Establishing Perennial Species

from Seed in Temperate Climates

LARGE
or small scale
APPLICATIONS

Buffalo Brand
SHARP BROS. SEED CO.
sharpseed.com

Learning From EXPERIENCE

Sharp Brothers Seed Company has provided grass, forb, legume, turf and annual forage seed since 1958. The company's primary product lines are perennials including native and introduced grasses, forbs and legumes. Although these species demonstrate amazing tenacity once they are established, perennial seeds are generally slower to germinate and exhibit less seedling vigor than much of the domesticated crop seed of which we are more familiar.

Perennials of all kinds are more demanding to manage during the seedling establishment stage. In addition, Mother Nature's occasional lack of cooperation increases the challenge. Staffers have assisted customers in the design of seed mixes to fit their goals/environment, seed bed preparation and early management since our founding.

Combining our quality seed with good advice is a proven formula for success. Regardless if you plan to plant 5,000 acres or 500 square feet, range grasses or turf grasses, wildflowers or high yielding alfalfa, many of the concerns and strategies are the same. Following is some of what we have learned. We hope this will make your job easier.

QUALITY SEED
EXPERT ADVICE

Establishing Perennial Species

from Seed in Temperate Climates

STRATEGIC EARLY MANAGEMENT
- Pre-Plant Weed Control
- Residue/Mulch Considerations
- Erosion Control
- Minimizing Air Pockets
- Soil Fertility & pH

PLANTING
- Schedule
- Equipment
- Equipment Calibration
- Irrigation

LONGTERM MANAGMENT

fundamental differences
PERENNIAL SEED vs ANNUAL SEED

Perennial seed is frequently smaller, with lower seedling vigor, and is less abundant than annual seed.

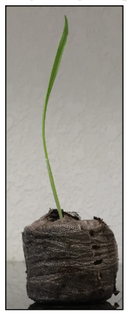
Perennials such as big bluestem, buffalograss or western wheatgrass may live for years. Plants of these species presently growing in the wild may have germinated hundreds of years ago. The growth habits of perennials are heavily weighed toward longevity of established plants. Small quantities of usually small seed are formed only after the requirements of maintaining the parent plant have been satisfied. Perennial seedlings develop from small seed and naturally have slow paced early growth patterns, making them mediocre competitors to annual weeds or existing vegetation.

Annual plants such as wheat, corn or soybeans complete an entire life cycle; germination, vegetative growth, flowering and seed formation in less than a year. The growth habit of annuals is oriented toward reproduction by producing the largest quantities of vigorous seed that is possible.

7 days after planting

Perennial Seed
Little Bluestem

7 days after planting



Annual Seed
Wheat

Weeds: Tillage Affects

When considering tillage before planting, attention should be given to the effect it will have upon weed seed germination.

Deep tillage will frequently reposition the existing bank of weed seeds and result in a heavy flush of weed seedlings emerging soon afterwards, especially on ground with a history of cultivation and crop production. When possible, complete major tillage and land reshaping as far in advance of perennial seed planting as is possible.

When tillage is necessary for vegetation control shortly before perennial seeding, it should be as shallow as possible while remaining effective.

Weeds: No Till Advantages

A "stale" or untilled seedbed will produce a lower population of emerging weeds than a freshly tilled seedbed in most situations.

When possible, plant perennial seed "no till" into the residue of a cover crop which was seeded "no till" to capture the greatest stale seedbed advantage. This strategy is also a good method of providing a firm seedbed which is so beneficial to most applications of small perennial seeds.

pre-plant WEED CONTROL

Reducing weed seed population before to planting is important. Preventing and **reducing weed seed formation** the season prior will insure a more successful seeding. It is important identify and target weed species prone to compete most strongly with the perennial seed that will be planted.

GREATEST THREAT ARE WEEDS...

with the capacity to form a thick canopy, depriving perennial seedlings of sunlight.

that **quickly re-canopy after mowing** or flash grazing, increasing the regularity that clipping is necessary and limiting the effectiveness of these practices. Pigweed, kochia, Russian thistle, foxtail, crabgrass, and downy brome are just a few examples of thick canopied, quick re-growing weeds.

with the ability to grow vegetatively from root stock or **rhizomes** (perennial weeds such as Johnsongrass, bindweed or quackgrass). This class of weeds combine capabilities for extremely rapid growth at the start of the season as well as regrowth after clipping.

that **cannot be controlled with post-emergent** herbicides during perennial seed establishment, either because effective herbicides would also damage the perennial or when no effective herbicides are available. Included in this group would be many broadleaf weeds where forbs and legumes are to be seeded. Grassy weeds such as foxtail, crabgrass, and downy brome are likely to be significant problems in new plantings of grassy perennials.

ALL WEEDS present immediately before planting should be destroyed, to give perennials the best opportunity for establishment.

Pre-Plant Herbicide Use

Herbicides with residual soil activity should not be applied before plantings of perennial seed unless:

- Those herbicides are labeled for preplant application without causing injury to the perennial species seeded.
- Sufficient time is allowed for herbicide decomposition/deactivation prior to planting. Many perennial seeds are small and must be planted shallow. As a result those seeds are sensitive to residues of surface applied herbicides. This concern applies to herbicides such as 2,4-D or dicamba (Banvel) that have short term soil residual activity even though they are not generally considered "residual herbicides" in the production of deeper planted domesticated crops.

RESIDUE/MULCH CONSIDERATIONS

Choosing Bare Soil or Organic Residue/Mulch

Bare Soil

Planting perennial seed into a bare soil seedbed allows good seed to soil contact to be easily achieved without the use of "no-till" planting equipment. This advantage should be evaluated against the value of organic residue/mulch seedbeds when the following are necessary:

SOIL STABILIZATION for **control of wind and water erosion**. Steep slopes and/or sandy soils, being prone to erosion, have a critical need for protective residue cover.

SOIL SHADING for the purpose of maintaining **consistent seedbed moisture**, reducing or eliminating wet/dry seedbed cycles. This is especially important during periods when soil temperatures are optimum for germination. Many perennial seeds are small and must be shallow seeded. Soil surfaces shaded by mulch will generally remain moist for a longer period of time than will bare soil surfaces following irrigation or a precipitation event. Need for soil shading is greatest in windy, low humidity environments and when temperatures are high. In humid regions, soil shading is less critical.

Applied Mulch

Applied Mulch refers to application of organic material such as straw, stover, bark, hydroseeder applied tacifier/mulch or any number of manufactured fiber mulching products. Because of the requirements for labor and/or equipment, mulch application is generally not feasible for large scale plantings, but may be the practical on small projects. Ability of emerging seedlings to access sunlight must be considered when evaluating mulch covers. High density mulch that is less than 1/4 inch thick can be effective since small seedlings can generally penetrate such a thin layer. A mulch layer more than 1/4 inch thick should be less dense, leaving 1/3 to 1/2 of the soil surface visible after application to assure that newly emerged seedlings have exposure to sunlight. Bare soil seed applications followed by mulch application can combine the advantages of good seed to soil contact, erosion control and soil shading.

Cover Crops

Cover Crops, for purposes of this discussion, are planted to produce cover and remain as a dead residue for perennial seeding. Weed seed, as well as volunteer seed formed by the cover crop itself, should be prevented from development if at all possible during cover crop growth. Cash crop stubble from sorghum, corn, wheat or other small grains have all been used with good results. Broadleaf crop stubble such as soybean, sunflower or cotton stubble may also be suitable, although these crops generally produce lower quantities and less durable residue than that of grass crops. Where residue is needed, persistent materials that do not readily decompose have obvious advantages.

In addition to stubble from cash grain crops, plantings solely dedicated to cover establishment are also widely used prior to perennial plantings. Grassy (monocot) plants are most frequently used as cover crops because of the durability of their residue. When planting grassy cover crops, use modest seeding rates targeted toward grain/seed production since this will also maximize stem number and stem coarseness. Heavy seeding rates appropriate for production of leafy hay, may fail to produce stem (reproductive) growth because of overcrowding.

Cover crop residue with many prominent stems is favored because stems provide the most durable cover as compared to leafy growth which rapidly deteriorates as a result of weathering. Forage sorghum, sorghum sudangrass, pearl millet and foxtail millet, widely used as warm season cover crops, and are grown the summer prior to planting perennials. Cool season cover crops, planted in the fall prior to seeding perennials, can also be used. Oats, rye, wheat, barley or triticale would be the choices in this category. Spring plantings of cool season cover crops can be beneficial, however time may not allow effective quantities of residue to develop. It should be noted that cool season cover crops will not generally form as persistent a residue cover as will warm season alternatives and that the sorghums are generally the most durable of the warm seasons. For that reason, sorghums should be used whenever time allows and on soils where they are adapted. Volunteer sorghum seed formation can be limited by planting male sterile sorghums which are economical and widely available. Production of viable seed in any cover crop should be restricted to limit the risk of competition with perennial seedlings during the following season. Herbicide application as seed heads begin to develop can stop viable seed formation without cultivation or mowing. Cover crops are most effective when left standing, un-mowed and undisturbed, prior to perennial seeding, so that plant residue remains attached to the soil as best as possible. By leaving residue attached, equipment used for planting perennial seed is better able to pass through cover crop residue without "raking" or accumulating material in front of equipment running gear.

Frequently, constraints of time do not allow for cover crop

Standard Nurse Crops

establishment during the season prior to perennial seeding. Standard Nurse Crops as discussed here, refer to quick growing annuals that are seeded at the same time as are perennials. After having grown for a period of time, they provide some of the same beneficial functions as do dead residue cover crops regarding soil stabilization and shading. Annual ryegrass is often used as a standard nurse crop because it is adapted to the same shallow seeding depths necessary for perennial seed. Small grains such as oats or triticale are alternatives. Sterile small grains, such as sterile wheat or sterile triticale are gaining in popularity, despite high cost for sterile seed, since they eliminate the possibility of regrowth by volunteer seed.

Relay Nurse Crops

Relay Nurse Crops reduce the time period that severe erosion can damage stands of perennial seedlings as compared to standard nurse crops. Relay nurse crops, such as oats or triticale, are generally planted 1 to 1.5 inch deep prior to perennial seed planting to facilitate quick germination. Perennial seed is shallow planted either immediately after or as much as a month later. Long time periods between relay nurse crop and perennial plantings may completely eliminate erosion risk, short time periods will yield only modest reductions of risk.

A SUMMARY OF FACTORS

Comparing cover crops, standard nurse crops and relay nurse crops

Cover crops provide residue prior to seeding perennials, offering immediate soil stabilization and shading. Nurse crops must develop before accomplishing these functions, frequently leaving a period of erosion risk and no soil shading for weeks after perennial seeding.

Nurse crops are actively growing while perennial seedlings are germinating and establishing. Competition for soil moisture and sunlight, between nurse crop and perennial seedlings, must be considered. Nurse crops will generally germinate and grow taller than perennials during the establishment year. When possible; rank, overly competitive nurse crop growth should be managed by frequent mowing during perennial establishment.

Relay nurse crops have the potential to be more competitive against perennial seedlings than standard nurse crops, and this disadvantage should be weighed against the need to control erosion to find the best compromise position.

COMPARITIVE SEED BED COVER RATING

Equal Biomass Quality & Distribution Assumed

Cover Type	Ease of Seed to Soil Contact	Erosion Risk	Soil Shading	Risk of Competition
Bare Soil	10	1	1	10
Bare Soil, Mulch Applied	10	8	10	10
Cover Crop Attached to Soil	1	10	10	10
Standard Nurse Crop	10	5	5	4
Relay Nurse Crop, Short Delay	7	7	7	2
Relay Nurse Crop, Long Delay	8	9	9	1

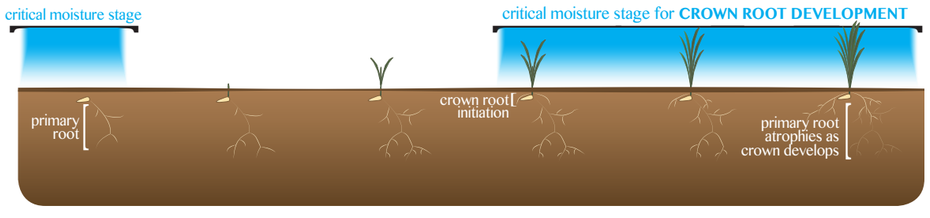
1: Least Advantage 10: Best Advantage

soil note

- Accumulation of subsoil moisture PRIOR to planting is important in preserving and ***prolonging seedbed moisture***.
- The soil surface will not dry as rapidly after a precipitation event when moist soil is below.
- **Moisture will wick up** through capillary movement partially replacing water that has evaporated.

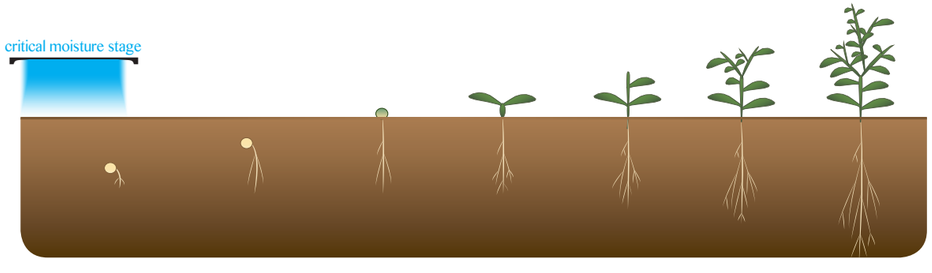
Surface Moisture: Grasses vs. Broadleaf Plants

Comparison of Germination and Early Development | Both grassy (monocot) and broadleaf (dicot) species require surface soil moisture for germination when shallow seeded.



MONOCOT

Surface soil moisture is essential for seedlings of grassy species to develop the permanent crown roots which are positioned above the seed, at or near the soil surface. If soil is dry in this zone, permanent crown root development, essential to the transition from weak seedling to hardy plant, will stall.



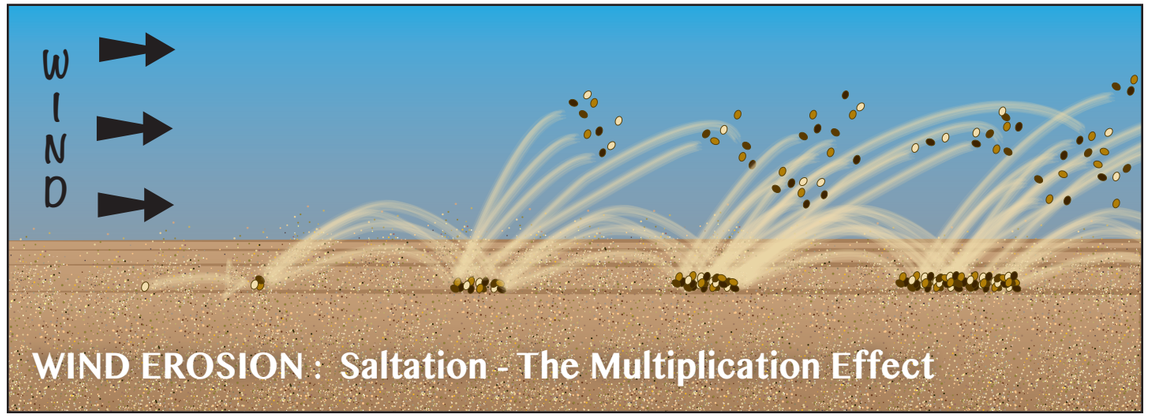
DICOT

The seedling roots of broadleaf species transform into the permanent root system. Development can proceed without serious interruption due to dry soil surface.

EROSION CONTROL
Block Wind's "First Bite"

When planting cover crops or nurse crops, they will generally be most effective when planted with rows at a perpendicular to prevailing winds. Although this is practical advice, it is frequently not adopted when planting center pivot irrigated ground, where planting in a circular pattern is common. When planting in a circle, some areas of the field will have cover/nurse crop rows running parallel with wind direction. These areas will be most susceptible to wind erosion; where the wind can most easily take the "first bite" and initiate saltation.

Saltation is a process where soil particles break loose and bounce across the soil surface like tiny basketballs, each impact causing more particles to break loose and multiplying the destructive bouncing pattern. The saltation process can quickly spread serious erosion to areas that were initially not at risk. Returning to the proven practice of planting cover/nurse crops in straight lines at a perpendicular to prevailing winds is the best method to prevent wind's access to the "first bite".



Minimizing Air POCKETS
Seed to Soil Contact

Seed must reach adequate moisture levels before germination will initiate. Moisture absorption from direct soil to seed contact is very efficient. Transfer of moisture across air pockets is very inefficient. Speedy germination is facilitated by minimizing the air pockets surrounding the seed. The presence of clods of soil or gravel in the seedbed indicates the presence of air pockets. Cloddy soil should be pulverized and worked into a firm seed bed to eliminate air pockets. Gravel presents a special problem since it cannot be pulverized; as a counterbalance, all other possible management strategies should be implemented.

These considerations are of greater consequence with many perennial seedings than with most domesticated crop seedings for two reasons:

Most perennial seeds are small, necessitating placement in shallow seed beds that can quickly dry. Since shallow seed beds are prone to rapid moisture loss, it is essential that moisture be absorbed by the seed as quickly as possible, before seed beds dry.

Often times the caryopsis or viable portion of perennial seed is encased in either a chaffy or woody cover. These covers have the benefit of protecting the seed but the disadvantage of slowing water absorption from the soil. Firm seed to soil contact with a minimum of air pockets in the seed bed is essential in overcoming these naturally occurring barriers.

Good seed to soil contact may be achieved mechanically; with well managed planting equipment, roller packers, and occasionally on small sites, with nothing more than foot pressure. The forces of nature; freezing/thawing cycles, heavy snows, beating rains and/or livestock hoof traffic can add to or substitute for mechanical seed to soil contact. These natural forces are more likely to occur with dormant seedings, discussed on page 7. Please read that portion before adopting the plan that is best for your circumstances.

GENERAL SOIL FERTILITY & pH

General Soil Fertility and pH should be determined with soil tests to determine nutrient availability and low pH. Deficiencies may be corrected by fertilizer or lime application prior to cover crop seeding or perennial grass seeding. Soil tests are strongly recommended where extensive earth moving has occurred. Fertility levels may be far from "normal" in such areas.

Nitrogen Fertility Requirements

Nitrogen Fertility Requirements during the early establishment stage vary greatly across the classes of perennial plants. As a result, the correct nitrogen fertility management strategy is determined by both soil tests and by the perennial species to be planted.

Warm season perennial grass seedlings, either native or introduced, will exhibit little additional growth or vigor where soil nitrogen is plentiful as compared to sites where soil nitrogen is limited. By contrast, most weed species are more vigorous when soil nitrogen is plentiful. As a result, fertilization with nitrogen prior to seeding warm season perennial grasses is generally counterproductive, encouraging weed growth while having only minor benefit to perennial grass seedlings. As an extension of this strategy, seeding managers may choose to not fertilize or to under fertilize cover crops which precede warm season perennial seeding. Cover crops will absorb much of the residual soil nitrates in this situation and "tie up" absorbed nitrogen within the cover crop plant tissue. As cover crop residues decompose nitrogen will slowly be returned to the soil.

Grass mixes that are exclusively cool season or dominated by cool season species respond vigorously to plentiful soil nitrogen fertility shortly after emergence. As a rule of thumb, when cool season grass seedlings reach the three leaf stage, approximately 2 to 4 weeks after emergence, protein supplies contained in the seed itself are generally depleted. Ideally 25 to 50 pounds of nitrogen should be available in the upper 4 inches of soil at this stage of growth so that seedling nitrogen (needed for protein synthesis) requirements can be absorbed by the shallow, immature root system and seedling development does not stall. Nitrogen amendments can be effectively applied before planting to most sites. Locations where nitrogen is prone to loss from leaching; very sandy soils, high precipitation or heavily irrigated sites; should be considered for top dressing in the early seedling stage. If top dressing over small seedlings, be mindful of the risk of traffic injury, especially at field edges where equipment makes sharp turns. Liquid fertilizer can severely burn tender seedling leaves and should not be used at this stage unless applied via a dilution in irrigation water. Generally, dry fertilizer may be directly applied without leaf burn.

Nitrogen: Warm & Cool Grass Mixes

Combined Warm Season/Cool Season Perennial Grass Mixes are commonly used in many temperate climate plantings. Cool season grasses can sprout earlier than warm season species when soil is cool, an establishment advantage in many environments. When the targeted objective is that warm season species will dominate the mature landscape, nitrogen availability should be restricted so that cool season grasses do not become too vigorous and limit warm season grass seedling establishment due to excessive competition. An exception to these objectives occurs in "critical area" sites such as waterways, dam sites or other steep slopes where erosion is an immediate as well as long term concern. In these situations, durable cover is the objective, with little regard for the exact component percentages of the mature landscape. High seeding rates of both cool and warm season grasses are commonly applied so as to have strong odds of successful seedling establishment regardless of when favorable germination conditions occur. Critical area site managers may choose to encourage early development of cool season grasses with nitrogen fertilization.

Nitrogen: Adding Forbs & Legumes

Perennial Grass, Forb, Legume Mixes should be managed to favor the dominant grass component in most cases.

Introduced Perennial Legumes such as alfalfa, birdsfoot trefoil, Cicer milkvetch, sainfoin, white (Ladino) clover and red clover, a short lived perennial, are all capable of meeting their own nitrogen requirements through symbiotic association with rhizobia after they have become established. During establishment, before rhizobia development, these species will frequently benefit from soil nitrogen availability similar to that of perennial cool season grass seedlings, 25 to 50 pounds in the upper 4 inches of soil. Low pH or other nutrient deficiencies should also be corrected for the long term vigor and productivity of these perennial legumes.

WHAT ABOUT *High Soil pH / Salty Soils?*

High soil pH limits some soil nutrient plant uptake as well as the ability of many species of plants to establish and thrive. Salty soil conditions also restrict nutrient uptake and the survival of many species of plants. Soil amendments can correct both soil problems. Despite this, soil amendments are less commonly used on high pH and/or salty sites, than lime applications are for the correction of low pH sites. The quantity of materials (elemental sulfur, sulfuric acid or gypsum) commonly applied to correct high pH and/or alkali soils may be cost prohibitive on large scale sites. Soil sampling followed by consultation with a qualified agronomist would be the best means of determining costs of remediation. When soil amendments are determined to be too costly, selection of species that are adapted to the site usually remains as a viable option. Sharp Brothers has years of experience advising customers who are dealing with either soil problem.

PLANTING SCHEDULE: EARLY OR LATE SEASON

Perennial seed can be planted year round with successful establishment. However the chance of success can be substantially improved by developing a strategy that encompasses the local conditions, environment, climate, availability of equipment and labor combined with an awareness of the characteristics of the perennial seed to be planted. Following are key considerations.

SEEDING DEPTH

Most perennials are small seeded and should be planted ¼ to ½ inches deep.

A few exceptions such as Eastern Gamagrass and Indian Ricegrass benefit from deeper placement.

Dormant Seed Adapted

Most perennial seed differs from most domesticated crop seed in that it is resistant to deterioration during exposure to cold wet soils. This resistance allows seed to be successfully dormant planted, from early winter to early spring, sometimes months before the soil warms to temperatures adequate for germination. This characteristic allows a planting season of several months per year in most cases.

Seed to Soil Contact

Dormant planting has the advantage of allowing labor and equipment to be utilized over more of the calendar year. In addition, seed to soil contact is frequently enhanced during the winter and early spring period.

Weed Management

In many environments, emergence of summer annual weeds (examples: kochia, pigweed, foxtail, crabgrass), emergence of warm season perennial weed seedlings (example: seedling Johnsongrass) and growth of warm season perennials from vegetative structures (example: rhizomatous Johnsongrass) is most vigorous in spring and early summer. These classes of weeds pose the greatest threat to warm season perennial plantings. As the season progresses the initiation of new warm season weed growth is generally less.

Winter annual weeds (example: multiple mustard species, volunteer cereal grains, downy brome or cheat grass) usually emerge in late summer or early fall, occasionally in spring, producing seed and maturing by early summer. These weeds pose the greatest threat to cool season perennial plantings. Emergence during late spring through mid-summer is very rare.

The disadvantage to planting into cold soils is that large populations of weeds may emerge early in the season before perennial warm season seed has sprouted. This places an extra burden on the site manager, determining vegetation control options that will not jeopardize the safety of the perennial seeds and/or seedlings, while the status of both weeds and perennials may be changing on a day to day basis. When heavy weed populations are expected, or weed pressures are not known, a planting date later in the season can have a strong advantage over dormant plantings because weeds can be controlled immediately before planting.

Winterhardiness of Seedling

Many warm season grass species are considered winter hardy if they have grown for 8 to 12 weeks before growth is terminated by frost and when crown development is not delayed by dry soil *(see "Surface Moisture: Grasses vs. Broadleaf Plants" on page 3)*.

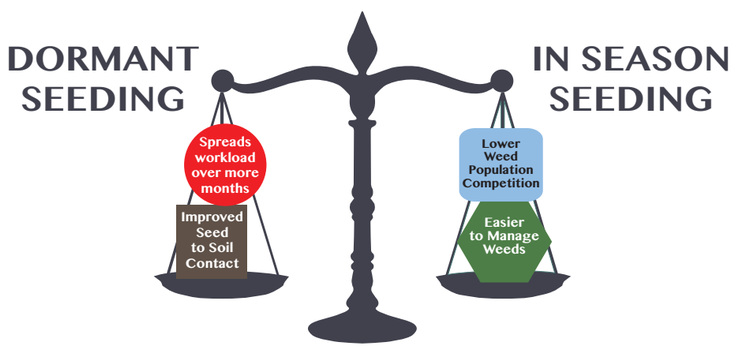
Both grass and broadleaf warm season species will be at increasing risk of winter kill as germination dates progress later into the summer and fall.

Cool season grasses may begin to germinate in February or March. Note that cool season grasses may also be planted in August or September so that they are able to sprout and establish before winter.

Cool season species, both grasses and broadleaf species require less time for development to achieve winter hardiness. Generally 6 to 8 weeks growth before termination by frost is sufficient. Concerns regarding crown root development in cool season grass species are similar to that of warm season grasses *(page 3)*.

Late season perennial plantings have the best chance for success where rapid, reliable germination and early seedling development can be assured with irrigation or during periods of favorable rainfall. Late plantings in locations where moisture for germination is unreliable are at risk of failing to develop into plants with sufficient hardiness to survive the upcoming winter.

Perennial seed, both warm and cool season, that germinates during unusually warm wet fall periods, "Indian summer", is at great risk of winter kill since seedlings will be very winter tender when hard freezes occur. Considerations of labor and equipment availability or contract deadlines may over ride this risk, but the risk should be understood by all parties with an interest in the project. Where very late season germination is possible, higher seeding rates are recommended. Larger quantities of seed will generally place more dormant seed into the seed bed. Dormant (slow germinating) seed, would be especially valuable in late season plantings as it would serve as a backup in case winter kill eliminated faster germinating seed.



MATCHING PLANTING EQUIPMENT TO SEED AND PLANTING SITE

Some perennial seeds may be planted using commonly available agricultural or turf seeding equipment. However seedbed conditions and/or the unique structure of some perennial seeds may necessitate the use of specialized equipment.

This paper is intended to provide guidance in choosing seed feeds that are compatible with the structure of seed to be planted. Additional guidance is offered to help choose soil openers that are designed for the existing seedbed conditions. Since planting equipment can be assembled with any combination of components, seed feeds and soil openers will be discussed separately. Bulking materials, which are mixed with seed in instances where planting rates are below the capabilities of the equipment, are suggested for the seed feeds discussed.

Seed Feeds & Seed Box Agitation Devices determined by unique seed structure

Picker Wheel Seed Feed & Agitator

Cutaway view of picker wheel & seed feed agitator

Exterior view of picker wheel seed cups

Picker Wheel, for chaffy seed or chaffy seed/easy flowing seed mixes. Agitation devices are always mounted above picker wheels to prevent seed bridging and to maintain a uniform mix of seed components that might otherwise segregate during the drilling process. Used by various manufacturers in most modern chaffy seed planting equipment. Compatible bulking materials include cotton seed hulls, rice hulls or similar products.

Little Bluestem

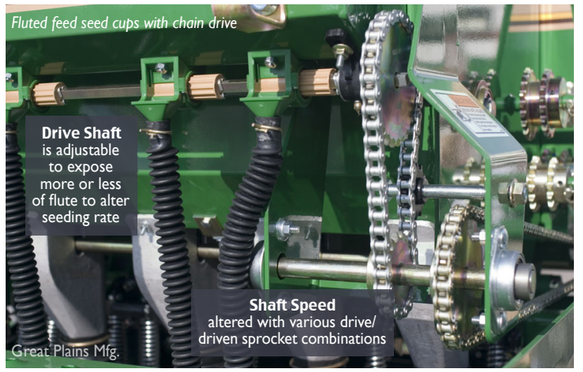
CHAFFY SEED is what the picker wheel was designed for. *Note that mixes of smooth and chaffy seed may also be planted with the* ***picker wheel - agitator.***

Blue Grama

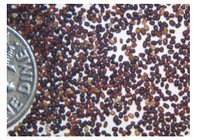
Fluted Feeds

The basic Fluted Feed design is used by a number of different manufacturers using flutes ranging from 1.25 inch to 3.5 in diameter. Cracked sorghum is a compatible bulker with both large diameter and small diameter flutes.

Fluted feed seed cups with chain drive



SMALL DIAMETER FLUTED FEEDS are used for small, smooth, easy flowing seed such as alfalfa, switchgrass and sand lovegrass. Turfgrass seed boxes or legume boxes on "conservation" type seed drills are frequently equipped with this type of feed. Pictured: Sand Lovegrass seed, compatible with small diameter fluted feeds.



LARGE DIAMETER FLUTED FEEDS are capable of metering a variety of seed sizes ranging from small seed such as sand lovegrass to large seeds such as Illinois bundleflower or eastern gamagrass. Modern grain drills with gravity feeds are commonly equipped with large diameter fluted feeds. Pictured: Eastern Gamagrass seed, compatible with large diameter fluted feeds.

LARGE DIAMETER FLUTED FEEDS + AGITATION DEVICES

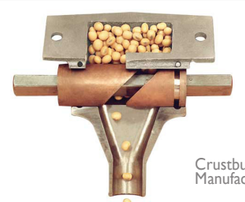
Large Diameter Fluted Feeds combined with Agitation Devices are used to facilitate the metering of brome, fescue, wheatgrass or seeds of similar structure, that flow moderately well but with some tendency to "bridge" above or not drop into, the seed feed. Note that this type of seed is also commonly planted with picker wheel equipped seed boxes. Pictured: Perennial cool season grass seed species, that may be metered through large fluted feeds when combined with seed box agitation devices.

Intermediate Wheatgrass

Smooth Brome

Wooble Slot Feeds

Wobble Slot Feeds for various sizes of smooth easy flowing seed. This type of seed feed is used exclusively on Crustbuster gravity feed grain drills: *Same seed compatibility and bulker as* ***large diameter fluted feeds***.



Wobble slot feed meter with capabilities similar to fluted feeds.

SOIL OPENERS
& Associated Planting Equipment Components

Light duty equipment is frequently adequate for the job where seedbeds have been prepared with conventional tillage. Heavy duty equipment with significan down pressure per row is generally useful when soil is very firm such as no till sites.

Depth control devices such as depth bands on disc openers or press wheels which are engineered to control depth of seed placement are critical to the success of many seeding projects.

Equipment with coulters and rows that are staggered from front to back are better able to negotiate high residue plantings sites without plugging

Press wheels or other devices that facilitate good seed to soil contact should be kept in good working condition since those devices are the last opportunity to achieve good seed to soil contact through mechanical means.

SHARP EQUIPMENT CALIBRATION
(GRAVITY FEED PLANTERS)

This simple calibration method requires a scale to determine the gram weight of samples which are collected. Many agricultural retailers or grain elevators are equipped with gram scales and may be willing to weigh samples as a service for their customers.

1 Measure your equipment's row spacing (in inches).

2 Determine the calibration distance that is appropriate for the row spacing of your equipment using the following formula:

$$\frac{\textbf{1152}}{\textbf{ROW SPACING } \textit{(inches)}} = \textbf{CALIBRATION DISTANCE } \textit{(feet)}$$

3 Measure and flag the **CALIBRATION DISTANCE**.

4 Collect a sample of the seed from one row (seed feed) of the equipment for the length of the calibration distance.

SHARP TIP: The delivery tube can be used to collect a sample by detaching the bottom of the tube from the implement and plugging it with a rag to catch the seed over the calibration distance.

5 Weigh the sample. The gram weight of the sample equals the pounds per acre which the equipment is applying at its present setting. *Example: a 10 gram sample indicates the equipment is applying 10 pounds per acre.*

6 Adjust the equipment to apply more or less seed if necessary. Repeat the calibration process until sample weights indicate that the application rate is within an acceptable range of accuracy.

For additional information about planting equipment & calibration visit sharpseed.com

AVOID IRRIGATION FAILURE
Determine Maximum Irrigated Acres

Small seeds require placement in shallow seedbeds, soil surface to ¼ inch deep. Shallow seedbeds can lose moisture very rapidly, jeopardizing successful germination. Large area receiving not enough water, can result in complete failure.

Use of sprinkler irrigation to facilitate germination and establishment of seed in a shallow seedbed should be planned to maintain as consistent seed bed moisture as is possible. The following method provides a simple formula for determining the acres that can be reasonably irrigated with a known quantity of water after estimating the seedbed moisture loss projected for the planting site conditions.

Step 1: Estimating SML (Seedbed Moisture Loss)

Seedbed Moisture Loss, an estimated projection of inches of water lost in a 24 hour period due to evaporation, gravitational flow and/or downward capillary movement. Even in perfect conditions a minimum SML of 0.05" will occur. Since nothing is perfect, other environmental factors must be considered when estimating total projected SML. Caluculate the sum of the following conditions that apply or are likely to apply to the planting site to find SML.

Low Humidity Increased drying when expected afternoon relative humidity is below 50% **add 0.03"**	**High Temperatures** Projects timed for mid-summer, or during warmer than normal periods in spring or fall **add 0.02"**	**Windy** Average wind speeds above 15 mph **add 0.09"**
Dry Subsoil Soil below seedbed is dry & unable to wick-up replacement moisture **add 0.05"**	**Coarse Textured Soil** Soil is course, sand or loamy sand, creating poor seed to soil contact **add 0.03"**	**Bare Soil** No mulch to create shade and lower seedbed evaporation **add 0.13"**

example

Minimum SML 0.05" Moisture Loss in Perfect Conditions + **Windy** add 0.09" + **Bare Soil** add 0.13" = **0.27" SML**

Step 2: Determine GPM (Gallons per minute)

Determine gallons per minute of your irrigation system. GPM is entered into the formula without alteration when the sprinkler system will be operated continuously, 24 hours per day. When the sprinkler system will not be in continuous operation, the GPM value should be lowered accordingly.

example

A sprinkler applying 200 gallons per minute will be in operation for only half of the day, or 12 hours. **100 GPM** (½ of 200 GPM) should be entered into the formula to find MIA.

Step 3: Calculate MIA (Maximum Irrigated Acres)

Find maximum acres over which the irrigation system is capable of replenishing SML. **Divide GMP by SML, and multiply by conversion factor (0.0533) to find MIA.**

example

$$\frac{\textbf{100 GMP}}{\textbf{0.27" SML}} \times \textbf{0.0533} = \textbf{19.74 MIA}$$

post-plant
WEED CONTROL

Perennial grass and wildflower species, while germinating and during early establishment, are at risk of failure when weed competition is intense. A strategy to control competing vegetation is essential to any perennial seeding project. Herbicides can be very useful, reducing the labor and expense dictated by vegetation control during the first year or two after perennial planting. Seedling tolerance to herbicides varies greatly from species to species, region to region and soil types within a region. For that reason herbicide application should be undertaken only after careful research and accounting for all variables that are part of each individual project. Many site managers of perennial seedings avoid herbicides during establishment. Mowing is a time honored method of weed control in perennial seed plantings. Weeds commonly achieve plant heights well above that of perennials in the first season of growth. Mowing reduces the weed canopy so that more sunlight reaches perennial seedlings. Examine the site in order to determine the best mowing height. The goal is to remove as much foliage from weeds as is possible while removing minimal leaf area from the perennials. Choose a mowing height that best meets that goal. Mow frequently, whenever significant damage can be dealt to the weed population as this will nearly always benefit perennials. Infrequent mowing may allow heavy weed growth to develop prior to each mowing. Two problems can occur as a result:

Heavy growth may be "windrowed" by rotary mowers resulting in clumps of heavy residue deposited on small perennial plants.

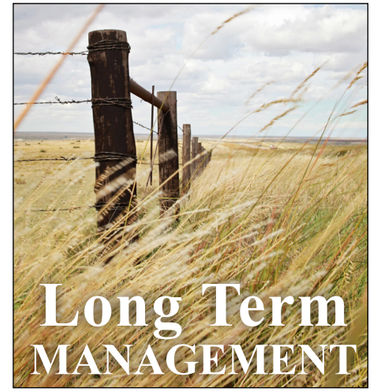
Removal of thick weed canopy can occasionally cause perennial seedlings to be "shocked" by sudden transition from heavy shade to full sunlight.

As perennials develop, their ability to compete with and suppress weed growth improves substantially. After perennials have become established, usually in the second or third season after planting, a regular mowing schedule may be counterproductive since many established perennials are not well suited to frequent in season defoliation. When regular mowing of the established stand is planned, as a lawn or farmstead setting, care should be taken to use species that are tolerant to such treatment in the environment where they are intended. Buffalograss, blue grama, sideoats grama, bermudagrass or western wheat grass are all examples of species that are tolerant of regular mowing in dry as well as wet environments. Tall fescue tolerates regular mowing in moderate to high rainfall areas but does poorly as a turf grass in dry environments without irrigation. Burning old residue of warm season perennial grasses initiates early, vigorous spring growth and can be highly beneficial as a means of weed control. Burning is commonly used in the spring of the second season, third season or afterward whenever residue accumulation warrants. Non selective herbicides such as glyphosate (Roundup) can be safely applied to stands of warm season grasses (not advised in warm/cool mixed stands) when dormant – winter and early spring, and can be an effective means of controlling cool season weeds. Dormancy should be carefully verified with close inspection of the crown of the plants before proceeding with glyphosate application. Glyphosate should not be applied if any spring growth has initiated in warm season species. Such a treatment can control unwanted cool season grasses (perennials or annuals) as well as broadleaf weeds such as dandelion or mustard.

WILDFLOWERS
AS AN OVER SEEDING

Native wildflowers are an important addition to many native grass plantings. Besides adding beauty to stands of native grasses, wildflowers are an important food source for game birds, song birds, and mammalian wildlife as well as grazing livestock.

Choosing when to seed these wildflowers depends largely on the management strategies that are intended. Inclusion of wildflowers eliminates the possibility of some herbicide use. Many herbicides which control weeds may also kill wildflowers. Where use of such herbicides is planned it would be best to delay planting wildflowers for one to three years. This would allow herbicide use until the grasses are established and herbicides are not needed. Wildflowers species will generally establish well in stands of established grass. Wildflower species have been added as an enhancement planting to thousands of acres of conservation reserve programs (and with good results).



Once established, the practices applied to any perennial site will be determined to some extent by the goals of the manager; forage production, wildlife habitat or durable turf being just a few examples. Regardless of the specific goal, managers should always be mindful of the energy flow and energy reserves maintained in the perennial plant. Energy flow is created by photosynthesis. If photosynthesis is restricted by excessive defoliation; overgrazing or close mowing, the plant's health and longevity is put at risk. Partial or total stand loss may occur. In temperate climates, perennials may go dormant because of either cold temperatures or drought. As plants approach winter dormancy in the fall or a drought induced dormancy as soil moisture becomes depleted; it is especially important to allow as much leaf area as is possible to develop and be retained by the plant with the goal of maximizing photosynthesis, energy flow and the energy reserves that the plant is able to store. The ability of a plant to recover and initiate vigorous new growth with the return of warm spring weather or after a drought breaking rain is an indicator of adaptability to the environment as well as the energy reserves which the plant has accumulated before becoming dormant.

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Medium Grass Hardland
Medium Grass Sandy Soil
Tall Grass Hardland
Tall Grass Sandy Soil
Badger Dirt Mix
Tall-Medium Shoreline Mix
Tall Pasture Mix
Windbreak Blend

WILDFLOWER MIXES

Bonnie's Butterfly & Bee Mix
Monarch Butterfly & Honey Bee Mix
Big 10 Wildflowers
Cowgirl's Delight
Short Wildflower Mix
Medium Wildflower Mix

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PM7 Horse Candy
PM8 High Plains Pasture Mix
Stampede Paddock Mix