

Turcz. ex Grieseb.

DAHURIAN WILDRYE GRASS



Seed Production of
Dahurian Wildrye Grass

Canada



Saskatchewan

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I. Introduction

Dahurian wildrye (*Elymus dahuricus*) is a short-lived perennial bunch grass native to Siberia, Mongolia and China. Seed production of Dahurian wildrye is a recent diversification for Canadian grass seed producers. The first commercial pedigreed production in Canada was grown in 1990 and acreage of Dahurian wildrye grew quickly because of its high seed yields and ease of production. Canadian production peaked in 1994 over 1000 acres before declining just as quickly as it rose. The Saskatchewan-based acreage was over 700 acres in 1994 representing almost 5% of the pedigreed grass seed acreage in the province. The market presently requires about 200 acres of production per year. Two varieties, Arthur and James, are currently registered in Canada. Average seed yields are 250 kg/ac, but yields as high as 450 kg/ac have been harvested in Saskatchewan.

II. Field selection

A. Adaptation

Dahurian wildrye has been grown successfully on a wide range of soil textures from sandy to clay soils throughout the province. The grass bears large seed heads 13-15 cm long on culms 100 - 150 cm tall. Although the grass is described as a short-lived species, its persistence is longer in moister regions. The leaves are wide, lax and are borne well up the stems. The grass is tolerant to cold and drought, but is less winter-hardy than crested wheatgrass. Young stands of Dahurian wildrye are very productive in moderately saline soil, but their performance in saline soils relative to other grasses declines as the stand ages. Stands persist for one to three years in the more variable climate of the southern prairies and two to five years in more northerly regions. The grass has a shallow root system and is easily uprooted if disturbed.

B. Freedom from weeds

The field selected for Dahurian wildrye seed production must be free of noxious grassy and broadleaf weeds. A field may be left unattended for several weeks with only minimal weed growth and no appearance of quackgrass or Canada thistle only to have these weeds appear later. Noxious weed seeds disqualify the seed for market as pedigreed seed.

Weeds with similar size and shape of seeds to Dahurian wildrye are extremely difficult to separate at the cleaning plant. Primary noxious weeds which are inseparable are quackgrass, Canada thistle, and perennial sow thistle. Secondary noxious weeds which are difficult to remove from seed lots include wild oats, stickseed (bluebur), and Persian darnel. Fields selected for seed production of Dahurian wildrye must be sown on land free of these weeds.

Three applications of glyphosate over two to three years are required to control quackgrass. Pre-harvest glyphosate application at 1 liter per acre prior to sowing the grass greatly improves control of quackgrass, Canada thistle, and sow thistle. Quackgrass from the seed bank and dormant rhizomes in the soil will re-infest the field, so several years of control are essential to reduce the possibility of recontamination. A fallow or partial fallow period prior to seeding controls several flushes of annual broadleaf and grassy weeds.

Prior to seeding the grass, weed control is easily achieved with broad spectrum herbicides and cultivation.

C. Freedom from herbicide residues

Dahurian wildrye seedlings are sensitive to injury from soil residues of grassy herbicides. The residues of trifluralin herbicides (Advance 10G, Rival, Treflan) pose the greatest risk of herbicide injury for new seedlings of grasses. These herbicides disappear from soil by volatilization. If these products have been applied at the maximum rate for oilseed or pulse crop production, grasses should not be sown for 24 months following a spring application or 30 months following a fall application. Fortress may also have some carryover residue if the volatilization of the herbicide is restricted by dry conditions. Dahurian wildrye should not be sown in a rotation directly following a crop treated with Fortress.

Other products which have injured grass seedlings include Ally, Assert, Atrazine, Banvel, Glean, Princep/Simazine, Pursuit and Sencor. Many of the herbicides in this listing are only problems if used at high rates in the growing season prior to sowing the grass. Check the latest edition of Saskatchewan Agriculture and Food's Crop Protection Guide for current guidelines.

D. Pedigreed Requirements

There are three classes of pedigreed forage seed production in Canada: Breeder, Foundation, and Certified. Foundation seed is grown from Breeder seed and Certified seed is grown from Foundation seed. The seed must meet standards for germination, genetic purity, freedom from disease, and absence of the seed of weeds and other crops. The Canada Seed Act specifies that seed must be pedigreed to be sold as a named variety.

The regulations for pedigreed status of seed are outlined in the Canadian Seed Grower Association Circular 6. In the year of seeding, the grower must notify the Canadian Seed Growers' Association of the pedigree of the seed planted and the area and previous cropping history of the production field. The field should be free of volunteer Dahurian wildrye prior to seeding. Manure or other potentially weed contaminating material should not be applied to the field prior to seeding or during the productive life of the stand. Table 1 summarizes the regulations on the minimum cropping interval.

Table 1: Intervening crop seasons before re-cropping with Dahurian wildrye as required by CSGA regulations

<u>Class of seed sown</u>	<u>Class of seed harvested</u>	<u>Contaminating crop</u>	<u>Number of intervening crop seasons required</u>
Breeder	Foundation	Non-pedigreed or different variety of Dahurian wildrye	5 seasons
Breeder	Foundation	Same variety of Dahurian wildrye	3 seasons
Breeder or Foundation	Certified	Dahurian wildrye	2 seasons

A field sown with Breeder Dahurian wildrye seed is eligible for three years of Foundation seed production. A field sown with Foundation Dahurian wildrye seed is eligible for three years of Certified seed production. Two inspections are required annually for each pedigreed seed lot - a field inspection and a seed analysis. The production field must be inspected after the crop has headed, but prior to swathing or harvesting for each year that pedigreed seed is harvested. The seed lot must also be analyzed for weed and disease contamination and tested for germination. The identification tags from the seed bags must be retained for the life of the stand for presentation to the crop inspector.

Dahurian wildrye is one of the few self-pollinated grasses. Isolation requirements are minimal for maintaining genetic purity of the seed. The isolation required depends on the class of seed produced.

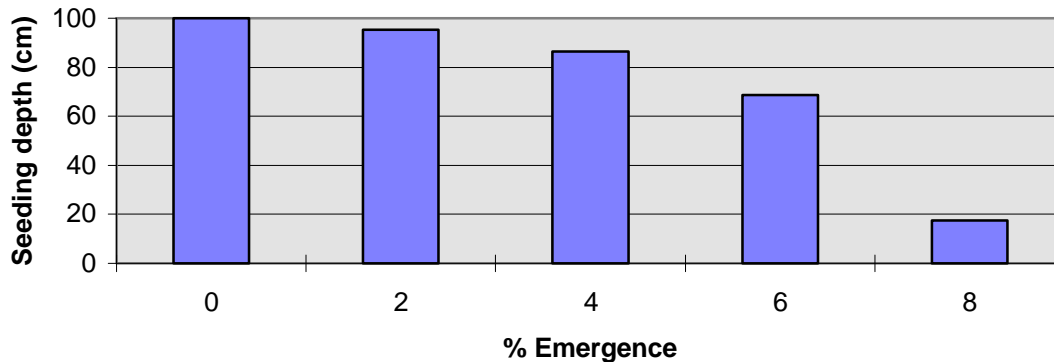
Foundations production fields require 20 m of isolation from other Dahurian wildrye plants while Certified production fields need only 5 m of isolation.

III. Crop establishment

A. Seeding

The main objective for the establishment year is to produce a healthy stand of seedlings which are vigorously tillering. Dahurian wildrye may be sown with any conventional planting equipment if shallow seeding and adequate packing are achieved. Sowing no deeper than one-half inch with firm packing helps achieve maximum germination and rapid emergence of seedlings. As the seeding depth increases, the time required for the seedling to emerge increases and the percentage of seedlings that emerge decreases. Although air seeder cultivators and hoe drills have successfully established Dahurian wildrye, disc drills are the most common seeding implement. Zero-till seeding provides the firm moist seedbed into which the seed can be planted shallowly without difficulty. When zero-till seeding, ensure that there are options for controlling volunteer crop seedlings.

Figure 1: Effect of seeding depth on emergence of Dahurian wildrye (Lawrence et al., 1991)



A firm seedbed is the most important requirement for shallow, even placement of grass seed. Packing after the last tillage operation helps firm the soil. Pulse crop rollers are an excellent way to level and firm the soil prior to seeding. A rainfall following the final tillage operation will also firm and moisten the seedbed.

Planting into a “stale seedbed” is an effective method for establishing Dahurian wildrye. The land is tilled, packed, leveled, and left to settle for two to three weeks. Dew and one or two rains during the interim period firm the seedbed. A burn-off rate of glyphosate is applied just prior to or immediately after seeding with a disc press drill. The herbicide application effectively controls weed seedlings and minimal disturbance prevents new weed growth. The seedbed remains firm and moist to the soil surface which is an excellent environment for germination and growth of new grass seedlings.

Applying this technique for planting into standing cereal stubble is an equally effective variation. The standing stubble provides protection from the wind, an ideal microclimate for establishment of the grass seedling. The anchored stubble also reduces the risk of erosion from heavy summer rains. Effective spreading of chaff and straw prior to seeding are essential for successful use of this technique.

Simple equipment modifications relieve many potential difficulties and minimize the risk of poor

establishment. Depth control bands on discs maintain a shallow sowing depth and prevent overdeep seed placement. Depth control bands on discs improve uniform seed placement. Packer wheels following directly behind the seeding disc provide good seed to soil contact.

The Dahurian wildrye seed crop should be sown in early May to harvest a satisfactory seed yield in the year of seeding. With a delay in seeding, the first crop seed yield will be reduced, although subsequent crops often compensate for the smaller initial seed crop. The productive life of the stand is only two to three years, however, so a satisfactory first seed crop is important for a profitable average seed yield for the life of the stand. Late fall and dormant seedings are another option for establishment of Dahurian wildrye, but there is little advantage for this practice since the crop will produce seed in the year of seeding.

Dahurian wildrye has a light chaffy seed that readily bridges in seed cups. Bridging causes inconsistent plant stands and missing seed rows. Agitators in the seed box prevent bridging and improve the flow of the light chaffy seed to the seed cups. If agitators are not available for your seed tank to disturb the grass seed, filling the seedbox only half full and getting extra help to mix the seed in the seedbox while planting will work. Polymer seed coatings improve the seed flow in the drill and protect the user from exposure to any seed treatments which may be added to control disease organisms. Carriers such as phosphate fertilizer (11-52-0) up to 15 lb P₂O₅/ac, non-viable grain, or horticultural vermiculite clay may be mixed with the grass seed to help prevent bridging. Seed may also be mixed with phosphate fertilizer and "drilled" through the fertilizer attachment. Fertilizer will absorb hygroscopic moisture from the air over time and increase the moisture content of the seed. The increase in moisture content of the seed will decrease its viability. Seed mixed with fertilizer can be stored up to 3-4 weeks without injuring the seed germination as long as the mixture is stored under dry conditions.

B. Row spacing

Wide row planting of Dahurian wildrye has several advantages. Planting in wider-spaced rows reduces the seed requirements, lowering input costs. As the stand ages, the plants can expand into the vacant area between the rows and maintain a higher seed yield potential. Although inter-row cultivation may stimulate new weed growth, tillage is easily performed with a row crop cultivator or gang rototiller. If inter-row tillage is practiced, the minimum row spacing should be increased to 30 - 36 inches. At this spacing, however, some weeds and shattered Dahurian wildrye seed will invade the stand if inter-row cultivation is not practiced. Weeds for roguing are easier to spot when the grass is sown in rows. Row production without irrigation also reduces the risk of seed yields reduced by drought.

The ideal row spacing for seed production of Dahurian wildrye is 12 inches. The 12 inch spacing is easily accomplished with conventional equipment by placing tape over the unwanted seed cups in the seed box. Depending of the equipment, raising unwanted discs or seed boots may also be possible. Some growers release the spring pressure on hoe drills so that the shoe just rides along the surface of the soil. With airseeders, blocking of outlets in discharge heads needs to be symmetrical to maintain uniform airflow. A wide range of modifications are easily accomplished depending on the type of equipment owned.

The objective is to sow enough seed to achieve a satisfactory stand without too much inter-plant competition. Seedlings which are vigorously tillering will produce a higher seed yield. Because weather is an important factor in successful establishment, the safe approach is to seed at a higher rate than is suitable for ideal conditions. Dahurian wildrye is among the easiest of grasses to establish. The seeder should be calibrated to sow eight seeds per foot of seed row. When another material is mixed with the seed to eliminate bridging, the seeds per foot method of drill calibration eliminates guesswork. Dahurian wildrye, on average,

contains 88,000 seeds per pound. For a row spacing of one foot and a seeding rate of 10 seeds/ft, one acre (43,560 ft²) contains 43,560 feet of seed row and requires 435,600 seeds or 5.0 lb seed/ac. The drill is easily calibrated by seeding over a sheet of plywood or a pad of concrete and counting the seeds sown over a measured distance.

C. Fertility

The soil fertility of the seed field should be determined by soil analysis prior to sowing. When sowing Dahurian wildrye for seed production on fallow or partial fallow, nitrogen is likely adequate to carry the grass until the first fall after seeding. When stubble fields are sown prior to June 1, 20-40 lb N/ac should be applied to dryland fields and 40-60 lb N/ac to irrigated fields. A fall application of 30 lb N/ac to establishing seedling fields will promote maximum seed production in the first seed crop.

Phosphorus and potassium deficiency are best corrected prior to establishment of the crop. Phosphorus enhances the growth rate and vigour of the seedlings. Yield responses of grasses to applications of phosphorus and potassium are marginal once the stand is established. For fields testing less than 15 lb P/ac, phosphate fertilizer should be applied at 50-75 lb P₂O₅/ac. Likewise, for fields testing less than 200 lb K/ac, 100 lb K₂O/ac. should be applied prior to sowing the grass. Sulphur levels will be adequate if the field has been fertilized with enough sulphur for optimum canola production within the last two years. Dahurian wildrye responses to micronutrients have not been documented on the prairies.

The quantity of fertilizer which is safely placed in the seedrow with the grass seed is dependent on a number of factors. The organic matter and clay content of the soil, the moisture content of the soil at seeding, the time interval between seeding and the first precipitation after seeding, the row spacing, and the seedrow width affect the risk of seedling injury. As the content of organic matter and clay increase, risk of fertilizer injury to grass seedlings decrease. A soil moisture content near field capacity reduces "fertilizer burn" of seedlings. Rainfall immediately after seeding replenishes soil moisture and removes fertilizer salts from the vicinity of the seed. For a constant rate of fertilization, as the spacing between the rows widens, the amount of fertilizer next to the seeds increases. A narrow width of the seedrow itself will also place more fertilizer in close contact to the seed. The general guideline for forage seeds is for no nitrogen, potassium, or sulphur fertilizers placed in the seedrow. Application of phosphate fertilizer up to 15 lb P₂O₅/ac is generally safe.

D. Companion crop

Seed production of Dahurian wildrye is higher when sown without a companion crop. The seedlings grow larger, tiller more, and compete more effectively with weeds during establishment and first seed year when sown without a companion crop. Dahurian wildrye is an aggressive seedling, however, and is able to recover from the reduced vigour associated with establishment under a companion crop better than many other grass seed crops. By sowing the companion crop on a wider row spacing at a reduced rate, competition of the companion crop with the establishing grass seedlings is minimized. The least competitive companion crops are flax and oats.

IV. Crop Management

A. Weed control

Weed control options are limited once the Dahurian wildrye is sown. Selective control of many broadleaf weeds is possible within the grass seed stand, but risk of reduced quality can be avoided and weed

control measures simplified if these weeds are controlled before the crop is sown. Weeds also compete with the young Dahurian wildrye seedling, reducing its vigour and the yield potential of the stand.

Herbicide applications play an important role in the production of quality grass seed. Typical herbicide requirements during the seedling year for crops sown in the spring include late spring application of wild oat and broadleaf herbicide followed by a second broadleaf herbicide in fall. Since Dahurian wildrye produces seed in the year of establishment, mowing is not a suitable alternative for control of weeds. A broadleaf herbicide may be sprayed in fall to control winter annuals. Check the latest edition of the Crop Protection Guide published by Saskatchewan Agriculture and Food for new registrations of herbicides for grass seed crops.

Field roguing is a requirement for production of quality grass seed for the Canadian market. Primary noxious weeds such as quackgrass, Canada thistle, cleavers, and wild mustard must be removed from the stand. Selective herbicide control of quackgrass in Dahurian wildrye is not available. Quackgrass can only be removed from the field after sowing by spot spraying glyphosate with a backpack sprayer or hand roguing. Unthreshed wild mustard seeds lodge in the beak of the seed pod and this broken remnant of the pod cannot be removed because of its similar size to Dahurian wildrye seed. Secondary noxious weeds such as wild oats, Persian darnel, scentless chamomile, shepherd's purse, stickseed (bluebur), and stinkweed are tolerated in small numbers, i.e. 4-10 in 25 g.; however, some market standards are more stringent than Canada Seed Act standards. Certain seeds are very difficult to separate and must be eradicated in the field.

The seed grower must be vigilant to prevent re-introduction of weeds to the field. Crowns and rhizomes from previous perennial grass crops in the rotation will re-establish in seedling stands. Weed or crop seed in irrigation water or on equipment are one source of contamination when deposited within the field.

B. Disease and insect monitoring

Disease and insect problems in Dahurian wildrye seed fields are usually minor and rarely cause substantial yield reduction. Powdery mildew has been reported in one production field in which a loss of seed yield was likely.

C. Irrigation management

Dahurian wildrye responds to good moisture conditions. Irrigation will increase seed yields if moisture stress occurs during the rapid spring growth, pollination or seed development stages. Frequent light sprinkler irrigation after seeding provide adequate moisture for germination and establishment. Flood irrigation is difficult in newly seeded fields because of the risk of erosion and crusting. Once the crop is established, irrigation during periods of high evapotranspiration promote vigorous growth. Soil moisture should be maintained above 50% of field capacity. Adequate soil moisture during the period of rapid growth in spring and during the boot stage are the most critical periods for high seed yields. Water penetration to a depth of 60 - 120 cm indicates adequate soil moisture. The soil profile should be at field capacity just prior to pollination. Irrigation during flowering may reduce seed set, but a final irrigation just after pollination may be required to fill the developing seeds. Seed production of Dahurian wildrye on dryland is also feasible, but seed yields are more variable.

V. Harvest

Grasses need about 30 days after flowering for the seeds to develop. Hot, dry weather shortens the ripening period while cool, moist conditions delay seed maturity. Grasses grown under irrigation or moister conditions have a higher ash content which increases the likelihood of shattering. Ripening begins at the top of the seed head and proceeds down the stem. Seeds at the top of the head may begin to shatter while those at

the bottom are only starting to fill seed. Frequent inspection of the seed field is important to determine the best time to harvest the seed. Dahurian wildrye is usually ready to swath in mid August. The crop is ready to swath at the medium dough stage which corresponds to a seed head moisture content between 40-45%. At this stage of maturity, no liquid is left in the seed and some pressure is required to imprint the seed. The straw will be turning golden yellow at this stage. Some seed will shatter when the seed head is firmly struck against the palm of the hand.

The moisture content of the seed head is unreliable when determined with conventional grain moisture testers. The seed head should be clipped off just below the lowest seed. Sample enough seed heads to weigh about 100 g. After determining the wet weight, dry the sample in a conventional oven set at 82°C until the sample reaches a constant weight. The sample may also be dried in a microwave oven using relatively short heating intervals of about 1 minute. Place a cup of water in the microwave with the sample to prevent it from catching fire at lower moisture contents. Record the dry weight of the sample. The moisture content of the sample is calculated using the following formula: % moisture = ((wet weight - dry weight) / wet weight) * 100.

Conventional equipment is suitable for harvest of Dahurian wildrye. Some combines may separate more seed if equipped with a fan speed modification kit to slow the fan speed. Swathing and picking up the windrow is usually the least risky harvest method, but in years of low seed yield, early maturity or reduced foliage, straight combining may be more appropriate. Dahurian wildrye has a high shatter risk relative to other grasses, but does not readily lodge. Swathing early in the morning or in the evening or at night when the air humidity is higher will reduce shattering losses. If the heads are laid in the center of the swath instead of to the side, some of the shattered seeds will be retained within the swath.

Under good drying conditions, the crop will be ready to combine in 4-7 days after swathing. Because of the potential for contamination and the value of grass seed, thoroughly clean the combine before threshing grass seed. Initial combine settings recommended for Dahurian wildrye are a cylinder speed of 950 rpm and a concave clearance of 1/16". The fan speed is generally set between 400-500 rpm with the sliding covers over the exterior fan housing open. The combine should be set so that the lemma and palea are retained on the seed. Seeds which retain these seed parts have longer viability in conventional storage. The concave setting should be adjusted to minimize straw breakage so the sieves do not become clogged. A properly adjusted concave just breaks up the head into separate seeds. Maintain an even flow of material into the combine. Dahurian wildrye often requires a slower forward speed than wheat to improve separation of the seed from the chaff and straw. The air flow needs to be high enough to lift the chaff about 10 cm at the front of the sieve so that the seed can be separated from the chaff on the sieve. A very clean sample, however, usually indicates that too much seed is being lost. Use a shovel to check seed loss at the back of the combine. Watch for plugging of the return when the sample is quite chaffy. The seed can be stored safely in storage bins up to one year when the moisture content is 10-12%. Mold growth and insect damage may still occur at this moisture content. The safe moisture content for storage of grasses for longer periods is 8-10%.

Dahurian wildrye is ready for straight combining at the first hint of seed shatter. When the seed shatters as the seed head is lightly struck against the palm of the hand, seed shatter is imminent and the field should be straight combined immediately. This is usually about 3-5 days after the crop was ready for swathing. The risk of losing the crop from brisk winds is high. Seed that is direct combined needs immediate aeration and drying to maintain seed quality. Some grass seed growers install an aeration tube directly into their grain truck so that the seed can be aerated without dumping into a storage bin. Running the seed over a sieve to remove

much of the green leaves, insects, chaff and short-stemmed straw reduces the risk of heating in the direct combined seed. Significant heating which reduces the viability of the seed may occur within only a few hours.

Handling of Dahurian wildrye seed can be challenging. Because of its light chaffy nature, the seed flows more like silage than like grain, especially if the sample is not dry. Belt conveyors and front-end loaders handle chaffy grasses gently and efficiently. Large diameter augers can effectively transfer the seed if the intake opening is large enough to avoid bridging. In the grain bin, the seed is sometimes more easily handled with a pitchfork than with a shovel.

Drying of grass seeds must be conducted with care to maintain the viability of the seed. When the seed has a high moisture content, the temperature of the air flow must be lower to prevent injury to the germination of the seed. The resistance of the seed to germination injury from high temperatures increases as the moisture content of the seed decreases.

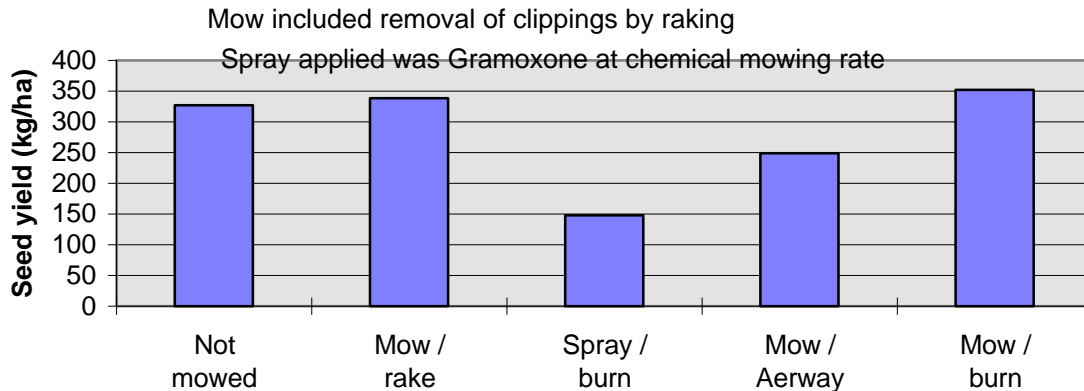
VI. Post-harvest management

Two fall management practices of Dahurian wildrye critical to sustaining seed yield potential are stubble management and nitrogen fertilization.

A. Stubble management

The first step is to windrow the straw behind the combine and bale and remove the straw as soon as possible after threshing. If the stubble was cut quite long and moisture conditions are good, the stubble should also be windrowed, baled, and removed as soon as possible to stimulate high future seed yields. Because Dahurian wildrye is shallow rooted, grazing will uproot plants and reduce the seed yield potential of the stand. No additional mowing is recommended once the stubble has been removed (Figure 2).

Figure 2: Effect of residue removal on seed yield of Dahurian wildrye at Melfort (Kruger et al., 1996)



B. Nitrogen management

Nitrogen increases the seed yield of grasses primarily by promoting growth of tillers and by stimulating the growth of larger seed heads in those tillers which will form seed heads. Tillers must have grown enough to be induced to form seed heads by the correct daylength and temperature for each species. The period of the year when this physiological change occurs differs among grass species. The period when tillers are induced to form seed heads and when the new seed head starts to grow may occur very close together or may be separated by several months. No information is available on the development of new seed heads in Dahurian

wildrye tillers. Fall or early spring application of nitrogen is suitable for seed production. Dryland fields require 50 -75 lb N/ac and irrigated fields require 100-125 lb N/ac.

The form of nitrogen applied to grass seed fields has a major impact on the seed yield response when applied with a broadcast spreader. The best nitrogen source for broadcast application is 34-0-0 (ammonium nitrate). This form is highly soluble in water and readily moves with soil moisture to plant roots for rapid uptake into the plant. Ammonium nitrate is not vulnerable to volatilization and is less prone to adsorption by stubble residues in the field. Liquid nitrogen is another excellent N source especially if dribbled under cloudy cool conditions or applied by spoke wheel injection. Because grasses efficiently absorb water from the soil, risk of leaching or denitrification is minimal. The ammonium nitrogen in urea (46-0-0) or even ammonium sulphate (20-0-0-24) is not only less accessible to the plant but also more vulnerable to loss by volatilization. If the application can be timed just prior to a significant precipitation event, any N form will be equally effective.

VII. Stand removal

Dahurian wildrye is easy to take out of rotation, especially after two seed crops have been harvested. The crop should be cut as high during the last harvest season to leave as many leaves as possible for absorption of glyphosate. Following harvest, glyphosate may be applied at 1-2 liter/ac on the green growth. The stand can then be broken with tillage with a lower fuel requirement. Although the vigour of the stand declines rapidly with age, some regrowth and volunteer growth of the grass is likely during the subsequent growing season. If a broadleaf crop is sown the following spring, several graminicides are available to control new seedlings during the growing season.

VIII. Additional references

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