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Producing Hay from Native Warm-Season Grasses in the Mid-South

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Introduction

What Are Native Warm-Season Grasses?

Native warm-season grasses (NWSG) are those that have grown in an area prior to human settlement and were not brought in more recently from other parts of the world. Such grasses are naturally well-adapted to the region's soils, climate and the insects and diseases that may also occur naturally in the area. While there are many species of grasses native to the Mid-South, this publication will focus on five species that are important for forage production: big and little bluestem, indiangrass, switchgrass and eastern gamagrass. These are tall, deep-rooted perennials with excellent drought tolerance and high yields.

Growth Seasons

These grasses grow during the summer and are thus referred to as "warm-season" grasses (Figure 1). They begin rapid growth in late April, slow the pace considerably by late June and become semi-dormant in August. During October, NWSG go dormant and remain so until they break dormancy in late March/early April.

All five of these grasses can produce excellent-quality hay. But, as is the case with other forage grasses, hay quality depends on timing of harvest, rate of drying and storage conditions. It should be noted though, that switchgrass hay should not be fed to horses because of a potential for phytotoxicity and liver damage. This is not an issue with the other four species of NWSG.

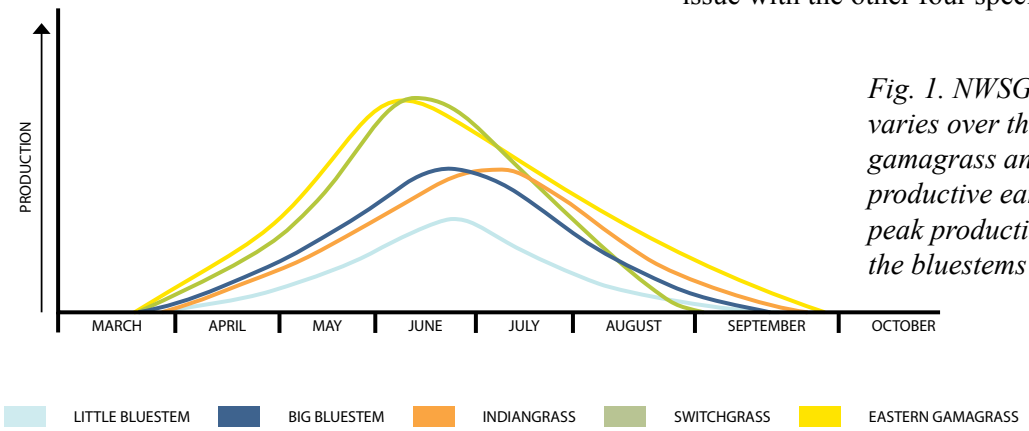

Fig. 1. NWSG forage production varies over the season. Eastern gamagrass and switchgrass are more productive early in the season, while peak production for indiangrass and the bluestems is in June and July.

How Do These Species Compare?

These grasses are similar, but have important differences in key characteristics. Switchgrass (Fig. 2) is probably the most well-known of these five species in the Mid-South because of the recent interest in growing it for biofuel production. While it can be a good forage, switchgrass tends to get stemmy and requires close management to ensure acceptable forage quality. Big bluestem (Fig. 3) may be best known as a major forage species of the Great Plains, where native stands are widely grazed by cattle. It is a highly palatable forage and often considered the best of the NWSG. Little bluestem (Fig. 4), as its name suggests, is much smaller than big bluestem or switchgrass and has lower yields. Indiangrass (Fig. 5) has a growth habit similar to big bluestem and is often planted in mixed stands with big and little bluestem. Eastern gamagrass (Fig. 6) produces as much or more forage than switchgrass and, like switchgrass, requires close management. It also is the earliest maturing of these five species and appears to maintain growth later in the summer as well, but requires higher fertility levels.

photo by Clarence Coffey

Fig. 2. Switchgrass is a tall grass with an open "panicle" seedhead produced in June.

photo by Clarence Coffey

Fig. 3. Big bluestem can be recognized by its "turkey foot" seedhead, which comes out in late June through July.

Drought and Native Warm-season Grasses

The summer of 2007 was the single worst drought year recorded in Tennessee and provided an unusual opportunity to measure drought tolerance. This example comes from a switchgrass biofuel trial that was being conducted in West Tennessee during 2004 – 2008. In this study, switchgrass, which was harvested only once each year in the fall, yielded about 8 tons of biomass per year. During 2007, the yield dropped, but still remained at 5.3 tons/acre!

Why Should I Use NWSG?

The vast majority of our forage production in the Mid-South is based on cool-season grasses, such as tall fescue and orchardgrass, species that grow best during the cooler months of the year (primarily, March through May and October and November). Cool-season grasses are not adapted to summer conditions and do poorly during that time of year. The native grasses do well in hot, dry summer conditions and, therefore, are a perfect complement to our existing forage base. When both cool-season and warm-season grasses are grown (in separate fields), they provide high-quality forage for a much greater portion of the year.

Higher Yields

Native warm-season grasses generally will produce more hay per acre than cool-season grasses (Table 1). An eight-year variety trial conducted by the University of Kentucky evaluated numerous varieties of NWSG. Except for switchgrass, for which we report yields for the variety *Alamo* only, all figures for NWSG are averages across all varieties tested. Tall fescue yields are only for the variety KY-31. In all cases, nitrogen was applied annually at green-up.

Reduced Acres Required for Hay Production

Because NWSG have a higher yield potential than cool-season grasses, they typically produce more hay from a given acreage. This can result in a smaller amount of land needed for hay production and more land being available for use as pasture.

Better Hay-Making Weather

Because conditions during early to mid-May are often not conducive to making high-quality hay, harvest of cool-season forages is often deferred until later in the month or until June when conditions are more favorable for drying. Unfortunately, cool-season forages have matured by then, resulting in substantial declines in hay quality. On the other hand, NWSG cut during June are normally at an earlier stage of development, and thus at their best for hay production. This is also true for second cuttings of NWSG taken during July or August (Table 2). Plant development is at an appropriate stage and the likelihood of good drying conditions is high.

Producing NWSG Hay in Your Forage Program

When Should I Harvest My NWSG for Hay?

As with any forage grass, there is a trade-off between forage quantity and quality. Early in the growing season, grasses are highly palatable and nutritious. As the growing season continues, plants mature and forage quality declines as a result of increasing stem-leaf ratios and declines in the quality of the leaves themselves. However, yield increases during this same time. For most forage grasses, harvesting during the late-boot or early-seedhead emergence stages provides an optimum combination of quality and quantity (Fig. 7). Because NWSG can become quite stemmy as they begin seedhead development, it is important not to delay harvest beyond the late-boot stage. This is particularly true with switchgrass, but is also a concern with indiangrass and big bluestem. Eastern gamagrass can be a bit more forgiving in this regard because of its growth habit – the leaves emerge directly from the base rather than from an elongated stem.

Although the date at which each of these species matures will vary somewhat each year depending on weather patterns, there are some fairly reliable guidelines that may be helpful. Eastern gamagrass will mature before the other four species, followed by switchgrass, the bluestems and finally indiangrass (Fig. 1). Eastern

Fig. 5. Indiangrass can be recognized by its pale green stems and golden head. The seedhead appears in August, later than the other NWSG.

Fig. 4. Little bluestem, as its name implies, is shorter than the other NWSG, but still retains the "bunch" growth habit common to these species.

Fig. 6. Eastern gamagrass is a robust grass with an unusual seed head that is the earliest of the NWSG to come out, typically in late May.

Fig. 7. This mature stand of Alamo switchgrass is ready to be harvested for hay. Photo was taken on June 10. Note that no seed heads have emerged yet, indicating the stand is still in boot stage.

gamagrass will normally be ready for a first cutting sometime in late May. Switchgrass will be ready to harvest in late May or early June. Big and little bluestem and indiangrass should typically be ready for harvest in mid- to late June.

In most summers, NWSG should be ready for a second cutting about six to eight weeks after the first cutting (Table 2). However, this will depend on rainfall and temperatures during the regrowth period. Native grass growth during the early portion of the growing season is not strongly influenced by spring rains. During mid and late summer, though, rainfall exerts greater influence. Also, keep in mind that while NWSG thrive at temperatures from the low 80s to the low 90s (F), sustained temperatures in the mid- to upper-90s or higher will slow regrowth and can impact yield.

If you take a second cutting, it should be done before the end of August. Native warm-season grasses, like many perennials, require a period of rest prior to entering winter dormancy. For much of the Mid-South, September 1 is a good target to begin that rest period. This will allow six weeks before the average first frost date in this region, allowing these perennial plants to restore their root reserves for winter dormancy. This is very important in maintaining the stand's vigor and ensuring a strong start the following spring.

With the exception of eastern gamagrass, NWSG should NOT be cut a third time for hay during the same growing season. Doing so will substantially weaken the plants over time and lead to thinner stands that are

Table 1. Yields for hay production for NWSG and tall fescue (for comparison). Yield data were taken at early seed-head emergence and are expressed on a dry-weight basis. Data from University of Kentucky variety trials conducted at Lexington, KY (2009 Native Warm Season Perennial Grasses Report, http://www.uky.edu/Ag/Forage/ForageVarietyTrials2.htm).

	Annual Yield (tons/ac)		Fertility	Harvests
Species	Range	Average	(lb N/ac)	(no./year)
Big bluestem	2.6 - 6.0	3.9	60	1 - 2
Indiangrass	2.5 - 5.9	4.6	60	1 - 2
Eastern gamagrass	3.1 - 9.6	4.9	60	1 - 2
Switchgrass (Alamo)	2.0 - 11.6	5.3	60	1 - 2
Tall fescue (KY31)	2.1 - 4.8	3.1	180	4

Table 2. Average hay yield and quality of Alamo switchgrass harvested twice at two locations in Tennessee during 2010. First cuttings were taken on June 2 and June 8 and second cuttings were taken on July 26 and August 6 at Lewisburg and Spring Hill, respectively. Data from the University of Tennessee Agronomic Variety Trials Program.

		Spring Hill		Lewisburg	
		Nitrogen		Nitrogen	
		0	120[a]	0	120[a]
First cut	Yield[b] (tons/ac)	2.1	2.6	1.9	2.7
	CP (%)	7.5	9.1	8.4	9.6
	NDF (%)	79.5	80.5	73.3	72.9
	ADF (%)	42.7	44.9	42.6	43.3
	TDN (%)	55.0	53.4	56.3	55.8
	RFV (%)	65.0	62.0	71.0	70.5
Second cut	Yield[b] (tons/ac)	1.0	1.2	1.8	2.4
	CP (%)	7.3	9.1	7.4	8.7
	NDF (%)	72.8	70.9	74.0	73.1
	ADF (%)	40.4	40.2	43.1	43.3
	TDN (%)	56.9	57.5	55.5	55.6
	RFV (%)	73.5	73.5	69.3	70.3
Total	Yield[b] (tons/ac)	3.0	3.9	3.7	5.1

[a] split application of 60 units N at greenup in spring and following 1st cutting.
[b] Yields are expressed on a dry matter basis.

Fig. 8. A mixed stand of big bluestem and indiangrass harvested for hay on July 1, five days before photo was taken. Note clumps in the foreground that were cut to about 8 inches residual height. Regrowth has already begun because the growing points were not removed.

prone to invasion by weeds. Studies have shown that tall-growing species, such as switchgrass and big bluestem, cannot sustain more than two cuttings per year. In fact, every two to three years you should plan to take only a single cutting because harvesting twice annually over several years will weaken your stand. While additional cuttings might increase single-year yields, work load (trips across the field) and costs would be increased and yields will be reduced in the long term.

Cutting Height

Regardless of whether you take one or two cuttings, it is critical that you *leave approximately 8 inches* of stubble when you mow. Because these grasses are tall-growing, they have few leaves close to the ground and growing points that are much higher than many of the other forage species we grow in this region. Therefore, if you cut them shorter than 8 inches, you will remove the growing point and virtually all leaf surface area (Fig. 8). The plant will need to regrow a new growing point and then new leaves, all the while drawing on root reserves and unable to photosynthesize because of a lack of leaves. Repeated close mowing will, like late harvests, result in poorer stands and reduced yields. To make matters worse, mowing too low will not significantly improve yield. As mentioned above, there is little leaf area below 8 inches and stems do not contribute much to hay quality.

What about Curing and Putting-up NWSG Hay?

Experience of producers in the Mid-South has demonstrated that NWSG can be cut, tedded, raked and baled with no more difficulty than more traditional hay species. In fact, some producers report that it is easier to cure because of the increased air circulation made possible by the higher cutting heights that result in hay being held off the ground. Too, curing hay is much easier on dry, 90-degree days than during the cooler, rainier weather of late spring. Others, however, have reported increased drying times for NWSG hay due to the larger amount of forage produced. This seems to be more of an issue with first cuttings of switchgrass, especially when it is over-mature and stems have gotten large. Using mower conditioners can help speed-up drying by crushing the larger stems. In many cases, disc mowers cannot be easily raised high enough for the desired 8-inch cutting height. A boot can be easily fabricated to solve that problem.

Can I Graze the Aftermath?

After the first cutting, you can graze the aftermath rather than trying to take a second cutting. Always allow adequate regrowth (about 15 inches) following the hay harvest. Depending on available moisture, this should take about four weeks. If you have cut earlier in the summer (early June), regrowth will occur more quickly than with a cutting made in mid to late summer (mid-July or later). As is always the case when grazing NWSG, it is important to maintain a minimum canopy height between 15 and 18 inches (see UT Extension publication, *Grazing Native Warm-season Grasses in the Mid-South,* SP731-C, for more details on managing grazing). You should still

Will Native Warm-season Grass Stubble Puncture My Tires?

You may have heard how stiff stubble left after harvesting switchgrass can puncture tires. While this has occurred, there are a few things to keep in mind. First, such punctures have occurred after mature switchgrass that remained unharvested all summer and fall was finally harvested as a biofuel crop. At that stage, stems have become quite large (1/8 inch or larger in diameter) and when cut close to the ground (3 – 4 inches), they can be stiff and are too short to flex under tire traffic. With more timely hay harvests, stems will not be this large or as stiff. Also, by leaving stubble at an 8-inch height, whether the stems were allowed to get large or not, it will easily flex when driven over and tires will not be punctured.

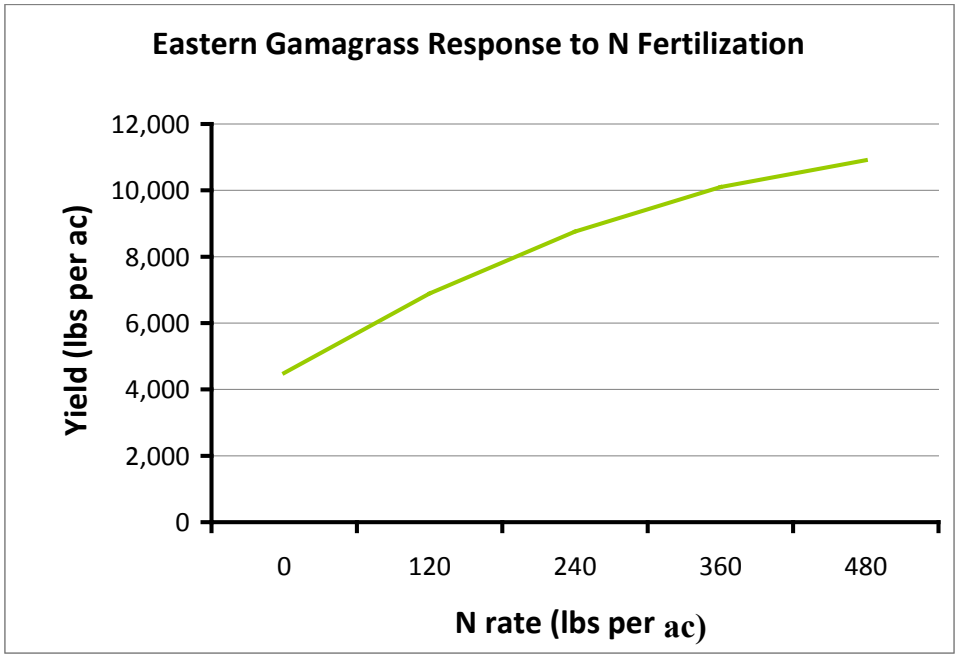

Fig. 9. Yield response of eastern gamagrass to N fertilization based on data collected by USDA-NRCS Plant Materials Centers at Coffeeville, MS and Americus, GA and the Mississippi Agricultural and Forestry Experiment Station, Starkville, MS.

adhere to the September 1 target for removing livestock for the season.

What about Liming and Fertilization?

Before adding any soil amendments, soil test your hayfields to determine current fertility level and recommended application rates. Because NWSG are adapted to low-nutrient environments, they are not particularly responsive to fertilization. Studies of switchgrass for biofuel production suggest there is no growth response once soil pH is above 5.0. If soil pH tests below 5.0, lime should be added per soil test recommendation. For hay production, modest N inputs – up to 60 units/ac – will provide increased production where needed. An additional 30 to 60 lb/ac could be added after the first cutting if additional yield is desired. Regardless, no more than a total of 120 lb of N/ac should be applied, as yields will not increase and weed competition may be increased. Eastern gamagrass is an exception to this because it will respond to increased N inputs at higher levels and is less competitive at low N levels (see Figure 9). Fertilizer should not be applied too early in the season (prior to mid- to late April) because cool-season weeds may benefit more than the grass. A good guideline is to fertilize once the stand is about 12 inches tall and outgrowing weeds. Also, evidence shows such early applications are preferable to mid-season applications. Do not apply P and K unless they test in the low category. If they do test low, follow soil lab recommendations for supplementing P and K.

Fertilizing a weak stand is more likely to help the competition than the NWSG. Instead, you may want to consider resting the stand or possibly overseeding it to allow it to thicken-up first. Another alternative would be to control the weeds prior to fertilizer application.

What about Prescribed Burning?

Native warm-season grasses respond well to fire and will burn readily during the dormant season. When used properly, prescribed fire is an excellent practice for Mid-South forage growers. When burning your NWSG hayfields, it is important to take all necessary precautions, including securing a burning permit, checking weather forecasts, burning only when conditions are safe (moderate wind and humidity conditions), preparing adequate firebreaks in advance, and having enough help and equipment on hand to contain any spot-overs. Native warm-season grasses should be burned during early April in the Mid-South for best results. Earlier burns may encourage cool-season grass and weed encroachment, while later burns may set back growth of NWSG. Ideally, stands should be burned once every two to three years.

Summary

Native warm-season grasses can be a valuable tool for Mid-South forage producers and can complement existing cool-season forages. They can provide large volumes of high-quality forage, may be harvested during summer months when curing weather is at its best – and the grasses are at the appropriate stage of maturity, and can provide considerable protection against drought (Fig. 10). In addition, they require minimal fertilizer or lime to sustain their productivity and have few insect or disease pests. On the other hand, they require closer management of harvest height and timing to capture their potential and prevent weakening the stand. If you would like to learn more about how these grasses might fit into your system, please contact your local Extension office.

Fig. 10. A well-managed stand of big bluestem ready for harvest in central Kentucky. Photo taken on July 5. Native warm-season grasses can be quite productive in the Mid-South, providing high-quality forage during hot, dry summer months.

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