Native Warm-Season Grasses as Forage in Mississippi: *Establishment*

What Are Native Warm-Season Grasses?

Native warm-season grasses (NWSG) are perennial species that are characterized predominantly by their bunch-type growth, drought tolerance, and ability to provide wildlife cover and structure for ground-nesting birds, small mammals, and many insects. However, one characteristic often overlooked is their ability to generate high-quality livestock forage with limited external inputs. If they are successfully established and managed properly, NWSG can provide Mississippi livestock producers with a dependable summer forage source while simultaneously creating grassland habitat for local wildlife.

Historically, NWSG were dominant components in major land resource areas across Mississippi, including the Black Belt and Jackson Prairie. These crescent-shaped landmasses were originally characterized by their dark, shallow soils and extensive grassland prairies, which were interspersed with chalk outcroppings, oak lowlands, and cedar groves. This ecosystem was comprised of grasses, legumes, and forbs similar to the tall-grass prairies of the Midwest and was maintained by frequent fire activity. In the late 1800s and early 1900s, a majority of this native Blackland Prairie was overgrazed and replaced with row-crop production, particularly cotton.

Cotton production declined with the 1920s boll weevil infestation, and agricultural lands were slowly converted to nonnative forage grasses such as bermudagrass (Africa), bahiagrass (South America), Johnsongrass (Middle East), and tall fescue (Europe) for use in animal agriculture. These forage grasses were easy to establish, responded well to inorganic fertilizers, and resisted heavy grazing better than the existing native forages. However, with these advantages came unfortunate repercussions, such as the loss of critical wildlife habitat, the surge of nonnative species into natural areas, fire suppression (resulting in encroachment of undesirable brushy species, increased litter, and reduced diversity of wildflowers and grasses important to wildlife and insects), and the incorporation of continuous grazing systems that diminished soil/plant productivity and promoted the proliferation of nonnative, rhizomatous, sod-type grasses.

Federal policies regarding invasive species, conservation plantings, and cost-share farm programs have generated enthusiasm for converting old pastures and hay ground into rotational grazing systems comprised of native grasses. These lands could then serve a dual purpose: providing forage for livestock and habitat for wildlife.

NWSG provide quality forage for animals and can extend the grazing season. They can be easily integrated into a rotationally grazed system complemented with cool-season forages, or into a continuously grazed system with low stocking rates. As the name implies, NWSG produce a majority of their biomass in the summer months (May to August). This gives producers who have cool-season species (tall fescue, ryegrass, small grains) a summer forage source during the drier months. The primary concern associated with NWSG is getting them established.

Planning and Site Preparation

Site preparation is extremely important when adding NWSG to your grazing system. Extensive planning and attention to detail is required before planting. These grasses are notoriously slow to establish, often resulting in unsuccessful stands. Stand failures can be caused by several factors, including low germination percentages, poor seedling vigor, inadequate weed control, planting too deep, and impatience. To ensure a successful planting, address these factors well before sowing. It can take up to a year or more to effectively remove existing weeds or impediments (stumps, fence rows, rocks, etc.). After determining the planting area, assess the existing vegetation to determine proper weed control. A list of common weed species and their recommended control methods are listed in Table 1.

Previous cropping history will determine the exact methods used to prepare a site. When planting NWSG into an existing pasture or hay field composed of sod-type forage grasses, such as bermudagrass and bahiagrass, multiple herbicide applications may be required to eradicate the existing stand. If these existing grasses are not completely removed before seeding, they will inhibit seedling emergence and negate potential wildlife habitat

Table 1. Recommended herbicides for areas to be established with native warm-season grasses.

Preplant				
Situation and active chemical per treated land acre*	**Formulation needed for 1 acre treated broadcast**	**Time of application**	**Weeds controlled**	**Special instructions and remarks**
Glyphosate	Glyphosate 4/5 lb/gal at 1.2/2 pt in 3–10 gal water plus 0.5–1% surfactant	To actively growing weeds	Tall fescue, annual broadleaf, and grassy weeds	Multiple applications may be necessary to control newly emerged weeds
Metsulfuron methyl	Escort, MSM60 at 0.5 oz in 3–10 gal water plus 0.5–1% nonionic surfactant	To actively growing weeds	Bahiagrass, annual broadleaf weeds	2–3-month replant interval on soils with pH 7.5 or greater
Paraquat	Gramoxone Max at 0.75 pt/A or Boa 0.78 pt/A in 20 gal water	To actively growing weeds	Annual broadleaf and grassy weeds	Add 1 qt of nonionic surfactant per 100 gal of spray
Imazapyr	Arsenal, Polaris at 24 oz with nonionic surfactant	To actively growing weeds	Bermudagrass, several annual and perennial weeds, plus vines and undesirable woody plants	Do not apply more than 48 oz per year; 10–12-month plant-back interval
Preemergence				
Situation and active chemical per treated land acre*	**Formulation needed for 1 acre treated broadcast**	**Time of application**	**Weeds controlled**	**Special instructions and remarks**
Imazapic	Plateau 8–12 oz/A with nonionic surfactant	To bare soil or existing vegetation	Several annual and perennial weeds	Must be incorporated or rained in to be activated in soil
Imazapic + glyphosate	Journey 10.7–32 oz/A	To actively growing weeds	Several annual and perennial weeds	Contains glyphosate; burndown ability
Postemergence				
Situation and active chemical per treated land acre*	**Formulation needed for 1 acre treated broadcast**	**Time of application**	**Weeds controlled**	**Special instructions and remarks**
2,4-D	1–2 pt/A in 10–20 gal water	To actively growing weeds	Annual broadleaf weeds	Wait until grasses are fully established before application
2,4-D + picloram	Grazon P+D at 1–8 pt/A	To actively growing weeds	Most broadleaf weeds, woody brush, dogfennel, horsenettle	Wait until grasses are fully established before application
Aminopyralid + 2,4-D	Grazon Next at 1.5–2.6 pt/A in 20 gal water with nonionic surfactant	To actively growing weeds	Broadleaf weeds	Wait until grasses are fully established before application
Imazapic	Plateau at 8–12 oz/A with nonionic surfactant	To actively growing weeds	Tall fescue, Johnsongrass, annual broadleaf and grassy weeds	Will reduce or eliminate switchgrass stands
Quinclorac	Paramount at 5.3–8.0 oz/A with methylated seed oil	To actively growing weeds	Crabgrass, foxtail, signalgrass, some annual broadleaf weeds	Only for use in little and big bluestem, switchgrass, and sideoats grama
Nicosulfuron + metsulfuron methyl	Pastora at 1–1.5 oz/A with nonionic surfactant	To actively growing weeds fewer than 2 inches tall	Johnsongrass, vaseygrass, ryegrass, many broadleaf weeds	For use in switchgrass only

*Adapted from Mississippi State University Extension Service Publication 1532 *Weed Control Guidelines for Mississippi*.

benefits. Tillage is not recommended in this situation. Soil disturbance increases the chance of weed pressure after seeding, and if sod-forming grasses are present, tillage can divide and distribute rhizomes throughout the field causing future weed control issues.

Depending on the amount of standing vegetation, multiple herbicide applications may be necessary for complete control. One management tool to aid in this process is prescribed burning. For example, if warm-season grasses are present, allow them to go dormant in the winter months. In late winter, just before spring green-up, burn off the existing biomass. This will accomplish several objectives: 1) soil temperatures will warm faster, initiating weed germination and facilitating weed control; 2) dead plant material will be removed, improving herbicide contact on living plants; 3) less total biomass will be in the field following herbicide applications, improving seed-to-soil contact during planting. Extreme caution is necessary when conducting a prescribed burn. Always make sure a certified prescribed burn manager is on-site to conduct the burn. Contact your local Mississippi Forestry Commission office for more information on conducting a prescribed burn.

If the site was previously in row crops or small grains, weed control will be much easier. These fields typically have less weed pressure due to the use of herbicide-tolerant crops, so they provide excellent conditions for establishment. Also, the previous year's residue provides moisture retention for NWSG seedlings and helps in shading out emerging weeds. A word of caution: previous herbicide applications in the area may delay or prevent NWSG from germinating. Thoroughly check all herbicide labels for plant-back intervals or bioassays that may need to be conducted before planting.

When establishing indiangrass and big and little bluestem, a preemergent herbicide is available that helps control weeds during the critical time of germination and seedling development. The active ingredient imazapic, found in Plateau and Journey, can be applied preemergence to bare soil and dead, standing vegetation before planting. This herbicide effectively controls many problematic weeds commonly found in areas where NWSG are being established. These include grasses such as Johnsongrass, crabgrass, signalgrass, tall fescue, and foxtail (giant, green, and yellow) and broadleaf weeds such as pigweed, sicklepod, and morningglory, along with yellow and purple nutsedge. Imazapic can be applied for postemergence weed control, as well. Journey is a mixture of imazapic and glyphosate, so it will cause significant damage to native grass plants if it is used following establishment. As with any herbicide, thoroughly read and follow all instructions printed on the herbicide label before use.

Since weed control measures often require season-long monitoring, one other task that can be accomplished during this time is soil fertility management. Soil tests should be taken in a uniform manner across the site to determine nutrient levels. If tests report deficiencies for any nutrient, these should be addressed before planting. Optimum soil pH should range from 6.0 to 7.0. Phosphorous (P) and potassium (K) levels should be in the medium to high range. No nitrogen should be applied in the establishment year because this will encourage rapid weed growth.

Species and Variety Selection

There are six main NWSG species often used for grazing or hay production. These are switchgrass (upland and lowland), big bluestem, little bluestem, indiangrass, sideoats grama, and eastern gamagrass. Depending on landowner goals and objectives, there are several questions to answer before planting one or more of these grasses.

First, will the established stand of NWSG be grazed or hayed? If hayed, a monoculture (single species) may be of some benefit as it will produce uniform yield and quality results and make fertilizer and herbicide applications easier. In a mixed stand, some of the tall species, like lowland switchgrass, have been known to dominate and outcompete other natives; therefore, lower seeding rates are recommended for this species when used in a mixture with other native grasses.

Secondly, will the site be managed in a way as to create a diverse landscape for wildlife habitat? When managing wildlife habitat as an objective, greater diversity of grasses may be appropriate. Varying plant heights provides more diverse vertical structure, improving substrate for invertebrates, and provides better cover for brood-rearing, foraging, and predator avoidance for wildlife. Greater plant diversity also promotes soil microbial populations, which stimulates forage growth.

In terms of grazing, blends of big bluestem and indiangrass are easier to manage, and they provide high-quality forage for livestock. Eastern gamagrass and switchgrass, however, produce two to three times more dry matter per acre than big bluestem and indiangrass and may be better suited for haying.

Thirdly, what budget constraints are placed on establishment? The more species added to a seed mix, the greater the cost of establishment. Also, limited availability of certain species can cause prices to increase.

There are several improved and nonimproved varieties available for the Deep South (Table 2). Native warm-season

Table 2. NWSG species, varieties, seeding rate, origin, and availability for Mississippi.

Switchgrass				
Species/variety	**Seeding rate (for a monoculture)***	**Planting date**	**Origin of variety**	**Seed company/source****
Alamo	3–5 PLS lb/A	After potential of killing frost and as long as soil moisture is not limiting	Texas	Roundstone, Ernst, Turner
BoMaster			North Carolina	Ernst
Cave-in-Rock			New Jersey	Ernst
Colony			North Carolina	Ernst
Expresso			Mississippi	Roundstone
Kanlow			Oklahoma	Roundstone, Ernst
Kentucky Ecotype			Kentucky	Roundstone
Miami			Florida	Ernst
Performer			North Carolina	Ernst
Big bluestem				
Species/variety	**Seeding rate (for a monoculture)***	**Planting date**	**Origin of variety**	**Seed company/source****
Bison	6–8 PLS lb/A	After potential of killing frost and as long as soil moisture is not limiting	North Dakota	Ernst
Bonilla			South Dakota	Sharp Bros.
Kaw			Kansas	Roundstone, Ernst, Turner
Kentucky Ecotype			Kentucky	Roundstone
Pawnee			Nebraska	Ernst
Roundtree			Iowa	Roundstone, Ernst
Suther			North Carolina	Ernst
Little bluestem				
Species/variety	**Seeding rate (for a monoculture)***	**Planting date**	**Origin of variety**	**Seed company/source****
Aldous	6–8 PLS lb/A	After potential of killing frost and as long as soil moisture is not limiting	Kansas	Roundstone, Ernst
Camper			Nebraska	Ernst
Cimarron			Oklahoma	Roundstone, Ernst
Kentucky Ecotype			Kentucky	Roundstone
OK Select			Oklahoma	Turner
Prairie View			Indiana	Ernst
Eastern gamagrass				
Species/variety	**Seeding rate (for a monoculture)***	**Planting date**	**Origin of variety**	**Seed company/source****
Bumpers	10–12 PLS lb/A	After potential of killing frost and as long as soil moisture is not limiting	Arkansas	Ernst
Highlander			Tennessee	Johnston
Kentucky Ecotype			Kentucky	Roundstone
Pete			Oklahoma	Johnston
Sideoats grama				
Species/variety	**Seeding rate (for a monoculture)***	**Planting date**	**Origin of variety**	**Seed company/source****
Butte	12–14 PLS lb/A	After potential of killing frost and as long as soil moisture is not limiting	Nebraska	Ernst, Sharp Bros., Turner
El Reno			Oklahoma	Sharp Bros.
Haskell			Texas	Turner
Kentucky Ecotype			Kentucky	Roundstone
Vaughn			New Mexico	Sharp Bros.

Indiangrass				
Species/variety	**Seeding rate (for a monoculture)***	**Planting date**	**Origin of variety**	**Seed company/source****
Americus	6–8 PLS lb/A	After potential of killing frost and as long as soil moisture is not limiting	Georgia	Roundstone, Ernst
Cheyenne			Oklahoma	Roundstone, Ernst, Turner
Lometa			Texas	Turner
Kentucky Ecotype			Kentucky	Roundstone
NC Ecotype			North Carolina	Ernst
VA Ecotype			Virginia	Ernst

*Seeding rates for mixed stands should be adjusted by half for every additional species in the mix.

**Roundstone Native Seed, LLC, 9764 Raider Hollow Rd., Upton, KY 42784
Ernst Conservation Seeds, 8884 Mercer Pike, Meadville, PA 16335
Sharp Bros. Seed Company, 1005 S. Sycamore, Healy, KS 67850
Johnston Seed Company, 319 W. Chestnut, Enid, OK 73701
Turner Seed, 211 County Rd. 151, Breckenridge, TX 76424

grasses are still fairly "wild" in terms of breeding for certain desirable characteristics such as improved forage quality, persistence, or dry matter yield. A majority of the available varieties are simply ecotypes, which means they were collected in a certain geographical area and increased to seed production volume. Unfortunately, of the available ecotypes, even fewer have been selected from areas within the South (Table 2). Of the varieties listed, 'Americus' indiangrass (Americus, Georgia) and 'Expresso' switchgrass (Starkville, Mississippi) are the only two developed for the Deep South.

Breeding work currently being conducted at Mississippi State University aims to release improved varieties (increased germination percentages) of indiangrass, big bluestem, little bluestem, and upland switchgrass in the near future. The next-closest origin of seed is Kentucky. Seed with origins from more northern latitudes may mature earlier, reducing forage quality values later in the season. However, northern varieties may be more cold-tolerant compared to their southern counterparts. That being said, conscientious management is required in order for these plantings to continue to produce for years to come.

Seeding Rate and Planting Date

Native warm-season grass seeds vary in size and shape and express several characteristics that can contribute to planting difficulty. Of the six species mentioned, switchgrass and eastern gamagrass, though quite different in seed size, possess smooth seed coats. This allows them to flow evenly through a conventional grass seed drill, planter, or broadcast spreader. Little and big bluestem, indiangrass, and sideoats grama are "fluffy" by nature, meaning they have hairs, awns, or appendages that must be cleaned or removed during processing in order to flow through a conventional seed drill (Figure 1). Depending on seed source and cleaning methods, some distributers remove nearly all appendages to produce a seed that does not "bridge" in the seed box or clog seed tubes of a conventional drill. However, some cleaning methods damage the seed, reducing viability. Check with your seed source and seed label (germination percentage) before purchase to ensure seed quality will not diminish before planting.

Another characteristic inherent to NWSG seed lots is low germination percentages. Native warm-season grasses are notorious for testing low (< 50%) for germination.

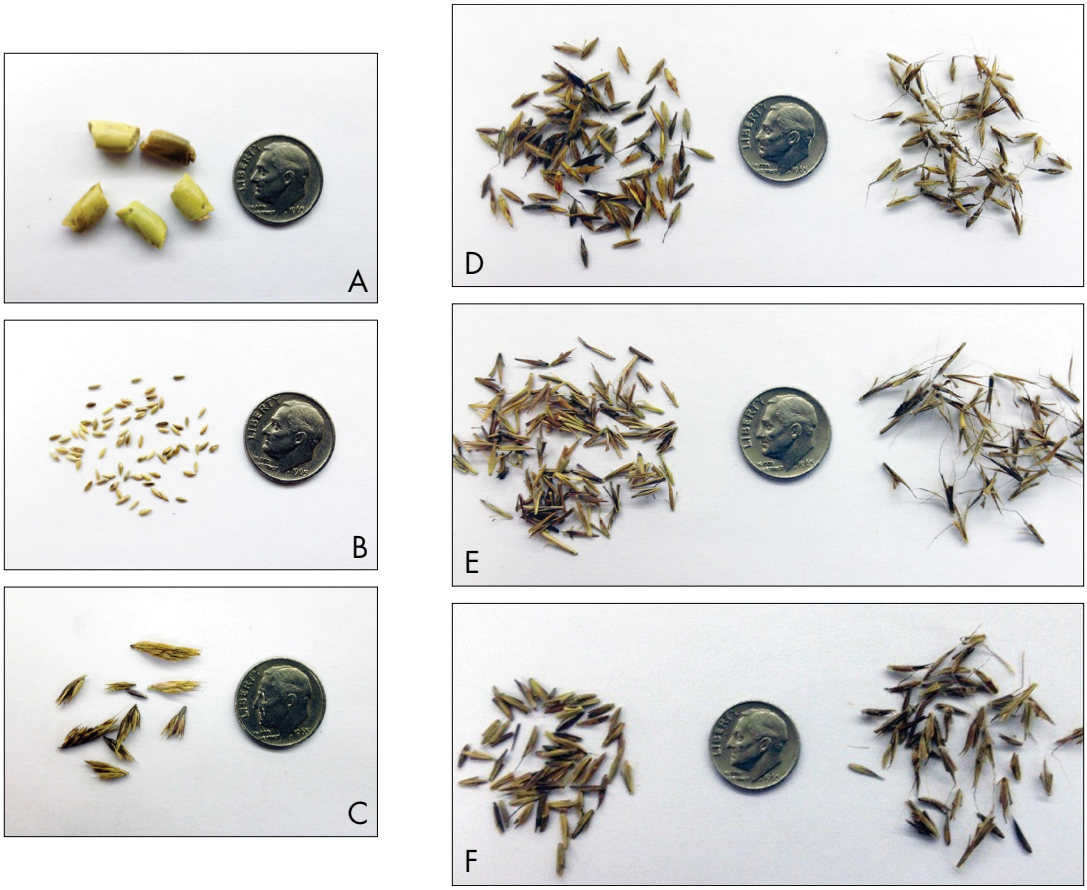

Figure 1. Six common species of native warm-season grasses for planting in Mississippi: A) eastern gamagrass, B) switchgrass, and C) sideoats grama. Examples of cleaned and uncleaned seed lots with cleaned seed on the left of the coin: D) big bluestem, E) little bluestem, and F) indiangrass.

As previously stated, a majority of NWSG varieties have not been improved. Seeding rates must be adjusted to accommodate high amounts of inert matter and lower germination percentages. In order to do this, planting must be made on a pure live seed (PLS) basis. This method allows for enough seed to be planted to meet desired stand plant population goals. To calculate PLS, refer to the example calculation on page 7. Recommended seeding rates for each of the six NWSG species can be found in Table 2.

Planting date is another factor to consider before planting. Suggested NWSG planting dates are similar to traditional, nonnative forage grasses. Following proper weed control, planting should commence as soon as possible in the spring (late March to early April). Depending on where you are in the state, this can range from mid-March in south Mississippi to late April in north Mississippi. Wait until there is no more threat of late frost. Earlier planting allows spring moisture to promote germination and seedling development and reduces the dependency on summer rains to sustain growth. Delaying planting later into spring and early summer can cause stand failure and increase the chance of summer annual weed competition if a preemergent herbicide is not used.

Planting Methods

Several planting methods can be used when establishing NWSG. Broadcast seeding can be accomplished by using carrier components such as sand or lime. Increased seeding rates are required for this technique, as some of the seed may not be placed into an optimum environment for germination (such as a rock, existing vegetation, soil crack, etc.). Be aware that lighter native grass seed may fall out faster than the carrier. Allow for enough overlap of broadcast strips to avoid missed or unplanted strips. Well-packed bare soil is required for this method to be successful. Before and after broadcasting seed, rolling or cultipacking the soil is critical to ensure good seed-to-soil contact. This allows more of the seed's surface area to come in contact with soil particles containing moisture.

Seeds also can be planted with a conventional grass seed drill. Smaller-seeded species (switchgrass) require drills with clover boxes to accommodate the smaller size. Again, bare soil is required for this practice to ensure proper soil contact. However, one potential problem associated with this method is too light, or fluffy, soil conditions. In a fluffy soil, seed may be placed at the

proper depth but can be pressed too deep into the soil by the packer wheel, decreasing emergence. A good rule of thumb is to walk across the field before planting, and if the soil covers the sole of your boot, it isn't compact enough. Use a cultipacker or allow rainfall to settle it.

The final method, which alleviates a lot of potential problems associated with soil disturbance, is no-till seeding. No-till drills have furrow openers or trash plows placed in front of the double-disc openers where the seed is dropped. These implements remove existing dead residue and prepare a small furrow for the seed to be placed. Another advantage of this method is the ability to plant fluffy, or "dirty," seed lots. Specialized seed boxes with picker wheels, agitators, or rotating funnels allow NWSG seed to be evenly distributed into the seed tubes regardless of the seed size, hairs, or amount of trash. Planting with a grass drill specialized for NWSG is highly recommended.

Seeding rates for conventional and no-till drills are substantially less than for broadcast seeding. No matter which planting method is used, proper calibration is necessary to ensure the correct amount of seed is being sown. Refer to the equipment owner's manual to verify seeding rates, and make sure all hopper boxes, seed tubes, and openings are clear and fully functional.

Seeding Depth

Native warm-season grasses are very sensitive to being planted too deeply. Optimum depth for switchgrass, little and big bluestem, indiangrass, and sideoats grama is ⅛ to ¼ of an inch. For these species, another rule of thumb is that ⅓ of the seed being planted should be observed on top of the soil surface when looking down the furrow. For eastern gamagrass, depths of ¼ to ½ of an inch are recommended for nonstratified seed. For stratified seed, a depth of ¾ to 1 inch is recommended.

All three planting methods outlined above are capable of placing a seed too deeply. Broadcasting or drilling onto uncompacted soil, followed by heavy cultipacking or an abundant rainfall event, can settle the seed lower into the soil profile, inhibiting emergence. No-till drills have depth bands set alongside double-disc openers to regulate the downward pressure of the drill onto the soil surface. However, if these bands are worn, broken, or missing, seeding depth is in jeopardy.

Postestablishment Weed Control

Once NWSG seedlings have emerged and any preemergent herbicide residual activity has dissipated, weed seed will begin to germinate and encroach into any bare areas that did not fully establish. Broadleaf weeds can be controlled using any number of effective herbicides. These include 2,4-D, dicamba, and triclopyr + fluroxypyr. For postemergence selective grass control, imazapic (indiangrass, little bluestem, and big bluestem only), and nicosulfuron + metsulfuron (switchgrass only) can be used.

There are other management options for postestablishment weed control. The first is mowing. Mowing is an easy way to reduce canopy heights and remove seed heads of competing weeds to allow NWSG seedlings adequate light and water. This gives NWSG seedlings a competitive opportunity to gain light exposure and carry out photosynthetic processes. Do not clip lower than 8 to 10 inches, as lower cutting heights can damage seedlings and result in possible stand thinning or loss.

Another weed control option, similar to clipping, is grazing. If the weeds present are palatable to cattle, such as Johnsongrass, light grazing at a very low stocking rate can reduce competition with NWSG seedlings while allowing for short-term grazing. As with clipping, do not graze lower than 8 to 10 inches. Also, if grazing is to be implemented, and herbicides have been applied, check herbicide labels to ensure you meet grazing restrictions before putting animals onto pasture.

Summary

Patience, extensive planning, attention to detail, and conscientious management are required in order to successfully establish NWSG on your property. However, if conducted properly, the practices and techniques outlined here can enable you to provide low-input, drought-tolerant, highly productive forage for your livestock and great nesting and brood-rearing habitat for numerous wildlife species. For more information on the establishment of native grasses and species selection, please contact your local MSU Extension office.

Calculating Pure Live Seed (PLS)

Purity and germination of seed lots for NWSG are often fairly poor, requiring seeding rates to be adjusted. In order to accomplish this, the amount of pure live seed (PLS) within a given lot must be calculated to determine seeding rates on a per-acre basis. The simple equation is as follows:

(germination % × purity %) / 100 = % PLS

Purity and germination percentages can be found on the seed label. Germination percentage is based on the number of seed that will germinate within a given period of time. Dormant seed percentage, which can be a significant amount when dealing with NWSG, is seed that is alive but will not germinate unless the dormancy

is broken (through stratification, cold treatment, or scarification). To get the total germination percentage, simply add these two categories together. Dealers or sellers of seed are required by law to place a label on each bag of seed sold. If a label cannot be found on the bag of seed purchased, return it or request a new label. Figure 2 shows an example of a seed label.

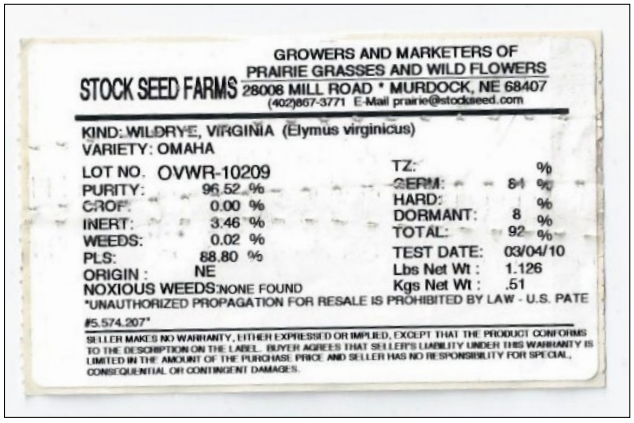
GROWERS AND MARKETERS OF
PRAIRIE GRASSES AND WILD FLOWERS
STOCK SEED FARMS 28008 MILL ROAD * MURDOCK, NE 68407
(402)867-3771 E-Mail prairie@stockseed.com
KIND: WILDRYE, VIRGINIA (Elymus virginicus)
VARIETY: OMAHA
LOT NO. OVWR-10209
PURITY: 96.52 %
CROP: 0.00 %
INERT: 3.46 %
WEEDS: 0.02 %
PLS: 88.80 %
ORIGIN : NE
NOXIOUS WEEDS:NONE FOUND
TZ: %
GERM: 84 %
HARD: %
DORMANT: 8 %
TOTAL: 92 %
TEST DATE: 03/04/10
Lbs Net Wt : 1.126
Kgs Net Wt : .51
"UNAUTHORIZED PROPAGATION FOR RESALE IS PROHIBITED BY LAW - U.S. PATE
#5,574,207"
SELLER MAKES NO WARRANTY, EITHER EXPRESSED OR IMPLIED, EXCEPT THAT THE PRODUCT CONFORMS TO THE DESCRIPTION ON THE LABEL. BUYER AGREES THAT SELLER'S LIABILITY UNDER THIS WARRANTY IS LIMITED IN THE AMOUNT OF THE PURCHASE PRICE AND SELLER HAS NO RESPONSIBILITY FOR SPECIAL, CONSEQUENTIAL OR CONTINGENT DAMAGES.

Figure 2. Example seed label.

To calculate PLS based on the example above, follow these steps:

purity (96.52%) × total germination (92.00%) / 100 = 88.80% PLS

To plant an 8 lb/A rate with the seed lot example from above:

desired rate (8 lb/A) ÷ PLS (88.80) × 100 = 9.00 PLS lb/A

Therefore, in order to achieve an 8 lb/A planting rate, 9 lb of bulk material of this seed lot must be planted per acre.

References

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