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# Irrigated Production of Warm-Season Grass Seed in the High Plains

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Provides information to help producers successfully incorporate warm-season grass seed production into irrigated crop rotations to achieve maximum profit potential.

Crop diversification provides several benefits to cropping systems in the High Plains, including increased soil organic matter, the disruption of pest cycles, and reduced soil erosion. In addition, the production of alternative crops, such as warm-season grass seed, can fill opportunistic "niches" in the marketplace and enhance the economic viability of agricultural communities.

With proper management, several years of warm-season grass seed production can be realized from the expense of a single planting. The profit potential is good, but the market potential usually depends on limited demand created by mining and construction reclamation, Conservation Reserve Program (CRP) plantings, and the reestablishment of pastures or wildlife habitat. Before establishing the crop, it is important that the producer learn as much as possible about existing and future market needs.

Warm-season grasses that are native to North America have evolved within the environmental conditions of the Great Plains, ranging from severe drought and infertile soils to fertile soils in sub-irrigated flood plains. Seed of these species is essential for revegetation projects in the High Plains.

## Crop Establishment

### Establishment Time

Warm-season grass is usually planted one crop season prior to obtaining seed production. For example, a crop planted in June 2005 would be harvested for the first time in August 2006.

### Species and Cultivar Selection

Warm-season grass seed production will require an awareness of seed market trends, production/management practices, risks, costs, and potential seed yield for a given species and cultivar. Typically, seed that demands the highest price comes from a species with a low seed yield potential, is difficult to produce, or a combination of these factors. In addition, there can be significant price variations among cultivars of a species.

During a three-year study, research was conducted at the Panhandle Research and Extension Center (Scottsbluff, Nebraska) to determine the potential for warm-season grass seed production under regional, irrigated conditions. Four varieties of side-oats grama, six varieties of blue grama, and one cultivar of black grama grass were studied. Seed yield and winter survival were used as indicators of potential seed production (*Tables I* and *II*).

Lower seed yields for some black and side-oats grama cultivars (i.e., Nogal, Niner, and Vaughn) demonstrate their adaptation to milder, southern environments, rather than the harsh winter conditions associated with this research site. Lower seed yields for cultivars which are not well adapted are typical and may be further impacted by stand loss and weed invasion.

**Table I. Blue and black grama seed yields for three production years, Scottsbluff, Nebraska.**

| *Cultivar* | *1999* | *2000* | *2001* | *Mean* |
|---|---|---|---|---|
| | lb/acre | | | |
| Bad River | 720 | 220 | 480 | 470 |
| Willis | 680 | 190 | 470 | 450 |
| NE Experimental 1 | 470 | 200 | 310 | 330 |
| 421282 | 360 | 190 | 390 | 310 |
| Hachita | 280 | 190 | 340 | 270 |
| 421283 | 380 | 120 | 300 | 270 |
| Nogal (black grama) | 320 | 90 | 120 | 180 |
| | | | LSD | 110 |

**Table II. Side-oats grama seed yields for three production years, Scottsbluff, Nebraska.**

| *Cultivar* | *1999* | *2000* | *2001* | *Mean* |
|---|---|---|---|---|
| | ---------- | lb/acre | ---------- | |
| Trailway | 1140 | 670 | 990 | 970 |
| Butte | 1320 | 630 | 890 | 940 |
| Vaughn | 1090 | 370 | 1105 | 850 |
| Niner | 1120 | 230 | 440 | 600 |
| | | | LSD | 230 |

## Site Selection and Preparation

To maximize seed yield potential, warm-season grasses should be planted on well-drained sandy loam, loam, or silt loam soils, in fields that have been well managed for soil nutrients. A minimum soil profile depth of two feet is recommended to optimize availability and storage of soil moisture and nutrients for many species. Selected fields should not have produced seed from the same species within the past two years and must be isolated from cultivars or native plants of the same species to maintain seed integrity. Also, it is of utmost importance to adhere to cropping restrictions associated with herbicide use on previous crops.

The ultimate goal of all field preparations is an extremely firm seedbed that is free of weeds. A firm seedbed will facilitate good seed to soil contact, capillary movement of soil moisture, and uniform emergence and will reduce the potential for weed infestation.

No-till cropping systems offer several advantages in the establishment of a grass seed crop, including a firm seedbed, soil and water conservation, and seedling protection from wind and heat stress. These systems commonly use a cereal crop (i.e., oats, millet, or barley) that can be planted in the year prior to establishment or in spring of the establishment year. When planted in spring of the establishment year, the cereal crop could be harvested for hay or haylage and then the grass seed crop can be no-till planted into the stubble. In some instances the cereal crop is simply planted as a cover crop, which requires killing the crop with a non-selective herbicide, such as glyphosate (Roundup), at a height of 4-6 inches. No-till planting requires a light and uniform covering of surface residue in order to maximize uniform seed placement and emergence.

## Seeding

Planting foundation or registered seed is preferred since many reclamation projects require certified seed (see Seed Certification). Depending on the species of grass to be planted, seeding usually can be accomplished by modifying standard seeding equipment (including no-till drills) and practices. For many standard drills and seeders, this will require that the seedbox be equipped with additional mechanical agitation since thorough and constant mixing with an agitator is often necessary to prevent settling and facilitate seed flow. Carriers such as cracked wheat, oat groats, and heated (killed) proso millet also have been used to assist seedflow and prevent bridging in the drill.

The window for planting warm-season grass extends from mid-May through mid-June. Germination may occur over several weeks, depending on climate and soil conditions. For germination to occur, soil temperatures must reach 55° to 65° F. Since native grass seed can have germination rates less than 80 percent, they should be planted on the basis of pure-live-seed (PLS). Seeding rates providing 25-30 PLS per linear foot of row are commonly recommended to ensure adequate stand establishment.

Row spacings from 12 to 22 inches often are used for irrigated production of warm-season grass seed. The choice of row spacing will depend on factors such as the availability of seeding/maintenance equipment and the growth characteristics of a given species or cultivar. Wide row spacings (18-22 inches) allow for inter-row cultivation and make it easier to rogue off-types, while narrow row spacings (12-14 inches) have merit as a management practice in controlling weeds. Most warm-season grass produces higher yields in wide rows in comparison to row spacings less than 12 inches or solid stands from broadcast seeding. Broadcast seeding is seldom practiced, since weed control options are extremely limited.

Proper seeding depth is critical to successful crop establishment. Seeding depth for warm-season grass is shallow, ranging from 0.25 to 0.50 inch.

## Irrigation

Various irrigation systems can be used in the production of warm-season grass seed; however, pivot irrigation systems are most common and offer several advantages, including reduced labor costs, increased water efficiency, and ease of harvest.

Because native grass seed often does not have good seedling vigor and is shallow planted, adequate moisture must be maintained in the top 6 inches to promote seedling germination and emergence. If soil moisture conditions are dry at planting, apply water before planting to fill the top foot of soil to near field capacity. If later irrigations are required, they can be applied less frequently because soil moisture is available below the seed.

Warm-season grass is particularly vulnerable to fluctuations in temperature and the lack of moisture during germination and emergence. For example, blue grama requires 2-4 days of 96 percent humidity and a 59° F or greater soil temperature for germination and the development of adventitious roots. Germinating seeds and emerging seedlings will die if the soil surface (0-3 inches) is allowed to remain dry for an extended time; however, excessive irrigations and/or precipitation can cause stand loss due to “damping off” diseases and soil crusting problems.

## Fertilization

Fertilization is not usually recommended for the establishment of warm-season grass. Nitrogen applications actually may be detrimental because they stimulate the growth of annual weeds. Phosphorus, potassium, and sulfur are only required if a soil test indicates deficient levels. Native grass seedlings are salt sensitive, therefore, it is advisable that required fertilizer be separated from the seed by band or broadcast application.

# Crop Maintenance

## Irrigation

Irrigation is important to maintain adequate moisture for maximum growth and seed productivity. Since the active growth period for warm-season grass begins in late spring (mid-May), the crop requires only minimal moisture from late fall to early spring. Minimal moisture during these times reduces the potential for establishment of cool-season weeds.

Water use by an established crop will gradually increase, beginning in June, until it peaks at 1.0-1.5 inches per week just

prior to or during flowering and pollination (July-August). Unless precipitation is sufficient to meet crop demand, supplemental irrigation water will be required. During the active growing season, crop water use can exceed the delivery capacity of the irrigation system. It is extremely important that the top 1-2 feet of soil be near field capacity prior to this growth period. If the rooting zone contains 2-3 inches of available water at dough stage, additional irrigations are usually not required for seed maturation.

With the last irrigation (mid-late August), the soil profile needs to be completely filled to ensure plant survival through the winter. If necessary, after the spring burn (April-May), irrigate to recharge the top 1-2 feet of soil to field capacity.

**Fertilizer**

Nutrient recommendations for established stands of warm-season grass should be based on nutrient tests from incremental soil samples (0-6 and 6-18 inches). Nutrients of primary concern are nitrogen and phosphorus.

As a general guideline, it is recommended that established stands receive annual applications of approximately 50 pounds of phosphate ($P_2O_5$) and 100 pounds of nitrogen (N) per acre. Typically, phosphorus is broadcast applied in the spring, after burning. Nitrogen efficiency is enhanced by split applications through an irrigation system in late spring (May-early June) and later in season as needed. Late spring applications of nitrogen commonly account for 60-80 percent of the total amount applied. Deficiencies in soil sulfur and iron are likely to occur on sandy and high pH soils (7.8), respectively. Broadcast application of iron sulfate may be necessary.

**Weed Management**

For grass seed production, weed control in an established stand of warm-season grass presents some unique and difficult challenges. In addition, weed control measures often are required in areas surrounding the crop, since weed contamination from border areas can be a significant problem. Roguing, herbicides, and mechanical methods are commonly combined in an integrated approach to weed control.

Roguing, either by hand or by spot spraying with a nonselective herbicide, can be labor intensive and costly; however, it is the most effective method, and often the only option for removing off-type plants of the same species. It's critical to certified seed production that these plants be removed before pollination.

Herbicide use can be effective, but costly, and few are labeled for warm-season grass seed production. At the time of this writing, the preemergence herbicides atrazine (Aatrex DF) and metolachlor + atrazine (Bicep) were labeled for warm-season grass seed production in Nebraska. Imazapic (Plateau) can be applied early postemergence for control of annual grass and broadleaf weeds. Broadleaf weeds also can be suppressed with postemergence applications of 2,4-D, after seedling grass has reached the five-leaf growth stage. Nonselective herbicides like glyphosate (Roundup) are used for spot treatment of troublesome perennial weeds and also can be used in "wickers" or "wipers". Refer to University of Nebraska Cooperative Extension Publication EC-130, *Guide for Weed Management in Nebraska*, for more information on herbicide recommendations and use.

Although mowing is often used to control annual weeds during the establishment year, the most important mechanical method for weed control after crop establishment is cultivation. Tillage should be as shallow as possible and occur far enough from the row (1.5 inches or more) to avoid damage to plant roots. Ridging of the soil should be avoided since an uneven soil surface can be detrimental to swathing and combining. In addition to weed control, cultivation also helps maintain row integrity by restricting the growth of rhizomes within the inter-row area.

**Diseases**

Research on the incidence and potential effects of diseases in warm-season grass stands is limited. The occurrence and severity of diseases is usually observed to be sporadic and dependent on factors such as species, stand age, and environmental conditions. Stem rust (*Puccinia graminis*), leaf rust (*Puccinia recondita*), and ergot (*Claviceps purpurea*) are the diseases most frequently referenced. Some species may be susceptible to other diseases that infect small grain crops. In general, diseases have not been a problem for warm-season grass seed production in Nebraska.

**Insects**

As with diseases, research information regarding the incidence and potential effects of insects in warm-season grass stands in the High Plains is limited. Certainly, during the establishment year, high populations of grasshoppers can cause extensive stand loss by feeding on newly emerged plants. At high populations, it is thought that thrips, plant bugs, and spider mites may potentially reduce forage and seed yields. "Silvertop," the term used to describe the premature senescence of seed heads, may be caused by several pests, including thrips, plant bugs, spider mites, and billbugs. Excessive populations of cutworms and sod webworms also may be a concern if large areas of a field are affected.

With appropriate monitoring of insect populations, potential damage can be averted. At the time of this writing, carbaryl (e.g. Sevin) was the only insecticide labeled for warm-season grass seed production in Nebraska. Refer to label instructions for safety requirements and application information.

**Harvest**

Warm-season grass generally matures between early August and late September, with the first seed harvest during the second growing season. Seed maturity varies with cultivar and species of grass. Emergence of seedheads may occur over a period of days or weeks, depending on species and weather conditions. The time from seedhead emergence to full maturity is determined by weather and may take 30 days or more.

Seedheads ripen from the tips downward. For best results and highest seed viability, harvest should occur when the top seeds begin to shatter and the middle seeds are in the hard dough to mature stage. A common test is to apply thumbnail pressure to the seed kernel (caryopsis). If firm pressure is required to make an imprint, the seed is in the hard dough stage. Seed moisture content will usually vary from 15-30 percent at harvest, depending on factors such as climatic conditions, harvest method, harvesting characteristics of a given species, and post-harvest drying capabilities.

Direct combining may be an option for harvesting some species of warm-season grasses. Either a stripper header or a platform header can be used, but a stripper header offers the advantage of reducing the amount of trash in the harvested material. Since some seed may not be completely ripe, post-

harvest drying may be required. Harvest time is shortened with direct combining, but due to increased risk of inclement weather and seed shatter, potential seed yield is jeopardized. The grass seed crop can be swathed at the medium dough stage and allowed to ripen in the windrow for several days before combining to reduce shatter loss, especially on shatter-prone species.

Properly adjusting the combine and carefully monitoring the straw and seed output is necessary to optimize threshing and cleaning operations with minimal damage and seed loss. When species have relatively small seed, gaps or cracks in combine transfer/delivery systems may need to be sealed with duct tape or another means. In some instances, tank cross-augers may need to be removed to prevent "bridging" and enhance flow of harvested material from the grain tank.

Seed must be properly cared for after it has been harvested to maintain quality and avoid damage or loss due to moisture, insects and rodents. In many cases, harvested material will need to be dried on-farm before it is transported to a seed processing facility. Harvested material may be thinly spread on a flat storage surface to dry or various forced air drying systems can be used. As a general guideline, the seed moisture content of native grass seed should be 12-15 percent when stored in bags and 10-12 percent when stored in bulk.

As much as 40-60 percent of the harvested material consists of inert matter (i.e., stems, leaves, immature and broken seed). To decrease the quantity of inert matter and contaminants, some producers pre-clean the harvested material before it is transported to a seed processing facility. Weed seeds, especially seeds from other species of grass, are commonly the most difficult contaminants to remove during precleaning and processing operations. This emphasizes the need for effective weed control measures in the production field.

### Residue Management

Following grass seed harvest, the threshed straw is commonly baled as a value-added crop. Unlike most cool-season grasses, warm-season grass tillers do not require vernalization for seed head production. Removal of warm-season grass residue can therefore be delayed until mid-April to mid-May. Grazing, which may be an option for residue removal, is best delayed until after fall freeze up. The goal of residue management for both types of grass remains the same: to remove sufficient residue from the plant crown to allow sunlight to penetrate and stimulate regrowth of productive tillers.

Burning is the preferred practice for residue removal. In addition to removing residue, burning helps reduce insect, weed, and disease pressures. Open-field or propane burning can be used for this process and should be done between mid-April and mid-May for best results. Harvest straw left on the field and mowed stubble should be evenly distributed to provide a uniform and continuous fuel source near the soil surface. If residue and climatic conditions are extremely favorable (dry and low humidity), open-field burning can be as effective as propane burning. Propane burning, however, is more effective and often necessary when residue and climatic conditions do not support spontaneous and continuous burning. Producers have obtained good regrowth response and optimized weed control by burning when new leaves are 1.0-1.5 inches tall.

## Economics

Successful marketing of grass seed requires locating a reputable seed company or direct marketing to the end user. Names of companies dealing in warm-season grass seed can be obtained from several sources, including the Natural Resource and Conservation Service. Many buyers want a specific cultivar which may make cultivar selection a more important factor than yield.

The production of warm-season grass seed will require production practices and a cost structure more similar to regional, irrigated row-crops than irrigated small grains. With this type of production system, it is expected that annual economic costs will range from $350 to $550 per acre for a four-year production stand. Variability in total costs per acre will depend on several factors, primarily costs due to crop establishment, machinery operations, irrigation, and weed control.

Warm-season forage grass seed must be tested for viability and is purchased on the basis of pure-live-seed (PLS) per pound. Seed must be submitted for a germination test to determine the percentage PLS per pound. For example, if blue grama yields average 375 pounds of cleaned seed per acre and the PLS averages 60 percent, the producer will receive 60 percent of the cleaned seed yield multiplied by the price. With an average price of $3.00/PLS pound, the crop is valued at $675 per acre.

Marketing of these crops is critical. Typically, markets operate in a highly volatile manner. Prices for a specific grass seed may be high and offer an excellent return one year, while the next year, the market may be flooded, rendering the crop unsaleable. There are no viable secondary markets for this seed and a market that is overproduced will cease to exist until new demand for a given seed occurs. Warm-season grass seed may be an excellent alternative to traditional crops, on a limited basis, with good potential for profit when demand is high.

## Seed Certification

Certification of seed may be required if it is to be resold as production seed. Certified seed will be of higher value to the producer, but it also will require additional expense to produce.

The Nebraska Crop Improvement Association (NCIA) is the agency that certifies seed in Nebraska. For complete guidelines on seed certification contact the NCIA: P.O. Box 830911, Lincoln, NE 68583-0911; Ph: 402-472-1444. A few of the conditions which must be met for certification eligibility are documented seed source information, isolation from contaminating plant species, field inspection by a representative of the certifying agency and meeting seed purity and viability standards.

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