Tolerance of Fine Fescues For Seed Production to Graminicides and Tank Mixes

AARI Matching Grants Project #98M288

Final Report

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ABSTRACT

There are over 100,000 acres of fine fescue grown for seed production in western Canada. Creeping red fescue has been grown for over 50 years while chewings fescue and hard fescue are two relatively new fine fescues that are becoming more popular to grow. The seed from all three of these fine fescues is mainly sold into the U.S. and European markets as turf seed for lawns, golf courses and other areas where short, hard wearing vegetation cover is required.

Weed control is an important component of successfully growing a marketable fine fescue seed crop. Wild oat, quackgrass and cleavers seed contamination in a fine fescue seed crop lowers the quality and therefore the price paid for the seed and will jeopardize the sale of the seed into the U.S. and European markets.

As there is very little information available on what herbicides can be used safely and effectively on fine fescue seed crops, this project was established to determine the tolerance of fine fescues to the herbicides that would control the problem weeds in grass seed crops. This information can then be used to apply for Minor Use registrations to add the fine fescue crop to the herbicide labels when sufficient tolerance data has been accumulated.

Three of the four graminicides registered for use in western Canada on canola did not harm seedling or established creeping red fescue, chewings fescue or hard fescue. However, the graminicide Select caused severe damage and significant seed yield loss to all three fine fescues and therefore should not be recommended for controlling grassy weeds in fine fescue seed crops.

The broadleaf weed herbicides, Attain, Prestige, Curtail M, Buctril M, Target, Banvel + 2,4-D amine, Refine Extra, Ally and Unity, did not cause damage or seed yield losses when sprayed early in the spring to any of the fine fescues. Although injury was not visible, Accord caused a significant seed yield loss to established creeping red fescue, chewings fescue and hard fescue and should not be recommended for use on these established grass seed crops.

Several herbicides, such as Banvel + 2,4-D amine and Target, injured and caused a significant seed yield reduction to established hard and chewings fescue when sprayed later in the spring. These fine fescues bolt and start to produce seed heads very early in the spring so that fall herbicide application may be safer on the crop.

The tolerance of fine fescues to herbicide information is being made available to the seed trade, dealers and growers. Minor Use registrations need to be obtained so that these recommendations can legally be made.

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Table of Contents

List of Tables

List of Figures

BACKGROUND

Fine Fescues

The fine fescues are fine-leaved grasses that are used extensively in seed blends for lawns and golf courses in both sunny and shady conditions. They germinate rapidly and establish themselves quickly. The fine fescues include chewing, hard, creeping red, slender creeping red and sheep's fescue.

There is increasing potential in the fine fescue seed markets in Alberta. The Europeans and Americans are actively investigating the potential of growing hard fescue, chewings fescue, slender creeping red fescue and sheep's fescue grass seed crops in Alberta. Not only is the climate, environment and land base conducive to grass seed production in Alberta, population levels, environmental pressures and competition for high valued crops are forcing the industry out of traditional grass seed producing areas of the USA and Europe. Many world forage seed production and marketing firms are looking for seed production areas around the world. If western Canada can develop and prove its capabilities in grass seed production before other areas in Australia, South, America, Africa and Eastern Europe, it will have a major opportunity to acquire a significant proportion of this lucrative market. The Peace River area of Alberta and B.C. continues to be one of the major producers of creeping red fescue seed in the world.

Forage seed production has increased in Canada and has growing potential as a diversification alternative for agriculture producers. In 1999, Alberta had 11,476 inspected acres of creeping red fescue while Canada, as a whole, had a total of 16,742 inspected acres. Alberta accounted for 69% of the total creeping red fescue inspected acres in Canada (Canadian Seed Growers' Association Annual Report 1999). There were 1,761 inspected acres of hard fescue in Alberta, representing 88% of Canada's 2,006 inspected acres. Chewings fescue had 554 inspected acres, representing 90% of Canada's 614 inspected acres. Grass seed production occurs on over 500,000 acres in Canada with 50-60% of the production exported to the USA and Europe. The farm gate value is now over $100 million with tremendous value-added possibilities in employment, seed processing, handling, marketing, and retailing of the seed. The world trade in turf grass seed production alone is estimated at over $2.5 billion, with Canada annually importing over $15 million in turf grass seed.

The western Canadian provinces are co-operating to efficiently develop and disseminate the production technology skills and marketing expertise to capture a firm grass seed market. Organizations such as the Peace Region Forage Seed Association, Manitoba Forage Seed Association, Saskatchewan Forage Council, Agriculture and Agri-Food Canada and the provincial departments of Agriculture in Alberta, British Columbia, Saskatchewan and Manitoba have all invested in this co-operative endeavor.

Table 1. Characteristics of Creeping Red, Hard and Chewings Fescue.

	Fine Fescues		
Characteristic	**Creeping Red**	**Hard**	**Chewings**
Growth Habit	Tiller	Bunch	Bunch
Days to Germinate	7-14	10-21	10-21
Establish Rate	Medium	Slow/Medium	Medium
Weed Suppression	Low/Moderate	Moderate	Moderate
Thatch	Moderate	Moderate	High
Heat Tolerance	Poor	Fair	Fair
Shade Tolerance	Very Good	Very Good	Very Good

Drought Tolerance	Good	Very Good	Good
Cold Tolerance	Very Good	Excellent	Very Good
Wear Tolerance	Poor	Poor	Fair

(Taken from Ampac Seed Company, 1997)

The Problem

Weeds are a major problem in seedling and established grass crops grown for seed production. Seeds of foxtail barley, volunteer bromegrass and quackgrass are among the most serious contaminants (Darwent & Lefkovitch 1995). The small size of the industry contributes to the lack of herbicide company incentive to add grass seed crops to herbicide labels. Few herbicide options coupled with the perennial nature of grass seed crops offers a serious concern. Weeds hinder establishment of seedling grass stands and reduce seed yields of established stands and weed seeds contaminate seed crops decreasing their value. International grass seed marketing firms such as Barenbrug in Holland have zero tolerance for wild oat or quackgrass seed in grass seed purchased. Heavy infestations of wild oats and stinkweed in the year of seeding creeping red fescue have caused up to a 75 percent reduction in seed yields the following year (Agri-fax 1990). Similarly, perennial weeds can severely reduce seed yields in established stands. They can also impede harvest and spread weed seeds to cause a build-up of weed seeds in the soil. In order to be able to grow the new fine fescue grass seed crops, effective weed control options need to be determined.

As forages are slow to establish and less competitive stands with wide row spacing provide higher seed yields, herbicides are one of the main tools used in producing a grass seed crop. With the introduction of new grass seed species, the tolerance of the new species to the existing herbicides as well as new herbicides, needs to be determined. Unfortunately, the herbicide industry does not put much research effort into forage crops, as the industry does not see the potential for higher returns relative to the cereal and oilseed market. Thus collecting enough tolerance data to obtain Minor Use registrations for the legal use of these herbicides on these new crops is dependent on grower organization support.

There is also a need to obtain tolerance information on the currently grown grass seed crops for the new herbicides coming on the market. Several new herbicides providing control of cleavers are now registered for use in cereal crops in Alberta. Attain and Accord are very welcome cleaver control products as cleavers is becoming a widespread and serious weed concern. Several years of tolerance research over several locations is required to obtain the information needed to add forage seed crops to herbicide labels through the Minor Use program.

Alberta Agriculture, Food and Rural Development is not only taking a lead role in developing the necessary weed management tools for successful grass seed production, it has been charged, as part of the western Canadian co-operative endeavor, with developing the protocols and gathering the information to obtain herbicide registrations on the fine-leaved fescue seed crops through the Minor Use program.

The perennial weeds Canada thistle, perennial sow-thistle, dandelion, white cockle, volunteer alsike clover, foxtail barley and quackgrass; the biennial weeds narrow-leaved hawk's-beard and rough cinquefoil; the winter annual weeds cleavers, stork's-bill and flixweed; and the annual weed wild oats are major weed problems in grass seed crops in western Canada and are difficult to control with herbicide applications.

There are very few herbicides registered for use on the new fine fescue seed crops and producers cannot afford to experiment with unregistered herbicides on these high value crops.

The herbicide industry is not willing to support this investment in grass seed production when cereals and oilseed crops are more universal and have guaranteed cash returns. Thus the grass seed producers and Alberta Agriculture, Food and Rural Development have the unaddressed issue of registering herbicides for fine fescue seed production. When herbicide tolerance has been established, research must also investigate herbicide tank mixes as tank-mixing grassy and broad-leaf weed control herbicides can alter their efficacy and tolerance on weeds and crops (Hatzios and Penner 1985).

Reliance for weed control in fine fescue seed production falls mostly on 2,4-D and MCPA. Phenoxy herbicides are important for weed control in fine fescue seed crops as they control broadleaf weeds at a more economical cost. However, the weed control spectrum provided by the phenoxy herbicides is limited and it is important to have alternative herbicides available in the event of withdrawal of these herbicides from the market or the development of weeds resistant to these herbicides. Also, wild oat and grassy weed herbicides are needed for the production of fine fescue grass seed.

PROJECT OBJECTIVES

1. Determine the tolerance of fine fescue grass seed crops to herbicides.

2. Develop and submit data to the Expert Committee on Weeds for the fine fescue grass seed crops showing tolerance to the herbicides.

3. Add the tolerant fine fescue grass seed crops to the herbicide labels through the User Requested Minor Use Label Expansion program.

4. Provide this information to the fine fescue grass seed growers.

TOLERANCE OF SEED CREEPING RED FESCUE TO HERBICIDES

Introduction

Creeping red fescue, *Festuca rubra* L., became an important grass species in Canada during the first part of World War II. Demand has continued through export interest. Demand arose out of the need for turf-forming grass to seed on airfield strips and bare areas around military bases throughout North America (Elliott and Baenziger, 1977). Today, creeping red fescue is well known, second to Kentucky bluegrass, and used in lawns, golf courses, parks, and cemeteries. The Peace River Region of Alberta and British Columbia is the largest producing area of creeping red fescue seed in the world (Agri-Facts 2000).

Creeping red fescue is a perennial, fine-leaved grass native to both Europe and America. It is considered a hardy grass and can survive most prairie winters. Creeping describes the turf forming, fibrous root system characteristic of creeping red fescue. Due to its creeping ability, it competes well with weeds, however it does not have an aggressive competitive nature like that of bromegrass.

The dense turf formed by creeping red fescue is able to withstand heavy trampling. Leaves are dark green and can remain that way, under good conditions, into the winter. Seed stems form the second year of establishment in early June. Seed panicles are tinged with red to give an overall color of red on a stand. Seed is usually ready to be harvested in early August the

year after seeding. An average yield is 450 kg/ha (400 lb/ac), but yields of more than 1350 kg/ha (1200 lb/ac) have been reported (Elliott and Baenziger, 1977).

Creeping red fescue's thick turf and vigorous root system make this grass valuable for pasture and reclaiming soil. Growth starts early in the spring, slows in midsummer, and grows vigorously from late summer until freeze-up. It is practically unaffected by frost and provides succulent winter pasture without injury to the stand.

The variety "Boreal" creeping red fescue was developed at the Agriculture and Agri-Food Canada Research Station at Beaverlodge, Alberta, in 1966. It is considered a general-purpose variety for use in Western Canada. It gives excellent seed and forage yields.

Seed production is maximized when ample moisture and fertility is present. In aging stands these vital reserves are depleted and seed production also declines. Seed production is maximized when crop is seeded before June 15, so that the crop has ample time to establish and produce seed the following year. Companion crops are sometimes used, however they compete with seedling grasses and the competition effects can still be present the following seed production year. Once seed has been removed the crop can then be grazed without any subsequent injury to future seed production.

The natural growth habit of creeping red fescue involves a steady proliferation of tillers, which eventually become too dense to form seed heads (Fairey & Lefkovitch 1996). Thus it is then considered uneconomic to harvest more than two consecutive seed crops without introducing thinning management techniques. Rejuvenation of creeping red fescue is considered to take at least one year without seed production. Initial planting density and arrangement can also affect the optimized seed yield for one, two or three consecutive crops (Fairey & Lefkovitch 1996). Seeding of creeping red fescue requires critical decisions because a relatively high density of well-spaced plants is required at establishment to optimize seed head formation in the first crop but is detrimental to seed head formation and seed yield subsequently (Fairey & Lefkovitch 1996).

Table 2. Creeping Red Fescue Characteristics.

Characteristics	Creeping Red Fescue
Rhizomes	MANY
Ease of establishment	5
Sod density	8
Winter hardiness	9
Wear tolerance	5
Drought tolerance	7
Shade tolerance	8
Salt tolerance	6
Close mowing	6
Suitable for sports fields	5
Suitable for lawns	7
Suitable for golf courses	5

*1-9=best

(from Barenbrug Range of Varieties 1996, Barenbrug Holland Bv.)

Although there are a number of herbicides registered for use on seedling and established creeping red fescue, herbicide tolerance trials need to be conducted using the newer herbicides,

especially those that suppress or control cleavers. Producers will invariably use the new herbicides requiring that the tolerance work be conducted.

Table 3. Registered and Potential Herbicides for use on Creeping Red Fescue.

Registered Herbicides

Broadleaf Weeds

Seedling - 2,4-D, MCPA, Banvel II, Pardner, Buctril M, Lontrel, Basagran, Triumph Plus, Refine Extra

Established - 2,4-D, MCPA, Banvel II, Banvel II+2,4-D, Lontrel, Ally, Refine Extra

Grassy Weeds

Seedling - Poast Ultra, Venture, Assure II, Mataven L, Hoe-Grass 284, Hoe-Grass II, Avenge, Achieve, Triumph Plus

Established - Poast Ultra, Venture, Assure II, Assure II + Ally, Achieve

Potential Herbicides

Seedling - Prevail, Puma Super, Attain, Curtail M, Prestige, Accord, Target

Established - Attain, Unity, Prestige, Curtail M, Target

*Taken From Update on Tolerance of Grass Seed Crops to Herbicides-April 2001

Materials and Methods

The experiments were conducted from 1998 to 2000 on solid seeded blocks of creeping red fescue. The creeping red fescue was seeded with a double disc press drill at 1 cm deep and 30 cm row spacing. Trial locations were at the Ellerslie U of A Research Farm at Edmonton, Alberta and in the Peace region of northern Alberta.

The experiments were conducted using a randomized complete block design with four replicates. In 1998 and 1999, there were 5 treatments x 4 replicates = 20 plots of creeping red fescue. In 2000, there were 10 treatments x 4 replicates = 40 plots of creeping red fescue. The research plots were 2 m x 6 m plots with a total area of 20 m x 27 m in the creeping red fescue trials.

Herbicide application was conducted with a hand held CO_2 sprayer (R&D Sprayers, Inc., Opelousas, Louisiana, USA) using 80015 XR nozzles (Spraying Systems Ltd., Calgary, Alberta, Canada) at 138 kPa delivering 100 L of spray solution per hectare. The nozzles were 45 cm above the vegetation canopy height. The growth stages of the sprayed plant species are indicated in the table (Tables 11) following the herbicide treatment list tables (Tables 4-10).

A 1.5 m x 6 m ($9m^2$) area in each plot was straight combined with a Wintersteiger plot combine, the seed dried at 40ºC, cleaned with a seed scalper and total harvest dry weight taken. Seeds were then counted to determine 1000 kernel weight and percent germination. The 1000 kwt and germinations were not collected for the creeping fescue sprayed at the seedling stage as there is usually no effect the year after spraying. After harvesting, the stubble and straw were swathed at 10 cm, baled and removed. Fertilizer was then applied at recommended rates in the fall.

The trials treated as "seedling" grass were seeded in 1998 or 1999 and had visual tolerance evaluations (% injury) in the year of seeding and spraying and seed yield collected the following year. The trials designated as "established" were seeded in 1998 or 1999 and sprayed as established grass the following year with visual tolerance evaluations and seed harvest in the year of spraying. The trials designated as "2 year old established" were seeded in 1998 and

sprayed as a two year old established stand with visual evaluations in the year of spraying. Seed yield data was not collected due to low seed production.

Herbicide Treatment Lists

Table 4. 1997 and 1998* Peace Region Tolerance of Established Creeping Red Fescue to Cleaver Controlling Products (Exp#CR1, CR2, CR4 & CR5).

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Accord + Merge 1X	Quinclorac (surfactant)	75% SG	0.100 1.0% v/v	0.067 kg/ac 1.0% v/v
2	Accord + Merge 2X	Quinclorac (surfactant)	75% SG	0.200 1.0% v/v	0.135 kg/ac 1.0% v/v
3	Accord 1X+ Refine Extra 1X	quinclorac+ thifensulfuron methyl tribenuron methyl (surfactant)	75% SG 50% SG 25% SG	0.100+ 0.010+ 0.005 1.0% v/v	0.067 kg/ac 0.008 kg/ac 1.0% v/v
4	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
5	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800
6	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
7	Refine Extra + Agral 90 2X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.010 0.2% v/v	0.016 kg/ac 0.2% v/v
8	Refine Extra + 2,4-D ester Agral 90 1X	thifensulfuron methyl+tribenuron methyl+2,4-D ester (surfactant)	50% SG 25% SG 564 EC	0.010 + 0.005+ 0.560 0.2% v/v	0.008 kg/ac 0.100 0.2% v/v
9	Ally + Agral 90 1X	metsulfuron methyl (surfactant)	60% SG	0.0045 0.2% v/v	0.003 kg/ac 0.2% v/v
10	Banvel + 2,4-D amine 1X	Dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.280 0.800	0.230 0.690
11	Target 1X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
12	Target 2X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.816 + 0.185 + 0.185	1.2
13	Unity Agral 90 1X	Triasulfuron Bromoxynil (surfactant)	75% SG 280 g/L EC	0.008 0.140 0.25% v/v	0.0043 kg/ac 0.200 0.25% v/v
*	Prestige 1X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
*	Prestige 2X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620

14	Check				

Table 5. 1998 Edmonton Tolerance of Seedling (Exp#CR3) and 1999 Edmonton Tolerance of Established (Exp#CR8) Creeping Red Fescue to Graminicides

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Select + Amigo	Clethodim (surfactant)	240 g/L EC	0.090 1.0% v/v	0.152 1.0% v/v
5	Select + Amigo	Clethodim (surfactant)	240 g/L EC	0.180 1.0% v/v	0.304 1.0% v/v

Table 6. 1998 Peace Region Tolerance of Established Creeping Red Fescue to Herbicides (Exp#CR6 & CR7)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Select + Amigo 1X	Clethodim (surfactant)	240 g/L EC	0.090 1.0% v/v	0.152 1.0% v/v
2	Select + Amigo 2X	Clethodim (surfactant)	240 g/L EC	0.180 1.0% v/v	0.304 1.0% v/v
3	Unity+ Select Amigo 1X	Triasulfuron Bromoxynil Clethodim (surfactant)	75% SG 280 g/L EC 240 g/L EC	0.016 0.275 0.18 1% v/v	0.0086 kg/ac 0.400 0.304 1% v/v
4	Unity	Triasulfuron Bromoxynil	75% SG 280 g/L EC	0.016 0.275	0.0086 kg/ac 0.400
5	Assure 1X+ Refine Extra 1X+ Canplus	quizalofop+ thifensulfuron methyl+tribenuron methyl (surfactant)	96 EC 75 SG	0.145+ 0.010+ 0.005+ 1% v/v	1.500 0.200
6	Assure 2X+ Refine Extra 2X+ Canplus	quizalofop+ thifensulfuron methyl+tribenuron methyl (surfactant)	96 EC 75 SG	0.290+ 0.020+ 0.010+ 1% v/v	3.00 0.400
7	Check				

Table 7. 1999 Peace Region Tolerance of Established Creeping Red Fescue to Herbicides (Exp#CR9)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
2	Attain 2X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800
3	Prestige 1X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810

4	Prestige 2X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620
5	Unity	Triasulfuron Bromoxynil	75% SG 280 g/L EC	0.008 0.138	0.0043 kg/ac 0.200
6	Unity+ Assure+ Canplus	Triasulfuron Bromoxynil Quizalofop (surfactant)	75% SG 280 g/L EC 96 EC	0.008 0.138 0.144 1 % v/v	0.0043 kg/ac 0.200 1.5
7	Poast 1X+ Ally 1X+ Merge	Sethoxydim metsulfuron (surfactant)	450 EC 60 SG	0.500+ 0.0045+ 1 % v/v	1.100 0.0075kg/ac
8	Check				

Table 8. 1999 Peace Region Tolerance of Creeping Red Fescue to Herbicides at two different growth stages (Exp#CR10)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Lontrel+ MCPA Ester	clopyralid+ MCPA ester	330 EC	0.660	2.00
2	Lontrel	clopyralid	360 EC	0.112	0.311
3	Attain A	fluroxypyr	180 EC	0.144	0.800
4	Ally	metsulfuron methyl	60 SG	0.0045	0.0075
5	Assure	quizalofop	96 EC	0.071	0.740
6	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
7	Check				

Table 9. 2000 Peace Region Tolerance of Established Creeping Red Fescue to Prestige and Attain (Exp#CR11 & CR12)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
2	Attain 2X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800
3	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
4	Prestige 2X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620
5	Check				

Table 10. 2000 Edmonton Tolerance of 2 Year Old Established Creeping Red Fescue to Broadleaf Herbicides Applied at Two Stages (Exp#CR13)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				

2	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
3	Ally + Agral 90 1X	metsulfuron methyl (surfactant)	60% SG	0.0045 0.2% v/v	0.003 kg/ac 0.2% v/v
4	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
5	Curtail M	clopyralid+ MCPA ester	50 g/L EC 564 g/L EC	0.100 0.56	0.200 0.100
6*	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
7*	Ally + Agral 90 1X	metsulfuron methyl (surfactant)	60% SG	0.0045 0.2% v/v	0.003 kg/ac 0.2% v/v
8*	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
9*	Curtail M	clopyralid+ MCPA ester	50 g/L EC 564 g/L EC	0.100 0.560	0.200 0.100

*2nd Stage Treatments (30-40% heading)

Herbicide Treatment Application and Data Collection Dates and Stages

Table 11. Creeping Red Fescue - Herbicide Plant Growth Stages, Heights, Visual Evaluation and Harvest Dates.

Expt #	Locat.	Experiment	Fertilizer Application Date(s)	Herbicide Application Date(s)	Crop & Weed Spray Stages	Visual Evaluation Date(s)	Harvest Dates
CR1	**Peace Region** Spirit River	Established Cr Red Fescue Cleavers 1997	98/04/22	97/05/28	Shot Blade Stage	97/06/04 97/07/01 97/07/25	97/07/25
CR2	**Peace Region** Beaver-lodge	Established Cr Red Fescue Cleavers 1997	96/10/24	96/06/02	Shot Blade Stage	97/06/09 97/07/08 97/07/29	97/07/29
CR3	**Edmonton**	Seedling Cr.Red Fescue Graminicides 1998		98/06/23	7cm, 3leaf Chickweed 6leaf Stinkweed 8cm V.Canola 17cm	98 99/05/31	99/07/27
CR4	**Peace Region** Woking	Established Cr Red Fescue Cleavers 1998	97/10/15	98/05/12	25-30cm, Seed heads near base	98/06/09 98/07/10	98/07/10
CR5	**Peace Region** Debolt	Established Cr Red Fescue Cleavers 1998	97/10/15	98/05/13	25-30cm, Seed heads near base	98/06/10 98/07/10	98/07/10
CR6	**Peace Region** Woking	Established Cr Red Fescue Herbicides 1998	97/10/15	98/05/12	25-30cm, Seed heads near base	98/06/19 98/07/10	98/07/10

CR7	**Peace Region** Debolt	Established Cr Red Fescue Herbicides 1998	97/10/15	98/05/13	25-30cm, Seed heads near base	98/06/10 98/07/10	98/07/10
CR 8	**Edmonton**	Established Cr Red Fescue Graminicides 1999	98/10/26	99/05/27	30cm, 10% early heading	99/06/11 99/07/22	99/07/27
CR9	**Peace Region** Beaverlodge	Established Cr Red Fescue Herbicides 1999	98/10/19	99/05/20	Shot Blade Stage	99/06/17 99/07/29	99/07/29
CR10	**Peace Region** Beaverlodge	Established Cr Red Fescue Stages 1999	98/10/19	EARLY 99/05/20 LATE *99/06/18	Shot Blade Stage *Head Emergence		99/07/29
CR11	**Peace Region** Debolt	Established Cr Red Fescue Prestige, Attain 2000	99/10/15	00/05/24	Before Shot Blade Stage	00/06/19 00/07/10 00/07/28	00/07/28
CR12	**Peace Region** Beaverlodge	Established Cr Red Fescue Prestige, Attain 2000	99/10/20	00/05/30	Shot Blade Stage	00/06/19 00/07/11	00/07/31
CR13	**Edmonton**	2YREstablished Cr. Red Fescue Herbicides 2000	98/10/26 99/11/04	EARLY 00/05/26 LATE *00/06/26	22cm, 4 leaf, seed head in base *35cm, 2-3 leaf+3tillers, 60% headed out	00/07/12 00/08/22	None

Results and Discussion

In the trials conducted in 1998 and 1999, Select applied at 1x and 2x the recommended rate in the spring to established creeping red fescue severely reduced seed yields (Tables 46, 47 and 48; Figures 5, 6 and 7) . Select should not be recommended for use on any of the fine fescues and there is no need to recommend it with Venture, Poast Ultra and Assure II being registered on established creeping red fescue for grassy weed control and hard and chewings fescue exhibiting good tolerance to these three graminicides.

The work that has been conducted in the Peace Region on tolerance of established creeping red fescue to spring applications of herbicides that suppress or control cleavers has shown that Attain, Prestige and Unity tend to be safe on creeping red fescue but Accord can cause significant seed yield losses (Tables 41, 42, 44, 45, 49, 51 and 52; Figures 1, 3, 4, 8, 10 and 11). In 1997, Accord applied at the 2x recommended rate and Refine Extra 1x + Accord 1x rate tank mix applied to established creeping red fescue in the spring significantly reduced yields as compared to the check (Table 41; Figure 1). In 1998, creeping red fescue seed yields were reduced from spring applied Accord in two additional trials (Tables 44 and 45; Figures 3 and 4).

It is interesting to note that Accord did not cause visual damage to the creeping red fescue but that the damage occurred in reduced seed yields.

Creeping red fescue has shown good tolerance to Attain but it is important to note that Attain contains 400 ml/acre of 2,4-D ester, which can be hard on creeping red fescue. In 1999 Attain at 2x rate caused a significant yield loss (Table 49; Figure 8).

In 1999 a trial was established to evaluate the tolerance of herbicides applied on creeping red fescue before the shot blade stage compared to when the crop was headed out. There was not a significant difference in seed yield between application timings (Table 50; Figure 9).

The data collected in 1998 was submitted to the Expert Committee on Weeds as research reports in December 1998. Unfortunately, the Expert Committee on Weeds Research Report program was discontinued and the 1999 data was put on hold until the new data entry program was functioning. The new Expert Committee on Weeds Research Report program was reestablished in 2000 with a full text searchable database accepting reports with 1999 and 2000 data. Creeping red fescue information from 1999 and 2000 was submitted early in 2001.

Data collected in 1998 was submitted to the Pest Management Regulatory Agency as data to support a Minor Use label expansion adding seedling creeping red fescue to the Assure II label. This Minor Use label expansion was obtained in March of 1999. A Minor Use registration to add creeping red fescue to the Select label will not be applied for as visual evaluations indicated severe injury when Select was sprayed on seedling and established creeping red fescue.

Dr. Lloyd Darwent showed that 2,4-D applied in September of the year of seeding severely reduced seed yields the following year by 25-50% at Beaverlodge. Banvel applied at the same time had no effect on seed yields the following year. 2,4-D should not be applied to creeping red fescue in the fall of the year of seeding. After the 1st seed crop is harvested, 2,4-D application in the fall appears to be safe. Darwent and Smith (1984) have shown that herbicides applied in the spring or summer of the year of creeping red fescue establishment were effective in reducing weed populations and increasing seed-crop yields in subsequent years.

TOLERANCE OF SEED HARD FESCUE TO HERBICIDES

Introduction

Hard fescue (*Festuca ovina* var. *duriuscula*) is a fine fescue that originated from Europe but is found at higher elevations throughout northern United States and Canada. The turf quality of hard fescue is not as high as creeping red fescue, and it is most commonly used for low maintenance areas and erosion control. A key aspect of hard fescue for lawns is that requires low maintenance once mature. The amount of mowing required is low compared to other grasses. It grows as a bunch grass, and is slower to fill in gaps than chewings and creeping red fescue. It forms very dense crowns. But unlike creeping red fescue, these crowns will not "creep" or expand with the root system but will increase in crown size. Seed production is maximized when the crowns are not allowed to close in, so proper maintenance is required to ensure continued production. Burning, however, unlike other fescues, injures hard fescue so grass will need to be cut and removed from the field.

Hard fescue is shade tolerant, somewhat drought resistant, good flood tolerance and grows well in well-drained soils. It is highly resistant to dollar spot, leaf spot and red thread, and in general, is considered healthier than other fine fescues. It has the ability to stay green throughout the summer, even with extended dry periods. Its wear ability is fair since clumps

recover slowly from damage. Hard fescue has also been credited with being one of the "hardiest" of the fescues.

The Manitoba Forage Seed Association considers hard fescue difficult to establish for seed production purposes and there is usually only 2 or 3 years of seed production from the one crop.

Because there are a limited number of herbicides registered for use on seedling and established stands of hard fescue, herbicide tolerance trials have been conducted over the past few years using a number of products, especially herbicides that suppress or control cleavers. Herbicide research will need to continue as long as new herbicides are being introduced.

Table 12. Registered and Potential Herbicides for use on Hard Fescue.

Registered Herbicides

Broadleaf Weeds

Seedling - 2,4-D, MCPA

Established - 2,4-D, MCPA

Potential Herbicides

Seedling - Assure II, Poast Ultra, Venture, Buctril M, Banvel, Target, Refine Extra, Curtail M, Prestige, Attain, Accord, Lontrel

Established - Assure II, Poast Ultra, Venture, Banvel, Target, Refine Extra, Ally, Unity, Curtail M, Prestige, Attain, Lontrel

*Taken From Update on Tolerance of Grass Seed Crops to Herbicides-April 2001

In other countries, hard fescue is treated like creeping red fescue in regards to tolerance to herbicides. However, differences in the time that hard fescue heads out suggests that practices and perhaps herbicides used for creeping red fescue may not always apply to hard fescue. Hard fescue can head out 10 –14 days prior to creeping red fescue. Fall application may be more suitable so that herbicides are not applied at the time of heading. The Agronomy Unit initiated fall application trials in the fall of 2000 as an AARI Matching Grant project. Data will be collected in 2001 and 2002.

In Edmonton, the "Spartan" variety of hard fescue was used. Pickseed and Rutgers University developed it. Spartan has good seedling vigor and establishes quickly (7-10 days at soil temperatures over 65ºF). Pickseed recommends that it should be seeded at a rate of 150-200 lbs/ac. Spartan requires about half of the nitrogen fertilizer required by ryegrass or bluegrass. It will remain green and continue growth with 30-50% lower water requirement than bluegrass or ryegrass.

Materials and Methods

The experiments were conducted from 1998 to 2000 on solid seeded blocks of hard fescue. The hard fescue was seeded with a double disc press drill at 1 cm deep and 30 cm row spacing. The trials were located at the Ellerslie U of A Research Farm at Edmonton, Alberta and in the Peace region of northern Alberta.

The experiments were conducted using a randomized complete block design with four replicates. In 1998, 1999 and 2000, there were 13 broadleaf treatments x 4 replicates = 52 plots and 11 graminicide treatments x 4 replicates = 44 plots of hard fescue, 96 plots total. The research plots were 2 m x 6 m with a total area of 48 m x 27 m in the hard fescue trials.

Herbicide application was conducted with a hand held CO_2 sprayer (R&D Sprayers, Inc., Opelousas, Louisiana, USA) using 80015 XR nozzles (Spraying Systems Ltd., Calgary, Alberta,

Canada) at 138 kPa delivering 100 L of spray solution per hectare. The nozzles were 45 cm above the vegetation canopy height. The growth stages of the sprayed plant species are indicated in the table (Table 27) following the herbicide treatment list tables (Tables 13-26).

A 1.5 m x 6 m (9m2) area in each plot was straight combined with a Wintersteiger plot combine, the seed dried at 40ºC, cleaned with a seed scalper and total harvest dry weight taken. Seeds were then counted to determine 1000 kernel weight and percent germination. The 1000 kwts and germinations were not collected for the hard fescue sprayed at the seedling stage, as there is usually no effect the year after spraying. After harvesting, the stubble and straw were swathed at 10 cm, baled and removed. Fertilizer was then applied at recommended rates in the fall.

The trials treated as "seedling" grass were seeded in 1998 or 1999 and had visual tolerance evaluations (% injury) in the year of seeding and spraying and seed yield collected the following year. The trials designated as “established” were seeded in 1998 or 1999 and sprayed as established grass the following year with visual tolerance evaluations and seed harvest in the year of spraying. The trials designated as “2 year old established” were seeded in 1998 and sprayed as a two year old established stand with visual evaluations in the year of spraying. Seed yield data was not collected due to low seed production.

Herbicide Treatment Lists

Table 13. 1998 Edmonton Tolerance of Seedling Hard Fescue to Graminicides (Exp#H1)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge	sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v
8	Select + Amigo	clethodim (surfactant)	240 g/L EC	0.090 1.0% v/v	0.152 1.0% v/v
9	Select + Amigo	clethodim (surfactant)	240 g/L EC	0.180 1.0% v/v	0.304 1.0% v/v
10	Accord + Merge	quinclorac (surfactant)	75% SG	0.125 1.0% v/v	0.067 kg/ac 1.0% v/v
11	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
12	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810

13	Prestige 2X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620

Table 14. 1998 Edmonton Tolerance of Seedling Hard Fescue to Broadleaf Weed Herbicides (Exp#H2)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Target 1X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Target 2X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.816 + 0.185 + 0.185	1.2
4	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
5	Refine Extra + Agral 90 2X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.010 0.2% v/v	0.016 kg/ac 0.2% v/v
6	Buctril M 2X	bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.560 + 0.560	0.8
7	Banvel + 2,4-D amine 1X	dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.280 0.800	0.230 0.690
8	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
9	Attain 2X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800
10	Accord + 2,4-D ester + Merge 1X	quinclorac 2,4-D ester (surfactant)	75% SG 564 g/L EC	0.100 0.560 1.0% v/v	0.055 kg/ac 0.400 1.0% v/v
11	Accord + 2,4-D ester + Merge 2X	quinclorac 2,4-D ester (surfactant)	75% SG 564 g/L EC	0.200 1.120 1.0% v/v	0.110 kg/ac 0.800 1.0% v/v

Table 15. 1999 Peace Region Tolerance of Seedling Hard Fescue to Graminicides (Exp#H3)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Poast Ultra + Merge	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
4	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v

Table 16. 1999 Peace Region Tolerance of Seedling Hard Fescue to Broadleaf Weed Herbicides (Exp#H4)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				

2	Target 1X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
4	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
5	Banvel + 2,4-D amine 1X	dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
6	Puma Super + Buctril M 1X	fenoxaprop-p-ethyl bromoxynil MCPA ester	92 g/L 280 g/L EC 280 g/L EC	0.092 0.280 + 0.280	0.400 0.400
7	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
8	Accord + Merge 1X	quinclorac (surfactant)	75% SG	0.100 1.0% v/v	0.067 kg/ac 1.0% v/v

Table 17. 1999 Edmonton Tolerance of Seedling Hard Fescue to Graminicides (Exp#H5)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Check-hand weeded				
3	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
4	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
5	Poast Ultra + Merge	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
6	Poast Ultra + Merge	sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
7	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
8	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v
9	Accord + Merge 1X	quinclorac (surfactant)	75% SG	0.100 1.0% v/v	0.067 kg/ac 1.0% v/v
10	Accord + Merge 2X	quinclorac (surfactant)	75% SG	0.200 1.0% v/v	0.135 kg/ac 1.0% v/v

Table 18. 1999 Edmonton Tolerance of Seedling Hard Fescue to Broadleaf Weed Herbicides (Exp#H6)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Target 1X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Target 2X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.816 + 0.185 + 0.185	1.2

4	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
5	Refine Extra + Agral 90 2X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.010 0.2% v/v	0.016 kg/ac 0.2% v/v
6	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
7	Prestige 2X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620
8	Buctril M 1X	bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.280 + 0.280	0.400
9	Banvel + 2,4-D amine 1X	dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
10	Puma Super + Buctril M 1X	fenoxaprop-p-ethyl bromoxynil MCPA ester	92 g/L 280 g/L EC 280 g/L EC	0.092 0.280 + 0.280	0.400 0.400
11	Puma Super + Buctril M 2X	fenoxaprop-p-ethyl bromoxynil MCPA ester	92 g/L 280 g/L EC 280 g/L EC	0.184 0.560 + 0.560	0.800 0.800
12	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
13	Attain 2X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800

Table 19. 1999 Edmonton Tolerance of Established Hard Fescue to Graminicides (Exp#H7)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v
8	Select + Amigo 1X	clethodim (surfactant)	240 g/L EC	0.090 1.0% v/v	0.152 1.0% v/v
9	Accord + Merge 1X	quinclorac (surfactant)	75% SG	0.100 1.0% v/v	0.067 kg/ac 1.0% v/v
10	Accord + Merge 2X	quinclorac (surfactant)	75% SG	0.200 1.0% v/v	0.135 kg/ac 1.0% v/v
11	Accord + 2,4-D ester + Merge 1X	quinclorac 2,4-D ester (surfactant)	75% SG 564 g/L EC	0.100 0.550 1.0% v/v	0.055 kg/ac 0.395 1.0% v/v

Table 20. 2000 Peace Region Tolerance of Seedling Hard Fescue to Graminicides (Exp#H9)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	sethoxydim (surfactant)	450 g/L EC	0.100 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v

Table 21. 2000 Peace Region Tolerance of Seedling Hard Fescue to Broadleaf Weed Herbicides (Exp#H10)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
3	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.01 0.2% v/v	0.016 kg/ac 0.2% v/v
4	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
5	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.12	0.648 1.62
6	Target 1X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
7	Buctril M 1X	bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.280 + 0.280	1.0
8	Banvel + 2,4-D amine 1X	dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
9	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
10	Attain 2X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800
11	Accord + Merge 1X	quinclorac (surfactant)	75% SG	0.100 1.0% v/v	0.067 kg/ac 1.0% v/v
12	Accord + Merge 2X	quinclorac (surfactant)	75% SG	0.200 1.0% v/v	0.135 kg/ac 1.0% v/v

13	Accord + 2,4-D ester + Merge 1X	quinclorac 2,4-D ester (surfactant)	75% SG 564 g/L EC	0.100 0.550 1.0% v/v	0.055 kg/ac 0.395 1.0% v/v

Table 22. Edmonton 2000 Tolerance of Established Hard Fescue to Graminicides (Exp#H11)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v

Table 23. 2000 Peace Region Tolerance of 1 Year Old Established Hard Fescue to Graminicides (Exp#H13)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	sethoxydim (surfactant)	450 g/L EC	0.100 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v

Table 24. 2000 Peace Region Tolerance of 1 Year Old Established Hard Fescue to Broadleaf Weed Herbicides (Exp#H14)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
3	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
4	Target 1X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6

5	Banvel + 2,4-D amine 1X	dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
6	Unity Agral 90 1X	triasulfuron bromoxynil (surfactant)	75% SG 280 g/L EC	0.008 0.140 0.25% v/v	0.0043 kg/ac 0.200 0.25% v/v
7	Ally + Agral 90 1X	metsulfuron methyl (surfactant)	60% SG	0.0045 0.2% v/v	0.003 kg/ac 0.2% v/v

Table 25. 1999 and 2000 Edmonton Tolerance of Established 1 Year Old and 2 Year Old Established Hard Fescue to Broadleaf Weed Herbicides: Early and Late (Exp#H8,H12,H16&H18)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Target 1X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Target 2X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.816 + 0.185 + 0.185	1.2
4	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
5	Refine Extra + Agral 90 2X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.010 0.2% v/v	0.016 kg/ac 0.2% v/v
6	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
7	Prestige 2X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620
8	Banvel + 2,4-D amine 1X	dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
9	Unity Agral 90 1X	triasulfuron bromoxynil (surfactant)	75% SG 280 g/L EC	0.008 0.140 0.25% v/v	0.0043 kg/ac 0.200 0.25% v/v
10	Ally + Agral 90 1X	metsulfuron methyl (surfactant)	60% SG	0.0045 0.2% v/v	0.003 kg/ac 0.2% v/v
11	Ally + Agral 90 2X	metsulfuron methyl (surfactant)	60% SG	0.009 0.2% v/v	0.006 kg/ac 0.2% v/v
12	Attain 1X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
13	Attain 2X	fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800

Table 26. 2000 Edmonton Tolerance of 2 Year Old Established Hard Fescue to Graminicides: Early and Late (Exp#H15 and H17)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				

2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v
8	Curtail M 1X	clopyralid MCPA ester	50 g/L EC 280 g/L EC	0.100 0.56	2.0
9	Curtail M 2X	clopyralid MCPA ester	50 g/L EC 280 g/L EC	0.200 1.12	4.0
10	Buctril M 1X	bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.280 + 0.280	1.0
11	Buctril M 2X	bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.560 + 0.560	2.0

Herbicide Treatment Application and Data Collection Dates and Stages

Table 27. Hard Fescue - Herbicide Plant Growth Stages, Heights, Visual Evaluation and Harvest Dates

Expt. #	Location	Experiment	Fertilizer Application Date(s)	Herbicide Application Date(s)	Crop & Weed Spray Stages	Visual Evaluation Date(s)	Harvest Dates
H1	**Edmonton**	Seedling Hard Fescue Graminicides 1998		98/07/06	7 cm, 5 leaf	98/07/19 99/05/21	99/07/22
H2	**Edmonton**	Seedling Hard Fescue Broadleaf 1998		98/07/06	7cm, 5 leaf W. Mustard 40cm Shep. Purse 23cm Stinkweed 20cm Hemp Nettle 15cm	98/07/19 99/05/21	99/07/21
H3	**Peace Region** Beaverlodge	Seedling Hard Fescue Graminicides 1999	99/06/01	99/08/13	5 cm, 4-5 leaf	99/08/25 99/09/14 00/07/21	00/07/21

H4	**Peace Region** Beaverlodge	Seedling Hard Fescue Broadleaf 1999	99/06/01	99/08/13	5 cm, 4-5 leaf	99/08/25 99/09/14 00/07/21	00/07/21
H5	**Edmonton**	Seedling Hard Fescue Graminicides 1999		99/07/06	5cm, 4 leaf+1tiller Stinkweed 3cm	99/07/28 99/09/03	00/07/27
H6	**Edmonton**	Seedling Hard Fescue Broadleaf 1999		99/07/09	4cm, 4leaf	99/07/28 99/09/03	00/07/27
H7	**Edmonton**	Established Hard Fescue Graminicides 1999	98/10/26	99/05/27	27cm, 80% early heading	99/06/11 99/07/21	99/07/21
H8	**Edmonton**	Established Hard Fescue Broadleaf 1999	98/10/26	99/05/25 99/05/27	27cm, 80% early heading	99/06/11 99/07/21	99/07/21
H9	**Peace Region** Beaverlodge	Seedling Hard Fescue Graminicides 2000	00/05/18 00/10/12	00/07/11	2-4 lf	00/09/18 01/05/31 01/06/26	01/07/16
H10	**Peace Region** Beaverlodge	Seedling Hard Fescue Broadleaf 2000	00/05/18 00/10/12	00/07/11	2-4 lf	00/09/18 01/05/31 01/06/26	01/07/16
H11	**Edmonton**	Established Hard Fescue Graminicides 2000	99/11/04	00/05/12	16cm, 3leaf	00/06/30 00/07/25	00/07/25
H12	**Edmonton**	Established Hard Fescue Broadleaf 2000	99/11/04	00/05/12	16cm, 3leaf	00/06/30 00/07/31	00/07/25

H13	**Peace Region** Beaverlodge	Established Hard Fescue Graminicides 2000	99/06/01 99/10/06	00/05/26	Early Heading	00/06/20 00/07/10	00/07/24
H14	**Peace Region** Beaverlodge	Established Hard Fescue Broadleaf 2000	99/06/01 99/10/06	00/05/26	Early Heading	00/06/20 00/07/10	00/07/24
H15	**Edmonton**	2YrEstablished Hard Fescue Graminicides Early 2000	98/10/26 99/11/04	EARLY 00/05/17	16cm, 5leaf	00/07/08 00/08/02	None
H16	**Edmonton**	2YrEstablished Hard Fescue Broadleaf Early 2000	98/10/26 99/11/04	EARLY 00/05/19	17cm, 4leaf	00/07/08 00/08/02	None
H17	**Edmonton**	2YrEstablished Hard Fescue Graminicides Late 2000	98/10/26 99/11/04	LATE 00/06/07	22cm, 10% headed out	00/07/07 00/08/02	None
H18	**Edmonton**	2YrEstablished Hard Fescue Broadleaf Late 2000	98/10/26 99/11/04	LATE 00/06/07	22cm, 10% headed out	00/07/08 00/08/02	None

Results and Discussion

In a trial conducted in the Edmonton region in 1999, Select application caused severe damage and a significant seed yield loss to established hard fescue (Table 60; Figure 18). The damage basically kept the grass from heading out. The Select application also significantly reduced the germination of the harvested hard fescue seed (Table 60). The other three graminicides, Assure II, Poast Ultra and Venture, did not injure or reduce seed yields of established hard fescue (Tables 60, 64, 66, 68 and 70; Figure 18, 22 and 24). Select caused severe stunting of when applied to seedling hard fescue but the grass mainly recovered by harvest of the following year so that there was not a significant seed yield reduction (Table 54; Figure 12). Seedling hard fescue was not injured and did not have a seed yield reduction when sprayed with any of the other three graminicides (Tables 54, 56 and 58; Figures 12, 14 and 16).

Even though there was no visible injury to established hard fescue after being sprayed with Accord or Accord + 2,4-D in the spring of the year following the year of seeding, these treatments caused a significant seed yield reduction to established hard fescue (Table 60; Figure 18). These treatments also significantly affected the seed viability (Table 60). Accord and tank mixes applied on seedling hard fescue did not have a significant seed yield reduction by harvest of the following year (Tables 54, 55, 57, 58 and 63; Figures 12, 13, 15, 16 and 21).

For the most part, the broadleaf weed herbicides Prestige, Attain, Target, Refine Extra, Buctril M, Puma Super + Buctril M and Banvel + 2,4-D amine did not cause damage or seed yield reduction to seedling hard fescue (Tables 54, 55, 57, 59 and 63; Figures 12, 13, 15, 17 and 21) while these herbicides and Ally, Unity and Curtail M did not harm or cause seed yield reductions when sprayed on established hard fescue (Tables 61, 65, 67, 68, 69, 70 and 71; Figures 19, 23 and 25).

One point to consider on weed control in established fields of hard fescue is that hard fescue heads out very early in the year. A fall spraying program for broad-leaved weeds should be considered as spring is a busy time of the year and it is difficult to spray before the fescue is in the shot blade or early heading stage. Applications at these later crop stages could affect the seed yield. This may explain the significant seed yield loss that occurred from double the recommended rate of Target and recommended rate of Banvel + 2,4-D applied to established hard fescue in the spring (Tables 61 and 67; Figures 19 and 25).

The data collected in 1998 was submitted to the Expert Committee on Weeds as research reports in December 1998. Unfortunately, the Expert Committee on Weeds Research Report program was discontinued and the 1999 data was put on hold until the new data entry program was functioning. The new Expert Committee on Weeds Research Report program was reestablished in 2000 with a full text searchable database accepting reports with 1999 and 2000 data. Hard fescue information from 1999 and 2000 was submitted early in 2001.

As there are so few herbicides registered for use on this new grass seed crop in western Canada and because hard fescue appears to be tolerant to a number of broadleaf weed herbicides and graminicides, Minor Use applications will be submitted in the near future.

TOLERANCE OF SEED CHEWINGS FESCUE TO HERBICIDES

Introduction

Chewings fescue (*Festuca rubra commutata*) is a very aggressive, bunch type fine fescue that will out compete other grasses. It has a high shade tolerance and is best adapted to areas that offer a cooler summer. It does well in sandy, acidic and often infertile soils. Chewings fescue is susceptible to diseases in full sun, is slow to recuperate from injury and is intolerant of high temperatures.

Chewings fescue follows the growth pattern of tall fescue in that it grows upright but is still considered a fine fescue due to leave characteristics. It is not as wear tolerant as other fescues but can be mowed lower at 3.75 cm.

Table 28. Chewings Fescue Characteristics.

Characteristics	Chewings Fescue
Rhizomes	NONE
Ease of establishment	4
Sod density	9
Winter hardiness	8
Wear tolerance	6
Drought tolerance	8
Shade tolerance	8
Salt tolerance	6
Close mowing	8

Suitable for sports fields	6
Suitable for lawns	9
Suitable for golf courses	8

*1-9=best

(From Barenbrug Range of Varieties 1996, Barenbrug Holland Bv.)

Because there are a limited number of herbicides registered for use on seedling and established stands of chewings fescue, herbicide tolerance trials have been conducted over the past few years using a number of products, especially herbicides that suppress or control cleavers. Herbicide research will need to continue as long as new herbicides are being introduced.

Table 29. Registered and Potential Herbicides for use on Chewings Fescue.

Registered Herbicides

Broadleaf Weeds

Seedling - 2,4-D, MCPA

Established - 2,4-D, MCPA

Potential Herbicides

Seedling - Assure II, Poast Ultra, Venture, Buctril M, Banvel, Target, Refine Extra, Curtail M, Prestige, Attain, Accord, Lontrel

Established - Assure II, Poast Ultra, Venture, Banvel, Target, Refine Extra, Ally, Unity, Curtail M, Prestige, Attain, Lontrel

*Taken From Update on Tolerance of Grass Seed Crops to Herbicides-April 2001

In other countries, chewings fescue is treated like creeping red fescue in regards to tolerance to herbicides. However, differences in the time that chewings fescue heads out suggests that practices and perhaps herbicides used for creeping red fescue may not always apply to chewings fescue. Like hard fescue, chewings fescue can head out 10 –14 days prior to creeping red fescue. Fall application may be more suitable so that herbicides are not applied at the time of heading. The Agronomy Unit initiated fall application trials in the fall of 2000 as an AARI Matching Grant project. Data will be collected in 2001 and 2002.

In Edmonton, the "Victory" variety of chewings fescue was used. It was introduced in 1985 and was very successful but has undergone adjustments to improve endophyte level, color quality, and disease resistance. Endophyte levels provide resistance from insect attacks. Disease and low insect attacks are needed in order to provide a low maintenance grass. Chewings fescue has turf quality that can be maintained under low maintenance, shade, and drought. It has good seedling vigor and establishes quickly. Pickseed recommends that it be seeded at 150-200 lbs/ac. Victory chewings fescue requires about half the nitrogen fertilizer and 30-50% lower water requirement than bluegrass or ryegrass. Under low maintenance situations, chewings fescue will remain dormant in summer until fall rains occur and cooler temperatures arrive. Pickseed has suggested that chewings fescue should have tolerance to most turf herbicides.

Materials and Methods

The experiments were conducted from 1998 to 2000 on solid seeded blocks of chewings fescue. The chewings fescue was seeded with a double disc press drill at 1 cm deep and 30 cm row spacing. Trial locations were at the Ellerslie U of A Research Farm at Edmonton, Alberta and in the Peace region of northern Alberta.

The experiments were conducted using a randomized complete block design with four replicates. In 1998, 1999 and 2000, there were 13 broadleaf treatments x 4 replicates = 52 plots and 11 graminicide treatments x 4 replicates = 44 plots of chewings fescue, 96 plots total. The research plots were 2 m x 6 m plots with a total area of 48 m x 27 m in the chewings fescue trials.

Herbicide application was conducted with a hand held CO_2 sprayer (R&D Sprayers, Inc., Opelousas, Louisiana, USA) using 80015 XR nozzles (Spraying Systems Ltd., Calgary, Alberta, Canada) at 138 kPa delivering 100 L of spray solution per hectare. The nozzles were 45 cm above the vegetation canopy height. The growth stages of the sprayed plant species are indicated in the table (Table 40) following the herbicide treatment list tables (Tables 30-39).

A 1.5 m x 6 m (9m2) area in each plot was straight combined with a Wintersteiger plot combine, the seed dried at 40ºC, cleaned with a seed scalper and total harvest dry weight taken. Seeds were then counted to determine 1000 kernel weight and percent germination. The 1000 kwts and germinations were not collected for the chewings fescue sprayed at the seedling stage as there is usually no effect the year after spraying. After harvesting, the stubble and straw were swathed at 10 cm, baled and removed. Fertilizer was then applied at recommended rates in the fall.

The trials treated as "seedling" grass were seeded in 1998 or 1999 and had visual tolerance evaluations (% injury) in the year of seeding and spraying and seed yield collected the following year. The trials designated as “established” were seeded in 1998 or 1999 and sprayed as established grass the following year with visual tolerance evaluations and seed harvest in the year of spraying. The trials designated as “2 year old established” were seeded in 1998 and sprayed as a two year old established stand with visual evaluations in the year of spraying. Seed yield data was not collected due to low seed production.

Herbicide Treatment Lists

Table 30. 1998* and 1999 Edmonton Tolerance of Seedling Chewings Fescue to Graminicides (Exp#C1&C3)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge	Sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge	Sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v
8	Select + Amigo	Clethodim (surfactant)	240 g/L EC	0.090 1.0% v/v	0.152 1.0% v/v
9	Select + Amigo	Clethodim (surfactant)	240 g/L EC	0.180 1.0% v/v	0.304 1.0% v/v
10	Accord + Merge	Quinclorac (surfactant)	75% SG	0.125 1.0% v/v	0.067 kg/ac 1.0% v/v

11 *	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
12 *	Prestige 1X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
13 *	Prestige 2X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620

Table 31. 1998 Edmonton Tolerance of Seedling Chewings Fescue to Broadleaf Weed Herbicides (Exp#C2)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Target 1X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Target 2X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.816 + 0.185 + 0.185	1.2
4	Refine Extra + Agral 90 1X	Thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
5	Refine Extra + Agral 90 2X	Thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.010 0.2% v/v	0.016 kg/ac 0.2% v/v
6	Buctril M 2X	Bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.560 + 0.560	0.8
7	Banvel + 2,4-D amine 1X	Dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.280 0.800	0.230 0.690
8	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
9	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800
10	Accord + 2,4-D ester + Merge 1X	Quinclorac 2,4-D ester (surfactant)	75% SG 564 g/L EC	0.100 0.560 1.0% v/v	0.055 kg/ac 0.400 1.0% v/v
11	Accord + 2,4-D ester + Merge 2X	Quinclorac 2,4-D ester (surfactant)	75% SG 564 g/L EC	0.200 1.120 1.0% v/v	0.110 kg/ac 0.800 1.0% v/v

Table 32. 1999 Edmonton Tolerance of Seedling Chewings Fescue to Broadleaf Weed Herbicides (Exp#C4)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Target 1X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Target 2X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.816 + 0.185 + 0.185	1.2

4	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
5	Refine Extra + Agral 90 2X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.010 0.2% v/v	0.016 kg/ac 0.2% v/v
6	Prestige 1X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
7	Prestige 2X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620
8	Buctril M 1X	Bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.280 + 0.280	0.400
9	Banvel + 2,4-D amine 1X	Dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
10	Puma Super + Buctril M 1X	fenoxaprop-p-ethyl bromoxynil MCPA ester	92 g/L 280 g/L EC 280 g/L EC	0.092 0.280 + 0.280	0.400 0.400
11	Puma Super + Buctril M 2X	fenoxaprop-p-ethyl bromoxynil MCPA ester	92 g/L 280 g/L EC 280 g/L EC	0.184 0.560 + 0.560	0.800 0.800
12	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
13	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800

Table 33. 1999 Peace Region Tolerance of Seedling Chewings Fescue to Graminicides (Exp#C5)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Assure II + Sure-Mix	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Poast Ultra + Merge	Sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
4	Venture 25DG + Turbocharge	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v

Table 34. 1999 Peace Region Tolerance of Seedling Chewings Fescue to Broadleaf Weed Herbicides (Exp#C6)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Target 1X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
4	Prestige 1X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810

5	Banvel + 2,4-D amine 1X	Dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
6	Puma Super + Buctril M 1X	fenoxaprop-p-ethyl bromoxynil MCPA ester	92 g/L 280 g/L EC 280 g/L EC	0.092 0.280 + 0.280	0.400 0.400
7	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
8	Accord + Merge 1X	Quinclorac (surfactant)	75% SG	0.100 1.0% v/v	0.067 kg/ac 1.0% v/v

Table 35. 1999* and 2000 Edmonton Tolerance of Established Chewings Fescue to Graminicides (Exp#C7&C9)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	Sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	Sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v
8*	Select + Amigo 1X	Clethodim (surfactant)	240 g/L EC	0.090 1.0% v/v	0.152 1.0% v/v
9*	Accord + Merge 1X	Quinclorac (surfactant)	75% SG	0.100 1.0% v/v	0.067 kg/ac 1.0% v/v
10*	Accord + Merge 2X	Quinclorac (surfactant)	75% SG	0.200 1.0% v/v	0.135 kg/ac 1.0% v/v
11*	Accord + 2,4-D ester + Merge 1X	Quinclorac 2,4-D ester (surfactant)	75% SG 564 g/L EC	0.100 0.550 1.0% v/v	0.055 kg/ac 0.395 1.0% v/v

Table 36. 1999 and 2000* Edmonton Tolerance of Established and 2YR Old Established Chewings Fescue to Broadleaf Weed Herbicides: Early and Late (Exp#C8,C10,C14&C16)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Target 1X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
3	Target 2X	MCPA ester Mecoprop Dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.816 + 0.185 + 0.185	1.2
4	Refine Extra + Agral 90 1X	Thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v

5	Refine Extra + Agral 90 2X	Thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.020 + 0.010 0.2% v/v	0.016 kg/ac 0.2% v/v
6	Prestige 1X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
7	Prestige 2X	Fluroxypyr Clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.288 0.200 + 1.120	0.648 1.620
8	Banvel + 2,4-D amine 1X	Dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
9	Unity Agral 90 1X	Triasulfuron Bromoxynil (surfactant)	75% SG 280 g/L EC	0.008 0.140 0.25% v/v	0.0043 kg/ac 0.200 0.25% v/v
10	Ally + Agral 90 1X	metsulfuron methyl (surfactant)	60% SG	0.0045 0.2% v/v	0.003 kg/ac 0.2% v/v
11	Ally + Agral 90 2X	metsulfuron methyl (surfactant)	60% SG	0.009 0.2% v/v	0.006 kg/ac 0.2% v/v
12	Attain 1X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.105 0.560	0.240 0.400
13	Attain 2X	Fluroxypyr 2,4-D ester	180 g/L EC 564 g/L EC	0.210 1.120	0.480 0.800
14*	Curtail M 1X	Clopyralid MCPA ester	50 g/L EC 280 g/L EC	0.100 0.56	2.0
15*	Curtail M 2X	Clopyralid MCPA ester	50 g/L EC 280 g/L EC	0.200 1.12	4.0
16*	Buctril M 1X	Bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.280 + 0.280	0.400

Table 37. 2000 Peace Region Tolerance of Established Chewings Fescue to Graminicides (Exp#C11)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				
2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	Sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	Sethoxydim (surfactant)	450 g/L EC	0.100 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v

Table 38. 2000 Peace Region Tolerance of Established Chewings Fescue to Broadleaf Weed Herbicides (Exp#C12)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check				

2	Refine Extra + Agral 90 1X	thifensulfuron methyl tribenuron methyl (surfactant)	50% SG 25% SG	0.010 + 0.005 0.2% v/v	0.008 kg/ac 0.2% v/v
3	Prestige 1X	fluroxypyr clopyralid MCPA ester	180 g/L EC 50 g/L EC 280 g/L EC	0.144 0.100 + 0.560	0.324 0.810
4	Target 1X	MCPA ester mecoprop dicamba	275 g/L SN 62.5 g/L SN 62.5 g/L SN	0.408 + 0.093 + 0.093	0.6
5	Banvel + 2,4-D amine 1X	dicamba 2,4-D amine	480 g/L SN 470 g/L SN	0.290 0.700	0.245 0.600
6	Unity + Agral 90 1X	triasulfuron bromoxynil (surfactant)	75% SG 280 g/L EC	0.008 0.140 0.25% v/v	0.0043 kg/ac 0.200 0.25% v/v
7	Ally + Agral 90 1X	metsulfuron methyl (surfactant)	60% SG	0.0045 0.2% v/v	0.003 kg/ac 0.2% v/v

Table 39. 2000 Edmonton Tolerance of 2 Year Old Established Chewings Fescue to Graminicides: Early and Late (Exp#C13&C15)

	Trade Name	Chemical Name	Formulation	Rate(kg/ha)	Rate (L/ac)
1	Check-weedy				
2	Assure II + Sure-Mix 1X	quizalofop-ethyl (surfactant)	96 g/L EC	0.072 0.5% v/v	0.305 0.5% v/v
3	Assure II + Sure-Mix 2X	quizalofop-ethyl (surfactant)	96 g/L EC	0.144 0.5% v/v	0.610 0.5% v/v
4	Poast Ultra + Merge 1X	sethoxydim (surfactant)	450 g/L EC	0.50 1.0% v/v	0.445 0.40
5	Poast Ultra + Merge 2X	sethoxydim (surfactant)	450 g/L EC	1.00 1.0% v/v	0.890 0.40
6	Venture 25DG + Turbocharge 1X	fluazifop-p-butyl (surfactant)	25% SG	0.173 0.5% v/v	0.280 kg/ac 0.5% v/v
7	Venture 25DG + Turbocharge 2X	fluazifop-p-butyl (surfactant)	25% SG	0.346 0.5% v/v	0.560 kg/ac 0.5% v/v
8	Curtail M 1X	clopyralid MCPA ester	50 g/L EC 280 g/L EC	0.100 0.56	2.0
9	Curtail M 2X	clopyralid MCPA ester	50 g/L EC 280 g/L EC	0.200 1.12	4.0
10	Buctril M 1X	bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.280 + 0.280	1.0
11	Buctril M 2X	bromoxynil MCPA ester	280 g/L EC 280 g/L EC	0.560 + 0.560	2.0

Herbicide Treatment Application and Data Collection Dates and Stages

Table 40. Chewings Fescue - Herbicide Plant Growth Stages, Heights, Visual Evaluation and Harvest Dates

Expt #	Location	Experiment	Fertilizer Application Date(s)	Herbicide Application Date(s)	Crop & Weed Spray Stages	Visual Evaluation Date(s)	Harvest Dates

C1	**Edmonton**	Seedling Chewings Fes. Graminicides 1998		98/07/06	6 cm, 4 leaf	98/07/08 98/08/31 99/05/21	99/07/28
C2	**Edmonton**	Seedling Chewings Fes. Broadleaf 1998		98/06/25	5cm, 4 leaf W. Mustard 45cm Shep. Purse 15cm Stinkweed 12cm	98/07/09 98/08/31 99/05/21	99/07/28
C3	**Edmonton**	Seedling Chewings Fes. Graminicides 1999		99/06/30	5cm, 4 leaf W. Mustard 12cm	99/07/29 99/09/03 06/06/30	00/08/01
C4	**Edmonton**	Seedling Chewings Fes. Broadleaf 1999		99/06/30	5cm, 4leaf W. Mustard 12cm	99/07/29 99/09/03 06/06/30	00/08/01
C5	**Peace Region** Beaverlodge	Seedling Chewings Fes. Graminicides 1999	99/06/01	99/08/13	5 cm, 4-5 leaf	99/08/28 99/09/14 00/07/24	00/07/24
C6	**Peace Region** Beaverlodge	Seedling Chewings Fes. Broadleaf 1999	99/06/01	99/08/13	5 cm, 4-5 leaf	99/08/28 99/09/14 00/07/24	00/07/24
C7	**Edmonton**	Established Chewings Fes. Graminicides 1999	98/10/26	99/05/27	27cm, 10% flag leaf Dandelion 13cm	99/06/11 99/07/22	99/07/22
C8	**Edmonton**	Established Chewings Fes. Broadleaf 1999	98/10/26	99/05/27	27cm, 10% flag leaf Dandelion 13cm	99/06/11 99/07/22	99/07/22
C9	**Edmonton**	Established Chewings Fes. Graminicides 2000	99/11/04	00/05/12	17cm, 2-4leaf	00/06/30 00/07/31	00/07/31
C10	**Edmonton**	Established Chewings Fes. Broadleaf 2000	99/11/04	00/05/12	17cm, 2-4leaf	00/06/30 00/07/31	00/07/31

C11	**Peace Region** Beaverlodge	Established Chewings Fes. Graminicides 2000	99/06/01 99/10/06	00/05/26	Shot Blade	00/06/20 00/07/10	00/07/24
C12	**Peace Region** Beaverlodge	Established Chewings Fes. Broadleaf 2000	99/06/01 99/10/06	00/05/26	Shot Blade	00/06/20 00/07/10	00/07/25
C13	**Edmonton**	2YrEstablished Chewings Fes. Graminicides Early 2000	98/10/26 99/11/04	EARLY 00/05/19	18cm, 4leaf Dandelion 13-18cm	00/07/07 00/08/02	None
C14	**Edmonton**	2YrEstablished Chewings Fes. Broadleaf Early 2000	98/10/26 99/11/04	EARLY 00/05/19	15cm, 3leaf Dandelion 13cm	00/07/07 00/08/02	None
C15	**Edmonton**	2YrEstablished Chewings Fes. Graminicides Late 2000	98/10/26 99/11/04	LATE 00/06/07	21cm, 4leaf+1tiller Dandelion 13-19cm	00/07/07 00/08/02	None
C16	**Edmonton**	2YrEstablished Chewings Fes. Broadleaf Late 2000	98/10/26 99/11/04	LATE 00/06/07	21cm, 4leaf+1tiller Dandelion 13-19cm	00/07/07 00/08/02	None

Results and Discussion

Select application severely reduced the heading of established chewings fescue at Edmonton in 1999. Unlike the damage to the seedling fescue (Table 72; Figure 26), the established fescue did not recover by seed harvest time and there was a significant seed yield reduction from Select application on established chewings fescue (Table 78; Figure 32). The other three graminicides, Assure II, Poast Ultra and Venture, did not injure or reduce seed yields of established chewings fescue (Tables 78, 80, 82, 84 and 86; Figure 32, 34 and 36) or seedling chewings fescue (Tables 72, 74 and 76; Figures 26, 28 and 30).

Even though there was no visible injury to established chewings fescue after being sprayed with Accord or Accord + 2,4-D in the spring of the year following the year of seeding, these treatments caused a significant seed yield reduction to the established chewings fescue (Table 78; Figure 32). These treatments also significantly affected the seed viability of established chewings fescue (Table 78). Accord and tank mixes applied on seedling chewings fescue did not have a significant seed yield reduction by harvest of the following year (Tables 72, 73, 74 and 77; Figures 26, 27, 28 and 31).

For the most part, the broadleaf weed herbicides Prestige, Attain, Target, Refine Extra, Buctril M, Puma Super + Buctril M and Banvel + 2,4-D amine did not cause damage or seed yield reduction to seedling chewings fescue (Tables 72, 73, 75 and 77; Figures 26, 27, 29 and 31)

while these herbicides and Ally, Unity and Curtail M did not harm or cause seed yield reductions when sprayed on established chewings fescue (Tables 79, 81, 83, 84, 85, 86 and 87; Figures 33, 35 and 37).

The application of 1x and 2x rates of Target, Refine Extra, Prestige, Buctril M, Banvel and Puma + Buctril M on established chewings fescue near Portage, Manitoba by Integrated Crop Management Services (Expert Committee on Weeds Research Report, Western Section, 1997, p.201) did not injure or reduce the seed yield of chewings fescue as well. Other work is being conducted on established chewings fescue with grassy and broad-leaved weed herbicides at Melfort, Saskatchewan.

A consideration when planning a weed control program for an established chewings fescue field is that chewings fescue heads out very early in the year. A fall spraying program for broad-leaved weeds should be considered as spring is a busy time of the year and it is difficult to spray before this fescue is in the shot blade or early heading stage. Applications at these later crop stages could affect the seed yield. This may explain the significant seed yield loss that occurred from double the recommended rate of Target, Prestige, Ally and Attain as well as Banvel + 2,4-D amine applied to established chewings fescue in the spring (Tables 79 and 83; Figures 33 and 37).

The data collected in 1998 was submitted to the Expert Committee on Weeds as research reports in December 1998. Unfortunately, the Expert Committee on Weeds Research Report program was discontinued and the 1999 data was put on hold until the new data entry program was functioning. The new Expert Committee on Weeds Research Report program was reestablished in 2000 with a full text searchable database accepting reports with 1999 and 2000 data. Chewings fescue information from 1999 and 2000 was submitted early in 2001.

As there are so few herbicides registered for use on chewings fescue as a new grass seed crop to western Canada and because chewings fescue appears to be tolerant to a number of broadleaf weed herbicides and graminicides, Minor Use applications will be submitted in the near future.

CONCLUSIONS

Key findings from this research project conducted from 1998 to 2001:

1. The graminicides, Assure II, Poast Ultra and Venture did not injure or reduce seed yields of seedling or established hard fescue and chewings fescue. We will be applying for Minor Use registrations for these herbicides on these crops.
2. The broad-leaved weed herbicides, Attain, Prestige, Refine Extra, Buctril M, Target, Banvel + 2,4-D amine, Accord and Accord + 2,4-D ester did not cause visual injury (%) or seed yield reductions to seedling chewings fescue or hard fescue. We will be applying to have these grass seed crops added to these herbicide labels through the Minor Use program.
3. The broad-leaved weed herbicides, Attain, Prestige, Curtail M, Refine Extra, Buctril M, Target, Banvel + 2,4-D amine, Ally and Unity did not cause visual injury (%) or seed yield reductions when sprayed on established chewings fescue or hard fescue early in the spring. We will be applying to have these grass seed crops added to these herbicide labels but more data may be required.
4. Select caused visual injury (%) and reduced seed yields when sprayed on seedling and established creeping red fescue, hard fescue and chewings fescue.

5. Accord significantly reduced seed yields when sprayed on established creeping red fescue, hard fescue and chewings fescue, even though the damage was not visible.

6. As chewings and hard fescue produce seed stalks and head out very early in the spring, late applications of herbicides such as Banvel + 2,4-D and Target may cause some injury to these grass seed crops. We are investigating fall spraying as a safer application window.

IMPLICATIONS AND RECOMMENDATIONS

Grass seed growers in western Canada depend on weed control tools for obtaining a marketable product. They depend on herbicides for preventing weed seeds from contaminating their grass seed so that they can sell their product into the U.S., Europe and other markets of the world. The grass seed growers are not only able to sell their product but they can also receive a premium for a clean product. This research has been extremely valuable to the Alberta grass seed growers as fine fescues constitute a major component of the grass seed produced in Alberta and because there is a significant lack of information and registrations on what herbicides can be safely and effectively used on fine fescue seed crops.

This research has provided the information needed to successfully grow a fine fescue seed crop and passed on to the grass seed growers through Alberta Agriculture, Food and Rural Development, the seed trade and agricultural dealers. This information should also help prevent costly spray errors in the future.

This research has shown which graminicides can be safely used on fine fescues and which graminicide should not be used. If a fine fescue seed grower uses Select there may be a costly problem. Select should not be recommended for use on any of the fine fescues and there is no need to recommend it with Venture, Poast Ultra and Assure II being registered on established creeping red fescue for grassy weed control and hard and chewings fescue exhibiting good tolerance to these three graminicides. This research on the tolerance of grass seed crops to herbicides needs to be on-going as producers will want to use the new herbicides as they are being made available for use on other crops, especially when the grass can be under sown to these other crops.

This research has shown the importance of taking herbicide tolerance trials to seed yield and not depending on visual evaluations only. The researchers could not see any physical damage to the established fine fescues from Accord application but the seed yields indicated a significant seed reduction. This has large implications for the fine fescue seed grower trying to address a cleavers problem. The reduced seed yields can be attributed to Accord injury rather than some other factor such as drought or lack of fertility.

This research not only provides the information on what herbicides the grass seed grower can safely use on his fine fescue, it provides the data needed for Minor Use registrations. The Pest Management Regulatory Agency have indicated that they would like to see data showing good tolerance and efficacy from at least three locations over at least three years before adding a crop to a herbicide label. We will be applying for Minor Use registrations when we have adequate data and will be conducting research when more data is required. It is important that Minor Use registrations be obtained so that these weed control tools can be legally recommended.

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TABLES AND FIGURES

Creeping Red Fescue Results

Table 41. 1997 Peace Region Tolerance of Established Creeping Red Fescue to Cleaver Controlling Products (Exp#CR1)

Spirit River 1997	Visual Injury (%)			Seed Yield (kg/ha)	1000 kwt	Germ%
Treatment	Jun-04-97	Jul-01-97	Jul-25-97	Jul-25-97		
Check	0	0	0	393	1.0	96
Accord 1X	2	1	0	418	1.0	84
Accord 2X	3	1	0	273	1.0	84
Accord 1X+ Refine Extra 1X	3	2	0	229	1.0	86
Attain 1X	1	1	0	328	1.0	89
Attain 2X	3	1	0	289	1.0	88
Refine Extra 1X	3	1	0	461	1.0	94
Refine Extra 2X	5	1	0	391	1.0	91
Refine Extra 1X +2,4-D ester	7	1	0	412	1.0	94
Ally 1X	4	1	0	391	1.0	94
Banvel+ 2,4-D amine	4	1	0	288	0.99	90
Target 1X	3	1	0	362	1.0	95
Target 2X	8	1	0	319	1.0	88
Unity 2X	4	1	0	435	1.0	92
LSD(P=.05)				108	NS	6.1
CV				20.8	13.3	4.7

Table 42. 1997 Peace Region Tolerance of Established Creeping Red Fescue to Cleaver Controlling Products (Exp#CR2)

Beaverlodge 1997	Visual Injury (%)			1000 kwt	Germ%
Treatment	Jun-09-97	Jul-08-97	Jul-29-97		
Check	0	0	0	1.0	88
Accord 1X	0	0	0	1.0	74
Accord 2X	0	0	0	1.0	83
Accord 1X+ Refine Extra 1X	0	0	0	1.0	81
Attain 1X	0	0	0	1.3	91
Attain 2X	0	0	0	1.0	92
Refine Extra 1X	0	0	0	1.0	80
Refine Extra 2X	0	0	0	1.3	71
Refine Extra 1X +2,4-D ester	0	0	0	1.0	94
Ally 1X	0	0	0	1.0	91
Banvel+ 2,4-D amine	0	0	0	1.0	69
Target 1X	0	0	0	1.3	87
Target 2X	0	0	0	1.0	86
Unity 2X	0	0	0	1.0	81
LSD(P=.05)				NS	15.6

CV				25	13.1

*Seed yield very variable and not reported

Table 43. 1998 Edmonton Tolerance of Seedling Creeping Red Fescue to Graminicides (Exp#CR3)

Edmonton 1998	**Visual Injury (%)**			**Seed Yield (kg/ha)**
Treatment	Jul-09-98	Aug-31-98	May-31-99	Jul-27-99
Check	0	0	0	613
Assure II 1X	0	0	0	634
Assure II 2X	1	0	0	645
Select 1X	16	26	24	648
Select 2X	51	78	68	775
LSD(P=.05)				103.9
CV				10.17

Table 44. 1998 Peace Region Tolerance of Established Creeping Red Fescue to Cleaver Controlling Products (Exp#CR4)

Woking 1998	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-09-98	Jul-10-98	Jul-10-98		
Check	0	0	473	1.19	97
Accord 1X	0	2	516	1.30	92
Accord 2X	0	5	309	1.29	83
Accord 1X+ Refine Extra 1X	4	6	485	1.24	82
Accord 1X+ Ally 1X	4	4	434	1.23	86
Attain 1X	1	1	586	1.31	97
Attain 2X	1	1	547	1.24	96
Refine Extra 1X	1	4	549	1.23	96
Ally 1X	0	0	567	1.20	96
Banvel+ 2,4-D amine	0	1	535	1.24	95
Prestige 1X	0	1	661	1.29	96
Prestige 2X	0	0	600	1.29	95
LSD(P=.05)			175	NS	6.5
CV			23.2	6.13	4.8

Table 45. 1998 Peace Region Tolerance of Established Creeping Red Fescue to Cleaver Controlling Products (Exp#CR5)

Debolt 1998	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-10-98	Jul-10-98	Jul-10-98		
Check	0	0	604	1.30	96
Accord 1X	0	0	392	1.41	89
Accord 2X	0	1	328	1.35	85
Accord 1X+ Refine Extra 1X	0	3	284	1.39	90
Accord 1X+ Ally 1X	4	0	442	1.38	89
Attain 1X	0	0	525	1.34	94
Attain 2X	0	3	482	1.39	97
Refine Extra 1X	1	1	544	1.29	97

Ally 1X	1	1	510	1.31	98
Banvel+ 2,4-D amine	0	1	571	1.33	96
Prestige 1X	1	1	628	1.35	98
Prestige 2X	0	4	497	1.35	97
LSD(P=.05)			212	NS	4.2
CV			30.4	4.95	3.12

Table 46. 1998 Peace Region Tolerance of Established Creeping Red Fescue to Herbicides (Exp#CR6)

Woking 1998	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-19-98	Jul-10-98	Jul-10-98		
Check	0	0	513	1.26	97
Select 1X	34	45	289	1.29	97
Select 2X	55	84	148	1.24	96
Unity 2X+ Select 2X	55	88	143	1.23	96
Unity 2x	0	0	712	1.24	97
Assure 1X+ Refine Extra 1X	0	1	579	1.23	95
Assure 2X+ Refine Extra 2X	0	0	662	1.23	97
LSD(P=.05)			154	NS	NS
CV			23.9	7.1	2.54

Table 47. 1998 Peace Region Tolerance of Established Creeping Red Fescue to Herbicides (Exp#CR7)

Debolt 1998	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-10-98	Jul-10-98	Jul-10-98		
Check	0	0	552	1.35	98
Select 1X	35	58	252	1.37	98
Select 2X	55	97	24	1.31	96
Unity 2X+ Select 2X	55	97	28	1.34	96
Unity 2x	0	0	495	1.30	98
Assure 1X+ Refine Extra 1X	0	0	637	1.34	97
Assure 2X+ Refine Extra 2X	0	4	652	1.28	93
LSD(P=.05)			100	NS	NS
CV			17.8	5.74	2.1

Table 48. 1999 Edmonton Tolerance of Established Creeping Red Fescue to Graminicides (Exp#CR8)

Edmonton 1999	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jul-11-99	Jul-22-99	Jul-27-99		
Check	0	0	585	1.2	93
Assure II 1X	0	0	540	1.3	93
Assure II 2X	0	0	528	1.3	91
Select 1X	51	73	21	1.6	89
Select 2X	64	80	17	1.3	92

LSD(P=.05)			67.8	0.18	6.3
CV			13.0	8.73	4.44

Table 49. 1999 Peace Region Tolerance of Established Creeping Red Fescue to Herbicides (Exp#CR9)

Beaverlodge 1999	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-17-99	Jul-29-99	Jul-29-99		
Check	0	0	1453	1.38	97
Attain 1X	0	0	1408	1.44	96
Attain 2X	0	0	1167	1.51	95
Prestige 1X	0	0	1391	1.42	98
Prestige 2X	0	0	1329	1.46	95
Unity 1X	0	0	1390	1.37	98
Unity 1X+ Assure 1X	0	0	1325	1.36	97
Poast 1X+ Ally 1X	0	0	1449	1.36	97
LSD(P=.05)			150	0.07	NS
CV			7.5	3.3	1.7

Table 50. 1999 Peace Region Tolerance of Established Creeping Red Fescue to Herbicides Applied at Two Stages (Exp#CR10)

Beaverlodge 1999	**Seed Yield (kg/ha)**		**1000 kwt**		**Germ%**	
	1st	2nd	1st	2nd	1st	2nd
Treatment	Jul-29-99	Jul-29-99				
Check	1157	1217	1.34	1.32	99	98
Lontrel+MCPA Ester 1X	1273	1275	1.39	1.38	96	99
Lontrel 1X	1368	1286	1.35	1.36	98	98
Attain 1X	1310	1318	1.35	1.35	99	98
Ally 1X	1341	1236	1.35	1.41	98	99
Assure 1X	1261	1331	1.38	1.35	98	97
Refine Extra 1X	1306	1255	1.37	1.37	98	98
LSD(P=.05)	NS		NS		NS	
CV	6.7		2.6		1.6	

Table 51. 2000 Peace Region Tolerance of 1 Year Old Established Creeping Red Fescue to Prestige and Attain (Exp#CR11)

Debolt 2000	**Visual Injury (%)**			**Seed Yield (kg/ha)**
Treatment	Jun-19-00	Jul-10-00	Jul-28-00	Jul-28-00
Check	0	0	0	315
Attain 1X	0	3.8	0	367
Attain 2X	15.8	17.5	7.5	246
Prestige 1X	7.3	5.0	0	406
Prestige 2X	11.3	10.0	5.0	380
LSD(P=.05)				NS
CV				28.8

Table 52. 2000 Peace Region Tolerance of 1 Year Old Established Creeping Red Fescue to Prestige and Attain (Exp#CR12)

Beaverlodge 2000	Visual Injury (%)		Seed Yield (kg/ha)	1000 kwt	% Germ
Treatment	Jun-19-00	Jul-11-00	Jul-31-00		
Check	0	0	1323	1.312	95.5
Attain 1X	0	0	1342	1.347	89.3
Attain 2X	12	2.5	1184	1.299	95.8
Prestige 1X	0.5	0	1482	1.339	93.0
Prestige 2X	11.5	2.5	1337	1.314	97.5
LSD(P=.05)			NS	NS	NS
CV			9.6	2.9	2.8

Table 53. 2000 Edmonton Tolerance of 2 Year Old Established Creeping Red Fescue to Broadleaf Herbicides Applied at Two Stages (Exp#CR13)

Edmonton 2000	Visual Injury(%)	Visual Control (%)		Visual Injury(%)
Treatment	**Cr. Red Fescue**	**Dandelion**	**N.L. Hawk's-Bd**	**Cr. Red Fescue**
	Jul-12-00	Jul-12-00	Jul-12-00	Aug-22-00
Check	0	0	0	0
Refine Extra	0	84	88	0
Ally	0	98	99	0
Attain A	0	16	13	0
Curtail M	0	84	71	0
Refine Extra*	1	14	71	0
Ally*	19	61	81	18
Attain A*	0	50	39	0
Curtail M*	0	68	83	0

* 2nd Stage Treatments

Hard Fescue Results

Table 54. 1998 Edmonton Tolerance of Seedling Hard Fescue to Graminicides (Exp#H1)

Edmonton 1998	Visual Injury (%)			Seed Yield (kg/ha)
	Jul-18-98	Aug-31-98	May-21-99	Jul-22-99
Check	0	0	0	604
Assure II 1X	0	0	0	580
Assure II 2X	0	0	0	559
Poast Ultra 1X	0	0	0	591
Poast Ultra 2X	0	0	0	501
Venture 25DG 1X	0	0	0	611
Venture 25DG 2X	0	0	0	596
Select 1X	19	20	19	467
Select 2X	43	55	49	601
Accord 1X	0	0	0	499
Refine Extra 1X	4	0	0	583
Prestige 1X	0	0	0	611
Prestige 2X	0	0	0	544
LSD(P=.05)				138.2
CV				17.1

Table 55. 1998 Edmonton Tolerance of Seedling Hard Fescue to Broadleaf Herbicides (Exp#H2)

Edmonton 1998	Visual Injury (%)		Seed Yield (kg/ha)
	Jul-19-98	Aug-31-98	Jul-21-99
Check	0	0	517
Target 1X	0	0	463
Target 2X	0	0	436
Refine Extra 1X	0	0	450
Refine Extra 2X	0	0	463
Buctril M 2X	0	0	443
Banvel 1X+ 2,4-D amine 1X	0	0	455
Attain 1X	0	0	458
Attain 1X	0	0	422
Accord 1X+ 2,4-D ester 1X	0	0	458
Accord 2X+ 2,4-D ester 2X	0	0	400
LSD(P=.05)			NS
CV			20.97

Table 56. 1999 Peace Region Tolerance of Seedling Hard Fescue to Graminicides (Exp#H3)

Beaverlodge 1999	Visual Injury (%)			Seed Yield (kg/ha)
Treatment	Aug-25-99	Sep-14-99	Jul-21-00	Jul-21-00
Check	0	0	0	732
Assure II 1X	0	0	0	783
Poast Ultra 1X	0	0	0	753
Venture 1X	0	0	0	750
LSD(P=.05)				NS
CV				16.9

Table 57. 1999 Peace Region Tolerance of Seedling Hard Fescue to Broadleaf Herbicides (Exp#H4)

Beaverlodge 1999	Visual Injury (%)			Seed Yield (kg/ha)
	Aug-25-99	Sep-14-00	Jul-21-00	Jul-21-00
Check	0	0	0	613
Target 1X	0	0	0	625
Refine Extra 1X	0	0	0	629
Prestige 1X	0	0	0	607
Banvel 1X+ 2,4-D amine 1X	0	0	0	489
Puma Super+ Buctril M 1X	0	0	0	642
Attain 1X	0	0	0	729
Accord 1X	0	0	0	621
LSD(P=.05)				NS
CV				17.8

Table 58. 1999 Edmonton Tolerance of Seedling Hard Fescue to Graminicides (Exp#H5)

Edmonton 1999	Visual Injury (%)			Seed Yield (kg/ha)
Treatment	Jul-28-99	Sep-03-99	Jun-30-00	Jul-27-00
Check-weedy	0	0	0	888
Check-no weeds	0	0	0	922
Assure II 1X	0	0	0	842
Assure II 2X	0	0	0	925
Poast Ultra 1X	0	0	0	902
Poast Ultra 2X	0	0	0	902
Venture 1X	0	0	0	880
Venture 2X	0	0	0	846
Accord 1X	0	0	0	877
Accord 2X	0	0	0	739
LSD(P=.05)				NS
CV				14.47

Table 59. 1999 Edmonton Tolerance of Seedling Hard Fescue to Broadleaf Herbicides (Exp#H6)

Edmonton 1999	Visual Injury (%)			Seed Yield (kg/ha)
	Jul-28-99	Sep-03-99	Jun-30-00	Jul-27-00
Check	0	0	0	670
Target 1X	0	0	0	691
Target 2X	0	0	0	726
Refine Extra 1X	0	0	0	732
Refine Extra 2X	0	0	0	630
Prestige 1X	0	0	0	698
Prestige 2X	0	0	0	669
Buctril M 2X	0	0	0	653
Banvel 1X+ 2,4-D amine 1X	0	0	0	742
Puma Super+ Buctril M 1X	0	0	0	761
Puma Super+ Buctril M 2X	0	0	0	676
Attain 1X	0	0	0	684
Attain 2X	0	0	0	728
LSD(P=.05)				74.3
CV				7.38

Table 60. 1999 Edmonton Tolerance of Established Hard Fescue to Graminicides (Exp#H7)

Edmonton 1999	Visual Injury (%)		Seed Yield (kg/ha)	1000 kwt	Germ%
Treatment	Jun-11-99	Jul-21-99	Jul-21-99		
Check	0	0	603	1.2	85
Assure II 1X	0	0	524	1.2	84
Assure II 2X	0	0	585	1.2	80
Poast Ultra 1X	0	0	529	1.3	82
Poast Ultra 2X	0	0	634	1.2	84
Venture 1X	0	0	545	1.2	82
Venture 2X	0	0	596	1.3	83
Select 1X	54	75	48	1.3	61
Accord 1X	0	0	412	1.2	77

Accord 2X	0	0	428	1.2	66
Accord+2,4-D ester 1X	0	0	364	1.4	72
LSD(P=.05)			89.3	NS	8.6
CV			12.91	12.61	7.63

Table 61. 1999 Edmonton Tolerance of Established Hard Fescue to Broadleaf Herbicides (Exp#H8)

Edmonton 1999	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-11-99	Jul-21-99	Jul-21-99		
Check	0	0	614	1.1	86
Target 1X	0	0	442	1.0	76
Target 2X	0	0	402	1.3	77
Refine Extra 1X	9	0	662	1.0	85
Refine Extra 2X	20	0	521	1.1	79
Prestige 1X	0	0	424	1.1	83
Prestige 2X	0	0	453	1.0	70
Banvel+2,4-D amine 1X	0	0	414	1.1	78
Unity 1X	3	0	475	1.0	82
Ally 1X	13	0	519	1.1	87
Ally 2X	20	0	576	1.1	82
Attain 1X	0	0	483	1.1	76
Attain 2X	0	0	459	1.0	84
LSD(P=.05)			113.8	NS	14.1
CV			16.06	12.53	12.3

Table 62. 2000 Peace Region Tolerance of Seedling Hard Fescue to Graminicides (Exp#H9)

Beaverlodge 2000	**Visual Injury (%)**			**Seed Yield (kg/ha)**
Treatment	Sept-18-00	May-31-01	Jun-26-01	Jul-16-01
Check	0	0	0	880
Assure II 1X	0	0	0	946
Assure II 2X	0	0	0	915
Poast Ultra 1X	0	0	0	853
Poast Ultra 2X	0	0	0	918
Venture 1X	0	0	0	902
Venture 2X	0	0	0	940
LSD(P=.05)				NS
CV				12.5

Table 63. 2000 Peace Region Tolerance of Seedling Hard Fescue to Broadleaf Herbicides (Exp#H10)

Beaverlodge 2000	**Visual Injury (%)**			**Seed Yield (kg/ha)**
Treatment	Sept-18-00	May-31-01	Jun-26-01	Jul-16-01
Check	0	0	0	513
Refine Extra 1X	0	0	0	930
Refine Extra 2X	0	0	0	903
Prestige 1X	0	0	0	1005
Prestige 2X	0	0	0	1012
Target 1X	0	0	0	971
Buctril M 1X	1	0	3	914

Banvel 1X+ 2,4-D amine 1X	0	0	5	976
Attain 1X	0	0	0	831
Attain 2X	0	0	0	873
Accord 1X	0	0	0	551
Accord 2X	0	0	10	639
Accord+2,4-D ester 1X	0	0	0	898
LSD(P=.05)				239
CV				19.7

Table 64. 2000 Edmonton Tolerance of Established Hard Fescue to Graminicides (Exp#H11)

Edmonton 2000	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-30-00	Jul-25-00	Jul-25-00		
Check	0	0	674	1.0	89
Assure II 1X	0	0	673	1.0	92
Assure II 2X	0	0	732	0.9	92
Poast Ultra 1X	0	0	675	1.0	95
Poast Ultra 2X	0	0	621	1.0	93
Venture25DG 1X	0	0	665	1.0	89
Venture25DG 2X	0	0	657	1.1	90
LSD(P=.05)			NS	0.02	NS
CV			12.8	13.33	4.52

Table 65. 2000 Edmonton Tolerance of Established Hard Fescue to Broadleaf Herbicides (Exp#H12)

Edmonton 2000	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-30-00	Jul-25-00	Jul-25-00		
Check	0	0	641	1.0	88
Target 1X	0	0	686	0.9	80
Target 2X	0	0	610	0.9	77
Refine Extra 1X	0	0	728	0.9	82
Refine Extra 2X	0	0	585	0.9	74
Prestige 1X	0	0	666	0.9	76
Prestige 2X	0	0	655	0.9	73
Banvel 1X+ 2,4-D amine 1X	0	0	541	0.9	65
Unity	9	0	635	0.8	65
Ally 1X	0	0	763	0.8	78
Ally 2X	18	0	700	0.8	77
Attain 1X	0	0	667	0.9	82
Attain 2X	5	0	776	0.8	80
Curtail M 1X	0	0	733	0.8	76
Curtail M 2X	0	0	744	0.9	82
Buctril M 1X	0	0	749	0.9	80
LSD(P=.05)			NS	NS	9.9
CV			15.19	11.32	8.96

Table 66. 2000 Peace Region Tolerance of Established Hard Fescue to Graminicides (Exp#H13)

Beaverlodge 2000	Visual Injury (%)		Seed Yield (kg/ha)	1000 kwt	% Germ
Treatment	Jun-20-00	Jul-10-00	Jul-24-00		
Check	0	0	779	1.095	93.0
Assure II 1X	0	0	819	1.076	96.3
Assure II 2X	0	1.3	775	1.079	96.0
Poast Ultra + Merge 1X	0	0	719	1.072	94.3
Poast Ultra + Merge 2X	0	2.5	737	1.089	94.3
Venture 25DG + Turbocharge 1X	0	0	730	1.088	92.3
Venture 25DG + Turbocharge 1X	0	0	667	1.069	94.8
LSD(P=.05)			NS	NS	NS
CV			13.2	1.6	3.1

Table 67. 2000 Peace Region Tolerance of Established Hard Fescue to Broadleaf Herbicides (Exp#H14)

Beaverlodge 2000	Visual Injury (%)		Seed Yield (kg/ha)	1000 kwt	% Germ
Treatment	Jun-20-00	Jul-10-00	Jul-24-00		
Check	0	0	856	1.058	90.5
Refine Extra	0	0	942	1.029	96.3
Attain	0.5	0	876	1.089	95.0
Target	0	7.5	767	1.068	90.3
Banvel + 2,4-D amine	3.5	3.8	507	1.087	87.3
Unity	0	0	825	1.012	94.8
Ally	0	0	933	1.061	95.8
LSD(P=.05)			266	NS	NS
CV			21.9	3.2	4.8

Table 68. 2000 Edmonton Tolerance of 2 Year Old Established Hard Fescue to Graminicides: Early Application (Exp#H15)

Edmonton 2000	Hard Fescue	Dandelion	Hard Fescue
	Visual Injury (%)	Visual Control (%)	Visual Injury (%)
Treatment	Jul-08-00	Jul-08-00	Aug-02-00
Check	0	0	0
Assure II 1X	0	0	0
Assure II 2X	0	0	0
Poast Ultra 1X	0	0	0
Poast Ultra 2X	0	0	0
Venture25DG 1X	0	0	0
Venture25DG 2X	0	0	0
Curtail M 1X	0	56	0
Curtail M 2X	0	91	0
Buctril M 1X	0	24	0
Buctril M 2X	0	41	0

Table 69. 2000 Edmonton Tolerance of 2 Year Old Established Hard Fescue to Broadleaf Herbicides: Early Application (Exp#H16)

Edmonton 2000	Hard Fescue	Dandelion	Hard Fescue
Treatment	Visual Injury (%)	Visual Control (%)	Visual Injury (%)
	Jul-08-00	Jul-08-00	Aug-02-00
Check	0	0	0
Target 1X	0	19	0
Target 2X	0	68	0
Refine Extra 1X	0	40	0
Refine Extra 2X	0	70	0
Prestige 1X	0	65	0
Prestige 2X	0	91	0
Banvel+ 2,4-D amine	0	61	0
Unity	0	26	0
Ally 1X	0	94	0
Ally 2X	0	96	0
Attain1X	0	86	0
Attain 2X	0	83	0

Table 70. 2000 Edmonton Tolerance of 2 Year Old Established Hard Fescue to Graminicides: Late Application (Exp#H17)

Edmonton 2000	Hard Fescue	Dandelion	Hard Fescue
	Visual Injury (%)	Visual Control (%)	Visual Injury (%)
Treatment	Jul-08-00	Jul-08-00	Aug-02-00
Check	0	0	0
Assure II 1X	0	0	0
Assure II 2X	0	0	0
Poast Ultra 1X	0	0	0
Poast Ultra 2X	0	0	0
Venture25DG 1X	0	0	0
Venture25DG 2X	0	0	0
Curtail M 1X	0	43	0
Curtail M 2X	0	59	0
Buctril M 1X	0	45	0
Buctril M 2X	0	45	0

Table 71. 2000 Edmonton Tolerance of 2 Year Old Established Hard Fescue to Broadleaf Herbicides: Late Application (Exp#H18)

Edmonton 2000	Hard Fescue	Dandelion	Hard Fescue
	Visual Injury (%)	Visual Control (%)	Visual Injury (%)
Treatment	Jul-08-00	Jul-08-00	Aug-02-00
Check	0	0	0
Target 1X	0	68	0
Target 2X	0	76	0
Refine Extra 1X	0	68	0
Refine Extra 2X	0	73	0
Prestige 1X	0	68	0
Prestige 2X	0	83	0
Banvel+	0	80	0

2,4-D amine			
Unity	0	83	0
Ally 1X	0	85	0
Ally 2X	0	87	0
Attain1X	0	90	0
Attain 2X	0	93	0

Chewings Fescue Results

Table 72. 1998 Edmonton Tolerance of Seedling Chewings Fescue to Graminicides (Exp#C1)

Edmonton 1998	**Visual Injury (%)**			**Seed Yield (kg/ha)**
	Jul-19-98	Aug-31-98	May-21-99	Jul-22-99
Check	0	0	0	338
Assure II 1X	0	0	0	326
Assure II 2X	0	0	0	309
Poast Ultra 1X	0	0	0	295
Poast Ultra 2X	0	0	0	294
Venture 25DG 1X	0	0	0	322
Venture 25DG 2X	0	0	0	300
Select 1X	26	21	0	313
Select 2X	46	60	0	244
Accord 1X	0	0	0	312
Refine Extra 1X	8	3	0	303
Prestige 1X	0	0	0	304
Prestige 2X	0	0	0	294
LSD(P=.05)				53.7
CV				12.37

Table 73. 1998 Edmonton Tolerance of Seedling Chewings Fescue to Broadleaf Herbicides (Exp#C2)

Edmonton 1998	**Visual Injury (%)**		**Seed Yield (kg/ha)**
	Jul-09-98	May-21-99	Jul-21-99
Check	0	0	343
Target 1X	0	0	311
Target 2X	0	0	365
Refine Extra 1X	0	0	331
Refine Extra 2X	0	0	352
Buctril M 2X	0	0	329
Banvel 1X+ 2,4-D amine 1X	0	0	326
Attain 1X	0	0	344
Attain 1X	0	0	290
Accord 1X+ 2,4-D ester 1X	0	0	302
Accord 2X+ 2,4-D ester 2X	0	0	281
LSD(P=.05)			NS
CV			13.37

Table 74. 1999 Edmonton Tolerance of Seedling Chewings Fescue to Graminicides (Exp#C3)

Edmonton 1999	**Visual Injury (%)**			**Seed Yield (kg/ha)**
Treatment	Jul-29-99	Sep-03-99	Jun-30-00	Jul-27-00
Check-weedy	0	0	0	474
Check-no weeds	0	0	0	514
Assure II 1X	0	0	0	525
Assure II 2X	0	0	0	481
Poast Ultra 1X	0	0	0	497
Poast Ultra 2X	0	0	0	520
Venture 1X	0	0	0	550
Venture 2X	0	0	0	536
Accord 1X	0	0	0	558
Accord 2X	0	0	0	494
LSD(P=.05)				NS
CV				15.25

Table 75. 1999 Edmonton Tolerance of Seedling Chewings Fescue to Broadleaf Herbicides (Exp#C4)

Edmonton 1999	**Visual Injury (%)**			**Seed Yield (kg/ha)**
	Jul-29-99	Sep-03-99	Jun-30-00	Jul-27-00
Check	0	0	0	644
Target 1X	0	0	0	589
Target 2X	0	0	0	563
Refine Extra 1X	0	0	0	609
Refine Extra 2X	0	0	0	537
Prestige 1X	0	0	0	406
Prestige 2X	0	0	0	385
Buctril M 2X	0	0	0	522
Banvel 1X+ 2,4-D amine 1X	0	0	0	544
Puma Super+ Buctril M 1X	0	0	0	551
Puma Super+ Buctril M 2X	0	0	0	530
Attain 1X	0	0	0	434
Attain 2X	0	0	0	489
LSD(P=.05)				131.2
CV				17.54

Table 76. 1999 Peace Region Tolerance of Seedling Chewings Fescue to Graminicides (Exp#C5)

Beaverlodge 1999	**Visual Injury (%)**			**Seed Yield (kg/ha)**
Treatment	Aug-25-99	Sep-14-99	Jul-24-00	Jul-24-00
Check	0	0	0	742
Assure II 1X	0	0	0	713
Poast Ultra 1X	0	0	0	792
Venture 1X	0	0	0	749
LSD(P=.05)				NS
CV				14.7

Table 77. 1999 Peace Region Tolerance of Seedling Chewings Fescue to Broadleaf Herbicides (Exp#C6)

Beaverlodge 1999	Visual Injury (%)			Seed Yield (kg/ha)
	Aug-28-99	Sep-14-00	Jul-24-00	Jul-24-00
Check	0	0	0	725
Target 1X	0	0	0	618
Refine Extra 1X	0	0	0	757
Prestige 1X	0	0	0	679
Banvel 1X+ 2,4-D amine 1X	0	0	0	624
Puma Super+ Buctril M 1X	0	0	0	685
Attain 1X	0	0	0	765
Accord 1X	0	0	0	631
LSD(P=.05)				NS
CV				16.4

Table 78. 1999 Edmonton Tolerance of Established Chewings Fescue to Graminicides (Exp#C7)

Edmonton 1999	Visual Injury (%)		Seed Yield (kg/ha)	1000 kwt	Germ%
Treatment	Jun-11-99	Jul-22-99	Jul-27-99		
Check	0	0	353	1.2	89
Assure II 1X	0	0	406	1.2	90
Assure II 2X	0	0	389	1.2	90
Poast Ultra 1X	0	0	435	1.2	88
Poast Ultra 2X	0	0	329	1.2	93
Venture 1X	0	0	407	1.1	88
Venture 2X	0	0	395	1.1	92
Select 1X	55	80	18	1.1	83
Accord 1X	0	0	279	1.2	75
Accord 2X	0	0	165	1.2	74
Accord+2,4-D ester 1X	0	0	168	1.3	78
LSD(P=.05)			72.5	NS	8.3
CV			16.51	12.63	6.7

Table 79. 1999 Edmonton Tolerance of Established Chewings Fescue to Broadleaf Herbicides (Exp#C8)

Edmonton 1999	Visual Injury (%)		Seed Yield (kg/ha)	1000 kwt	Germ%
Treatment	Jun-11-99	Jul-22-99	Jul-27-99		
Check	0	0	409	1.1	88
Target 1X	0	0	367	1.0	90
Target 2X	3	0	305	1.0	88
Refine Extra 1X	21	13	371	1.1	89
Refine Extra 2X	30	19	320	1.1	91
Prestige 1X	3	0	326	1.1	91
Prestige 2X	0	0	303	1.1	90
Banvel+2,4-D amine 1X	3	0	313	1.1	90
Unity 1X	25	14	380	1.1	88
Ally 1X	25	16	335	1.1	90

Ally 2X	34	23	293	1.0	91
Attain 1X	3	0	336	1.1	89
Attain 2X	0	0	312	1.1	88
LSD(P=.05)			58.1	NS	NS
CV			12.1	5.26	4.72

Table 80. 2000 Edmonton Tolerance of Established Chewings Fescue to Graminicides (Exp#C9)

Edmonton 2000	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-30-00	Jul-31-00	Jul-31-00		
Check	0	0	295	1.1	90
Assure II 1X	0	0	351	1.1	86
Assure II 2X	0	0	350	1.2	84
Poast Ultra 1X	0	0	350	1.1	82
Poast Ultra 2X	0	0	352	1.2	85
Venture25DG 1X	0	0	327	1.3	83
Venture25DG 2X	0	0	328	1.1	90
LSD(P=.05)			NS	NS	NS
CV			27.18	7.75	6.16

Table 81. 2000 Edmonton Tolerance of Established Chewings Fescue to Broadleaf Herbicides (Exp#C10)

Edmonton 2000	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**Germ%**
Treatment	Jun-30-00	Jul-31-00	Jul-25-00		
Check	0	0	525	1.1	79
Target 1X	0	0	652	0.9	76
Target 2X	0	0	422	1.1	80
Refine Extra 1X	9	0	362	1.0	80
Refine Extra 2X	0	0	506	1.0	79
Prestige 1X	0	0	587	0.9	75
Prestige 2X	0	0	512	1.0	79
Banvel 1X+ 2,4-D amine 1X	0	0	339	1.1	75
Unity	8	0	543	1.0	74
Ally 1X	3	0	473	1.1	73
Ally 2X	11	0	601	1.0	76
Attain 1X	0	0	491	1.0	74
Attain 2X	4	0	516	1.0	74
Curtail M 1X	0	0	585	1.0	73
Curtail M 2X	0	0	445	1.2	79
Buctril M 1X	0	0	606	1.1	81
LSD(P=.05)			NS	0.129	NS
CV			35.66	8.96	10.02

Table 82. 2000 Peace Region Tolerance of 1 Year Old Established Chewings Fescue to Graminicides (Exp#C11)

Beaverlodge 2000	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**% Germ**
Treatment	Jun-20-00	Jul-10-00	Jul-24-00		
Check	0	0	909	1.176	97.5
Assure II 1X	2	0	1011	1.142	89.5

Assure II 2X	0	0	957	1.151	94.5
Poast Ultra 1X	1	0	923	1.177	96.3
Poast Ultra 2X	2.5	0	842	1.167	94.0
Venture 1X	0	0	929	1.145	94.3
Venture 2X	4.5	0	1046	1.161	96.3
LSD(P=.05)			NS	NS	NS
CV			14.8	2.8	3.6

Table 83. 2000 Peace Region Tolerance of 1 Year Old Established Chewings Fescue to Broadleaf Herbicides (Exp#C12)

Beaverlodge 2000	**Visual Injury (%)**		**Seed Yield (kg/ha)**	**1000 kwt**	**% Germ**
Treatment	Jun-20-00	Jul-10-00	Jul-25-00		
Check	0	0	1041	1.163	96.5
Refine Extra	0	0	1071	1.132	97.0
Attain	0	0	980	1.175	96.0
Target	0	3.8	1005	1.138	94.0
Banvel + 2,4-D amine	0	5.0	862	1.171	91.0
Unity	0	2.5	1079	1.131	93.5
Ally	1.5	1.3	1151	1.106	95.3
LSD(P=.05)			135	NS	NS
CV			8.8	3.3	3.7

Table 84. 2000 Edmonton Tolerance of 2 Year Old Established Chewings Fescue to Graminicides: Early Application (Exp#C13)

Edmonton 2000	**Visual Injury(%)**	**Visual Control (%)**		**Visual Injury(%)**
	Chewings Fesc.	**N.L.Hawk's-Bd**	**Dandelion**	**Chewings Fesc.**
Treatment	Jul-07-00	Jul-07-00	Jul-07-00	Aug-02-00
Check	0	0	0	0
Assure II 1X	0	0	0	0
Assure II 2X	0	0	0	0
Poast Ultra 1X	0	0	0	0
Poast Ultra 2X	0	0	0	0
Venture25DG 1X	0	0	0	0
Venture25DG 2X	0	0	0	0
Curtail M 1X	0	95	93	0
Curtail M 2X	0	100	100	0
Buctril M 1X	0	73	23	0
Buctril M 2X	0	98	36	0

Table 85. 2000 Edmonton Tolerance of 2 Year Old Established Chewings Fescue to Broadleaf Herbicides: Early Application (Exp#C14)

Edmonton 2000	**Visual Injury(%)**	**Visual Control (%)**		**Visual Injury(%)**
	Chewings Fesc.	**N.L.Hawk's-Bd**	**Dandelion**	**Chewings Fesc.**
Treatment	Jul-08-00	Jul-08-00	Jul-08-00	Aug-02-00
Check	0	0	0	0
Target 1X	0	68	61	0
Target 2X	0	81	80	0
Refine Extra 1X	0	78	56	0
Refine Extra 2X	0	100	86	0
Prestige 1X	0	90	61	0

Prestige 2X	0	100	98	0
Banvel+ 2,4-D amine	0	93	79	0
Unity	0	100	55	0
Ally 1X	0	99	98	0
Ally 2X	0	100	98	0
Attain1X	0	89	100	0
Attain 2X	0	89	100	0

Table 86. 2000 Edmonton Tolerance of 2 Year Old Established Chewings Fescue to Graminicides: Late Application (Exp#C15)

Edmonton 2000	**Chewings Fescue**	**Dandelion**	**Chewings Fescue**
	Visual Injury (%)	**Visual Control (%)**	**Visual Injury (%)**
Treatment	Jul-07-00	Jul-07-00	Aug-02-00
Check	0	0	0
Assure II 1X	0	0	0
Assure II 2X	0	0	0
Poast Ultra 1X	0	0	0
Poast Ultra 2X	0	0	0
Venture25DG 1X	0	0	0
Venture25DG 2X	0	0	0
Curtail M 1X	0	71	0
Curtail M 2X	0	81	0
Buctril M 1X	0	61	0
Buctril M 2X	0	73	0

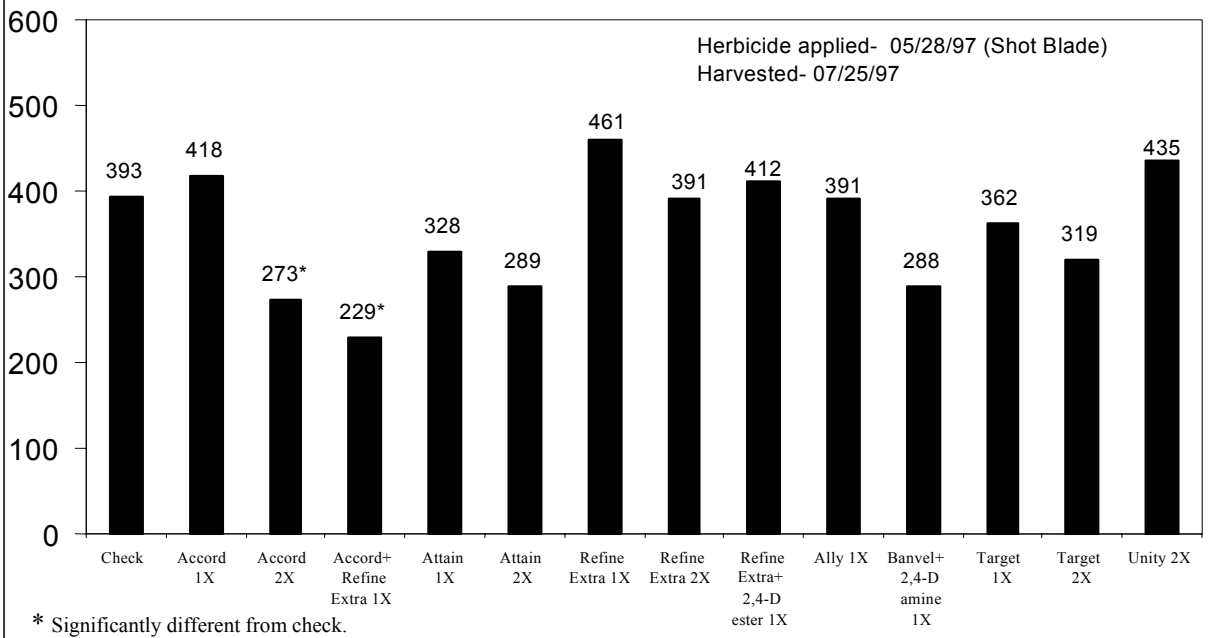
Table 87. 2000 Edmonton Tolerance of 2 Year Old Established Chewings Fescue to Broadleaf Herbicides: Late Application (Exp#C16)

Edmonton 2000	**Chewings Fescue**	**N. L. Hawk's-beard**	**Chewings Fescue**
	Visual Injury (%)	**Visual Control (%)**	**Visual Injury (%)**
Treatment	Jul-07-00	Jul-07-00	Aug-02-00
Check	0	0	0
Target 1X	0	75	0
Target 2X	0	94	0
Refine Extra 1X	0	98	0
Refine Extra 2X	0	99	0
Prestige 1X	0	99	0
Prestige 2X	0	100	0
Banvel+ 2,4-D amine	0	98	0
Unity	0	100	0
Ally 1X	0	100	0
Ally 2X	0	100	0
Attain1X	0	100	0
Attain 2X	0	98	0

Figure 1. Tolerance of Established Creeping Red Fescue to Cleaver Controlling Herbicides 1997 (Exp#CR1)

Spirit River - Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)

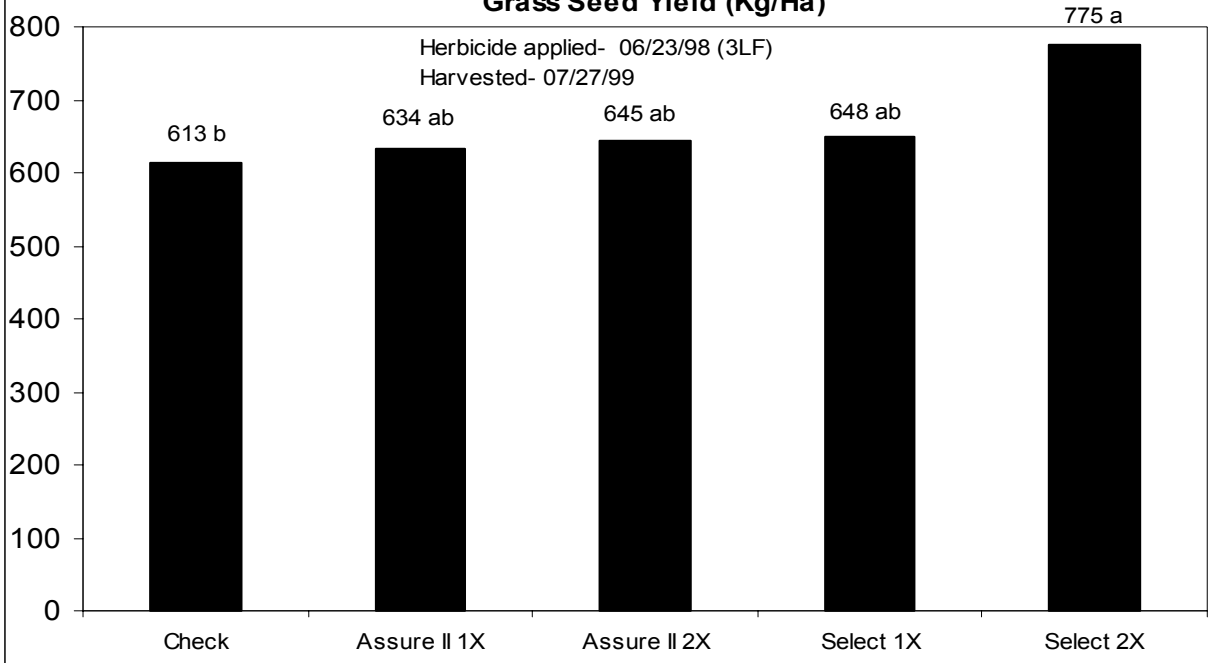


* Significantly different from check.

Figure 2. Tolerance of Seedling Creeping Red Fescue to Graminicides 1998 (Exp#CR3)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)



Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 3. Tolerance of Established Creeping Red Fescue to Cleaver Controlling Herbicides 1998 (Exp#CR4)

Woking- Harvested The Year Of Herbicide Application Grass Seed Yield (Kg/Ha)

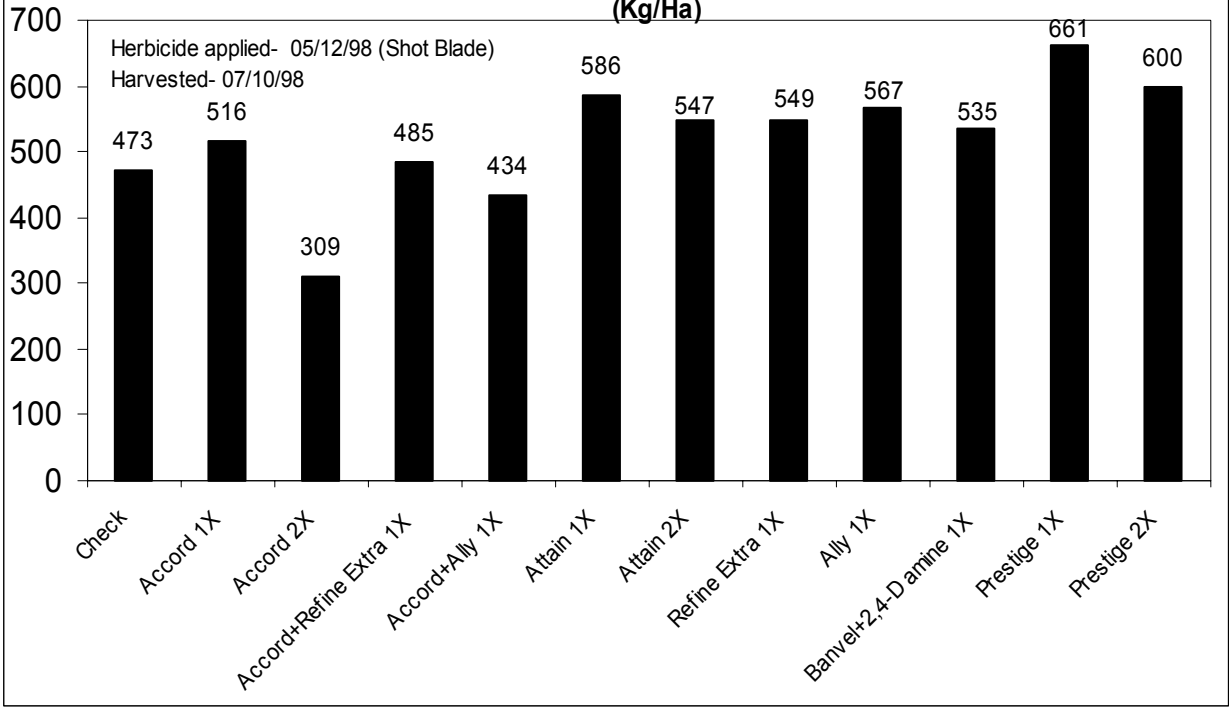
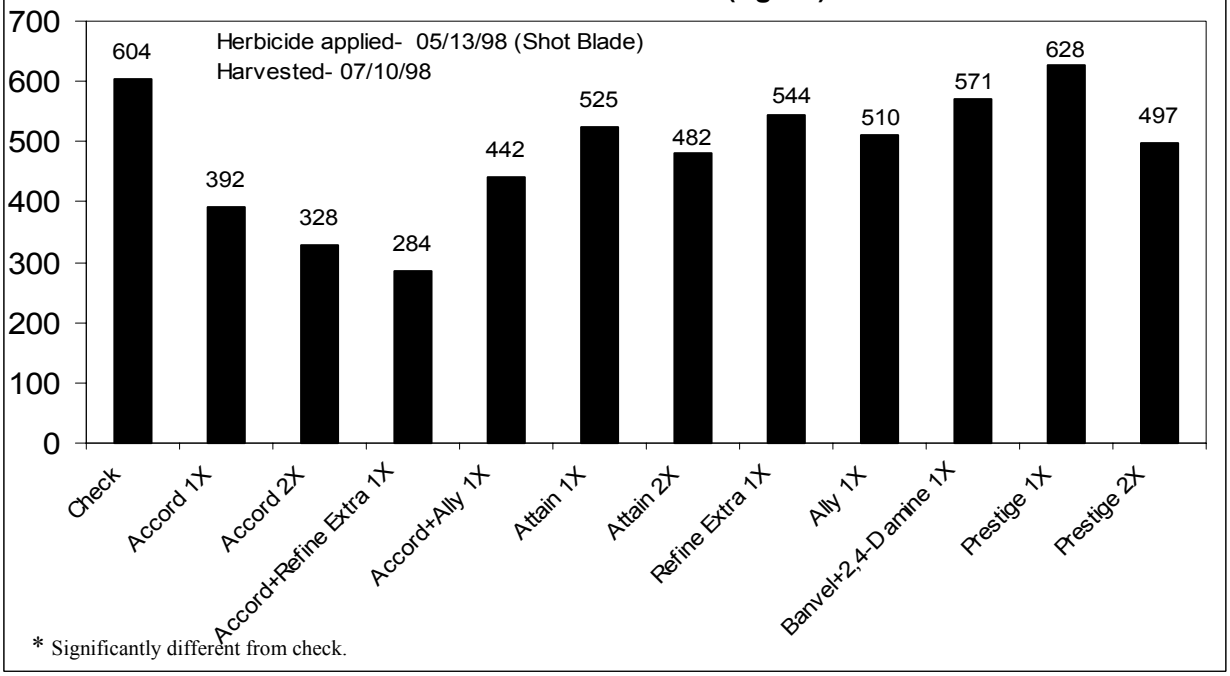


Figure 4. Tolerance of Established Creeping Red Fescue to Cleaver Controlling Herbicides 1998 (Exp#CR5)

Debolt- Harvested The Year Of Herbicide Application Grass Seed Yield (Kg/Ha)

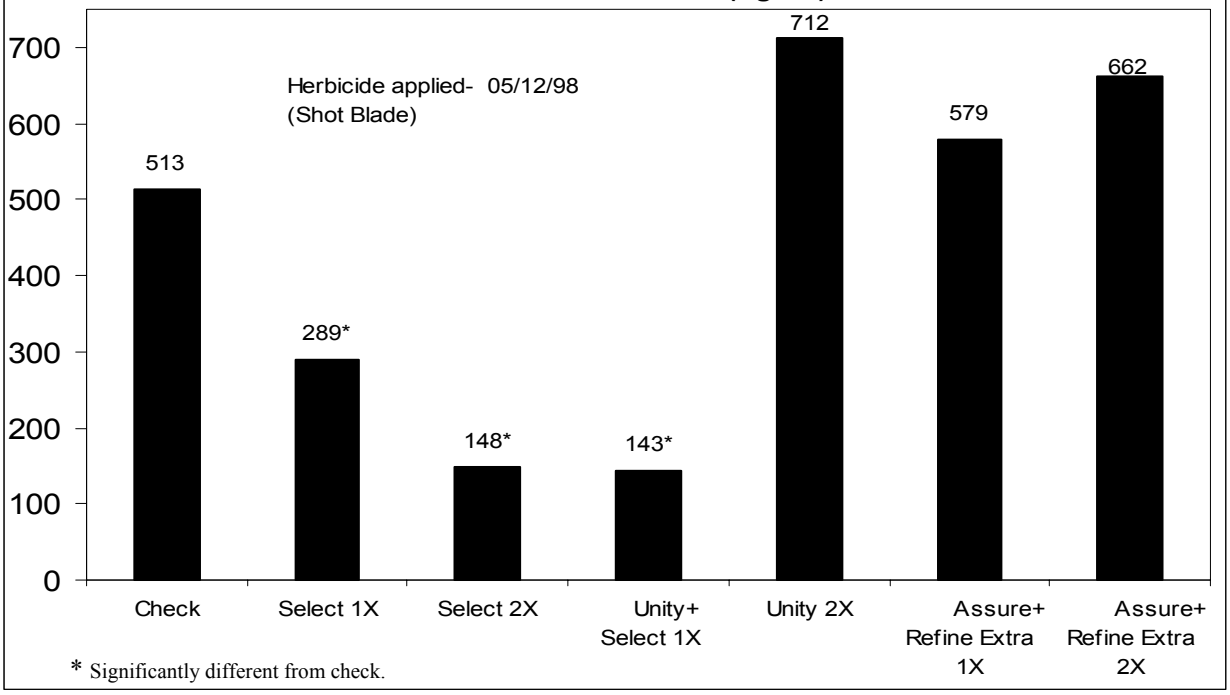


* Significantly different from check.

Figure 5. Tolerance of Established Creeping Red Fescue to Herbicides 1998 (Exp#CR6)

Woking- Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)

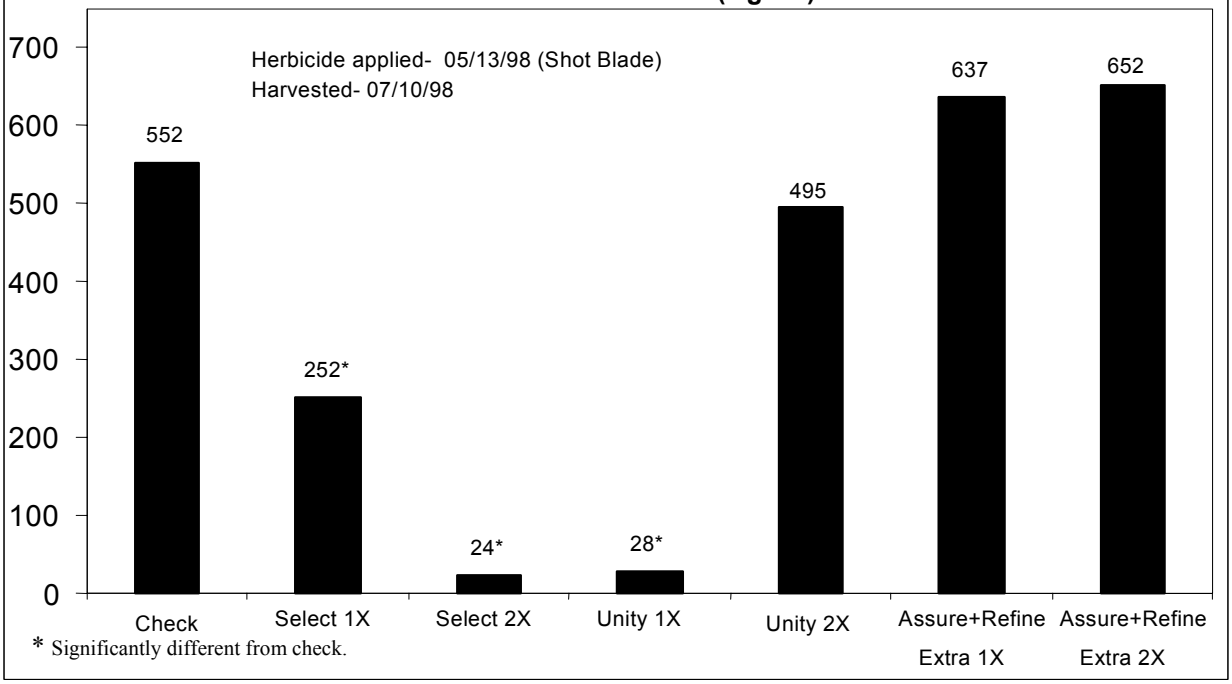


* Significantly different from check.

Figure 6. Tolerance of Established Creeping Red Fescue to Herbicides 1998 (Exp#CR7)

Debolt - Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)

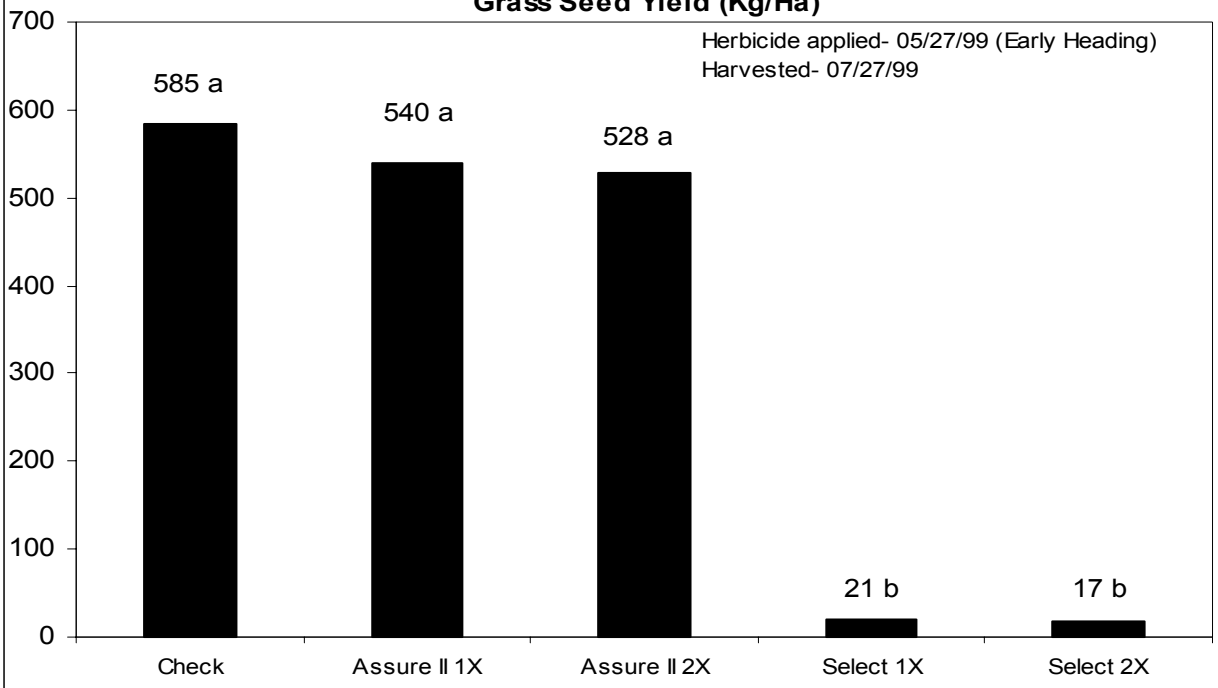


* Significantly different from check.

Figure 7. Tolerance of 1 Year Old Established Creeping Red Fescue to Graminicides 1999 (Exp#CR8)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)

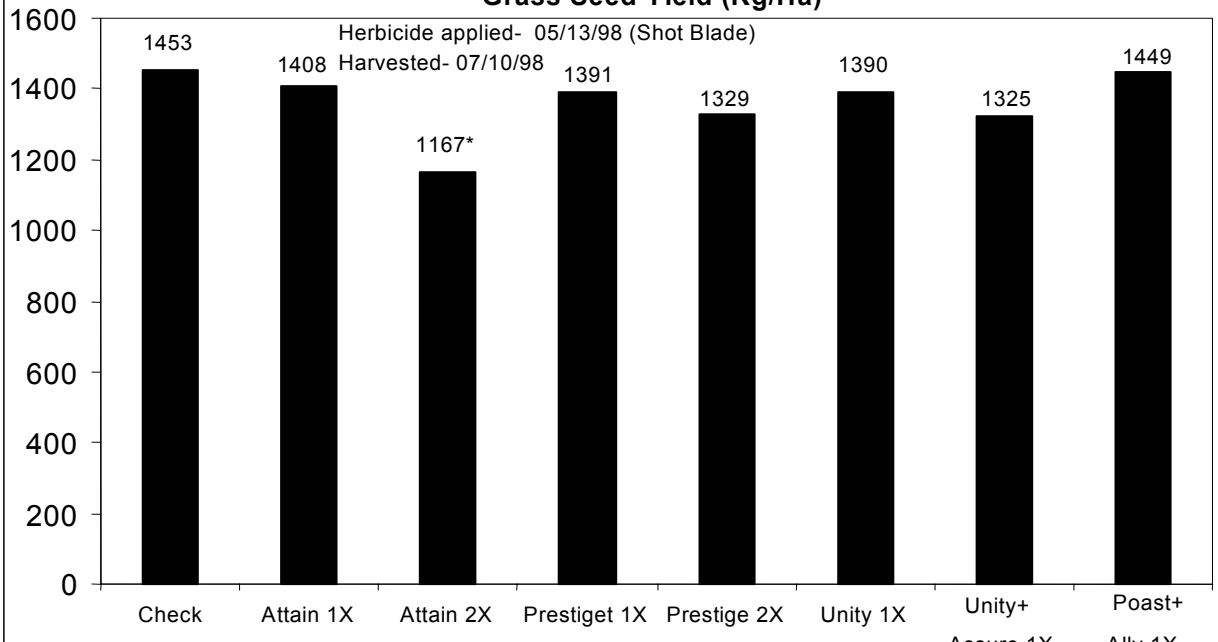


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 8. Tolerance of Established Creeping Red Fescue to Herbicides 1999 (Exp#CR9)

Beaverlodge- Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)



* Significantly different from check.

Figure 9. Tolerance of Established Creeping Red Fescue to Herbicides Applied at Two Stages 1999 (Exp#CR10)

Beaverlodge- Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)

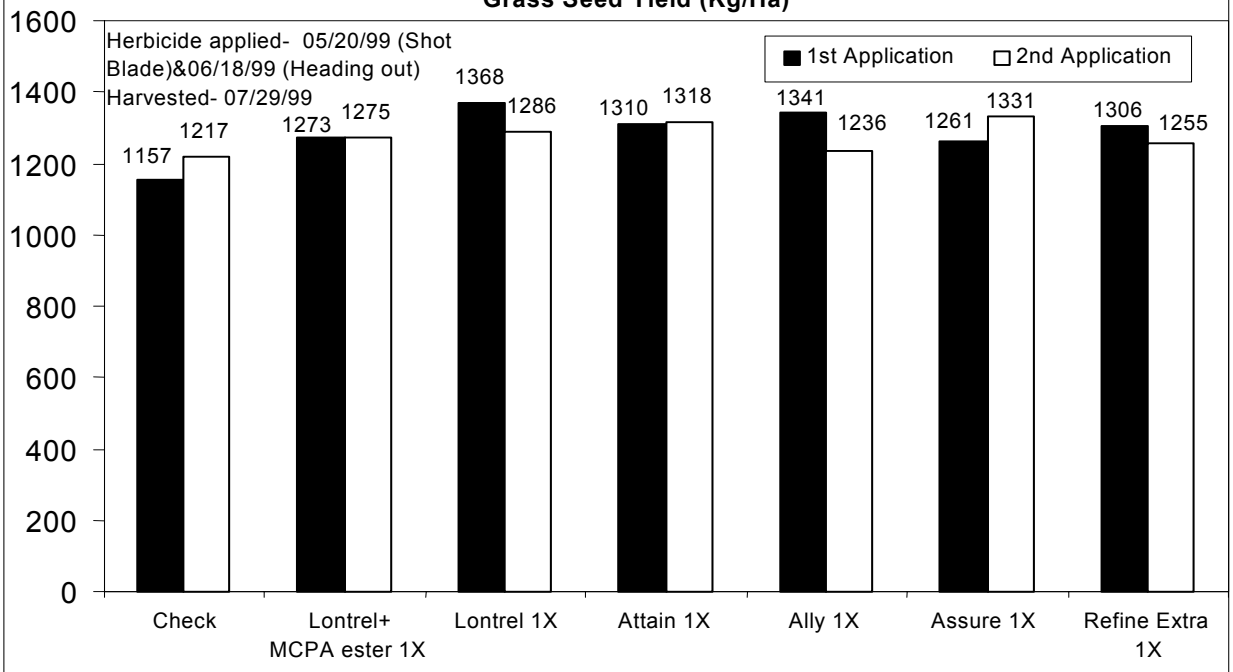


Figure 10. Tolerance of 1 Year Old Established Creeping Red Fescue to Prestige and Attain 2000 (Exp#CR11)

Debolt - Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)

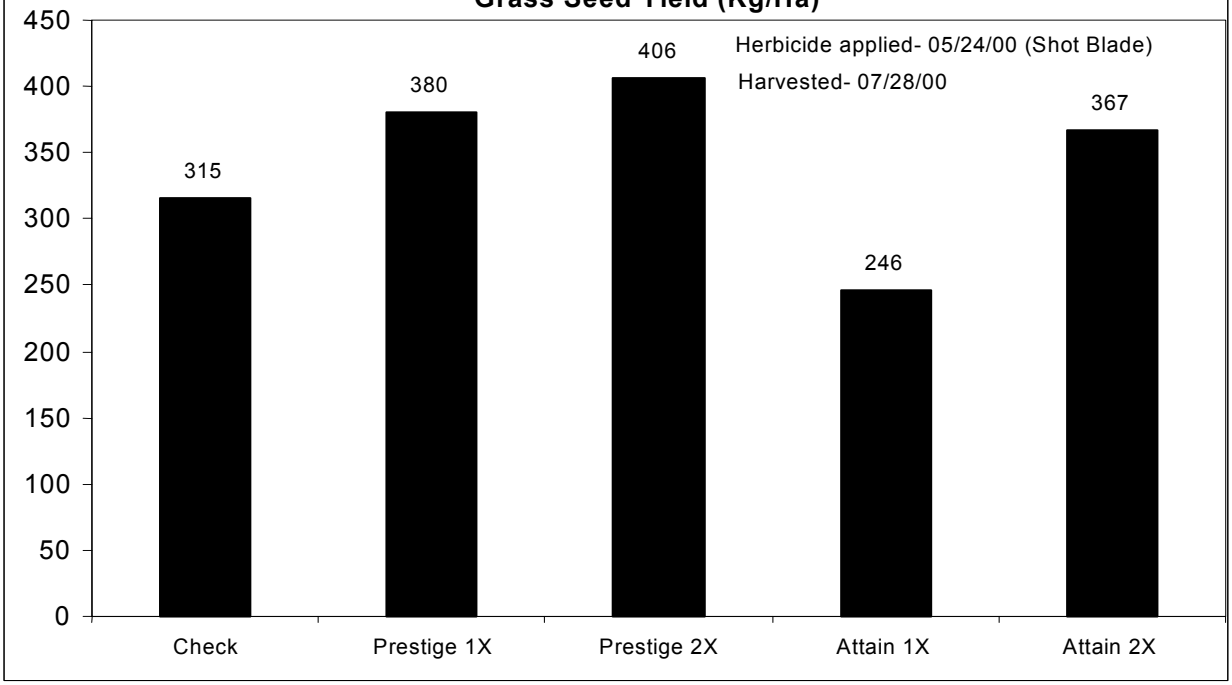


Figure 11. Tolerance of 1 Year Old Established Creeping Red Fescue to Prestige and Attain 2000 (Exp#CR12)
Beaverlodge- Harvested The Year Of Herbicide Application
Grass Seed Yield (Kg/Ha)

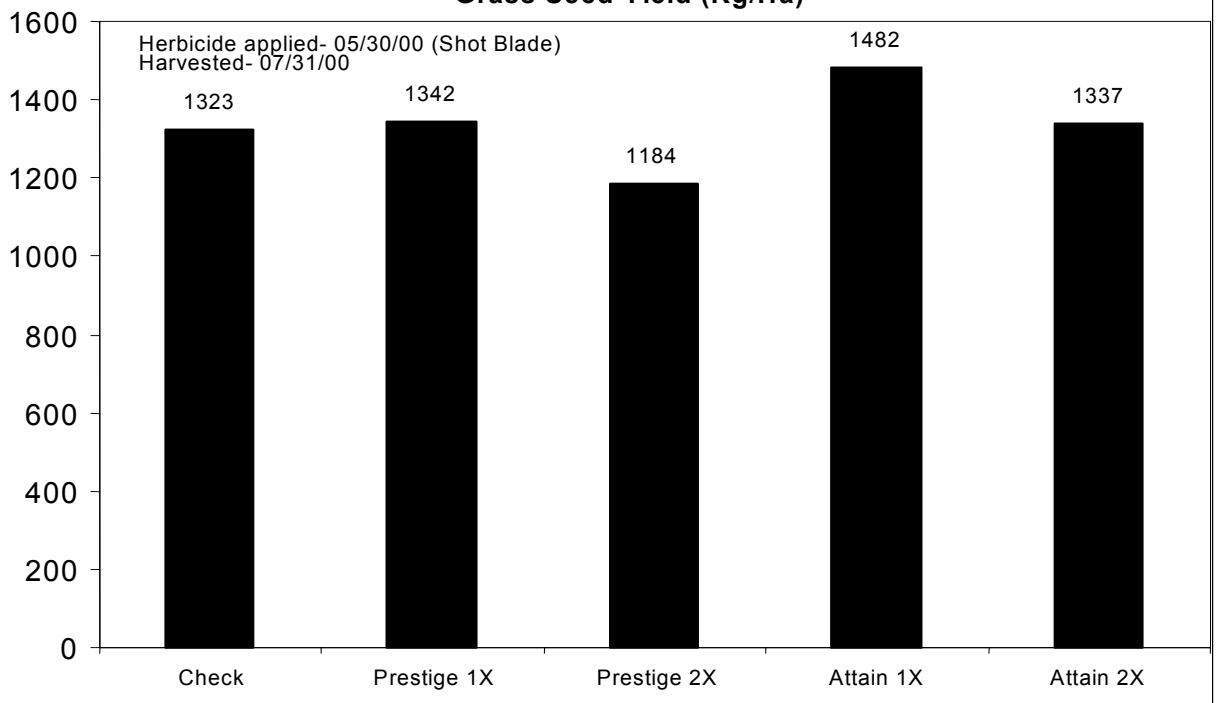
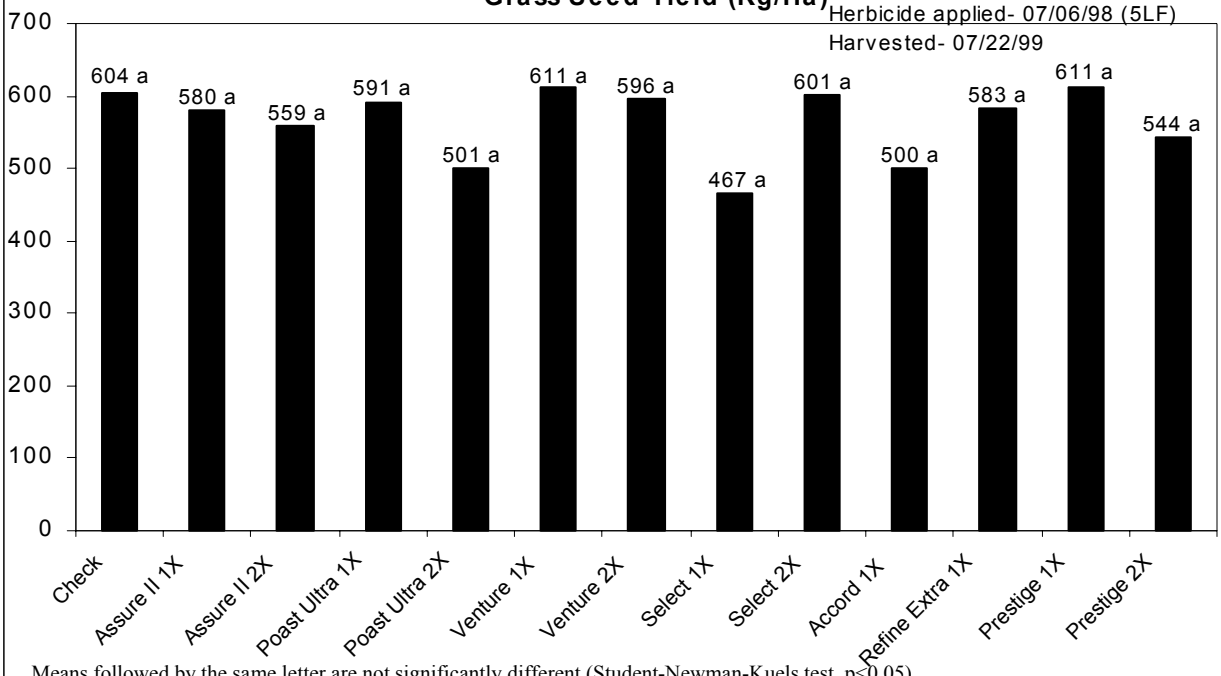


Figure 12. Tolerance of Seedling Hard Fescue to Graminicides 1998 (Exp#H1)

Edmonton- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)

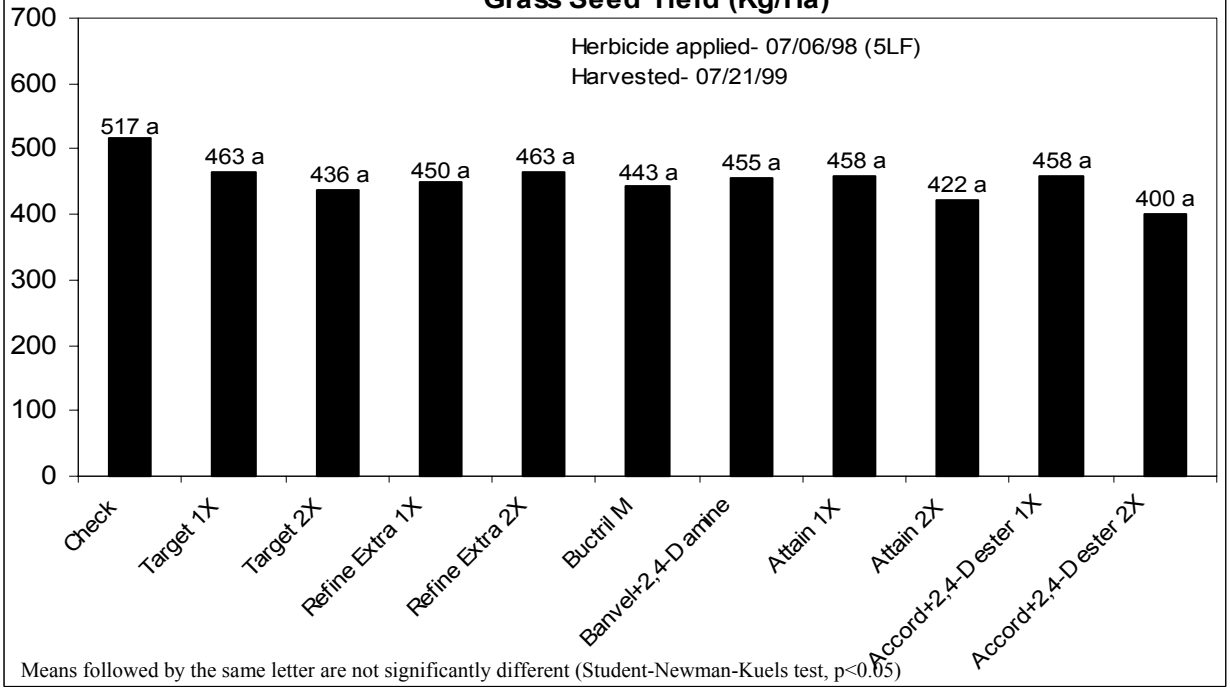


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, p<0.05)

Figure 13. Tolerance of Seedling Hard Fescue to Broadleaf Herbicides 1998 (Exp#H2)

Edomonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)



Means followed by the same letter are not significantly different (Student-Newman-Kuels test, p<0.05)

Figure 14. Tolerance of Seedling Hard Fescue to Graminicides 1999 (Exp#H3)
Beaverlodge- Harvested The Year After Herbicide Application
Grass Seed Yield (Kg/Ha)

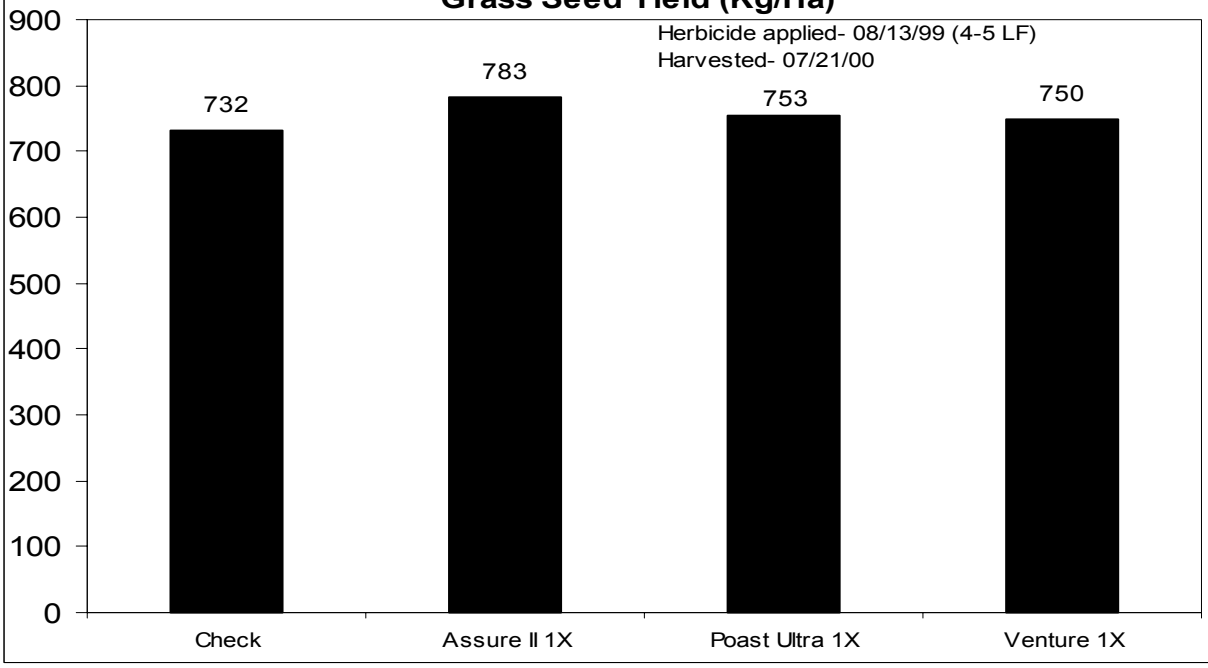


Figure 15. Tolerance of Seedling Hard Fescue to Broadleaf Herbicides 1999 (Exp#H4)
Beaverlodge- Harvested The Year After Herbicide Application
Grass Seed Yield (Kg/Ha)

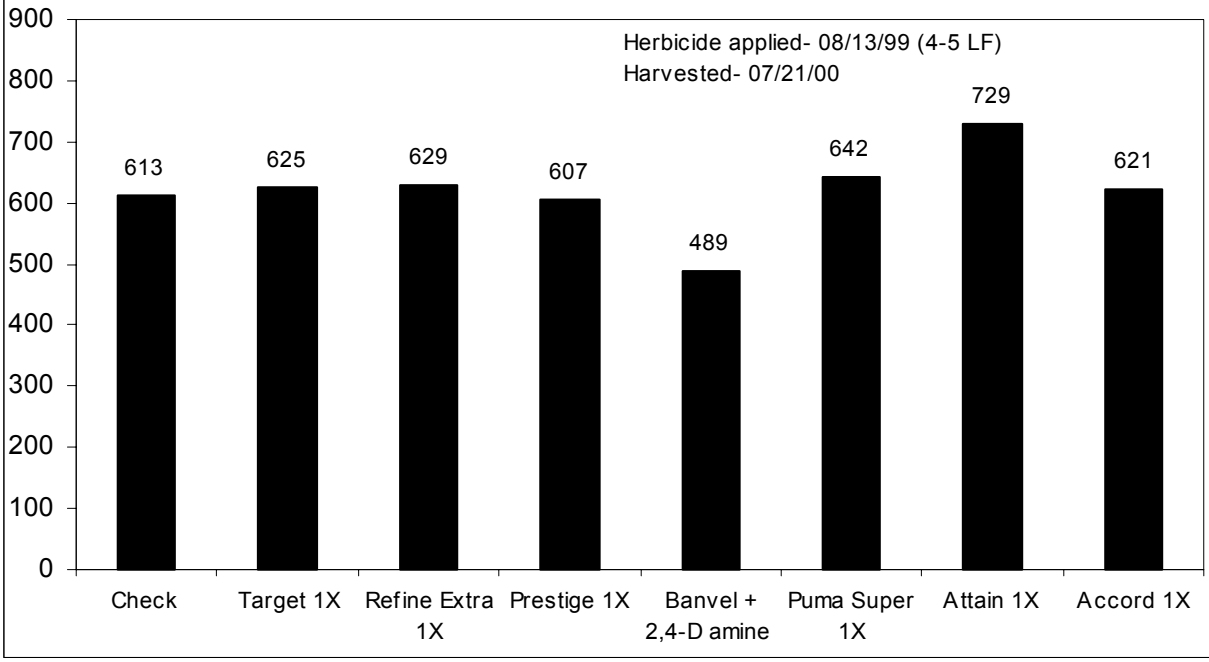


Figure 16. Tolerance of Seedling Hard Fescue to Graminicides 1999 (Exp#H5)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)

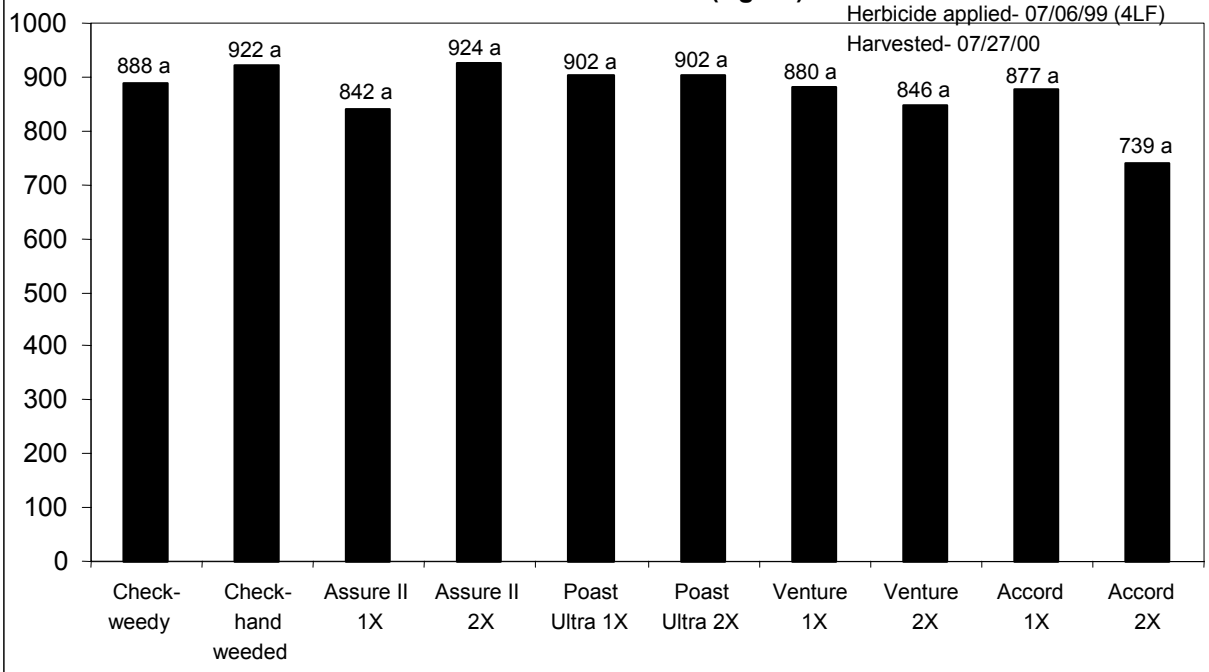
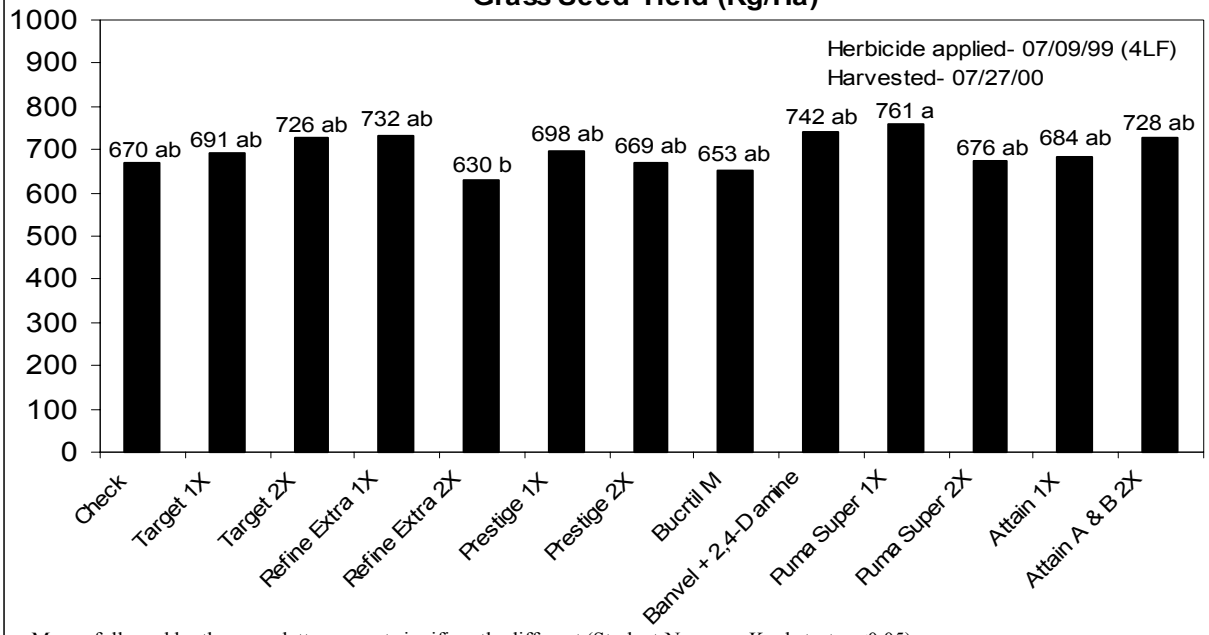


Figure 17. Tolerance of Seedling Hard Fescue to Broadleaf Herbicides 1999 (Exp#H6)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)

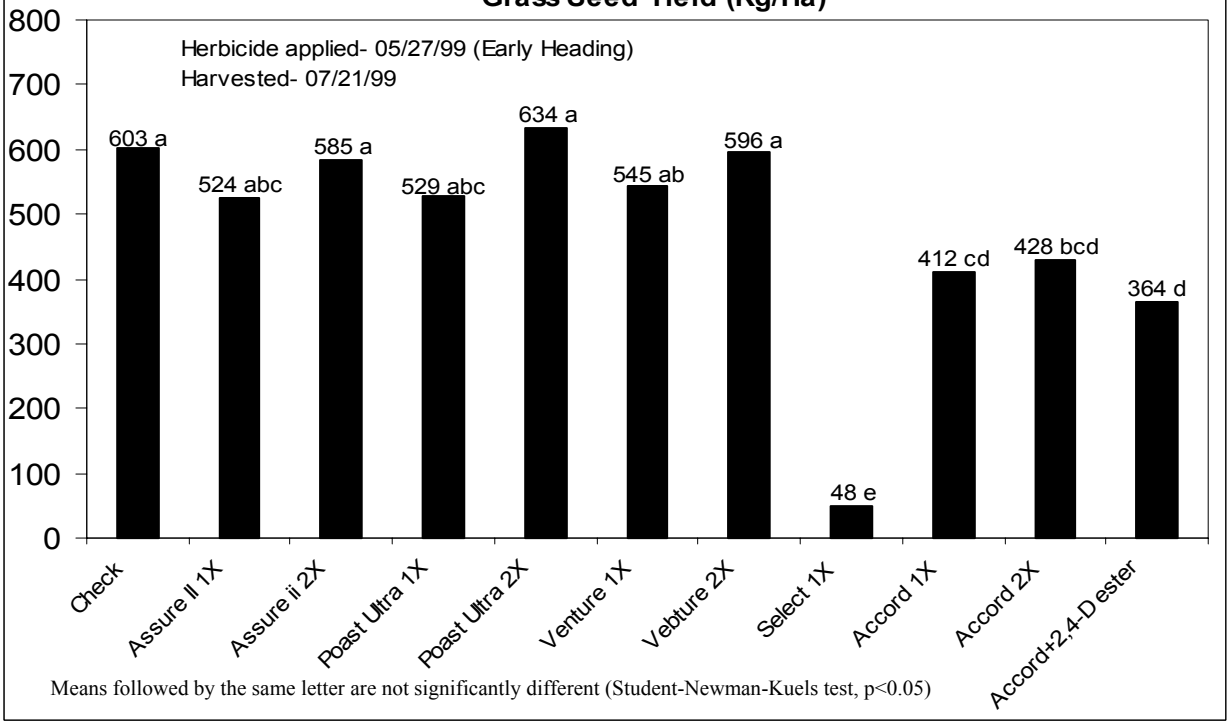


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 18. Tolerance of 1 Year Old Established Hard Fescue to Graminicides 1999 (Exp#H7)

Edmonton- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)

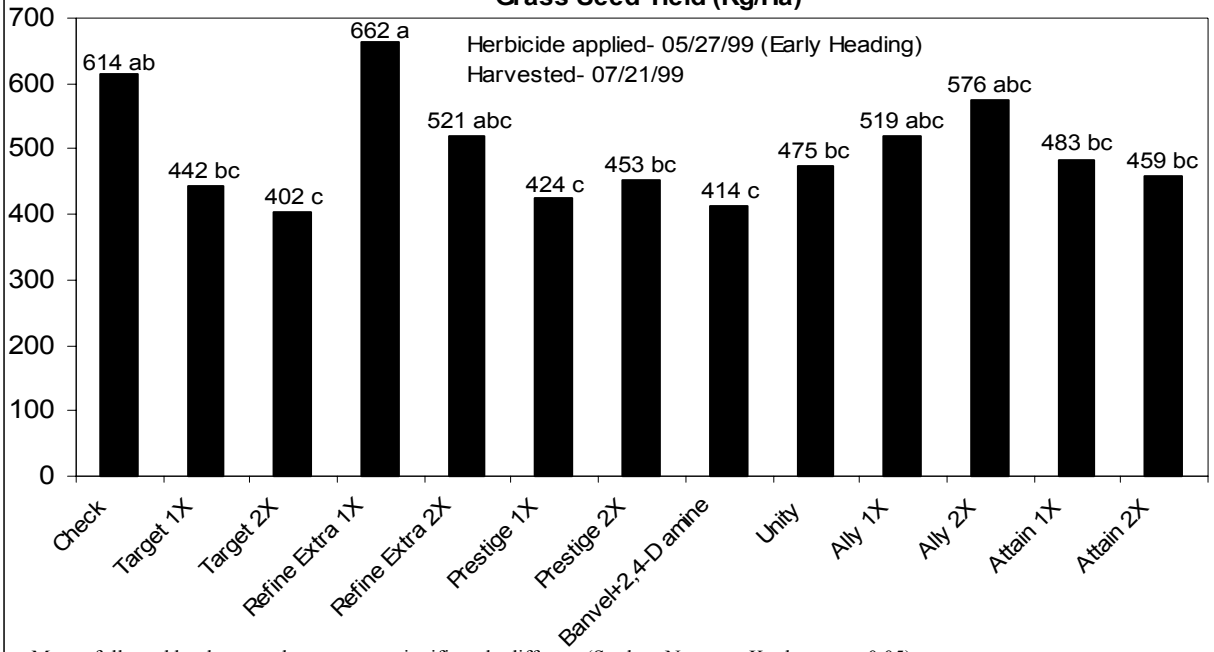


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 19. Tolerance of 1 Year Old Established Hard Fescue to Broadleaf Herbicides 1999 (Exp#H8)

Edmonton- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)



Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

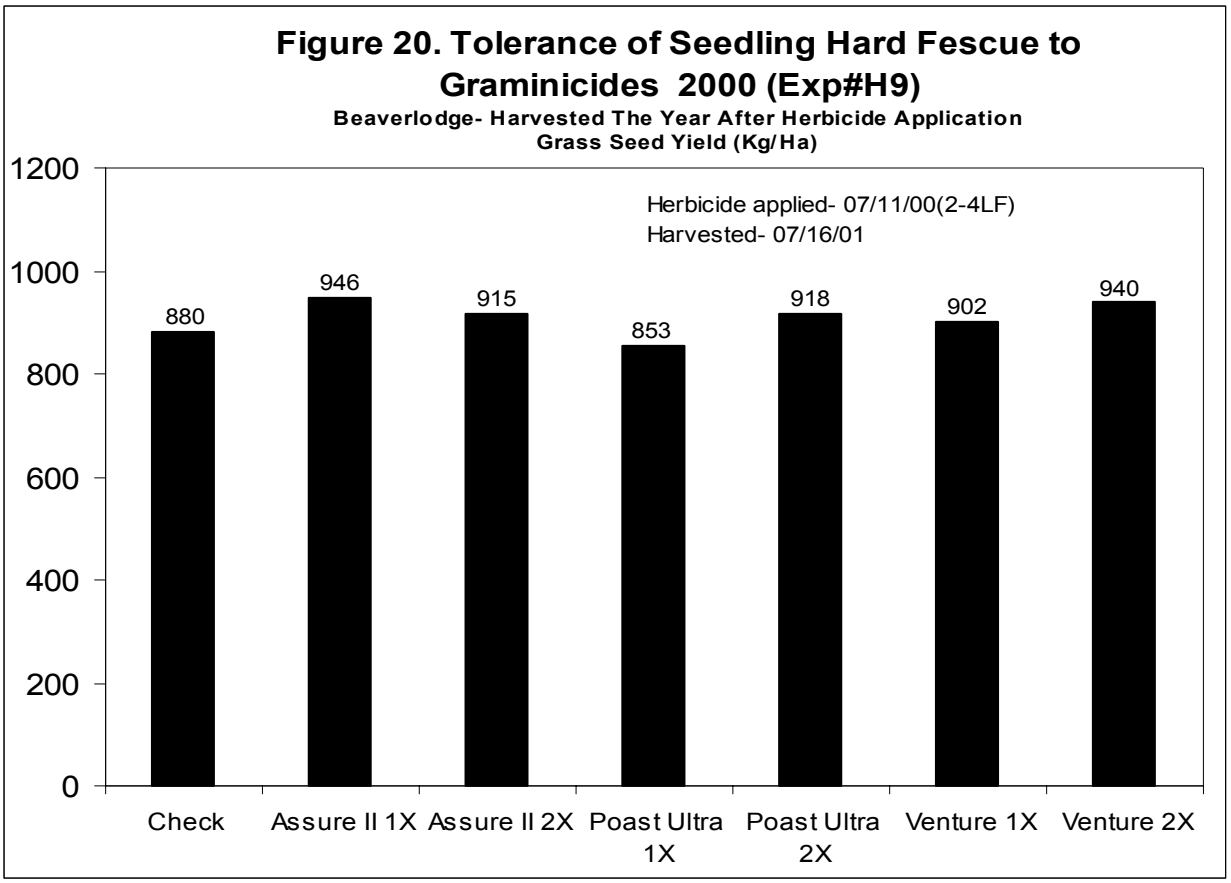


Figure 20. Tolerance of Seedling Hard Fescue to Graminicides 2000 (Exp#H9)
Beaverlodge- Harvested The Year After Herbicide Application
Grass Seed Yield (Kg/Ha)
Herbicide applied- 07/11/00(2-4LF)
Harvested- 07/16/01
1200
1000
800
600
400
200
0
880
946
915
853
918
902
940
Check
Assure II 1X
Assure II 2X
Poast Ultra 1X
Poast Ultra 2X
Venture 1X
Venture 2X

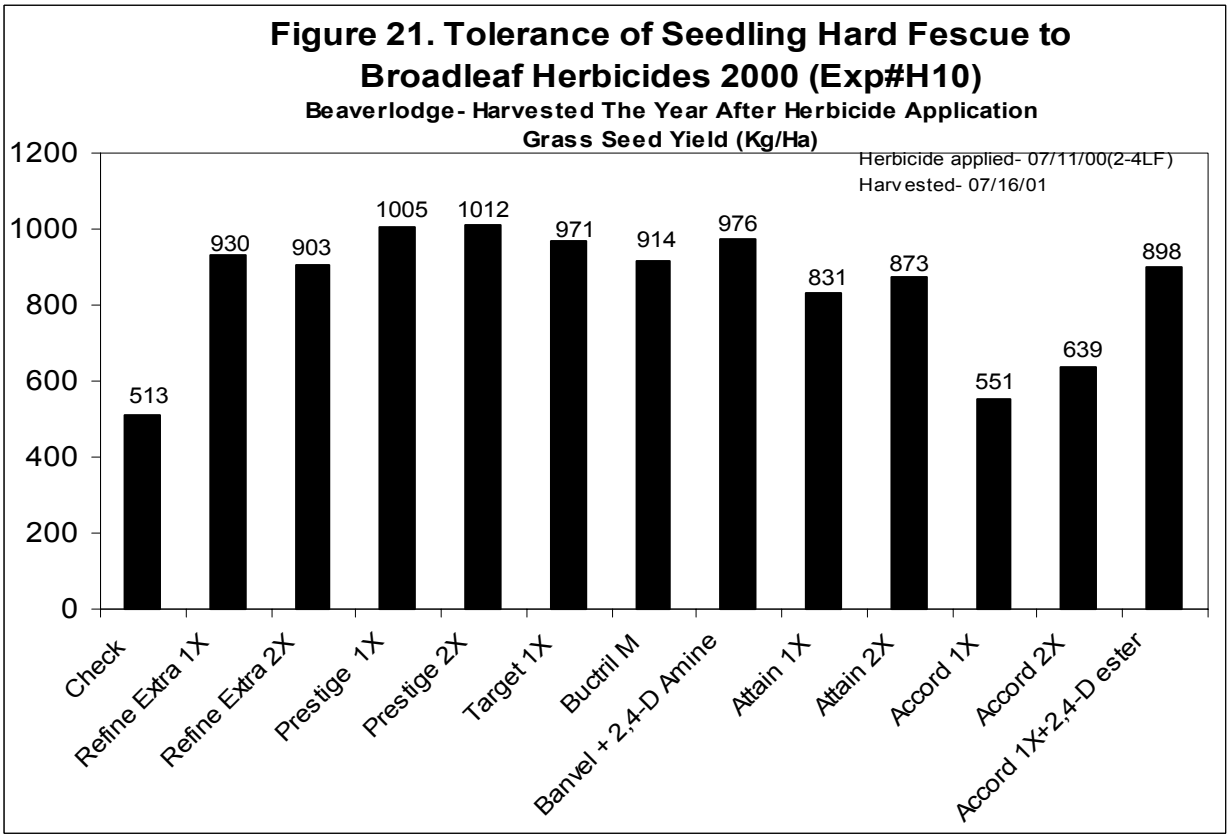
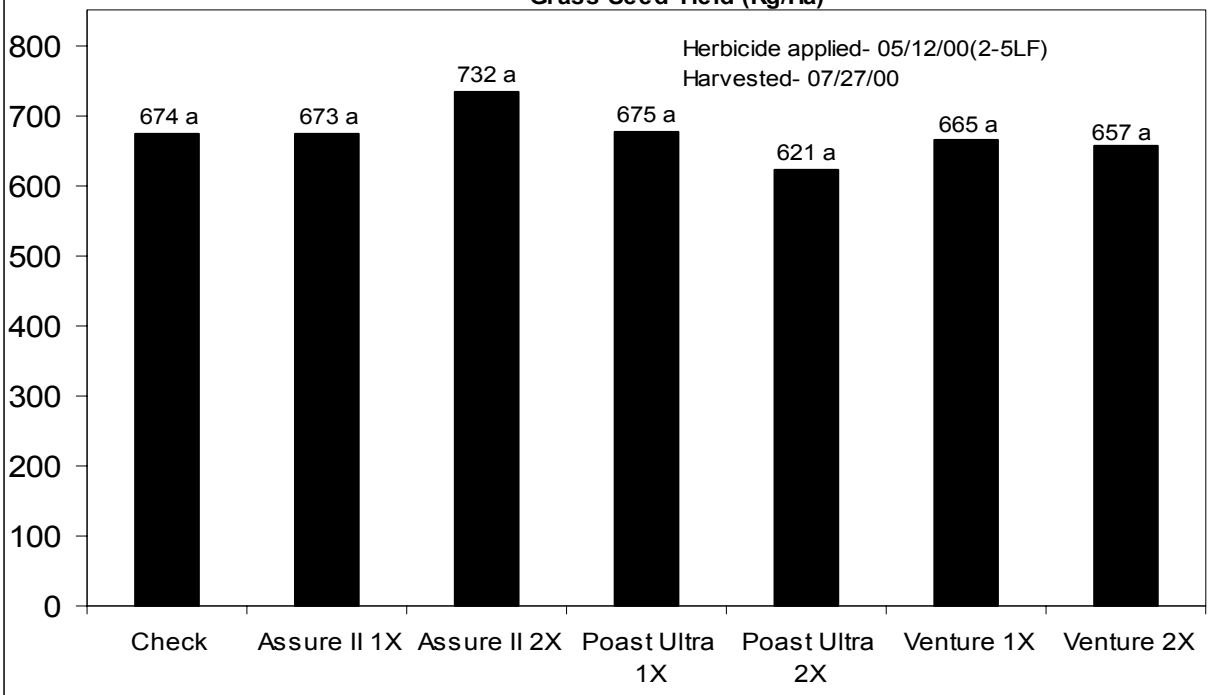


Figure 21. Tolerance of Seedling Hard Fescue to Broadleaf Herbicides 2000 (Exp#H10)
Beaverlodge- Harvested The Year After Herbicide Application
Grass Seed Yield (Kg/Ha)
Herbicide applied- 07/11/00(2-4LF)
Harvested- 07/16/01
1200
1000
800
600
400
200
0
513
930
903
1005
1012
971
914
976
831
873
551
639
898
Check
Refine Extra 1X
Refine Extra 2X
Prestige 1X
Prestige 2X
Target 1X
Buctril M
Banvel + 2,4-D Amine
Attain 1X
Attain 2X
Accord 1X
Accord 2X
Accord 1X+2,4-D ester

Figure 22. Tolerance of 1 Year Old Established Hard Fescue to Graminicides 2000 (Exp#H11)

Edmonton- Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)

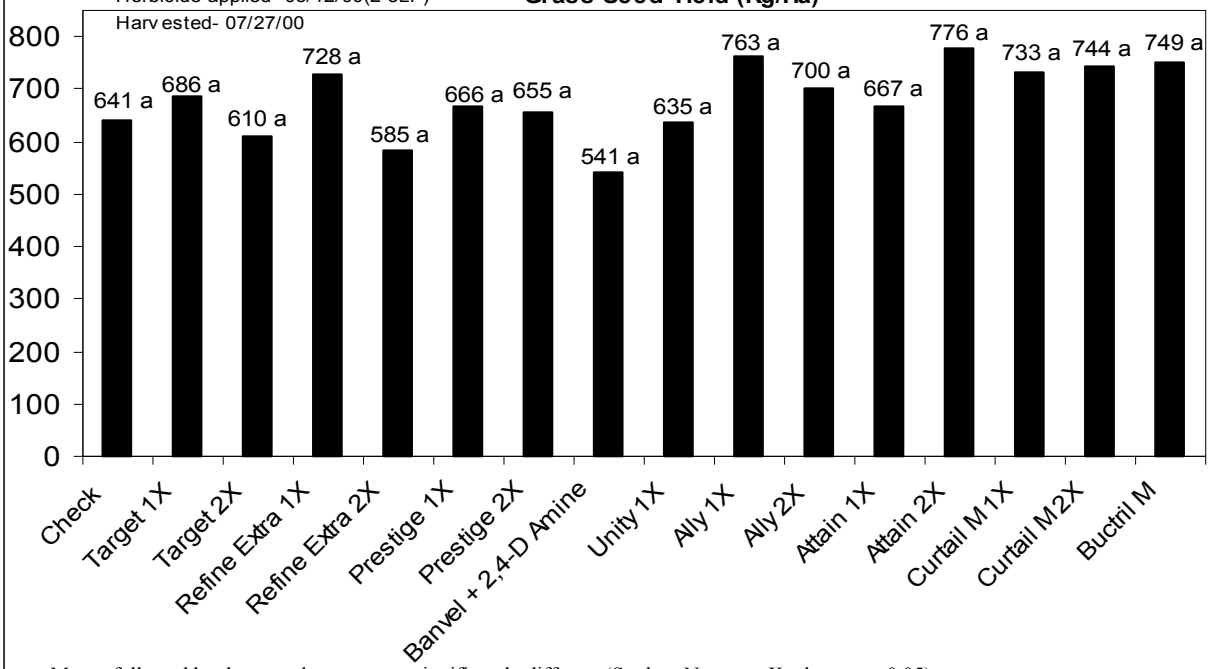


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 23. Tolerance of 1 Year Old Established Hard Fescue to Broadleaf Herbicides 2000 (Exp#H12)

Edmonton- Harvested The Year Of Herbicide Application

Grass Seed Yield (Kg/Ha)



Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 24. Tolerance of 1 Year Old Established Hard Fescue to Graminicides 2000 (Exp#H13)

Beaverlodge- Harvested The Year Of Herbicide Application Grass Seed Yield (Kg/Ha)

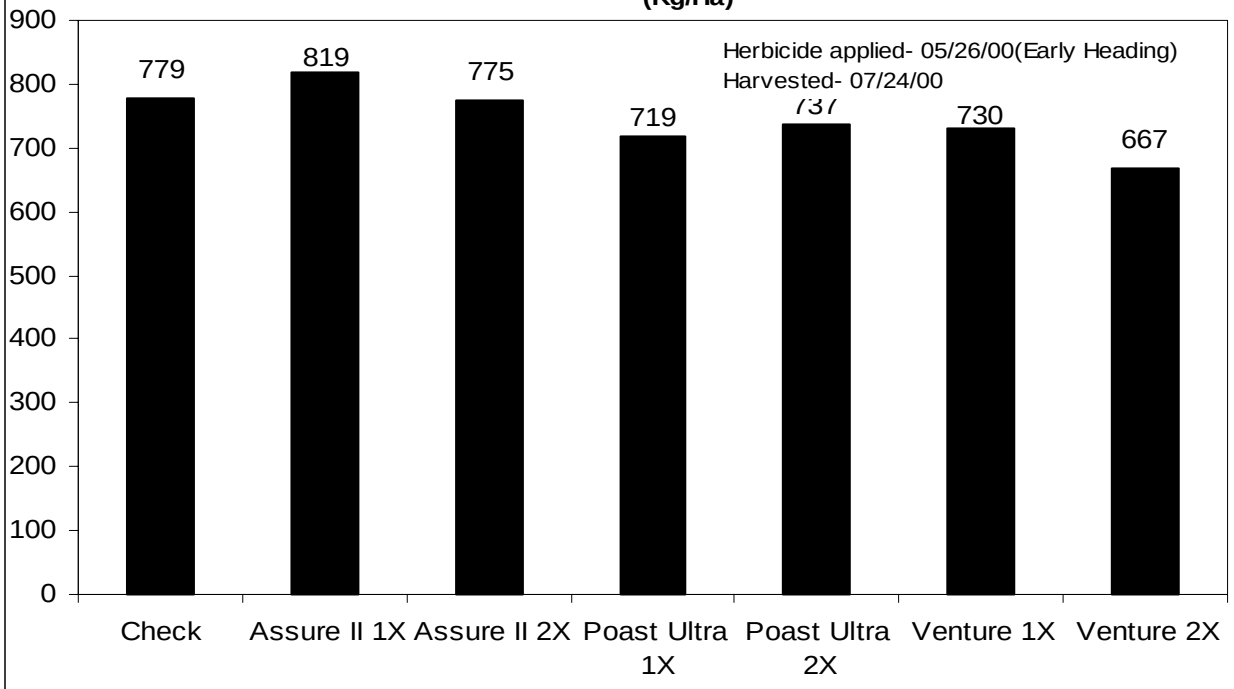


Figure 25. Tolerance of 1 Year Old Established Hard Fescue to Broadleaf Herbicides 2000 (Exp#H14)

Beaverlodge- Harvested The Year Of Herbicide Application Grass Seed Yield (Kg/Ha)

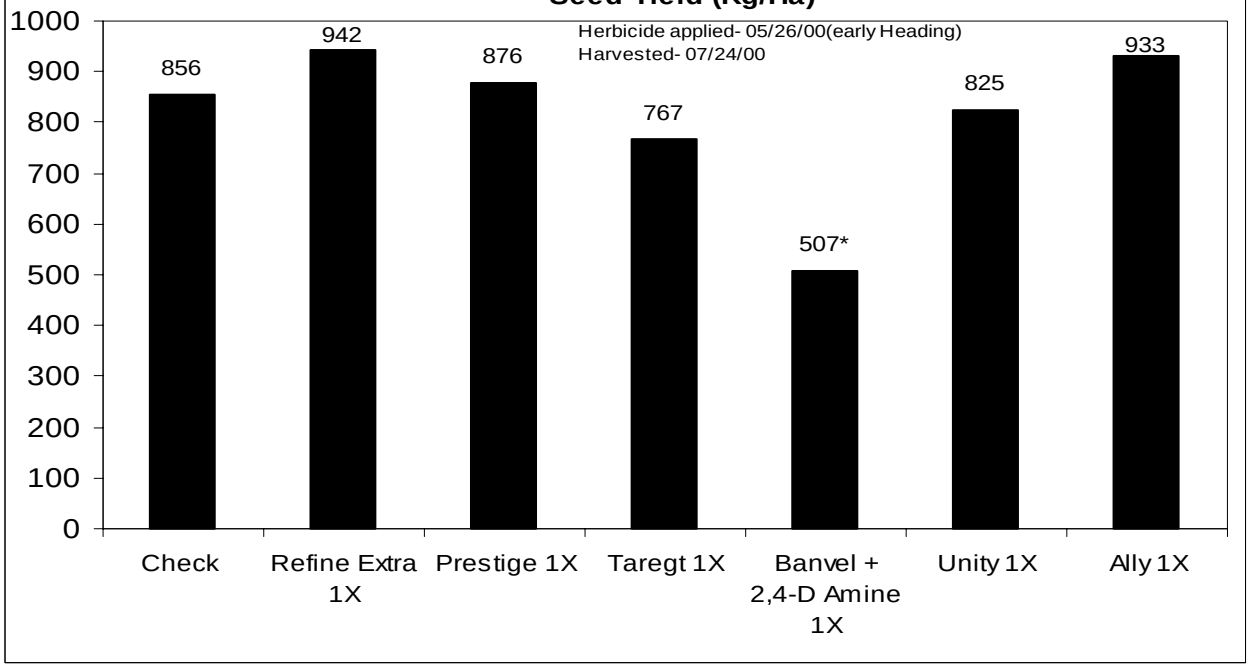
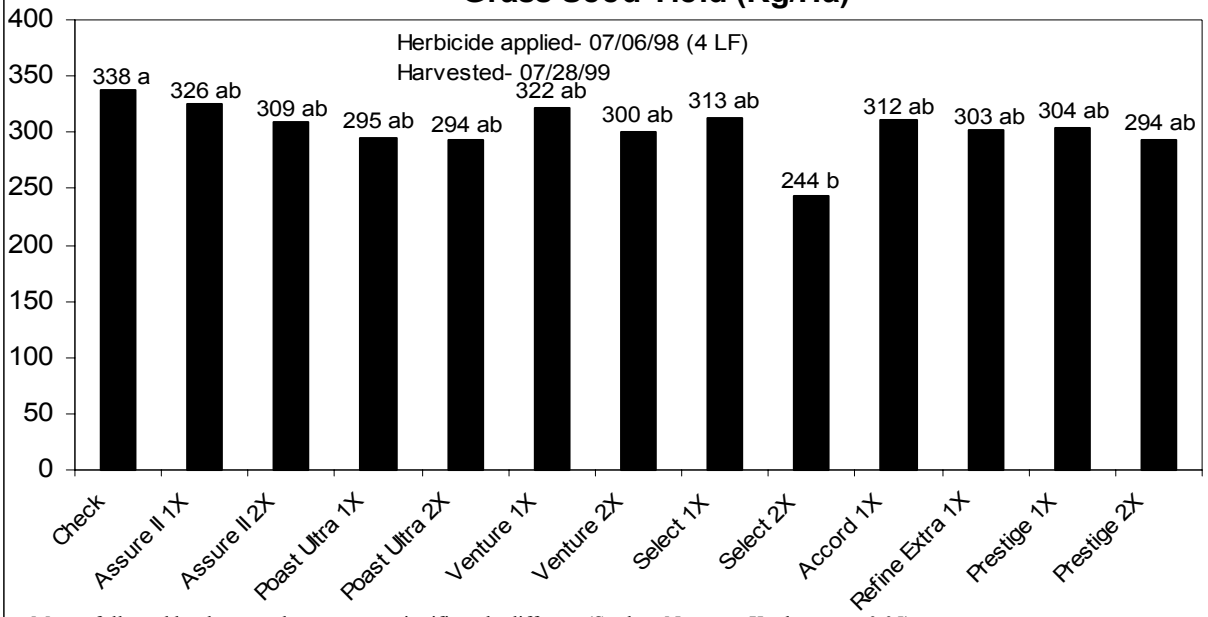


Figure 26. Tolerance of Seedling Chewings Fescue to Graminicides 1998 (Exp#C1)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)

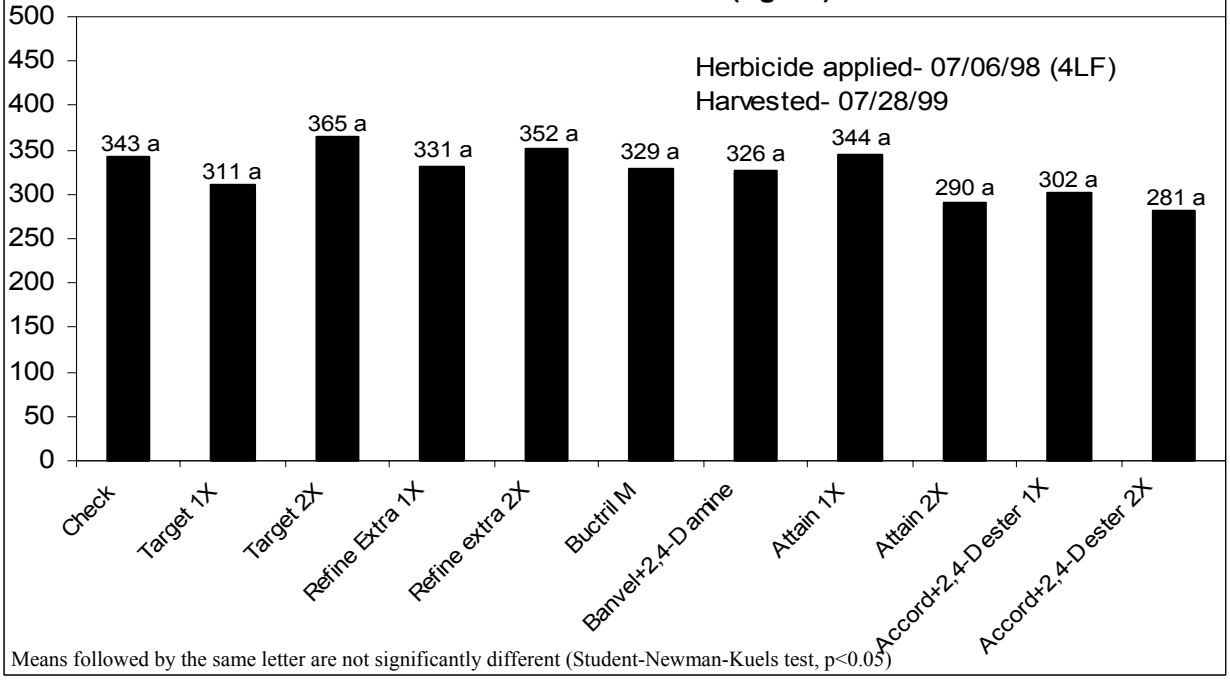


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 27. Tolerance of Seedling Chewings Fescue to Broadleaf Herbicides 1998 (Exp#C2)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)

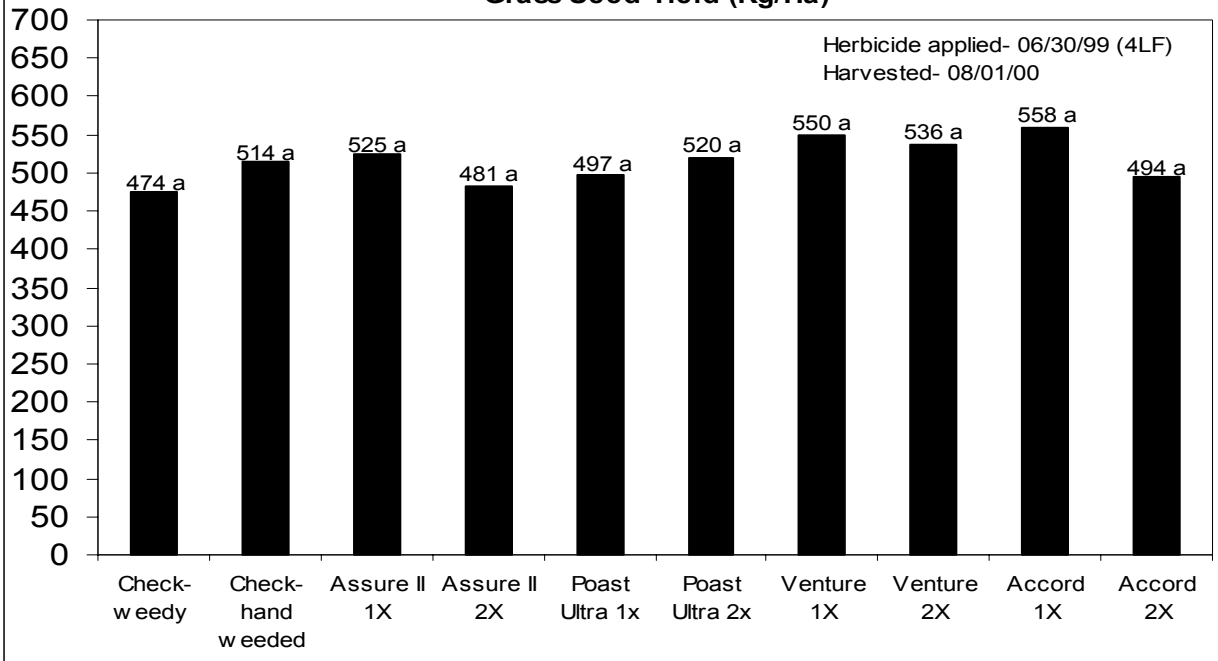


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 28. Tolerance of Seedling Chewings Fescue to Graminicides 1999 (Exp#C3)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)

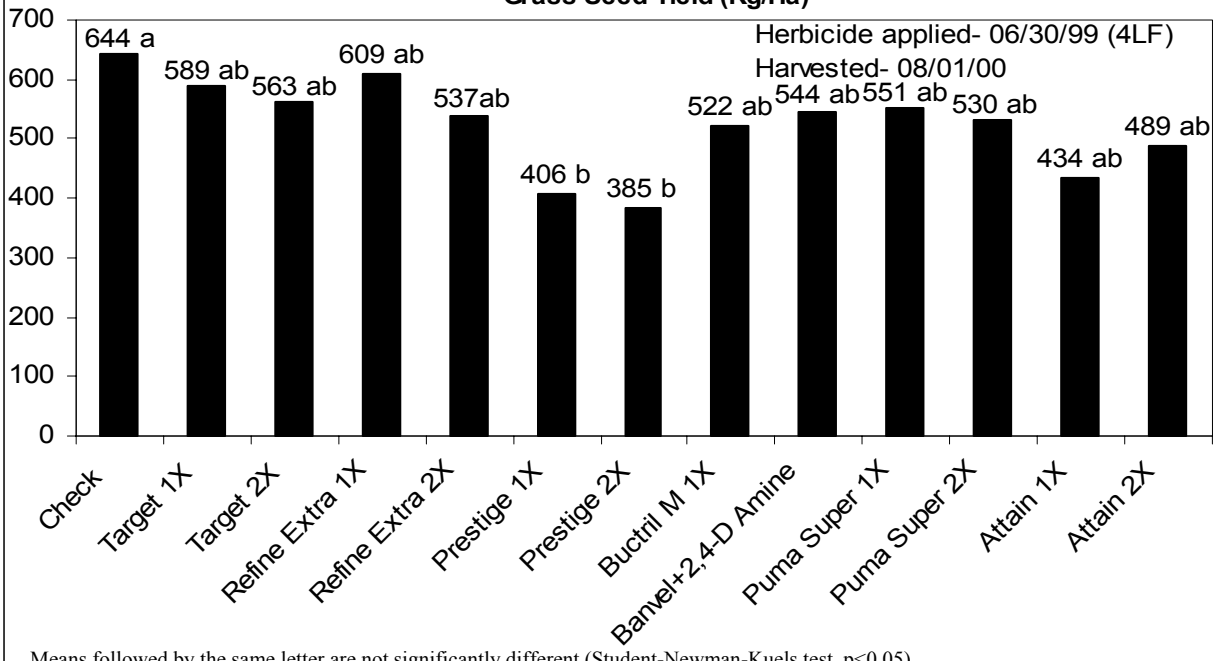


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 29. Tolerance of Seedling Chewings Fescue to Broadleaf Herbicides 1999 (Exp#C4)

Edmonton- Harvested The Year After Herbicide Application

Grass Seed Yield (Kg/Ha)



Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 30. Tolerance of Seedling Chewings Fescue to Graminicides 1999 (Exp#C5)
Beaverlodge- Harvested The Year After Herbicide Application
Grass Seed Yield (Kg/Ha)

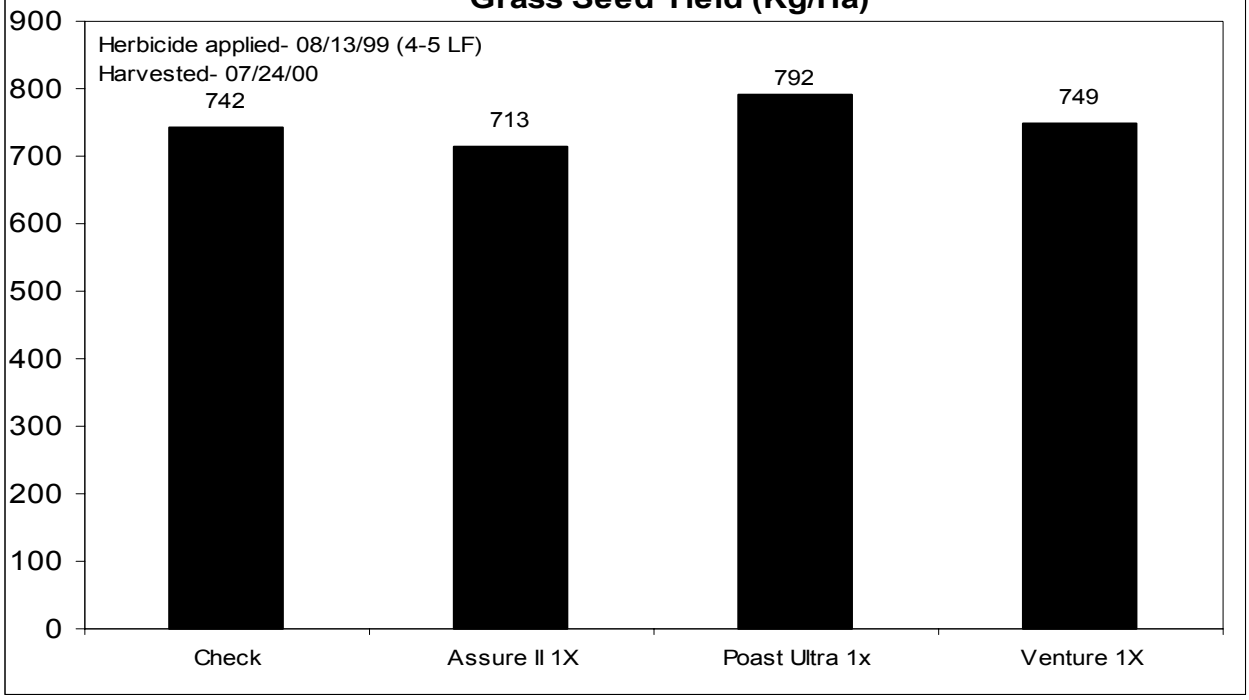


Figure 31. Tolerance of Seedling Chewings Fescue to Broadleaf Herbicides 1999 (Exp#C6)
Beaverlodge- Harvested The Year After Herbicide Application
Grass Seed Yield (Kg/Ha)

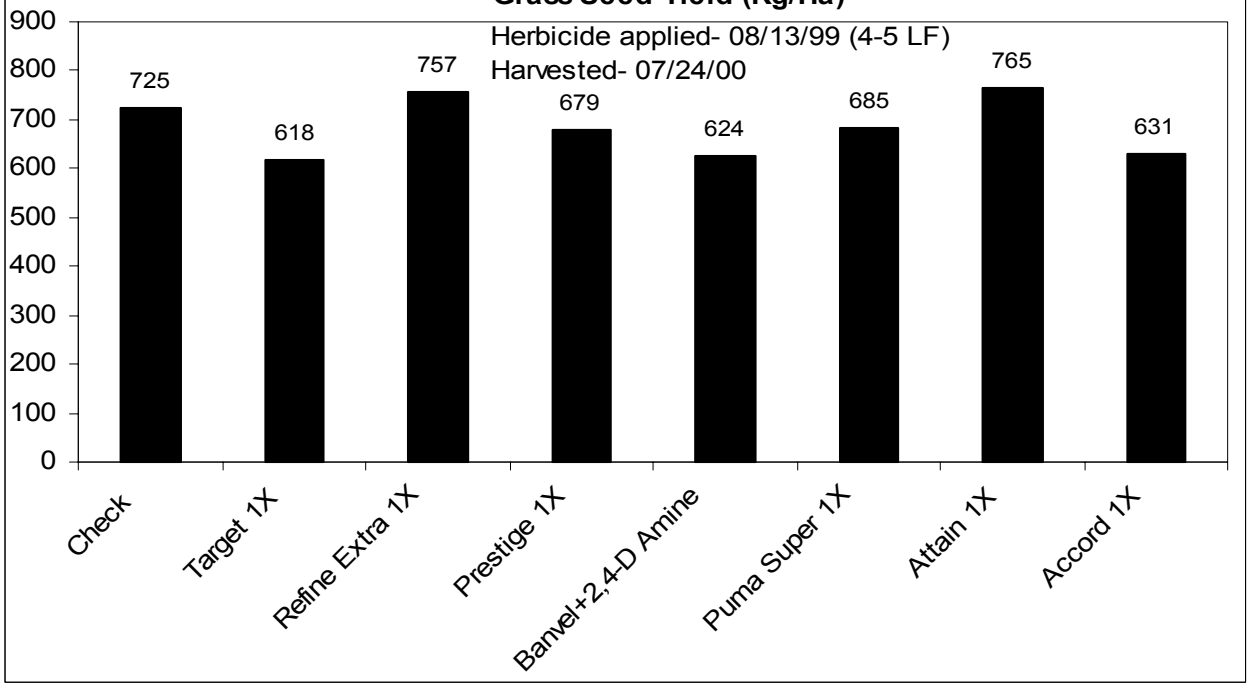
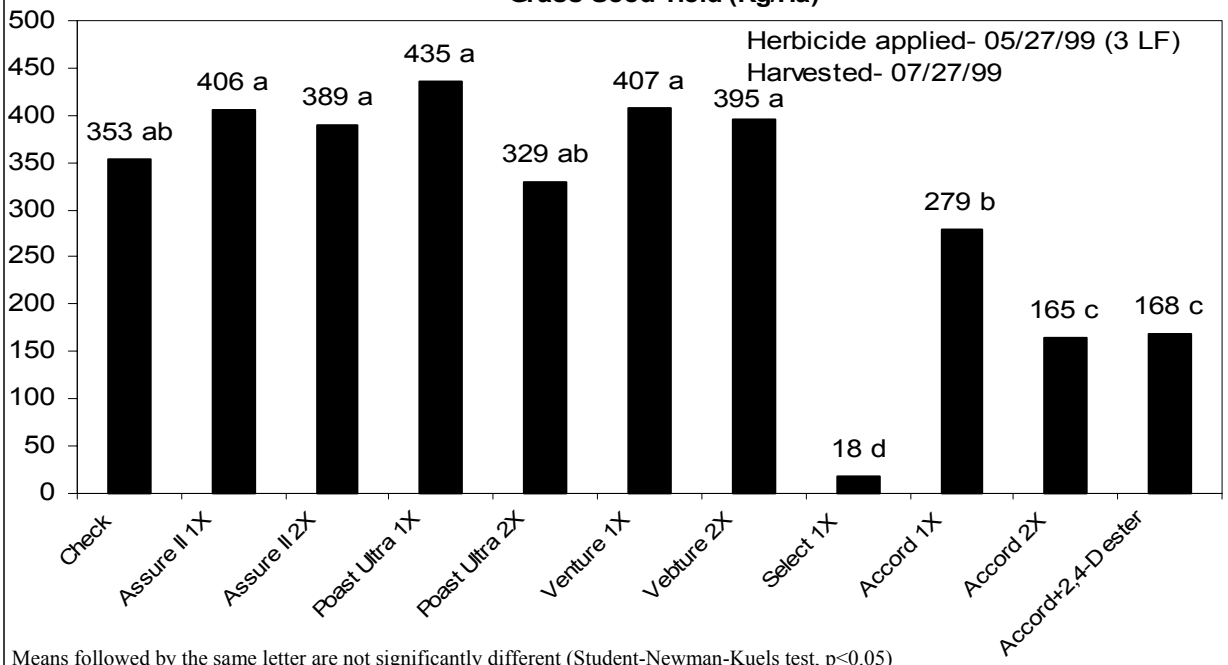


Figure 32. Tolerance of 1 Year Old Established Chewings Fescue to Graminicides 1999 (Exp#C7)

Edmonton- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)

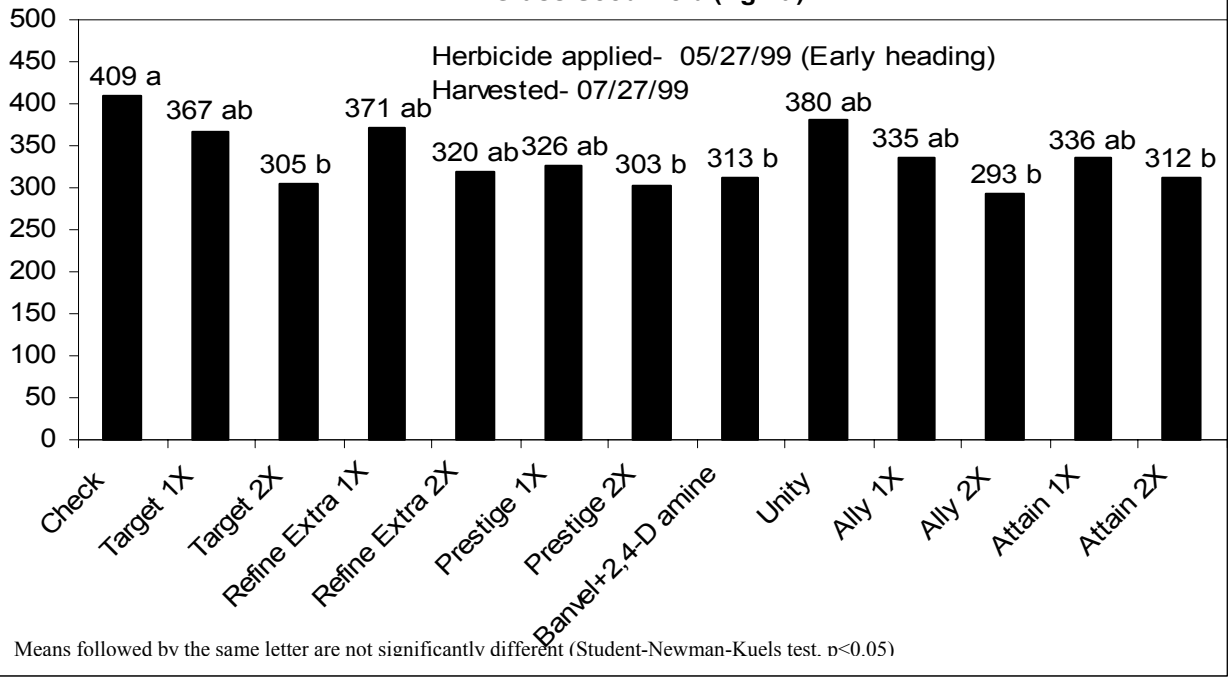


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 33. Tolerance of 1 Year Old Established Chewings Fescue to Broadleaf Herbicides 1999 (Exp#C8)

Edmonton- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)

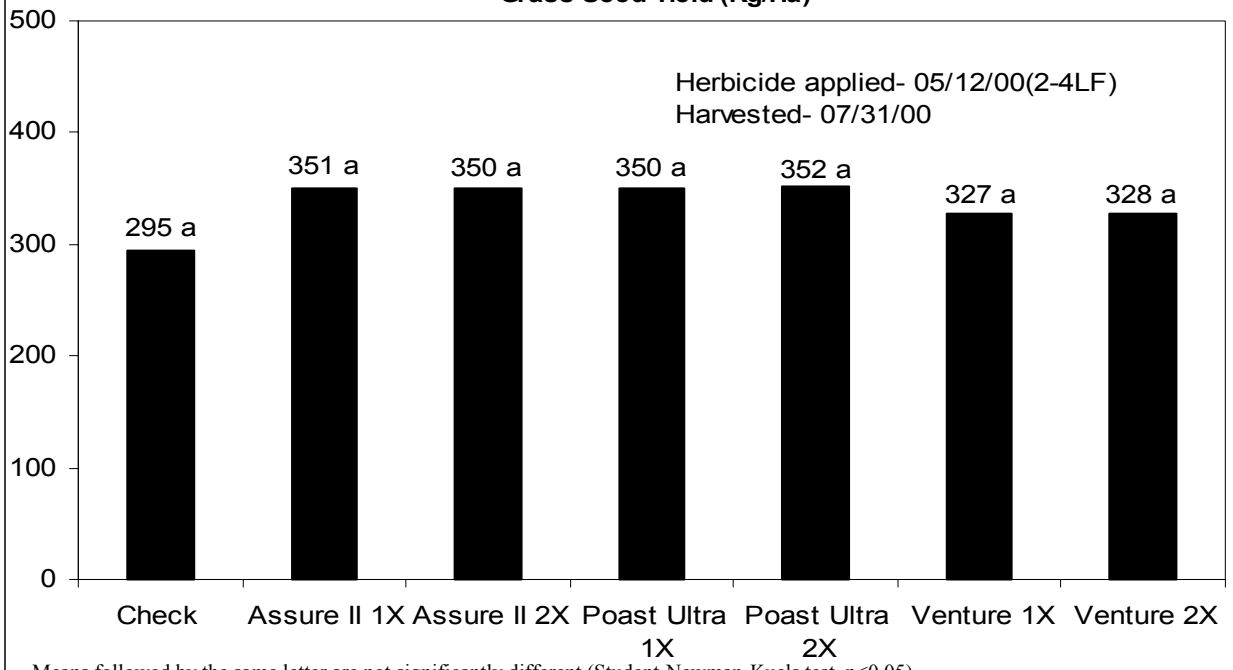


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, $p<0.05$)

Figure 34. Tolerance of 1 Year Old Established Chewings Fescue to Graminicides 2000 (Exp#C9)

Edmonton- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)

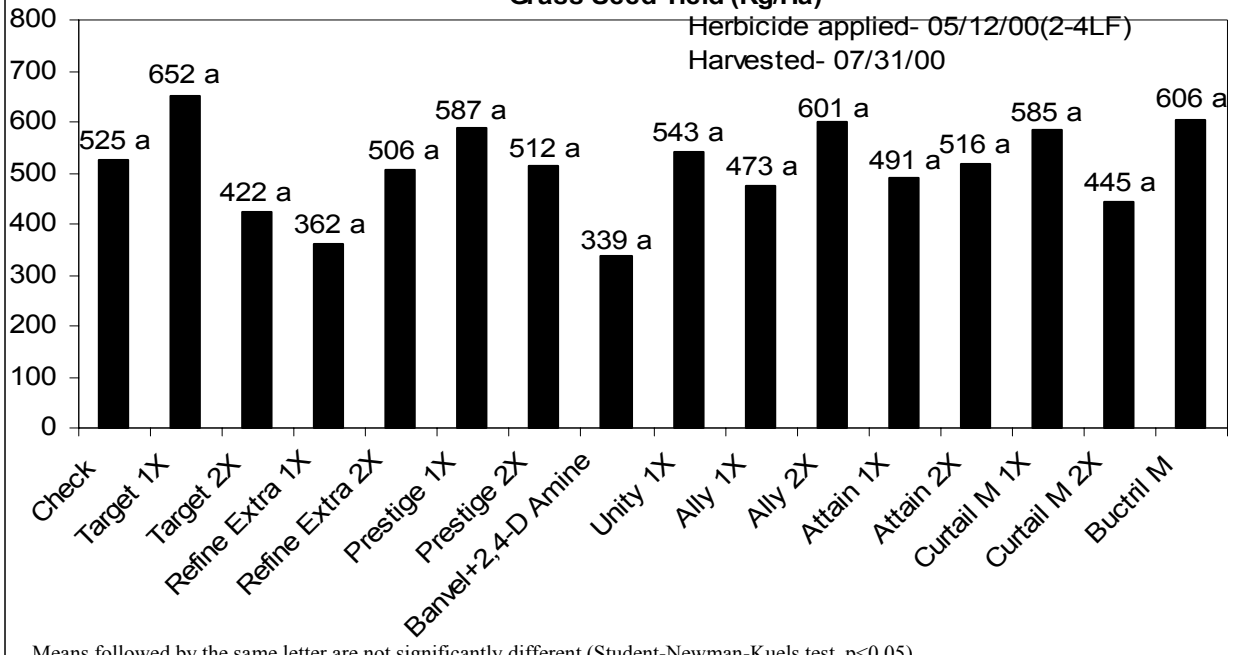


Means followed by the same letter are not significantly different (Student-Newman-Kuels test, p<0.05)

Figure 35. Tolerance of 1 Year Old Established Chewings Fescue to Broadleaf Herbicides 2000 (Exp#C10)

Edmonton- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)



Means followed by the same letter are not significantly different (Student-Newman-Kuels test, p<0.05)

Figure 36. Tolerance of 1 Year Old Established Chewings Fescue to Graminicides 2000 (Exp#C11)

Beaverlodge - Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)

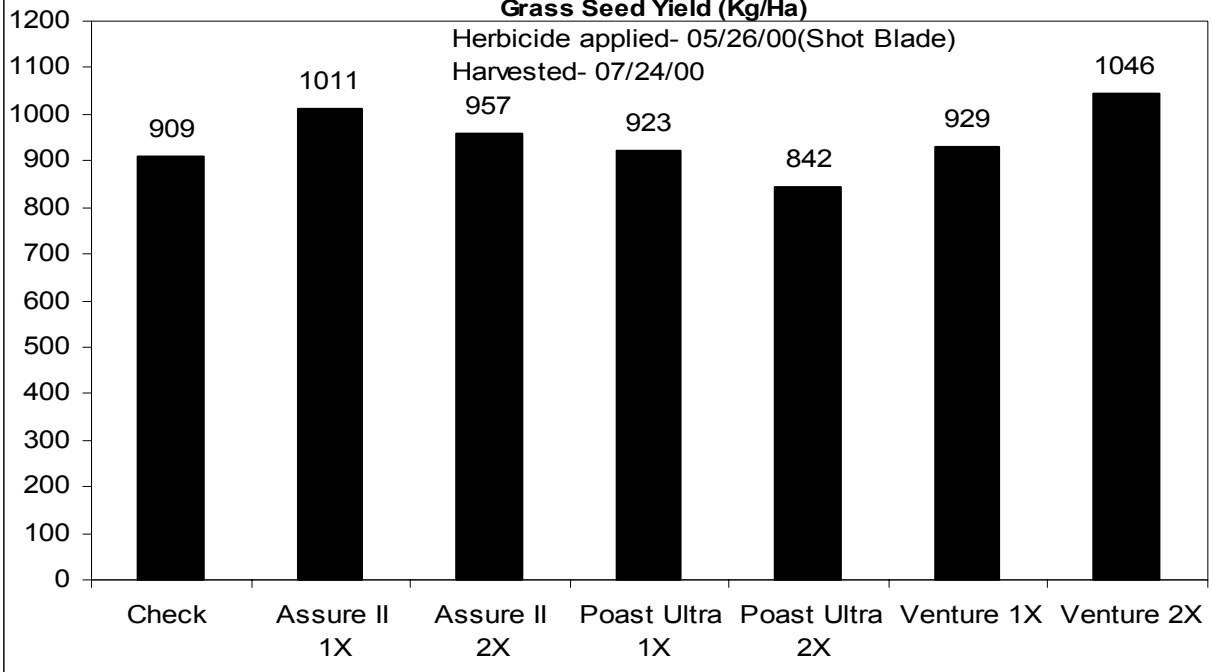
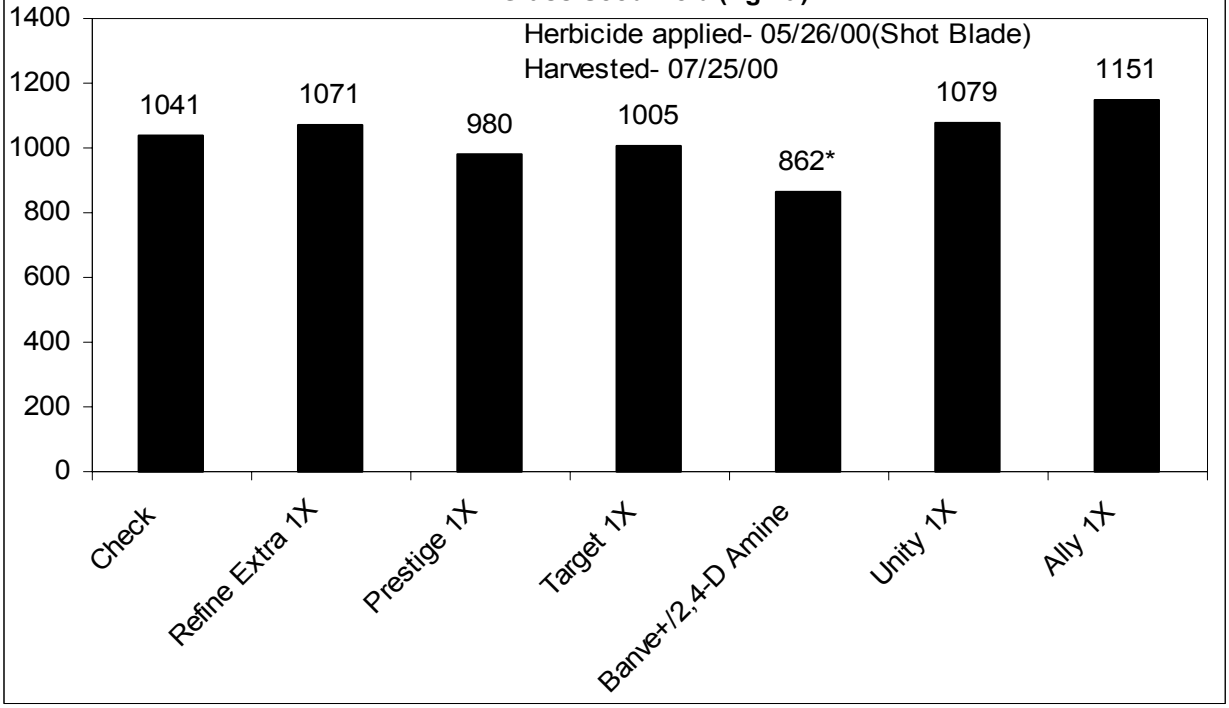


Figure 37. Tolerance of 1 Year Old Established Chewings Fescue to Broadleaf Herbicides 2000 (Exp#C12)

Beaverlodge- Harvested The Year of Herbicide Application

Grass Seed Yield (Kg/Ha)



BIOGRAPHICAL DATA

This personal information is being collected for the purpose of assessing the researchers' qualifications under the authority of the AARI Act. It is subject to the provisions of the Freedom of Information and Protection of Privacy Act.

Name (surname first):
Cole, Daniel Ernest

Post-Secondary Education and Training Relevant to Proposal:

Institution	Field Specialization	Degree/Diploma	Year Completed
University of Alberta	Plant Science	M.Sc.	1998
University of Alberta	Plant Science	B.Sc.	1972

Relevant Professional Experience (begin with present position):

Dates	Position or Function	Employer	Location
1988 to present	Weed Specialist	AAFRD	Edmonton
1979 - 1988	Weed Research Assistant	AAFRD	Edmonton
1976 - 1979	Research Technician	University of Alberta	Edmonton
1973 - 1976	Agriculture Extension	CUSO	Thailand

Research Activities Related to Research Proposal (list up to 4 projects):

Title	Date
Integrated Control of Ox-eye Daisy in Pastures and Hay Land	1995 - 1998
Integrated Control of Toadflax, Tansy and Wild Caraway in Pastures and Hay Land	1992 - 1997
Integrated Control of Canada Thistle in Pastures and Hay Land	1988 - 1991
Control of Scentless Chamomile, White Cockle and Narrow-leaved Hawk's-beard in Hay Land	1986 - 1991

Relevant Articles Published in Refereed Journals and Other Relevant Works in the Last Three Years

Cole, D.E. 1998. Effect of competition on growth of ox-eye daisy (*Chrysanthemum leucanthemum* L.) in pastures and hayland. M.Sc. Thesis. 156 p.

Darwent, A.L., D.E. Cole and N. Malik. 1997. Imazethapyr, alone or with other herbicides for weed control during alfalfa (*Medicago sativa*) establishment. Weed Technol. 11:346-353.

ith, E.G., H.M. Barbieri, J.R. Moyer, and D.E. Cole. 1997. The effect of companion crops and herbicides on economic returns of alfalfa-bromegrass establishment. Can. J. Plant Sci. 77(2):231-236.

Co-applicant (1) - Biographical Data

This personal information is being collected for the purpose of assessing the researchers' qualifications under the authority of the AARI Act. It is subject to the provisions of the Freedom of Information and Protection of Privacy Act.

Name (surname first):

Yoder, Calvin

Post-Secondary Education and Training Relevant to Proposal:

Institution	Field Specialization	Degree/Diploma	Year Completed
University of Alberta	Agriculture/Forages	B. Sc.	1990

Relevant Professional Experience (begin with present position):

Dates	Position or Function	Employer	Location
1994 - present	Forage Specialist	Alberta Agriculture, Food and Rural Development	Spirit River
1991 - 1994	Applied Research Agrologist	Smoky Applied Research And Demonstration Assoc.	Falher

Research Activities Related to Research Proposal (list up to 4 projects):

Title	Date
Tolerance of tall fescue to herbicides	1996 - present
Tolerance of creeping red fescue to herbicides	1996 - present
Tolerance of creeping red fescue to cleaver controlling herbicides	1997 - present
Tolerance of timothy to broad-leaved weed herbicides	1998 - present

Relevant Articles Published in Refereed Journals and Other Relevant Works in the Last Three Years

Yoder, C., N. Fairey and D. Cole. 1998. Tolerance of Established Tall Fescue to Broad-leaved Herbicides for Seed Production Purposes - Deadwood. Expert Committee on Weeds Research Report, Western Section. P. A1

Yoder, C., D. Stevenson and L. Darwent. 1998. Tolerance of Established Creeping Red Fescue to Cleaver Controlling Products For Seed Production Purposes - Spirit River. Expert Committee on Weeds Research Report, Western Section. P. A5.

Yoder, C., J. Drabble and D. Cole. 1998. Tolerance of Seeding Creeping Red Fescue to Graminicides- Beaverlodge. Expert Committee on Weeds Research Report, Western Section. P. A7.

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BIOGRAPHICAL DATA

Name (surname first):

LICKACZ, Jerome

Post-secondary Education and Training:

Institution Completed	Field of Specialization	Degree/Diploma	Year
University of Alberta	Agriculture/Soils	B.Sc.	1971

Relevant Professional Experience (begin with present position):

Dates	Position or Function	Employer	Location
1993 to present	Forage Agronomist	AAFRD	Edmonton
1984-93	Head, Soil Improvement	AAFRD	Edmonton
1972-1984	Soils Instructor	Fairview College	Fairview

Research Activities:

Title	Date
Nutrient Requirements Of Forages Grown On Organic Soils	Complete
Effects Of Fertilization And Date Of Harvest On Regrowth Of Timothy	Complete
Effects Of Rates, Placement And Forms Of Nitrogen On Yield Of Timothy	Complete
Effect Of Rates And Placement Of Phosphate On Yield Of Alfalfa And Red Clover	Complete
Interaction Of Nitrogen And Sulphur On Yield And Quality Of Timothy	1994
Interaction Of Sulphur And Selenium Fertilizers On Selenium Content Of Forages.	1994
rient Requirement of Mixed Forages	1995
Evaluation of Industrial By-Products as Sulphur Sources for Forage Crops	1996
Evaluation of Pulp and Sawmill By-Products as Liming Material for Agricultural Soils	1993

Relevant Articles Published in Refereed Journals and Other Relevant Works:

Lickacz, Jerome. 1998. Nutrient requirement of mixed forages. AARI Interim Report #95E108.

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