Perennial Warm Season Grasses For Ohio

The native, perennial warm-season grasses have potential to produce good hay and pasture growth during the warm and dry mid- summer months. These grasses initiate growth in late April or early May, and produce 65 to 75 percent of their growth from mid- June to mid-August in Ohio. Warm-season grasses produce well compared to cool-season grasses during the hot and dry weather of July and August, and on soils with low moisture holding capacity, low pH and low phosphorous levels.

The cool-season grasses produce surplus production in May and June, are less productive during the mid-summer period, and become more productive again in the fall with the advent of cooler weather and fall moisture. Warm-season grasses can be an attractive compliment to these cool-season species by providing forage when the cool-season grasses are less productive. Having part of the grazing area in warm-season perennial grasses would enable the accumulation (stockpiling) of cool-season forage growth from July through September for grazing later in the fall, thus extending the total grazing season. Utilizing both cool- and warm-season species should provide more uniform season-long forage production.

Recently there has been increasing interest from the Midwest in several of the native perennial warm-season grasses for livestock forage. These include switchgrass, big bluestem, indiangrass, and eastern gamagrass. Many of these grasses dominated the upland prairies from Ohio to Kansas and Nebraska prior to settlement. Although the early Ohio settlers largely found forests, areas of prairie grassland were found, primarily in western Ohio.

Adaptation, Species and Varieties

Switchgrass, indiangrass and big bluestem are winter hardy and will grow in all areas of Ohio. They do best on deep, fertile, well-drained soils with a good water-holding capacity. These grasses can be seeded alone or as a mixture. Seeding a single grass species is preferred because mixed species are difficult to manage. Legumes or cool-season grasses generally are not suited for planting with warm-season grasses because of interplant competition with the seedling grasses. Warm season legumes such as Marion Lespedeza can be planted after the grasses are established. Eastern gamagrass may also have potential in Ohio, but experience and data are very limited. There is some interest in caucasian bluestem, but there are some concerns with this species as discussed below.

Switchgrass (*Panicum virgatum*) is a tall, rhizomatous perennial that grows 3 to 5 feet tall. It appears bunch like, but the short rhizomes may produce a coarse sod under grazing. Later in the season, leafy regrowth develops from basal tillers and shoots emerging along the lower stems at leaf nodes. Switchgrass tolerates poorly drained soils, occasional flooding, and perched water tables better than other warm-season grasses.

Leaves and stems of switchgrass have good forage value and are readily grazed by livestock in the immature stage; however, it is considered to be of lower forage quality

than big bluestem or indiangrass. Palatability and nutrient content of switchgrass stems decline rapidly after heading. Switchgrass is often the first choice among farmers trying a warm-season grass for the first time. The seed is clean, free flowing and can be seeded with standard forage seeding equipment. Improved varieties of switchgrass for use in Ohio are Blackwell, Trailblazer and Cave- in-Rock. Cave-in-Rock is more palatable for livestock than other adapted varieties and it yields well in Ohio (Table 1). Niagra has performed well in Pennsylvania.

Big bluestem (*Andropogon geradi*) is an erect, robust, perennial bunchgrass that grows 3 to 6 feet tall and is often reddish- purple at maturity. It produces foliage in late spring from buds at basal nodes and from short, scaly rhizomes. Growing points stay close to the ground until late summer when heads appear. It is considered more palatable than switchgrass or indiangrass, especially after maturity. Big bluestem is more drought tolerant than other warm-season grasses and thus is better adapted to excessively drained soils with low water-holding capacity. The seed is light, chaffy and difficult to seed without a special grassland drill. The varieties Kaw, Roundtree, and Pawnee are suggested.

Indiangrass (*Sorghastrum nutans*) is an erect, robust perennial growing 3 to 6 feet tall. It has short, knobby rhizomes and spreads slowly. Indiangrass starts growth somewhat later than switchgrass or big bluestem and provides good quality forage during much of the summer. It is moderately palatable after heading. Indiangrass can be planted on moderately well-drained soils and can withstand occasional flooding. The seed is light, chaffy and difficult to seed without a special grassland drill. The varieties Osage and Oto have been tested in Ohio. Rumsey is a newer variety that should do well in Ohio also.

Eastern Gamagrass (*Tripsacum dactyloides*) is a lesser known native warm-season grass. It is a robust, upright, leafy bunchgrass that grows to 6 to 12 feet. It is adapted to deep soils with good water-holding capacity. In natural habitats it grows in fertile bottomland, swamps, and along streambanks. Eastern gamagrass is one of the earliest warm-season grasses to begin growth in the spring. It is slow to establish but once established produces high yields of good quality forage. Eastern gamagrass is a relative of corn. It has high yield potential and maintains it's quality better when mature that the other species. It has potential to be used for pasture or hay. One drawback to eastern gamagrass is it's need for a long, late summer rest period beginning by mid-August.

Establishing stands of eastern gamagrass that allow haying has been a problem. Eastern gamagrass tends to form rough, clumpy stands that are hard on equipment. Individual plants produce large clumps (up to 3 feet across) with large bare spaces between plants.

Care should be exercised when considering establishment, because seed dormancy is high and it is very slow to establish. Seed dormancy can be partially overcome by stratification (wet chilling treatment). Stratified seed cannot be allowed to dry before planting. An alternative may be to make dormant seedings in November through February, but experience and research information are limited. Experience in Kansas has shown that up

to 4 years may be required before acceptable forage production is achieved. In Ohio, experience with this grass is limited. Available varieties are Pete and Iuka.

Caucasian Bluestem (*Bothriochloa caucasica*) is native to southern Russia and is a member of the old world bluestems. Experience with this grass in Ohio is very limited. Caucasian bluestem is a fine-stemmed, leafy grass that is drought tolerant, aggressive, and a prolific seed producer. In the plains states it is considered an undesirable, unpalatable, and aggressive invader of warm-season grass pastures and range. Caucasian bluestem is reported to be quicker to establish than other warm-season grasses and more tolerant of heavy grazing pressure. Studies at the University of Missouri Southwest Research Center reported individual animal performance of caucasian bluestem was slightly lower than switchgrass. But caucasian had more growth which provided more grazing days per acre than switchgrass. When big bluestem and indiangrass can be properly managed, they offer greater animal performance potential than caucasian bluestem.

Caucasian bluestem should be winter hardy in southern Ohio but the full range of adaptation across Ohio is unknown. It is currently not recommended in Ohio because of the lack of information on its adaptation, and because of possible concerns with its aggressiveness as in western states.

Yield And Quality Results

Productivity of warm-season grasses will depend on soil fertility, soil water-holding capacity, rainfall during the growing season, and amount of fertilizer applied. Yields are greatly influenced by nitrogen (N) fertilization. A warm-season grass trial was conducted at Wooster over 10 years (Table 1). Cool-season grass trials were conducted in adjacent areas for 8 years (Table 2). Cave-in-Rock and Blackwell switchgrass had comparable yields to orchardgrass and tall fescue for the long- term average. Several dry years resulted in low yields of all species during these studies. Note that N fertilization levels were light. Fifty-one pounds of actual N were applied annually on the warm-season grasses and 68 pounds of N were used on the cool- season grasses. The cool-season grasses were harvested four times annually while the warm-season grasses were harvested twice, usually in mid-July and mid-September.

Table 1. Average yield of native warm-season perennial grasses at Wooster, OH from 1972 to 1981. Seeded April 8, 1971.

Species	Varieties	Dry matter yield* 10-year average	Yield Range
		tons/acre	
Big bluestem	Pawnee	2.49	1.15 - 3.75
	Kaw	2.38	1.35 - 3.19
Indiangrass	Osage	2.41	1.05 - 3.71
	Oto	2.32	0.99 - 3.65

Switchgrass	Cave-in-Rock	3.13	1.50 - 4.75
	Blackwell	2.89	1.20 - 4.70
	Pathfinder	2.54	1.06 - 3.99
	Kanlow	1.99	1.09 - 3.07
* Yield total for two harvests annually, except in 1974 when big and little bluestem and Indiangrass were cut once. Initial soil test: pH 6.3, P 36, K 135. Nitrogen fertilizer applied annually as 150 lb/acre of ammonium nitrate in late May, and 200 lbs/acre of 0-20-20 was applied each fall.			
Source: Van Keuren and Myers, 1981.			

Table 2. Average yield of cool-season forage grasses at Wooster, OH from 1973 to 1977 (seeded April 24, 1973) and 1980 to 1982 (seeded May 1, 1979).

Species	Cultivar	Dry matter yield* 8-year average	Yield Range
		tons/acre	
Orchardgrass	Potomac	3.06	1.70 - 5.14
	Pennlate	3.18	1.64 - 5.69
	Hallmark	3.25	1.94 - 5.56
Tall Fescue	Ky-31	3.03	1.97 - 5.05
* Yield total for four harvests annually, except for three harvests in 1973. Nitrogen fertilizer applied as 200/lbs./A. of ammonium nitrate in mid-June.			
Source: Van Keuren and Myers, 1978 and 1983.			

Iowa research demonstrates that yield is greatly influenced by N fertilizer (Table 3). Switchgrass was especially responsive to the addition of N fertilizer. Yields were doubled and crude protein was increased with heavy N fertilization. Forage digestibility was also increased with additional N.

Table 3. The effect of nitrogen fertilization on dry matter yield, % crude protein, and % in vitro digestible dry matter (IVDDM) of switchgrass, big bluestem, and Indiangrass. Summarized from three research studies in Iowa, 1972-79.

Species	N rate (lbs/acre)	Dry matter yield*	% Crude Protein	% IVDDM
		tons/acre		
Switchgrass	0	1.83-2.82	6.0-10.4	47.0-54.1
	67	3.19-3.58	7.5-15.9	48.6-54.8
	240-268	3.56-5.80	9.5-14.1	51.7-58.3
Big Bluestem	0	2.30	11.1	54.0
	67	3.07	15.1	55.0

	268	3.00	9.4	58.1
Indiangrass	0	2.23	8.9	54.7
	67	2.54	15.0	55.2
	268	2.93	8.8	61.1
*Yield and quality of switchgrass varied with thickness of stand and cutting management.				
Source: Barnhart, 1981.				

These grasses can provide good quality forage, especially for beef cattle. Warm-season grasses have adequate nutrient levels for beef brood cows and yearlings. Beef stocker gains of 1 to 2 lbs./acre have been reported and are influenced by maturity and protein levels in the forage. The warm-season grasses grown at Wooster (Table 1) usually had crude protein levels of 7 to 10% at harvest time. Rotationally grazed switchgrass pastures at the Jackson Branch of Ohio Agricultural and Research Center (OARDC) provided 109 to 169 cow grazing days per acre from late June to early September each year for six years. Rotational grazing management can improve livestock gains. Sheep generally have not performed as well as cattle on warm-season grasses. In digestibility trials, the dry matter digestibility of warm-season grass hay cut at the late vegetative stage was 71% for cattle and 60% for sheep.

Establishment

Warm-season grasses are slow to establish. They are weak competitors with weeds and cool-season grasses until established. An understanding of plant growth requirements and biology, as well as attention to detail is critical to successful establishment of warm-season grass. Patience is also required. Two years is generally required for successful establishment of warm-season grasses. Caucasian bluestem requires the shortest establishment time and Eastern Gamagrass the longest (up to 4 years).

Select fields with low weed pressure, and control weeds thoroughly before seeding. Weeds compete strongly with these grasses in the establishment phase. Attempts to establish warm- season grasses under heavy weed infestations may fail completely or will at best require 2 to 3 years before acceptable growth is achieved. Fields previously in row crops where weeds were controlled are ideal sites.

Warm-season grasses have been seeded successfully in conventionally tilled seedbeds, no-tilled into small grain stubble and no-tilled into pasture where the existing sod has been killed completely with herbicides. Good seed-soil contact is absolutely critical, so a tilled seedbed should be free of weeds, fine-textured, and firm. Plowing, disking, harrowing, and cultipacking are usually required to obtain a good seedbed. Drills with press wheels should be used to seed most species at 1/4 to 1/2 inch depth. Eastern gamagrass, which has a larger seed, should be planted 1/2 to 1 inch deep. Detailed information on seed stratification requirements of eastern gamagrass need to be followed closely to assist in germination of this species.

Spring Seedings should be made from mid-April to mid-May. In southern Ohio seed at the earlier dates. Later seedings do not establish as well resulting in lower yields and weedy stands the year after seeding (Table 4).

Table 4. Planting date effect on Blackwell switchgrass and weed yields one year after seeding.

	Planting date				
Component	**Early-mid May**	**Mid-late May**	**Early-mid June**	**Mid-late June**	**Early July**
	lbs/acre				
Switchgrass	3298	5081	3418	338	48
Weeds	276	143	260	1057	1053
Adapted from: Panciera and Jung, 1983.					

Dormant seedings in early November may be another option for seeding warm-season grasses. The Ohio Department of Natural Resources has successfully established switchgrass from drilled seedings in early November. In Kansas, the accepted time of seeding eastern gamagrass when using non-stratified seed is in November and December. In Iowa, warm-season grasses are sometimes drilled into mulched seedbeds after the first of November. Mulch is provided by shredding residue from a previous crop of corn or forage sorghum, or by a dead stand of fall-sown oats.

Switchgrass and eastern gamagrass seed can be handled with drills equipped to handle cool-season grasses. Other species have chaffy or fluffy seed and will bridge and not flow well through most drills unless it has been debearded, a process which removes the awns and appendages with fine hair from the seed. Specially designed no-till grassland drills such as the "Truax" will aid in a successful seeding of these species with chaffy seed. Depth gauge wheels on the disk openers combined with good press wheels and a seedbox adapted for fluffy seed are key components of a drill adapted for seeding warm-season grasses.

Seeding rate recommendations are given as pure live seed per acre in Table 5. Pure live seed is easily calculated as % germination x % pure seed/100.

Table 5. Seeding Rates for Warm-Season Perennial Grasses

Species	Lb. of Pure Live Seed/Acre
Big Bluestem	10-12
Indiangrass	10-12
Switchgrass	8-10
Eastern gamagrass	8-10

Evaluate the stand carefully at the end of the seeding year. The stand is adequate if there are at least 1 to 3 seedlings per square foot in September. If in doubt, reevaluate the stand in June of the second growing season, when the stand should be better than at the end of the seeding year.

Fertilizing at Establishment

Once you have selected an area, take a soil sample well ahead of seeding to determine the need for lime and fertilizer. The pH should be at least 6.0 for good establishment and production. If lime is needed (pH below 6.0) apply it before the soil is tilled so it can be incorporated and mixed well into the root zone where it is needed. Apply phosphorous (P) and potassium (K) according to soil test recommendations. Do not apply N fertilizer at seeding. The warm-season perennial grasses are slow to establish and N stimulates weed competition. Some N (30 lbs./A) can be applied on low fertility sites in July after the grasses have started growing provided the stand is very good and few weeds are present.

Fertilizing Established Stands

While warm-season grasses are more tolerant to low pH and fertility than the cool-season grasses they do respond to higher levels of fertility with improved vigor, persistence and productivity. Soil testing at least every 3 years is the best guide for maintenance rates of P and K. The timing of P and K applications are not critical, and rates are similar as those for cool-season grasses.

Nitrogen application rates and timing are different for warm- season grasses than for cool-season grasses. Nitrogen should not be applied to warm-season grasses until spring growth is 3 to 4 inches tall. This will be approximately mid-May, but will vary with species. Applying N earlier in the spring will give weeds and encroaching cool-season grasses an advantage. Lower N rates are suggested for warm-season grasses than for cool-season grasses. If a single application is made, 60 to 80 lbs of N can be applied in mid-to-late May. For higher rates, split the application with half in mid-May and half in early July. Higher rates should only be used on highly managed excellent stands.

Legumes in the stand can reduce or eliminate the need for N fertilizer. Promising results have been obtained in West Virginia with frost seeding of red clover in established stands of warm- season grasses. Marion lespedeza has proven to be a good warm- season companion legume in Missouri. Birdsfoot trefoil has also been used successfully. In Iowa, researchers have successfully drilled several cool-season legumes into switchgrass to reduce the need for N fertilizer and to improve forage yields and quality.

Harvest Management

A seeding year stand of warm-season grass should not be harvested unless growth is unusually good, the stand is vigorous, and the seed is mature in the seedhead. Weed competition in the seeding year can be reduced by clipping weeds above the warm-season

grass seedlings. Adjust the clipping height upward as the season progresses to prevent clipping off the warm-season grass seedlings. In late spring one may be able to clip as low as 3 to 4 inches without harming the warm-season grass seedlings. In June and July, clip to at least 6 inches high. If much of the grass plant is clipped off in the seedling stage, vigor will be greatly reduced. Do not clip or graze new seedlings after August 1. It is usually best not to graze warm-season grasses during the seeding year.

Once established these grasses should be harvested or grazed when they are 16 to 20 inches or more in height (boot stage). Once seedheads emerge, the quality decreases rapidly. Heading will occur in late June to early July depending on location, year and species. Mowing or grazing height is critical to stand maintenance. Leave at least a 5-inch stubble for rapid regrowth. Mowing or grazing closer than 5 inches will remove important plant carbohydrate storage organs and areas of new bud development.

Rotational grazing is advised for good persistence. The pasture should be divided into several paddocks to allow adequate recovery time between grazing. **CONTINUOUS OR CLOSE GRAZING WILL THIN OR KILL THE STAND.** Observations of cattle grazing switchgrass in Iowa reveal that they prefer to eat the less fibrous plant parts such as leaves, young stem tips, basal tillers, and volunteer seedlings. When managing established switchgrass pastures, the quantity of desirable plant tissue remaining may be more important than stubble height. If the supply of desirable plant tissue is being depleted, the animals should be removed to avoid the risk of overgrazing even though there is still a good supply of the coarser plant material. Overgrazing of basal tillers jeopardizes the regrowth potential of the grass.

Enough time should be allowed for at least 12 inches of fall regrowth before frost on all species. This means these grasses should not be grazed or harvested after mid-September. Plants can be harvested after a killing frost without damage to the stand and the forage is safe to livestock.

Removal of dead stubble in December will increase grass yields during the following growing season. This can be done with grazing animals but these animals will need protein supplement to balance protein needs. Leave at least an 8 inch stubble cover for the winter.

A well-managed, vigorous stand of warm-season grass should not normally have a broadleaf weed problem. However, thin stands may require some weed control. Consult the "Weed Control Guide for Ohio Field Crops" (Bulletin 789) for information on chemical weed control in grass pastures. Perennial cool-season grasses that invade warm-season grass stands can be somewhat controlled by spring grazing.

Summary

Warm-season perennial grasses establish relatively slowly, but once established and properly managed the stand can last many years. These grasses can provide acceptable quality forage for animals during the summer months when cool-season grasses become

less productive. Because of the expense and difficulty in establishment, these grasses should be established as permanent sod pastures or hay fields.

Producers utilizing warm-season grasses successfully have realized that the management requirements are different from those normally followed for cool-season grasses. Differences in establishment procedure, fertilization, and grazing management are especially important.

The following sources were used in developing this publication:

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