PRODUCING GRASS SEEDS

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INTRODUCTION

This is a brief summary of the grass seed research program at Beaverlodge. Discussion includes recent results, management recommendations and other sources of information available on request.

Our program is reviewed under the following headings:

1. Grass Seed Physiology
2. Seeding Dates
3. Cereal Companion Crops
4. Soil Fertility
5. Weed Control
6. Seed Moisture Content and Harvesting
7. Aftermath Removal
8. Insect Control
9. Disease Control
10. Grass Seed Crops for Acid Soils
11. Pedigreed Seed Production
12. Contract Seed Production
13. Publications for Grass Seed Producers

1. GRASS SEED PHYSIOLOGY

To the casual observer, seed production in grasses consists of the appearance of heads, the dispersal of pollen and the maturation of seed. But these are only the more advanced stages in seed development. A full understanding of the complete process is basic to the successful management of grasses for seed production. In view of the importance of the grass seed industry in northwestern Canada, we at the CDA Research Station, Beaverlodge, Alberta, are conducting experiments to determine the various factors that influence all stages of the phasic development of grasses.

It has long been known that a feature common to all perennial grasses is the sequence of stages through which an individual tiller passes in producing a seed head. Each tiller originates as a minute enlargement on the crown of the plant but soon becomes a vegetative shoot with leaves and roots. Under favorable conditions the growing point, after producing several leaves, undergoes chemical change (induction) in preparation for flowering. The next stage (initiation) is the morphological transformation of the growing point from the vegetative to the floral state with the rudimentary floral parts appearing as small protuberances. Only then does heading and development of seed occur.

Although grass species follow the same sequence of phasic development, the environments required to promote the successive stages differ considerably. The stages at which the plants are receptive to these stimuli also vary. For most grasses induction is completed in late autumn, but only in those tillers with one full season of uninhibited growth. Floral initiation occurs in the spring shortly after the spring thaw. If spring temperatures rise too rapidly in relation to lengthening daylight, floral initiation does not take place. For this stage of flowering, northwestern Canada provides the required spring climate for most cool season grasses.

In our plant physiology research, grasses are collected from the field and examined microscopically throughout the entire year to determine the exact date of the seed head development. Similarly, grasses are grown in controlled environments to determine the combination of environmental factors most suitable for seed production. These studies are designed to provide us with the best possible understanding of the life cycle and thus give us sight into how we can best manipulate our crops to cause them to produce the highest possible seed yields.

2. SEEDING DATES

Our research has found that grass species differ in the age requirements of tillers for responding to the short day, low temperature treatment of the late summer and autumn. In a dates of seeding study, seed yields the year after seeding declined sharply for the following grasses if they were seeded later than the date indicated:

Russian wildrye	May 23
Crested wheatgrass	June 13
Intermediate wheatgrass	July 17
Creeping red fescue	July 17
Reed canarygrass	July 17
Bromegrass	July 25
Meadow fescue	July 25
Timothy	Sept. 9

The above study, seeded in 1969, was favored by good moisture distribution thus many of the successful dates are later than we normally experience. Nevertheless, it shows how grasses differ in their age requirements. Our recommendations remain to be: grasses intended for seed production should be seeded in the early spring and seldom later than early June.

3. CEREAL COMPANION CROPS

The differences among grass species and their response to the influence of companion crops is demonstrated in a study involving 8 species and 7 companion crops established in 1969. Considering first

year seed yields obtained the year after seeding, it is noted that grasses tend to respond in two dictinct groups: those with a specific requirement for an uninterrupted growth period in the seedling stage, and those which tolerate some restraint during their first year. Russian wildrye, meadow fescue and creeping red fescue do best if seeded alone and relatively early in the spring to provide a full season of development in the year of seeding. Crested and intermediate wheatgrass and bromegrass all tolerated the companion crops in the year of seeding and still produced satisfactory seed yields the following year.

Rapeseed proved to be the companion crop most generally tolerated by perennial seed grasses except Russian wildrye, which was suppressed by all companion crops. Flax proved equally acceptable to crested and intermediate wheatgrass, bromegrass and meadow fescue. Wheat and early maturing varieties of barley were satisfactory companions for crested and intermediate wheatgrass and bromegrass. Oats can be considered a companion only for intermediate wheatgrass.

The late maturing variety of barley proved unsatisfactory as a companion seeding for any grass.

4. SOIL FERTILITY

Grasses grown for seed require large amounts of nitrogen. Soil tests invariably show a deficiency of nitrogen in established grass stands. While phosphorous and potassium are usually in adequate supplies, a soil test would tell if they should be added. On some soils, sulphur may be required and this will also be indicated by soil tests.

Studies at Beaverlodge show that creeping red fescue seeded alone in the spring on fallow seldom requires nitrogen for the first seed crop. But nitrogen is required for the production of the second and subsequent crops. This means that for fescue seeded alone in the spring of year "one", the first seed crop would be harvested in year "two" and the second crop in year "three".

If seeded with a companion crop in year "one", fescue would not produce a seed crop in year "two", regardless of fertilizers applied, because the companion crop retards the development of the grass plants and thus prevents floral induction in the fall of the year of seeding. Nitrogen should be applied in the fall of year "two" for use by the first seed crop to be harvested in year "three". Similarly, nitrogen would be required for all subsequent seed crops.

Between 30 and 60 lbs of nitrogen per acre are generally sufficient but some growers are applying up to 90 lbs nitrogen and obtaining good returns. In general, older stands require higher rates of nitrogen than new stands. Sod-bound stands, however, usually do not benefit from normal rates of nitrogen, particularly when seed yields were high in the previous year.

On sod-bound fescue, seed yields are greatly improved by rejuvenation (ploughing in June) and fertilizing with nitrogen in the autumn of the same year.

Sulphur-bearing fertilizers should not be used as a source of nitrogen for grass seed crops because, at the higher rates, the sulphur would be supplied at excessive rates and could cause the soil to become acid.

Floral initiation has very specific requirements for nitrogen, thus, the best time to apply nitrogen varies with the grass species. Russian wildrye produces seed from tillers which pass through the floral initiation stage in early autumn of the previous season. Thus, for Russian wildrye, fertilizing immediately after seed harvest is best. For grasses such as creeping red fescue that initiate heads in early spring, late autumn fertilizing is most effective. Very early spring applications are satisfactory if made prior to spring growth. For those that initiate floral parts later than creeping red fescue, such as bromegrass, intermediate wheatgrass and timothy, fertilizing with nitrogen may be delayed until the early spring.

For established grass seed stands phosphorus fertilizers, when required, are best broadcast in the early fall. However, for soils very deficient in phosphorus heavy rates drilled in or broadcast and worked into the soil prior to seeding should be beneficial for the life of the grass stand.

5. WEED CONTROL

The influence of herbicides normally used for the control of broad-leaf weeds were observed on the yield and quality of seed of 3 perennial grasses at Beaverlodge during 1969 and 1970. In one study the herbicides were applied when the grasses were in the seedling stage of development; in a second, the herbicides were applied during the year of seed production.

In the seedling-stand study seed yields and quality were not influenced. There was, however, a slight reduction in seed weight and germination of bromegrass sprayed at the 3-tiller stage of development. This reduction was not considered important and current recommendations are, in general, suitable for weed control in seedling stands of creeping red fescue, bromegrass and timothy crops intended for seed.

For established stands of creeping red fescue, herbicides can be divided into two groups. Dicamba and bromoxynil formed one group; 2,4-D, 2,4,5-T plus MCPA, and 2,4-D plus picloram formed the other group. Dicamba and bromoxynil should be applied before heading while the others may be applied at slightly later stages of development. Bromegrass seemed to be the most sensitive of the 3 grasses thus all herbicides should be applied before heading if seed yield and germination are to escape injury. Timothy was least affected by herbicide treatment at the maximum recommended rates.

In a separate experiment, wild oat herbicides were applied to seedling grasses. Triallate (Avadex BW) proved safe to use with Timothy and Russian wildrye, fairly safe with creeping red fescue and crested wheatgrass, reed canarygrass and alfalfa but definitely harmful to bromegrass. Barban (Carbyne) was safe with bromegrass, fairly safe with wildrye but it thinned stands of fescue, timothy, reed canarygrass and alfalfa by 1/3 and crested wheatgrass by 1/2. Diallate (Avadex) was only fairly safe with wildrye and it thinned fescue, crested wheatgrass, reed canarygrass, alfalfa considerably, and bromegrass and timothy drastically.

In another experiment, Barban (Carbyne) was applied to established stands of grasses on June 5 of their production year as a control for wild oats in the 2-leaf stage. Seed yield losses resulting from this treatment were bromegrass - 43%; creeping red fescue - 40%; timothy - 25%; and crested wheatgrass - 8%.

From the information available at this time, our recommendation would have to be: do not use wild oat herbicides on grasses intended for seed.

6. SEED MOISTURE CONTENT AND HARVESTING

Seed yield losses through shattering of overripe seed can be costly. It takes many years of experience with even one grass to know the exact time to swath the seed crop in preparation for harvest. Investigations with the seed moisture content and swathing time are attempting to provide better guidelines to new growers or to experienced growers with new crops.

One of the 21 grasses in the Beaverlodge study was Sawki Russian wildrye and it behaved in a classic manner. Between July 21 and July 25, the weight of seed increased slowly. Then, on July 25, the seed weight started to increase sharply, reaching a maximum on July 29. During that same eight-day period, moisture content dropped and the dockage also declined. Two days later, on July 31, moderately heavy shattering occurred and this triggered a drop in yield, a drop in the weight of 1,000 kernels and an increase in the amount of dockage because many of the best seeds had fallen to the ground. Germination also dropped, again because many of the best seeds had been lost.

Broad guidelines indicated by research to date would suggest the following optimum moisture content for the entire seed head as a measure of when to swath the field:

Group 1 - moisture content 35 - 40%.

Creeping red fescue
Crested wheatgrass
Orchardgrass
Siberian wildrye

Group 2 - moisture content 40 - 45%.

Russian wildrye
Timothy
Streambank wheatgrass

Group 3 - moisture content 45 - 50%.

Needlegrass
Oatgrass
Tall fescue
Meadow Fescue
Kentucky bluegrass

Group 4 - moisture content 50 - 55%.

Tall wheatgrass
Intermediate wheatgrass
Reed canarygrass
Perennial ryegrass
Bromegrass

Group 5 - moisture content 55 - 60%.

Creeping foxtail

Group 6 - moisture content 60 - 65%.

Pubescent wheatgrass

These figures are based on the moisture content of the entire seed head clipped off at the base of the lowest seed branch. Research in this area is continuing.

7. AFTERMATH REMOVAL

Many of our seed grasses yield large quantities of highly palatable and nutritious herbage. Problems are encountered in determining if, when, and how this aftermath can be removed for livestock use without reducing subsequent seed crops. Recent studies with creeping red fescue proved that autumn grazing at moderate stocking rates produced excellent animal gains without loss of seed but very heavy stocking rates were damaging.

Spring grazing proved less satisfactory because seed yields were reduced by 35 percent and the period was too short to provide measurable animal gains.

In a subsequent study herbage was removed as hay on 5 different dates in the autumn and once in the early spring from bromegrass, creeping red fescue, timothy and Russian wildrye. In all species, seed yields were increased by removing herbage from the fields. Removing herbage on September 15 resulted in seed increases as high as 35 percent for bromegrass and creeping red fescue and 20 percent for timothy. For Russian wildrye early spring haying was best but the increase in seed yield was less than 10 percent.

Fescue seed growers frequently report yield increases where stands provided winter grazing for horses. We are investigating the importance of herbage left on the ground in terms of the light, temperature and moisture factors at soil level.

8. INSECT CONTROL

The only insect which has caused any concern in the grass seed crops has been the plant bug which punctures holes through the leaf sheath and damages the tissue in the main seed bearing stem, thus causing the stem to turn white shortly after heading. These white heads are very conspicuous in the green crop prior to ripening. The condition is frequently referred to as silver top, seed blasting or white heads. The seed stalk is easily pulled from the leaf sheath and does not produce seed. Plant bugs are controlled by insecticides (Malathion) applied before the head emerges from the leaf sheath. Timing of the insecticide is important because treatment after the heads have emerged is too late.

Some fescue growers have developed a rotation of two years seed harvest and one year recovery from rejuvenation. The rejuvenation treatment is plowing immediately after the second seed harvest. Plant bugs are controlled in this rotation by burning the grass stubble and the debris from the harvests immediately after the second harvest and just before the plowing.

9. DISEASE CONTROL

Grasses are attacked by many stem and leaf diseases but the one which is causing the greatest current concern is a fungus called stem eyespot which attacks the stem and seed head. This disease can be readily identified by the black, elongated lesions along the stem which, in severe cases, join together to give the entire stem a blackened appearance. Seed losses attributed to this disease have been estimated as high as 80 percent.

Current research is directed at control measures through field sanitation employing both fire and fungicides. While we do not have a specific recommendation, we did note that the incidence of the disease was somewhat reduced in those fields subjected to the three year rotation employing fire for the control of plant bugs as described in the foregoing section.

Since stem eyespot is seldom a problem on first-year seed crops, we developed a procedure to handle fescue as a biennial. We recommend increasing the seeding rate to 10 kg/ha, seed in early June without a companion crop, fertilize in the autumn (mid to late October) with 60 kg/ha of N, and plan on harvesting only one seed crop. This procedure provides for a maximum yield in the first crop but, because of increased plant density, reduces the yields in the second and third harvest years.

10. GRASS SEED CROPS FOR ACID SOILS

As new wooded areas are converted to productive farm land, acid soils are being encountered with increasing frequency. Research with these soils involves studies with corrective measures such as employing lime along with the search for acid-tolerant species. Grasses such as timothy, creeping red fescue, bromegrass, Kentucky bluegrass, and Russian wildrye were tested for their adaptability on acid soils in the Bessborough areas of British Columbia and the Silver Valley and the Fort Vermilion areas of Alberta. When grown as seed crops, timothy and creeping red fescue proved most suitable at all locations and deserve being considered in the cropping programs for these problem soils.

11. PEDIGREED SEED PRODUCTION

Growers contemplating the production of pedigreed grass seed should be aware of Circular 6 of the Canadian Seed Growers Association outlining the rules and regulations for the production of pedigreed seeds. In summary, the regulations concerning grasses are as follows:

a) Classes and generations

1) Breeder seed - controlled by the plant breeder
2) Foundation - one generation
3) Registered seed (for non Canadian varieties) - one generation
4) Certified seed - one generation

b) Age of stand

Details differ for each grass species, thus growers should have Circular 6. For example, a stand of creeping red fescue established with Breeder seed may produce 4 years of Foundation plus one year of Certified. If established with Foundation seed, it may produce 5 years of Certified seed. Some foreign varieties eligible for sale in Canada may be pedigreed through Breeder, Foundation, Registered and Certified classes.

c) Crop inspection requirements

Growers intending to have crops inspected must make application to the Canadian Seed Growers'Association for membership and have the field inspection each year if a pedigreed seed crop is to be harvested.

d) Isolation

The genetic purity of a pedigreed crop must be protected from being contaminated by pollen from non-pedigreed crops of the same kind, thus, minimum isolation distances are specified as follows: If the area is 5 acres, the isolation distances are 1200 feet for Foundation, 900 feet for Registered and 450 feet for Certified. If the field is

larger than 5 acres the isolation distances are 900 feet for Foundation; 300 feet for Registered and 165 feet for Certified. A minimum isolation distance of 10 feet is required for all other crops to avoid mixing of crop seeds which are difficult to separate.

12. CONTRACT SEED PRODUCTION

Grass seeds are commonly increased for specific markets on a contract basis whether they be of Canadian or foreign origin. Canadian bred varieties are released to the public through the Canadian Forage Seeds Project, an organization involving both federal and provincial governments, the seed growers and seed trade. As new varieties are developed in Canada, the Breeder seed stocks are released to both the Seed Trade and the provincial governments on request. Seeds are subsequently released to growers on a contract basis for increase. All varieties licensed for sale in Canada are described in the Canada Agriculture Publication $1405 "Licensed varieties of cultivated grasses".

The Canadian Seed Trade frequently require growers to increase seed of foreign varieties brought into Canada under the Horbage Scheme of the Organization for Economic Cooperation and Development (O.E.C.D.). This is an international organization of several nations of which Canada is a member. Herbage seeds certified with this scheme can flow freely from country to country in international trade and retain their names and pedigree. Consequently, grass seeds from other countries are being offered for seed increase in our area on a contract basis with the objective of shipping the seed back to the country of origin for seeding hay and pasture lands. Our research program at Beaverlodge attempts to evaluate all the material being considered for contract production and thus provides data on winter hardiness, general adaptability and seed yield potential to assist with the preparation of contracts. The data are published annually in a bulletin entitled "Forage Introductions" which is readily available on request.

13. PUBLICATIONS FOR GRASS SEED PRODUCERS

Creeping Red Fescue - C.D.A. Bulletin No. 1122
Crested Wheatgrass - C.D.A. Bulletin No. 1295
Factors Affecting Grass Seed Yields (reprint, Canada Agriculture)
Forage Introductions NRG 77-16
Grass Seed Yield Data NRG 77-14
Licensed Varieties of Cultivated Grasses and Legumes - C.D.A. Publication No. 1405. Available from Information Canada, Publishing Division, Ottawa, for $7.50
Pedigreed Forage Seed Production - Distributed by the Canadian Seed Growers' Association, Box 8455, Ottawa, K1G 3T1
Producing Certified Seed of Bromegrass in Western Canada - C.D.A. Bulletin No. 366.
Regulations and Procedures for Pedigreed Seed Crop Production. Circular No. 6-77. Available from The Canadian Seed Growers' Association, Box 8455, Ottawa, Ontario. K1G 3T1