A Guide to Overseeding Warm-Season Perennial Grasses with Cool-Season Annuals

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Introduction

In the Lower South, defined as adaptation zone A in Southern Forages (1), warm-season perennial grasses are the basis of pasture systems. In the Middle South, defined as adaptation zone B in Southern Forages (1), a combination of warm-season and cool-season perennial grasses are grown. The growing season of warm-season perennial grasses in the southeastern US is from the last killing frost in early spring to the first killing frost in late autumn with the peak growing period in May and June (5). The predominant species are bermudagrass (*Cynodon dactylon* [L.] Pers.), bahiagrass (*Paspalum notatum* Flugge), and dallisgrass (*Paspalum dilatatum* Poir.).

The hot and dry periods during the summer prevent or impede persistence of cool-season perennial grasses in the Lower South. Cool-season annuals such as small grains, annual ryegrass, and legumes, are frequently overseeded on warm-season perennial grasses in autumn to achieve a year round growing season. The cool-season forages provide winter and spring grazing that reduces the need for stored forages (2), have a higher nutritive value than warm-season grasses that improves animal performance (3), provide spring weed control (4), and if a legume, adds nitrogen to the pasture system (Evers, 1985). The overseeding of warm-season perennial grasses avoids erosion since there is no deep tillage. The pasture system is ideal for animal manure application since there is year round nutrient uptake. In autumn and late spring, the growing seasons of the warm-season perennial grass and the cool-season annual overlap. In autumn it is especially difficult for a cool-season annual seedling to compete with a well established warm-season perennial grass. Periods of hot and/or dry weather during this time also contribute to the risk of cool-season annual establishment. Following is a discussion of management practices to enhance successful establishment of cool-season annuals when overseeding warm-season perennial grasses.

Reducing Warm-Season Grass Competition in Autumn

Bermudagrass has stolons and rhizomes and bahiagrass and dallisgrass have tufted rhizomes near the soil surface that make them very tolerant to close, frequent defoliation. Persistence under continuous, heavy grazing (poor management) is one of the reasons for their wide use. Under continuous grazing, they form a tight prostrate sod that shades the soil surface and is very competitive to emerging annual forage seedlings. A more upright growth and open sod

develops if the warm-season perennial grass is allowed to grow undefoliated for 4 to 5 weeks before overseeding. The top growth can be removed as hay or by flash grazing. This more open sod allows sunlight to reach the soil surface and is less competitive to emerging seedlings.

Another practice to reduce the warm-season grass competition is a light disking about from 1 to 2 inches deep. With bermudagrass growing on sandy soils, the total sod can be disked. The bermudagrass will recover in the spring from stolons, rhizomes, and roots. However, recovery will be slower than if the bermudagrass was not disked. Another option is to turn the blades on the disc almost straight. This will result in alternating strips (4 to 5 inches wide) of disked and undisked sod. This practice can be used on all warm-season perennial grasses with improved spring recovery compared to complete disking. Another advantage to light disking is that it provides some loose soil for covering the seed.

Chemical desiccants have been used to reduce warm-season grass competition. Extensive research was conducted on paraquat (1,1'-dimethyl-4,4'-bipyridinium) and glyphosate ([N-phosphonomethyl] glycine) in the 1970's (8). Paraquat activity is rapid with complete desiccation in 24 hours. However, warm-season perennial grasses initiate new growth within days after application. Complete desiccation with glyphosate takes about a week after application. Glyphosate can be phytotoxic to warm-season grasses, usually resulting in some stand loss. For good desiccation, at least 6 to 8 inches of top growth is required for glyphosate absorption and translocation which must be mowed off before overseeding. Overseeding of cool-season annuals should be delayed until 1 day after paraquat application and 1 week after glyphosate application. Use of desiccants on warm-season perennial grasses is an added cost and does not always improve early production of the cool-season forage (12).

Planting Date

The general guideline is to overseed cool-season annuals from 4 to 6 weeks before the average first killing frost date. From the cool-season forage standpoint, planting should be as early as possible when night temperatures drop to the low 60's with day temperatures in the low 80's. Germination and seedling growth is rapid under these mild temperatures. As planting is delayed, cooler temperatures slow germination rate and seedling growth which result in lower autumn and winter forage production. The risk with early planting is that periods of high temperatures and/or limited rainfall following planting, can result in stand reduction or loss of the overseeded annual. When cool-season forages are planted early, they also have to compete with a more vigorous warm-season perennial grass sod. A light disking of the warm-season perennial grass is essential for successful early planting. Without disking, planting should be delayed until night temperatures are consistently below 60°F to slow growth of the warm-season perennial grass.

Cool-Season Annual Species

Annual ryegrass (*Lolium multiflorum* L.), rye (*Secale cereale* L.), wheat (*Triticum aestivum* L.), and oat (*Avena sativa* L.) are the primary cool-season annual grasses used for overseeding warm-season perennial grasses. Their rankings for cold tolerance, maturity, and yield are listed in Table 1. Rye has a tendency to do better on sandy soils and wheat on loam and clay soils that are well drained. Rye and wheat are usually mixed with annual ryegrass to extend the grazing season. Small grains provide more forage production in autumn and winter than annual ryegrass but they mature from late March to mid-April. Annual ryegrass is productive through spring.

Annual ryegrass is the most popular cool-season annual for overseeding in the southeastern US. It is adapted to all soil types and does better on poorly drained soils than the small grains (11). In contrast to the small grains, successful ryegrass stands can be obtained by broadcasting the seed on the soil surface. However, thicker stands occur if ryegrass seed is placed from ¼ to ½ inch in the soil. Seed cost per acre is less than other cool-season annual forages and ryegrass has the ability to volunteer each autumn if managed for reseeding.

Cool-season legumes are more soil specific than grasses and therefore producers must know their soils and select the best adapted legume species. Preferred soil characteristics and species traits are listed in Table 2 (10). It is recommended that ryegrass be mixed with legumes for grazing. The ryegrass provides earlier grazing than the legume alone and reduces the potential for bloat. Another advantage for mixing ryegrass with the small seeded legumes is that the ryegrass can act as a carrier for the legume seed if a planter with a small seed box is not available. A more extensive discussion of legume species, management, and utilization is reported by Evers (7).

Seeding Rates

Recommended seeding rates are reported in Tables 1 and 2. Using a drill places a higher percentage of the seed at the proper planting depth resulting in better stands than broadcasting the seed and covering the seed with a drag or packer. Seeding rates should be increased from 25 to 35 % when broadcasting seed to get the same stand density as drilling the seed. When a small grain-ryegrass mixture is planted, the normal small grain seeding rates are used with from 20 to 25 lb/acre of ryegrass. For legume-ryegrass mixtures, from 15 to 20 lb of ryegrass is planted with 2/3 the recommended seeding rate for a pure stand of the legume.

Planting Methods

Planting options are a light disking followed by drilling or broadcasting the seed, drilling the seed in an undisturbed sod with a sod seeder, or broadcasting the seed on an undisturbed sod. In all cases, it is critical for the warm-season perennial grass to be as short as possible by using a hay harvest, grazing, or mowing. Mowing may not be a good option if the grass is very tall since the cut grass will act as a mulch and shade the soil surface. As stated previously, light disking

reduces the summer grass competition permitting early planting and some loose soil for covering the seed. If seed are broadcast on a lightly disked sod, some type of drag should be used to help cover the seed.

Sod seeders are equipped with fluted coulters that cut a slit in undisturbed sod followed by some type of opener that places the seed in the slit.

In both scenarios the small grain seed should be placed from ½ to 1 inch deep for good stands. If the small grain seed is broadcast on a disked sod, the area should be disked lightly again to help cover the seed. Annual ryegrass and most legumes should be planted from ¼ to ½ inch deep. It is best to broadcast very small seeded legumes like ball (*Trifolium nigrescens* Viv.) and white (*Trifolium repens* L.) clovers on the soil surface. Attempts to drill the small seed in the soil usually put the seed too deep and results in poor stands. Large seeded legumes like hairy vetch (*Vicia villosa* Roth.) must be placed in the soil ½ to 1 inch deep.

Placing the legume seed in the soil has several advantages. If the seed is in the soil, the emerging root system can reach soil moisture sooner and have better drought tolerance. This is especially important in sandy soils where the soil surface dries out quickly after rainfall. A second advantage to legume seed burial is survival of the *Rhizobium* bacteria, which is responsible for N_2-fixation. The bacteria are sensitive to sunlight and high temperatures. Preinoculated legume seed is coated and offers some protection of the rhizobia bacteria if the seed is broadcast on the soil surface.

Broadcasting seed on an undisturbed sod is an option only for annual ryegrass and small and medium seeded legumes. Dragging the area after broadcasting the seed is recommended to shake down any seed caught in the grass stubble to the soil surface. Average recommended seeding rates should be increased at least 25% to compensate for a smaller percentage of the seed becoming established as seedlings. Seeding must be delayed until late autumn when low temperature slow growth of the warm-season perennial grass.

Annual ryegrass and most legumes can be mixed with the first fertilizer application and broadcast on a lightly disked or undisturbed grass sod. It is important that the fertilizer and seed be spread within 6 to 8 hours of mixing or reduced germination and seedling vigor may occur (6). Survival of the rhizobia on the legume seed may also be affected.

Warm-Season Grass Recovery

Mid to late spring is the other period when the growing seasons of the cool-season annual and warm-season perennial grass overlap. Late maturing cool-season annuals such as arrowleaf clover (*Trifolium vesiculosum* Savi) and annual ryegrass are the most competitive. Recovery of the warm-season grass is especially slow in a dry spring because the cool-season annual has depleted all the soil moisture. The nutritive value of warm-season perennial grasses peaks in the

spring. If overseeded with late maturing annuals, the first hay harvest with the highest nutritive value is lost.

Management practices such as light disking and short warm-season perennial grass height enhance early forage production of overseeded cool-season annual forages. These same practices however, slow spring recovery of the warm-season perennial grass. A 3-year study at the Texas A&M University Agricultural Research and Extension Center at Overton has shown that the autumn sod treatments hindered Coastal bermudagrass recovery even if not overseeded (Table 3). Compared to undisturbed sod, light disking reduced first harvest bermudagrass yields by an average of 600 to 700 lb/acre. Compared to the 4-in. sod height, the 1-in. sod height reduced bermudagrass yields an average of 500 lb/acre when overseeded with clover, and 250 lb/acre when overseeded with ryegrass or not overseeded. Winter weeds were present on the Coastal bermudagrass that was not overseeded demonstrating the cool-season forage benefit of weed control.

Volunteer Reseeding of Cool-Season Annuals

Legumes that produce a high percentage of hard seed and annual ryegrass are capable of volunteer reseeding each fall. The first requirement for successful reseeding is to produce sufficient amount of seed in the spring. Stocking rates may have to be reduced or terminated by a certain date for satisfactory seed production (9). High temperature dormancy in annual ryegrass is the mechanism that prevents summer seed germination (14). Volunteer ryegrass does not germinate until mid or late autumn because of the high temperature dormancy trait. Purchased ryegrass seed will germinate when planted in early autumn. Broadcasting about ½ the normal ryegrass seeding rate will improve early forage production. Embryo dormancy and hard seed coat are the mechanisms in legumes that reduce summer seed germination (13). The initial percentage of hard seed is dependent on species and sometimes the climatic conditions during seed maturity (15). Alternating high and low temperatures and wet and dry periods cause the hard seed to soften. The rate at which hard seed soften also varies by species.

Whether to manage the cool-season annual for reseeding and sacrifice some loss of grazing or to graze the cool-season forage out and replant the following autumn is a management decision that varies with producer and economic situation. Usually by mid-April there is sufficient forage growth on other warm-season perennial grasses that were not overseeded to support the livestock that were grazing the winter pasture. The monetary savings would be the planting and seed costs to reestablish the cool-season forage in the following autumn. If the overseeded pasture is utilized by young growing animals that have a high nutrient requirement, it may be more economical to graze it out and replant each autumn. Allowing the cool-season annual to reseed will delay recovery of the warm-season perennial grass.

Summary

Overseeding warm-season perennial grasses with cool-season annuals in the southeastern US has many benefits. Because the growing seasons overlap in autumn, management practices to reduce the warm-season grass competition are necessary. Cool-season forage production and distribution is dependent on species, seeding rates, and planting methods. Growing seasons also overlap in spring which delays spring recovery of the warm-season grass.

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Table 1. Cool-season annual grass traits and seeding rates.

Species	Cold tolerance	Maturity	Yield	Seeding rate
				lb/ac
rye	1+	1++	4	90-120
wheat	2	2	3	90-120
oats	3	3	2	90-120
ryegrass	3	4	1+++	25-30

+1 = most cold tolerant
++1=earliest maturity
+++1=highest yield

Table 2. Cool-season annual legume species, preferred soil characteristics, plant traits, and seeding rates.

Species	Soil			Plant				Seeding rate
	pH	Texture	Drainage	Maturity	cold tolerance	Bloat potential	Reseeding potential	
Arrowleaf	6.0-7.0	sand, loam	good	late	good	low	high	8-10
Ball	6.5-8.0	sand, loam, clay loam	fair	medium	good	high	high	2-3
Berseem	6.5-8.5	loam, clay	poor	medium	poor	low	low	12-16
Crimson	6.0-7.0	sand, loam	good	early	good	medium	low	16-20
Persian	6.0-8.0	loam, clay	poor	medium	fair	high	medium	6-8
Red	6.5-8.0	loam, clay	good	late	good	low	low	10-12
Rose	6.0-8.0	sand, loam, clay	good	medium	good	low	high	12-16
Subterranean								
subterranean sp.	6.0-7.2		fair	medium	fair	medium	low	16-20
brachycalcinum sp.	7.0-8.0	loam clay loam clay	fair	medium	poor	medium	low	16-20
Sweetclover, annual	6.5-8.0	loam, clay	fair	medium-late	good	medium	high	12-15
Medics, annual	7.0-8.0	sand, loam, clay	fair	early	poor	high	high	10-12
Vetch	5.5-8.0		good	medium	good	low	low	20-30
White	6.0-7.5	loam, clay	poor	late	good	high	high	3-4

Table 3. First harvest yields of Coastal bermudagrass following fall sod treatments (1 vs. 4 in. sod, control vs. disking) and overseeding of arrowleaf clover, crimson clover, ryegrass, or not overseeding at Overton (3-year mean).

	Sod height					
	1 in.	4 in.	Mean	1 in.	4 in.	Mean
	----------Coastal bermudagrass (lb/acre)----------					
	Arrowleaf overseeded			Crimson overseeded		
Control	1459	2069	1764*	1870	2492	2181
Disk	906	1263	1085	1466	1718	1592
Mean	1183	1666		1668	2105	
	Ryegrass overseeded			Not overseeded		
Control	1522	1778	1650	1989	2260	2125
Disk	887	1142	1015	1407	1602	1505
Mean	1205	1460		1698	1931	

*All means between sod heights and undisturbed vs. light disking, significantly different at 0.05 level, $P < 0.001$.