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Using Cool-Season Annual Grasses for Grazing Livestock

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Introduction

From 2006 to 2010, the Texas Specified Performance Analysis indicated that producers lost an average of $163 per cow, but 32 percent of beef producers surveyed made profits in excess of $82 per cow. In 1986 the noted forage scientist Carl Hoveland stated that "the greatest opportunity for profitable beef production in the southeastern U.S. is through retained ownership of calves through the stocker phase on high-quality pastures." This is just as true today as it was over 25 years ago.

Use of Cool-Season Annual Forages

Cool-season annuals can be used as hay, silage or pasture. Pasture is the primary use because spring weather, when these forages make most of their growth, is not favorable to forage preservation. However, a hay cutting can be obtained in mid-April to May if cattle stocking rates are not adequate to keep up with rapid grass growth. Small grains make the highest quality hay when cut in the boot or flag leaf stage. Annual ryegrass should be cut no later than the early head stage. Because good hay drying weather is rare in spring, making round-bale silage instead of hay may be a viable option for dairy or stocker cattle producers who need the highest possible forage quality. For more information on managing cool-season annual grasses for hay and silage production, refer to University of Arkansas fact sheet FSA3063, *Using Cool-Season Annual Grasses for Hay and Silage*.

Winter annuals are an important part of Arkansas forage production. They decrease dependence on stored forages such as hay and silage and decrease purchased feed expense by providing green grass for grazing in winter months. When interseeded into dormant warm-season grass pastures, cool-season annuals produce forage on acreage that would be nonproductive in the winter months. Lastly, wheat pastures have the potential to be used for both grazing and grain production if managed properly.

Cool-season annual grasses are extremely high in nutritive quality from the early fall through the spring, enabling growing calves to gain bodyweight at rates in excess of 2 to 2.5 pounds per day. A disadvantage of cool-season annuals is that cows may become too fat for optimal calving and rebreeding performance if allowed unlimited intake of these forages. This may be managed by increasing stocking rates to reduce individual cow intake or by limit-grazing (limiting cow access time to annuals). Limit-grazing of winter annuals is a practical method for using the benefits of these forages for cows while minimizing the area that needs to be planted to annuals. Under limit-grazing, cows are routinely pastured on dormant pasture or dry-lot but are allowed to eat their fill from a limited-access winter annual pasture several times per week. At the University of Arkansas Southwest Research

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and Extension Center (SWREC) near Hope, Arkansas, limit-grazing of beef cows and calves on 0.2 acre of wheat/rye/ryegrass per head for two days per week produced the same cow, calf and rebreeding performance as cows fed unlimited hay plus a supplement, but limit-grazed cows consumed 30 percent less hay during the winter feeding period. Winter annuals can also be used as creep pastures for calves, a method that maximizes the benefits of the high-quality forage for promoting calf performance while keeping cows from becoming too fat. In creep grazing systems, calves are allowed unlimited access to excellent pasture via creep gates or a single electric wire set high enough so that they can walk under it but cows cannot.

Establishment

Cool-season annual pastures are typically planted in the fall as early as local conditions allow. Planting date has a large impact on fall forage production. In clean-tilled or no-tilled crop fields, planting of these pastures for fall pasture is recommended to be done by the first week of September. Calves may be stocked at 1 to 1.5 calves per acre by the first of November in well-managed small grain fields. When interseeded into a warm-season grass sod, they must be planted later to decrease competition between warm-season grasses and cool-season annual seedlings. Fall growth of interseeded cool-season annuals is thus less than in dedicated crop fields, but moderate levels of grazing may be attained at reduced stocking rates compared with crop fields. Often calves may be placed on interseeded pastures by early to mid-December at 1.5 to 2 acres per calf.

Dedicated Crop Fields

Planting wheat and other cool-season annuals for grazing should occur earlier than recommended for grain production. Wheat has been planted in dedicated crop fields at the Livestock and Forestry Research Station (LFRS) in Batesville during the first week of September every year since 1996. This planting date has resulted in grazeable pasture by late October or early November in most years. Planting early can provide ideal habitat for pests, such as fall armyworms, and stands can be decimated in a short period of time in these early-planted fields. So, fields should be scouted regularly and sprayed when necessary for these pests.

Methods for establishing cool-season annuals may include preparing a clean seedbed by deep-tilling the soil prior to planting, no-till drilling seed into an undisturbed seedbed or broadcasting seed using a spreader or aerial application into a lightly disturbed seedbed. However, producer decisions, such as tillage method and planting date, can have a large impact on animal performance. No-till has become more favorable because of the reduction in time requirements for field preparation, fuel and labor costs and required equipment. Additional benefits of no-till for establishment of small grain pastures include fewer planting delays due to wet fields and reduced bogging by livestock.

Planting depth should be about 1 inch for small grain species but should be much shallower (about ¼ to ½ inch) for annual ryegrass. In clean-tilled situations, seedlings planted in a dry seedbed may be affected by hard rains, causing the soils to crust. Seedlings sprouted by the rain may be unable to emerge through this crusted soil, thus causing stand failure to occur. No-till fields with adequate residue on the soil surface do not have issues with crusting. For more information on the relative advantages and disadvantages of conventional, reduced and no-till establishment of small grain pastures, refer to University of Arkansas fact sheet FSA3116, *Impact of Conservation Tillage Practices on Winter Wheat Production for Grazing Stocker Cattle.*

Interseeding Into Warm-Season Pastures

Interseeding cool-season annuals into a warm-season grass sod can provide some advantages and disadvantages to the operation. High-quality forage can be grown on a site that will not be used until the following summer, and cool-season pastures interseeded into warm-season grass sod will have reduced bogging by livestock compared with conventionally tilled pastures in crop fields. Pastures can be established using a no-till drill to cut through the sod and place the seed into the soil or by lightly disking the pasture to disturb the sod, spreading the seed with a conventional fertilizer spreader and then harrowing to cover the seed. The disadvantage of the no-till drilling method is the requirement of the specialized drill. The disk and spread method has the disadvantages of disrupting the sod, which may cause fields to be rough and uneven, and the lack of ideal seed placement.

Competition from warm-season sods that have not yet gone dormant is the most serious problem for early sod-seeding of winter annuals in Arkansas. Warm-season grass on interseeded sods must be controlled in some way prior to planting winter annuals. Warm-season pastures should be prepared by grazing or haying to 3- to 4-inch stubble height. Plant 100 to 120 pounds per acre of small grain and 20 pounds per acre annual ryegrass when the warm-season grass growth slows. This is usually early October in northern Arkansas and mid-October in southern Arkansas, but the recommended planting date changes due to conditions in the local area each year. If growth of bermudagrass or other warm-season grasses has not slowed, then rains that cause seedling cool-season grasses to emerge will also

stimulate warm-season grasses to grow and choke out the seedlings.

Bermudagrass pastures can be sprayed with a low dose of Roundup or generic glyphosate (1 pint of 41 percent glyphosate per acre) to force bermudagrass into dormancy. This will allow seeding of cool-season annuals in early to mid-September, with little risk of competing warm-season grasses choking out newly emerged seedlings. Research conducted at SWREC during the fall and winter of 2005 and 2006 compared planting wheat and annual ryegrass in mid-September or mid-October with and without an accompanying application of glyphosate at planting (Table 1). Calves were able to start grazing pastures planted in September on January 18, while pastures planted in October were grazed starting on February 15 when pastures accumulated 2,600 pounds of forage dry matter (DM) per acre. The stands of cool-season annuals were reduced when pastures were planted in September without glyphosate, and gains during the winter grazing period were reduced by about ½ pound per day in these pastures compared to pastures sprayed with glyphosate at planting. Pastures planted in October were not as greatly affected by glyphosate application as earlier planted pastures. Overall, pastures planted in September with glyphosate produced 45 more animal grazing-days per acre, 140 pounds more calf gain per acre and $100 greater return per acre (using market conditions in 2006). In conclusion, earlier planting along with reduced competition by spraying warm-season grasses before interseeding can increase carrying capacity, animal bodyweight gain and net return of interseeded cool-season annual pasture.

No matter how the interseeded pastures are established, plans should be made to fully utilize the pastures before the warm-season grasses break dormancy in the spring or the cool-season annuals will shade out the warm-season grasses, thereby weakening or killing the stand.

Plant Characteristics and Nutritive Quality

Cool-season annual grass forages are extremely high in CP (> 25 percent DM basis) and low in fiber (40 to 49 percent neutral detergent fiber (NDF) and 19 to 29 percent acid detergent fiber (ADF), DM basis) during the fall and early spring (Table 2). During the late fall and winter there are slight decreases in crude protein (CP) and increases in fiber. This is associated with increased age of leaves as forage growth slows during the winter months. When rapid forage regrowth resumes during the early spring, there is an uptick in forage protein and a slight decline in fiber content. As the plants begin to

Table 1. Effects of glyphosate application on warm-season grass sod and planting date of interseeded cool-season annuals on forage production and performance of grazing beef calves at Hope, Arkansas, during the 2005-2006 production year.

	Planting Date			
	September		October	
Item	No Spray	Glyphosate	No Spray	Glyphosate
Grazing start	January 18	January 18	February 15	February 15
Winter ADG, lb/d	1.95	2.49	1.67	2.20
Spring ADG, lb/d	2.40	2.30	2.07	2.44
Total gain/calf, lb	244	267	163	197
Calf grazing days/acre	176	220	182	173
Bodyweight gain/acre	392	539	385	402

Table 2. Forage nutritive content of cool-season annual grasses from research over 10 years (2003 to 2013) at the University of Arkansas Southwest Research and Extension Center in Hope, Arkansas, and Livestock and Forestry Research Station near Batesville, Arkansas.

Month	Crude Protein	Neutral Detergent Fiber	Acid Detergent Fiber	Dry Matter Digestibility
November	30.7	39.6	18.1	78.8
December	24.9	39.8	19.2	78.7
January	24.6	46.4	21.1	74.3
February	25.2	46.1	21.8	74.5
March	26.4	44.5	21.5	75.5
April	21.0	50.9	28.5	71.2
May	19.3	57.2	36.0	67.1

mature in April and May, forage protein decreases precipitously and fiber content increases dramatically. Even though increases in fiber concentration (increasing to over 50 percent NDF) and reductions in CP concentrations (decreasing to 20 percent DM basis) were noted during April and May, CP content and digestibility of the forages were greater than animal requirements for a 550-pound growing steer to gain in excess of 2.5 pounds per day until the end of the spring grazing season each year. This indicates that this forage provides a nutrient-dense diet for grazing cattle, and any differences in animal performance are likely due to restrictions in forage availability.

Mineral Content

Mineral imbalances and deficiencies can be easily rectified by feeding a balanced mineral supplement. The calcium level of these forages is low and phosphorus is generally adequate, so a low phosphorus mineral is called for. In heavily fertilized pastures with high levels of potassium, magnesium levels can be too low for lactating cows. A high-magnesium mineral supplement should be provided from a month prior to calving through the rest of the spring.

Forage mineral content was analyzed in research conducted at LFRS over the 2010-2011 and 2011-2012 production years. Wheat forage in 2010-2011 was adequate to borderline deficient in Ca yet was deficient in Ca in 2011-2012. Phosphorus content was adequate during both years. In 2010-2011 the Ca:P ratio ranged between 1.4 to 2.3, yet the Ca:P ratio in 2011-2012 indicates an imbalanced state, ranging between 0.92 to 1.1. Magnesium content of wheat forage was above the suggested requirement value and within the acceptable range set on all sampling dates in both years. But, the potassium content of the wheat forage was in excess of requirements and at some sampling points approached or exceeded the maximum tolerable level of 3 percent. Thus, the ratio of K in relation to Ca and Mg, calculated by K/(Ca+Mg), indicates an imbalanced state in wheat forage and for all sampling dates exceeded the 2.2 ratio that indicates grass tetany potential. While this has been found to be an issue for lactating cows, the importance of this ratio for growing steer calves has not been established. This indicates that growing cattle on wheat pasture require mineral supplementation that is low in P in relation to Ca and do not necessarily need to be supplied with additional K or Mg.

The level of Cu supplied by the wheat forage was analyzed to be within the adequate range (4 to 10 ppm) at all sampling points during both years of the experiment. Zn content was near or below the 30 ppm suggested level during the fall and early spring but was generally adequate during the late spring grazeout period.

Species and Varieties

Winter wheat is the most widely grown winter annual in the U.S. Most wheat grown in Arkansas is soft red winter wheat. It is dependable, high in quality, adapted to a range of climates and soils and tolerant of grazing. The seed cost per acre to plant wheat is consistently among the lowest of all the winter annual forages, which contributes a great deal to its popularity. Wheat grows at temperatures between 38°F and 77°F. In Arkansas, most sod-seeded wheat pastures are used solely for grazing and potentially provide pasture from January to April, with peak forage availability in March. Once wheat has begun to head, regrowth potential is minimal.

Wheat also has potential as a dual-purpose crop where grown for grain. If cattle are removed from soft red winter wheat pastures at the time wheat stems begin to elongate (jointing), a grain crop can be harvested with little effect on grain yield. Dual-purpose wheat may provide grazing as early as November when planted early under ideal conditions. (refer to FSA3130, *Dual-Purpose Wheat Systems for Grazing and Grain or Hay Production in Arkansas*, for more information.)

Almost all wheat varieties were developed for maximum grain yield under a specific combination of environmental factors to fit specific areas of the U.S. There is little data on forage production of soft red winter wheat varieties, although Oklahoma researchers found that grain yield was not a good predictor of prejointing forage production in hard red winter wheat varieties. It is not proven whether the same relationship holds for soft red varieties. Therefore, the most important consideration when selecting a soft red wheat variety should be adaptation to local conditions.

Arkansas Small-Grain Cultivar Performance Tests is published annually by the Arkansas Agricultural Experiment Stations. This publication reports only grain yields, but some useful information for screening wheat varieties for forage potential can be found in it. Useful information in the report includes disease ratings in different parts of the state (low disease ratings are desirable for both forage and grain production) and date of heading (which can vary among varieties by up to three weeks at a location).

Cereal Rye

Cereal rye is the most cold-tolerant of the cool-season annual species. Rye is the second most common small grain grown for forage in Arkansas. Rye is unique among the small grains in that it can reseed itself to some extent. This makes it unwanted for winter grazing where a grain crop will also be harvested, because volunteer rye is difficult to

remove from wheat grain crops. However, rye is an excellent winter annual choice when all forage will be grazed. It grows at cooler temperatures than any other winter annual and on average makes more forage in late fall, winter and early spring than wheat, oats or annual ryegrass. Rye is the earliest to head of all the winter annuals but will make some regrowth if not grazed too close and often. When given a choice, cattle find rye to be slightly less palatable than other winter annuals. Rye is more adapted to better drained soils and lower pH than other small grains. Rye seed is usually more expensive than wheat, but since rye often yields more forage, it is often cost effective.

Some rye varieties were developed specifically for forage. These include 'Koolgrazer,' 'Elbon,' 'Maton' and 'Wintergrazer 70.' Cattle producers should avoid planting rye varieties that were developed for grain production.

Oats

Oats are the least cold-tolerant of the cool-season annual species. Oats are not as widely used as wheat or rye but have some excellent characteristics. Oat forage is extremely palatable. Compared to wheat, oats make more fall growth, head out slightly later in spring and typically yield slightly less. The price of oat seed is generally intermediate between wheat and rye. The main disadvantage of oats is lack of cold tolerance, and a severe winter poses the risk of extensive stand loss in any part of Arkansas. Oats are also more susceptible to leaf rusts than wheat or rye, especially in southern Arkansas.

The *Arkansas Small-Grain Cultivar Performance Tests* report contains winterkill and rust rating information for oat varieties that were evaluated for grain production. 'Ozark' and 'Bob' are time-tested varieties for forage throughout the state.

Triticale

Triticale was developed by crossing wheat with rye. It retains the high palatability of wheat with the vigor of rye, has produced yields similar to rye in Arkansas forage tests and has an intermediate heading date. It is not as cold-tolerant as rye. Seed is usually more expensive than rye and can be difficult to obtain. If seed can be obtained at a price near that of rye seed, triticale may be a good option.

Annual Ryegrass

Annual ryegrass provides a long period of high-quality forage growth in the late spring. Annual ryegrass is an outstanding winter annual forage for Arkansas. This grass will reseed itself aggressively if allowed, although drilling some new seed every year is recommended as insurance. The forage is palatable, high-quality and abundant, and average yields are higher than for any of the small grains. This grass is later to mature than small grains, reaching peak production in early May and often producing some forage well into June. Ryegrass will tolerate wetter soils than wheat or oats and is more tolerant of poor fertility than the small grains. Annual ryegrass is the best winter annual for emergency plantings. It may succeed when planted as late as December in south Arkansas, although the risk of frost damage is higher. Ryegrass can also be planted from late January to February as an emergency spring forage. The seed cost per acre to plant ryegrass is usually cheaper than planting wheat or other small grains, making it a very economical choice.

The key factor when selecting a ryegrass variety for regions of Arkansas is cold tolerance. Leaf rust is not usually a serious problem on ryegrass in Arkansas, but varieties do differ in resistance to rust if this is a local problem. There is some variability in heading date among varieties. 'Marshall' is the time-tested variety throughout the state, and its performance is still hard to beat. Other varieties that can perform well throughout the state are 'Jackson,' 'Surrey' and 'Rustmaster.' In southern regions, 'Gulf,' 'Multimo,' 'Tetrablend 444' and 'Florida 80' can be used, but these varieties lack enough cold tolerance for northern regions. There are many new varieties of annual ryegrass that have performed as well as 'Marshall' in forage tests in neighboring states but have not yet been widely tested by actual use in Arkansas. These promising new varieties include 'Big Daddy,' 'Stampede,' 'Passerel,' 'Ribeye,' 'Rio,' 'Winter Hawk,' 'Striker' and 'Nelson.'

Research conducted at LFRS and SWREC comparing the small grain species for stocker cattle production indicates Arkansas producers have the opportunity to utilize soft red winter wheat, ryegrass or combinations of rye and ryegrass or wheat and ryegrass with little difference in cattle performance and economic efficiency. Utilization of oats and rye alone or combinations of small grains (the wheat and rye or wheat, rye and ryegrass combinations) did not result in superior animal performance or profitability over the time of this study. The choice of which cool-season annual combination to interseed into bermudagrass sod is dependent on climatic conditions. However, interseeding rye or wheat is generally superior in animal performance and profitability to other small grains. In southern Arkansas, there appears to be little advantage in utilization of oats in the interseeding program, and triticale offered no benefit compared to planting annual ryegrass alone. Annual ryegrass is a necessary addition when interseeding cool-season annuals into bermudagrass sod for grazing programs to produce the highest

possible animal performance, bodyweight gain and profitability. In crop fields, planting ryegrass alone and wheat alone or combinations of rye with ryegrass or wheat with ryegrass were the most profitable alternatives. The late maturity of annual ryegrass can cause issues with shading of warm-season grasses if the ryegrass is not grazed or cut for hay or silage in a timely manner in the spring.

Forage Yield and Setting Stocking Rates

The forage production of cool-season annual grasses follows a biphasic production curve in which productivity during the fall and winter is at a much lower level than during the spring. Thus, stocking rates are necessarily much less in the fall and winter from early November to late February (1 to 2 acres per calf) than in the spring from late February to early May (2 to 3 calves per acre). Stocking rate is a fundamental variable for managing pastures, and there is a distinct relationship between stocking rate and animal performance for each forage type. Research from Oklahoma indicates that steers' dry matter intake and thus performance is limited on wheat pasture that has less than 1,100 pounds of forage dry matter per acre. Thus, pastures should not be stocked with livestock until forage production has at least reached this level.

In order to determine the forage allowance that would result in the optimal stocking rate for fall and winter grazing of cool-season annual pastures, the wheat forage production and steer performance from 10 years of experiments at SWREC and LFRS were used to determine the response of average daily gain (ADG) to forage allowance (pounds of forage DM per pound of calf bodyweight). Managers are faced with decisions regarding stocking rate at the beginning of the grazing season with only the forage produced up to that point to consider in setting the stocking rate. The response of ADG to the initial forage allowance indicates that a maximum ADG of 2.7 pounds per day could be expected at 5.0 pounds forage DM per pound of initial calf bodyweight, and ADG of 2 pounds per day could be expected at an initial forage allowance of approximately 2.4 pounds of forage DM per pound of initial calf bodyweight (Figure 1).

When determining the stocking rate for calves being placed on cool-season annual pasture, care should be taken to ensure that forage growth has at least reached 900 to 1,000 pounds of forage dry matter per acre. Additionally, the stocking rate should be set so that animal production goals are met. Referring to Figure 1, if gains of at least 2 pounds per day are desired, then calves should be allowed at least 2.4 pounds of forage DM per pound of animal bodyweight. Therefore, if 500-pound calves are to be placed on cool-season annual pasture, then it would require approximately 1.2 acres per calf of pastures containing 1,000 pounds of forage DM per acre. An easy-to-gauge rule of thumb is that there are approximately 200 pounds of forage DM per acre for every inch in plant height. Therefore, to reach the goal of 1,100 pounds of forage DM per acre, pastures should not be stocked until they reach at least 5 to 6 inches in height.

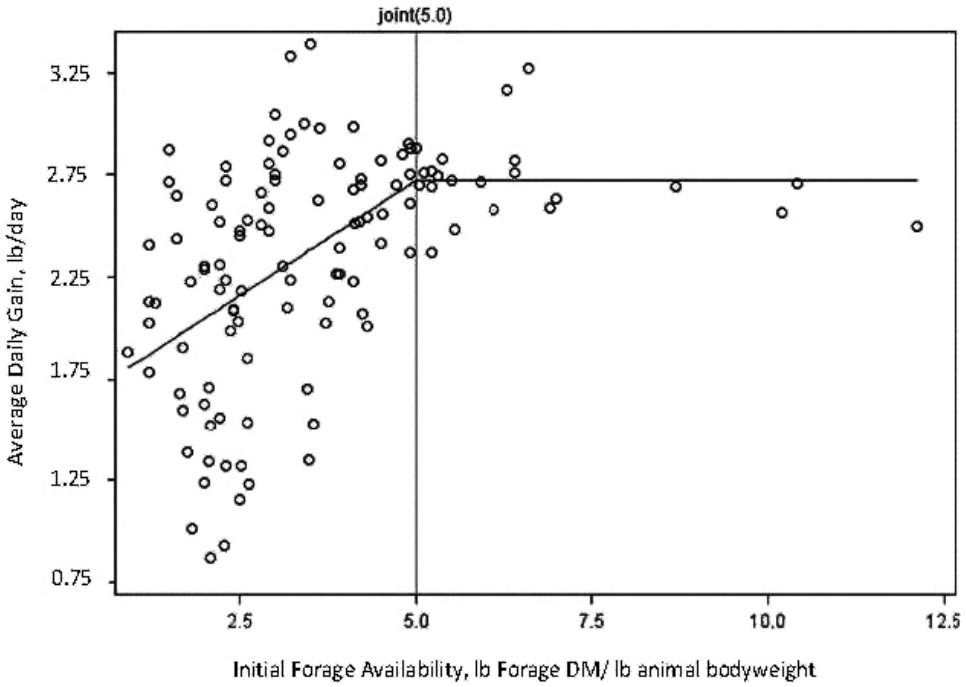

Figure 1. Average daily gain vs. initial forage availability.

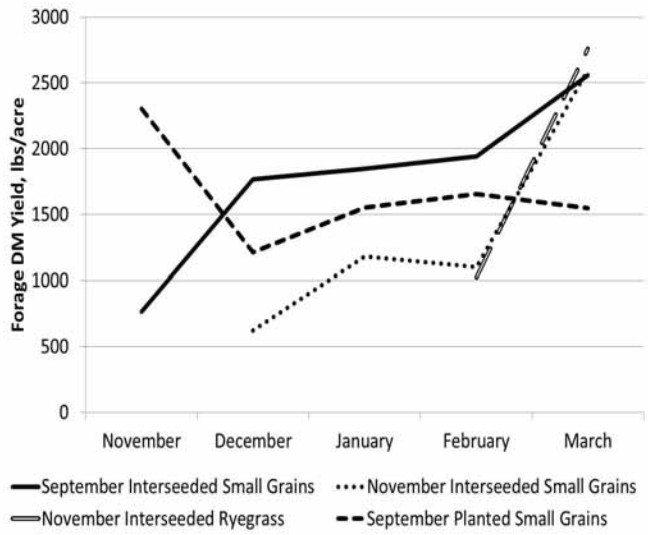

Figure 2. Forage DM yield per acre of cool-season annual grasses planted at the University of Arkansas SWREC and LFRS during the fall of 2011.

Figure 2 shows the yield of available forage of cool-season annual pasture planted at LFRS and SWREC in the fall of 2011. Crop fields at LFRS were planted during the first week of September. These fields were planted to wheat using either conventional clean tillage methods or no-till. By November these pastures produced an average of 2,250 pounds of forage DM per acre. Compare these yields to that of small grains (wheat or cereal rye mixed with ryegrass) interseeded into warm-season grass sod from mid-September to mid-October. These fields only produced about 750 pounds of forage DM per acre by November and were not ready to be stocked with calves until December. When interseeding was conducted in November (which incidentally was the planting date if a producer was to wait to plant in ideal conditions following a rain), stocking was delayed until January. And finally, if only ryegrass was planted at the November planting date, stocking was delayed until February. This is data from only one year, but it is an excellent example of how seemingly short delays in planting can have large impacts on forage growth and subsequent animal grazing.

Ongoing research at the SWREC confirms that management of ryegrass is critical to preventing excessive delay of bermudagrass development. Pastures should be stocked heavily enough in April and May to prevent formation of a dense canopy of headed-out ryegrass that will shade the understory warm-season grass and delay its growth. If extra cattle cannot be added to pastures to handle the flush of ryegrass growth, part of the pasture should be set aside for a hay cutting to be made when ryegrass is in the boot to early head stage. Otherwise, forage may temporarily be in short supply during the transition period from ryegrass to warm-season grass.

Fertility

Pastures where winter annuals will be grown should be maintained at soil pH above 6.0 for best productivity. Warm-season grass pastures (bermudagrass or bahiagrass) intended for winter annual production should not be fertilized with nitrogen after August because this will delay the onset of dormancy and encourage too much fall warm-season grass growth. Nitrogen application for sod-seeded winter annuals should be delayed until after sods are dormant (October in the north, November in the south) to ensure the nitrogen is used by the annual forage.

Phosphorus and potassium can be applied at planting as indicated by soil testing or can be applied with the nitrogen. For small grains, a second nitrogen application should be made when forage begins to joint (usually in February). If annual ryegrass is being used, a third split application of nitrogen in April gives that grass a boost in productivity. Winter annuals can easily use 50 pounds of actual N per acre at each fertilization (150 pounds per acre ammonium nitrate or 100 pounds per acre urea).

Bloat

The disadvantages of cool-season annuals are few and easily controlled with management and nutrition. These forages can be bloat-provocative when forage is lush. Bloat is caused when the rapidly degradable soluble protein and sugars are released from the plant cell. These can cause a stable matrix to form on the top of the mat of rumen contents. As fermentation gases pass through this matrix, it causes a foam to form that is not easily disrupted by ruminal contractions. Calcium deficiencies can be a contributing factor in bloat as ruminal contractions may be less frequent and weaker.

The incidence and severity of bloat is easily reduced by providing a supplement containing Rumensin (monensin sodium, Elanco Animal Health). If and when bloat is observed, Bloat Guard (poloxalene) supplements can be provided as a treatment. This provides the benefits of improved rate of gain of about ¼ pound per day for grazing stocker calves supplied Rumensin and provides an avenue to rapidly respond when bloat is present. Both Rumensin and poloxalene are labeled for self-feeding to growing cattle. Other ionophores can be used to improve animal performance, but only Rumensin has been shown in research settings to decrease the incidence and severity of wheat pasture bloat.

Pest Control

Control of common broadleaf weeds (buttercup, henbit, chickweeds) in winter annuals is easily accomplished using 2,4-D. The most effective control with the least amount of chemical is obtained by spraying when weeds are small and weather is warm. February to early March works well in most areas. Good fertility promotes a thick, healthy stand of annual grass that competes well with weeds, as well as helps plants to resist disease and insect pressure.

Disease problems such as leaf rust, powdery mildew, barley yellow dwarf virus, rhizoctonia and helminthosporium can be minimized by late planting, using resistant varieties and using fungicide-treated seed. Homegrown grain from diseased stands should not be used for seed.

The insect most likely to cause problems in winter annual stands grown for forage is the armyworm (both the true armyworm and fall armyworm species). Fall armyworms can destroy a seedling stand of winter annuals in a single day if infestations are heavy. Seedlings will not recover unless at least 4 inches of shoot remains. Risk is higher for early-planted stands since fall armyworm activity decreases as weather gets colder. Stands should be sprayed if there are more than five armyworms per square foot. Always follow label instructions for grazing withdrawal periods. For more information regarding product pesticide use, refer to University of Arkansas miscellaneous publication MP144, *Insecticide Recommendations for Arkansas*.

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