefits can be worth it! This buck was killed as it walked out of a warm-season food plot. However, Mike Wolkonowski had absolutely no recollection of how much he spent on the food plot as the buck approached!*

Herbicides can be expensive, but they are often necessary for successful food plots. Despite the apparent "sticker shock," herbicides are actually quite cost-effective (see ***Appendix 2***), especially considering all the other costs can be completely wasted if weeds overtake your planting. Make no mistake; a sprayer is just as important as a seed sower. Seed is usually the least expensive item when establishing food plots, averaging $50–80 per acre.

Considering "average" costs for lime, fertilizer, seed and herbicide, food plots typically average $150–200 per acre (not including costs for equipment, fuel or labor). But don't worry; you won't remember what you paid when you are watching a 140-class buck feed in your clover patch or when killing limits of doves with family and friends in your dove field!

What and how much to plant?

Not all wildlife species benefit from all food-plot plantings. *What* you plant and *how much* you plant should depend upon the wildlife species you want to attract, the seasonal requirements of those species and overall habitat quality. When evaluating available habitat, consider *habitat composition* and the *surrounding land-use practices* carefully before deciding what and how much you plant. Species such as white-tailed deer, wild turkeys, cottontail rabbits and bobwhite quail thrive in areas with considerable habitat diversity. Productivity and carrying capacity are usually highest where several habitat types and successional stages are well interspersed. If agriculture is prominent on adjacent properties, your food plots should provide needed nutrition after the crops are harvested. Also, in agricultural areas, less acreage typically needs to be devoted to food plots. Often, food/nutrition is not limiting in these areas; instead, cover may be a limiting factor.

Where surrounding properties are primarily forested, food plots can make a dramatic impact on available nutrition. In these areas, considerable acreage in food plots (as well as forest management) may be necessary to meet your objectives. Some properties are too small to provide a variety of habitats or food plot plantings. In this situation, it is particularly beneficial to work with adjoining landowners and form a cooperative food-plot program including as large an area as possible. Managers of several small properties working together can make a big impact on available nutrition and overall habitat quality.

Another major consideration when evaluating the surrounding habitat is deer density. If deer density is so high that food plots have little chance to establish, you are wasting time and money until deer density is lowered and/or additional habitat management is implemented (see ***White-tailed deer*** on page 47).

Fig. 2.2 *Habitat composition and surrounding land-use practices greatly influence how much acreage should be devoted to food plots and what should be planted. Less acreage in food plots is needed where there is a diversity of habitats that include row-crop agriculture. When possible, use agriculture to your advantage. Given the cost and effort involved with planting food plots, paying a farmer to leave a portion of a crop for wildlife can actually save you money.*

Where to plant?

Where you plant should depend upon several factors. It is always a good idea to first identify locations on the property where targeted wildlife species are often found. Then look for sites nearby that are suitable for planting. The best sites are generally flat, where more moisture is retained, nutrient levels are higher and it is easier to operate equipment. Keep in mind that for several wildlife species (such as deer, quail and rabbits), food resources are more readily used if located near suitable cover. Sometimes suitable openings (existing fields, woods roads, log decks, utility rights-of-way) are nearby and available for planting. If not, don't overlook the possibility of creating new openings. This may sound extreme, but it

Fig. 2.3 *Have you ever found just the right spot for a food plot, but there was no opening? Then create one! This linear strip for deer was created with a front-end loader in just a few hours, costing less than $300. Considering the heavy clay soils and tendency for dry conditions where this plot is located, the landowner oriented the plot north-south to retain as much moisture as possible.*

isn't. Bulldozer/front-end loader operators typically charge around $80 per hour. If the site is timbered, the cost of road building may be offset by the value of timber removed. A respectable equipment operator can easily clear a two-acre opening in a day. At $80 per hour, a two-acre food plot is created for approximately $600–800, plus there is easy access into the area and the woods road itself can be planted. Constructing/clearing a woods road for equipment access can save money over time and help make food plots much more productive. With a clear road to get to the plot, a lime truck can be contracted to lime the site and equipment access is much easier, which makes it much more likely the plot will be maintained with fertilizer applications and herbicides when needed.

When creating new openings, remember to consider soil type, orientation and drainage patterns for desired plantings. Shallow soils on ridgetops and southern exposures are generally not good places to plant ladino clover, for example, in the South. North- and east-facing slopes, as well as the lower third of slopes and bottomlands, hold considerably more moisture than south- and west-facing slopes and ridgetops. Not only do south- and west-facing slopes and ridgetops receive more sun during the afternoon and evening, these areas also receive more wind. Nonetheless, for any given exposure, you can still influence soil moisture by orienting your plots in certain directions and by considering plot width. For example, if soil moisture might be a limitation, consider linear plots oriented north-south, or plant the southern side of plots oriented west-east. If the area might be too moist, the northern and eastern sides of plots should be drier because they receive the most sun during the hottest part of the day.

Also, when creating new openings for deer, and hunting is an objective, refer to an aerial photo and consider prevailing wind directions and how the terrain influences travel patterns via corridors and funnels. Think about using smaller food plots

Fig. 2.4 *Identifying the best sites for food plots is important. Animal movements, surrounding habitat, soil fertility and equipment access should be considered. This corn plot and wheat/clover plot are intended for deer and turkeys and are located in a bottom, along a brushy creek drainage with plenty of early successional cover on both sides. These plots are out of sight of any road and have easy equipment access.*

Ryan Basinger

Fig. 2.5 *When determining food plot size and shape, distance to cover is an important consideration for several wildlife species. Rectangular-shaped plots provide an advantage by keeping distance to cover relatively short, while size can be increased as needed with added length.*

that lead from bedding areas to larger food plots or other feeding areas. Now is the time to influence deer movements to your advantage.

Do not plant food plots within sight of a road or property boundaries. This only advertises your work and encourages poachers and trespassers. Visibility from roads can be limited by planting trees and shrubs adjacent to the road and by allowing naturally occurring vegetation to grow at will along a road edge. When planting trees and shrubs along a road, evergreens (such as white pine and eastern redcedar) should be used; trees and shrubs that might attract wildlife (soft-mast producers) should not be used for this purpose.

Size and shape

According to your objectives and the targeted wildlife species, food plot size and shape may vary considerably. Specific recommendations concerning food plot size and shape (as well as other initial considerations) are provided later for various wildlife species. Nonetheless, when planning food plots, it is important to consider equipment operation, especially where large tractors and implements and lime trucks will be operated. Food plots with irregular edges make it difficult to maneuver equipment when preparing the seedbed, planting, fertilizing, liming, spraying and cultipacking the plot. Obviously, this is less of a concern when an ATV is used to prepare a plot as opposed to an 80-hp tractor; however, the extra edge added to a ½-acre food plot planted with an ATV is meaningless anyway (see discussion for white-tailed deer on page 49). *Relative to food plot use*, the most important consideration is *distance* from edge, not *amount* of edge. Where larger plots are warranted and distance to cover is a concern, rectangular plots provide an advantage. Relatively narrow strips may be planted for small game in early successional fields and firebreaks may be seeded as well (see ***Managing firebreaks for quail, rabbits and other wildlife*** on page 95).

Measuring plot size

Measuring plot size is an often-overlooked step that is important in order to spread the correct amount of lime and fertilizer, spray the correct amount of herbicide and plant the correct amount of seed. Don't try to estimate plot size by guessing. Measuring plot size is easily accomplished with a GPS, a rangefinder, a 300-foot tape or by pacing. Plot area can be determined by measuring length x width in feet and dividing by 43,560 (the number of square feet in an acre). If the plot is irregularly shaped, it may be necessary to mark off sections and measure them separately. Or, numerous length and width measurements may be taken, then averaged before calculating area.

Distribution of food plots

In most cases, food plots should be distributed across the property to make them available to as many animals as possible and lessen foraging pressure on any one plot. Special consideration should be given to areas on the property where little other forage is available. For example, if white-tailed deer is the focal species and half of the property contains considerable early-successional cover (old-fields and/or agriculture) and the other half is wooded, additional food-plot acreage should be devoted to the forested half. Planting woods roads and log landings is a good way to increase food-plot acreage in forested areas (see ***Managing Woods Roads for Wildlife*** on page 121). These "linear wildlife openings" can provide forage throughout an area, potentially reaching more animal home ranges (per acre planted) than a single opening of similar size. Similarly, power line rights-of-ways (ROWs) cut through all types of habitats over vast areas, providing additional opportunities to "partner with the neighbors" and influence a larger area. Where deer hunting is important, planting woods roads, log landings and ROWs also helps ensure more hunters have access to food plots across the property, which can be an important aspect in hunter management and satisfaction. Linear wildlife strips also can be integrated with other habitat management practices. Firebreaks around old-fields can be planted to provide supplemental forage adjacent to naturally occurring forbs and fresh browse, which should represent quality nesting, brooding, bedding and/or loafing cover (see ***Managing Firebreaks for Quail, Rabbits and Other Wildlife*** on page 95).

Crop rotation

Rotating various crops over time is an important consideration when managing successful food plots. The most popular rotation is following legume crops (such as soybeans) with grass crops (such as corn). Surplus nitrogen produced by bacteria on the roots of legumes remains available for nitrogen-hungry grasses (see ***Inoculating legume seed*** on page 35). Other rotations are also important. It is never a good idea to continue to plant a specific plant in a particular plot year after year. Over time, clovers are susceptible to fungal diseases and grub damage, *Brassicas* are susceptible to fungal diseases, production declines in grain crops and chufa tuber production declines. All of these problems are remedied by rotating crops and allowing plots to remain fallow occasionally (see ***Using Corn and Wheat as "Two-year Grain Plots" for Brood Habitat*** on page 82). Not only can legumes be rotated with grasses, but other forbs (such as buckwheat, chicory, sesame, sunflowers, etc.) can be included in the rotation as well. Plots designated for warm-season crops can be rotated with cool-season crops after 3–5 years. Perennial forage plots can be plowed/disked and allowed to remain fallow for a year once productivity wanes and/or annual crops can be grown in that plot for a few years before planting another perennial crop.

Figs. 2.6 and 2.7 *Planting logging roads and decks in forested areas can supply high-quality forage that may be limited during certain times of the year. This logging deck was planted in iron-clay cowpeas and sunflowers.*

Soil Fertility and Amendment

Soil fertility is the single-most important factor in food-plot production. Plants serve as transfer agents, moving nutrients from the soil into animals. If nutrients aren't available in the soil, then plant growth and mineral content will be reduced and animal growth and production will be sub-optimal.

Soils within the United States have been classified into 10 taxonomic orders, based on soil origin and physical properties. Several soil orders are found throughout the South, but Ultisols predominate. Ultisols are ultimately leached of nutrients with a high clay content and low pH. Ultisols can be very productive, however, if limed, fertilized and managed properly. Soil pH is often 5.0–5.7 and phosphorus (P) and potassium (K) levels are typically low (<18 pounds P per acre; <90 pounds K per acre). Amending Ultisols with proper amounts of lime and fertilizers is necessary to realize optimum plant growth and transfer the needed nutrition to wildlife.

Other soil orders that may be found in relatively sizeable areas in the South include Inceptisols, Alfisols and Spodosols. Inceptisols are weakly developed soils found along the Mississippi River and near the Gulf and Atlantic coastlines. These are often excellent for agricultural production. Alfisols are moderately weathered soils with a high base mineral content. These are probably the most naturally productive soils without irrigation or fertilization and are prevalent in the Corn Belt of Indiana, Ohio, Michigan and Wisconsin. In the South, Alfisols occur along Mississippi River drainage areas, within the Black Belt of Alabama and Mississippi, and in northern Kentucky, northern Missouri, central Oklahoma and east-central Texas. Spodosols are acidic sandy soils usually well-leached of nutrients. The majority of Spodosols in the South are found along the Atlantic Coastal Plain. Mountainous areas (especially the Appalachians) may contain several soil orders as a result of variable drainage patterns and parent material. Thus, soil fertility may be very high or quite low.

Concerning mountain soils in the South, there is a common misconception that mountain soils are poor and this results in relatively low and less productive wildlife populations. This is not accurate. Some areas (such as ridges and steep slopes) do have shallow, rocky, relatively unproductive soils, but some areas (lower slopes, coves, bottomlands) have very deep, productive soils. Wildlife populations respond to land-use practices (that is, vegetative cover types). The reason white-tailed deer, wild turkey, rabbit, quail or mourning dove populations may be lower or less productive in some mountainous areas (such as national forests in the southern Appalachians) is not because of soils, but because the habitat composition is not suitable to support or produce populations found in the Piedmont or Inner Coastal Plain, for example. Vast continuous woods cannot support deer, turkeys, rabbits, doves, or bobwhites like broken woodlots with agriculture and quality early-successional cover.

Soil pH

Soil pH has a great influence on nutrient availability and plant growth because it affects the solubility of minerals. When soil pH is low (<5.8), many nutrients (such as N, P, K, S, Ca and Mg) needed by plants are relatively unavailable. Phosphorus, for example, forms insoluble compounds with aluminum (Al) at soil pH <5.5 and with calcium (Ca) at soil pH >7.5. Strongly acid soils (pH 4.0–5.0) can have toxic concentrations of soluble aluminum and manganese (Mn), which adversely affect growth and development of many food-plot plantings, such as corn,

grain sorghum, alfalfa and clovers. This condition is corrected by liming. By simply adjusting soil pH to 6.1–6.5 (without any fertilization), plant growth may improve substantially because nutrients are released through chemical reaction and organic decomposition. After the pH has been corrected, annual applications of the appropriate fertilizers will boost nutrient availability and plant growth.

Soil pH also influences microorganism activity. In acid soils, nitrogen-fixing bacteria and other bacteria that decompose organic material are not active. This negatively affects legume production and reduces the amount of nutrient release through the decomposition process. Soils become acid as basic cations (such as Ca^{++}, Mg^{++}, K^{+} and Na^{+}) are replaced (exchanged) on soil colloids by hydrogen ions (H^{+}). Hydrogen ions are formed from water and dissolved carbon dioxide and are increased when ammonium-containing or other acid-forming fertilizers are applied. The replaced cations are then moved deep into the soil profile or carried away by water (leached) from the site. Thus, plant-available nutrients can be drastically reduced.

Cations (positively charged ions) are attracted to (or adhere to) the surface of clays, humus (decomposing plants) and the surface of plant roots, which are negatively charged by electrostatic attraction. Adsorbed cations can be exchanged by other cations through mass action and move into the soil solution. The soil cation-exchange capacity is influenced by the amount and type of clay present and the amount of organic material in the soil. Clay particles are much smaller than silt particles, which are much smaller than sand particles. Further, less-weathered clay particles are layered (like a deck of cards); thus, they have much more surface area than silts or sands. This results in soils with a high clay content having a much higher cation-exchange capacity and buffering value than other soils. What this means is that it requires substantially more lime to raise soil pH to 6.5 in a clayey soil that has a pH of 5.5 than a sandy soil that has a pH of 5.5.

pH

The "power of hydrogen" (pH) is a measure of the hydrogen ion (H^{+}) concentration in soil and is measured on a logarithmic scale from 0 (extremely acid, or sour) to 14 (extremely basic, or sweet). What this means is a soil of pH 5 has 10 times more H^{+} in solution than soil of pH 6 and 100 times more H^{+} in solution than a soil of pH 7. The extreme pH range found in soil is approximately 3.5–9.5.

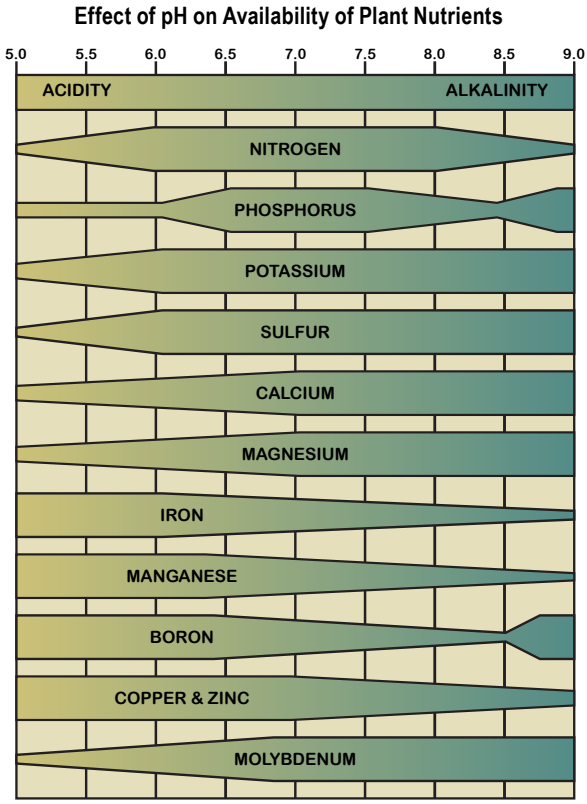

Fig. 3.1 *Soil pH should be adjusted to 6.0–7.0 to ensure soil nutrients are available to plants. (Adapted from International Plant Nutrition Institute.)*

Benefits of correcting soil pH with aglime

Low soil pH is increased by adding liming materials, most commonly carbonates, but sometimes oxides, hydroxides and/or, where available, industrial byproducts, such as silicates of calcium and magnesium. The vast majority of agricultural lime (aglime) used is calcitic limestone (ground limestone) and, more commonly in many areas, dolomitic limestone (ground limestone high in magnesium).

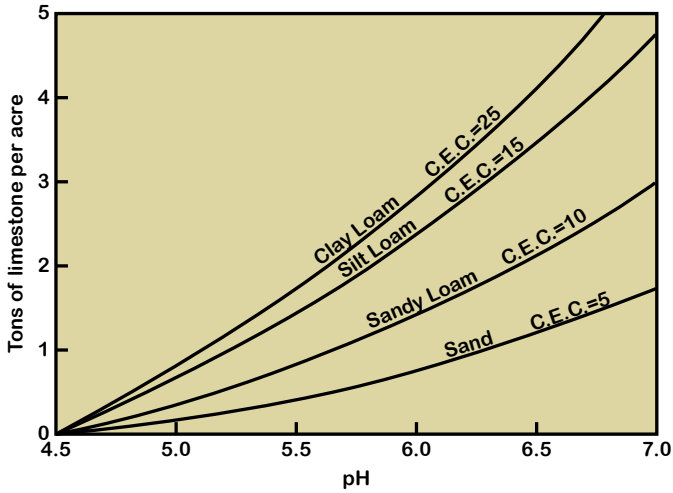

Fig. 3.2 *More lime is required to increase pH in clayey soils as opposed to sandy soils. This graph shows the approximate tons of lime needed to raise the pH of a 7-inch layer of soils with different Cation Exchange Capacities. (Adapted from R.L. Donahue, R.W. Miller and J.C. Shickluna,* ***Soils: An introduction to soils and plant growth****, Prentice Hall, Inc.)*

Various liming materials have a different calcium carbonate ($CaCO_3$) equivalent (CCE). The CCE of several liming materials is shown in Table 3.1. Most states require liming materials offered for sale have a minimum CCE, usually 70–80. The relative neutralizing value and overall quality of aglime is determined by CCE and fineness of grind. Most states also require liming materials to be ground to a particular fineness. This is important because lime particle size influences how quickly it begins neutralizing soil pH. In Tennessee, for example, aglime must be ground so that at least 85 percent passes through a 10-mesh sieve (100 openings per square inch) and at least 50 percent passes through a 40-mesh sieve (1,600 openings per square inch). Aglime coarser than 60-mesh will require several months to produce significant changes in pH, while 60- to 100-mesh aglime will produce changes within 2–3 weeks if weather conditions are favorable and recommended amounts are applied. Regardless, the full neutralizing effect is not usually realized for at least 6 months.

Aglime increases soil pH by replacing adsorbed hydrogen ions on soil colloids with calcium ions, but there are many other benefits of liming acid soils besides increasing pH. Liming adds calcium

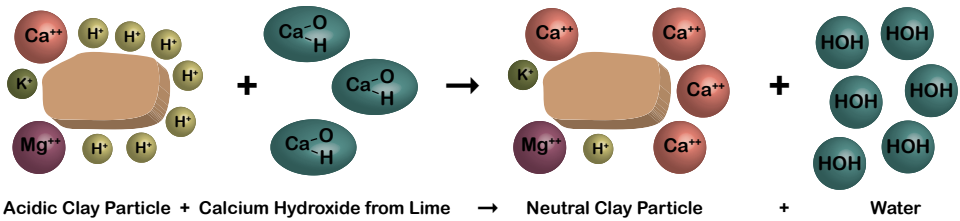

Fig 3.3 *Calcium hydroxide (and some calcium carbonate) is formed when lime is added to acidic soils. The H^+ from exchangeable sites combines with the OH^- of the solubilized lime to form water, thus effectively neutralizing H^+. (Adapted from R.L. Donahue, R.W. Miller and J.C. Shickluna,* ***Soils: An introduction to soils and plant growth****, Prentice Hall, Inc.)*

Table 3.1. Acid-neutralizing values for several liming materials.

Aglime material	Calcium carbonate ($CaCO_3$) equivalent	Pounds needed to equal 1 ton of pure $CaCO_3$
Calcium carbonate	100	2,000
Calcitic limestone	85 – 100	2,000 – 2,350
Dolomitic limestone	95 – 108	1,850 – 2,100
Calcium oxide (burnt or quick lime)	150 – 175	1,145 – 1,335
Calcium hydroxide (hydrated or slaked lime)	120 – 135	1,480 – 1,670
Calcium silicate	86	2,325
Basic slag	50 – 70	2,860 – 4,000
Ground oyster shells	90 – 100	2,000 – 2,220
Cement kiln dusts	40 – 100	2,000 – 5,000
Wood ashes	40 – 50	4,000 – 5,000

and magnesium (if dolomitic aglime is used) to the soil. Liming increases nitrogen availability by increasing soil microbial activity, which speeds up organic decomposition and improves nitrogen fixation on the roots of legumes. Liming makes phosphorus more available by reducing the solubility of aluminum and iron, which tie up phosphorus. Liming reduces excessive uptake of potassium by plants. Liming increases plant-available molybdenum. Liming improves fertilizer efficiency by 50 percent or more. And finally, as nutrient availability and plant growth are improved, the efficacy of herbicides is increased.

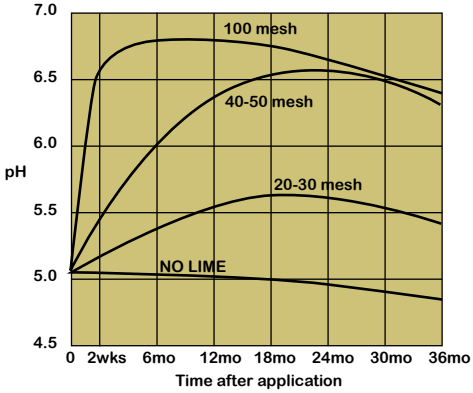

Fig. 3.4 *The finer the lime, the more quickly it reacts with the soil to raise pH and the quicker the calcium becomes available to the plant. (Adapted from International Plant Nutrition Institute.)*

Lime moves very slowly through the soil profile; therefore, when possible, it is best to incorporate lime into the soil by disking. This gets the lime down into the soil column 4–10 inches and more quickly corrects soil pH where plant roots will be growing. Because the full effect of liming is not realized until at least six months after application, it is important to plan ahead and lime plots in spring before fall planting or lime in fall before spring planting. Nonetheless, if you are ready to plant and haven't limed the site, go ahead and lime just before planting – that's much better than not liming at all. Growth and production will improve through the season as soil pH slowly increases. Over time (5–10 years), soil pH will slowly fall back to original levels. That is why it is important to soil test each plot every other year and top-dress as necessary.

If you are no-till planting, surface applications of lime will increase soil pH, but not as deep or as quickly as incorporated lime. Surface applications are highly susceptible to runoff. Top-dressing lime doesn't require incorporation. However, if

Fig. 3.5 *These iron-clay cowpeas were planted in soil with a pH of 5.1. Lime, phosphate and potash were added as recommended by a soil test and incorporated into the soil in May, just prior to planting. Notice how the lower leaves have crinkled and curled with yellowish coloration. Some are scorched along the leaf edges and have become ragged. This is symptomatic of Mn toxicity (as opposed to Mn deficiency). Also associated with Mn toxicity is Al toxicity, which, along with K deficiency, results in poorly developed root systems and slow growth. Poorly developed root systems may lead to several deficiency problems. However, in this case, as soil pH began to neutralize and nutrients became available to the cowpeas, additional growth (on top of the plant) appeared normal. By late July, the cowpeas looked completely normal and were growing vigorously. This illustrates the importance of liming several months in advance of planting if possible.*

the site has not been top-dressed over time and crop rotation is planned, incorporation of lime prior to planting is advisable.

Most soils across the South will require 1–2 tons of lime per acre to increase soil pH to 6.5. Some soils require 3 tons per acre, and there are a few areas that will require 4 tons per acre (very rarely more). The entire recommendation can be applied at once. There is no benefit to making split applications. Aglime can be purchased in bulk or bagged. Agriculture supply dealers can be contracted to spread bulk aglime or it can be delivered and you can spread it yourself, usually with a rented "lime buggy." Bagged lime is also available, both pulverized (in 50-pound bags) and pelletized (in 40-pound bags). Note that **bagged pelletized lime has the same neutralizing effect as bagged pulverized lime** (they meet the same mesh size requirements). Pelletized lime is produced by compressing smaller particles into larger granules that are easy to spread onto yards with a push-type lawn spreader without the white dust. This process results in pelletized lime costing more than twice as much as pulverized lime. Do not let a salesperson tell you less pelletized lime is needed than pulverized lime (because pelletized lime costs more than pulverized). It's just not true!

Fig. 3.6 *Site and nutrient availability are major considerations when planting food plots. Liming is absolutely critical to increase soil pH, improve availability of nutrients, improve nitrogen fixation among legumes and increase herbicide effectiveness. Hiring a lime truck from the local fertilizer supplier is much more efficient and economical than buying and applying bagged lime.*

Improving soil fertility

Plants require non-mineral nutrients and mineral nutrients. Plants obtain non-mineral nutrients, hydrogen (H), oxygen (O) and carbon (C), from air and water. Mineral nutrients are obtained from the soil. The primary nutrients (or macronutrients) include nitrogen (N), phosphorus (P) and potassium (K) (the *big three* fertilizer nutrients). The secondary nutrients include calcium (Ca), magnesium (Mg) and sulfur (S). The micronutrients include boron (B), chloride (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), zinc (Zn), cobalt (Co) and nickel (Ni). Availability of these nutrients for maximum plant production is essential, but not as often limiting as the macronutrients and secondary nutrients. Other micronutrients have been found essential for at least some plants, but information is limited and they are almost never deficient in soils to limit plant growth.

The main source of nutrient anions (nitrate N, P, S, B, Cl and Mo) is soil organic matter. Incorporation and decomposition of organic matter slowly releases these nutrients throughout the growing season for plant uptake, thus reducing fertilizer costs. *This is an important consideration you shouldn't overlook.* The main source of nutrient cations (ammonium N, K, Ca, Cu, Fe, Mg, Mn, Zn, Ni and Co) is cation exchange with soil particles and humus. In many soils, these processes are not adequate to supply enough nutrients for optimum plant growth; thus, fertilizers are needed.

International Plant Nutrition Institute

Fig. 3.7 *The yellow discoloration on the older leaves of this corn show N is limiting. It is common for yellowing to begin at the leaf tip in corn and extend along the midribs.*

Nitrogen

Nitrogen (N) is the key nutrient in plant growth. It is a part of all proteins (plant and animal), chlorophyll and nucleic acids. Nitrogen is supplied by atmospheric reactions (especially electrical storms), decomposition of organic material (about 5 percent by weight) and N fertilizers. Adequate nitrogen leads to increased plant growth and produces more palatable and higher-quality forage with thinner cell walls, increased protein and increased water-use efficiency. Increased plant growth and quality provide additional food and nutrition for wildlife. Crops usually contain more nitrogen than any other nutrient; however, various crops require more nitrogen than others. Corn, for example, is a heavy nitrogen user, while wheat requires considerably less. Inadequate nitrogen usually leads to pale, yellowish-green plants and reduced production (see ***Key to nutrient deficiency symptoms in crops*** on page 20). Crude protein levels are also much lower when nitrogen is limiting.

Nitrogen is unique in that plants can use it in both the cation form (ammonium–NH^{4+}) and anion form (nitrate–NO^{3-}). Both of these are very soluble in soil water and are readily taken in by plants if available during the growing season. With heavy rainfall, nitrogen may be lost through leaching or surface run-off. Nitrogen may also be lost or made unavailable through denitrification and volatilization. Soil bacteria can change nitrate nitrogen to gas when certain soil conditions prevail (primarily wet periods in clay soils). Volatilization is common when nitrogen fertilizers containing non-stabilized urea are broadcast and not incorporated into the soil by disking or if it doesn't rain soon after application. This can lead to as much as 30 percent loss of available nitrogen within 1–2 days after application. Incorporation after application, as well as rain or irrigation, prevents volatilization of urea fertilizers. Volatilization of ammonium nitrate and ammonium

sulfate is not a concern, unless applied on soils where heavy lime applications were recently top-dressed and not incorporated.

Availability of nitrogen in a usable form is critical for most plants. Only legumes can obtain nitrogen from a gaseous form (see ***Inoculating legume seed*** on page 35).

Phosphorus

Phosphorus (P) is the second key plant nutrient. Wildlife managers should be particularly concerned about phosphorus availability because of its role in bone and tissue growth, including antlers and teeth, which are mostly calcium phosphates, and its role in fruiting and seed production. Phosphorus is also involved in metabolizing fats, carbohydrates and amino acids. Phosphorus influences plant use of other nutrients, such as nitrogen, and plays an essential role in cell division and growth, in muscle contractions and in the function of DNA molecules.

Young plants absorb phosphorus quickly if it is available. In fact, some crops accumulate approximately 75 percent of their phosphorus requirement by the time they produce 25 percent of their dry weight biomass. A deficiency of available phosphorus interferes with the ability of plants to use water and regulate internal temperature. Soil moisture, temperature and soil pH greatly influence phosphorus availability. The main source for plant-available phosphorus is the decomposition of organic material. Cold, wet weather slows bacterial action, which reduces decomposition of organic material and reduces phosphate availability, causing plant leaves to turn purplish-red (see ***Key to nutrient deficiency symptoms in crops*** on page 20). In mineral soils, phosphorus is largely unavailable when soil pH is below 5.5 and above 7.0, as phosphate ions react with iron and aluminum ions in acid soils and adsorb to calcium carbonate surfaces in alkaline soils.

Phosphorus availability is improved by adjusting soil pH between 6.1 and 6.5, incorporating organic matter into the soil and applying phosphate fertilizers. Phosphorus reacts quickly with the soil and does not move appreciably from the point of application

Fig. 3.8 *P-deficient plants, such as this dwarf essex rape mixed with clover, may appear purplish-red.*

(if not washed away). Because of its immobility, it is important to mix phosphate fertilizers into the top few inches of soil when preparing a seedbed.

Potassium

Potassium (K) is the third key plant nutrient. Potassium is critical in nearly every aspect of plant growth. Potassium regulates water and nitrogen uptake, aids in photosynthesis, allows adequate sugar and nutrient transport, helps build plant proteins and carbohydrates, increases root growth and improves drought resistance and disease resistance. These factors play an important role in terms of stand longevity among perennial forages and where plant cold hardiness is a factor in forage persistence. In animals, potassium is important for nerve and muscle function, and regulates sodium and fluids. Potassium-deficient plants experience poor seedling vigor, have weak stems, poorly developed root systems and often exhibit leaves that appear scorched along the margins (see ***Key to nutrient deficiency symptoms in crops*** on page 20).

Although potassium is relatively abundant in many soils, it may not be readily available because it is often tied up primarily in micas and feldspars that weather very slowly. The addition

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Fig. 3.9 *The yellowish discoloration and scorching along the edge of these soybean leaves suggest K is limiting.*

Fig. 3.10 *Acquiring plenty of calcium is necessary for deer to grow large antlers and turkeys to grow long "hooks"!*

of potassium fertilizers (such as potash, K_20) is necessary to increase potassium availability. When managing soil potassium, it is wise to use split applications (avoiding heavy single applications) and maintaining soil pH near 6.1–6.5 to reduce losses from leaching. Returning crop residues (organic matter) can also help retain potassium present on the site and reduce leaching.

Secondary nutrients

Calcium influences cell wall strength and cell division (especially rapidly growing root tips), protein synthesis and carbohydrate movement. In animals, calcium is a major component of bones (including teeth and antlers) and is important for proper nerve and muscle functioning. Magnesium is essential for the production of chlorophyll. In fact, at the heart of each chlorophyll molecule is a magnesium atom. Therefore, without magnesium, there would be no green plants. In animals, magnesium allows the nervous and various enzyme systems to function properly. Sulfur is required for the production of three amino acids found in plants and animals. These amino acids are necessary for synthesizing proteins, which are vital for both plants and animals.

Chris Shaw

Fig. 3.11 *Micronutrient availability is important for various crops, such as this alfalfa plot in West Tennessee.*

Calcium is easily supplied through liming (calcium carbonate). Magnesium levels are also increased when dolomitic lime is used. Across the South, most sulfur comes naturally from decomposition of organic matter and rainfall. The addition of fertilizers containing sulfur or calcium sulfate (gypsum) can easily correct any deficiencies.

Micronutrients

The micronutrients are essential for plant growth, but they are needed and used in minute quantities relative to the macronutrients and secondary nutrients. With the exception of boron, micronutrients are not often limiting for forage growth across the South. However, sandy soils are more likely than clay soils to be deficient in available micronutrients. Several micronutrients (as well as several macro- and secondary nutrients) are also less available in cold, wet soils.

Alfalfa, clovers and *Brassica*s may benefit from 1–2 pounds of boron per acre per year (about 10–20 pounds of Borax™ per acre will work). Other micronutrients, such as zinc, are particularly important for other plants, such as corn and grain sorghum, and may improve yields if amendments are made. Wheat, oats, grain sorghum and clovers have responded positively to an addition of copper, especially in sandy soils where leaching is common. Of course, the only way you will know if a micronutrient application is needed is through soil testing. Proper micronutrient availability is ensured by carefully managing pH. A soil pH of 6.1–6.5 helps ensure micronutrients are available, but not at toxic levels.

Soil testing – a cheap source of knowledge

Correcting soil pH and providing adequate nutrition is absolutely critical to food plot success! Do not skimp on liming and fertilization if you want lush, productive food plots. The only way to know how much lime and fertilizer is needed is to collect soil samples and have them tested (see ***Appendix 9*** for contacts). Soil tests are cheap (usually around $8–15; free in some states) and provide much-needed information. Unbelievably, relatively few people take advantage of soil testing. This is unfortunate because nutrient availability is the single biggest factor in forage production. It is amazing that food-plot enthusiasts will pay $70 or more per acre on seed, but will not take the time to get a soil sample tested to determine how much lime and fertilizer are necessary to enable the plot to produce all it can.

Table 3.2 Soil test ratings[1] for phosphorus and potassium in pounds per acre.

Rating[2]	Phosphorus (P)	Potassium (K)
Low	0 – 18	0 – 90
Medium	19 – 30	91 – 160
High	31 – 120	161 – 320
Very High	120+	320+

[1] These ratings are based on research data collected under various soil conditions and cropping systems from locations throughout Tennessee by the University of Tennessee Agricultural Experiment Station and University of Tennessee Extension personnel.

[2] Low: crops are probably yielding less than 75 percent of their potential and should respond to application of that nutrient.
Medium: crops are probably yielding 75 percent or more of their potential and may or may not respond to application of that nutrient.
High: crops are probably producing at or near 100 percent of the soil's potential without addition of that nutrient. Any amount recommended is to maintain present soil test levels.
Very High: nutrient is well in excess of the amount needed to produce 100 percent of the soil's potential. Application of the nutrient is not recommended; further addition may create nutrient imbalances.

Key to nutrient deficiency symptoms in crops[1]

Nutrient	Color change in lower leaves (translocated nutrients)
N	Plants light green; older leaves yellow (chlorosis); yellowing begins at leaf tip and extends along midribs in corn and sorghum
P	Plants dark green with purple cast; leaves and plants small
K	Yellow/brown discoloration and scorching along outer margin of older leaves; begins at leaf tip in corn and grain sorghum
Mg	Older leaves have yellow discoloration between veins; finally reddish-purple from edge inward
Color change in upper leaves (nutrients not translocated); terminal bud dies	
Ca	Emergence of primary leaves delayed; terminal buds deteriorate; leaf tips may be stuck together in corn
B	Leaves near growing point yellowed; growth buds appear as white or light brown dead tissue
Terminal bud remains alive	
S	Leaves, including veins, turn pale green to yellow; young leaves first
Zn	Pronounced interveinal chlorosis on citrus and bronzing of leaves; on corn, broad white to yellow band appear on the leaves on each side of the midrib; plants stunted, shortened internodes; new growth may die in some bean species
Fe	Leaves yellow to almost white; interveinal chlorosis to leaf tip
Mn	Leaves yellowish-gray or reddish-gray with green veins
Cu	Young leaves uniformly pale yellow; may wilt and wither without chlorosis; heads do not form or may be grainless on small grains
Cl	Wilting of upper leaves, then chlorosis
Mo	Young leaves wilt and die along margins; chlorosis of older leaves because of inability to properly utilize nitrogen

[1] Information courtesy the International Plant Nutrition Institute and other plant scientists.

It is important to note that deficiency symptoms are not often clearly defined. Masking effects from other nutrients, secondary diseases or insect infestations can prevent accurate field diagnosis. Deficiency symptoms always indicate severe nutrient availability. Many crops start losing yields well before deficiency symptoms appear. Positive identification of nutrient deficiencies requires soil testing and analyzing plant tissue samples. Refer to ***Appendix 9*** for information on where to send soil and plant samples.

Soil tests are no better than the sample collected. A soil sample should be representative of the field being planted. Each field should be sampled and tested separately. Where there is a considerable change in soil color or texture within a field, multiple soil samples might be needed for a single field. Regardless of color or texture, soil nutrient availability can vary considerably across a field. Therefore, a *soil sample should actually represent a number of evenly distributed sub-samples* (10–20 per acre) collected across the field. For relatively large fields, a general recommendation is to collect separate soil samples per five acres.

Soil samples are best collected with a soil probe, but a small garden shovel works fine. Samples should be taken to the depth used for fertilizer calibration trials. For most food plot plantings, that is approximately 4–6 inches. Mix these sub-samples together in a bucket and pour a sample of this material in a soil test box (available from your county Extension office). Remove rocks and organic debris from the sample before filling the box. Soil samples should be dry. If your sample is moist when collected, allow it to dry before boxing and mailing. Label the box and accompanying soil test sheet as directed and return it to your county Extension office or send it directly to the soil test lab. Results may be sent to you via regular mail or email by most labs.

Soil tests vary among soil testing labs, but a basic test usually provides soil pH, current levels of phosphorus (P) and potassium (K), and recommendations for lime, nitrogen (N), phosphate ($P_2 0_5$) and potash ($K_2 0$) per acre according to the requirements of the stated crop. Levels of N are generally not included in a soil test because soil N is not stable and fluctuates over time. N recommendations are given for each stated crop. Soil samples also can be tested for micronutrients, organic material and soluble salts for an additional charge. Nutrients are normally reported in pounds-per-acre present in the soil. Ratings for P and K are low, medium, high and very high (Table 3.2). Ratings for micronutrients may be sufficient (S) or deficient (D). A basic soil test usually provides all the information you need. However, requesting information on micronutrients and organic matter is a good idea when planting a plot for the first time or if plot production is less than desirable, yet pH and levels of macronutrients are sufficient. If you have any confusion reading the soil test, call or visit your county Extension agent for *free* advice and consultation! For best results and continued successful plot production, it is best to soil test annually until pH and nutrient deficiencies have been corrected, then at least every 2–3 years for maintenance, while applying additional lime/fertilizer as recommended.

Fertilizer applications

The three numbers on a fertilizer bag refer to the grade, or the percentage of total nitrogen (N), phosphate (P_2O_5), and potash (K_2O) in the bag. For example, a 50-pound bag of 15-15-15 will contain 7.5 pounds of N, 7.5 pounds of P_2O_5 and 7.5 pounds of K_2O. Although commonly used, complete fertilizers are not necessary for many food plots. A more sensible approach is often to apply a specific-nutrient (or high-analysis) fertilizer. For example, a 50-pound bag of ammonium nitrate (34-0-0) contains 17 pounds of N. One bag of a phosphate fertilizer, such as triple super phosphate (0-46-0), contains 23 pounds of P_2O_5. A bag of muriate of potash (0-0-60) contains 30 pounds of K_2O. One bag of these fertilizers costs about the same as a bag of 15-15-15, but you get more than twice the amount of the nutrient needed per bag and you don't apply unneeded fertilizer. This is particularly important when planting legume plots (such as clovers, alfalfa, cowpeas, soybeans, lablab, jointvetch, etc). Properly inoculated legumes assimilate nitrogen from bacteria attached to their roots; thus, relatively little, if any, N fertilizer is necessary and N applications may lead to increased weed pressure. Also, if one nutrient is already rated high in availability, additional application of that nutrient may create a nutrient imbalance. Secondary nutrients and micronutrients are typically added separately if needed, but occur in several blended fertilizers. Fertilizer analysis is printed on the bag.

Fertilizers are most often applied with a three-point, hitch-mounted or pull-behind spreader. As with lime, it is important to incorporate fertilizer into the top 4–6 inches of soil where it will be most readily

THE UNIVERSITY of TENNESSEE Extension

SOIL TEST REPORT

ANY PRODUCER

YOUR TOWN, TN 37000

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Date Tested: 8/2/2007

County: Wilson **Lab Number:** 250159

Mehlich 1 SOIL TEST RESULTS and RATINGS*

(Pounds Per Acre)

Sample Number	Water pH	Buffer Value	P Phosphorus		K Potassium		Ca Calcium		Mg Magnesium		Zn Zinc		Cu Copper		Fe Iron		Mn Manganese		B Boron	Na Sodium
1	5.2	7.6	4	L	69	L	1150	S	55	S	3.8	S	0.1	S	114	S	86	S	1.2	36

Sample Number	Organic Matter %	Soluble Salts PPM**
	1.5%	

RECOMMENDATIONS

Sample Number	Fertilizer/Lime Application Rate and Timing

1 **Cool Season Legume Establishment (Clovers)**

N / P_2O_5 / K_2O

Nitrogen/Phosphate/Potash: 0-15 / 90 / 90 pounds per acre

Limestone: 2 tons per acre

This recommendation should be used for new crops or to renovate an existing crop. For future maintenance of the new or renovated crop, decrease amount of phosphate and potash by 30 pounds each. If establishing wheat or oats into clovers, omit nitrogen.

1 **Corn (100-125 BU/A)**

N / P_2O_5 / K_2O

Nitrogen/Phosphate/Potash: 120 / 100 / 100 pounds per acre

Limestone: 2 tons per acre

If nitrogen sources containing urea are not incorporated, some loss of nitrogen may occur if applied to moist soils followed by three or more days of rapidly drying conditions without rainfall.

Reduce nitrogen rates following leguminous cover crops. A good crop of crimson clover in early bloom stage will supply about 50-70 pounds per acre of nitrogen.

1 **Warm Season Grains (Millet, Milo, Sunflower, Buckwheat, etc.)**

N / P_2O_5 / K_2O

Nitrogen/Phosphate/Potash: 90 / 120 / 180 pounds per acre

Limestone: 2 tons per acre

If growing buckwheat, reduce nitrogen rate by 40 lbs.

***Ratings: Indicates relative availability of nutrients to plants.**

****PPM = Parts per Million**

If you have questions about these recommendations, contact your County Extension office.

Visit our web site at http://soilplantandpest.utk.edu for additional information.

This is a soil test report as provided by UT Extension. Your name and address, county where soil sample was collected and the date tested are identified at the top of the report. The lab number identifies this sample so it can be pulled from files later if needed.

The Mehlich 1 Soil Test Results and Ratings identify soil pH and the actual amount of nutrients in pounds per acre extracted in the soil sample. Nutrient availability is rated as low, medium, high or very high for P and K (see Table 3.2), and satisfactory or unsatisfactory for secondary nutrients and micronutrients. This soil test report provides recommendations for only one sample, identified on this report as Sample Number 1. You can identify the sample number with up to six digits or letters.

Water pH refers to the actual pH of the soil. It is determined by mixing the soil with de-ionized water, then measuring the pH of the de-ionized water solution. The buffer value represents the cation exchange capacity (CEC; see ***Soil pH*** on page 11) of the soil. This is calculated by adding a buffer solution to the soil and allowing it to sit for approximately 10 minutes. The buffer solution slurry is then measured for pH. This measure represents how much cation exchange took place within the soil sample and is highly influenced by the percentage of clay in the sample. Thus, the buffer value explains how much lime is needed, as a clayey soil of a given pH will require more lime than a sandy soil with the same pH. As you can see, available P and K are low. However, Ca, Mg, Zn, Cu, Fe and Mn are sufficient for the crops identified.

In a basic soil test, only soil pH and levels of P and K are given. For an additional charge, soil samples can be tested for micronutrients, organic matter, soluble salts and nitrate nitrogen. Levels of nitrogen are not provided in a basic test because N fluctuates so much over time, depending upon site conditions and weather. A recommendation for nitrogen fertilization is given for each crop, even though current availability is not shown in the report. A rating is not provided for B or Na because data are still being collected to determine satisfactory levels for various crops. Organic matter is 1.5 percent. This is important information when using preplant or preemergence herbicides. Some of these herbicides have different recommended rates depending on percent soil organic matter. Usually, application rates will be higher if soil organic matter is higher than 3 percent.

Following the soil test results and ratings are the recommendations. For this field (Sample Number 1), separate recommendations are provided for establishing clovers, corn and other warm-season grains. This is a common scenario if you want to grow a cool-season plot in one half of the field and a warm-season plot in the other half.

Prior to planting either a cool- or warm-season plot, soil pH should be amended by incorporating 2 tons of lime per acre approximately 6 inches into the soil. To establish clovers, 0–30 pounds of N, 90 pounds of phosphate, and 90 pounds of potash per acre are recommended. This could be accomplished with approximately four bags of 0-46-0 and three bags of 0-0-60 per acre. When establishing plots, these fertilizers should be incorporated 4–6 inches by disking or tilling. N (no more than one bag of 34-0-0 per acre) should be incorporated prior to planting or top-dressed after germination and initial growth. If you are maintaining a perennial plot of clovers, the P and K recommendations can be lowered by 30 pounds each. That is because a greater amount of P and K is needed during establishment for initial root development. N fertilization is typically not needed when establishing legumes if the seed have been properly inoculated. If the seed were not inoculated, N fertilizer should be applied.

For an area to be planted in corn, 13 bags of 15-15-15 could be applied per acre and incorporated prior to planting. After the corn germinates and grows to approximately 12–18 inches tall, one or two bags of 34-0-0 could be applied. If legumes are being rotated with corn, the N recommendation can be reduced as indicated.

Prior to planting various warm-season grains, 120 pounds of phosphate and 180 pounds of potash should be incorporated into the top 4–6 inches of soil. P and K could be amended by applying six bags of 0-46-0 and six bags of 0-0-60. Half or more of the N recommendation (90 pounds) may be incorporated prior to planting and the other half could be top-dressed approximately three weeks later and just prior to rain. Buckwheat does not require as much N as millets, grain sorghum or sunflower, so only 50 pounds are needed if planting buckwheat alone.

If you have questions interpreting your soil test, contact your county Extension office for free assistance and advice.

Fig. 3.12 *It is impossible to know how much lime or fertilizer is required without collecting a soil sample and having it tested. Without question, it is the best $6–10 that can be spent on food plots.*

available to plant roots. This is particularly important for phosphate fertilizers because phosphorus is quite immobile in the soil. And, unless applied just before rain, it is important to incorporate N fertilizers containing urea because volatilization can occur rapidly. Incorporation of fertilizers is most important prior to planting plots. If the site has been amended in the past, maintenance applications of lime and fertilizer can be top-dressed. However, the effect of these applications will be less (per pound applied) as volatilization and leaching occur. It is important to realize good fertilizer management is possible only with adequate moisture, and split fertilizer applications, rather than one large application, allow plants to use added nutrients more efficiently and lead to increased production.

Balanced nutrition through fertilization refers to the continuous availability of all required nutrients in the proper amounts. This is not a simple process. All plants do not require all nutrients in the same amount. For example, when grown together, some grasses may absorb various nutrients more readily than some legumes, leaving the legumes deficient. Some crops (such as oats) may not need as much fertilization as others (such as alfalfa) because of an ability to absorb particular nutrients (such as P) without additional fertilization. When planting or managing mixtures (for example, oats/clover/chicory), always follow soil test recommendations for fertilization. As a general rule, you should fertilize according to the plant with the highest nutrient requirements.

Soil nutrients are commonly removed from the site through harvest and by grazing animals not fenced within an area. As nutrients are removed by wildlife foraging on plants, they must be replenished or soil fertility and productivity will decline. Balanced plant nutrition through fertilization is only possible by soil testing regularly (at least every other year).

Fig. 3.13 *Fertilizer applications are most easily accomplished with a cyclone spreader. Calibrating the spreader prior to fertilizer applications is just as important as calibrating it prior to sowing seed! Here, fertilizer is being spread prior to disking and planting a warm-season food plot.*

Plot Preparation and Planting

Some basic plant definitions

An understanding of plant types and growth patterns is essential when growing and managing food plots. Plants grown in food plots include forbs, grasses and one sedge. Forbs are broadleaf herbaceous plants. Forbs commonly planted in food plots include the *Brassica*s (or "greens," such as the rapes, kale and turnips), buckwheat, burnette, chicory, sesame and sunflowers, as well as various legumes, including alfalfa, alyceclover, the true clovers, cowpeas, jointvetch, lablab, lespedezas, partridge pea and soybeans. Grasses commonly planted in food plots include corn, grain sorghum, various millets, oats, cereal rye and wheat. The one sedge often planted as a food plot is chufa.

All of these plants are further defined as annual, biennial or perennial, and warm- or cool-season (see ***Appendix 1***). Annual plants germinate, grow, flower and produce seed in one growing season and, depending on the plant, variety and management strategy, may or may not reseed. Biennial plants normally require two growing seasons to complete their life cycle. Perennials continue living after flowering and producing seed and, depending upon management, may persist for several years.

Warm-season plants typically germinate in the spring and grow through the summer. All of the warm-season plants planted in food plots are annuals. Most cool-season plants produce the majority of their growth during fall, spring and early summer; however, some produce considerable forage throughout the summer and some continue to grow during the winter, especially mild winters. Both annual and perennial cool-season plants are commonly grown in food plots.

These same plant category definitions also apply to weeds, which can include forbs, grasses and sedges. Weeds are defined as *unwanted plants for a specific purpose*. For example, ragweed, pokeweed, beggar's-lice and tropic croton produce seed relished by bobwhite quail and mourning doves, and deer graze the foliage. These plants are promoted when managing quality early-successional habitat. However, they should be considered weeds in a clover plot grown for white-tailed deer and wild turkeys because they exhibit a different growth pattern than clovers and will reduce clover production when present. Separate acreage should be devoted to early-succession (or old-field) management, just as separate acreage should be devoted to warm- and cool-season food plots. Realizing the growth patterns (warm- or cool-season) and life cycles (annual or perennial) of weeds is absolutely critical when trying to control them.

Fig 4.1 *Understanding plant growth cycles is critical to manage successful food plots and control various weeds, such as this musk thistle, which is a biennial and is about to bolt.*

Fig. 4.2 *Before planting perennial food plots, eradicate perennial cool-season grasses by spraying the appropriate herbicides.* ***Preparing the plot by plowing and disking does not get rid of these grasses!*** *If you do not kill them by spraying before planting, many of the root systems will remain alive, and you will have to fight them later, as evident in this ladino clover food plot where residual tall fescue is coming back seven months after planting the clover.*

Preparing the site – controlling problem weeds before planting

Preparing the site before planting is extremely important, especially if perennial weeds are present and you are planting a perennial food plot (such as ladino clover and chicory). Annual weeds are not a big concern, especially if they are disked before they flower and produce seed. However, perennial grasses (especially tall fescue, bermudagrass and johnsongrass) and some specific perennial forb weeds (such as curly dock and horsenettle) may present major competition problems in perennial food plots if not controlled prior to planting. If you plan to plow/disk and plant an annual crop year after year, eradicating perennial weeds with herbicide applications is not as critical.

Perennial weeds are best controlled with a post-emergence herbicide (sprayed on top of the growing plant). The most widely used broad-spectrum post-emergence herbicide is glyphosate. It is available under several trade names with various formulations. The most familiar trade name is Roundup™. A glyphosate herbicide is recommended to control most perennial weeds; however, there are some exceptions (explained later). Regardless, it is critical to use a surfactant with any postemergence herbicide (see ***What are surfactants?*** on page 28). A few glyphosate herbicides contain a surfactant; some do not. If the postemergence herbicide you are using does not contain a surfactant, be sure to add one according to herbicide label directions.

If perennial cool-season grasses (such as tall fescue or orchardgrass) are present where you intend to plant, spray 1.5–2.0 quarts of a glyphosate herbicide per acre in the fall before a spring planting or two quarts per acre in the spring before a fall planting. Fall spraying is most effective because nutrients are being transported from the leaves to the roots in preparation for winter senescence. Spring spraying is more likely to require repeat applications. Regardless, you should burn, hay, graze or mow the field before spraying. Burning or haying is best. This provides a "clean" field for spraying, free of thatch and dead material that will block much of the herbicide from contacting the growing grass. The grass should be growing vigorously and 6–10 inches in height when sprayed for best results. It is important to note perennial grasses should be killed before applying and incorporating lime. Do not apply lime and plow or disk it in prior to spraying perennial grasses. Kill perennial grasses before plowing or disking.

To control bermudagrass, burn the field in late winter. Spray bermudagrass the following summer about the time the bermudagrass begins to flower. Imazapyr (48 ounces of Arsenal™ per acre) or glyphosate (5 quarts of Roundup™ per acre) are options. Imazapyr is more effective killing bermudagrass than glyphosate; however, there is a 12-month minimum crop rotation restriction following application of imazapyr. Therefore, you cannot plant the field any time soon. If you want to plant the field in the fall after spraying, use a glyphosate herbicide. As with perennial cool-season grasses, do not apply and incorporate lime prior to spraying bermudagrass. Incorporate lime by plowing or disking no sooner than four weeks after spraying. At this time, you are ready if you intend to plant annual crops. However, **it is not advisable to plant a perennial forage in the fall after spraying bermudagrass**. If you intend to plant a perennial plot, such as ladino clover and chicory, plant a cool-season annual plot in early September and then disk the field the following May and see how much bermudagrass returns through the summer. Re-growth should be fairly sparse, but don't let that fool you. It will spread across the field in a couple of growing seasons if not sprayed again! Roundup Ready™ crops can be used to reduce coverage of several weeds, but this practice is not as effective with bermudagrass, for a couple of reasons. Numerous applications of glyphosate are necessary to eradicate bermudagrass. If a Roundup Ready™ crop (such as soybeans) is planted, a canopy is created over the field and further bermudagrass growth is suppressed because of the shade effect. The bermudagrass is not dead, just suppressed, and it will grow again when conditions permit. If you intend to plant a perennial forage, it is best to provide bermudagrass good conditions to grow so you can effectively get rid of it.

John Gruchy

Fig. 4.3 *For optimum results, perennial cool-season grasses, such as tall fescue and orchardgrass, should be sprayed in the fall with glyphosate. Fields should be "clean" before spraying. This field was hayed in early October to prepare for spraying in early November. This allowed the herbicide to come in contact with growing grass, not dead thatch and stems from previous years' growth.*

John Gruchy

Fig. 4.4 *This field of bermudagrass was effectively killed with Arsenal AC. However, an annual cool-season plot should be planted and the field checked for residual bermudagrass cover next summer before planting a perennial forage food plot.*

If johnsongrass is a problem, wait until it reaches 18–24 inches in height and spray with 2 quarts of a glyphosate herbicide or 10–12 ounces of a clethodim herbicide (such as Arrow™) per acre. Another way to control johnsongrass is with a

preemergence herbicide (sprayed prior to germination). A preemergence application of Pursuit™ (4 ounces per acre) when planting warm-season legumes (such as cowpeas, lablab, soybeans) provides excellent control (see ***Weed control*** on page 37) of johnsongrass germinating from seed. Later, johnsongrass sprouting from rhizomes can be sprayed with a grass-selective herbicide if forbs (such as cowpeas or lablab) were planted.

Warm-season forb weeds are best controlled with glyphosate and/or a forb-selective herbicide, such as 2,4-D, Banvel™ or Clarity™ (see ***Appendix 2***).

Several forb-selective herbicides can be tank-mixed with a glyphosate herbicide for increased broad-spectrum control. Refer to herbicide labels for tank-mixing application rates. Planting Roundup Ready™ crops for one or more seasons is another option for controlling stubborn perennial forb weeds. Using Roundup Ready™ crops, however, should be approached with caution. Continued use of glyphosate alone can lead to physiological resistance in certain weeds. Using herbicides other than glyphosate one out of three years will provide better long-term control of problem weeds.

What are surfactants?

Surfactants are water- or oil-soluble *surface-active agents* added to postemergence herbicides to modify or enhance the effectiveness of the active ingredient. Surfactants help herbicides stick, spread, wet, penetrate and disperse on the surface of plants. Hence, surfactants are not added to preplant incorporated or preemergence applications, only postemergence. In short, surfactants make postemergence herbicides more effective by helping them penetrate the plant.

Non-ionic surfactants (NIS) are commonly used with both broad-spectrum and selective herbicides. NIS are soluble in cold water, are outstanding dispersing agents, do not foam much and have low plant and animal toxicity. Thus, NIS are almost always used with selective herbicides where desirable plants also occur. Further, NIS do not ionize in water; therefore, they do not form insoluble salts and can be used with hard water. NIS are usually added to herbicide solutions at 0.25 percent by volume of spray solution (0.32 ounces per gallon of solution or 32 ounces per 100 gallons).

Crop oil concentrates (COC) are petroleum- or vegetable-based oils that contain surfactants and increase the absorption of herbicides into plant leaves. Methylated Soybean Oil (MSO), for example, is a commonly used, vegetable-based COC. COC usually contain 80 percent oil and 20 percent NIS. Depending upon the application, some herbicide labels may recommend COC rather than NIS because COC alone can alter the structure of cell membranes and cause damage to plants. That is why NIS are normally used with selective herbicide applications, while COC are often used with “burn-down” applications where the intention is to kill all vegetation present. Nonetheless, it is important to use a high-quality surfactant and follow the herbicide label instructions as some herbicides perform better with COC than NIS.

Liquid nitrogen fertilizers, such as urea-ammonium nitrate or ammonium sulfate, may increase the uptake of postemergence herbicides. However, they are not surfactants, even though they may be recommended on some herbicide labels as an additive to the spray mixture.

Preparing the seedbed

Plowing/disking or drilling?

Once problem weeds have been controlled, it is time to prepare the seedbed. Lime should be incorporated into the root zone via plowing/disking at this time if you have not done so already. If you intend to plant with a no-till drill, you may need to mow or burn the dead vegetation before drilling; otherwise, no further preparation is needed. If you are planting via conventional methods, and if fertilizers have been disked into the seedbed, the plot may be ready to plant (top-sow or drill with a conventional drill). If not, plowing, disking and/or tillage (with a rotovator) will incorporate lime/fertilizers and create a clean seedbed. Mowing or burning may be necessary to reduce vegetative cover on the field prior to plowing/disking/tilling. If you don't burn the site, moldboard plowing or disking with a heavy offset disk (a tandem disk is not usually sufficient for this task) does an excellent job of incorporating organic material, which adds considerable nutrients to the site (especially

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Figs. 4.5 and 4.6 *Burning thatch and other dead material is an excellent way to prepare the field for plowing or disking.*

Fig. 4.7 *A chisel plow with shanks 16–20 inches long does a great job incorporating lime and breaking hardpans created after many years of disking and shallow plowing.*

N and P). After plowing, disking with a tandem disk or tilling prepares a fine seedbed. A clean, smooth, firm seedbed is desirable (but not absolutely necessary) for sowing small seed such as clovers, jointvetch and alfalfa. These small-seeded forages can also be established successfully by light disking after the existing vegetation has been killed and top-sowing. This is especially applicable when planting woods roads and mowed paths where plowing or heavy disking may not be desirable. After many years, continued plowing and disking can create a hardpan (compacted soil 8–15 inches deep that inhibits deep root systems and reduces soil moisture). A subsoiler or chisel plow (with shanks penetrating 16–20 inches deep) can be used to break the hardpan and conserve soil moisture.

Soil moisture & level of preparation – what to look for

The correct amount of soil moisture is critical when preparing a seedbed, especially in clay soils. If the soil is too dry, dirt clods will be large. If too wet, discs will clog with mud, and large clods will result once the soil dries out. When worked at the proper moisture level, dirt clods fall apart in relatively loose, small particles. Of course, this is not as much a concern in loamy soils and not a concern in sandy soils. Soil moisture can be deceiving by looking at the surface. Only by digging down to the depth the soil will be worked can soil moisture be determined. Soil moisture should be checked in a few spots across the field, similar to collecting soil samples for testing. By digging down 6–8 inches with a shovel, the moisture level can be checked by squeezing a handful of soil. If the soil sticks together in a ball, it is too wet. If it looks and feels moist, yet crumbles, it is perfect. If no moisture is felt and it is fairly difficult to crumble because it is hard, it may be too dry to prepare a fine seedbed for small-seeded species (such as alfalfa and clovers).

Larger seed (such as cowpeas, lablab, Austrian winter peas, oats) do not require a fine seedbed. They will germinate well in a relatively coarse seedbed provided they are covered an inch or so and receive rainfall within a few days. If adequate soil moisture is present, a previously plowed seedbed should need a couple passes with a disc harrow prior to planting large seed. Germination and initial growth of smaller seed is *considerably* better in a finer seedbed. Additional disking or tillage is usually needed for these species. A rotovator is an excellent implement for preparing a seedbed for small-seeded species.

Planting

It is best to plant when adequate soil moisture is present to improve germination and establishment. Nonetheless, the very best time to plant is just prior to rain. When it is dry for an extended period after planting, germination and growth are usually less than desirable. If seed germinate and seedlings do not get adequate rainfall soon, they will desiccate and die. Therefore, planting by a certain date is of little concern unless there is projected rainfall.

Food plots are planted either by broadcast spreading seed or using a drill or other type of planter. Both techniques can be used with conventional tillage or no-till technology. Broadcast seeding is normally done over a well-prepared seedbed using tillage techniques. Drilling seed is normally accomplished with no-till drills. However, some drills and planters require a cultivated seedbed. Also, some small-seeded forages (such as clovers) can be top-sown without tillage (with proper weed control).

Broadcast seeding

Most broadcast spreaders are mounted to a three-point hitch behind a tractor. These spreaders are very efficient in planting relatively large plots ($\geq$ 2 acres) as well as spreading fertilizer. Hand-held broadcast spreaders are effective and efficient when planting smaller plots. Calibrate the seeding rate by marking off a 1/10th-acre area and weighing the appropriate amount of seed. **This is a critical step in successful planting**. Start at a low setting and adjust up as necessary. Practice (with additional plantings) to get the seeding rate just right. When broadcast seeding with a hand-held seeder, walk at a slow-to-moderate pace. When using a broadcast seeder, be sure to record the gear, RPM

and seeder setting when the correct rate and setting are determined. You will need to do this separately for different species, because the seeder setting will be different for larger seeds than for smaller seeds.

Drilling seed

Calibrating drills and planters prior to planting is absolutely critical. There are a few methods for calibrating drills. One method involves counting the number of revolutions the drill wheel makes to cover 1/10th acre (this is measured accounting for the width of the drill). Once determined, elevate the drill with a jack, and turn the wheel the predetermined number of times. Collect the seed in buckets or on a tarp and then weigh the seed. Then you can set the drill as needed. Another method involves removing the seed drop tubes and attaching plastic sandwich bags over the bottom of the tubes with rubber bands. Then operate the drill over 1/10th acre. Remove the seed bags and weigh the seed. Then you can set the drill as necessary. Planters operate by allowing seed to pass from seed boxes through plates that have certain-sized openings. Plates with different-sized openings can be used to increase or decrease planting rate or to plant larger or smaller seed.

Advantages and disadvantages with drilling vs. top-sowing

Conventional tillage and no-till drilling both have advantages and disadvantages. An advantage of conventional tillage is that organic material is incorporated into the soil, recycling valuable nutrients for plant growth. Depending on the existing plant cover and the type of plot planted, herbicides may not be necessary with conventional tillage (but usually are). On the other hand, conventional tillage disturbs the soil and stimulates germination of weed seed in the seedbank. This can release problematic weeds and decreases available soil moisture, increasing the chances of seed desiccation if a prolonged dry spell ensues. This is the main reason why it is so important to watch the weather forecast and plant just ahead of rain. Exposed soil is also subject to erosion. Relatively steep slopes should not be planted with conventional tillage techniques.

No-till drilling seed obviously requires a drill, which is expensive, and most drills are quite large, requiring large trucks to transport them from site to site. Also, because of their large size, it may not be possible to get some drills into remote locations. Prior to planting, herbicide applications are necessary to

Fig. 4.8 Drilling seed is a most reliable planting technique. All seed are easily planted at the desired depth and germination rates are higher, thus less seed is required per acre.

kill existing plant cover. If the existing cover is not sprayed, planted seed have little chance of germinating and growing amid existing growing vegetation. Soil moisture is conserved when using a no-till drill, and the possibility of soil erosion is virtually eliminated by no-till planting. When using a planter with conventional tillage techniques, considerable weed control is possible by cultivating between rows. Drilling or planting requires 25–50 percent less seed sown per acre than broadcast seeding, because seed placement is precise and germination rate and seedling survival are higher.

No-till top-sowing

Another option in no-till planting is top-sowing with the aid of herbicides. You must kill existing vegetation with herbicides (such as Roundup™). Sow small-seeded species on top of the dying vegetation. (Note: increase your seeding rate approximately 30 percent above the normal broadcast rate). This allows rain to carry the seed down to mineral soil while the existing vegetation begins to decay. This method can work well with clovers, alfalfa, *Brassica*s, American jointvetch and alyceclover. It does not work with larger seed that require coverage. Frost-seeding is another example of top-sown no-till plantings. Sow small-seeded, cool-season species on top of snow and frost-heaved ground in February/March prior to thawing. A selective herbicide application is usually necessary once spring green-up begins, depending on the existing cover and weed pressure.

Fig. 4.9 *No-till top-sowing clovers can be successful, but careful attention must be given to killing the existing cover and applying the correct postemergence herbicide application during establishment.*

Fig. 4.10 *Large-seeded species, such as cowpeas, soybeans, grain sorghum and cool-season grains, can be covered by disking. However, don't disk-in clovers – you will cover them too deeply! Small seed should be cultipacked after top-sowing.*

Seeding depth

Regardless of planting method, seeding depth is a major consideration. Planting or covering seed too deep is a common reason for plot failure. Grains and other relatively large seed (such as corn, grain sorghum, Austrian winter peas, cowpeas, soybeans, lablab and sunflowers) should be drilled (planted) or covered by disking approximately 1 inch deep. The cool-season grains (oats, wheat and rye) germinate better when lightly covered (especially oats). Small-seeded species (such as clovers) should be covered no more than ¼ inch. When mixtures of both large- and small-seeded species (such as

cowpeas and American jointvetch or Austrian winter peas and clover) are planted using conventional tillage methods, the large seed should be planted first. After seeding, cover the large seed by disking, then plant the small seed.

Seeding depth can be a real problem with some pre-mixed commercial seed blends. With both large and small seed in the bag (such as lablab/soybeans/cowpeas with milo/jointvetch/alyceclover), the small seed tend to gravitate to the bottom of the seed box and are sown before all the large seed are sown. This is not a problem if you sow the seed separately or if you drill large and small seed in separate boxes, sowing each at a different rate (if necessary) simultaneously.

Cultipacking

Cultipacking improves the germination rate of top-sown seed, especially small seed that lack firm seed-to-soil contact after sowing. A cultipacker is the implement of choice for firming a seedbed. The results are far superior to dragging a chain-link fence or some other crude object around the field behind a tractor or ATV. Cultipacking is necessary prior to seeding small seed if the seedbed is fluffy and is always recommended after seeding small-seeded species (such as alfalfa, clovers, *Brassica*s, jointvetch). Cultipacking prior to seeding is often necessary when a rotovator is used to prepare the seedbed. As a general rule, if you leave a boot imprint deeper than an inch, the seedbed should be cultipacked before planting small-seeded species. Small seed usually can be sown on top of lightly disked soil without cultipacking

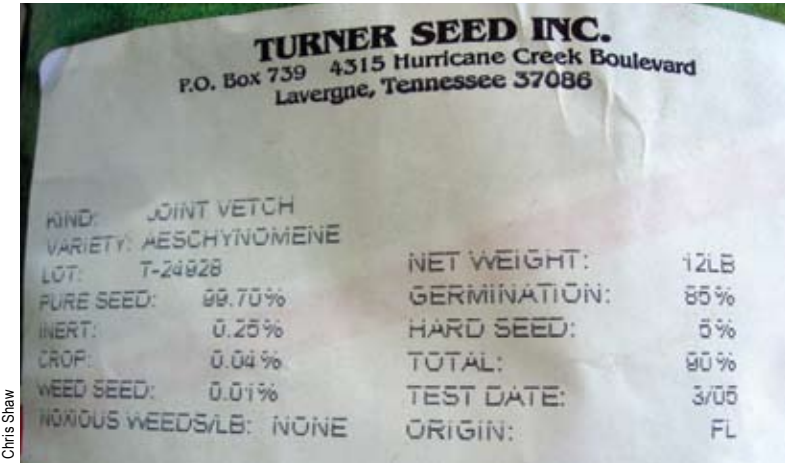
Planting large and small seeds together

Broadcast planting mixtures of large and small seed is best accomplished by the following procedure.

1. Prepare seedbed by plowing, disking and/or tilling. Lime and fertilizer should be incorporated at this time if you have not done so already. Also, if you are applying a preplant-incorporated herbicide, it should be done prior to disking or tilling.
2. Sow large seed (such as oats, winter peas, cowpeas) onto prepared seedbed.
3. Cover seed by disking approximately 1 inch deep.
4. Firm the seedbed using a cultipacker (this is an especially important step for really small seeds, such as ladino clover and alfalfa).
5. Sow small seed (including clovers, alfalfa, chicory, trefoil, *Brassica*s, jointvetch, millets).
6. Cultipack seedbed once again (most important) to ensure firm seed-to-soil contact and improve the germination rate.
7. Apply preemergence herbicide, if appropriate.

This procedure allows good germination and seedling establishment of both large- and small-seeded plants. Also, it leads to an even distribution of seed. When large- and small-seeded species are planted together, the small seed tend to gravitate to the bottom of the seed hopper or box and are sown before the large seed. Thus, an uneven distribution results.

Fig. 4.11 *A cultipacker is the best implement to firm a seedbed prior to sowing small seed (such as ladino white clover) and to establish firm seed-to-soil contact after sowing. Some folks use a section of chain-link fence to smooth a plot and reduce clods prior to planting. This can lead to better seedbed, but it is not a replacement for a cultipacker, which is needed for firm seed-to-soil contact.*



Chris Shaw

Fig. 4.12 *Certified seed will have a seed tag attached that tells you exactly what you are buying, and gives you information regarding seed quality.*

beforehand. After sowing small seed, the seedbed should be firmed using a cultipacker. Cultipacking will also improve germination of large-seeded species. Cultipacking is a very important step in successful food plot establishment.

Seed selection and calculating Pure Live Seed (PLS)

After you have decided what you are going to plant, you should purchase quality, certified seed with a high germination rate. Each bag of certified seed should have a seed tag attached.

If there is no seed identification tag attached to the bag, do not buy it. This tag should identify the variety of seed in the bag, seed origin, percentage of pure seed, percentage of inert material, germination rate, test date and the presence/amount of weed seed. If the seed is a legume and it is pre-inoculated, the percentage weight of the seed coating also should be identified on the seed identification tag. If you are ordering seed, the salesperson or seed representative should be able to provide this information over the phone or e-mail. Seed germination rates of most food plot seed typically decrease over time. If it has been more than a year since the seed was tested, true germination will probably be lower than that reported on the seed identification tag. Quality seed should have a germination rate of at least 80 percent.

Seed should be sown according to the percentage of Pure Live Seed (PLS); that is, the percentage of crop seed in the bag that is expected to germinate. The procedure for calculating PLS is shown below.

Variety:	Regal ladino clover
Pure seed:	98.00%
Inert matter:	1.30%
Other crop:	0.20%
Weed seed:	0.50%
Germination	80.00%

Pure seed (0.98) × Germination (0.80) = 0.784 (78.4% PLS)

Desired planting rate (8 pounds per acre) ÷ 0.784 = 10.2

Therefore, in order to plant 8 pounds of this Regal ladino clover per acre, you should sow 10.2 pounds of seed from the bag. It is important to realize for pre-inoculated seed, the percentage of pure seed may be considerably less than 98 percent because 20 – 30 percent of the material in the bag may be seed coating.

Inoculating legume seed

Legumes are plants that bear seed in a pod and have a symbiotic relationship with certain species of nitrogen-fixing bacteria (such as *Rhizobium* spp., *Bradyrhizobium* spp.). These bacteria attach themselves to the roots of legumes and form nodules. From these nodules, the bacteria extract nitrogen from the air. *Rhizobia* and others obtain energy from the plant, while the plant receives nitrogen produced by the bacteria. Thus, both bacteria and plant benefit from the relationship. Nitrogen fixation is influenced by many factors, including soil pH, nutrient availability, soil moisture, temperature and plant health.

Nitrogen fixation is important when planting legumes in wildlife food plots for three reasons: 1) minimal nitrogen fertilization is required (thus, you save money), 2) nitrogen is not a limiting factor to properly inoculated plants and 3) weed competition is reduced because little or no nitrogen fertilizer is applied. Depending on the legume planted, properly inoculated seed may later produce up to 200 pounds or more of nitrogen per acre. This is significant in terms of reducing fertilization and herbicide costs, especially when rotating a legume crop with a grass, such as corn, grain sorghum, wheat or oats.

Particular legumes require specific bacteria; no one kind of bacteria will properly inoculate all legumes. Therefore, you must use species-specific inoculant (see ***Appendix 8***). Although bacteria, such as *Rhizobia*, are found naturally in the soil, it is critical to inoculate seed prior to planting to ensure the *proper* bacteria are *in contact* with the seed. Legume seed are inoculated with *live* bacteria and there is a shelf life associated with each bag of inoculant or pre-inoculated seed. Inoculant should be stored in the refrigerator and never placed in direct sunlight (such as the dashboard of a truck). Bacterial survival is highest in soils with a relatively neutral pH (6.0–7.0). Acid soils (<5.8) do not support bacteria as well and inoculation efforts often fail in these conditions. Ideally, inoculated seed should be sown in a moist seedbed or just before rain. Dry conditions extending a few days after planting will reduce inoculation success significantly and nitrogen fertilization then may be necessary.

You can buy pre-inoculated seed of several legumes. This means the seed have been inoculated with the proper bacteria prior to bagging. Pre-inoculated seed are coated to protect the bacteria and usually are off-white, pink, gray or blue. Pre-inoculated seed should be sown before the inoculant expiration date, as indicated on the seed identification tag. If the inoculant surrounding the pre-inoculated seed has expired, inoculate the seed before planting.

Figs. 4.13 and 4.14 *Inoculated seed, such as these soybeans (left), should be allowed to dry in the shade. The seed should be ready to plant in an hour or so. If allowed to dry in direct sunlight, the bacteria may be killed. Properly inoculated seed (right) is obvious. You can see the black peat from the inoculation mixture stuck all over these lablab seeds.*

Legume seed inoculation can be somewhat messy. It is much easier to buy pre-inoculated seed. Nonetheless, if pre-inoculated seed are not available, inoculation is a very important step in establishing successful legume food plots. Improper inoculation methods, acid soils and planting in dry seedbeds are reasons why many attempts at establishing and maintaining healthy legume forage food plots fail. At the same time, it is important to realize inoculation is not necessary when planting a particular legume in a field where that legume was successfully established in the past few years. If successfully inoculated previously, those bacteria should remain in the soil on that site for a number of years. This is why most soybean producers, for example, do not inoculate soybean seed every year in those fields where soybeans have been grown in the last two or three years.

Steps for inoculation

1. Buy specific inoculant for each legume planted. Inoculant has a limited life span (it contains live bacteria), so check the expiration date and store inoculant in the refrigerator prior to planting. Do not expose inoculant to heat or direct sunlight. Always use fresh inoculant. Do not use left-over inoculant from last year.
2. Inoculants are packaged in a medium of peat, which is black. Pour the inoculant over the seed in a bucket. Be aware that a bag of inoculant will inoculate a lot of seed (50 pounds or more of some plant species). Therefore, relatively little inoculant is needed for an acre's worth of clover, for example.
3. Add a commercial sticker or sugar-water solution (4 parts water to 1 part sugar) to the seed/inoculant. Commercial stickers may be available in powder or liquid form, but they can be difficult to find. Sugar water works just as well. **Soft drinks should not be used as a sticker** because the pH of most soft drinks is very low and the acid solution may kill the bacteria.
4. Add just enough water to form a "slurry" (you don't want it too wet – just enough to stick the inoculant to the seed). Mix the inoculant/sticker/seed slurry well, making sure all seeds are coated with inoculant. This is critical. This can be done by hand. Although there are live bacteria in the inoculant, it is no different than picking up a handful of soil (which contains millions of bacteria). If the inoculant does not stick to the seed, the entire process is of no value.
5. Spread inoculated seed out on some newspaper, cloth bags or a sheet to allow the inoculated seed to dry **in the shade** (it will take no more than an hour). Once dry, you can sow the seed. If you do not sow the seed right away, you can store inoculated seed in a cool, dry place for no more than a couple of days or re-inoculation will be needed. Likewise, planting on a moist seedbed or just prior to rain is important to ensure inoculation success. Inoculated seed should not be mixed with fertilizer, as the salts in fertilizer may kill the bacteria.

Seeding rates

Seeding rates for individual plant species are normally given on a per-acre basis, and thus represent the amount of seed necessary to plant and cover a one-acre area. Seeding rates are based on a PLS rating of 100 percent (see ***Seed selection and calculating Pure Live Seed (PLS)*** on page 34). That is why it is so important to calculate PLS and adjust the seeding rate as appropriate.

Most food plots are composed of multiple species to form a combination, blend or mixture. When mixing species for a blend, the seeding rate for each species is reduced according to the number of species or varieties in the mixture, the composition preferred, and the growth form and desired structure of the resulting stand. The individual seeding rates for each species are **not** combined! This would result in overseeding and money wasted. It also would result in some species being crowded out and underrepresented in the plot. For example, small grains (such as wheat and oats) are often planted with ladino clover and chicory, primarily as a fall attractant and a nurse crop while the clover and chicory develop. The individual seeding rate for wheat and oats is

up to 120 pounds per acre. If combined, this would result in 240 pounds of small grain planted (a double seeding rate) and little or no clover and chicory would germinate and grow through the fall and spring because the plot would be completely filled with wheat and oats. By reducing the rate of wheat and/or oats to 30–50 pounds, the small grains will complement the developing clover/chicory very well and help them establish with less weed pressure and less grazing pressure. The seeding rate of ladino clover and chicory should be reduced as well (their individual seeding rates are 8 and 10 pounds, respectively). A good mixture would include 20 pounds wheat, 20 pounds oats, 5 pounds ladino clover and 4 pounds chicory.

The recommended seeding rates for various plants are quite accurate and should be followed fairly closely to expect planting success. Overseeding is a common occurrence. Most people think more is better. More is not better when seeding food plots, especially grain plots. When forage plots (such as clovers, cowpeas and chicory) are overseeded, seedlings are crowded and the plants compete with each other. Some die, some live and the plot produces forage – only money is wasted. However, when grain plots (such as corn and milo) are overseeded, seedlings are crowded and little space is available for seed production. Vegetative growth may be acceptable, but seed production is significantly less than that produced by properly spaced plants. If the seeding rate of grains is questionable, it is always better to sow less than more. This will allow more seed production per plant. However, it also means additional space between plants will allow more weed response. This may be good or bad, depending on the weed and the type of plot you are growing (this is discussed thoroughly under ***Weed control*** and with the focal wildlife species).

Sowing the precise amount of seed is not difficult. First, you must accurately determine the area to be planted. Second, you must accurately calibrate your seeding equipment. And third, you must weigh the seed! Do not guess the weight of the seed. This is extremely imprecise and, when coupled with disregard of the first two steps, leads to grossly inaccurate seeding rates. Hand-held scales for weighing seed are inexpensive and are an important piece of equipment in establishing successful food plots.

Recommended seeding rates for various food plot plantings are normally given as broadcast rates. Because of seed desiccation and less precise placement of seed, broadcast rates are higher than those when using a drill or planter. When using a drill or planter, the seeding rate can be reduced by 25–50 percent, depending on what you are planting

Weed control

Weed control is a huge factor in food plot success, especially with forage plots. In many cases, weeds completely overtake food plots before planted seed can begin to grow. Weeds arise from the seedbank – those seeds occurring naturally in the top few inches of soil – and from seed "hitch-hiking" on equipment, such as the top of a rotary mower or on/around the radiator of the tractor. Seedbank composition varies tremendously in different areas and from site to site, but you should expect weed problems on most sites. In many cases, prevalent weeds are not those that provide quality forage or cover for wildlife. If so, all that would be needed is to simply disk an area and amend with lime and fertilizer. Indeed, this can be a beneficial management practice, but only after the undesirable plants have been eradicated from the field.

The most common food plot weeds (warm- and cool-season, annual and perennial) in the South include crabgrass, broadleaf signalgrass, foxtail grasses, goosegrass, fall panicum, barnyardgrass, johnsongrass, bermudagrass, yellow nutsedge, sicklepod, spurges, carpetweed, cocklebur, jimsonweed, common lambsquarters, morningglories, spiny amaranth, pigweeds, ragweed, pokeweed, horseweed (marestail), prickly sida, catchweed bedstraw, curly and broadleaf dock, horsenettle, narrowleaf and broadleaf plantain, maypop passionflower, white-heath aster, Pennsylvania smartweed, yellow nutsedge, thistles, sowthistles, tall ironweed, sumpweed, tall fescue, orchardgrass, bluegrass, velvetgrass, bromegrasses, wild onion, chickweeds, Carolina geranium, henbit, purple deadnettle,

Fig. 4.15 *A weed is an undesirable plant. Although deer may graze tropic croton, and quail, doves and other birds relish the seed, it should be considered a weed in a clover food plot. Separate acreage should be devoted to food plots and early-successional, fallow or old-field habitats that might contain tropic croton and other desirable plants.*

speedwells, ground ivy and hairy bittercress. If you are not familiar with these plants, purchase a weed identification guide with nice color pictures (see ***References and recommended reading*** on page 164).

Of course, a few of these plants produce highly desirable forage and/or seed for wildlife. Whether some of these plants should be determined "weeds" or not is dependent on the type of food plot they occur in and your objectives. For example, pokeweed, ragweed and tropic croton produce seed readily eaten by doves and bobwhites, and deer eat the young leaves of these plants. As a result, they would complement a corn/sunflower plot planted for doves, but they should be discouraged in a clover plot because they shade out clovers and lead to a diminished stand that would only be more susceptible to other, less desirable weeds. Without question, managing and maintaining naturally occurring, early-successional plant communities should be a top priority if you are interested in white-tailed deer, bobwhite quail, cottontail rabbits, mourning doves and many other species. However, in general, separate acreage should be devoted to naturally occurring, early-successional plant communities and food plots.

Figs. 4.16 and 4.17 *An integrated weed control program is usually needed when managing food plots. Mowing, for example, will help get rid of many annual weeds, such as horseweed (left), if mowed before they produce seed; however, herbicides will be required to get rid of curly dock (right).*

Fig. 4.18 *Mowing annual weeds before they produce seed in perennial forage plots, such as this chicory/clover plot, will reduce weed seeds in the seedbank and future weed pressure.*

There are three primary methods used to control weeds in food plots: cultivation, mowing and herbicide applications. All three are useful in various scenarios, but best results are realized with an integrated approach.

Plowing and disking are most often used when preparing a seedbed. This is effective in incorporating organic material into the soil and killing annual weeds, but you can expect annual weeds to return from the seedbank. Also, many perennial weeds often return after plowing/disking (if not sprayed beforehand) if the root systems are not killed. Several crops, such as corn, grain sorghum, sunflowers, sesame, soybeans, cowpeas, lablab and chufa, may be cultivated postemergence when planted in rows with a planter. (This is also possible with a drill, but it may be necessary to close alternating seed ports to obtain sufficient row spacing to accommodate a cultivator.) This is an excellent weed control method that helps the planted crop outgrow and shade out competing weeds. Planting successive annual plots over 2–3 years with conventional tillage also helps reduce perennial weed problems, especially perennial grasses.

Mowing can help control weeds in perennial forage plots (perennial clovers, chicory and alfalfa). Continued mowing can effectively reduce annual weed competition if the weeds are mowed before they produce seed. Mowing sets back perennial weeds, but does not kill them. Mowing is not recommended for annual food plots.

The single most effective weed control practice is herbicide applications. That is why they are used with every commercial field crop grown in the United States. There are herbicides available for a myriad of applications (see ***Appendix 2***). Herbicides are applied *preplant incorporated* (applied and then incorporated into the seedbed by disking, tilling or cultivation), *preemergence* (applied without incorporation before the weeds have germinated) or *postemergence* (over the growing weeds). When spraying postemergence, it is crucial to include a surfactant with the herbicide (see ***What are surfactants?*** on page 28). Preplant incorporated and preemergence applications are most advantageous because susceptible weeds are killed as they germinate and you never see them! Also, they do not rob the crop of nutrients as it is trying to develop. With several crops, the best herbicide weed control strategy is the use

Fig. 4.19 *Weed control is* **critical** *to food plot success. Preemergence and postemergence applications are necessary for maximum production in many areas.*

of a preplant or preemergence herbicide and a postemergence herbicide.

Herbicides kill plants in various ways (or modes of action; see comments in ***Appendix 2***). Some reduce or block the production of amino acids, which are the building blocks of proteins. Others disrupt cell membranes, regulate growth, inhibit photosynthesis, inhibit lipid formation, inhibit lateral root development and prevent shoot growth immediately following germination. Weed control varies greatly among herbicides (see ***Appendix 3***). The most effective herbicide long-term weed control programs often require the use of two herbicides with different modes of action. This reduces the potential for weed resistance to a particular herbicide and increases control on many hard-to-kill weeds. Refer to the ***Weed Control Manual for Tennessee*** (PB 1580) for more complete information on herbicides and their use (http://weeds.utk.edu).

It is a huge advantage if you are able to identify weeds and know the composition of the seedbank. If you cannot identify weeds, you cannot determine which herbicide to use. If you know the weed composition, you then can decide which herbicides can be used to control them and match that with a planting labeled for that particular herbicide. This is exactly opposite of how most people determine what they plant. You will be much more successful in your weed control efforts if you determine which herbicide is needed (based on your knowledge of the seedbank), then decide what to plant, as opposed to planting something and finding out later there is no labeled herbicide that will control the problem weed(s) and not harm what you planted.

The easiest herbicide solution, if you know perennial broadleaf weeds are going to be especially problematic, is to plant a grass crop (such as wheat, corn or grain sorghum). Then you can use broadleaf-selective herbicides, such as 2,4-D, Banvel™ or Clarity™. If you know grasses are going to be a real problem, plant a forb (such as cowpeas, sunflowers, chicory or clovers). Then you can use grass-selective herbicides, such as Arrow™ or Poast™. If you know you will have a problem with both forbs and grasses (which is usually the case), identify a specialty herbicide that controls your worst problem weeds and plant something that is labeled for that herbicide. Make no mistake, **this is a major consideration and will ultimately save you time, money and frustration**.

Although herbicides might be expensive by the container, the application cost (per acre) is quite reasonable (see ***Appendix 2***). If the initial cost is too high for you, contact some friends and neighbors and split the cost with them. Specific herbicide applications and other management strategies are provided for the plantings recommended under each wildlife species or group. **General herbicide recommendations are provided in the text. Primary active ingredients, rates and other information are provided in *Appendix* 2. Nonetheless, before using any herbicide, you should read the herbicide label and follow the directions specific for its application. To access herbicide labels prior to purchase, visit http://www.cdms.net/manuf/manuf.asp.** And remember, professional advice concerning herbicide weed control is available *free of charge* at your county Extension office.

Finally, a last-ditch effort for controlling weeds in a food plot is pulling them up by hand. While this might sound crazy, this technique is actually quite effective and efficient for some specific weed problems in relatively small plots. This is particularly true with stubborn annual weeds that have gotten too tall or mature for herbicide applications, and when they are growing in various annual plots where mowing is not an option. Some examples include horseweed, jimsonweed, pigweeds, sicklepod and morningglories. Even when these weeds are mature and about to produce seed, they can be pulled out of the ground easily within a couple of days after a rain. This technique can also reduce some hard-to-kill perennial weeds, such as horsenettle (wear your leather gloves!). Pulling weeds may take a few hours, depending on plot size and number of weeds, but it can be very effective, *and* it's a good way to get your kids outside and let them make some money at the same time!

Considerations Before Planting

Preference vs. availability and wildlife use

Nearly an infinite number of planting combinations can be used in food-plot mixtures (see ***Appendix 1***). Various wildlife species will eat a wide variety of forages and grains. And while some species, such as white-tailed deer, may differ somewhat in forage/grain selectivity from one area to another, hungry animals with little to choose from will eat many plants and seed they wouldn't otherwise if something else was available. For example, if you see white-tailed deer eating bark, dead leaves, rhododendron or tall fescue, rest assured quality forage is limited! Just because an animal eats something doesn't necessarily mean the animal is gaining nutrition. Some of the food items consumed might even be detrimental to the animal. Don't let this happen. *Preference and selectivity is dictated by availability.* If you want to benefit wildlife populations with maximum nutrition, make sure quality foods that wildlife readily eat are available year-round, but especially during nutritional stress periods (such as late summer and late winter).

The mixtures listed throughout this book incorporate high-quality forages and grains and have produced highly successful food plots when planted in the appropriate soil types and moisture regimes. However, **please realize there is nothing magic about the recommended mixtures**! Any of them could be altered slightly by changing the ratio of specific plants or by adding/deleting a specific plant. You should be excited about trying new things and finding what works best for you. **Making sure soils are amended correctly and the mixture is planted and managed correctly is far more important than the exact ratio of plants in the mixture**. Although only six species or groups of wildlife are listed, many other species (such as groundhogs, squirrels, raccoons, black bears, ruffed grouse, cardinals, blue jays, flickers, sparrows, juncos, goldfinches and bluebirds) will benefit from various plantings.

A word about commercial seed blends

There are many commercial food plot mixtures available. You can't pick up a hunting magazine or catalog without seeing a barrage of advertisements. Most commercial mixtures contain quality seed and can produce quality food plots if planted correctly on the appropriate site at the appropriate time. Many commercial mixtures contain seed that are readily available, but some use improved varieties of seed that have been developed over years of testing (for drought tolerance, resistance to insects/disease, etc.). As a result, many commercial mixtures are worth what they cost. In fact, many are not that much more expensive than buying and mixing seed yourself. However, be aware that marketing is a powerful tool. Commercial blends cannot guarantee trophy bucks (even if some of the advertisements say they do!) and it takes a lot more than a food plot or mineral supplement to produce a quality buck or a healthy deer herd.

A problem with a few commercial seed blends is they contain odd mixtures. Some commercial blends contain both large seed and small seed – seed that require different seeding depths. Some contain seed suited for moist areas as well as

Fig. 5.1 *A problem with some commercial food plot mixtures is they contain various combinations of seed for which no selective herbicide can be used. When you plant a legume (such as cowpeas) with a non-legume (such as sunflowers or buckwheat) and a grass (such as grain sorghum), you are at the mercy of the seedbank. And you* ***cannot*** *count on a broad-spectrum herbicide and mechanical weed control! This plot was sprayed twice with a glyphosate herbicide at six weeks and three weeks prior to planting and disked prior to planting, killing additional weeds that had germinated after the second herbicide application. Still, additional weeds in the seedbank out-competed this popular commercial mixture.*

seed suited for dry areas. Some blends contain seed for both warm- and cool-season plants. This is done intentionally because the company wants to make sure something comes up and grows regardless of when or where the buyer plants it. Obviously, this is a waste of money for the educated food-plot manager because much of the seed is destined to fail, wherever and whenever it is planted. Before purchasing a commercial seed blend, always read the seed tag on the bottom of the bag. Identify the plant species included, then make up your mind if that is what you want to plant. Always follow the steps outlined in the previous chapters for plot preparation and planting; they are critical to success, whether you decide to form your own mixture or buy a commercial blend. Do not be misled by advertisements stating all you have to do is spread the seed on the ground with no preparation necessary. This usually leads to disappointment.

Measuring food plot success

Unfortunately, few people actually evaluate the success of their food-plot program. Time spent keeping records on your food plots and the wildlife that use them is very rewarding and will provide important information that will make your efforts more successful. For obvious reasons, it is important to record what and when you planted and what and how much lime and the types and amounts of fertilizers you applied. This simply helps you remember what you did. The next step is to record your management efforts – when you mowed, disked or applied herbicides (and which herbicides and rates you used). This information, along with precipitation data, should be coupled with observations on plant growth and wildlife use.

Plant growth and wildlife use are easily measured using exclusion cages (see ***Monitoring food plot success with exclusion cages*** on page

77). These cages protect plants from wildlife and allow you to see what the plot would look like if there were no grazing (this is most applicable with forage food plots as opposed to grain food plots). Not only does this help you identify which forages wildlife eat, but also the ones they don't eat! Ideally, two or three cages per acre should be used to provide an accurate estimate of growth and use across the field. These cages also let you see the effects of your liming, fertilization and weed control efforts. Overgrazed plots are usually weedy and may not be able to respond to soil amendments. Other tidbits of information you should record include days until germination after planting, days until maturity (especially for seed- or grain-producing plots), rainfall through the season, effects of weed control and forage growth/availability through the season.

Chris Wolkonowski

Figs. 5.2 and 5.3 *Infrared-triggered cameras can give you a good idea of which species are using your food plot. These cameras are not just suitable for dry plots, but flooded plots as well!*

Wildlife use can also be estimated using infrared-triggered cameras. Placing these cameras around and within your food plots can provide some fascinating pictures, showing you things you might not have imagined if there wasn't a picture to prove it! While placing a few cameras around a food plot does not constitute a census of wildlife populations, the cameras will show you many of the species visiting the plot and can give you a reasonable idea of how many animals are using the plot.

The final consideration when evaluating the success of your food plot program is deciding if your objectives have been met. If added nutrition/wildlife health were your objectives, do animals appear healthier? Have average weights/antler sizes increased? Has grazing/browsing pressure on native food resources been reduced? If your objective was hunting/observation, did you kill or observe more wildlife as a result of your food plot(s)? Are you happy with your efforts? Do you feel the benefits of your food plots were worth the cost/effort you put into them? Only you can answer these questions and make the final determination if your food plot program is successful or not.

White-tailed Deer

The primary usefulness of food plots for deer is providing additional food during nutritional stress periods (August – September and January – March). **Intensive use during other times of the year may be an indicator of over-population and/or poor habitat quality**. If deer density is so high it is having a deleterious effect on the habitat, you are mismanaging the property, and it is time to re-evaluate your objectives and management strategies.

Many landowners try to establish 1 to 5 percent of their property in food plots for deer. This may be a good ballpark figure but, in reality, there is no cookbook percentage of land that should be planted. Every property has unique characteristics. The correct amount of food plots is determined by your objectives, overall habitat quality and deer density. If food is a limiting factor on your property, implement additional habitat management (including food plots) and/or lower the deer density. Continue to do this until you provide ample forage for the deer (and other species). You should not, however, try to carry more deer than the land will support.

In many areas, a mixture of both warm- and cool-season forage and grain plots should be incorporated into a food-plot program. However, according to your objectives and surrounding land-use practices, that may not be necessary. For example, if your property is relatively small and surrounded by soybean fields, warm-season food plots may not be needed.

If you are planting both warm- and cool-season plots, plant them in different fields or different sections of a field. That is, don't take away available food in preparation to plant something else. For example, iron-clay cowpeas provide nutritious forage until the first frost, which is usually in October (November/December for the Deep South). If the plot is mowed, disked and planted in clovers in early September, forage is taken away when it is needed most (late summer). Likewise, arrowleaf clover provides quality forage through late June. If a plot of arrowleaf clover is disked in May to plant jointvetch and/or cowpeas, a prime food source is removed during a period when it may be readily used (just before fawning and during early antler development).

Fig. 6.1 *Unnaturally high deer densities decimate the forest understory and degrade habitat for other species. Food plots alone do not remedy this. In this situation, the deer population should be lowered, the forest should be managed and additional habitat management should be implemented.*

Fig. 6.2 *Separate acreage should be devoted to both warm- and cool-season forages where white-tailed deer is a focal species. Separate fields can be planted or half of a field dedicated to warm-season and the other half to cool-season forages. Here, crimson clover has been planted as a border around a corn patch. Deer and turkeys love this arrangement!*

Generally, forage plots for deer are between ½ and 3 acres. Plots planted specifically for hunting may be smaller, and some plots in areas with high deer densities may need to be considerably larger. Grain plots are often 3–5 acres, sometimes larger. The primary determinants of plot size are your objectives, overall habitat quality, deer density, shade effect and distance to cover. Food plots should be large enough and wide enough to allow at least four hours of direct sunlight, and the distance to cover, ideally, should not be more than approximately 50 yards. Thus, plots larger than 3–5 acres should be as long as necessary, but no more than 100 yards across (this would be appropriate for properties with relatively high deer densities). Fields larger than this can be made more attractive by breaking the field up into sections using hedgerows planted in trees, shrubs and native grasses that provide hard and soft mast and serve as visual breaks across the field. Regardless of

Fig. 6.3 *When deer density is high, plots larger than three acres may be necessary to avoid overgrazing.*

John Gruchy

Fig. 6.4 *Food plots with wavy edges are not required to attract deer. If quality forages are grown in areas where deer normally travel, they will come. Wavy edges make it more difficult to maneuver equipment. A border of native grasses, forbs and brambles has been established around the edge of this field and has been used to divide the field (the right side of the field is not visible in this picture). Thus, the food plot is not competing with trees for sunlight and nutrients, and the relatively straight edges make planting and spraying easy. The native grass "corridor" across the field is used to influence deer movements near the treestand where this picture was taken.*

plot size, it is generally beneficial to distribute food plots throughout the property (except within site of roads and property boundaries) to ensure quality forage is available to all the deer.

For optimum use, plots should be located in areas where deer feel comfortable and travel regularly. Usually, this is where two or more habitats meet, such as where brushy cover and mature woods meet; where a brushy creek bottom flows through an old-field; or where an odd corner of a crop field is not planted. Certainly, you can influence where deer travel by creating additional attractive cover, primarily through forest management and old-field management. Nonetheless, increased use can be expected when food plots are planted where *deer want to go* as opposed to trying to entice them to an area where *you want them to go*. Topography, as well as natural and constructed funnels, can influence how deer enter and exit the food plot. Savvy hunters plan ahead and use this to their advantage.

Much "ado" has been made about food plot shape. Irregularly shaped plots with "wavy" edges are sometimes recommended. This idea has little merit. The edge added to a one-acre clover plot by creating wavy borders is **not** going to make it more attractive or receive more use by deer. It will, however, make it more difficult to manage when it comes time to plow, spray or plant. Of course, this is less of a concern when planting with an ATV, but trying to make turns and curves causes discs to break and results in overspraying and overplanting (with a tractor-mounted spreader) certain areas of the plot. You should realize this does not prevent you from

creating openings with various shapes to hopefully influence where deer may enter or move through the field. Various-shaped food plots can be created without wavy edges. For example, the planted portion of an hourglass-shaped food plot does not have to hug the woods edge (see next paragraph). The planted area on both sides of the hourglass and the connecting corridor may have relatively straight edges to facilitate equipment operation. Regardless, food plots are made most attractive by planting foods deer *prefer*, in or near areas they *already* travel. Find a good spot, plant the right forage and deer will come.

Planting food plots too close to the woods edge is a common mistake. *Unless the plot is designed specifically to hunt over*, planting adjacent to a tree line is ill-advised because of shade effect and nutrient competition from the trees. A much more sensible solution is to establish the plot 30–50 feet from the woods or tree line and allow a soft edge of forbs, grasses and brambles to develop between the woods and the plot. This holds true even when planting plots with respect to orientation. If you are planting plots with a north-south orientation or along the southern side of an opening to conserve soil moisture (see ***Where to plant?*** on page 5), you still should not plant within the drip line of the trees' crown. Move away from the tree line 30–50 feet for better forage production.

Thinning undesirable trees 100 feet into the woods around openings is another way to enhance the ecotone from forest to field and provide additional browse (leaves and twigs of woody species). The enhanced structure created with soft edges and thinned woods around a field make deer feel more comfortable in this area and may influence them to use the plot earlier (before dark) than later (after dark). Regardless, if you continually hunt over the food plot, it won't be long before deer are using it only at night. Instead of trying to shoot deer in the food plot, hunt them in staging areas, along trails leading to the field, or downwind of the food plot where bucks often scent-check for does in estrus.

Finally, as you determine what is best for your property, consider these questions. Is the forage you are planting available during stress periods? Is the quantity of forage available enough to justify establishment and management costs? Are the deer actually eating the forage? Is forage quality sufficient for the deer to gain nutritional benefit?

Forage quality

Deer select the food they eat based on availability, palatability and nutritional content. Deer cannot eat a particular food if it is not available and, if it is available, deer preference is certainly based on some combination of palatability and nutritional content, which is known only to the deer themselves! Nutrition alone does not dictate preference. For example, sicklepod may provide >70 percent total digestible nutrients with 32 percent crude protein. The problem is, deer won't eat sicklepod unless they are about to starve. The presence of tannins, toxins and other compounds can heavily influence forage selectivity.

Forage quality is based on digestibility and nutritional content. Foods that are highly digestible provide lots of energy, which is obtained primarily through non-structural carbohydrates (or plant cell contents, such as sugars, starch and protein). Structural carbohydrates compose cell walls and include lignin, cellulose and hemicellulose. Deer cannot digest lignin; however, bacteria found in a deer's stomach enable deer to obtain some energy from cellulose and hemicellulose. Therefore, digestibility is highly correlated not only to the type of plant, but also to the part of the plant the deer eats and plant maturity. Young, leafy material is highly digestible, while stems are less digestible because they contain more structural components. Older plants have more stems and more structural components than young plants; thus, a given plant part is more digestible in young plants than older plants. Food-plot programs designed to provide maximum nutrition for deer should contain forage that is at least 65 percent digestible and available year-round, but especially in late summer/early fall and mid to late winter. This requires different types of plantings as described in the pages that follow.

Cellulose and hemicellulose take much longer to digest than sugars and starch; thus they stay in the stomach longer. Therefore, when deer are forced to eat poor-quality foods (when high-quality foods are not available), the total amount of food

Chris Shaw

Fig. 6.5 *Forage quality decreases over time as the plant matures and lignin content increases. Grazing and mowing perennial forages promote fresh growth and better-quality forage. Here, red clover is being "mowed" by the deer.*

the deer can consume is reduced because it takes a relatively long time for the poor-quality food to pass through the digestive system. Obviously, this can have a direct impact on weight, milk production, antler growth and survival.

Protein is also found in plant cell contents and cell structures. Proteins found in cell contents are readily digestible, while those in cell structures are not. Digestible protein is strongly influenced by plant maturity and available nitrogen. As plants mature, cell walls become more lignified and constitute a larger percentage of the plant. This reduces the amount of digestible protein and energy within the plant. Available nitrogen influences plant protein content because nitrogen is a component of all proteins.

Protein requirements for white-tailed deer vary by sex, age and season. Adult deer require 6–10 percent protein to maintain body condition, whereas fawns may require 20 percent or more for optimum growth and development. Maximum growth and development of yearling and adult bucks may be realized when available forage provides approximately 16 percent protein. Lactating does may need 20–22 percent protein for optimal milk production.

Forage quality is estimated with a variety of laboratory techniques. Most common is neutral-detergent fiber (NDF) and acid-detergent fiber (ADF) analyses, which chemically distinguish the soluble cell contents from the relatively indigestible material. NDF represents all cell wall material. ADF represents only the indigestible lignified portions of the sample. This is most suitable for evaluating forages for deer as some of the cell wall material (cellulose and hemicellulose) may be digested. Digestible energy may be estimated as total digestible nutrients (TDN) using equations that incorporate NDF values. Forages with ADF values below 35 percent are generally highly digestible for white-tailed deer.

If you have questions about the quality of your food plots, visit your county Extension agent. Forage samples can be analyzed for just a few dollars. When this is coupled with a soil test, you can get an excellent idea of the amount of nutrition you are providing through your food plots.

Annual or perennial plots – which is best?

A common dogma persists that perennial food plots provide more forage, cost less and require less work than annual plots. If both are managed for maximum production, a detailed analysis shows this belief may not be accurate. If portrayed by season (in the Mid-South), it is clear annual forages produce more during the primary stress periods (late summer and winter) than perennial forages (see sidebar on page 52). Cool-season annual forages produce more than perennial forages during the winter and warm-season annual forages produce more than perennial forages during the summer. Obviously, this varies by region. Perennial forages may produce through the winter in the Deep South, and perennial forages may produce well through the summer in the higher elevations of the southern Appalachians and in the northern states. However, annual warm-season forages

Annual vs. Perennial plots

An economic assessment of annual and perennial forage plots for white-tailed deer is shown below. This assessment considers two acres managed in annual food plots and two acres managed in a perennial plot over a two-year period. **Actual costs and production data from demonstration/research plots in Tennessee are shown**. This assessment implies you are doing the work yourself and does not include costs for labor, equipment, or fuel, which can be considerable. It also does not include costs for lime and fertilizer or initial broad-spectrum herbicide, as both types of plots would require roughly the same amendments and preparatory treatment. Be aware the associated costs will not be the same on all sites. For example, on some sites, herbicide applications may not be needed; thus, associated costs and number of visits to the site would be lower. Of course, prices vary by dealer and year, but these were our prices.

Annual plots

Cool-season (**1 acre** over 2 years)
$25 seed (oats – 1st year) in September
$5 postemergence herbicide (Harmony Extra™) in November to kill cool-season weeds
$25 seed (oats – 2nd year) in September
$5 postemergence herbicide (Harmony Extra™) in November to kill cool-season weeds

Total forage produced for both years (Oct–early April): 5,918 pounds dry weight (Note: this includes palatable biomass only; it does **not** include biomass data from the bolt/flowering/seed-forming stages)

Number of visits to the plot: 4 (2 to plant; 2 to spray)

Warm-season (**1 acre** over 2 years)
$64 seed (iron-clay cowpeas – 1st year) in May
$20 preemergence herbicide (Pursuit™) at planting
$64 seed (iron-clay cowpeas – 2nd year) in May
$20 preemergence herbicide (Pursuit™) at planting

Total forage produced for both years: 18,775 pounds dry weight (Note: this includes palatable forage only; **not** large stems)

Number of visits to the plot: 2 (to plant and spray preemergence)

Total forage produced from 2 acres of annual plots over 2 years: **24,693** pounds dry weight

Total cost for both annual plots (2 acres; 2 years): $228

Cost per pound forage produced: **$0.009**

Total visits to both annual plots: 6

Perennial plot

Cool-season (**2 acres** over 2 years)
$102 seed (ladino clover and oats) in September (because oats were added, weed pressure was reduced and herbicides were not necessary in the fall after planting)
Mowed in June after clover had produced seed
Mowed in August (to knock back warm-season weeds before they produced seed)
$58 postemergence herbicide (Butyrac 200™ and Select™) application in October
$58 postemergence herbicide (Pursuit™ and Select™) application in May
Mowed in July/August

Total forage produced from a 2-acre perennial plot over 2 years: **13,846** pounds dry weight (includes approximately 2,000 pounds produced by the oats from October through early April following planting)

Total cost: $218

Cost per pound forage produced: **$0.015**

Total visits to the perennial plot: 6 (1 to plant; 2 to spray; 3 to mow)

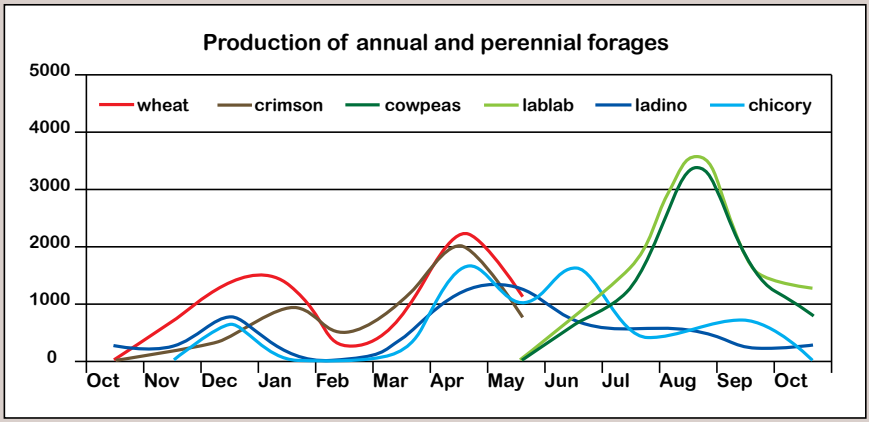


Fig. 6.6 *These data show monthly production for two perennial and four annual forages averaged across three fields in Tennessee (all forages present in separate plots in each field) with varying deer densities over several years. Production of annual forages is shown from the time they were planted until maturity. Production of perennial forages is shown through the year. Production of annual cool-season forages continues through the winter, while production of perennial cool-season forages wanes. Nothing out-produces annual warm-season forages during summer. Refer to* ***Appendices 4 and 5*** *for information concerning deer preference and use of various forages.*

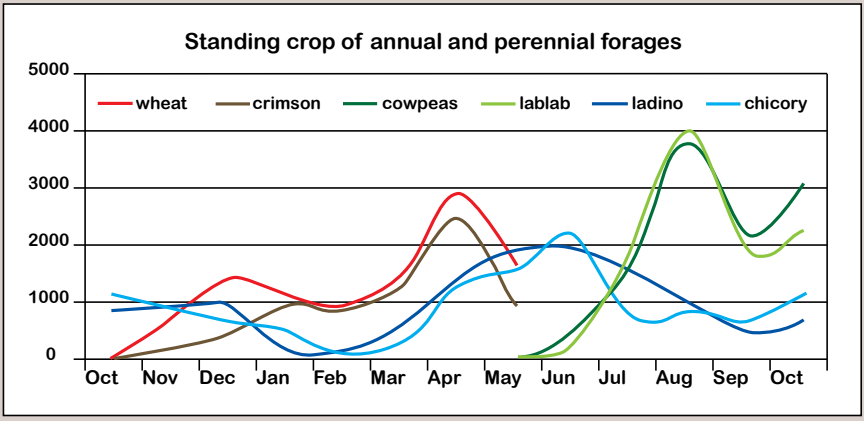


Fig. 6.7 *These data show standing crop (forage available) of two perennial and four annual forages averaged across three fields in Tennessee (all forages present in separate plots in each field) over several years. Standing crop will vary greatly depending upon deer density and habitat quality. Here, standing crop has been averaged across three areas where deer density ranged from 30–90 deer per square mile. Of particular interest is forage availability during the primary stress periods for white-tailed deer (late summer and winter). It is clear annual forages provide by far the most forage during these periods. Established perennial forages complement annual forages by providing nutrition in fall while annual cool-season forages are developing and in spring while annual warm-season forages are developing.*

produce far more during summer than perennial forages in the Deep South, and cool-season annuals, especially wheat, cereal rye, Brassicas, and Austrian winter peas, are desperately needed up north during the winter. Recent advances with improved varieties of clovers and chicory have helped with late summer production, and alfalfa is renowned for its summer production, but production of these forages in winter is woefully inadequate to feed many deer, especially from the Mid-South northward.

Although seed for annual plots can be more expensive, over time, than seed for perennial plots, you can easily spend more money managing perennial plots than you would reseeding annual plots. Considering work load, perennial plots may require more visits to the field than annual plots, depending on how many times you need to spray or mow. The related work and associated fuel costs may be greater for annual plots, because planting may require more tractor time per field visit than mowing or spraying (plots planted via no-till drilling would be the exception). So, which is best? Only you can make that decision for your property. Both annual and perennial forages have clear advantages when developing a sound food plot management plan to meet forage production needs for white-tailed deer throughout the year. For most properties to realize their full potential for white-tailed deer, both annual and perennial plots are needed.

Food plot recommendations for white-tailed deer

The following food plot mixtures for white-tailed deer were developed after nine years of experimentation where many forages were compared side-by-side with respect to germination, growth, deer preference, resistance to grazing and nutritional quality (see **Appendices 4 and 5**). When grown on the proper site, and soil amendments are added as recommended by a soil test, all of these

Fig. 6.8 *Here is one of several demonstration/research fields established across Tennessee. Data have been collected to determine germination and growth rates, deer preference, resistance to grazing, nutritional quality and herbicide recommendations for a wide variety of forages since 1999. Forages are planted in 0.10-acre cells. Yield and consumption are monitored through stationary and mobile exclusion cages, placed at random within each cell at the end of each month.*

forage mixtures exceed the nutritional demands of white-tailed deer. Depending upon growth stage, expect crude protein levels to exceed 20 percent, with total digestible nutrients constituting more than 65 percent of the forage. **All rates and approximate costs are per acre**. Approximate costs represent the average of several seed dealers (2008).

Michael McCord

Fig. 6.9 *Quality warm-season forages, such as these soybeans, provide nutrients needed by does that are drawn down by nursing fawns.*

Warm-season plots

Warm-season forages provide nutrients necessary for milk production, fawn growth and antler development through summer until the first frost. Warm-season forages can be especially important in the Deep South where they may be planted as early as late March and produce forage through November. Warm-season grains (especially corn) provide digestible carbohydrates and fat for energy from late summer through fall and winter (depending upon management and other factors). Warm-season forage plots are excellent areas to hunt near during the early part of deer season before hard mast (acorns and beechnuts) becomes available. Warm-season grains can be attractive throughout the deer season, particularly in areas with little acorn production and after the mast crop has been consumed. Warm-season food plots should be planted after danger of frost and before the overly dry conditions of summer prevail. Planting usually occurs mid-April through early June, though later plantings can be successful if adequate moisture is available.

Various forbs (broadleaf herbaceous plants) make up approximately 70 percent of a white-tailed deer's diet during the warm growing season. Last in diet preference during this time is grass. Warm-season food plots should contain high-quality legumes and other forbs that supplement naturally occurring forages and browse. Legume-dominated, warm-season forage plots provide high levels of protein and total digestible nutrients – exactly what growing deer need during summer. Some grasses (corn and grain sorghum), however, provide grain high in energy that can help deer and other wildlife get through winter in good shape. Therefore, it is often desirable to offer both legumes and grain. The problem is that some of the worst warm-season weeds are grasses, especially johnsongrass and crabgrass. Where grass weeds are problematic and grains are needed, one strategy is to grow legume-dominated forage plots and corn or grain sorghum plots separately. This enables you to use different selective herbicides on both plots.

The addition of corn or grain sorghum with legumes or other forbs prevents you from using grass-selective herbicides to remove competitive grass weeds. Grain sorghum can be an excellent companion plant for various legumes to climb; however, this is only advisable if grass weeds are not a problem. A better option where grass weeds are problematic is sunflowers. The addition of sunflowers to a legume-dominated warm-season mixture *limits* the number of herbicides that can be used on the plot; however, the addition of sunflowers **and** a grass to a legume plot *prohibits* the use of *any* herbicide. This is a problem with many commercial mixtures – they combine a legume forb (such as cowpeas or lablab) with a non-legume forb (such as sunflowers or buckwheat) and a grass (such as grain sorghum). There is no help for controlling weeds with this combination (unless the grain sorghum seed is treated with a seed safener as described below). There are better mixtures to use and some simple solutions.

Figs. 6.10, 6.11 and 6.12 *These three photos show the importance of preemergence weed control in warm-season forage plots. The top picture shows a plot of iron-clay cowpeas that was not sprayed. The middle photo shows a plot of iron-clay cowpeas (grown adjacent to the plot in the top photo) that was sprayed preemergence with Pursuit™. The bottom photo shows the two plots side by side a few weeks later. Johnsongrass has overtaken the unsprayed plot.*

Mowing annual food plots is not recommended as with perennial plots because of the annual forage's life cycle and primary production period. However, if you have not maintained the plot with the appropriate herbicides and annual warm-season weeds (such as sicklepod) have essentially overtaken the plot, just mow as needed to prevent them from producing seed and adding to the seedbank. Spraying warm-season annual weeds in late summer is a waste of time and money. The ultimate deciding factor of whether to mow weeds in an annual plot is the amount of forage in the plot and whether or not deer are using it. This may test your personal "weed threshold"! If weeds have become large in your

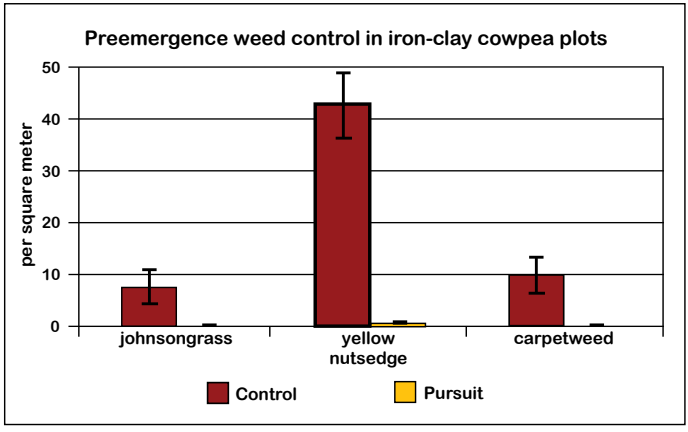


Fig. 6.13 *These data graphically show the weed control possible with a preemergence application of Pursuit™ (4 ounces per acre) when applied to iron-clay cowpeas (as well as other labeled applications). "Control" plots received no herbicide application and can be seen in the pictures above.*

Fig. 6.14 *This plot of iron-clay cowpeas was not sprayed, either pre- or postemergence. As a result, redroot pigweed has become established and is about to produce seed. Goosegrass is also about to produce seed in another area of the plot. Nonetheless, there is still plenty of quality forage available (iron-clay cowpeas) and deer are visiting the plot regularly. Rather than disturbing the deers' feeding pattern, it is best to leave this plot alone. Mowing would only destroy available forage, and herbicide applications at this point would not be effective. The weed problem can be tackled next spring with an incorporated herbicide application prior to planting another warm-season plot.*

warm-season plots, but there is plenty of quality forage available and deer are regularly using the plot, it is not advisable to mow the plot. Just let the weeds mature with the plot and allow the deer to continue feeding. You can address the weed problem in that particular plot the following spring with a selective preemergence herbicide.

Several herbicide options are available for warm-season food plots. Preplant incorporated or preemergence applications are highly recommended when possible. **If postemergence applications are used, weeds should be sprayed soon after they germinate and before they reach several inches in height** (see herbicide labels for maximum heights to control various weeds). Also, be aware all herbicides do not control all weeds equally (see ***Appendix 3***). Herbicide labels list the specific weeds controlled by that herbicide. **General herbicide recommendations are provided for each of the warm-season mixtures on the following pages. Refer to *Appendix 2* for rates**

and additional herbicide information. Also, be aware that application of soil-active herbicides may prevent you from planting certain other crops on that site for a given time period (see ***Comments*** in ***Appendix 2***). For example, if you spray Pursuit™ prior to planting iron-clay cowpeas, it is recommended to wait four months before planting wheat or 18 months before planting grain sorghum in that plot or crop injury may result. Be sure to read herbicide labels before use, as they have different specific rotational crop restrictions. To access herbicide labels prior to purchase, visit **http://www.cdms.net/manuf/manuf.asp. Seeding rates represent PLS per acre.**

Fig. 6.15 *Protein-filled legumes climbing sparse sunflowers provide an excellent warm-season forage plot for whitetails. Although American jointvetch and/or alyceclover can be added to this mixture (as seen in this plot), they are relatively slow to establish and may be overwhelmed by the cowpeas and lablab.*

Warm-season plantings for white-tailed deer

Warm-season deer mixture 1

Approximate cost: $72

50# iron-clay cowpeas

10# lablab

5# peredovik sunflowers

Benefit and considerations: Iron-clay cowpeas and lablab provide excellent forage for deer, especially in late summer/early fall when the palatability of natural forage and browse is decreased. These legumes also withstand browsing pressure relatively well as they are developing and grow on a wide variety of sites. This combination is recommended for sites that are droughty and/or clayey, as well as bottomland sites. Although deer may browse newly appearing heads of sunflowers, they are not added to this mixture for forage, but as a substrate the cowpeas and lablab can climb and grow upon later in the season.

American jointvetch and alyceclover may be added to this mixture, but be aware they are relatively slow to establish and may get overwhelmed and grown over by the climbing legumes. Thus, adding jointvetch or alyceclover in a mixture containing cowpeas and lablab may provide an insignificant increase in forage production, quality or attraction. If added, they should not be added in the seed sower with the peas and beans because they will fall to the bottom of the spreader and their distribution will be uneven. If you want to plant jointvetch and/or alyceclover, they will do best if planted separately (see ***Warm-season deer mixture 2***).

Management: Prowl™, Dual Magnum™ or Treflan™ can be applied preplant incorporated to control various forb and grass weeds. A grass-

selective herbicide can be sprayed postemergence for additional grass weed control if necessary. If grass weeds are not problematic and/or if deer density is so high sunflowers are overgrazed as they are establishing, grain sorghum (3 pounds) can be used in place of sunflowers. If grain sorghum is added, however, do not apply Prowl™ or Treflan™. Dual Magnum™ may be applied if grain sorghum seed is treated with Concep™ seed safener.

Re-seeding warm-season deer mixture

Approximate cost: $82

40# Quail Haven soybeans

5# peredovik sunflowers

Benefit and considerations: Bush-type soybeans may be the all-time most preferred warm-season forage for white-tailed deer. The problem is they do not tolerate grazing well, especially when young. Deer often eat soybean plants soon after germination and there is little or no forage left. Unless a large field or considerable acreage is planted in soybeans and/or deer density is relatively low (no more than about 30 deer per square mile within good habitat), bush-type soybeans may be overgrazed and produce little or nothing. An exception is the Quail Haven re-seeding soybeans, which produce a tremendous amount of forage and resist grazing pressure very well, in fact, equal to iron-clay cowpeas and lablab.

Management: Prowl™, Dual Magnum™ and Treflan™ can be applied preplant incorporated for weed control. A grass-selective herbicide can be applied postemergence for additional grass weed control. Quail Haven soybeans have excellent re-seeding capabilities. If allowed to mature and produce seed, another stand can be stimulated by light disking. Often, after the plot dies in the fall, there is a lot of dead plant material in the plot. Just allow it to "melt" down to the ground through the winter. Spray cool-season annual weeds with a glyphosate herbicide *before they flower and produce seed.* In early April, spray the plot with Prowl™ or Treflan™, apply fertilizer and/or lime as recommended by a soil test and then disk the plot. You have effectively re-seeded your QH beans. You can use a grass-selective herbicide later (postemergence) if a grass weed problem develops. If you want to add sunflowers or grain sorghum to the plot, just sow them before disking or drill them into the plot after you have disked the QH beans. If you add grain sorghum, do not apply herbicides. Pursuit™ also may be used for pre- or postemergence weed control if **only** QH beans are planted (or disked for re-seeding without adding other seed, such as sunflowers and grain sorghum).

Fig. 6.16 *Quail Haven re-seeding soybeans are a preferred forage for whitetails and they resist grazing pressure quite well. If allowed to produce seed, QH beans can be retained for at least two years with proper management. A variety of weed control options are available (see text).*

Fig. 6.17 *American jointvetch and alyceclover can produce quality forage for white-tailed deer. This picture of a jointvetch plot was taken October 1. The middle cage shows cumulative growth through the summer. The other two cages show growth and use just for September. Deer density at this site was approximately 70 per square mile. This picture also shows the importance of dedicating separate acreage to warm- and cool-season plots. Plenty of jointvetch is available in in early October while cool-season plots are establishing in the background.*

Warm-season deer mixture 2

Approximate cost: $110

15# American jointvetch (*Aeschynomene*)
5# alyceclover
20# buckwheat

Benefit and considerations: Both American jointvetch and alyceclover provide quality forage for white-tailed deer, but they are relatively slow to establish. Adding buckwheat to the mixture provides quick green-up for available forage and soil stabilization. If buckwheat is not added to the mixture, jointvetch and alyceclover can be established relatively well via no-till top-sowing. Kill existing vegetation with a glyphosate herbicide in the spring prior to seeding. Seed production and availability influences cost of American jointvetch greatly.

Fig. 6.18 *This trail of American jointvetch and alyceclover was planted via no-till top-sowing after spraying and killing tall fescue. This is a great way to establish quality warm-season forage on sites that might be too steep to disk.*

Management: A grass-selective herbicide can be used to control grass weeds postemergence if sprayed when weeds are young.

Warm-season deer mixture 3

Approximate cost: $34

60# iron-clay cowpeas
8# corn

Benefit and considerations: This is a great warm-season plot that provides quality forage (cowpeas) through summer and fall and high-energy grain (corn) from late summer through winter. Grain availability into winter will depend upon field size and location, management, deer density, raccoon and squirrel density and acorn availability. Larger plots (2–3 acres, or more) may be warranted, but not necessary in all situations. Small plots, especially when located near drainages, may be decimated in a night or two by raccoons after the corn ears develop. Squirrels may be problematic if corn is located adjacent to woods. *However*, **you should expect *and welcome* species other than deer to benefit from your food plots**! Your habitat management efforts should benefit many wildlife species, even

Fig. 6.19 *The correct preemergence herbicide application (see text) provides weed-free cowpea/corn plots such as this one.*

if you are focusing on one or two. There is much satisfaction in providing needed resources for *all* native wildlife on a particular area. That being said, managing raccoon populations can be similar to managing deer populations. Sometimes the population should be lowered to match habitat limitations. Problematic raccoons can be trapped and killed relatively easily.

Because the ratio of cowpeas to corn is so disparate, it is a good idea to sow them separately (or place in separate seed boxes if drilling seed) to ensure even distribution of the corn. If desired, lablab (15 pounds) can be used instead of cowpeas. Also, grain sorghum (5 pounds) may be used instead of corn, if desired, and if weed pressure is low. Be aware, if you plant corn or grain sorghum at higher rates than recommended for this mixture, forage production by cowpeas or lablab will be reduced.

Fig. 6.20 *Iron-clay cowpeas show great resiliency to grazing. As opposed to bush-type soybeans, cowpeas continue to produce side shoots and additional leaves even in the presence of heavy grazing.*

Fig. 6.21 *Corn and cowpeas grown together produce a quality warm-season plot providing much-needed protein (cowpeas) during the summer and a source of energy (corn) into the fall and winter.*

Fig. 6.22 *Iron-clay cowpeas are much more tolerant of grazing than soybeans; however, at 90 deer per square mile, even cowpeas can't keep up! Here, you can see from the exclusion cage how much forage would be available from the cowpeas and what the structure would look like if not for overgrazing.*

If not overgrazed, cowpeas will vine up the corn stalks in mid- to late summer and provide forage until the first frost. The advantage of this mixture over a corn/soybean mixture is that cowpeas are much more tolerant of grazing than soybeans. Also, this mixture is cheaper than Roundup Ready™ corn and soybeans, and just as nutritious for white-tailed deer. And when the appropriate herbicide is used, weeds should not be a problem.

Management: Corn/cowpea plots may be sprayed preplant incorporated or preemergence with Dual Magnum™ to control most annual grasses, yellow nutsedge and certain forb weeds and/or postemergence with Basagran™ to control various forb weeds and yellow nutsedge. Prowl™ also can be used preemergence, but not preplant incorporated or you may kill the corn as it germinates. If you use Prowl™, make sure corn seed is completely covered with soil and at least 1.5 inches deep. If grain sorghum is added to the mixture, do not apply Prowl™, and use Dual Magnum™ only if grain sorghum seed is treated with Concep™ seed safener.

Warm-season deer mixture 4

Approximate cost: $55

45# Roundup Ready™ soybeans

8# Roundup Ready™ corn

Benefit and considerations: This is a high-protein, high-energy mixture that benefits deer and many other species as well. As discussed earlier, considerable acreage may need to be planted to ensure soybeans are not decimated soon after planting. As with ***Warm-season mixture 3***, it is a good idea to sow the soybeans and corn separately to ensure even distribution of corn.

Management: Glyphosate herbicides with a Roundup Ready™ label, such as Roundup WeatherMax™, can be sprayed postemergence over Roundup Ready™ corn and soybeans. Postemergence applications may be applied anytime from emergence until the V8 stage (8 leaves with collars) for corn or until the corn reaches 30 inches in

Chris Wolkonowski

Fig. 6.23 *If deer density is not too high, there is no better warm-season forage for white-tailed deer than soybeans. Soybeans and corn provide high-quality forage and grain for whitetails, and the Roundup Ready™ varieties enable relatively easy weed control. However, be aware that Roundup Ready™ technology is not a cure-all for weed problems. Alternating the use of glyphosate with other herbicides every two or three years helps prevent glyphosate-resistant weeds from developing.*

height, whichever comes first. An initial application of 1–2 pints should be applied when weeds are 2–8 inches tall. For best results on several perennial weeds, allow them to grow to 6 inches before spraying. A sequential application may be necessary if a new flush of weeds appear.

Roundup Ready™ technology is a great strategy to use when tough-to-handle weeds are present. However, after growing Roundup Ready™ crops, there can be problems with volunteer sprouting if another crop is planted. If desired, residual Roundup Ready™ corn can be killed with a grass-selective herbicide (such as Arrow™). Roundup Ready™ soybeans can be killed with a broadleaf selective herbicide, such as 2,4-D, Banvel™ or Clarity™. For optimum weed control with Roundup Ready™ soybeans and corn, *or* if you plant non-Roundup Ready™ varieties of corn and soybeans, Dual Magnum™ may be applied preplant incorporated to control annual grasses, yellow nutsedge and various forb weeds as they germinate. Also, Python™ may be applied preplant incorporated to control various forb weeds and Basagran™ may be applied postemergence to control various forb weeds and yellow nutsedge.

Grain plots and single-species plantings

Although warm-season mixtures can provide a variety of quality forages, **don't think you *have* to plant a mixture to have a productive, high-quality, warm-season food plot**. Weed control is much easier with single-species plantings than mixtures, and grain production may be

Marcus Lashley

Figs. 6.24 and 6.25 *There's nothing wrong with planting single-species food plots. Here, soybeans, iron-clay cowpeas and lablab were planted in three separate ¾-acre sections to evaluate deer preference. Deer prefer soybeans and, if not overgrazed, a single-species plot of soybeans may produce 1,800 pounds or more of grain per acre, which is an important source of energy through fall and into winter.*

higher when grain crops are planted separately (see ***Appendix 1*** for seeding rates for single-species plots). When taller "substrate" plants (such as grain sorghum or sunflowers) are added to forage plots, they typically are added at a reduced rate, so the forage plants are not overly shaded. Although a fair amount of grain may be produced in these mixed plots, the primary goal is to provide structure for climbing legumes so more forage can be produced. A full rate of corn or grain sorghum, for example, will not allow cowpeas, lablab or soybeans to produce as much forage as they would if sown separately or with a reduced rate of corn or sorghum.

Grain plots are an important component in a food-plot program, especially in areas or during years with relatively little acorn production. Strips of corn or grain sorghum 100–150 feet wide adjacent to strips of forage plots make excellent sources of food and/or cover for deer and other species, such as wild turkeys, bobwhites, doves and rabbits. Corn can be left standing for cover or the grain can be

September 2005

March 2006

Figs. 6.26, 6.27 and 6.28 *Corn can be left standing for cover or cut a little at a time. A few rows of this two-acre corn patch were mowed each month, December through March, to make grain more readily available throughout winter. When juxtaposed to cool-season forage plots, such as this crimson clover, these areas are even more attractive to deer and turkeys.*

Fig. 6.29 *Corn and/or grain sorghum are used for both food and cover by deer and a number of other species. Although corn and grain sorghum are normally planted separately, they can complement each other in a mixture.*

made more readily available to many wildlife species (especially ground-feeding birds) by silage chopping, mowing or burning a little at a time through the fall and winter.

Corn is normally planted with a corn planter in 36- to 38-inch rows at about 13 pounds per acre for optimum grain production. Grain sorghum is normally planted with a grain drill at about 10 pounds per acre. If you don't have access to such equipment, these grains can be top-sown and covered by disking approximately 1 inch deep. Although normally planted separately, corn (10 pounds) and grain sorghum (4 pounds) can be mixed, if desired.

Corn is a heavy nitrogen user and it is especially important to manage soil fertility as recommended after soil testing when trying to maximize grain production. Seed corn prices are variable and fluctuate year to year. However, both seed corn and grain sorghum are often available free through local chapters of conservation organizations (such as Quail Unlimited and Quail Forever) or state wildlife agencies. A 50-pound bag of seed corn or grain sorghum will plant at least four acres.

Grain sorghum is not as attractive to deer as corn, but deer will often eat the seedheads, sometimes during the milk stage, but most often after maturity. The variety of grain sorghum should be considered carefully before planting. Tall varieties may compete better with weeds and bird-resistant varieties help prevent seed depredation through the summer by house sparrows, starlings and grackles. There are many varieties of grain sorghum. Contact your county Extension office and ask them for recommendations in your area. Wild Game Food (WGF) sorghum is a popular, relatively short (3 feet) grain sorghum developed to resist bird depredation. Bird resistance is related to tannin content. Typically, white grain sorghums (such as Hegari) contain fewer tannins than red or brown grain sorghums; thus, white grain sorghums may be preferred. This is a moot point for deer, however, if birds consume all the seed before they mature. Tannin content drops considerably after a couple of frosts, increasing palatability of red and brown sorghums during late fall and winter.

Prior to planting corn and grain sorghum, atrazine, Bicep II Magnum™ or Dual Magnum™ may be applied preplant incorporated to control a wide variety of grass and forb weeds (***Note:*** grain sorghum seed must be treated with Concep™ seed safener before applying Bicep II Magnum™ or Dual Magnum™). Basagran™ or Permit™ can be applied postemergence to control several forb weeds and yellow nutsedge. 2,4-D, Aim™, atrazine, Banvel™ and Clarity™ are other herbicides that can be applied postemergence to control forb weeds only. Before spraying, it is important to realize many "weeds" can complement corn/grain sorghum plots. Common ragweed, pokeweed, smartweeds, giant foxtail, crotons and others can provide additional seed relished

Fig. 6.30 *Not all grain sorghums are milo. Hybrids and varieties of grain sorghum grown in the U.S. today were derived from crosses of milo and kafir.*

Grain sorghum or milo – which is it?

The terms "grain sorghum" and "milo" are often used interchangeably. Technically, this is incorrect. Milo is a grain sorghum, but there are several other grain sorghums besides milo.

The sorghums include many species, but they are classified into four broad groups: broomcorn, sorgos, grass sorghums and grain sorghums. Broomcorn plants have woody stalks with very long panicle branches, which are used by some cultures as brooms. The sorgos generally have tall, juicy, sweet stalks and are grown primarily for livestock forage, silage or syrup. Grass sorghums, such as sudangrass and johnsongrass, have been produced for livestock forage. The grain sorghums, of course, are grown primarily for cereal grain.

Grain sorghums were introduced into the United States from different areas within Africa and Asia and are classed into seven groups: durra, feterita, hegari, kafir, kaoliang, milo and shallu. The durras have bearded, fuzzy heads; large, flat seeds; and dry stalks. The feteritas have few leaves; dry, slender stalks; and compact seed heads with large, chalky-white seeds. The hegaris have nearly oval heads with chalky white seeds on plants that tiller abundantly. The kafirs have thick, juicy stalks; large leaves; and cylindrical heads with white, pink or red seed. The kaoliangs have dry, woody, sparsely-leaved stalks that produce bitter brown seeds. The milos have fairly juicy stalks and wavy leaf blades with a yellow midrib. The heads of true milos are compact and fairly oval and the seeds are large and creamy white or salmon-colored.

The vast majority of the grain sorghums grown in the United States, however, are hybrids and varieties derived from crosses of milo and kafir. Few, if any, are fully typical of the parent group. The other grain sorghum sometimes grown in wildlife food plots is hegari. The white seed of hegari grain sorghum (see Fig 10.12 on page 110) are quite attractive and readily consumed by wildlife.

by many birds, including bobwhites, doves and several species of native sparrows. A weedy grain plot also attracts wild turkey and bobwhite broods (see ***Using corn and wheat as "two-year grain plots" for brood habitat*** on page 82). Herbicides and/or cultivation should be used, however, if undesirable plants such as cocklebur, curly dock, broadleaf signalgrass, goosegrass, horsenettle, jimsonweed, sicklepod, spiny amaranth, johnsongrass and yellow nutsedge are expected. In addition to those listed above, Python™ may be applied preplant incorporated or preemergence for corn, but not grain sorghum. Prowl™ can be applied preemergence for corn, but not preplant incorporated (see ***Appendix 2***). Prowl™ may also be applied postemergence incorporated for corn and grain sorghum after crop plants are least 4 inches tall (that is, crop must be cultivated with at least 1 inch of soil thrown over the base of the crop prior to herbicide application). Pursuit™ can be applied preplant incorporated, preemergence or postemergence in Clearfield™ varieties of corn **only** (do not apply Pursuit™ to non-imidazolinone varieties of corn). Of course, if Roundup Ready™ corn is planted, Roundup™

Fig. 6.31 *Clovers are the primary cool-season forage planted for white-tailed deer – and for good reason. They are productive, nutritious, can be managed over a long season of growth, and deer love them!*

can be used postemergence. Roundup Ready™ technology is especially effective when one of the preplant/preemergence herbicides listed above for corn is also used.

Another consideration when planning to plant corn or grain sorghum is using surrounding agriculture to your advantage. If row cropping occurs on or around the property you are hunting/managing, it may be cost effective for you to pay the producer to leave a section of the field unharvested for deer (as opposed to you spending time and money planting a food plot). Find out what the producer is getting per acre for the grain, then offer him or her that amount per acre you wish to be left unharvested. Be sure and explain how the profits will actually be increased because time and fuel will not be spent harvesting those acres.

When planting single-species warm-season forage plots, consider time to maturation and how some broadleaf legumes (such as cowpeas, lablab, Quail Haven soybeans) may provide an advantage in forage quality as they continue to "vine" and produce new growth throughout the season. Although early-maturing soybeans may not produce forage as long as later-maturing varieties, bean production and availability through fall/winter may be more important. American jointvetch continues to grow and produce forage through the season, but the stem can become quite woody by late September if grazing pressure through the summer was light. Alyceclover is similar to American jointvetch, but does not produce as much biomass and is not considered a preferred forage. Buckwheat grows fast, but goes to seed quickly and is generally not preferred over soybeans, cowpeas, lablab or American jointvetch.

Cool-season plots

Cool-season plots are the backbone of most food plot programs for white-tailed deer. In the South, the majority of cool-season forages grow well during spring and fall, a few produce quality forage through winter, and several of the perennial forages continue substantial production through mid-summer. Cool-season forages may be annual or perennial and peak in production at different times of the year. Therefore, a variety of cool-season forages must be planted to ensure adequate nutrition is available from early fall (when warm-season forages are waning) through mid-winter (when little or nothing else green is available) until mid-summer (when warm-season plots begin producing tremendous amounts of forage) (see Figs. 6.6 and 6.7 on page 53).

The need for an annual cool-season grain

Including oats or wheat as a companion plant when establishing perennial forages is a good idea. Oats and wheat are preferred forages for white-tailed deer and they germinate and establish quickly. This enables them to provide quality forage soon after planting, suppress weed growth and help prevent soil erosion. The perennial clovers, chicory, alfalfa and birdsfoot trefoil are relatively slow to establish. Oats and wheat thus serve as a "nurse crop" through the first winter after planting, bearing the brunt of grazing pressure and allowing the perennial forages to establish a good stand by April. The oats and wheat produce seed in May, die and decompose into the perennial plot through the summer. Barley is not recommended because whitetails did not eat barley in any of our trials. Cereal rye and triticale (wheat/rye hybrid) are generally not included *as companion plants* because they can get very tall (6–7 feet) upon maturity and leave a tremendous amount of dead material on top the perennial forages.

Figs. 6.32, 6.33 and 6.34 *This series of pictures illustrates the typical progression of an annual (such as oats) planted in a perennial clover mixture. This plot was sown in September 1999. Soon after planting, the oats germinated and became established, providing forage for deer quickly. By May, the oats had matured and produced seedheads and the clover had become well established. While growing, the oats served as a "nurse crop" for the ladino white clover. By July, the oats had died and started to fall over. By September, the dead oats had "melted" into the clover (the plot was not mowed), leaving a pure clover stand that can be maintained for several years with the appropriate management techniques.*

Some cool-season forages germinate and grow quickly soon after planting, while others are slow to establish and require months before considerable forage is available. Most cool-season plots are planted in late summer/early fall, but mid-February through early April is also a good time to plant several cool-season forages in the South and through May further north. If planted in late August/early September with adequate rainfall, several annual cool-season forages will provide quality grazing by mid-October. Timing of planting cool-season annual grains (such as wheat and oats) and *Brassicas* (such as forage rape) is critical. If planted early (such as late August in the South), they may bolt and go to seed prior to cold weather during a relatively warm fall with plenty of rain. If planted too late, forage production will be limited until spring.

Use of cool-season plots during the fall is influenced greatly by acorn availability. Particularly during years with little acorn production, cool-season forages can play an important role in providing plenty of digestible energy through winter, helping deer enter spring in good shape. All perennial cool-season forages are slow to establish. Thus, one or more annuals are typically added to perennial forage mixtures. When planted in the fall, perennial forages begin substantial production the following March, which coincides with a period (March through May) when forage high in protein (16–22 percent) is needed for developing maximum antler growth and meeting reproductive demands.

Cool-season food plots are vulnerable to a host of weeds, especially perennial plots, which have both cool- and warm-season weed problems. The biggest threats during fall and winter are the cool-season broadleaf weeds, particularly henbit, purple deadnettle and common chickweed. These annual weeds can be especially problematic during establishment. Preemergence weed control is possible with a few mixtures, but not with most. If clovers and/or alfalfa are planted alone (*without* a cool-season grain or other plant), Eptam™ can be used preemergence to control winter annual weeds. Adding oats and/or wheat to a clover mixture, however, is highly desirable because they germinate and establish quickly, suppress weed growth to some degree and act as a nurse crop for establishing legumes by buffering grazing pressure. Thus, preemergence herbicides are not used with many cool-season mixtures. Instead, postemergence herbicides are used later as needed.

Figs. 6.35, 6.36 and 6.37 *Chickweed (top), henbit (middle), and purple deadnettle (bottom) are three winter annual weeds common in food plots. All can be removed with the appropriate herbicide applications.*

Selective postemergence applications are particularly needed for controlling grasses and warm-season perennial forb weeds. All annual and many perennial weeds are most effectively

Fig. 6.38 *High-preference, high-quality, cheap, easy, grows just about anywhere. That pretty much sums up this mixture. Crimson and arrowleaf clovers are excellent re-seeders and good companion plants. Crimson germinates and grows quickly, while arrowleaf persists about two months longer than crimson.*

controlled if sprayed when young. However, if weeds get too tall or mature for herbicides to be effective (see herbicide labels for optimum heights to control different weeds with various herbicides), you can set them back by mowing. Some can be sprayed as they begin to re-grow after mowing, but herbicide efficacy may be reduced. Mowing perennial plots also stimulates forage production and can be quite effective in reducing hard-to-control annual weeds (such as horseweed). It is very important, however, to mow before weeds produce seed.

Specific management recommendations are given for each mixture below. **Seeding rates are per acre. General herbicide recommendations are included. Refer to *Appendix 2* for additional herbicide information**.

Cool-season plantings for white-tailed deer

Cool-season annual mixture 1

Approximate cost: $46

10# crimson clover
5# arrowleaf clover
20# Austrian winter peas
40# wheat or oats

Benefit and considerations: If you are planting on poor ground and/or don't want to spend too much money, this is the mixture to use. This annual mixture is as close to fool-proof as it gets. Plus, **there is no mixture that will attract deer and turkeys any better than this one!** Both crimson and arrowleaf clover are important com-

ponents in this mixture. They are both adapted to a wide variety of soil types and do well even on dry hills and ridgetops. Crimson clover germinates and begins to produce quality forage faster than arrowleaf. Arrowleaf clover flowers and dies at least six weeks later (late June/early July) than crimson clover, thus extending the period of production for this mixture.

Management: This mixture establishes very quickly; thus, winter annual weeds should not be a problem (unless the plot is overgrazed). Both crimson and arrowleaf clover are excellent re-seeders. You can retain these clovers for many years without replanting if they are not overgrazed and are able to flower and produce seed. After the arrowleaf clover dies (early July), mow the plot. Wait a couple of weeks and spray the entire plot with a glyphosate herbicide (1–2 quarts per acre) to kill all volunteering weeds (mid-July). It is important to spray before the weeds flower. Not only is a better kill realized, it also helps reduce the seedbank. In a few weeks, top-dress the plot with lime and fertilizer as recommended from a soil test and disk in mid-August. This will effectively re-seed the clovers. If you want to include a cool-season grain or Austrian winter peas, just sow prior to incorporating the lime and fertilizer or drill them in later.

A variation of this mixture is to replace arrowleaf clover with red clover (8 pounds). Red clover is relatively slow to establish like arrowleaf clover; however, red clover will persist throughout the summer if there is good soil fertility and adequate moisture is available. This provides an additional two months of high-quality forage. As the red clover declines in productivity (late August), top-dress with lime and fertilizer as needed and lightly disk the plot to stimulate the crimson clover. Additional wheat, oats or peas can be drilled into the plot if desired.

Cool-season annual mixture 2

Approximate cost: $44

100# wheat or cereal rye

20# Austrian winter peas

2# dwarf essex rape (or other forage rape)

Benefit and considerations: Clovers are a preferred forage for white-tailed deer and they provide excellent nutrition. However, they do not provide much forage through mid-winter because they typically wilt down with hard freezes in December through February. This mixture could be called the "winter grazing plot" because it withstands cold temperatures very well and provides forage high in digestible nutrients through the cold winter months.

Fig. 6.39 *Wheat and cereal rye can provide excellent forage through winter. Including Austrian winter peas and dwarf essex rape provides additional nutrition that will grow and remain erect through the winter.*

Management: Because this mixture establishes very quickly, preemergence herbicides are typically not needed. If extreme weed pressure is expected, use wheat instead of rye and preplant incorporate Treflan™. Even though you amended the soil according to a soil test prior to planting, applying an additional 30–60 pounds of N per acre in December will give the plot an added boost for increased production through winter. This N boost also will increase percentage crude protein in the forages. If you plant rye (cereal rye, **not** ryegrass), mow the plot once or twice in April if possible to keep the rye palatable. Wheat can be allowed to produce seed for wildlife.

Cool-season annual hunting plot

Approximate cost: $45

120# oats (approximately 4 bushels)

OR

120# wheat (approximately 2 bushels)

Benefit and considerations: If you are primarily interested in attracting deer to make them more visible and facilitate hunting, planting a plot of oats (or wheat) will do the job. Deer cannot resist a lush stand of green oats – that is one reason why oats are recommended in most of the cool-season forage mixtures listed for white-tailed deer. It is important to plant a variety of oats that is relatively winter-hardy. Buck Forage™ oats have performed very well throughout the South. Ask your county Extension agent for the variety that does best in your area. If you are concerned with winter kill, plant wheat instead or the ***Cool-season annual mixture 2.***

Management: Don't think you can just disk a field, sow the oats or wheat and deer will come. It is still important to get the pH between 6.0 and 6.5, adjust P and K levels to medium, if not high, and add 30–60 pounds of N per acre as the plot is getting established. When the soil is amended correctly, a stand of oats is quite nutritious (test plots contained 26.5 percent crude protein with only 17.9 percent acid detergent fiber – 23 March 2003).

As the plot becomes established, several forb-selective herbicides (such as 2,4-D, Aim™, Banvel™, Clarity™, Harmony Extra™) can be applied postemergence if needed. For best results, spray before weeds are 4 inches tall. If wheat is sown instead of oats, Osprey™ can be used to control

John Gruchy

Fig. 6.40 *Oats germinate and grow fast, providing high-quality attractive forage soon after planting. When limed and fertilized as recommended, crude protein and total digestible nutrient levels are very high. Choosing a winter-hardy variety is important. These Naked Oats from Wannamaker Seed Company performed very well through the winter of 2005–06 (photo taken in January 2006).*

Fig. 6.41 *This is as good as a perennial plot gets! Preferred perennial forages with high-quality, fast-growing annuals. With proper management, the clovers and chicory can be maintained for several years.*

several annual grasses (including ryegrass) and forb weeds. Achieve™ can also be used to control ryegrass in wheat plots.

Palatability and digestibility decrease as oats mature and begin to produce seed. At this time, the plot can be disked under in preparation for an annual warm-season planting or left fallow for planting the following fall. Another option is using a glyphosate herbicide to prepare the field for planting a warm-season plot with a no-till drill. This strategy conserves soil moisture and may reduce "downtime" between cool-season and warm-season production. Yet another option is to allow the oats to stand through the summer (making the seed available for wildlife), spraying weeds as appropriate, and disking in late August. At this time, you might allow the oats to re-seed (oats re-seed fairly well if seed production is adequate and if a substantial amount of seed remain after wildlife feed in the plot) or re-plant the plot in a cool-season mixture. Sow oats in late August/early September just prior to rain to help ensure quick establishment and considerable growth during the hunting season.

Cool-season perennial mixture 1

Approximate cost: $62

4# ladino white clover
5# red clover
2# chicory
1# dwarf essex rape
40# oats or wheat

Benefit and considerations: This is an excellent perennial mixture; however, do not expect to retain ladino clover on exposed sites that become excessively dry during the summer. A cool-season annual mixture is much better suited to those sites. There are several varieties of ladino and intermediate clovers to choose from, including Advantage™, California™, Durana™, Osceola™, Patriot™, Regal™, RegalGraze™ and others. Some are better adapted to wet conditions; some adapted to drier conditions; some are more resistant to viruses. However, all produce excellent forage for deer. Expect high use of this mixture for several years, provided

the plot is managed correctly by top-dressing as needed with lime and fertilizer and with weed control. Red clover and chicory tolerate dry conditions fairly well (especially chicory). Rape and wheat are included because of their ability to withstand hard freezes during the winter after planting and provide forage when clovers are often "wilted down." This is often a critical time for deer when forage availability is quite low. Berseem is an annual clover that germinates and grows fast initially and is highly preferable to deer. It can be added (5 pounds) to this mixture for quick clover growth and attraction; however, it does not tolerate cold temperatures well and may be dead by late winter, even in the mid-South.

Fig. 6.42 *Alfalfa, red clover and chicory produce outstanding forage for whitetails. This is a great perennial mixture for relatively dry sites.*

Management: There is no preemergence herbicide that can be used with this mixture. However, given the rapid germination and early growth of oats and wheat, preemergence herbicides are usually not needed. After the oats (or wheat) have produced seed and died and the clovers have flowered and produced seed, the plot should be mowed. Pursuit™ then can be sprayed postemergence as necessary to control various weeds. For control of grasses (especially crabgrass, johnsongrass, residual tall fescue and bermudagrass), a grass-selective herbicide (such as Arrow™) is recommended (refer to herbicide label for optimum height to spray various grasses). Following an herbicide application during summer, a fall top-dressing in September with the appropriate amount of lime and fertilizer will have this perennial forage plot looking good. An insecticide treatment for white grubs (Japanese beetles and June bugs) may be necessary in the third or fourth year after establishment.

Cool-season perennial mixture 2

Approximate cost: $93

10# alfalfa
5# red clover
3# chicory
30# oats or wheat

Benefit and considerations: This is a perennial mixture that will do well in upland areas prone to becoming fairly dry during summer (but it does best where moisture is not limiting). Expect stand thinning to occur during prolonged dry periods; however, with proper management, the stand can be retained and invigorated. Exposed sites that become excessively dry during summer should be planted as an annual cool-season plot or not planted at all. Expect the alfalfa and chicory to persist

for many years if top-dressed annually according to a soil test and if weeds and weevils are sprayed as necessary. This mixture is not cheap; therefore, it is important to realize the management effort needed to maintain a stand before planting.

Management: Alfalfa is sensitive to acid soils and low fertility and alfalfa weevils can become problematic. To maintain alfalfa, the pH should be raised to 7.0, both macro- (phosphorus and potassium) and micronutrients (especially sulfur and boron) should be applied if needed, and insecticides will be necessary to combat alfalfa weevil infestations (4–8 ounces per acre of Way-Lay 3.2 AG™ has been successful).

The oats or wheat will produce seed in May. Afterwards, they will slowly "melt" into the plot as they die. At this time, incoming weeds can be mowed or sprayed with Pursuit™ or Raptor™ postemergence. Alfalfa, chicory and red clover flower in mid-summer. After they have produced seed, mow the plot to encourage fresh growth. Problem grasses can be controlled with a grass selective herbicide if sprayed before they reach 6 inches in height. Top-dress the plot with lime and fertilizer in August/September as recommended by a soil test.

Cool-season perennial mixture 3

Approximate cost: $53

5# alsike clover
4# ladino white clover
5# berseem clover
40# oats or wheat

Benefit and considerations: This perennial mixture is very well-suited for bottomland sites that are fairly moist most of the time. Berseem is a high-preference annual clover that can be added because it germinates and establishes relatively quickly.

Management: Pursuit™ and/or 2,4-DB (Butyrac 200™) can be sprayed postemergence as needed to control various weeds after the oats/wheat produce seed. A grass-selective herbicide can be sprayed postemergence to control grasses. This mixture should be mowed after the clovers have produced seed and as necessary to prevent weeds from flowering if the plot is not managed with the appropriate herbicides.

Fig. 6.43 *Berseem clover is a high-preference annual clover that germinates quickly and grows well in association with ladino and alsike as they develop.*

Red clover and alfalfa – not just for cattle!

Red clover and alfalfa should be considered seriously when planting a perennial cool-season food plot for white-tailed deer. Red clover is classified as a biennial clover, but with proper management, it can be retained for at least three years in the Mid-South and northward. In the Deep South, red clover is an annual. Alfalfa is a perennial legume that can be retained for many years with proper management, including strict attention to pH and insect pest control. Red clover and especially alfalfa are tolerant of dry conditions and very productive where soils have been amended properly. In recent years, red clover and alfalfa have gotten bad publicity by some companies and consultants that sell commercial food plot mixtures, calling them "cattle forages." Their claim is that red clover and alfalfa are too stemmy to be considered deer forages. These claims are quite misleading. Red clover and alfalfa do produce relatively large stems as they mature, but this is not what deer eat. Deer eat the foliage produced on the ends of the stems! The ability of red clover and alfalfa to produce high-quality forage through the summer months has been noteworthy. This is an important factor when or where warm-season plots are not grown.

Figs. 6.44 and 6.45
*The red clover and alfalfa shown here are both in their **third** year. Their ability to withstand relatively dry conditions and produce high-quality forage through summer is impressive.*

Monitoring food plot success with exclusion cages

Planting success and use of food plots (especially forage plots, such as clovers or soybeans) should be monitored using exclusion cages. These cages allow you to observe how much forage is being consumed over time and estimate the success of your planting. Exclusion cages (approximately 4 feet in diameter and 4–5 feet tall) can be made of chicken wire or hog-panel wire wrapped around four stakes driven into the ground. It is easy to assume your planting efforts were futile when you visit a plot and all you see are weeds. In areas with high deer densities and little other available food, this is common, as food plots are ravaged as soon as the plants germinate. Exclusion cages will make this problem very evident, as knee-deep lush forage may be found in the cage.

Fig. 6.46 *Exclusion cages make it very evident when deer density is too high and/or quality forage is limited.*

The solution to overgrazed food plots is simple: kill more does and/or implement additional habitat management. Many people try to use exclusion fences and/or deer repellents around the perimeter of food plots *planted for deer* to keep deer out until the plot has established and/or just before hunting season. If the plot was planted for another species (doves, for example), this practice has merit. However, if the plot was planted for deer, erecting an exclusion fence only addresses the symptom, not the problem, of overgrazing. If you cannot grow a food plot because there are too many deer, then the population needs to be lowered and/or you need to provide more food, whether through food plots or other habitat management practices. Yes, additional forage may be provided by allowing the plot to establish before deer can graze it, but you must consider what the deer are eating while they are fenced out of the food plot! Overpopulated deer destroy habitat for many other species by overgrazing and overbrowsing. If quality food is not available throughout the year, you are not allowing the deer herd to reach its potential. If all you want to do is shoot some deer, then surely you don't need a food plot to help if there are so many deer they won't let it grow! Without question, habitat management has to be coupled with population management to have healthy wildlife populations. Further, healthy wildlife populations are a product of healthy habitats. **Food plots should never be eaten to oblivion, at any time of year**. If so, you have just identified a limitation! A successful food plot program helps ensure a nutritious food source is available year-round, but especially during those times when naturally occurring foods are limited.

Fig. 6.47 *Exclusion cages also show when excessive weed pressure is the result of overgrazing. Here is an example of good clover growth inside the cage. However, excessive grazing allowed henbit, chickweed and wild garlic to completely take over the plot.*

Don't plant perennial cool-season grasses

Do not include tall fescue, orchardgrass, bromegrasses, timothy or bluegrass in any food-plot mixture! Perennial grasses are ranked at the bottom in terms of forage preference by white-tailed deer. In the experimental plots used to determine the planting recommendations for white-tailed deer, there was virtually no measure of deer foraging on tall fescue, orchardgrass or timothy at all, in any year or season. White-tailed deer food habit studies across the South over the past 50 years have noted a lack of perennial grasses in the diet. Not only are they not preferred, perennial grasses are competitive and usually choke out clovers by the second growing season, leaving nothing but a rank field of grass with relatively high lignin content, providing low palatability, low digestibility and low nutrition. Even if other desired forages were not choked out completely, why would you want a certain percentage of your food plot taken up by non-preferred plants with lower nutritional quality? It doesn't make sense!

Are you interested in wild turkeys, bobwhite quail or ruffed grouse using your plot(s)? If so, then there are more reasons why you shouldn't plant perennial cool-season grasses (see ***Bobwhite quail*** on page 87).

Fig 6.48 *Here is a plot of orchardgrass (foreground) and an adjacent plot of oats – 24 January 2006. Nothing really needs to be said – the picture speaks for itself. Fresh, nutritious oats, or senescent, rank orchardgrass. The choice is yours.*

Fig 6.49 *Here is a lush plot of timothy – 2 May 2005. Horses may love this stuff,* ***but deer don't!*** *You won't find a single blade of timothy grazed in the entire plot.*

Table 6.1 Production of three annual forages and orchardgrass grown in separate plots in the field shown in Fig. 6.46 and 6.47 from October 2005 to April 2006. These data were collected at the end of each month, except April, when data were collected prior to flowering for each of the forages. It is clear these annual forages out-produce and are highly preferred over orchardgrass by white-tailed deer. The deer density in this area was approximately 70 per square mile.

	Forage produced (pounds per acre – dry weight)	Percent eaten by deer
crimson clover	4050	97
oats	3676	92
triticale	4049	89
wheat	3952	85
orchardgrass	2212	2

Table 6.2 A comparison of three annual grasses, two perennial grasses and crimson clover grown from October 2004 to April 2005 show the same general results as Table 6.1. These data were collected in the same field in the same manner as those from Table 6.1. It is clear the annual small grains and crimson clover are highly preferred by white-tailed deer over ryegrass, orchardgrass and timothy. Oats (variety not stated) are not included in the comparison, because they were winter-killed in January 2005.

	Forage produced (pounds per acre – dry weight)	Percent eaten by deer
crimson clover	3726	78
wheat	5736	65
cereal rye	7378	50
ryegrass	4889	10
orchardgrass	2449	3
timothy	2486	0

Wild Turkeys

All the cool-season forage plots listed for white-tailed deer will attract wild turkeys as well, especially clovers. Expect heavy use in late winter/early spring after the acorn crop has been consumed and turkeys begin searching for green patches. In addition, wild turkeys will use perennial cool-season plots as "bugging sites." These plots usually harbor an abundance of insects and other invertebrates that are critical components in the diet of wild turkey poults during early to mid-summer.

Wild turkeys readily feed upon available grain during fall and winter. The warm-season mixtures containing grain and other seeds listed for deer and doves are also excellent choices for wild turkeys. Another strategy is to consider paying a local producer to leave a portion of a cornfield unharvested. This may be cheaper than if you planted a plot yourself. Unharvested cornfields burned or silage-chopped in mid- to late March are absolute magnets for wild turkeys.

Wheat should not be overlooked as a very valuable food source for many species of wildlife. Deer, rabbits and groundhogs eat the forage, while turkeys,

Figs. 7.1, 7.2 and 7.3 *Nothing attracts turkeys like a freshly burned area. Burning in late February/March consumes leaf litter and creates an open structure at ground level, making seeds and invertebrate parts (such as snail shells and beetle parts) readily available for hens just prior to laying eggs (upper left). Planting strips of wheat and clovers through fields that have been burned, or adjacent to woods that have been burned, makes the area irresistible to turkeys. Where hens are attracted, so are gobblers (center)! By late May, optimum cover for broods is available where fields are managed with prescribed fire (bottom).*

Fig. 7.4 *Wheat plots allowed to remain fallow for a year can provide outstanding brood habitat for wild turkeys and bobwhite quail. Forbs, such as ragweed, sticktights and 3-seeded mercury, provide superb umbrella cover for broods moving about underneath, while they feed on seeds and invertebrates.*

quail, doves and many songbirds eat the seed. If you want to manage for turkeys and quail along with deer, use wheat instead of oats in the forage mixtures listed for deer. If the soil is amended properly, green wheat forage is quite nutritious (test plots contained 24.9 percent crude protein with 21.4 percent acid detergent fiber – 23 March 2003).

Use of food plots by wild turkeys is increased dramatically when food plots are located adjacent to favorable cover. Use in winter and spring is especially increased when food plots are near favored roosting areas. Use in spring is also increased when food plots are in proximity to old-fields and woods that have been burned recently. Burning exposes seeds and charred invertebrates (such as snail shells and beetle parts), which provide an excellent source of calcium as hens prepare for laying eggs. As hens are attracted to these areas, so are gobblers. Recently burned old-fields and woods are open and provide exceptional strutting areas. Later, use of food plots in summer is increased when favorable brood habitat is nearby. Coincidentally, prime brooding habitat is usually provided in those old-fields and woods that have been burned recently (refer to ***Bobwhite Quail*** for discussion on brood habitat).

Using corn and wheat as "two-year grain plots" for brood habitat

If wheat plots are not overgrazed during winter and early spring and you allow them to mature and produce seed in May, a quality food source is available for birds through the summer. If allowed to remain fallow, these fields can provide **excellent** brood habitat for wild turkeys and bobwhites the following summer as a variety of forbs become established from the seedbank. If you plant wheat specifically for wild turkeys, use a lighter seeding rate (80 pounds per acre) as opposed to a heavier seeding rate for deer forage production (120 pounds per acre). This will encourage better growth from the seedbank for brooding cover after the wheat matures. If weeds are problematic during establishment, refer to management recommendations for the ***Cool-season annual hunting plot*** on page 72.

Corn or grain sorghum plots can be treated similarly. By allowing corn patches to remain fallow the year after planting, quality brood habitat often develops. During good mast years the fall after planting, do not mow your corn. As deer and other

wildlife feed upon the acorns, a considerable amount of corn is usually left hanging on the stalks. Allow this to stand through the following summer. Toward the end of summer (2–3 weeks before dove season), mow the corn a little at a time, finishing by mid-September. At this time, a cool-season plot can be planted. Rotating grass crops with legumes is recommended. Refer to ***Grain plots and single species plantings*** on page 63 for pre- and postemergence weed control strategies.

Fig. 7.5 *Corn plots left fallow the year after planting can provide* ***outstanding*** *brood habitat for wild turkeys and bobwhites. Depending on the forbs that pioneer into the plot from the seedbank, the perfect "umbrella" cover develops, protecting broods while they feed upon the bugs and various seed below. Managers on the Chuck Swan State Forest and Wildlife Management Area in Union County, Tennessee, have done a great job with this.*

Planting specific for wild turkeys

Chufa

Approximate cost: $90

50# chufa

Benefit and considerations: Chufa (a nutsedge) is a very popular planting for wild turkeys. Turkeys feed upon the nut-like

National Wild Turkey Federation

Fig. 7.6 *A field of chufa can be a magnet for wild turkeys. The energy-rich tubers (see Fig 11.7 on page 119) should be available throughout fall and winter.*

Using prescribed fire in upland hardwoods

Prescribed fire can be used in upland hardwoods to improve food and cover availability for wild turkeys and several other wildlife species. However, before burning in woods, it is important to prepare a burn plan and review fire laws with your state forestry agency. In the plan, outline your objectives clearly. This is especially important when timber management is also a consideration with wildlife management objectives. When planned and implemented accordingly, low-intensity prescribed fire can be used to protect the stand from wildfire, influence the composition of regeneration, and increase groundcover to enhance food and cover for wildlife.

Fig. 7.7 *Just as when burning fields, it is critical to establish safe firebreaks when burning woods. According to terrain and woody stem density, this may be accomplished with a tractor and a disk, but a dozer is often needed. With forethought, firebreaks can be planned so they provide access throughout your property.*

Fig. 7.8 *Remove slash and other debris from the base of trees you want to retain after harvest or thinning. Debris maintains heat around the trunk, which will scar the tree, such as this white oak (left). Fire scars lower timber value and allow fungus to enter the tree, which may eventually kill the tree.*

Figs. 7.9, 7.10 and 7.11
Low-intensity prescribed fire in upland hardwoods (top) should not damage overstory trees (center), and should result in improved cover for nesting, brooding and fawning; increased availability of seed, soft mast and invertebrates; and increased forage and browse (bottom).

tubers (see Fig 11.7 on page 119) produced among the roots of chufa. Chufa grows well in a variety of soil types. However, you should realize it is more difficult for turkeys to scratch down into heavy clays and turn up the roots to feed upon the tubers than when chufa is planted in loamy soils. If tubers are planted in clay soils, you should disk the plot in the fall to help make the tubers available and attract turkeys. Maximum tuber production usually occurs in bottomlands with full sunlight where moisture is not limiting. Drought conditions severely reduce tuber production and plant survival.

Management: Chufa does best in fertile soils; therefore, P and K should be raised accordingly (50 and 160 pounds available per acre, respectively). Top-dress with a nitrogen fertilizer (60 pounds N per acre) when plants reach approximately 6 inches in height and rain is in the forecast. Chufa matures approximately 100 days after germination. “Clean” chufa plots typically produce greater yields than weedy plots. Planting chufa in rows allows cultivation for weed control possibly without the need for herbicides. Forb weeds can be controlled with 2,4-D, Banvel™ or Clarity™ and problem grasses can be controlled with Arrow™ or Poast™. When growing chufa, it is important to rotate the crop each year. This will encourage healthier plants and help manage plant density. Chufa plots typically volunteer the year after planting.

Bobwhite Quail and Rabbits

Shane Wellendorf

Bobwhite Quail

Bobwhites eat a wide variety of seed from naturally occurring plants, as well as planted forbs and grasses. **Food, however, is rarely a limiting factor for bobwhites** (especially in the South). A lack of quality cover is almost always what limits bobwhite populations. Housing developments, shopping centers, closed-canopy woods and tall fescue (or bermudagrass) hayfields/pastures do not represent quality cover for bobwhites! Quality cover is also the limiting factor for quail on farms with large fields (greater than 10 acres) and "clean" fencerows, creekbanks and ditches. Further, it is important to realize you can have the best quail cover in the county and still not see any bobwhites if your property is only a few acres and you are surrounded by poor-quality habitat. **Food plots will never help quail in these situations, even if you trapped every raccoon and shot every hawk you saw!**

Quail require all of their habitat needs in close proximity. That means nesting cover, brooding cover, loafing cover and escape cover must all be close together (generally, within a 40-acre area). Thus, to increase bobwhite populations, you should concentrate on improving quality cover and the proximity of required cover types to meet the year-round needs of these game birds.

Quail can nest in a variety of cover types, but nothing provides better structure for nesting than broomsedge bluestem, little bluestem and sideoats grama. Nesting habitat should be adjacent to brooding habitat. Quail broods frequent "weedy" fields and patches of sparse brush/shrubs as they search for insects and other invertebrates. Fields intended for use by quail should be relatively open at ground level with a forb canopy overhead. This type of environment enables quail chicks in search of invertebrates to move about easily while protected by the "umbrella cover." Forbs that should be encouraged for bobwhites include ragweed, pokeweed, partridge pea, beggar's-lice, native lespedezas, Carolina geranium, milk pea, butterfly pea, smartweeds, 3-seeded mercury and tropic croton. Grasses that provide quality seed for bobwhites include annual panicgrasses (especially the *Dichanthelium* spp.) and foxtail grasses. Shrubs (such as blackberry, sumac, wild plum and elderberry) scattered throughout the field provide protective cover for loafing and escaping predators. Thickets of dense brush and blackberry provide critical winter cover bobwhites need to escape predators and harsh weather. These areas should never be far from potential loafing and feeding areas.

As you can see, having the right plant composition is only one piece of the habitat management puzzle for bobwhites. *Arranging various cover types correctly* within a 40-acre area is equally important. It is also important to understand how desirable cover types also provide a quality food source for bobwhites. Thus, food is usually provided ***by default*** when quality cover is present!

Quality quail cover can be created by killing non-native perennial grass cover. Perennial cool-season grasses are killed most effectively by spraying a glyphosate herbicide (1.5–2 quarts per acre) in late October/early November as they prepare for winter senescence. Native warm-season grasses (nwsg) and forbs will not be harmed by this application, as they have already undergone

Fig. 8.1 *Quality early-successional habitat is a major limiting factor for bobwhites throughout the South. This 20-acre field used to be covered with tall fescue and orchardgrass. At that time, quail did not use the field. After killing the tall fescue and orchardgrass with Roundup™ and Plateau™, native grasses and forbs were established. The field now supports two 15-bird coveys. Note how various sections of the field are divided with firebreaks (see aerial photo on page 97). This allows burning and/or disking various sections every 2–4 years and juxtaposes nesting cover, brooding cover, loafing cover, roosting cover, escape cover and food all within the same field.*

senescence by this time of year. Selective herbicides (such as Plateau™) also can be used to kill tall fescue when desirable forbs and grasses are present. Techniques used for eradicating bermudagrass and other undesirable warm-season grasses are described under ***Preparing the site – controlling problem weeds before planting*** on page 26.

After the undesirable plant cover has been eradicated, desirable plants in the seedbank often can be stimulated to germinate by disking in October through February in the Deep South, through March in the Mid-South, and through April further north. Disking in April (and later in the spring) is not recommended in the South, as undesirable species, such as johnsongrass, crabgrass, nimblewill, goosegrass, sicklepod and thistles are often stimulated by disking at this time if they are present in the seedbank. Cover around crop fields can be enhanced by allowing a 50-foot-wide buffer of tall grasses, forbs, brambles and shrubs/brush to develop. Tree invasion into buffers can be controlled with an application of Arsenal AC™ or Garlon 3-A™ (see ***Appendix 2***). Quality winter cover for bobwhites can further be enhanced along the field/woods interface by killing undesirable trees and allowing additional brush to develop approximately 100 feet into the woods around the field.

Once you have established quality early-successional habitat, the best way to maintain it is by periodic burning. Disking also can be used to influence plant composition and structure. **Prescribed fire is strongly recommended to manage quail habitat.** Burning fields every 2–4 years consumes dead vegetation, recycles nutrients, stimulates fresh plant growth, creates an open structure at ground level, makes seed and invertebrates more available and maintains an early-successional plant community.

Fig. 8.2 *Quail populations have been increased in many areas throughout the South and Midwest by establishing/promoting field borders of native grasses and forbs around crop fields. The concept is simple – bobwhite populations increase when additional usable space is provided. Here, a border of broomsedge, brambles and forbs has been allowed to establish around a soybean field.*

Before burning, establishing a firebreak is necessary to keep the fire out of areas not intended to burn. Firebreaks can serve two purposes. In addition to restricting fire from spreading into unwanted areas, firebreaks surrounding quality cover can be planted to provide additional food resources (see ***Managing firebreaks for quail, rabbits and other wildlife*** on page 95). Thus, *linear food strips* that are long and narrow along field borders (and *within* large fields) are provided adjacent to *blocks of cover* (such as old-fields, thickets, brushy fencerows, hedgerows, brushy gullies and woodlots). This represents good habitat arrangement for bobwhites.

Whatever you do, **do not plant tall fescue, orchardgrass, bromegrasses, timothy or bluegrass in your firebreaks**! These non-native perennial cool-season grasses can be detrimental to bobwhites and other wildlife for several reasons. To begin, they displace good nesting and brood-rearing habitat (such as the native grasses and forbs described above). Because of the sod-forming nature of non-native perennial cool-season grasses, a dense "carpet" is created at ground level. This limits the mobility of quail chicks, as well as wild turkey and grouse poults. Also, fields dominated by these non-native grasses typically do not harbor as many invertebrates as fields predominately comprised of forbs, providing less food for young game birds. When invertebrates are less abundant, broods have to spend more time searching for food, which leads to increased energy expended and increased exposure. Later in life, when seeds become more important in the diet, the thatch produced by non-native, cool-season grasses limits seed availability (if any is present). Further, consumption of tall fescue seed by bobwhites leads to weight loss, cloacal swelling and, ultimately, increased mortality. For these reasons, it is obvious that establishing non-native, cool-season grasses displaces quality habitat for bobwhites and, over time, can lead to increased mortality and reduced recruitment into the fall population.

8.3 *March*

8.4 *May*

8.5 *August*

8.6 *November*

Figs. 8.3–8.6 *This field was a tall fescue hayfield from the late 1970s until the mid-1990s. Since, the tall fescue has been eradicated and the field is managed by burning every other year. Vegetation composition and structure for bobwhites, wild turkeys, white-tailed deer, indigo buntings, field sparrows and others are outstanding.*

Figs. 8.7 and 8.8 *This is the structure presented by tall fescue (left) and orchardgrass (right). These grasses inhibit travel for young bobwhites and wild turkeys, reduce seed and invertebrate availability and inhibit the seedbank from germinating. These grasses are not "wildlife friendly" and should be eradicated where wildlife is a concern.*

Mike Hansbrough

Want more quail?

If so, then you should realize **food plots, pen-reared birds and shooting hawks are not the answer**! Bobwhites need quality cover to survive. Look around your property. Do you see tall fescue, orchardgrass, timothy, bromegrasses and/or bermudagrass? If so, then your first step toward increasing the quail population should be to eradicate these grasses and turn those fields into quality quail habitat. **Don't be afraid if some brambles and shrubs develop in the field**. Quail need them for loafing and escape cover, as well as the food they provide. By simply eradicating the undesirable grasses and managing fields with prescribed fire and/or disking every 2–4 years, you will improve bobwhite habitat dramatically.

Your next step should be to reduce the basal area of closed-canopy woods by cutting and burning. **Quail are not woods birds**. If you find quail using closed-canopy woods to any real extent, that should be an immediate indication of poor-quality habitat. Ideally, the basal area (the amount of an area represented by tree trunks at 4.5 feet aboveground) should not exceed 50 square feet per acre where bobwhites are a focal species. Further, **the percentage of your property in woods should not exceed 30–50 percent if you are specifically managing for bobwhites**. The majority of the property should be in quality early-successional habitat, composed of native forbs, grasses, brush and shrubs. (Note: are you ***really*** interested in managing your property for bobwhites? If so, read this paragraph again and think about what your property *and the surrounding properties* look like.)

Yes, pen-reared birds can provide some fun shooting, but they **cannot** be used to re-establish quail populations. Their survival rate is simply too low. Finally, it is important to realize it is rarely feasible to control *predators*, but you can control *predation* to an acceptable level for wild bobwhites by establishing and maintaining quality cover.

A word about native warm-season grasses…

Native warm-season grasses (particularly broomsedge bluestem, big bluestem, little bluestem, indiangrass, sideoats grama, switchgrass and eastern gamagrass) are promoted to provide cover for wildlife. In particular, quality cover can be provided for quail, rabbits and several species of songbirds that require early-successional habitat. Nwsg grow in bunches and, when sown and managed correctly, contain open ground between bunches. Bobwhites prefer to nest at the base of these bunchgrasses (especially broomsedge bluestem, little bluestem and sideoats grama) and the open structure at ground level allows them space to travel, dust and feed throughout the field, not just along the edge. Relatively sparse nwsg cover (30–60 percent grass coverage) allows a variety of forbs and shrubs to develop throughout the field (40–70 percent forb coverage with scattered shrubs), providing quality cover, forage and seed production. White-tailed deer use fields of nwsg and associated forbs/shrubs as bedding sites and fawning areas. Deer also graze various forbs throughout spring and summer. Nwsg are not, however, planted as food plots for wildlife. To learn more about native warm-season grasses, refer to ***Native Warm-Season Grasses: Identification, Establishment and Management for Wildlife and Forage Production in the Mid-South***, PB 1752 (http://www.utextension.utk.edu/publications/wildlife/default.asp).

Figs. 8.9 and 8.10 *Native grasses provide nesting cover for bobwhites and many other birds. However, to provide cover and food for a wide variety of species, including bobwhites, rabbits, wild turkeys and white-tailed deer, a field of grass is not desirable. Rather, the field should include native grasses, as well as forbs and shrubs (top right).* ***It is most important to realize that where favorable native grasses (such as broomsedge bluestem) and forbs already occur (whether standing or in the seedbank), planting is not necessary!*** *Burning and/or disking every 2–4 years promotes desirable plant composition, with an open structure at ground level and an umbrella canopy overhead (bottom). Neither of these fields was planted. Native vegetation was promoted through selective herbicides and fire after tall fescue was eradicated.*

Rabbits

There are four species of rabbits in the South: the eastern cottontail, Appalachian cottontail, swamp rabbit and marsh rabbit. The eastern cottontail is by far the most prevalent and is found throughout the region. Each species uses slightly different cover types; however, early-successional vegetation managed with periodic disturbance is important for all four. Rabbits primarily eat green forbs and grasses when available, but they also eat bark and browse when necessary (fall through winter). This is when green-forage food plots benefit rabbits most (similar to deer).

Rabbits are prolific breeders. A female rabbit may raise 3–4 litters of 3–4 young per year. This reproductive rate is quite necessary, however, as they are preyed upon heavily by a wide variety of predators. Less than 25 percent of all rabbits born each year survive until fall. Thus, protective cover is absolutely necessary to have an abundant rabbit population on your property. You may wonder why so much space

Aubrey Deck

Fig. 8.11 *Quality supplemental food is of little value to rabbits unless there is quality cover available. Here, a rabbit is feeding in a firebreak adjacent to a field of native grasses, forbs and shrubs.*

Fig. 8.12 *This firebreak was planted with the* ***Annual cool-season firebreak mixture*** *listed on page 98. Quality cool-season forages (wheat, clover, winter peas) adjacent to quality old-field cover and a good soft edge of brambles represents the perfect arrangement of food and cover for rabbits. A field of cover with a strip of food will support* **many** *more rabbits than a field of food and a strip of cover. Again, quality cover also provides food by default.*

Fig. 8.13 *Plenty of grain was still available in February when these beagles jumped four rabbits amongst the native grasses and blackberries near this strip of corn. When managing old-field cover for rabbit hunting, it is a good idea to mow or disk some strips (right of the corn) to provide shooting opportunities.*

is being devoted to cover in a book about food plots. The reason is, you can have rabbits and quail without food plots *if you have quality cover*, but you cannot have rabbits or quail without quality cover *even if you have food plots*. Again, managing food plots is only one habitat management practice, and it is not as important as developing quality cover.

The habitat needs of rabbits are very much like those for bobwhite quail. Quality habitat can support at least three rabbits per acre. The lifetime home range of an individual rabbit is less than 10 acres when quality habitat is present. Areas with considerable early-successional cover, including abundant brushy thickets less than head high, are magnets for rabbits. Quality early-successional cover can be created by eradicating non-native perennial cool-season grasses and allowing various native forbs and grasses with scattered shrubs to establish. Fields of tall fescue can be especially detrimental to rabbits. The endophyte fungus associated with tall fescue is toxic to rabbits, leading to lower weights and smaller litters, not to mention the poor structure at ground level and lack of overhead cover afforded by tall fescue.

If you are interested in maximum rabbit production, manage your old-fields by burning every 3–4 years. Depending on the size of the field, you can break it up into several sections, two to five acres each, and manage them separately. By burning the sections on rotation (one-fourth to one-third of the total field acreage each year), you can provide several different successional stages across the field.

Burning requires firebreaks, which can be planted to provide additional forage adjacent to cover. Both warm- and cool-season plots are beneficial, but quality cool-season forages are especially important for rabbits in fall and winter. Rabbits will eat the green forage of clovers, wheat and oats, as well as peas, beans and grain produced by warm-season plantings. Mixtures that can be planted in firebreaks to benefit rabbits are listed in the following chapter.

Managing Firebreaks for Quail, Rabbits and Other Wildlife

Prescribed fire is the most efficient and effective management technique to enhance and maintain quality early-successional habitat. Prescribed fire is also highly recommended to improve habitat conditions for many wildlife species in forested areas, such as upland hardwoods. Whenever controlled burning is conducted, it is most important to establish a firebreak around the area to help keep fire from spreading into areas where burning is not intended. Most firebreaks around fields are created with a tractor and a disk. Creeks, field edges and roads may be used as firebreaks when burning woods. Bulldozers may be used to establish firebreaks within forest stands (some of which may be used as woods roads). Another option for firebreaks in woods is a backpack leaf blower. Clearing a strip 8–10 feet wide of leaves and other debris around the area to be burned can be an effective firebreak.

Firebreaks can be managed in several different ways. You can plant cool-season plots, warm-season plots or leave them fallow to stimulate the seedbank and establish naturally occurring legumes and other forbs. Managing firebreaks for year-round food resources is recommended to benefit several species of wildlife. You can do this by planting different sections of your firebreak (depending on your objectives) in different types of food plots. An example of managing firebreaks with various plantings is shown in Fig. 9.3. Another approach is to maintain a 2-strip firebreak. In this scenario, two firebreaks are established side by side all the way around the field. The inside firebreak is planted with warm-season forages and/or grains, and the outside firebreak is planted with cool-season forages and/or grains. This facilitates disking in late winter/early spring as the warm-season planting will be dead and need disking and the cool-season planting should be green.

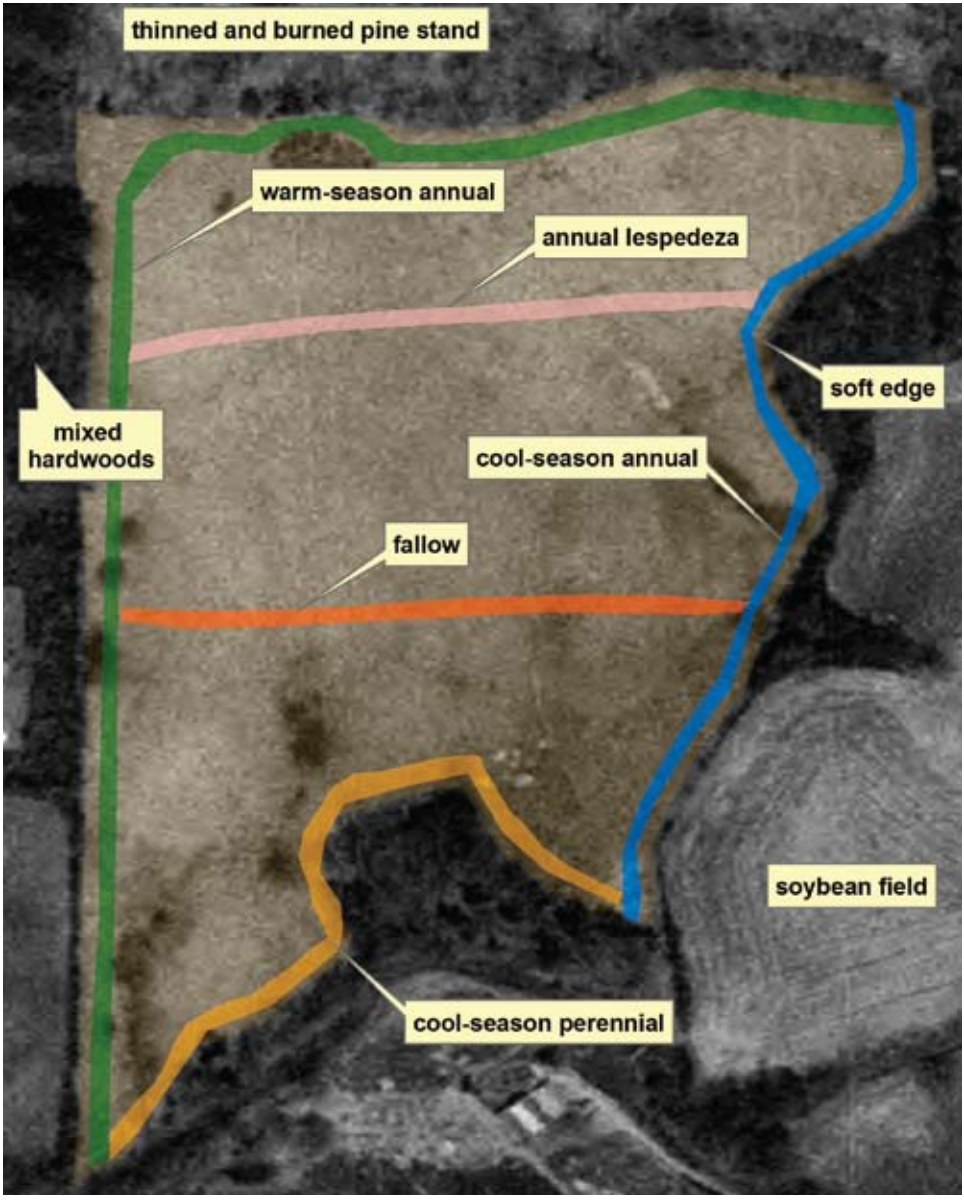
Firebreaks around fields can be established well ahead of the projected burning date. If you plan to burn in March/April, you can establish your firebreak the previous September and plant a cool-season food plot, if desired. However, if the firebreak is located adjacent to woods and you intend to burn the following March/April, you will need to disk after the leaves fall because fire will

Fig. 9.1 *Firebreaks are easily established around fields with a tractor and disk.*

Fig. 9.2 *Firebreaks can be left fallow to stimulate the seedbank, or planted lightly, such as this firebreak, which was planted with only a couple pounds of sunflower seed per acre (primarily for aesthetics). Note the ragweed, beggar's lice and 3-seeded mercury growing in the firebreak.*

move across a firebreak filled with leaves and/or pine needles. In this scenario, it is best to plant a warm-season strip in spring after the field has been burned or allow the strip to go fallow until the following fall when it can be planted with a cool-season mixture. Regardless, when establishing firebreaks adjacent to woods or a tree line, **position the firebreak outside of the drip line of the trees –** at least 30, if not 50 feet from the tree line. This is a major consideration overlooked by most people. Moving the firebreak away from the trees will allow much better production from your planting, as there will be reduced competition for sunlight, water and nutrients, and will reduce leaf litter buildup. It will also allow a soft edge to establish between the trees and the firebreak, which will provide desirable cover for quail, rabbits and many songbirds.

Fig. 9.3 (aerial photo, next page) *This 20-acre field is managed for bobwhites and rabbits (see Fig 8.1 on page 88). The plant community consists of various native grasses and forbs with scattered clumps of shrubs throughout the field. Shrub thickets include sumac, blackberry, wild plum and elderberry, and can be seen as dark areas in this photo. The field is managed in at least three sections (sometimes more), separated by firebreaks to facilitate management by burning and/or disking on a 2- to 4-year rotation. Firebreaks are planted in various mixtures to provide a supplemental food source throughout the year, juxtaposed to an outstanding cover source. Warm-season annuals (not all in the same mixture) include grain sorghum, Egyptian wheat, millets, iron-clay cowpeas and soybeans. Cool-season perennials include red and ladino clover and alfalfa. Cool-season annuals include crimson and arrowleaf clover, wheat and oats. The various sections of firebreaks are not always maintained in these plantings, but rotated around the field as needed, depending upon which foods may be needed more than others, timing of management and weed pressure. Always be*



flexible and ready to adapt your plantings as needed. It is important to maintain some fallow firebreaks. Planned crop rotation and weed pressure determine which sections of firebreak remain fallow around this field. Although two coveys of bobwhites and scores of rabbits can be found regularly in this field, white-tailed deer, groundhogs, raccoons, striped skunks, coyotes, red and gray foxes, evening bats, red bats, deer mice, meadow voles, wild turkeys, indigo buntings, field sparrows, yellow-breasted chats, loggerhead shrikes, American kestrels, great horned owls, eastern kingbirds, eastern bluebirds, common yellowthroats, blue grosbeaks, dickcissels, American goldfinches, box turtles, fence lizards, garter snakes, rat snakes, kingsnakes, copperheads and American toads can also be found using this field and enjoy the management efforts of the landowner.

David Buehler

Fig. 9.4 *A mixture of crimson clover, Austrian winter peas and wheat is easy to grow and produces high-quality forage adjacent to cover in fields where little other green forage may be available during winter.*

Firebreak width is another consideration. Most firebreaks are 1- to 2-tractor-widths or 1- to 2-disk-widths wide. Management is much easier if you establish firebreaks the width of your sprayer. Firebreaks require spraying periodically, just like food plots. **It is difficult and troublesome to spray a firebreak that does not "fit" the sprayer.** To avoid having to close off the end nozzles and recalibrate the sprayer, simply establish the firebreak 1- or 2-sprayer-widths wide. Disking a firebreak that is 1½ times as wide as a disk is much easier than spraying a firebreak 1½ times as wide as a sprayer.

Several mixtures are possible when planting firebreaks. The mixtures listed below are modifications of those recommended for deer and doves. Most of the mixtures recommended for firebreaks are annuals. This facilitates the need to re-disk the firebreak before burning again. Perennial mixtures can be used if the field (or portion of) is not going to be burned for another 3–4 years. Otherwise, perennial firebreaks fill in with leaves and accumulate dead plant material over time. Thus, perennial mixtures need disking before burning. The notion of a "perennial green firebreak" is a myth – it will need re-disking before burning.

Firebreak plantings

Annual cool-season firebreak mixture

Approximate cost: $35

10# crimson clover

20# Austrian winter peas

40# wheat

Benefit and considerations: This mixture will provide quality forage for deer, turkeys, quail and rabbits, as well as other species, such as groundhogs and ruffed grouse. It is adapted from ***Cool-season annual mixture 1*** for deer on page 70, except arrowleaf clover is not included. If Austrian winter peas are not included, just increase the percentage of crimson clover (another 5 pounds). Also, there is nothing wrong with just

Fig. 9.5 *Perennial mixtures can be planted in firebreaks if you are not going to burn for another 3–4 years. Alfalfa, clovers and chicory attract large populations of grasshoppers, leafhoppers and other insects that are important foods for young bobwhites and turkeys. Because this firebreak was planted primarily for quail, the ragweed was not sprayed, but allowed to grow in the firebreak. Undesirable weeds (such as johnsongrass and crabgrass) were sprayed with Select™ earlier in the season. Deer and rabbits were feeding in this section of the firebreak regularly.*

planting a strip of winter wheat in your firebreak. It is cheap, nutritious and will provide a good seed source later in the summer. If only wheat is planted, increase the rate to 80–100 pounds per acre. Wheat is a better choice than oats in firebreaks, especially the further north you go, because of the susceptibility of oats to winter kill. Winter-killed leaves of oats burn readily and a fire is likely to creep across a firebreak with dead leaves (either from dead grass or fallen leaves from trees).

Management: Follow the recommendations given for ***Cool-season annual mixture 1*** for deer on page 70.

Perennial cool-season firebreak mixture

Approximate cost: $95

4# ladino white clover
5# red clover
8# alfalfa
2# chicory
30# wheat

Benefit and considerations: This is an excellent perennial mixture to use around a field or portion of a field that is not going to be burned again for 3–4 years. These high-quality perennial forages will easily persist 3–4 years if managed accordingly. This mixture will produce palatable, nutritious forage for many wildlife species, and support high invertebrate populations important for game bird broods. The structure at ground level does not prohibit broods from using the planting. Do not include a perennial grass in this mixture! Although the price per acre is a little high, firebreaks represent relatively little acreage, even when surrounding large fields.

Management: Follow the recommendations given for ***Cool-season perennial mixture 2*** on page 74.

Fig. 9.6 *Iron-clay cowpeas not only provide quality forage for deer and other species, they also provide a high-energy seed source if not overgrazed.*

Annual warm-season firebreak mixture 1

Approximate cost: $37

40# iron-clay cowpeas

5# grain sorghum

Benefit and considerations: Cowpeas provide quality forage for deer as well as a high-energy seed source for birds later in fall and winter. Grain sorghum provides substrate for the cowpeas to grow and a desirable seed for birds. Quail Haven soybeans (20 pounds) can be used instead of iron-clay cowpeas, especially if you want to retain the soybeans by annual disking (see ***Re-seeding warm-season mixture*** on page 59).

Management: Dual Magnum™ can be applied preplant incorporated to control annual grass and several forb weeds *only if* grain sorghum seed is treated with Concep™ seed safener. Otherwise, there is no preemergence herbicide labeled for this mixture. If weeds are expected to be problematic and treated grain sorghum seed cannot be found, you can substitute 5 pounds of peredovik sunflowers for the grain sorghum and apply Treflan™ or Prowl™ preplant incorporated to control various forb and grass weeds. A grass-selective herbicide also may be used postemergence to control annual grass weeds if sunflowers are planted instead of grain sorghum.

Annual warm-season firebreak mixture 2

Approximate cost: $19

7# Egyptian wheat

7# white proso millet

3# grain sorghum

Fig. 9.7 *Egyptian wheat grows tall and provides good cover for ground-feeding birds, such as bobwhites. Grain sorghum and various millets can provide additional seed. Several plants germinating from the seedbank (such as partridge pea) also provide quality seed.*

Fig. 9.8 *Kobe and Korean lespedeza and partridge pea provide relatively little forage value for deer, but where bobwhites are a focal species, these legumes can provide a quality seed source through winter.*

Benefit and considerations: If you are looking to provide additional seed for birds in an area with a lot of deer, you should consider this one. Deer eat very little grass during summer; thus, this mixture does well even where deer density is high. Seed production is excellent for a variety of birds, including quail, doves and turkeys, as well as many songbirds, including cardinals, several species of sparrows, juncos, flickers and others.

Management: Undesirable broadleaf weeds can be controlled with 2,4-D, Aim™, Banvel™ or Clarity™.

Annual warm-season firebreak mixture 3

Approximate cost: $35

10# Kobe and/or Korean lespedeza without partridge pea: $15

2# partridge pea

Benefit and considerations: Bobwhites relish seed from these annual lespedezas and partridge pea, which are available through winter, making areas planted with this mixture primary feeding spots from December through February. If not already present in the seedbank, partridge pea is a good addition to this mixture. Partridge pea seed, however, is expensive (approximately $12 per pound), but you shouldn't need to plant it but once. You should be able to retain it thereafter with annual disking.

Management: The best time to plant (inoculate seed, disk, top-sow, cultipack) is late winter (mid-

February–early April), which coincides with when fields may be burned to maintain early successional plant cover. Kobe and Korean lespedeza and partridge pea are all excellent re-seeders, which allows you to retain them by disking in late winter. Clean lespedeza/partridge pea firebreaks are possible by spraying Pursuit™ prior to planting. Postemergence applications of Pursuit™ over established strips will also be effective if weeds are sprayed while they are young. Problem grasses can be controlled postemergence with a grass-selective herbicide.

Mourning Doves

Dan Hicks

Doves are attracted to many different seeds and grains, including sunflowers, millets, grain sorghum, corn, buckwheat and sesame. Relatively large fields (5–20 acres or more) are recommended to attract large numbers of doves. Freshly cut grain fields are preferred feeding spots for doves. Doves do not scratch and are "weak-beaked;" therefore, they prefer feeding upon loose grain (rather than corn still attached to the cob) or other seed in relatively open sites with some bare ground available. This is best accomplished by providing "clean" weed-free fields and/or by silage chopping, burning, mowing or disking to make seeds more available and feeding sites more attractive. Burning is an excellent way to provide an open structure at ground level and make seed readily available. You cannot burn, however, unless there are adequate fine fuels (dead or dry grass and other debris) to carry the fire. This is not usually a problem in a mature millet plot or a 1-year-old wheat field. In weed-free plots without thatch, burning is not needed to enhance conditions at ground-level. Silage chopping, mowing or disking will scatter seed and make them available. Silage chopping provides most desirable results.

Marion Barnes

Robin Mayberry

Figs. 10.1, 10.2 and 10.3 *Grain fields are most attractive to doves when seed is scattered by silage chopping or mowing. Either way, don't clear an entire field, but cut strips, leaving food available for later in the season.*

Doves prefer fields with structure nearby (such as trees or power lines) that allow them to perch and loaf near the field. An excellent way to provide perching sites is to plant dove fields along or adjacent to power lines. If this is not possible, you can erect old telephone poles in a line through the middle of the field and string a cable from the top of each pole. Another way to provide perching sites is to kill undesirable trees (such as elms, sweetgum, maples, etc.) along the edge of the field and leave them standing. Doves are attracted to dead trees around a good dove field like magnets. Dove hunters are usually "pulled" toward them as well! In addition to perching sites, a source of water and grit (such as a nearby gravel road) will make the area more attractive for doves.

Weed control can be a problem in dove fields, but be aware several naturally occurring weeds (such as pokeweed, ragweed, barnyardgrass, tropic croton, redroot amaranth [pigweed], Carolina geranium and foxtail grasses) produce seed readily eaten by doves and actually can make a food plot more attractive to these birds. Where weed control is necessary, preemergence herbicides are strongly recommended whenever possible. Planting single species, instead of mixtures, will also make weed control easier. Consider planting grass crops (such as millets, grain sorghum or corn) where certain broadleaf weeds (such as cocklebur and sicklepod) are problematic and planting forbs (such as sunflowers, buckwheat or sesame) where grass weeds (such as crabgrass, goosegrass or johnsongrass) are problematic. This will allow you to use preemergence herbicides that kill a variety of weeds, as well as postemergence grass-selective or forb-selective herbicides for optimum control of problem plants (see ***Appendix 2***).

Juxtaposing single-species plantings for doves

Many planting mixtures are possible for attracting doves; however, planting a section of a field in a single species adjacent to another section(s) with a different species is highly recommended when managing fields *specifically* for doves. **As mentioned above, there are real advantages in weed control when you plant single species, but the biggest advantage is timing maturation rates of different species so that a fresh seed source is becoming available from mid-summer through winter.** When planned properly, your management opportunities increase dramatically.

Buckwheat and browntop millet mature and provide seed within 60–65 days, sesame requires 100 days, sunflowers approximately 110 days and grain sorghum and corn will need 120–145 days, depending on variety. When several species with different maturation dates are mixed together, the field cannot be managed (silage chopped, burned, mowed, disked) until the latest-maturing species is ready. If single species are planned in separate sections of a field, and planned accordingly, a dove field may provide seed in various sections June through winter. For example, wheat planted in the fall provides seed in June and July. Millets or buckwheat planted in the spring provide seed July through August. Millets and buckwheat planted in mid- to late June mature in August/September and grain sorghum and corn planted in the spring can provide seed from late August through winter, depending upon management. Management strategies include burning or mowing millet and wheat and silage chopping or mowing sunflowers, sesame, grain sorghum and corn when the seed/grain has matured and is dry.

Management should not stop when the crop is silage chopped, burned or mowed. After doves consume the wheat crop, buckwheat or browntop millet can be planted to mature in late summer. If buckwheat or millets were planted in spring, the crop can be managed in mid-summer. After doves consume the buckwheat or millet in mid- to late summer, the field or section can be disked to prepare a seedbed and wheat planted by top-sowing and cultipacking in late August/early September (about a week before dove season opens, where legal – see ***Managing wheat fields for dove hunting*** on page 109). Before planting wheat, be sure to have a soil sample tested and add lime and fertilizer as recommended. This will provide additional nutrition for deer grazing the wheat through winter and will encourage a better seed yield the

Marion Barnes

Fig. 10.4 *Single-species plantings, such as these strips of sunflowers, browntop millet and corn, allow several management options. Because of varying maturation dates, crops can be cut at different times. This also allows for better weed control (as there is no labeled herbicide for many seed mixtures) and can enable double-cropping.*

following June. Wheat can also be planted (late August through November) following management of sunflowers, grain sorghum and corn.

When a field is planted in separate sections with different species, each entire section may be managed when the seed is mature. Other sections are then managed as they become ready. If, however, you only plant one species, do not manage the entire field at once, but manage sections or strips to provide seed as long as possible.

Plantings for mourning doves

Millets

Approximate cost: $20

25# browntop millet *OR*

30# dove proso millet

Benefit and considerations: Many will argue millets are the preferred seed of mourning doves. Others argue for sunflowers. Regardless, both should be planted in separate sections of a field to attract large numbers of doves. Browntop millet may be preferable in some areas because it is not as prone to chinch bug damage as the proso millets. Browntop millet requires approximately 60 days for dry seed as compared to 70–80 days for the proso millets.

Management: There are no labeled preemergence herbicides for millets. Therefore, you are at the mercy of grass weeds, especially crabgrass, johnsongrass and broadleaf signalgrass. Broadleaf weeds should not be a problem as several forb-selective herbicides can be used (such as 2,4-D, Aim™ and Banvel™). Mature millet fields can be burned or mowed to make seed more available. Unlike wheat, most millets (browntop, proso, foxtail) do not stand up long after the seed matures. This often creates thatch on the ground and mowing may exacerbate this problem. Burning is recommended to provide a clean, open structure at ground level.

Fig. 10.5 *It's hard to beat a field of sunflowers for dove hunting. Here, two sections of this field have been planted with sunflowers, but one section (foreground) was planted later than the other to prolong availability of sunflower seed in the field. A section of corn has also been planted specifically for doves adjacent to one of the sunflower sections. Various sections will be managed by silage chopping to make seed available throughout fall and winter.*

Sunflowers

Approximate cost: $15

25# peredovic sunflowers (black-oil type) *OR*
8# in 38-inch rows

Benefit and considerations: Sunflower seeds contain lots of energy and are a preferred food source for doves and a number of other bird species.

Management: Planting in rows allows considerable weed control via cultivation. Prowl™, Dual Magnum™ or Treflan™ should be applied preplant incorporated. Arrow™ or Poast™ may be used for postemergence grass control. Beyond™ can be applied postemergence to Clearfield™ sunflower varieties **only**. Applications should be made before weeds exceed 3–5 inches in height and when sunflowers are in the 2- to 8-leaf stage. Do not apply Beyond™ to sunflower varieties that are not resistant/tolerant to imidazolinone herbicides. Preplant incorporated applications of Prowl™ and postemergence applications of Beyond™ can be used with Clearfield™ sunflower varieties for optimum weed control. Sunflower fields are normally managed by silage chopping or mowing sections or strips before and during dove season.

Deer may eat developing sunflower seedheads as they develop. If deer are problematic, you need to shoot more deer! Concentrate on shooting does – that is the only way you will ever lower the population. Contact your state wildlife agency for depredation permits and use them. If your property is relatively small, try to get your neighbors to join you in the fun. Deer meat may be donated to food banks if you can't use it all or give it away to friends and neighbors. Where doves are a focal species, electric poly-tape fencing may be used to repel deer. Nonetheless, management should address overabundant deer herds by lowering the population and implementing additional habitat management.

Fig. 10.6 *Many weeds can be controlled with Pursuit™ in Clearfield™ varieties of corn.*

Grain sorghum or corn

Approximate cost: $10 – 20

10# grain sorghum *OR*

13# corn

Benefit and considerations: Grain sorghum and corn are both readily eaten by doves. If given a choice, doves usually prefer grain sorghum over corn if a low-tannin grain sorghum (such as hegari) is used or after tannin levels drop following frost.

Management: Atrazine can be applied preplant incorporated or preemergence for both grain sorghum and corn. Bicep II Magnum™, Dual Magnum™, Prowl™ and Python™ also may be applied preemergence for corn plantings. Pursuit™ can be applied preplant incorporated, preemergence or postemergence in Clearfield™ varieties of corn **only** (do not apply Pursuit™ to non-imidazolinone varieties of corn). Basagran™ and Permit™ may be applied postemergence to grain sorghum or corn to control various weeds. 2,4-D, Aim™, Banvel™ and Clarity™ may be applied postemergence to both grain sorghum and corn to control broadleaf weeds. Of course, if Roundup Ready™ corn is planted, Roundup™ can be used postemergence.

Manage grain sorghum and corn so grain is available from late summer through winter. Always leave some grain standing until winter to provide a high-energy source during the cold months, even if dove season is not in! Many wildlife species will benefit from your efforts.

Buckwheat

Approximate cost: $30

40# buckwheat

Benefit and consideration: Buckwheat matures quickly (within 60 days) and doves are readily attracted to the seed. Buckwheat is a vigorous re-seeder; if planted relatively early (late April), you may get as many as three crops from one seeding even without disking.

Fig. 10.7 *Buckwheat germinates fast, grows fast and produces seed fast.*

Management: If broadleaf weeds are a problem in the field you are planting, do not plant buckwheat. There are no labeled herbicides to control broadleaf weeds in buckwheat. Grass weeds can be controlled with Arrow™ or Poast™.

Sesame

Approximate cost: $15 – 30

12# sesame (or 6# in 38-inch rows)

Benefit and consideration: Sesame (also known as benne) is another good seed producer that doves seek out when available. Like buckwheat, sesame should be considered where broadleaf weeds are not severe.

Fig. 10.8 *Sesame can be a great attraction for late-season doves.*

Management: Grass weeds can be controlled with Arrow™ or Poast™. Planting in rows allows considerable weed control with cultivation.

Wheat

Approximate cost: $30

120# wheat

Benefit and consideration: Wheat provides an abundance of grain that is relished by doves, as well as many other wildlife species. Before producing seed, deer, rabbits, wild turkeys, groundhogs, black bears and others will forage on the green wheat.

Management: Broadleaf weeds can be controlled postemergence with 2,4-D, Aim™, Banvel™, Clarity™ and Harmony Extra™. Various weeds (including some grasses, forbs and nutsedge) can

Fig. 10.9 *It's late June and this wheat is ready to mow or burn to make seed available for doves. If there are many weeds present, it may be desirable to spray the field with 1 quart per acre of a glyphosate herbicide two weeks prior to burning. This will facilitate burning or help reduce thatch if you mow.*

be controlled in Clearfield™ varieties of wheat with a postemergence application of Beyond™. If you have a problem with annual ryegrass, Achieve™ and Osprey™ may be applied postemergence. After the seedheads have matured and dried (usually in June), spray the plot with a glyphosate herbicide if undesirable weeds are present. After the weeds die, burn or mow the wheat to make the seed readily available. If an abundance of weeds were present prior to spraying, burning is recommended. If weeds were not a problem and the plot was relatively clean at ground level, mowing will produce desirable results. If mowed, cut the wheat just below the seedhead and not down low near the ground. This will reduce thatch buildup, scatter the seed better and provide better feeding conditions for doves.

Managing wheat fields for dove hunting

Hunting over baited fields is always a concern for dove hunters (at least most of them!). Because mourning doves are migratory, the U.S. Fish and Wildlife Service regulates the restrictions placed on dove hunting. **The U.S. Fish and Wildlife Service allows dove hunting over mowed or cut grain fields as well as fields grown specifically for doves and other wildlife**. In addition, "Lands planted by means of top-sowing or aerial seeding can be hunted [for doves] where seeds are present solely as the result of a normal agricultural planting or normal soil stabilization practice. Normal agricultural planting, harvesting or post-harvest manipulation means a planting or harvesting undertaken for the purpose of producing and gathering a crop, or manipulation after such harvest and removal of grain, that is conducted in accordance with official recommendations of State Extension Specialists of the Cooperative State Research, Education, and Extension Service of the U.S. Department of Agriculture." (*Note: By policy,* ***the Service does not make a distinction between agricultural fields planted with the intent to harvest and those planted without such intent*** *as long as the planting is in accordance with Cooperative Extension Service recommendations.*) (Excerpts from Title 50, Code of Federal Regulations, Parts 20.11 and 20.21i)

This means dove hunting over harvested and non-harvested agricultural fields is legal, *providing your state wildlife agency allows it.* Further, it is legal to hunt doves over fields of top-sown or drilled winter wheat *where the seedbed has been prepared* and as long as the seeding rate does not exceed that recommended by the State Agricultural or Cooperative Extension Service, *providing your state wildlife agency has not implemented additional restrictions or regulations on managing fields for doves.* **Always check current federal, state and local laws before manipulating and hunting fields for doves**.

After wheat produces seed and dies, the field can be burned to attract doves again. When the dead foliage is consumed by fire, the seed are released and made available to ground-feeding birds (if not already consumed by wild turkeys, songbirds, small mammals and/or deer).

Table 10.1 Recommended rates for top-sowing winter wheat on a prepared seedbed (UT Extension)[1].

Use	Seeding rate[2]	Seeding dates
Winter cover	1 – 1.5 bushels per acre	Sept 15 – Oct 20
Fall grazing	2 – 3 bushels per acre	Sept 1 – Oct 1
Cover, wildlife enhancement or fall grazing	1.5 – 3 bushels per acre	Aug 15 – Oct 15

[1] These planting rates are applicable to Tennessee. *If you do not live or hunt in Tennessee, check with your state wildlife agency and Cooperative Extension Service to determine what is legal in your area.*

[2] Seeding rate may be increased 50 percent if using combine-run seed.

Fig 10.11 *A variety of millets readily attracts doves.*

Planting mixtures for doves

If you would prefer to plant a mixture rather than single species, there are several options. However, it is important to keep weed control in mind if undesirable seed is present in the seedbank. Two of the three mixtures listed below have herbicide options.

Dove mixture 1

Approximate cost: $29

10# white proso millet

10# dove proso millet

10# browntop millet

3# grain sorghum

Benefit and considerations: Research has shown white proso millet is the preferred seed for mourning doves, followed closely by dove proso millet and browntop millet. Regardless of type, if a good crop of millet (including foxtail and pearl) is established, doves will come. The propensity for doves to feed on grain sorghum seed is no secret; however, non-target birds (such as house sparrows) may be a problem in some areas.

Management: Undesirable broadleaf weeds can be controlled with 2,4-D, Aim™, Banvel™ or Clarity™.

Fig. 10.12 *A blend of corn, grain sorghum and sunflowers will attract large numbers of doves. It is important to realize not all weeds are bad when managing a dove field. Seed from common ragweed and giant foxtail in this field were eaten by doves and several other birds. The cover made available by several weeds is also desirable for brooding wild turkeys and bobwhite quail. Note the white seed heads of the hegari grain sorghum.*

Fig. 10.13 *A mixture of cowpeas, corn and sunflowers can double as a warm-season plot for deer and a dove field.*

Dove mixture 2

Approximate cost: $18

6# corn

5# grain sorghum

5# peredovik sunflowers

Benefit and considerations: A variety of grains will attract doves and other wildlife as well. The rate shown above will leave the corn plants not more than about 4 feet apart, ensuring good pollination. Be aware, there are no labeled herbicides for this mixture.

Management: If undesirable weeds are likely to be a problem, just plant sunflowers, or use another mixture, according to your objectives. Be aware, however, several "weeds" can be beneficial in a field managed for doves. This mixture is ready to silage chop once the corn has matured and dried. If cut in sections or strips, this plot can provide seed well into winter.

Dove/deer mixture

Approximate cost: $43

40# iron-clay cowpeas

6# corn

5# peredovik sunflowers

Benefit and considerations: This mixture is similar to ***Warm-season mixture 4*** for deer, except sunflowers have been added. This is an excellent mixture to use when you are interested in providing quality warm-season forage for deer and want to cut it for doves as well.

Management: Dual Magnum™ may be applied preplant incorporated to control annual grass and several forb weeds. Prowl™ or Pendimethalin™ may be applied preemergence, but not preplant incorporated (or you may kill the corn as it germinates). The field may be cut for doves after the corn matures (usually in September), or, the best way to manage this mixture, if deer are a consideration, is to allow deer to forage on the cowpeas until first frost. When the plot dies after frost, use a silage chopper to make grain available for doves.

Waterfowl

Food plots in areas that can be flooded 6–18 inches are magnets for ducks. A shallow dike with some type of water-control structure (such as a flashboard riser) enables you to manipulate the water level over the field. Flooding should be conducted gradually beginning September through November (according to your objectives and if/when the crop is harvested), with full flood occurring by early December. Drawdowns also should be conducted gradually and completed by mid-March, if another crop is to be grown.

It is important to realize food plots for ducks **cannot** be manipulated like those for doves. Current federal regulations allow waterfowl hunting over standing crops and harvested crops (flooded or not). However, crops can only be manipulated by standard agricultural practices used to establish, manage and harvest the crop. Grain or other seed inadvertently scattered through harvest operations, entering or exiting the field, placing decoys or retrieving birds is **not** considered bait. Nonetheless, you should always check the current US Fish and Wildlife Service and state hunting regulations before hunting.

The main consideration when establishing a food source for waterfowl is seed availability, primarily after inundation (flooding). Waste grain availability in a *harvested* corn field averages 150–200 pounds per acre. That is not much food for wintering waterfowl. Availability is reduced even further when you consider 40–60 percent may be lost every month post harvest prior to inundation through decomposition, depredation and/or germination. Therefore, timing of harvest and initial flooding is critical. After flooding, the deterioration rate of waste corn after harvesting is only 35–50 percent after 90 days. Thus, the overall loss rate is greater prior to flooding a harvested field than post flooding. Obviously, if the field is planted specifically for ducks and the corn is not harvested, an abundance of grain should be available.

As mentioned above, harvested grain fields (such as corn) provide some waste grain, but the amount is miniscule compared to an unharvested field (5,600 pounds per acre in a field producing 100 bushels of corn per acre). To increase grain availability in harvested fields, leave as much of the field unharvested as possible. Even if only a few rows, this will provide substantial increases in grain availability. If you own land, but do not have the means to plant, you can allow a producer to lease the field for row cropping and arrange for him or her to leave a section of the field unharvested to increase available food for migrating and wintering waterfowl. If you lease fields to hunt, consider paying the producer the same price per acre he or she is receiving for the harvested grain to leave a few acres unharvested. This will be a bargain for the producer, because he or she will not have to spend time and fuel harvesting the grain from that area, and the increase in the number of ducks using the field will be worth the extra expense for you.

An approach to facilitate hunting and avoid potential problems associated with manipulating unharvested corn is to plant the area in front of your blind to the buckwheat/millet mixture listed below. Buckwheat and millets (with the exception of pearl) fall to the ground soon after a frost. Therefore, an open “hole” is provided for landing and feeding in front of the blind within a larger field of corn. Decoys can be placed around the

edge of the corn, where they are visible and to attract ducks to land in the open hole. [Note: Some people may find this distasteful – to manipulate a food source to facilitate shooting an animal. What these people fail to understand or acknowledge is that these management efforts provide food and resting areas to support a surplus of ducks, whose populations are carefully managed by the U.S. Fish and Wildlife Service and state wildlife agencies. Also, a myriad of non-game wildlife species receive benefit from fields flooded primarily for duck hunting. Without question, many more ducks and geese benefit from these management efforts than are killed. The last thing duck hunters want to see is declining populations of waterfowl. Indeed, this is true for other hunters and game species as well.]

Another important consideration, because you actually *care* about wildlife, is the crop planted. Soybeans, for example, is **not** a good crop to flood for ducks, for several reasons. Soybeans decompose rapidly after inundation (70 to nearly 100 percent over 90 days), thus availability is relatively low. Even when soybeans are available, waterfowl do not select them. Some studies have noted a relative lack of soybean consumption by waterfowl, even when acreage of planted soybeans within a particular region has increased. This is difficult for some people to understand, especially when they see lots of ducks using harvested soybean fields that have been flooded. This is another example of use vs. availability (see ***Preference vs. availability and wildlife use*** on page 43) and is perfectly analogous to white-tailed deer feeding in a tall fescue field. Look around. Are other flooded foods available? Or, do 80 percent of the flooded fields in the county just happen to be soybean fields? Are the ducks actually eating soybeans, or are they primarily loafing in the flooded field and/or consuming weed seed and invertebrates? Certainly, ducks may eat soybeans; however, decreases in body mass and fat reserves have been recorded among mallards after feeding upon soybeans. Further, soybeans may cause food impaction in a duck's crop, which can be fatal.

Regardless of crop, agricultural grains do not represent a complete diet for waterfowl. As with doves, it is a good idea to provide a variety of foods to attract and hold waterfowl through the winter. While many grains are high in metaboliz-

Fig. 11.1 *A shallow dike across a flat field can provide an important food source and quality resting site for migrating waterfowl.*

Fig. 11.2 *A water-control structure allows the water level to be manipulated when fields are flooded.*

able energy, they do not contain the amino acids, vitamins and minerals needed for migrating and wintering waterfowl to maintain body mass. Therefore, naturally occurring moist-soil plants should be encouraged as well, either in the same flooded unit or in an adjacent flooded unit, to provide optimum feeding conditions for waterfowl. An added benefit of naturally occurring moist-soil plants is they persist longer than agricultural crops. Many moist-soil plants (such as smartweeds, sedges, panicgrasses) experience only 20–25 percent deterioration after 90 days of flooding.

Plantings for waterfowl

Buckwheat/millet mixture

Approximate cost: $31

20# buckwheat

10# pearl millet

10# white proso millet

Fig. 11.3 *If it's too late to plant corn or grain sorghum, don't despair! Buckwheat and proso millet will germinate and produce seed within about 10 weeks. Plus, the seed is readily available when the field is flooded.*

Benefit and considerations: Buckwheat and millet seed germinate and grow quickly and are highly sought by dabbling ducks. White proso millet has a maturation date of only 70 days and a low deterioration rate after 90 days of inundation. Pearl millet remains standing for a while after flooding, which lengthens its availability and helps retain seed quality longer because its deterioration rate is approximately 70 percent after 90 days of inundation. Foxtail millet can also be used if desired.

Management: Undesirable broadleaf weeds can be controlled with 2,4-D Aim™ or Banvel™.

Wild (or duck) millet

Approximate cost: $25

25# wild millet

Benefit and considerations: Wild millet (or barnyardgrass, *Echinochloa crusgalli*, and others, including *E. frumentacea*, sometimes called Japanese millet) produces an abundance of seed preferred by ducks. Wild millet can be flooded shallowly, but not inundated, soon after establishment. This supports wetland habitat into the growing season and helps provide weed control. Wild millet has a maturation date of approximately 55 days after germination and a deterioration rate of 57 percent after 90 days of inundation. Although wild millet will mature relatively quickly, larger seed yields (≥1,000 pounds per acre) are commonly obtained if wild millet is planted prior to July 1. Later plantings may yield less than 500 pounds per acre. *Chiwappa* is a variety of *E. frumentacea* that produces larger heads and additional seed per plant. It is planted at the same rate, but must be planted earlier (by June 1) as it requires 120 days for maturity.

Management: Often, wild millet re-establishes in an area where previously grown if it is allowed to

Fig. 11.4 *Wild millet (whether planted or naturalized) and smartweeds provide a good seed source for wintering waterfowl. The U.S. Fish and Wildlife Service allows you to manipulate (burn, mow, disk) moist-soil vegetation for duck hunting; however, it is illegal to manipulate planted crops, whether grown for ducks or agriculture.*

Bill Smith

Fig. 11.5 *This patch of flooded corn has provided a high-energy food source for migrating and wintering ducks from December through March. When the water level is near the corn ears, ducks have easy access to the grain.*

mature and produce seed. "Naturalized" wild millet (that coming up naturally at least one growing season after it was planted) can be manipulated legally, as can other naturally occurring, moist-soil plants. What this means is it is legal to mow, disk or burn *a naturalized stand* of wild millet if nothing else has been planted with the naturally occurring millet. Undesirable broadleaf weeds can be controlled with 2,4-D, Aim™ or Banvel™.

Corn (or 8# grain sorghum)

Approximate cost: $21

13# corn

Benefit and considerations: Corn plots can provide a high-energy food source that is particularly important during mid- to late winter when other foods may be scarce. Remember, however, ***it is illegal to hunt over corn that has been manipulated (other than harvesting for grain)***. That should not a problem, however, because ducks will knock the stalks over if they cannot reach the corn from the water. Amazingly enough, ducks can shuck an ear of corn to get to the grain about as efficiently as a raccoon! Flooded standing corn also provides cover ducks use for loafing and protection from wind. If the corn has been harvested, expect approximately 50 percent of the available waste grain to deteriorate within 90 days after inundation.

Grain sorghum can also be planted for ducks, but it is not as preferable to ducks as corn, rice or millets, and grain sorghum is highly susceptible to blackbird damage in wetlands. A relatively light seeding rate (8 pounds, as opposed to 10) may be desired because the lighter rate will still provide thermoregulatory cover and not be too dense for

Tim White

Fig. 11.6 *Rice is grown in the South primarily along the coast and major rivers. However, it can also be grown further inland within impoundments. The ability to shallowly flood rice for weed control is desirable, but not absolutely necessary. Rice can be grown in bottomland fields that remain fairly moist through the summer.*

ducks to feed. Depending on water depth, short varieties of grain sorghum (such as W.G.F.) may be used to make seed more available for ducks. Grain sorghum has a deterioration rate of 42 percent after 90 days. White proso (10 pounds) or pearl millet (10 pounds) and/or buckwheat (20 pounds) can be added if desired. If so, decrease the grain sorghum rate to 4 pounds.

Management: Management strategies for fertilization and weed control of corn and grain sorghum (and additional information on varieties of grain sorghum) are the same as those listed under ***Grain plots and single-species plantings*** on page 63. If millets are added to grain sorghum, 2,4-D can be used to control broadleaf weeds, but do not apply atrazine. If buckwheat is added, do not apply herbicides.

Rice

Approximate cost: $60

100# dry-land rice

Benefits and considerations: Rice is a "Cadillac" duck food. Managed correctly, it provides high seed yields with lots of digestible energy that ducks feed upon readily. Optimally, rice should be grown on truly flat ground that can be flooded for weed control; however, this is not absolutely critical when growing rice specifically for ducks, as opposed to grain production. Planting success is generally best when rice is sown on a prepared seedbed (that can be flooded later) by disking or drilling about 1 inch deep. Rice may also do well if not flooded while growing, but it does require considerable moisture (such as a bottomland field

that doesn't drain very well). Don't expect to grow rice in dry conditions. Rice also can be top-sown on mud flats or in shallow water (no more than 2–3 inches deep), but it does best when and where the soil can be amended. Medium-grain rice varieties generally have better seedling vigor and produce more seed than long-grain varieties. Medium-grain varieties also seem to be preferred by ducks. Early-maturing (110–115 days), medium-grain varieties include *Alan*, *Jackson*, *Kaybonnet*, *Lagrue* and *Tebonnet*. Late-maturing (130–140 days), medium-grain varieties include *Bengal*, *Cypress*, *Lemont*, *Newbonnet* and *Orion*.

National Wild Turkey Federation

Fig. 11.7 *The tubers produced among the roots of chufa are a strong attractant for waterfowl. When shallowly flooded (2–10 inches), ducks can grub up the tubers quite well.*

Management: As with most grass crops, rice responds well to nitrogen. P, K and soil pH should be amended according to soil test and 90 pounds of N should be applied when the rice is approximately 2–3 inches high and another 90 pounds 60 days later. Rice will respond best if flooded shallowly (2–4 inches) when it is about 6–8 inches high for seven to 10 days, and then drained. Obviously, this provides adequate moisture, but also helps with weed control. It is best to apply N just prior to rain if irrigation or controlled flooding are not possible. Facet™ or Prowl™ may be applied preemergence or postemergence, and Basagran™ or Permit™ may be applied postemergence to control various forbs and grasses. 2,4-D or Storm™ can be applied postemergence to control forb weeds. Be sure to check herbicide labels before any application because there are several restrictions and limitations when spraying rice. Also, be sure the "weeds" you are trying to control aren't actually desirable plants for ducks. Wild millet, smartweeds and various panicgrasses complement rice when grown for ducks by providing a diversity of food.

Chufa

Approximate cost: $90

50# chufa

Benefit and considerations: Chufa can be planted for ducks, just as for wild turkeys. Ducks "dig" the tubers, much as turkeys do! Waterfowl have an amazing ability to detect underground tubers, even though the field is flooded. And while turkeys may have a problem scratching up tubers in clay soils, this is not as big of a problem for ducks because flooded soils are relatively soft, enabling ducks to get to the tubers.

Management: Refer to chufa management for wild turkeys on page 86.

Fig. 11.8 *Geese and wigeon readily feed on flooded wheat. Here, wheat has been planted along and in front of the dike several weeks prior to flooding.*

Winter wheat

Approximate cost: $30

120# wheat (2 bushels)

Benefit and considerations: Wheat sown in the fall can be flooded after it gets about 6 inches high. This produces an excellent food source for Canada geese and American wigeon. You do not have to plant the entire field to attract wigeon and geese. A better option is to plant the field in a warm-season crop (such as corn, millets or grain sorghum), or manage for fallow growth, and plant wheat along one edge of the field or along the dike. Geese and wigeon will readily "dry feed" on the wheat adjacent to the water line.

Management: Refer to ***The Cool-season annual hunting plot*** on page 72 for fertilization and weed control strategies.

Managing Woods Roads for Wildlife

Planting and maintaining woods roads (or logging roads) in quality forages can do more than prevent erosion and sedimentation, it also can provide a considerable amount of high-quality forage for a variety of wildlife species. Thus, planted wood roads can be called *linear wildlife openings*. Planted woods roads can be particularly important to wildlife in vastly forested areas where there is relatively little early-successional vegetation or quality forage. Planting woods roads can help increase your overall food plot acreage (without clearing additional forest land) while dispersing quality forages throughout the property. Thus, planted woods roads can impact more animals *per acre of ground planted* than food plots when the road traverses and winds through an area, encompassing the home range of more animals.

All of the planting procedures outlined under ***Initial Considerations*** also apply when planting woods roads. However, plowing and heavy disking are often not possible, especially on roads where vehicle travel will continue. Light disking, no-till top sowing and drilling seed are effective techniques when planting woods roads.

Fig. 12.1 *In vastly forested areas, woods roads can receive a lot of use when planted in desirable species. This road, planted with clover in the mountains of North Carolina, has received heavy use from deer, wild turkeys, black bears and ruffed grouse.*

Soil pH is often a limiting factor along woods roads, especially where acidic leaves and needles have fallen and accumulated over the years and where topsoil has been removed. However, the biggest limitation and foremost consideration when planting woods roads is the amount of light reaching the road. At least four hours of direct sunlight are desirable when maintaining forages in wooded areas. Unless the adjacent stand has been thinned or regenerated recently, the road will need "daylighting" – that is, trees will need to be removed along at least one side of the road to allow sufficient sunlight to reach the road for considerable forage production. You do not have to remove all the trees. Instead, you may leave residual trees with mast-bearing potential and remove the others.

Roads can be managed for wildlife in a variety of ways if the road is closed to traffic. If the road is gated, yet still receives considerable traffic from land managers or hunters, it probably should be graveled. These roads still can be managed for wildlife by clearing and planting the sides of the roads.

Roadsides also can be left fallow. Woody growth can be suppressed by spraying selective herbicides (such as Arsenal AC™). Disking every other year just before spring green-up will stimulate and encourage additional herbaceous growth from the seedbank. If the road is gated and does not get too much traffic, the road itself can be planted.

Fig. 12.2 *This road has been daylighted on one side to produce additional browse for deer and nesting habitat for wild turkeys. The road itself has been graveled because it is traveled frequently.*

Fig. 12.3 *Another option for frequently traveled roads is to plant the sides of the road after daylighting. The sides of this road were planted with crimson clover and wheat and have received tremendous use by white-tailed deer and wild turkeys.*

Fig. 12.4 *When woods roads do not receive much traffic, the road itself can be planted. This road was initially planted in ladino white clover and oats. After three years, a solid stand of clover remains. Encroaching japangrass has been sprayed along the sides. Can't you just see a deer feeding or a gobbler strutting his stuff along this road?!?*

Many of the same forages used in food plots can be planted on woods roads; however, some are better suited than others. For example, crimson clover, subterranean clover and white clovers are all *relatively* shade tolerant. Ladino white clover persists well on roads traversing through bottomlands and on hillsides with an eastern or northern exposure. Ladino white clover does not, however, do well on southern or western exposures in the South. Red clover and alfalfa do not respond to traffic as well as the white clovers. Taller forages, such as sweetclover and arrowleaf clover, are not usually desirable on roads and do not stand up to traffic well. If the road has been closed and is essentially no longer used by vehicular traffic, it can truly be treated as a linear opening and planted with anything you might consider for your other food plots, including warm-season forages.

Soil erosion and siltation are often associated with woods roads and logging decks after logging. In fact, research from the Coweeta Hydrologic Lab near Franklin, North Carolina has shown more than 95 percent of the erosion and siltation into creeks following logging come from improperly constructed and planted roads, not the logging itself. Because erosion and siltation are such important factors, many land managers have been led to the false assumption that it is necessary to include tall fescue or orchardgrass in a mixture sown on woods roads. **This is not true and certainly counterproductive for wildlife!**

Germination and growth of annual cool-season grasses (such as wheat) are considerably faster than perennial cool-season grasses, which is important for reducing soil erosion from winter rains. The preference for oats and wheat as forage over perennial cool-season grasses, such as orchardgrass and tall fescue, was discussed under ***Don't plant perennial cool-season grasses*** on page 78 and illustrated in Tables 6.1 and 6.2 on page 79. The value of wheat seed and resulting brood habitat for wild turkeys and bobwhite quail was covered under ***Using corn and wheat as "two-year grain plots" for brood habitat*** on page 82. This practice also benefits ruffed grouse in the same manner when implemented on woods roads where grouse occur.

It also should be made clear that, for a number of reasons, most native warm-season grasses (nwsg) are not suited for planting woods roads either. Nwsg are established for wildlife to provide cover, not forage (see ***A word about native warm-season grasses...***, on page 92). Deer, rabbits, groundhogs and other species rarely eat nwsg. In fact, all perennial grasses (whether native or not) are simply not preferred forages. Cover along old logging roads is **not** a limiting factor, as slash, brambles and other "weedy" growth are normally in abundance all along these roadsides. The primary limitation for many species of wildlife on vastly forested tracts is *forage*, particularly **during the fall and winter months**. Thus, *quality* cool-season forages should be planted along roads in these areas, not warm-season grasses.

Fig. 12.5 *This road was planted with orchardgrass in September after the logging operation was completed. Orchardgrass is a perennial cool-season grass and is relatively slow to establish. Precipitation through the fall and winter eroded this road before the orchardgrass could become established. The problem with this erosion, however, was not related to orchardgrass, but improper road construction. No planting will hold soil together on a road coming straight down the hill. The bottom line is orchardgrass and tall fescue are not "cure-alls" to prevent erosion of forest roads. Sensible road construction and use of annual and "wildlife-friendly" perennials, as well as the seedbank, are much better solutions for managing woods roads after logging.*

Logging roads need to be planted soon after the logging operation is finished. However, planting logging roads November through February or in July is a waste of time and money. Nothing is going to germinate and establish a root system any time soon if planted in November through January. Frost-seeding clovers is often conducted in February, but cool-season plants in general are best sown in March/April and late August through October. Warm-season plantings should be sown mid-April through June. If a road needs to be sown in late spring/early summer, a warm-season annual planting should be considered. If planting can wait until late August, plant a cool-season forage.

Plantings for woods roads

Perennial woods road mixture

Approximate cost: $58

4# ladino white clover
4# white clover
50# wheat

Benefit and considerations: Wheat germinates and grows relatively quickly, helping prevent soil erosion while providing quality forage for wildlife. The amount of wheat planted may be increased over that for a food plot because erosion soon after planting is such a consideration. The clovers will be retained longer on sites that are not overly dry during the summer.

Management: Pursuit™ and/or 2,4-DB (Butyrac 200™) can be sprayed postemergence to control various weeds after the wheat produces seed. Arrow™ or Poast™ can be sprayed postemergence to control problem grasses (such as japangrass) after the wheat produces seed. The road can be mowed after the clovers have produced seed and as necessary to prevent weeds from flowering if the road is not managed with the appropriate herbicides. Or, desirable incoming forbs and grasses from the seedbank can be allowed to pioneer into the road and provide quality brood-rearing habitat for turkeys, grouse and quail.

ACGRP

Fig. 12.6

Ruffed grouse don't like orchardgrass either!

From 2000 to 2002, 53 ruffed grouse were collected during March in western North Carolina to determine the physiological condition of grouse and see what grouse were eating during this time of year. The effort was part of a regional project – the Appalachian Cooperative Grouse Research Project – that studied the ecology and management of ruffed grouse in the central and southern Appalachians. Crop contents from all birds killed were identified, weighed and preserved. All of the grouse were killed from gated woods roads initially planted in an orchardgrass/white-dutch clover mixture. Leaves and flowers of herbaceous plants were found in 92 percent of the 53 crops examined and comprised 40 percent of the material in the crops over the three-year period. Other foods included evergreen and deciduous leaves, acorns, ferns, soft fruits, buds and twigs. Of the herbaceous material eaten, cinquefoil, clover and wild strawberry represented the vast majority, followed by avens and ragwort. The interesting thing was that orchardgrass, which was the dominant cover on most of the roads, was not present in **any** of the grouse crops. In fact, the graduate student who sorted through crops of 326 grouse from NC, VA, WV, KY, MD and PA reported, "Grasses were not eaten much at all at any site in any year. I did get a few grasses in crops, but their quantities were usually not measurable and were classified as 'trace' (<0.1 gram dry mass). It seemed like grouse only ate grass incidentally while foraging on the forbs in between the grasses." (Bob Long, 2007, M.S. Thesis, West Virginia University)

Figs. 12.7 and 12.8 *This woods road was limed, fertilized and sown with a mixture of white-dutch clover and orchardgrass in the fall of 1993. By July 1995, the clover was out-competed and disappeared from the site, resulting in a road of orchardgrass, which offered poor structure for poults and fewer invertebrates. Non-native perennial cool-season grasses should never be included in a planting mixture where wildlife is a consideration.*

Annual cool-season woods road mixture

Approximate cost: $45

15# crimson clover

50# wheat

Benefit and considerations: This annual mixture will provide lots of high-quality forage, especially during winter when very little, if any, other green forage is available.

Management: This annual mixture can be managed as ***Cool-season annual mixture 1*** on page 70 or it could be left fallow to encourage naturally occurring forbs and grasses. Where japangrass is problematic, an application of a glyphosate herbicide or a grass-selective herbicide in late spring/early summer (June) is recommended. Another option is 4 ounces per acre of Plateau™, of which crimson clover is tolerant.

Annual cool-season woods road planting

Approximate cost: $30

120# wheat (2 bushels)

Benefit and considerations: Sowing a road to wheat protects it from erosion. In addition, forage and seed for wildlife are produced.

Management: Weed control strategies are outlined with the ***Cool-season annual hunting plot*** on page 72. During the summer following establishment (after the wheat has produced seed and died), naturally occurring annual grasses and forbs in the seedbank will germinate and may create excellent wildlife habitat for future years and protect against erosion. Wild strawberry, annual panicgrasses, beggar's-lice, cinquefoil, asters and blackberry provide forage, soft mast and seed for deer, turkeys, grouse, black bears and songbirds, while the perfect structure for brood habitat is created (see ***Using corn and wheat as "two-year grain plots" for brooding habitat*** on page 82). If the site does not contain desirable species in the seedbank, the perennial woods road mixture should be used.

Annual warm-season woods road mixture

Approximate cost: $36

12# browntop millet

12# foxtail millet

20# buckwheat

Benefit and considerations: Sometimes logging operations finish in spring or early summer. Thus, a warm-season planting mixture is needed. Seeding a road to a cool-season forage during this time is usually a waste of time and money. Buckwheat and millets germinate very quickly with high seedling survival, provided there is adequate sunlight. Buckwheat provides forage for deer and rabbits, while the millets and buckwheat provide seed for a number of bird species. Some re-seeding may occur, but the real benefit is having a quick-establishing annual planting that survives the summer well, provides forage and seed, and holds the soil together through the year. Unless the road was cut deep and the seedbank removed, expect grasses and forbs germinating from the seedbank to dominate the following year.

Management: Once the warm-season mixture produces seed, a cool-season mixture can be sown in September, especially if additional cool-season forage is needed and/or if possible erosion through fall/winter is a factor. The road can be disked lightly to prepare a seedbed and a cool-season mixture top-sown, then cultipacked, or the cool-season mixture can be drilled. Another option is no-till top-sowing white clover over the existing warm-season mixture after it has produced seed. If birds and other wildlife are continuing to eat the millet/buckwheat seed into fall and groundcover is sufficient to prevent erosion, cool-season forages may be planted the following February/March if desired.

Conclusions

Planting and managing food plots can be very rewarding, not only by benefiting wildlife, but the practitioner as well. Planting and managing food plots requires knowledge of farming practices. This helps instill a land ethic. To work with the land and watch the habitat and wildlife respond to and benefit from your efforts can be intoxicating.

A successful food plot program requires planning, dedication and can be fairly expensive. It requires year-round effort, especially if you hope to actually increase the nutritional carrying capacity of your property. Perhaps the most important thing to realize is there is no "magic bean." There is no single planting that provides a quality year-round food source for wildlife. Multiple plantings in the appropriate sites are absolutely necessary to make a real difference in terms of available nutrients and energy for wildlife. Pay no attention to all the ads and gimmicks. There are no worthy shortcuts to quality food plots and there is no "trophy in the bag."

Finally, the savvy manager realizes habitat management must be coupled with population

Fig. 13.1 *Working with the land and seeing wildlife respond to your efforts is very rewarding. Growing and maintaining quality food plots is an excellent way to make wildlife more visible while providing increased nutrition needed throughout the year.*

management, that planting food plots is only one habitat management practice and that food plots do not take the place of forest management and old-field management. Nonetheless, when done correctly, let there be no doubt that incorporating quality food plots into a sound habitat management program will enable wildlife populations to respond in ways they were previously unable.

Appendix 1.
Planting guide for wildlife food plots

Crop species[1]	Seeding rate (lbs/ac)[2]	Planting date[3]	Planting depth
Cool-season legumes[4]			
Alsike clover (perennial)	10	Sept 1 – Oct 15; Feb 15 – Apr 1	¼
Arrowleaf clover (annual)	10	Aug 15 – Oct 15	¼
Ball clover (annual)	6	Aug 15 – Oct 15	¼
Berseem clover (annual)	20	Aug 15 – Oct 15	¼
Crimson clover (annual)	25	Aug 15 – Oct 15	¼
Ladino white clover (perennial)	8	Sept 1 – Oct 15; Feb 15 – Apr 1	¼
Red clover (biennial)	15	Sept 1 – Oct 15; Feb 15 – Apr 1	¼
Rose clover (annual)	20	Aug 15 – Oct 15	¼
Subterranean clover (annual)	20	Aug 15 – Oct 15	¼
White-dutch clover (perennial)	6	Sept 1 – Oct 15; Feb 15 – Apr 1	¼
Sweetclover, yellow or white (biennial)	20	Sept 1 – Oct 15; Feb 15 – Apr 1	¼
Alfalfa (perennial)	20	Aug 15 – Sept 15; Feb 15 – May 1	¼
Austrian winter peas (annual)	50	Aug 15 – Oct 15	1 - 2
Birdsfoot trefoil (perennial)	10	Aug 15 – Oct 15; Feb 15 – Apr 1	¼

Crop species[1]	Seeding rate (lbs/ac)[2]	lbs/ bushel	Approx. days to *dry* seed	Planting date[3]	Planting depth
Cool-season grasses					
Oats (annual)	120	32	170	Aug 15 – Oct 15; Feb 15 – Mar 15	1 - 2
Rye (annual)	120	56	180	Aug 15 – Oct 15	1 - 2
Triticale (annual)	120	48	180	Aug 15 – Oct 15	1 - 2
Wheat (annual)	120	60	180	Aug 15 – Oct 15	1 - 2
Ryegrass (annual or perennial)	30	24		Aug 15 – Oct 15; Feb 15 – Apr 1	¼ - ½

Crop species[1]	Seeding rate (lbs/ac)[2]	lbs/ bushel	Approx. days to *dry* seed	Planting date[3]	Planting depth
Warm-season legumes[4]					
Alyceclover (annual)	20			Apr 1 – June 15	¼
American jointvetch (annual)	20			Apr 1 – June 15	½ - 1
Catjang cowpeas (annual)	30			Apr 15 – June 15	½ - 1
Iron-clay cowpeas (annual)	75	60	110	Apr 15 – June 15	½ - 1
Lablab	25			Apr 15 – June 15	1
Soybeans (annual)	85	60	125	Apr 15 – June 15	1 – 2
Re-seeding soybeans (Quail Haven; annual)	40			Apr 15 – June 15	½ - 1
Florida beggarweed	10			Apr 15 – June 15	¼
Kobe and Korean lespedeza (annual)	15			Feb 15 – Apr 1	½ - 1
Partridge pea (annual)	10		110	Feb 15 – June 1	½ - 1
Warm-season grasses					
Corn (annual)	13	56	145	Apr 1 – May 15	1 - 2
Grain sorghum (annual)	10	50	120	Apr 15 – June 15	1
Egyptian wheat (annual)	15		110	Apr 15 – June 15	½
Browntop millet (annual)	25		65	Apr 15 – Aug 15	¼ - ½
Foxtail millet (annual)	25		80	Apr 15 – June 15	¼ - ½
Wild millet (annual)	25		55	May 1 – Aug 15	¼ - ½
Pearl millet (annual)	30			Apr 15 – June 15	¼ - ½
Dove proso millet (annual)	30		80	Apr 15 – Aug 15	¼ - ½
White proso millet (annual)	30		80	Apr 15 – Aug 15	¼ - ½
Rice (annual)	100		150	Apr 15 – June 1	1
Other plantings					
Buckwheat (annual; warm-season)	40		60	Apr 15 – Aug 15	½ - 1
Burnet, small (perennial; cool-season)	20			Aug 15 – Oct 1; Mar 1 – May 1	¼
Chicory (perennial; cool-season)	10			Aug 15 – Oct 1; Mar 1 – May 1	¼
Chufa (annual; warm-season)	50		110	Apr 15 – June 1	1 - 2
Rape (annual; cool-season)	8			Sept 1 – Oct 15	½ - 1
Sesame (annual; warm-season)	12		100	Apr 15 – June 1	½
Sunflower (annual; warm-season)	25		110	Apr 15 – May 15	1 - 2
Turnip, forage-type (annual; cool-season)	8			Sept 1 – Oct 15	¼

Crop species	Optimum pH	Preferred soil type
Cool-season legumes		
Alsike clover	5.8 – 6.5	Adapted to cool climate; tolerates wet bottomland soils
Arrowleaf clover	6.0 – 6.5	Fertile, well-drained sandy loams and light clay; good re-seeder
Ball clover	5.8 – 7.0	Sandy loams and clay loams; tolerates poor drainage and relatively low fertility; good re-seeder
Berseem clover	6.0 – 7.5	Tolerates poor drainage; high fertility requirements; not cold tolerant; poor re-seeder
Crimson clover	5.8 – 7.0	Well-drained sandy loams to heavy clays; moderately shade tolerant; good re-seeder
Ladino white clover	6.0 – 6.5	Sandy loam to clay; moderate fertility requirements; mildly shade tolerant; tolerates poor drainage
Red clover	6.0 – 7.0	Sandy loam to clay; wide range of moisture regimes; fairly drought tolerant
Rose clover	6.0 – 7.0	Well drained sandy loam to clay; tolerant to low soil fertility and drought; good re-seeder
Subterranean clover	5.8 – 7.0	Sandy loam to clay; moderately shade tolerant; poor drought tolerance; not cold tolerant; prefers moist soils
White-dutch clover	6.0 – 6.5	Sandy loam to clay; moderate fertility requirements; mildly shade tolerant; tolerant to poor drainage
Sweetclover	6.5 – 7.5	Well-drained loams and clays; fairly drought tolerant
Alfalfa	6.5 – 7.5	Well-drained loams; high P,K,S,B requirements; moderately drought tolerant
Austrian winter peas	6.0 – 7.0	Loam to heavy clay; moderate fertility requirements
Birdsfoot trefoil	5.8 – 7.0	Widely adapted; tolerant to drought and poor soil drainage
Cool-season grasses		
Oats	6.0 – 6.5	Sandy loam to clay; well-drained
Rye	5.8 – 6.5	Sandy loam to clay; well-drained
Triticale	5.8 – 6.5	Sandy loam to clay; well-drained
Wheat	6.0 – 7.0	Light-textured - not in poorly drained or heavy clay
Ryegrass	5.8 – 6.5	Most textures; tolerates poorly drained soils; moderate fertility requirements

Crop species	Optimum pH	Preferred soil type
Warm-season legumes		
Alyceclover	6.5 – 7.0	Sandy loam to clay
American jointvetch	5.5 – 6.5	Sandy loam to clay
Catjang cowpeas	5.5 – 7.5	Widely adapted; well-drained soils
Iron-clay cowpeas	5.5 – 7.5	Well-drained soils; drought tolerant; tolerates relatively low fertility
Lablab	5.5 – 7.5	Well-drained soils; drought tolerant; tolerates relatively low fertility
Soybeans	5.8 – 6.5	Widely adapted; well-drained soils
Re-seeding soybeans (Quail Haven)	5.8 – 6.5	Well-drained soils
Florida beggarweed	5.8 – 6.5	Sandy loam to clay
Kobe and Korean lespedeza	5.8 – 6.5	Widely adapted; tolerates relatively low fertility; not wet soils
Partridge pea	6.0 – 6.5	Sandy loam to clay
Warm-season grasses		
Corn	5.8 – 7.0	Widely adapted, well-drained soils; high fertility requirements
Grain sorghum	5.8 – 7.0	Widely adapted, well-drained soils; moderate fertility requirements
Egyptian wheat	6.0 – 7.0	Widely adapted, well-drained soils; moderate fertility requirements
Browntop millet	5.5 – 7.0	Well-drained soils; moderate fertility requirements
Foxtail millet	5.5 – 7.0	Well-drained soils; moderate fertility requirements
Wild millet	5.5 – 7.0	Loams and clays; tolerates shallow flooding after establishment; moderate fertility requirements
Pearl millet	5.5 – 7.0	Well-drained soils; moderate fertility requirements
Dove proso millet	5.5 – 7.0	Well-drained soils; moderate fertility requirements
White proso millet	6.0 – 7.0	Well-drained soils; tolerates dry sites; moderate fertility requirements
Rice	6.0 – 7.0	Poorly drained soils; not on sandy soils; prefers shallow inundation
Other plantings		
Buckwheat	5.8 – 7.0	Widely adapted; tolerates relatively low fertility
Burnet, small	5.8 – 7.0	Widely adapted; moderate fertility requirements; drought tolerant; does not tolerate poor drainage
Chicory	5.8 – 7.0	Widely adapted; drought tolerant
Chufa	5.8 – 7.0	Sandy or loam soils; avoid clay soils; moderate fertility requirements
Rape	5.8 – 7.0	Widely adapted; high fertility requirements
Sesame	6.0 – 7.0	Well-drained loams and clay
Sunflower	5.8 – 7.0	Well-drained soils; high P and K requirements
Turnip, forage-type	5.8 – 7.0	Widely adapted; high fertility requirements

[1] Most commercial mixes are comprised of three or more of the species (or varieties) included in this chart. Annual plantings complete their life cycle in one growing season and, depending on the plant, variety and management strategy, may or may not reseed. Biennials normally require two growing seasons to complete their life cycle. Perennials continue living after flowering and producing seed and, depending upon management, may be present for many years.

[2] All seeding rates in this chart are for a single-species broadcast planting. When planting mixtures, the seeding rate for each species included should be reduced according to the number of species in the mixture, the composition preferred and the growth form and desired structure of the resulting stand. Drilled plantings typically require approximately 20–50 percent less seed, depending on plant species.

[3] Appropriate planting dates vary with location. The planting dates shown represent a general range appropriate throughout the South. The later dates for cool-season plantings are appropriate for the Deep South, while the later dates for warm-season plantings are appropriate for the Mid- and Upper-South.

[4] All legume seed should be inoculated with species-specific inoculant prior to planting unless the seed was purchased pre-inoculated (see Appendix 8).

Appendix 2.

Various herbicides[1] and labeled applications for establishing and managing wildlife food plots.

This chart should be used as a reference only. Always read the herbicide label prior to application. Refer to herbicide labels prior to purchase by visiting http://www.cdms.net/manuf/manuf.asp.

Primary active ingredient	Trade name (% active ingredient)	Suggested rate per acre[2]	Application[3]	Selected labeled crop / application	Manufacturer
Broad-spectrum herbicides					
glyphosate	Roundup Ultra Max (50.2); Gly-4 Plus (41); Accord (53.8); several others	1 – 5 quarts	postemergence	Roundup Ready™ corn, Roundup Ready™ soybeans; many other applications	Monsanto and several others
Grass-selective herbicides					
clethodim	Select Max (12.6); Arrow 2 EC (26.4)	9 – 32 ounces (Select Max); 6 – 16 ounces (Arrow 2 EC)	postemergence	alfalfa, birdsfoot trefoil, *Brassica*s, peanuts, soybeans, sunflowers, non-crop areas	Valent and others
fluazifop	Fusilade DX (24.5)	8 – 24 ounces	postemergence	soybeans	Syngenta
quizalofop	Assure II (10.3)	5 – 12 ounces	postemergence	*Brassica*s, soybeans	DuPont
sethoxydim	Poast 1.5L (13)	2 – 3 pints	postemergence	alfalfa, clovers, birdsfoot trefoil, Austrian winter peas, soybeans	BASF
tralkoxydim	Achieve Liquid (35)	7 – 9 ounces	postemergence	wheat, triticale	Syngenta

	Approximate cost	Residual soil activity	Herbicide mode of action / purpose for spraying / comments[4]
			Broad-spectrum herbicides
	$45 – 140 per 2.5 gallons	No	Amino acid synthesis inhibitor; controls wide variety of weeds in Roundup Ready™ crops; controls existing vegetation for new plots; kills weeds in dormant plots; rainfall within 6 hours after application may reduce weed control
			Grass-selective herbicides
	$324 per 2.5 gallons (Select Max; $9 – 32 per acre); $85 per gallon (Arrow 2EC; $4 – 11 per acre)	No	Lipid biosynthesis (ACC'ase) inhibitor; Select Max contains surfactant; controls various grass weeds; does not harm yellow nutsedge, including chufa; use higher rates and/or multiple applications for perennial grasses (such as johnsongrass, tall fescue, orchardgrass and bermudagrass); rainfall within 1 hour after application may reduce weed control
	$152 per gallon ($10 – 28 per acre)	No	Lipid biosynthesis (ACC'ase) inhibitor; controls various grass weeds; split applications (10 and 8 ounces) are recommended for rhizome johnsongrass; rainfall within 1 hour after application may reduce weed control
	$135 per gallon ($8 – 13 per acre)	No	Lipid biosynthesis (ACC'ase) inhibitor; controls various grass weeds; does not harm yellow nutsedge, including chufa; two 5-ounce split applications are recommended for rhizome johnsongrass; higher rates are needed for annual grasses and bermudagrass; rainfall within 1 hour after application may reduce weed control
	$173 per 2.5 gallons ($17 – 26 per acre)	No	Lipid biosynthesis (ACC'ase) inhibitor; controls various grass weeds; does not harm yellow nutsedge, including chufa; apply before annual grasses exceed 4 inches; use higher rates and/or multiple applications for perennial grasses (such as tall fescue, orchardgrass and bermudagrass); rainfall within 1 hour after application may reduce weed control
	$601 per 2.16 gallons ($15 per acre)	Yes	Lipid biosynthesis (ACC'ase) inhibitor; controls annual ryegrass and foxtail grasses; will kill oats; spray when ryegrass is in 1 – 4-leaf stage; dieback may take 4 weeks; does not control forbs; rainfall within 1 hour after application may reduce weed control; crop rotation minimum (days) following application: cereal grains and leaf crops (30), all other crops (106)

Primary active ingredient	Trade name (% active ingredient)	Suggested rate per acre[2]	Application[3]	Selected labeled crop / application	Manufacturer	
Forb-selective herbicides						
2,4-D	2,4-D Amine (46.8)	0.5 – 3 pints (refer to label for specific rate)	postemergence	field corn, grain sorghum, wheat, oats, rye, millets, rice	several	
2,4-DB	Butyrac 200 (25.9)	11 – 15 ounces for soybeans; 1 – 3 quarts for alfalfa, birdsfoot trefoil, alsike, ladino and red clovers	postemergence	soybeans, alfalfa, clovers, birdsfoot trefoil	Agri-Star	
dicamba	Banvel (48.2)	2 – 4 ounces for wheat, oats and rye; 8 ounces for grain sorghum; 8 – 16 ounces for field corn	postemergence	field corn, grain sorghum, wheat, oats, rye	Micro Flo	
dicamba	Clarity (56.8)	2 – 4 ounces for oats, triticale, and wheat; 8 ounces for grain sorghum; 8 – 16 ounces for field corn	postemergence	field corn, grain sorghum, oats, triticale, wheat	BASF	
dicamba (12.4) and 2,4-D (35.7)	Weedmaster	1 pint for grain sorghum and 1 – 2 pints for wheat	postemergence	grain sorghum, wheat	BASF	
thifensulfuron-methyl	Harmony Extra (50)	0.3 – 0.6 ounces	postemergence	wheat, oats	DuPont	

	Approximate cost	Residual soil activity	Herbicide mode of action / purpose for spraying / comments[4]
			Forb-selective herbicides
	$37 per 2.5 gallons ($1 – 6 per acre)	Yes	Growth regulator; controls various forb weeds; 2,4-D volatilizes quickly in hot weather and is highly susceptible to spray drift; 2,4-D should not be applied near growing broadleaf agricultural crops (such as tobacco or cotton); applications prior to crop emergence can be made to emerged weeds; oats are less tolerant to 2,4-D than wheat—do not spray over oats during or immediately after cold weather
	$37 per gallon ($3 – 4 per acre for soybeans; $9 – 28 per acre for other plantings)	Yes	Growth regulator; controls various forb weeds; good control on sicklepod; does not control chickweed, henbit, plantain or dock; apply before weeds exceed 3 inches and when legume has two or more trifoliate leaves
	$140 per 2.5 gallons ($1 – 7 per acre)	Yes	Growth regulator; controls various forb weeds; use caution to prevent drift and injury to sensitive crops; apply to grain sorghum after all sorghum plants have emerged, but before they are 15 inches tall; apply to small grains after seedlings reach 3-leaf stage; crop rotation guidelines following application: corn, grain sorghum and soybeans may be planted in the spring following applications made the previous year
	$238 per 2.5 gallons ($2 – 12 per acre)	Yes	Growth regulator; controls various forb weeds; use caution to prevent drift and injury to sensitive crops; apply to grain sorghum after all sorghum plants have emerged, but before they are 15 inches tall; apply to small grains after seedlings reach 3-leaf stage; rainfall within 4 hours after application may reduce weed control; no crop rotation restrictions 120 days or more following application
	$34 per gallon ($5 – 10 per acre)	Yes	Growth regulator; controls various forb weeds; rainfall within 4 hours after postemergence application may reduce weed control
	$240 per 20 ounces ($4 – 7 per acre)	No	Amino acid synthesis inhibitor; controls various forb weeds and wild garlic; apply after wheat and oats reach 2-leaf stage; rainfall within several hours after application may reduce weed control; crop rotation minimum (months) following application: *Brassica*s (2), any other crop (1½)

Primary active ingredient	Trade name (% active ingredient)	Suggested rate per acre[2]	Application[3]	Selected labeled crop / application	Manufacturer	
Specialty herbicides						
imazethapyr	Pursuit (22.9)	3 – 6 ounces	preplant incorporated, preemergence or post-emergence	alfalfa, clovers, Austrian winter peas, Southern peas (cowpeas), soybeans, Clearfield™ corn	BASF	
pendimethalin	Pendulum 3.3 EC (37.4); Prowl 3.3 EC (37.4); Prowl H_2O (38.7)	2 – 4 pints (varies by crop and soil type)	preplant incorporated, preemergence or postemergence incorporated	field corn, Southern peas (cowpeas), Austrian winter peas, soybeans, sunflowers, rice, peanuts	BASF	
trifluralin	Trifluralin 4EC (43) or Treflan HFP (43)	1 – 2.5 pints	preplant incorporated	chicory, *Brassica*s, Southern peas, soybeans, wheat, sunflowers	Dow AgroSciences	
atrazine	Atrazine 4L (*restricted use*, 42.2); AAtrex 4L (*restricted use*, 42.6); others	3 – 4 pints	preplant incorporated, preemergence or postemergence	field corn, grain sorghum	several	
atrazine (33) and S-metolachlor (26.1)	Bicep II Magnum (*restricted use*)	1.5 – 2.5 quarts	preplant incorporated or preemergence	field corn, (also grain sorghum if seed treated with Concep™)	Syngenta	
S-metolachlor	Dual Magnum (83.7)	1.3 – 2.0 pints	preplant incorporated or preemergence	field corn, Southern peas (cowpeas), soybeans, peanuts, sunflowers (also grain sorghum if seed treated with Concep™)	Syngenta	

	Approximate cost	Residual soil activity	Herbicide mode of action / purpose for spraying / comments[4]
			Specialty herbicides
	$538 per gallon ($13 – 25 per acre)	Yes	Amino acid synthesis inhibitor; controls various **forb** and grass weeds; **apply postemergence only** on alfalfa or clover plots (2 trifoliate stage or larger); **apply to Clearfield™ varieties of corn only;** postemergence applications most effective when applied before weeds exceed 3 inches; rainfall within 1 hour after postemergence application may reduce weed control; for optimum control with preemergence applications, sufficient moisture in the top 2 inches of soil is necessary within 7 days after application; crop rotation minimum (months) following application: alfalfa, clover, rye, wheat (4), field corn (8½), oats, grain sorghum, sunflowers (18)
	$100 per 2.5 gallons ($10 – 20 per acre) $59 per 2.5 gallons ($6 – 12 per acre)	Yes	Root growth inhibitor; controls various **grass** and forb weeds; **do not apply** preplant incorporated in corn plots, but only preemergence; corn should be planted at least 1.5 inches deep and completely covered with soil; use no more than 2.4 pints per acre on rice plots; most effective with adequate rain soon after application; pendimethalin does not control established weeds; wheat may be planted in the fall 4 months after application
	$46 per 2.5 gallons ($3 – 6 per acre) $83 per 2.5 gallons ($5 – 11 per acre)	Yes	Amino acid synthesis inhibitor; controls various grass and forb weeds; incorporate immediately after application; trifluralin does not control established weeds; crop rotation minimum (months) following application: proso millet, grain sorghum, oats, annual grass crops (12 – 14)
	$25 per 2.5 gallons ($4 – 5 per acre)	Yes	Photosynthetic inhibitor; controls various forb and grass weeds; atrazine can travel through soil and can enter ground water; wastes from atrazine may be toxic; refer to label for restrictions; weed control may be reduced without adequate soil moisture; do not rotate to any crop except corn or sorghum until the following year, or injury may occur; if applied after June 10, do not plant crop other than corn or grain sorghum the following year; do not plant spring-seeded small grains or small-seeded legumes and grasses the year following application or injury may occur
	$115 per 2.5 gallons ($18 – 29 per acre)	Yes	Photosynthetic inhibitor and shoot growth inhibitor; do not use on soils with less than 1% organic matter; controls various forb and grass weeds (including crabgrass); do not rotate to any crop except corn or sorghum until the following year, or injury may occur; if rain does not occur within a few days after application, weed control may be decreased; crop rotation minimum (months) following application: soybeans, peanuts (12), spring-seeded small grains, small-seeded legumes (24)
	$285 per 2.5 gallons ($15 – 29 per acre)	Yes	Shoot growth inhibitor; controls various **grass** and forb weeds and nutsedge; does not control emerged weeds; if rain does not occur within a few days after application, weed control may be decreased; crop rotation minimum (months) following application: alfalfa (4), oats, rye, wheat (4½), clovers (9), buckwheat, grain sorghum, rice (12)

Primary active ingredient	Trade name (% active ingredient)	Suggested rate per acre[2]	Application[3]	Selected labeled crop / application	Manufacturer	
S-metolachlor	Dual II Magnum (82.4)	1 – 2 pints	preplant incorporated or preemergence	field corn, Southern peas (cowpeas), soybeans, peanuts, (also grain sorghum if seed treated with Concep™)	Syngenta	
flumetsulam	Python WDG (80)	0.9 – 1.3	preplant incorporated or preemergence	field corn, soybeans	Dow AgroSciences	
EPTC	Eptam 7-E (87.8)	3.5 pints	preplant incorporated	alfalfa, birdsfoot trefoil, clovers, lespedeza	Syngenta	
mesosulfuron methyl	Osprey (4.5)	4.75 ounces	postemergence	wheat	Bayer CropScience	
nicosulfuron	Accent (75)	0.3 – 1.3 ounces	postemergence	field corn	DuPont	
carfentrazone-ethyl	Aim EC (22.3)	0.25 – 0.5 ounce (soybeans); 0.5 – 1.0 ounce (corn, grain sorghum); 0.5 – 2.0 ounces (millets, oats, cereal rye, triticale, wheat); 1.6 – 6.4 ounces (rice)	postemergence	field corn, grain sorghum, soybeans, rice	FMC	

	Approximate cost	Residual soil activity	Herbicide mode of action / purpose for spraying / comments[4]
	$285 per 2.5 gallons ($15 – 29 per acre)	Yes	Shoot growth inhibitor; controls various **grass** and forb weeds and nutsedge; does not control emerged weeds; if rain does not occur within a few days after application, weed control may be decreased; crop rotation minimum (months) following application: alfalfa (4), oats, rye, wheat (4½), clovers (9), buckwheat, rice (12)
	$160 per 4 ounces ($36 – 52 per acre)	Yes	Amino acid synthesis inhibitor; controls various **forb** and grass weeds; plant corn at least 1.5 inches deep when using this product; extended cold, wet conditions following preemergence application to corn may result in crop injury; if rain does not occur within 7 – 10 days following preemergence applications, weed control may be reduced; preplant incorporated applications are recommended if dry weather is expected; crop rotation minimum (months) following application: alfalfa, peas, oats, rye, wheat (4), clovers, birdsfoot trefoil, lespedeza, native grasses (9), grain sorghum (12), sunflowers (18), canola (26)
	$85 per 2.5 gallons ($15 per acre)	Yes	Shoot growth inhibitor; incorporate immediately after application; controls annual grasses and winter annual forb weeds, as well as yellow nutsedge; does not control plantains or docks; **do not use if small grain nurse crop is planted with legumes**; does not control established weeds; may be difficult to find
	$361 per 95 oz ($18 per acre)	Yes	Amino acid synthesis inhibitor; controls annual bluegrass, annual ryegrass and a few annual forbs, including wild mustard, chickweed, henbit and redroot pigweed; **do not apply to wheat sown with legumes**; rainfall within 4 hours after application may reduce weed control; crop rotation minimum (days) following application: sunflowers (1), soybeans, rice, peas, peanuts (3), corn (12)
	$350 per 10 ounces ($11 – 46 per acre)	Yes	Amino acid synthesis inhibitor; controls several grasses and a few forb weeds; rainfall within 4 hours after application may reduce weed control; crop rotation minimum (months) following application: soybeans (0.5), oats, rye, wheat (4), canola, grain sorghum, peas (10), sunflowers (11), alfalfa, red clover (12)
	$189 per quart ($3 – 19 per acre)	No	Cell membrane disrupter; controls various forb weeds; rainfall within 6–8 hours after application may reduce weed control; do not apply to soybeans until 3-leaf stage; up to 0.5 ounce may be applied to later maturing soybeans than Group 3.5; soybeans may show burn, speckling or necrosis, but will quickly outgrow initial effects; apply to rice when rice is at 2-leaf stage or larger, but before internode elongation

Primary active ingredient	Trade name (% active ingredient)	Suggested rate per acre[2]	Application[3]	Selected labeled crop / application	Manufacturer	
imazamox	Raptor (12.1)	4 ounces (chicory, cowpeas, soybeans); 4 – 6 ounces (alfalfa)	postemergence	alfalfa, chicory, Southern peas (cowpeas), soybeans	BASF	
imazamox	Beyond (12.1)	4 – 6 ounces	postemergence	Clearfield™ varieties of sunflowers, wheat, or corn	BASF	
halosulfuron-methyl	Permit (75)	0.6 – 1.3 ounces	postemergence	field corn, grain sorghum, rice	Gowan	
bentazon	Basagran (44)	1 – 2 pints	postemergence	field corn, Southern peas (cowpeas), grain sorghum, soybeans, rice	BASF	
bentazon (29.2) and acifluorfen (13.4)	Storm	1.5 pints	postemergence	soybeans, peanuts, rice	UPI	
quinclorac	Facet 75 DF (75)	0.33 – 0.67 pounds	pre- or postemergence	rice	BASF	

	Approximate cost	Residual soil activity	Herbicide mode of action / purpose for spraying / comments[4]
	$582 per gallon ($18 – 27 per acre)	Yes	Amino acid synthesis inhibitor; controls various forb and grass weeds; most effective when applied before weeds exceed 5 inches; weak on sicklepod and 3-seeded mercury; applications must be made at least 1 hour prior to rain; crop rotation minimum (months) following application: Clearfield™ sunflowers, Clearfield™ wheat (0), wheat (3), rye (4), corn (8½), grain sorghum, millets, oats, peanuts, rice, turnips (9)
	$545 per gallon ($17 – 25 per acre)	Yes	Amino acid synthesis inhibitor; controls various broadleaf and grass weeds in Clearfield™ varieties of sunflowers, wheat or corn **only**; apply to sunflowers during 2- to 8-leaf stage; applications must be made at least 1 hour prior to rain; crop rotation minimum (months) following application: alfalfa, wheat (3), rye (4), field corn (8½), grain sorghum, millets, oats, peanuts, rice, sunflowers, turnips (9)
	$350 per 20 ounces ($11 – 23 per acre)	Yes	Amino acid synthesis inhibitor; controls various forb weeds and nutsedge; weak on sicklepod and morningglory; do not use more than 1 ounce per acre on grain sorghum; make only one application per season; rainfall within 4 hours after application may reduce weed control; crop rotation minimum (months) following application: field corn (1), oats, proso millet, rice, rye, grain sorghum, spring cereal crops, wheat (2), peanuts (6), alfalfa, clovers, dry beans, field peas, soybeans (9), canola (15), sunflowers (18)
	$218 per 2.5 gallons ($11 – 22 per acre)	No	Photosynthetic inhibitor; controls various forb weeds and yellow nutsedge; may cause yellowing or speckling in soybeans and cowpeas, but this is temporary and outgrown within 10 days; rainfall within 4 hours after application may reduce weed control
	$190 per 2.5 gallons ($14 per acre)	Yes	Photosynthetic inhibitor and cell membrane disrupter; controls certain broadleaf weeds; may also provide partial control of some grasses; may cause foliar burn on soybeans, but it is short-lived; rice must be past 3-leaf stage; do not apply to rice when field is flooded or splashing will wash herbicide off leaves; rainfall within 4 hours after application may reduce weed control; crop rotation restrictions: do not plant small grains within 40 days following treatment
	$275 per 5-pound bag ($18 – 37 per acre)	Yes	Cellulose inhibitor/synthetic auxin; controls a variety of annual grasses and broadleaf weeds; optimum weed control is dependent upon adequate soil moisture, including flush irrigation; do not plant any crop other than rice for at least 10 months after application

Primary active ingredient	Trade name (% active ingredient)	Suggested rate per acre[2]	Application[3]	Selected labeled crop / application	Manufacturer	
imazapic	Plateau (23.6); Cadre (23.6); Panoramic 2SL (23.3)	4 – 12 ounces	pre- or postemergence	many applications	BASF and others	
imazapic (8.1) and glyphosate (21.9)	Journey	16 – 32 ounces	pre- or postemergence	many applications	BASF	
imazapyr	Arsenal AC (53.1); Arsenal (28.7); Chopper (27.6); Imazapyr 4 SL (52.6); Rotary 2 SL (27.8)	6 – 24 ounces	postemergence	many applications	BASF and others	
triclopyr	Garlon 3-A (44.4); Triclopyr 4 EC (44.3)	1 – 8 quarts	postemergence	many applications	Dow AgroSciences and others	

[1] Use of brand, trade or company names in this publication is for clarity and information; it does not imply approval of the product or company to the exclusion of others, which may be of similar composition or equal value. Always be sure to read, understand and follow directions, precautions and restrictions on herbicide labels before use. For optimum long-term herbicide weed control, use two herbicides with different modes of action to reduce potential for weed resistance. As herbicides, herbicide labels, and their availability and recommendations may change, it is best to consult your local Extension agent or farm supply distributor for the latest recommendations on herbicide use.

[2] Various crops labeled for a particular herbicide often require or tolerate different application rates. Application rates may differ depending on soil texture and percent organic matter. Always refer to herbicide labels for specific application rates for a given crop.

[3] Various crops labeled for a particular herbicide often require or tolerate different types of applications, such as preplant incorporated, preemergence or postemergence. A surfactant should be added to all postemergence herbicide applications unless the herbicide already contains surfactant. Refer to the herbicide label as to which surfactant to use, mixing instructions, and recommended rates.

	Approximate cost	Residual soil activity	Herbicide mode of action / purpose for spraying / comments[4]
	$270 per gallon ($8 – 25 per acre)	Yes	Amino acid synthesis inhibitor; selectively kills tall fescue, crabgrass, johnsongrass, sicklepod, yellow nutsedge and others to promote quality nesting and brood-rearing habitat for bobwhites and wild turkeys; also can be used to control japangrass (*Microstegium vimineum*) along woods roads, including those planted to crimson clover; Plateau™ is available through select government agencies; Panoramic™ can be purchased at local seed/herbicide supply stores; Cadre™ is labeled for peanuts only in select states; rainfall within 3 hours of a postemergence application may reduce weed control; crop rotation minimum (months) following application: wheat, rye (4), field corn, cowpeas, soybeans (9), grain sorghum, oats (18)
	$275 per 2.5 gallons ($10 – 20 per acre)	Yes	Amino acid synthesis inhibitor; kills tall fescue, crabgrass, johnsongrass and others to promote quality nesting and brood-rearing habitat for bobwhites and wild turkeys; crop rotation minimum (months) following application: wheat, rye (4), cowpeas, soybeans (9), grain sorghum, oats (18)
	$160 per quart ($30 – 120 per acre)	Yes	Amino acid synthesis inhibitor; kills bermudagrass in the season prior to planting food plots; good for spot spraying woody encroachment in perennial plots and broadcast spraying around plots to prevent woody encroachment; rainfall within 3 hours of a postemergence application may reduce weed control; rotational crops may be planted 12 months after application at the recommended pasture and rangeland rate
	$200 per 2.5 gallons ($20 – 160 per acre)	No	Growth regulator; good for spot-spraying woody encroachment in perennial plots and broadcast spraying around plots to prevent woody encroachment; also very effective in eradicating hard-to-control perennial forb weeds prior to plot establishment

[4] Many herbicides have multiple uses. Read the herbicide label before use. The purposes stated in this table are for general information. Herbicide mode of action describes how a herbicide inhibits plant growth. Moreover, herbicide site of action describes the exact location within the plant where the herbicide binds. Refer to the ***Weed Control Manual for Tennessee*** (http://weeds.utk.edu) to identify herbicide site of action and other information. Crop rotation restrictions may preclude you from planting specific crops for a given amount of time after applying various herbicides. Refer to herbicide label for additional information concerning crop rotation restrictions. The majority of postemergence herbicides work best when applied to actively growing plants, often before they reach a certain size/height. Refer to herbicide label to identify optimum application effectiveness.

Appendix 3.

Response of various weeds to specific herbicides[1,2].

Key to response ratings: 0 = no control or crop injury; 10 = 100% control or severe crop injury; blank boxes indicate data were not available. Ratings are based on application of each herbicide at labeled rates applied at optimum timing for each weed.

	Roundup (postemergence)	Accent (postemergence)	Aim (postemergence)	Atrazine (postemergence)	Banvel (postemergence)	Basagran (postemergence)	Select (postemergence)	Poast Plus (postemergence)	2,4-D (postemergence)	2,4-DB (Butyrac) (postemergence)	
Grass weeds											
barnyardgrass	7		0	4	0	0	9	9	0	0	
large crabgrass	9	6	0	6	0	0	9	9	0	0	
smooth crabgrass	9		0	4	0	0	9	9	0	0	
fall panicum	9		0	6	0	0	9	9	0	0	
foxtail	9	9	0	7	0	0	9	9	0	0	
goosegrass	9		0	7	0	0	9	9	0	0	
broadleaf signalgrass	9	8	0	6	0	0	9	9	0	0	
seedling johnsongrass	10	9	0	0	0	0	9	8	0	0	
rhizome johnsongrass	9	9	0	0	0	0	9	6	0	0	
annual ryegrass										0	
bermudagrass			0	2	0	0			0	0	
Forb weeds											
buttercup							0	0	9		
chickweed							0	0	2	2	
dock							0	0	7	1	
wild garlic							0	0	7		
Carolina geranium							0	0	9		
henbit							0	0	1	1	
purple deadnettle							0	0	1	1	
horseweed (marestail)							0	0	9		
wild mustard							0	0	8		
pepperweed							0	0	9		

	Clarity (postemergence)	Harmony Extra (postemergence)	Atrazine (preemergence)	Dual Magnum (pre-plant incorporated)	Bicep II Magnum (pre-plant incorporated)	Pursuit (preemergence)	Pursuit (postemergence)	Prowl (pre-plant incorporated)	Treflan (pre-plant incorporated)	Python (pre-plant incorporated)	Beyond (postemergence)	Eptam (pre-plant incorporated)
	0	0	6		9		7					8
	0	0	7	9	9	8	7	9	9	5	7	8
	0	0	3	9	9	8	7	9	9	5	7	8
	0	0	3		9		7					8
	0	0	6	9	9	8	7	9	9	5	7	8
	0	0	6	9	9	8	7	9	9	5		8
	0	0	4	8	8	6	7	8	8	4	7	8
	0	0	1	8	8	8	7	8	9	4	8	8
	0	0	0		2		6					6
		0										8
	0	0			0							
		9										
		8										9
		9										0
		9										
		5										
		7										8
		7										8
		6										
		9										
		8										

	Roundup (postemergence)	Accent (postemergence)	Aim (postemergence)	Atrazine (postemergence)	Banvel (postemergence)	Basagran (postemergence)	Select (postemergence)	Poast Plus (postemergence)	2,4-D (postemergence)	2,4-DB (Butyrac) (postemergence)	
wild turnip							0	0	8		
vetch							0	0	8		
cocklebur	10	6	6	7	9	9	0	0	9	8	
groundcherries			7	7	9	3	0	0	8		
black nightshade			7	7	9	6	0	0	8		
horsenettle		2	4	4		0	0	0	4		
jimsonweed			7			8	0	0	8		
lambsquarters	8	2	8	8	9	6	0	0	8	4	
morningglory	8	7	8	7	9	4	0	0	9	8	
Palmer pigweed	9	3	7	9		0	0	0	8		
smooth pigweed	9	9	8	9	9	0	0	0	9	6	
common ragweed	8			8	9	5	0	0	8	6	
giant ragweed	8	2	2	6	9	5	0	0	9		
sicklepod	9	6	1	6	8	0	0	0	8		
tropic croton							0	0	8		
prickly sida			4	6	8		0	0	9		
smartweed	8		7	8	8	7	0	0	6		
spotted spurge			6				0	0			
velvetleaf	7	7	9	7	8	8	0	0	8		
Sedge weeds											
nutsedge	7	4	0	6	0	8	0	0	0	1	

[1] Table adapted from the ***Weed Control Manual for Tennessee***, PB 1580 (http://weeds.utk.edu).

[2] Data collected by personnel with the University of Tennessee Agricultural Experiment Station and UT Extension.

	Clarity (postemergence)	Harmony Extra (postemergence)	Atrazine (preemergence)	Dual Magnum (pre-plant incorporated)	Bicep II Magnum (pre-plant incorporated)	Pursuit (preemergence)	Pursuit (postemergence)	Prowl (pre-plant incorporated)	Treflan (pre-plant incorporated)	Python (pre-plant incorporated)	Beyond (postemergence)	Eptam (pre-plant incorporated)
		9										
		7										
	9		7	0	7	8	8	0	0	7	8	2
				7	8	9	8	0	0	9		
				7	8	8	8	0	0	9		
	6		3		3							
	9		8	0	8	8	9	0	0		6	
	9		9	6	9	7	5	8	7		5	7
	9		8	2	8	7	8	6	6	6	7	4
	9		9	6	9	3	3	7	8	4	3	
	9		9	8	9	9	9	7	8	9	8	7
	9		9	0	9	8	7	3	0		6	2
	9		6		6		7	0				
	8		6	3	7	0	0	0	0	7	0	
	8							4	0			
				0		8	6	0	0	9	6	
	8		9	0	9	8	6	3	4	9	6	
				7		9	8	0	0	9	8	
	8		6	0	6	8	8	2	2	9	8	
	0		4	9	7	8	3	0	0		0	8

Appendix 4.

Growth, deer preference and nutritional information for various forages in the Mid-South region

Information in this chart reflects 9 years of experimentation using side-by-side comparisons and collecting monthly data (measuring, clipping and analyzing forage) inside and outside exclusion cages. Not all of the forages listed are recommended for food plots, but have been included for comparative purposes.

Species[1]	Germination and initial growth rate	Grazing preference[2]	Resistance to grazing	
Cool-season legumes				
Arrowleaf clover	slow	moderate	excellent	
Berseem clover	moderate	high	excellent	
Crimson clover	moderate	high	excellent	
Alsike clover	slow	high	excellent	
Ladino clover	slow	high	excellent	
Red clover	slow	moderate	excellent	
Sweetclover	slow	moderately low	good	
White-dutch clover	slow	moderate	excellent	
Alfalfa	slow	moderate	excellent	
Austrian winter peas	moderate	moderate	fair	
Birdsfoot trefoil	slow	moderate	good	
Hairy vetch	moderate	moderately low	good	
Crown vetch	extremely slow	no use recorded	n/a	
Blue lupine	slow	no use recorded	n/a	
Sainfoin	slow	no use recorded	n/a	
Cool-season grasses				
Barley	fast	extremely low	n/a	
Oats	fast	high	excellent	
Wheat	fast	high	excellent	
Rye	fast	high	excellent	
Triticale	fast	high	excellent	
Ryegrass	fast	low	excellent	
Orchardgrass	slow	extremely low	n/a	
Tall fescue	slow	no use recorded	n/a	
Matuagrass	relatively slow	low	excellent	
Timothy	slow	no use recorded	n/a	
Bluegrass	slow	no use recorded	n/a	

	Crude protein (percent)[3]	Acid detergent fiber (percent)[3]	Date forage collected	Quality forage available[4,5]
	31.0	19.7	April	March – June
	24.8	16.8	April	October – December; March – May
	28.4	14.9	April	October – December; March – April
				March – July; October – December
	31.5	17.7	April	March – July; October – December
	23.7	26.7	June	March – August; October – December
	31.1	18.1	April	March – early June
	31.3	17.7	April	March – July; October – December
	24.7	35.1	April	March – early August; October – December
	28.0	18.9	April	September – April
	28.2	19.9	April	March – July; October – December
				September – April
	23.7	36.9	July	n/a
	34.1	12.6	Jan	n/a
	20.6	26.5	April	n/a
	23.9	23.4	March	n/a
	26.5	17.9	March	September – early April
	24.9	21.4	March	September – early April
	23.6	23.1	March	September – early April
	20.5	26.0	March	September – early April
	12.0	23.5	March	September – early April
	14.6	36.8	early April	n/a
	16.6	31.5	early April	n/a
	22.0	19.6	March (after planting)	November – April
	29.8	34.8	July	n/a
				n/a

Species[1]	Germination and initial growth rate	Grazing preference[2]	Resistance to grazing	
Warm-season legumes				
Alyceclover	slow	moderately low	good	
American jointvetch	slow	moderate	good	
Iron-clay cowpeas	moderate	moderate	good	
Red ripper peas	moderate	moderate	good	
Lablab	moderate	high	good	
Soybeans	moderate	extremely high	poor	
Quail Haven soybeans	moderate	high	excellent	
Florida beggerweed	moderate	high	excellent	
Lathco flatpeas	extremely slow	no use recorded	n/a	
Velvetbean	moderate	no use recorded	n/a	
Non-legume broadleaf forbs				
Buckwheat	fast	moderately low	good	
Chicory	relatively slow	high	excellent	
Rape (dwarf essex)	moderate	moderately low	good	
Turnips (pasja)	moderate	moderately low	good	
Small burnette	relatively slow	moderately low	good	

[1] This list contains many forages, good, bad and in-between. Many are recommended in this manual for planting, but several are not. The main reason some of them are not recommended is because deer do not eat them (unless they are about to starve) and some of them are invasive and can be difficult to control once established.

[2] Preference is always relative to what is available. These preference ratings are based on their use within the demonstration/research plots where many other forages were also available. You may find deer differ somewhat in their selections on your property.

[3] Crude protein includes digestible proteins as well as those proteins found in plant cell walls that may be lignified and indigestible. Acid detergent fiber is a measure of the lignified, undigestible portion of the plant. Levels of crude protein and acid detergent fiber vary greatly with respect to plant maturity, soil fertility and soil moisture. The data presented in this appendix merely represent what these forages are capable of on certain sites at certain times of the year. All of the forage samples collected for this appendix were taken when the plant was actively growing and before stem elongation and flowering had begun.

[4] This represents the general time period(s) when forage production is best, starting from the time of planting. Forage availability is naturally dependent upon many factors, such as time of planting, soil conditions, weather and weed control.

[5] Perennial cool-season legumes generally do not produce considerable forage during the fall of establishment. Production is best the following spring through mid-summer, then picks up again in the fall. In addition, clovers normally “wilt down” in the winter following hard frosts and very cold temperatures. In milder winters, mid-winter production may be significant.

	Crude protein (percent)[3]	Acid detergent fiber (percent)[3]	Date forage collected	Quality forage available[4,5]
	25.7	25.5	July	July – October
	25.3	22.6	July	July – October
	29.7	19.1	July	June – October
	29.4	24.7	July	June – October
	25.7	28.8	July	June – October
	33.7	25.9	July	June – October
	24.5	30.5	August	June – October
	20.8	22.7	August	June – October
				n/a
	28.8	36.2	July	n/a
	25.6	27.0	July	May – September
	23.6	19.5	December	November – December; March – July; September – October
	32.9	13.1	December	October – early April
	25.8	24.4	July	October – early April
	21.8	24.7	July	November – December; March – July; September – October

Appendix 5.

Annual production of several forages planted for white-tailed deer

Shown with the percent of the crop consumed by deer on an annual basis.

Forage	Average annual production[1,2] (lbs dry matter)	Percent consumed by deer[3]		
		Low density[4]	Medium density	High density
Perennial				
ladino clover	7500	25	41	83
red clover	6500	12	38	91
alfalfa	7500	15	52	91
birdsfoot trefoil	3500	13	--	73
chicory	4500	59	66	85
Cool-season annual				
crimson clover	7000	20	79	73
berseem clover	4000	27	85	91
arrowleaf clover	6500	11	46	76
Austrian winter peas	3000	13	39	97
oats	3000	16	87	80
wheat	3000	19	58	57
dwarf essex rape	3000	10	13	30
Warm-season annual				
iron-clay cowpeas	8500	5	63	100
lablab	7500	45	44	100
Quail Haven soybeans	6000	27	77	100
soybeans	8000	81	90	100
American jointvetch	7500	28	46	91
alyceclover	6000	1	40	93
buckwheat	3000	--	29	--

[1] Annual production per acre estimated by clipping forages within exclusion cages at the end of each month and summing the production (not standing crop) through the year. This was completed in plots that were open for deer grazing. In general, forage production estimates were lower on the high deer-density site and higher on the low deer-density site.

[2] Production data do not include biomass from the stem elongation/bolting/flowering/seed formation stages for chicory, wheat, oats or dwarf essex rape because that would inflate production estimates and bias consumption percentages low.

[3] Percent consumed by deer measured by clipping forages within and outside exclusion cages at the end of each month. Keep in mind, however, a variety of forages were available at each field throughout each year data were collected. **Thus, these values represent *preference*, and not necessarily the amount of forage you should expect deer to eat at a given density if other forages were not present**. For example, you should not expect deer to necessarily eat 13 percent of available Austrian winter pea production (as shown in the table for low deer density) when there is little else for the deer to eat. Another important consideration is food availability in the surrounding area. On the low-density site, habitat quality and food availability was tremendous. On both the medium- and high-density sites, surrounding habitat and food availability was relatively poor.

[4] Low, medium and high deer density are relative terms in this table. Here, low deer density represents an average of approximately 30 deer per square mile. Medium deer density represents an average of approximately 50 deer per square mile. High deer density represents an average of approximately 90 deer per square mile. These density estimates are for three sites across Tennessee. Deer density was estimated at each site by using infrared-triggered cameras and by visual observations at each field, all recorded for 3 – 7 years consecutively at each field.

A virtual cafeteria at the high deer-density site.

Appendix 6.

Wildlife and nutritional value (crude protein and acid detergent fiber) of various forbs and shrubs commonly found in old-fields[1].

Common name	Scientific name	CP	ADF	Selectivity by deer[2]	Value as brood cover	Seed value for birds
pokeweed	*Phytolacca americana*	32.0	12.0	High	High	High
old-field aster	*Aster pilosus*	23.3	30.7	High	Med	None
prickly lettuce	*Lactuca serriola*	21.7	21.2	High	Low	None
blackberry	*Rubus* spp.	19.3	18.9	Med	High	High
partridge pea	*Chamaecrista fasciculata*	29.6	36.5	Med	High	High
beggar's-lice	*Desmodium obtusum*	28.2	20.7	Med	High	High
ragweed	*Ambrosia artemisiifolia*	17.8	23.9	Med	High	High
sumac	*Rhus* spp.	23.1	12.5	Med	High	Med
goldenrod	*Solidago* spp.	16.1	26.2	Med	Med	None
3-seeded mercury	*Acalypha virginica*	24.7	16.7	Med	Low	Med
honeysuckle	*Lonicera japonica*	16.2	34.2	Low	Low	Low
Canadian horseweed	*Conyza canadensis*	32.9	19.8	Low	Low	None
sericea lespedeza	*Lespedeza cuneata*	22.2	32.6	None	Low	Low
passion flower	*Passiflora incarnata*	36.6	18.9	None	None	Low

[1] All samples were collected in June 2005 from a field in McMinn County, TN that was burned the previous April.

[2] Selectivity by deer was measured by estimating the percentage of individual plants eaten and the frequency that deer fed upon that plant species throughout the field. It is important to note that while deer forage selectively, plants are not necessarily eaten based on nutritional content. For example, deer did not browse or graze all of the plants in the chart above. While old-field aster, prickly lettuce and pokeweed were grazed heavily, blackberry, goldenrod, ragweed and 3-seeded mercury were only browsed or grazed occasionally. For other species, such as passion flower and sericea lespedeza, there was no sign of grazing or browsing at all, even though crude protein and digestibility ratings were high. It is also important to note deer density in this area was approximately 25 deer per square mile and there was an abundance of soybean fields around the field where these data were collected.

beggar's-lice

goldenrod

prickly lettuce

partridge pea

The next time you are walking around in an old-field or along the edge of the woods, look at the plants closely and see which ones the deer are grazing. Various field management practices, such as burning and disking, can be used to maintain these important forages.

Appendix 7.

Selectivity (in relation to availability) by deer and nutritional value (crude protein and acid detergent fiber) of several browse species as determined in three forested areas across Tennessee.[1]

Common name	Scientific name	CP[2]	ADF	Selectivity by deer[3]		
				Chuck Swan	Rocky River	Ames
American beech	*Fagus grandifolia*	12.5	38.4	=		
American hornbeam	*Carpinus caroliniana*			=		
black cherry	*Prunus serotina*	13.5	25.1	–		–
blackberry	*Rubus* spp.	12.8	17.9	+	+	–
blackgum	*Nyssa sylvatica*	13.2	17.9	+	+	+
blueberry	*Vaccinium* spp.	7.8	23.0	–	–	
Carolina buckthorn	*Frangula caroliniana*	13.8	15.2	–		–
chestnut oak	*Quercus prinus*			–		
Eastern hophornbeam	*Ostrya virginiana*			=		
Eastern redbud	*Cercis canadensis*			=		
hickory	*Carya* spp.			–	–	–
honeysuckle	*Lonicera japonica*	13.2	34.2	–		–
huckleberry				–		
flowering dogwood	*Cornus florida*	8.5	14.9	+		
greenbrier	*Smilax rotundifolia*	12.7	24.1	+	+	+
poison ivy	*Toxicodendron radicans*	13.4	23.4	–		–
red maple	*Acer rubrum*	9.6	27.0	–	–	–
red oak	*Quercus rubra*	10.7	25.1	–	–	–
sassafras	*Sassafras albidum*	14.1	26.9	–	–	–
serviceberry	*Amelanchier arborea*			=		
sourwood	*Oxydendrum arboreum*	10.7	20.8	=	–	
sugar maple	*Acer saccharum*			=		
supplejack	*Berchemia scandens*	14.0	20.7			+
strawberrybush	*Euonymus americana*	9.7	26.3	+		

Common name	Scientific name	CP[2]	ADF	Selectivity by deer[3]		
				Chuck Swan	Rocky River	Ames
Virginia creeper	*Parthenocissus quinquefolia*	13.3	18.4	–		–
white oak	*Quercus alba*			–	–	–
white ash	*Fraxinus americana*			=		–
wild grape	*Vitis* spp.	14.7	22.9	+		–
winged elm	*Ulmus alata*	12.8	28.2			+
winged sumac	*Rhus copallinum*	23.1	12.5	=		
yellow poplar	*Liriodendron tulipifera*	12.1	17.5	–		–

[1] Data collected at Chuck Swan State Forest and Wildlife Management Area, Union County, TN (2003), Rocky River Hunting Club, Sequatchie County, TN (2004 – 2005), and Ames Plantation, Fayette County, TN (2002 – 2005).

[2] Generally, crude protein levels decrease and acid detergent fiber levels increase through the growing season as plants mature. These figures represent browse quality averaged across sites, June – July.

[3] Selectivity by deer was determined by recording the degree and frequency of browsing upon browse species along transects. Browse preference was based on use vs. availability analysis. If a plant was "browsed more than expected" (+), the species was browsed *more than would be expected*, statistically, given the abundance or occurrence of that species. (=) represents the plant was browsed *as would be expected* given the abundance or occurrence of that species. (**–**) represents the plant was browsed *less than would be expected* given the abundance or occurrence of that species. If the space is has no mark, that species did not occur on that site or did not occur with enough frequency to include in the analysis. **For this reason, do not compare how deer preferred a particular browse species across sites (because not all species were available at all three sites, and a species that was present at all three sites did not necessarily occur at the same frequency). Rather, pay close attention at which species deer selected at a particular site and which browse species were available to choose from at that site.**

Appendix 8.

Legumes grown in wildlife food plots and their associated inoculant groups.[1]

	Inoculant code	Bacterium
Alfalfa group		
Alfalfa	A	*Sinorhizobium meliloti*
Sweetclover		
Clover group		
Alsike clover	B	*Rhizobium leguminosarum* biovar *trifolii*
Ball clover		
Ladino white clover		
Red clover		
White-dutch clover		
Arrowleaf clover	O	*Rhizobium leguminosarum* biovar *trifolii*
Crimson clover	R	*Rhizobium leguminosarum* biovar *trifolii*
Berseem clover		
Rose clover	WR	*Rhizobium leguminosarum* biovar *trifolii*
Subterranean clover		
Pea and vetch group		
Austrian winter peas	C or “Garden”	*Rhizobium leguminosarum* biovar *viceae*
Field peas		
Flat peas		
Hairy vetch		
Sweet peas		
Cowpea group		
Alyceclover	EL	*Bradyrhizobium* spp.
American jointvetch		
Cowpeas		
Lablab		
Lespedezas		
Partridge pea		
Peanuts		
Velvet bean		

	Inoculant code	Bacterium
Lupine group		
Blue lupine	H	*Rhizobium lupini*
White lupine		
Other		
Prairieclover	F	*Rhizobium* spp. (*Petalostemum*)
Sainfoin		*Rhizobium* spp. (*Onobrychis*)
Birdsfoot trefoil	K	*Mesorhizobium loti*
Soybeans	S	*Bradyrhizobium japonicum*

[1]For additional information regarding LiphaTech Nitragin Brand inoculants, call (800) 558-1003.

Appendix 9.
Soil testing labs for several land-grant institutions.

Alabama
Auburn University Soil Testing Laboratory
ALFA Agricultural Services and Research Building
961 South Donahue Drive
Auburn University, Alabama 36849-5411
(334) 844-3958
http://www.ag.auburn.edu/dept/ay/soiltest.htm

Arkansas
Arkansas Soil and Research Testing Laboratory
008 Lee 214
P.O. Drawer 767
Marianna, Arkansas 72360
(870) 295-2851
http://www.uark.edu/depts/soiltest

Florida
UF/IFAS Extension Soil Test Laboratory
Wallace Building 631
P.O. Box 110740
Gainesville, FL 32611-0740
(352) 392-1950 ext. 221
http://soilslab.ifas.ufl.edu

Georgia
Soil, Plant, and Water Analysis Laboratory
University of Georgia
College of Agricultural and Environmental Sciences
2400 College Station Road
Athens, Georgia 30602
(706) 542-5350
http://aesl.ces.uga.edu

Kentucky
University of Kentucky Soil Testing Laboratory
103 Regulatory Service Bldg.
Lexington, KY 40546
(859) 257-2785
http://soils.rs.uky.edu/index.php

Louisiana
Cooperative Extension Service
Louisiana Agricultural Experiment Station
Soil Test and Plant Analysis Lab
Department of Agronomy
Baton Rouge, LA 70803
(225) 578-1261
http://www.lsuagcenter.com/STPAL

Mississippi
Soil Testing Laboratory
Mississippi State University
Cooperative Extension Service
Box 9610
Mississippi State University, Mississippi 39762
(662) 325-3313
http://msucares.com/crops/soils/testing.html

Missouri
Soil and Plant Testing Laboratory
University of Missouri
Mumford Hall
Columbia, MO 65211
(573) 882-3250
http://www.soiltest.psu.missouri.edu/

North Carolina

North Carolina Dept. of Agriculture
Agronomic Division – Soil Testing Section
4300 Reedy Creek Rd.
1040 Mail Service Center
Raleigh, NC 27699
(919) 733-2655
http://www.ncagr.com/agronomi/

South Carolina

South Carolina Agricultural Service Laboratory
Clemson University Cooperative Extension Service
171 Old Cherry Rd.
Clemson, SC 29634
(864) 656-2068
http://www.clemson.edu/agrsrvib

Tennessee

University of Tennessee Soil Test Lab
5201 Marchant Drive
Nashville, Tennessee 37211
(615) 832-4936
http://soilplantandpest.utk.edu

Texas

Soil, Water and Forage Testing Laboratory
345 Heep Center
2474 TAMU
College Station, TX 77843-2474
(979) 845-4816
http://soiltesting.tamu.edu

Virginia

Virginia Tech Soil Testing Lab
145 Smyth Hall (0465)
Blacksburg, VA 24061
(540) 231-6893
http://www.eext.vt.edu

West Virginia

WVU Soil Testing Laboratory
Division of Plant and Soil Sciences
1090 Agricultural Sciences Building
P.O. Box 6108
Morgantown, WV 26506-6108

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Chris Shaw

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C.A.H.

About the author

Craig A. Harper is a Professor and the Extension Wildlife Specialist at the University of Tennessee. His primary responsibility is assisting Extension agents and landowners with issues concerning wildlife throughout Tennessee.

Craig's passion has always been applied habitat management for wildlife, especially game species. In addition to his interest in food plots, Craig maintains an active Extension and research program involving forest management and managing early-successional cover for various wildlife species.

Craig earned an A.A.S. in Fish and Wildlife Management from Haywood Community College, a B.S. in Natural Resources Management from Western Carolina University, an M.S. in Biology from the University of North Carolina at Wilmington and a Ph.D. in Forest Resources from Clemson University. Between degrees, he worked as a wildlife technician with the North Carolina Wildlife Resources Commission.

Craig is a 9th generation North Carolinian and was raised on a small farm in the Piedmont. His interest in food plots began when, as a teenager, he sowed some ladino clover for deer in an area he cleared of leaves in the middle of the woods – and wondered why it didn't grow well! He has worked with food plots on both public and private lands throughout the South as a wildlife professional since 1988. Craig is a Certified Wildlife Biologist and a Certified Prescribed Fire Manager. Craig and his family live in Blount County, Tennessee.

A Guide to Successful

Wildlife Food Plots

Blending Science with Common Sense

- Are you planting food plots for the first time and wondering how to get started?
- Do you need information on planting equipment and/or how to read a soil test?
- Are you an experienced "food plotter" looking to take your food plots to the next level?
- Are you wondering which forages deer prefer, and what you should plant to provide needed nutrition and attract deer year-round?
- Do you need to know what herbicides you can use on various plantings for weed-free plots?
- Would you like to know how to manage food plots for food and cover for wild turkeys, bobwhites and rabbits?
- Would you like to grow the best dove field in the county, or attract ducks miles from the nearest wetland?
- Have you ever wondered how you could make your woods road into a "linear wildlife opening"?

If you answered "Yes" to any of these questions, the answers are inside this handy reference guide. Knowledge gained after years of practical experience guided by scientific study is explained clearly to help you grow and manage top-quality food plots that will benefit many wildlife species.

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