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Final Research Report

Research & Feasibility Report for a Lawn Seed Crop Insurance Program
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A report prepared for

United States Department of Agriculture
Federal Crop Insurance Corporation
Risk Management Agency

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EXECUTIVE SUMMARY

This report examines the feasibility of applying crop insurance to the production of seeds of selected grasses used for turf. The grasses examined are: perennial ryegrass, tall fescue, fine fescue, Kentucky bluegrass, creeping bentgrass, Bermuda grass, and bahia grass. Information for the study was collected through personal interviews, a mail survey of growers in Oregon, Minnesota, California, and Florida, and from secondary sources. Survey data were analyzed to develop a preliminary set of insurance rates.

The principal conclusions of the study are as follows:

- Production of these grass seed crops is highly concentrated in a small number of areas that satisfy the growing requirements of the individual crops. Cool season grasses are grown principally in the Willamette Valley of Oregon and parts of Missouri, Washington, Idaho, and Minnesota. Of the warm season grasses, Bahia grass is grown in Florida and adjoining states while Bermuda grass is primarily grown in California's Imperial Valley.
- Beyond the need for favorable weather conditions, the production of grass seed requires highly specialized systems of production and intensive management.
- Grass seed production is subject to a range of disease and pest risks though weather events, particularly the timing of rainfall, are the key determinants of fluctuations in yield. Overall, growers in most of the main production areas do not view grass seed as a high risk crop.
- A mail survey of producers in four key production areas was conducted in the spring of 2005. With the exception of the Minnesota survey that had a 99 percent response, survey response rates of around 25 percent were disappointingly small.
- As suggested by these response rates, grower interest in development of a grass seed crop insurance program appears high in Minnesota while restrained in the other three states.
- For many of the grass seed growers in Missouri, California, and Florida, grass seed production is largely incidental to other farm enterprises, including beef production and haying. As a result, it is concluded that an insurance product is probably not feasible for grass seed growers in these areas.
- Most of the grass seed grown in Oregon and Minnesota is either grown under contract or for use as certified seed. Only 41 percent of California producers and 23 percent of Florida producers reported growing their crops under contract.

- Given the relatively small number of growers of some of the minor species (e.g. creeping bentgrass and the fine fescues) and the diversified nature of the production of fescue in Missouri, Bermuda grass in California, and bahia grass in Florida, we concluded that it would not be feasible to develop crop insurance products for these crops. We concluded that tall fescue and perennial ryegrass in Oregon, and Kentucky bluegrass in Minnesota are the best candidates for a lawn seed pilot program.
- Using production data collected through the survey in combination with data from secondary sources, a simulation model was used to estimate insurance rates under coverage levels of 50 percent to 75 percent and at 75 percent and 95 percent confidence levels. In comparison with the established rates for other crop insurance programs available in these growing areas, it was concluded that the estimated rates for the indicated grasses are comparable in Oregon and lower in Minnesota.
- We recommend that RMA proceed in development of a modest-scale pilot program for tall fescue and perennial ryegrass in Oregon and Kentucky bluegrass in Minnesota. We suggest that this be done in two stages, first, by developing the general outline of the proposed program and second, by taking the outline to growers in these areas for their reactions. Only after RMA is satisfied that there is a market for the product do we recommend proceeding to further development and implementation of the pilot.
- While price variability was one of the concerns cited by the producers responding to the survey, the absence of market price information for lawn seed leads us to recommend an APH program.
- In developing the program, we recommend that it be patterned in part after the Forage Seed Pilot Program. This includes covering only those crops grown under contract and/or grown as certified seed and use of minimum stand requirements. We also recommend that the Agency take a conservative approach to setting rates for the program.

SECTION 1: INTRODUCTION

1.1 Purpose

This report examines the feasibility of applying crop insurance to the production of seeds of selected grasses that are used for turf purposes. The study, initiated on May 1, 2003, was conducted on behalf of the Risk Management Agency (RMA) of the U.S. Department of Agriculture. The types of grasses included in the study are: perennial ryegrass, tall fescue, fine fescue, Kentucky bluegrass, creeping bentgrass, Bermuda grass, and bahia grass.

The purpose of this Final Research Report is to review information collected in the course of conducting the study, to interpret its implications for developing and implementing a crop insurance program for producers, and to make recommendations to RMA.

1.2 Methodology

This study has been conducted in three phases. The initial phase was devoted to fact finding. The six Subject Matter Experts (SMEs) who took part in the study were particularly helpful during this phase. In response to a request to provide information on specified topics relevant to the study, the SMEs assembled relevant information and forwarded it to project staff for review. In addition, individual SMEs responded to numerous telephone and e-mail questions and in some cases met with project staff to discuss aspects of the study.

To collect additional information from key stakeholders in the grass seed industry, a series of on-site interviews were conducted in Oregon, Washington, Idaho, and Missouri. These interviews were conducted with seed producers, seed company representatives, grower association representatives, university extension and research personnel, USDA field staff, and seed certification officials. This initial phase concluded with the preparation of an Interim Report, submitted to RMA on August 15, 2003. This report contained a brief overview of the industry, a description of the production and marketing of the grass seed crops under study, and a summary of the findings to date and their implications for the remainder of the study. Among other conclusions, it was recommended that fescue seed production in Missouri be excluded from further analysis due to characteristics that make it an unlikely candidate for an insurance program.[1]

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[1] Among the findings that led to this recommendation are the following: (a) for most growers in Missouri, fescue seed is considered a by-product of growing fescue hay and therefore is not managed as a separate crop, (b) the general absence of reliable historical data, (c) a heightened risk of weed contamination from the many low-management farms, and (d) the relatively small number of fescue growers who are applying best management practices and would qualify for insurance coverage. Should the relatively small number of progressive Missouri growers now specializing in the production of fescue seed expand in the future, this finding should be revisited.

In the second phase of the study, a mail survey of grass seed producers in key production states was conducted. Oregon producers of tall fescue, perennial ryegrass, Kentucky bluegrass, Chewings fescue, red fescue, and creeping bentgrass were surveyed. So too were producers of Bermuda grass in California's Imperial County and producers of bahia grass in Florida. After the study was underway, Minnesota producers of Kentucky bluegrass and perennial ryegrass were added to the study and were also surveyed. While producers of Kentucky bluegrass in the state of Washington were considered a viable candidate for inclusion in the study, we lacked a suitable list of growers that could be used in conducting the survey, so opted to concentrate on production in neighboring Oregon.

Given the relatively small number of producers, the entire universe of growers was surveyed in each of the four production regions. Lists of names and addresses were obtained from a variety of sources. A list of 1,174 Oregon grass seed producers was provided by the Oregon Seed Council. The Oregon Seed Council is the principal grower association representing Oregon's grass seed industry.

The mailing list for producers of Bermuda grass seed was secured from records of the Imperial County (California) Agricultural Commissioner's office. Imperial County is the leading source of Bermuda grass seed production in the nation, accounting for around 85 percent of the total in 2002. Though this list contained the names of 120 growers of Bermuda grass, it was anticipated that approximately half of this number would not qualify to complete the survey in that they grow Bermuda grass solely for purposes of cutting hay rather than harvesting seed. The Subject Matter Expert for Bermuda grass reviewed the list and confirmed its completeness.

Mailing lists for producers of bahia grass in Florida and Kentucky bluegrass and perennial ryegrass in Minnesota were obtained with the help of Risk Management Agency staff. A list of 174 Florida bahia grass seed producers was provided by the US Department of Agriculture's Farm Service Agency from their administrative records. For surveying Minnesota growers, the RMA obtained a list of 137 growers from industry sources in the state. Most of the Minnesota growers operate in Roseau and Lake of the Woods Counties in the Northwestern corner of the state.

About 10 days in advance of sending the survey, a pre-notification letter was sent to each grower. This letter alerted growers that the survey would be arriving and briefly described why the survey was being conducted and its potential benefit to the grass seed industry. A letter from the Executive Secretary of the Oregon Seed Council endorsing the study was included with the pre-notification letter going to Oregon growers. Nonrespondents were contacted up to three times, twice by postcard and once by letter accompanied by a replacement survey.

With the exception of growers in Minnesota, response rates were relatively low, as indicated in the table below. The response rate for growers in Oregon, California, and Florida ranged between 24 percent and 28 percent. Nearly all Minnesota growers (99 percent) responded, though over one-quarter of the addresses on the mailing list were undeliverable. The low response rates in Oregon, California, and Florida appear to have been due to a combination of (a) grower wariness of Federal programs, (b) timing of the survey due to delays in obtaining approval under the Paperwork Reduction Act, (c) respondent burden of retrieving the requested production data, and (d) lack of grower knowledge of and experience with crop insurance. The high response rate in Minnesota, in contrast, appears to be largely due to the interest of Minnesota's grass seed industry in the development of a crop insurance program for their industry. Growers in this region have historically made extensive use of crop insurance for other crops.

Table 1: Number of Grass Seed Growers Surveyed and Number of Responses, by State, 2005

	Oregon		California		Florida		Minnesota	
Item	number	%	number	%	number	%	number	%
Initial mailing list	1,174	---	120	---	174	---	137	---
Undeliverable	67	---	1	---	13	---	39	---
Growers receiving survey	1,107	100.0	119	100.0	161	100.0	98	100.00
Responded	305	27.6	28	23.5	44	27.3	97	99.0
Qualified to complete survey	149	48.9	13	46.4	24	54.5	52	53.6
Provided production data	111	36.4	10	35.7	15	34.1	44	45.4

Source: Research & Feasibility Report for a Lawn Seed Crop Insurance Program, August 2005.

The third and final phase of the study was devoted to analysis of the data collected during the two previous phases. Production data collected through the mail survey was analyzed using a simulation model.

1.3 Report Outline

The report is organized as follows. Section 2 provides an overall description of the lawn seed industry. This includes a brief history of the crop, a description of the major grasses and their principal production regions, and discussion of the economic significance of the crop. In Section 3, production and marketing practices are reviewed, first for cool-season grasses and then for warm-season grasses. Production and revenue risks for lawn seed production are examined in Section 4, again distinguishing between cool-season and warm-season grasses. This is followed in

Section 5 by a review of survey findings. Section 6 is devoted to actuarial analysis. Data collected through the survey supplemented by data from other sources are used to calculate a preliminary set of rates. The final chapter, Section 7, is devoted to a brief summary of the report's major conclusions followed by recommendations. Supplementary tables and a copy of the survey instrument appear in the Annexes.

SECTION 2: INDUSTRY BACKGROUND

2.1 History

Seed production began in the eastern and central regions of the US in the late 1800's to supply a growing nation with seeds for vegetables and flowers. By the early 1900's, vegetable and flower seed production had largely migrated to California to take advantage of the favorable climate. This was followed in the 1930s by development of the hybrid seed corn industry in the Midwest. This highly specialized industry evolved to supply farmers with seed of the newly developed corn hybrids. Because of the genetic nature of these hybrids, farmers could not save seed and therefore, had to purchase new seed each year to grow the crop. In contrast, seed industries that focus on the production of self-pollinated crops remained small, regardless of the number of acres grown. For example, wheat production is an extensive, worldwide enterprise, yet the production of wheat seed is a surprisingly small endeavor. Since wheat is a self-pollinated crop and commercial cultivars are not hybrids, many farmers save seed from harvest for planting the following year.

Forage seed crops were originally produced as a by-product of forage production in the Midwest. Grass seed crops were introduced as early as the 1920's as an alternative crop for farmers in the Willamette Valley of Oregon. During the 1930's and 1940's, farmers in the Pacific Northwest and elsewhere began planting additional acreage of forage grasses and legumes solely for seed production.

Ryegrass was especially well adapted to the wet soils of the Pacific Northwest and soon became an important crop. Grass seed also established itself as an excellent alternative crop for highly erodible foothill soils. The newly emerging forage seed industry in the Pacific Northwest developed rapidly in large part because of the favorable climate and the evolution of specialized management practices to take advantage of this climate. In the post-World War II period, the growing affluence of the USA and other nations in the industrialized world led to an increased demand for grass seed for lawns, highways, golf courses, and other recreational fields and facilities. As this demand increased, plant breeders at several universities and in companies began the development of grass cultivars specifically bred for use in turf applications.

Forage and turf seed production industries that developed in the Midwest had largely relocated to the Pacific Northwest by the 1960's. While relatively small volumes of cool-season grass seeds are grown in a number of states, the most significant source outside the Pacific Northwest is in Missouri, where tall fescue is produced. Although most seed production moved to the Northwest, the primary consumers of grass seed remain in the Midwest and in the eastern US. Production of turf grass seed in the US is now second only to corn seed production in economic value, with the majority of production taking place in the Pacific Northwest.

2.2 Major Production Regions

Grasses are categorized as either cool-season or warm-season grasses, depending on their tolerance of temperature extremes. Of the seven types of grasses included in this study, five are cool-season grasses and two are warm-season. Cool-season grass seeds are produced in far larger volumes than the warm-season grasses. In 2002, cool-season grasses accounted for 98 percent of the total volume of seed produced of these seven types.

Production of cool-season grasses is concentrated in two regions, the Pacific Northwest and Missouri, with smaller volumes spread among a number of other states. Within the Pacific Northwest, Oregon is the principal locus of production accounting for over 90 percent of the region's production in 2002 of ryegrass, fescue, bentgrass, and Kentucky bluegrass. Washington and Idaho primarily produce Kentucky bluegrass. Grass seed production in Missouri is largely limited to Kentucky 31, a long-established variety of tall fescue.

The two warm-season grasses studied, Bermuda grass and bahia grass, are also highly concentrated in their principal areas of production. Florida is the largest producer of bahia grass seed, accounting for 57 percent in 2002, although production in recent years has been shifting toward Alabama and Texas. Bermuda grass seed is produced largely in the Imperial Valley of California and adjoining areas of Arizona. In 2002, California accounted for 87 percent of US production with 103 of California's 105 Bermuda grass seed-producing farms located in Imperial County.

An overview of the production of selected grass seed species as reported in the 2002 Census of Agriculture appears in Table 2. Changes in the acreage and quantity harvested of these crops between the last two agriculture census years, 1997 and 2002, are shown in Table 3. Production of fescue, Bermuda grass, and Kentucky bluegrass increased sharply over this period while the production of ryegrass (annual and perennial combined)[2] declined slightly.

[2] The Census of Agriculture does not differentiate between annual ryegrass and perennial ryegrass.

Table 2: National and State Production of Selected Grass Seeds, 2002

Species/State	Number of farms	Acres harvested	Quantity harvested (000 lbs)
Fescue[a]			
National total	5,172	565,691	323,023
Oregon	807	188,101	241,967
Missouri	3,548	319,954	64,790
Ryegrass[b]			
National total	1,039	290,963	459,929
Oregon	814	280,222	456,542
Kentucky bluegrass			
National total	525	148,418	76,415
Oregon	96	18,090	16,349
Minnesota	59	22,097	5,369
Bermuda grass			
National total	184	42,617	16,757
California	105	34,281	14,499
Bentgrass			
National total	79	9,451[c]	4,656[c]
Oregon	77	9,361	4,634
Bahia grass			
National total	443	29,021	2,275
Florida	167	19,916	1,304
US Total	7,442	1,086,161	883,055

Source: USDA, NASS, 2002 Census of Agriculture

[a] Includes all types of fescue, including tall fescue and the fine fescues.

[b] Annual ryegrass and perennial ryegrass combined. Census of Agriculture does not differentiate between the two species. Annual ryegrass is not among the species included in this study.

[c] Estimated

Table 3: Change in National Production of Selected Grass Seeds Between 1997 and 2002

	Acres harvested			Quantity harvested		
Species	1997	2002	Percent change	1997	2002	Percent change
			(%)	(000 lbs)		(%)
Fescue	485,598	565,691	+16.5	214,605	323,023	+50.5
Ryegrass	313,449	290,963	-7.2	466,983	459,929	-1.5
Kentucky bluegrass	121,921	148,418	+21.7	59,830	76,415	+27.7
Bermuda grass	20,454	42,617	+108.4	8,924	16,757	+87.8
Bentgrass[a]	12.240	9,451	-22.8	6,325	4,656	-26.4
Bahia grass	23,912	29,021	+21.4	2,559	2,275	-11.1
US Total	977,574	1,086,161	+11.1	759,226	883,055	+16.3

Source: USDA, NASS, *2002 Census of Agriculture*
[a] Estimated

2.3 Economic Significance

Nationally, lawn seed production accounts for a very small share of total agricultural production. The six grass seed crops represented in Tables 2 and 3 accounted for 0.3 percent of all farms and 0.4 percent of all harvested cropland in 2002. Although there are no national estimates of the value of production of these grass seeds, we estimate their value at $440 million to $460 million in 2003. This is the equivalent of 0.2 percent of total farm sales and 0.4 percent of total crop sales that year.

Of course, given the highly concentrated nature of the production of these crops, their economic significance to the localities where they are produced is far greater. In the state of Oregon, for example, grass seed crops were valued at $350.8 million in 2004 making them the fifth highest value crop produced in the state that year. If the focus is further narrowed to the Willamette Valley, where most of the grass seed is grown, the relative importance of these crops is even greater. In Linn County, Oregon, the leading source of production in the state, grass seed accounted for 50 percent of all farm sales in 2004. In the state of Washington, Kentucky bluegrass seed production valued at $28.0 million in 2004 gave it a ranking of 25th highest value crop in the state. As noted above, the production of Bermuda grass seed is even more highly concentrated with Imperial County, California the dominant source. As a result, production valued at $10.3 million in 2004 made it the 21st most important crop in a large, highly irrigated county specializing in cattle and a wide variety of high-value vegetable crops.

In summary, in the national context these crops are of relatively minor economic significance while in a small number of areas where production is highly concentrated they have somewhat greater economic influence.

2.4 Data Limitations

Since grass seed production accounts for a relatively small share of national crop production, descriptive data on the industry is scarce. The only comprehensive national description of the industry is that provided by the Census of Agriculture with the 2002 Census results the most recent available at the time of this study.

Some state agricultural statistics agencies and state extension services publish data on seed production in their states. The most notable of these are in Oregon and Washington. The most comprehensive source of data is provided by the Oregon State University Extension Service for seed production in Oregon.

Care should be exercised in interpretation of grass seed data for two other reasons. First, there are many different types and varieties of grasses. In the absence of a common nomenclature, there is an opportunity for confusion. For example, the Census of Agriculture combines all ryegrasses (annual and perennial) in one category though we are interested only in perennial ryegrass for this study. Also, while one of the target species for this study has been described as "fine fescue", in reality the fine-leaved fescues are a related group of species and subspecies. The most economically important of these crops are: strong creeping red fescue, slender creeping red fescue, and Chewings fescue. Where the information permits, we distinguish among these subunits in the remainder of this report.

A second caution in the interpretation of the data relates to utilization of the seed. The focus of this study is on grass seeds that are used for turf (as opposed to forage) purposes. Since seeds harvested from many of these crops can be used interchangeably in both uses, it is not possible to know with certainty how the seed will ultimately be used. In general, however, most of the seed from the species included in this study is used for lawns, golf courses, parks, roadside margins, and other turf purposes.

SECTION 3: PRODUCTION AND MARKETING PRACTICES

In this section, we examine in some detail the practices followed in the production and marketing of lawn seed. The section is divided into two major parts, one for cool-season grasses and the other for warm-season grasses. Key production practices and marketing techniques are described for each category.

3.1 Cool-Season Grasses[3]

The principal cool-season grasses are perennial ryegrass, tall fescue, fine fescue, Kentucky bluegrass, and creeping bentgrass. These grasses are the subject of our inquiry. Of the five, perennial ryegrass and tall fescue are grown in largest volume. Production of these grasses is geographically concentrated with the Pacific Northwest (Oregon, Washington, and Idaho) accounting for 90.4% of the volume produced in 2002. Of this amount, Oregon alone accounted for 92.1%. In 2002, Minnesota accounted for about 7.0% of national production of Kentucky bluegrass seed.

Prior to the 1980s, some of these grasses, including perennial ryegrass and tall fescue, were grown primarily in other regions. Beginning in the early 1980s, production shifted in a major way to the Pacific Northwest with its favorable weather and a community of growers who were willing to invest in the specialized production systems and intensive management that were required.

Much of the information that is available and reported in this section is from research conducted in the Pacific Northwest and is therefore most applicable to production in this region.

3.1.1 Production Practices

3.1.1.1 Biological Principles and Production Stages

An understanding of the biological nature of plant development, its relationship to seed yield, and the impact of the environment on management is useful in understanding the role of management in producing grass seed.

a) Yield Components

Seed yield is the product of several components. The actual yield harvested usually falls short of the potential yield of any seed crop. The number of plants in the population or stand density is affected by self-thinning processes in most crops (Fig. 1). At high plant populations, the stand

[3] This section is based in part on material prepared by Dr. Thomas G. Chastain of Oregon State University, a consultant to this study.

density is reduced by signals triggered by crowding so that the density-dependent optimum is attained. This change in density can be achieved by plant mortality and/or reduced branching at high density or by increased branching at low population density.

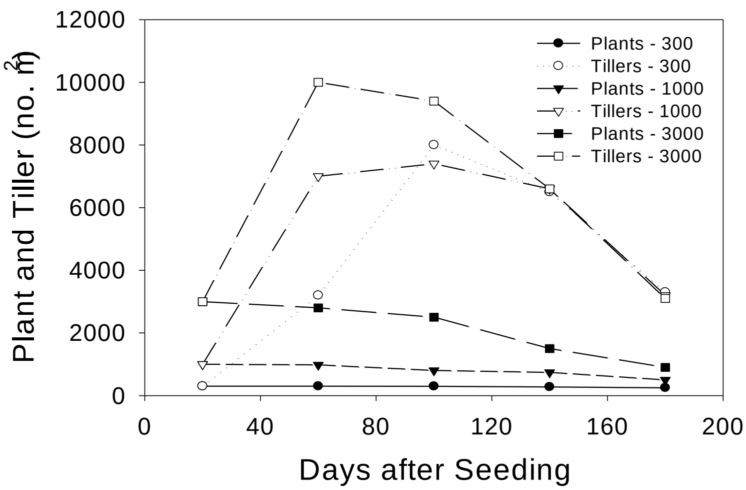

Figure 1. Planting density effects on plant and tiller number in perennial ryegrass. Perennial ryegrass was sown at 300, 1000, and 3000 plants/m². Redrawn from Kays and Harper, 1974.

The development of seed yield in cool-season perennial grass seed crops is comprised of two distinct phases: (i) establishment of the yield potential and (ii) utilization of the yield potential (actual yield at harvest). The components of seed yield potential in most cool-season grass species include (i) number of plants/area, (ii) number of fertile tillers/plant, (iii) spikelets/fertile tiller, and (iv) florets/spikelet. Components of actual seed yield include seed number and seed weight. Grasses pass through several developmental gateways to achieve the yield potential during flowering and realization of that seed yield potential at harvest. For instance, the number of fertile tillers present at harvest is a function of the proportion of the vegetative tillers present after the previous harvest that were induced to flower. A significant portion of the seed yield potential in cool-season perennial grasses is based on developmental processes taking place prior to flowering. Factors such as heat, drought, pests, nutrient deficiency, and others can individually and collectively, influence the realization of the seed yield potential during spring and summer months.

An estimate of seed yield is therefore the mathematical product of the yield components, i.e.:

Seed yield = Plants/Area x Fertile tillers/Plant x Spikelets/Fertile tiller x Florets/Spikelet x Seeds/Floret x Weight/Seed

The tiller is a branch on a grass plant and is the fundamental demographic unit of perennial grass populations. The number of fertile tillers is one component of seed yield potential in cool-season grasses that is set during vegetative development prior to flowering (Hebblethewaite *et al.,* 1980).

As much as 92% of the seed yield potential in several cool-season perennial grasses is set before flowering. Tiller population density at the cessation of fall regrowth has been positively correlated with fertile tiller number and subsequent seed yield.

Flowering in cool-season grasses requires two different environmental stimuli at two different points in time, first low temperature and/or short day length followed by long days and increasing temperatures. The post-harvest regrowth period is a critical phase of seed crop development that can strongly influence flowering and seed yield. The number and condition of tillers prior to the onset of an environment conducive to flowering are limited by a relatively short regrowth period in late summer and early fall. If regrowth of the crop is retarded by poor weather conditions or inadequate management, then fewer tillers will be in a receptive state when floral induction begins.

Vernalization is the promotion of flowering by exposure to low temperature. Vernalization is inherent in many plants of temperate origin. Some plants will not flower without low temperature exposure. In other plants flowering is hastened or intensified by low temperature exposure. Some perennial ryegrass genotypes within cultivars require low temperatures while others do not (Chastain, unpublished). In some species, both low temperatures and short photoperiods may be needed to induce flowering. Kentucky bluegrass is an example of a plant that requires both.

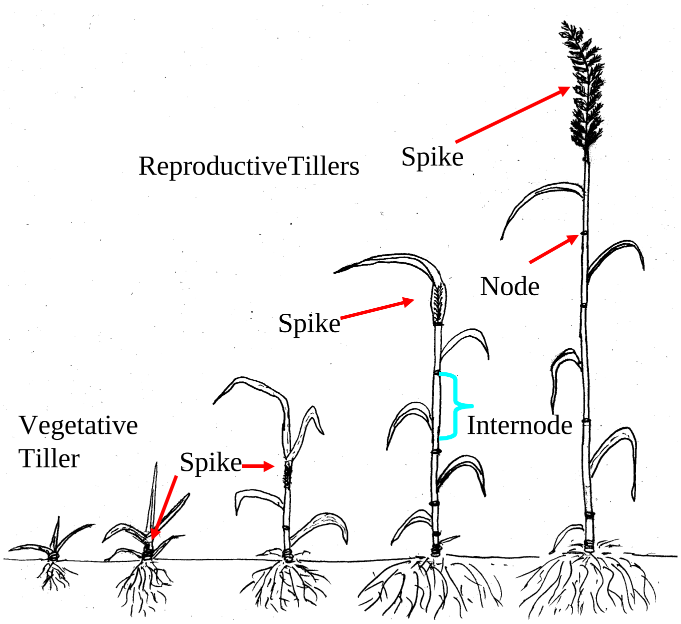

Figure 2. Not all tillers produce an inflorescence at the time of flowering. If all tillers were to become fertile (flower), the plant would cease to be a perennial and would die. Consequently, many vegetative, non-flowering tillers are present at the time of seed harvest. Also, the number of tillers that become fertile tends to decline as the age of the stand increases, thereby increasing the number of vegetative tillers present at harvest in older stands.

3.1.1.2 Planting Practices

Fine, firm seedbed conditions are required for successful seeding of cool-season grass seed crops. Primary tillage is often done with a disk although many producers use a moldboard plow, followed by disk tillage. The field needs to be rolled prior to seeding. The time of sowing depends on crop species and the location of production. Most grass seed crops are sown in spring with the notable exception of perennial ryegrass, which is mostly fall sown. Cool-season grass seed is planted with a drill at a shallow depth of ¼ to ½ inch, depending on the species. Grass seed crops are sown in rows rather than broadcast seeded in solid stands because field inspections for off-types are easier in rows and seed yield is generally greater when sown in rows.

Time of planting is an important consideration for grass seed production. Crop competition can aid in the suppression of weeds in grass seed fields. Early canopy closure increases shading which can decrease weed seed germination, and also leaves fewer open niches for weeds.

There are three fundamental planting systems for perennial grass seed crops. Two of these are considered to be conventional seeding practices in the Pacific Northwest; chemical seedbed and carbon seeding (also known as charcoal banding). The third method is companion cropping.

The chemical seedbed method is accomplished in three steps: (i) prepare seedbed in fall, (ii) control weeds with herbicides during winter, and (iii) drill crop in spring with minimum disturbance of the seedbed.

Carbon seeding is a two-step operation and is most often employed in the fall seeding of perennial ryegrass. First, an activated carbon-water slurry is applied over the seed during drilling. The final step involves application of a non-selective herbicide over the seedbed. The germinating crop seed is protected from the herbicide by the activated carbon in the charcoal band while weeds emerging outside this band are unprotected.

Companion cropping involves the planting of a slow-to-establish perennial grass seed crop with an annual crop, often a small grain cereal, in the same field. The availability of effective and economical herbicides has made seeding forages alone a viable alternative, and as a result, the practice of companion cropping has declined in the USA. A limited number of seed producers practice the seeding of grass seed crops with companion crops in the Pacific Northwest. In sandy soils or other soils prone to erosion, grass seed crops are sometimes sown with cover crops. Cover crops protect seedling grasses during establishment from wind and other adverse conditions, and protect the soil from erosion.

3.1.1.3 Fertility Management

Fertilizer management in grass seed crops requires a careful balancing of the costs of the nutrients and the benefits of the nutrient as measured by seed yield. Application of a complete fertilizer is made prior to planting and is incorporated into the seedbed or is banded near the seed at the time of planting. On established crops, nitrogen (N) is the only fertilizer element that gives consistent, economic increases in seed yield of cool-season grasses. N is vital because it stimulates tiller growth and development, and can therefore impact seed yield. The amount of N required depends on: (i) residual N in the soil, (ii) species – different species have different requirements for N, (iii) age of stand, (iv) moisture availability – water is needed to move N into the root zone and for plant uptake, and (v) susceptibility to lodging.

Phosphorus (P) is generally found in sufficient quantities in grass seed production. Phosphorus has only minimal effects on seed yield, but soil P levels should be maintained for best crop growth and development. Residue management can affect soil P status. Field burning of crop residue returns P to the soil, but baling removes P with the straw. Full straw load management (discussed below) maintains or increases P levels in the soil.

Potassium (K) can also be an important nutrient in grass seed production. Non-thermal management of crop residues has an effect on soil potassium oxide (K_2O) levels. Field burning recycles potassium in the soil whereas baling removes potassium with the straw. Full straw management maintains or increases soil K_2O levels.

Sulfur needs for grass seed crops are minimal. In some irrigated fields, sufficient sulfur might be present in the irrigation water to supply plant needs. Requirements for other nutrients in grass seed production have not been established nor has the need for these nutrients been shown to be limiting to seed yield.

3.1.1.4 Irrigation Management for Grass seed Crops in the Willamette Valley

Traditionally, most grass seed crops grown in the Willamette Valley have been produced without the aid of irrigation. However, the prevalence of later-maturing cultivars that mature during drier conditions than early-maturing cultivars, and the movement of grass seed crop production onto farms with irrigation have led to the increased use of irrigation. Unfortunately, very few studies have examined the impact of drought and irrigation on seed production.

In many years, a single application of water in late May or early June (prior to seed development) can be sufficient to supply the needs of the crop. Anecdotal reports by Willamette Valley seed growers indicate that yield increases in perennial ryegrass from a single irrigation range from 300 to 400 lbs/acre (equivalent to 20-25 percent of average yield). Dry springs can require multiple irrigations.

3.1.1.5 Harvest and Storage

There are two methods for harvesting grass seed crops: (i) windrow-combine method and (ii) direct combine method. The windrow-combine method is primarily used in the Pacific Northwest and other regions having low rainfall and humidity at the time of harvest. The standing crop is cut with a swather at high seed moisture content and the cut crop is dried in windrows until ready for combining (several days to 2 weeks, depending on weather). The crop is then threshed at about 12% seed moisture content by using combines with pickup attachments.

The optimum timing to windrow the crop is an issue of some importance to seed growers in the Pacific Northwest. Proper harvest timing can reduce the volunteer crop population in grass seed crops and maximize seed yield and quality. Several methods have been employed by producers with varying degrees of success. The visual observation method is based on the apparent readiness of the crop for harvest as determined by color of seed at maturity. This is not a reliable method as the crop at maturity can appear quite green when preceded by a long period of cool-dry weather. In the endosperm texture method, the crop is cut at the firm dough stage of the seed. This method is more reliable than basing the decision on the color of the seed but is still not very accurate. The seed shattering method is based on timing the cutting of the crop to when the seed starts to shatter when individual tillers are struck. Growers that use this method find that they are usually harvesting too late since shattering losses are great.

The seed moisture method is the most reliable method for determining time of cutting grass seed crops in the Pacific Northwest. Seed growers use electronic meters, exhaust meters, and microwave ovens to determine seed moisture content. Optimum seed moisture content for grass seed crops established by Klein and Harmond (1971) have been the recommended values for decades. More recent studies by Andrade et al., (1994) have concluded that maximum seed yield in tall fescue grown in the Willamette Valley could be attained when the crop is windrow harvested at 35 to 41% seed moisture content.

Table 4: Optimum seed moisture content for windrow harvest of grass seed crops (Klein and Harmond, 1971)

Grass Seed Crop	Seed Moisture Content (%)
Orchardgrass	44
Tall fescue	43
Perennial ryegrass	35
Chewings fescue	30
Kentucky bluegrass	28
Creeping red fescue	25

The direct combine method is used in Europe and other regions having high rainfall and high relative humidity at harvest, and is rarely employed by producers in the Pacific Northwest. Since seed is direct combine harvested at high seed moisture content, it must be artificially dried prior to storage, thereby increasing the cost of production.

3.1.1.6 Seed Yield

Seed yield of perennial grass seed crops can be influenced by factors other than growing conditions. Three factors identified during this study deserve special mention. One of these is the age of the stand. With the exception of the first year when seed crops are often not fully established, seed yield usually declines with each successive year's harvest as the stand ages. The cause or causes of this decline in yield are not fully understood, though they are widely observed. In perennial ryegrass, the seed yield potential (expressed as floret production) and reproduction efficiency (seed: floret ratio) both decline as the stand ages, resulting in lower seed yields. Results from experimental stands in the Willamette Valley of Oregon are shown in Figure 4 and Table 5.

A second factor that can affect yield is the variety of seed within a given species. Most species of lawn seed are produced under contracts that run for 3 or 4 years, with a few exceptions. Some production in the Columbia River Basin is for only one year. Likewise, perennial ryegrass seed production in Minnesota is treated as an annual crop. With each new contract, there is very often a change in variety. Seed companies are continually developing new varieties in an effort to strengthen the marketability of their seeds.

Given the absence of yield data at the variety level and the rapidity with which new varieties are introduced, it is difficult to know how much effect variety has on yield. Grass seed specialists at Oregon State University tell us that although differences exist, they are probably no more than

10 to 15 percent. While there is no reliable evidence that we know of to confirm this, that is the professional judgment of these specialists. It is their belief that the much larger differences in yield that are observed in the field are associated with other exogenous factors such as soil type, field drainage, water and nutrient availability, and management practices.

A third factor that was observed to effect yields of Kentucky bluegrass seed in Minnesota was the practice of bringing portions of a given field into and out of production. When yields in part of a field fall due to a part of the field becoming sod-bound, growers will often "strip" that portion of the field. Conversely, Minnesota growers frequently replant portions of an established field. As a result, a given field might contain a combination of newly planted and established stands of various ages. This can obviously have an important impact on the measured yields of these fields.

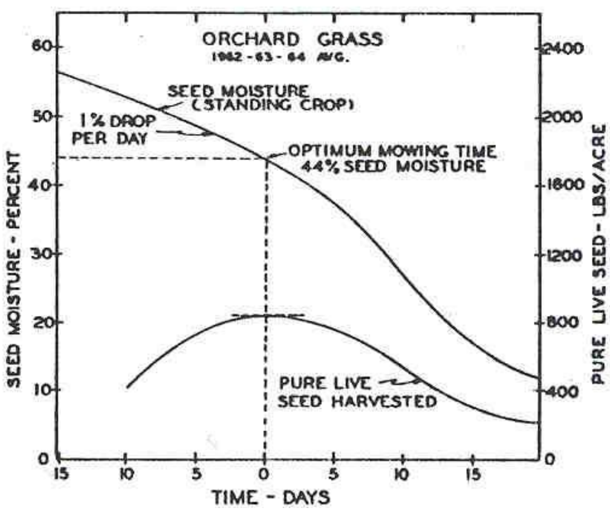

Figure3. Seed moisture and harvest timing effects on seed yield in orchardgrass seed crops (Klein and Harmond, 1971).

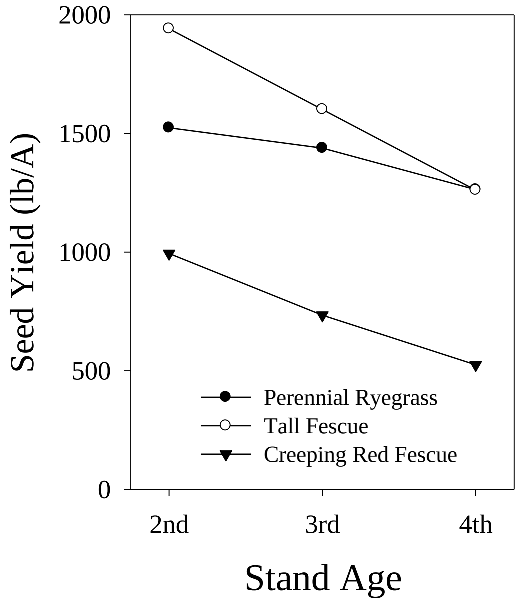

Figure 4. Stand age effects on seed yield of perennial grass seed crops in the Willamette Valley (Chastain, unpublished).

Table 5: Effect of stand age on seed yield, seed yield potential, and reproductive efficiency in three stands of Cutter perennial ryegrass in the Willamette Valley. The experimental stands were seeded in three consecutive years and harvested over a three-year period. (Chastain, unpublished).

	Stand Age		
Harvest Year	1st Year	2nd Year	3rd Year
		lbs/acre	
1998	1284		
1999	2144	1393	
2000	1753	1325	1040
2001		1108	1276
2002			1049
Stand Age Means:			
Seed Yield (lbs/acre)	1727	1275	1122
Potential Yield (florets/ft^2)	54,652	47,839	43,340
Reproductive Efficiency (%)	17.7	14.9	15.0

3.1.1.7 Post-Harvest Field Practices

Post-harvest management of crop residue is essential for attaining consistent high seed yields in grass seed crops. Historically, field burning was an important residue management practice in cool-season grass seed crops grown in the Pacific Northwest. Residue burning was used for several reasons, including disease control, weed control, and stimulation of seed yield. In recent years, public concern over air quality led to regulation of field burning and to the identification of alternative residue management practices. Agronomically feasible alternatives to field burning have been found to exist for all species grown in the region except for creeping red fescue.

Studies were initiated in the 1960's to find alternatives to field burning for grass seed crops grown in the Pacific Northwest (Chilcote, 1968). Legislation adopted in Oregon in 1991 required a gradual reduction in the number of acres burned in the Willamette Valley. Field burning in the Willamette Valley is regulated by the Department of Agriculture and is restricted to 40,000 acres for all species, with another 25,000 acres set aside for steep terrain and species that have shown an economic response to field burning. In recent years, around 50,000 acres have been burned, on average. In 2004, just over half (54 percent) of the acreage burned was planted to annual ryegrass. Elsewhere in Oregon, field burning is locally regulated by special field burning districts. In Idaho, field burning is regulated by the state, but the acreage allowed for burning is not restricted.

In the state of Washington, rules imposed by the State Department of Environmental Quality in 1996 virtually eliminated the burning of grass seed crop straw and stubble by 1999.

Three major approaches to residue management of perennial grass seed crops have evolved in the Pacific Northwest; thermal, clean nonthermal, and full straw load.

a) Thermal Management

Field burning was used in the past because it provided disease control, especially diseases of the seed including blind seed and ergot, though not foliar diseases. Weed control was aided by field burning as fire destroys volunteer crop seed, weed seed and weed plants. In creeping red fescue, field burning has a direct stimulative influence on seed yield, but this is not observed in other grass seed crops. Field burning also recycles several important nutrients to the soil including potassium and phosphorus but not nitrogen.

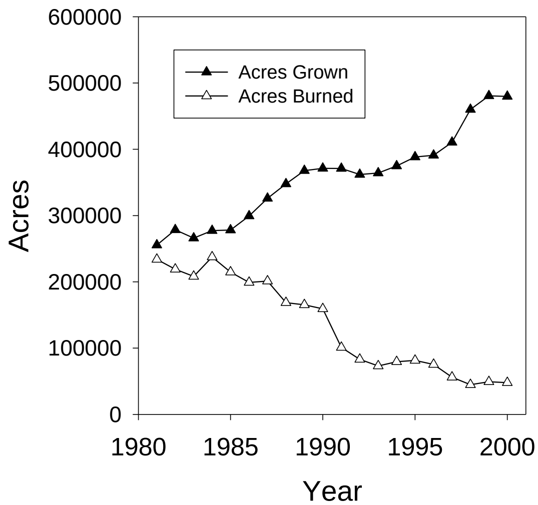

Figure 5. Grass seed production acreage and field burning acreage in the Willamette Valley.

For awhile, propane burning of straw and stubble was used primarily by perennial ryegrass and tall fescue producers in the Willamette Valley as a replacement for field burning, but the practice was an expensive and highly regulated management alternative. Consequently, interest in propane burning has waned and few acres are now managed by this method in the Willamette Valley. Some propane burning continues in the Grande Ronde Valley of northeastern Oregon, where it is used as a field-burning substitute for Kentucky bluegrass and Chewings fescue seed crops. However, in general Willamette Valley growers have turned to other options.

b) Clean Nonthermal Management

Economical clean nonthermal management in Oregon has been made possible by the development of an off-farm straw removal and handling industry. 'Straw farmers' are independent operators who bale and remove straw after harvest of grass seed fields. Some grass seed producers bale their own straw after harvest. The straw is stored or is shipped directly to bale compressor facilities where the bulk is reduced for export to international straw markets, especially Japan. Some straw is also used for animal feed within the region. Baling removes on average about 75% of the straw remaining after harvest (by weight). Stubble management by flail mowers or rotary mowers is also a major component of clean nonthermal management.

Numerous studies have been conducted in recent years to determine the effect on seed yields of alternative nonthermal residue management techniques. The alternatives range from leaving all the straw in the field (full straw load) to baling to baling combined with the removal of remaining residue using different techniques. The studies indicate that species with a bunch-type growth habit (e.g. tall fescue, orchardgrass, and perennial ryegrass) are more tolerant of residue management without straw removal. Perennial ryegrass and tall fescue seed yields are best maintained over the life of the stand by nonthermal management practices that remove more than 60% of the straw. Field burning is not required to maintain seed yield of tall fescue and perennial ryegrass under Oregon conditions (Young et al., 1999). Orchardgrass seed yield is equally responsive to any of the residue management possibilities.

Several clean nonthermal management methods produce seed yield that are equivalent to field burning in Kentucky bluegrass, Chewings fescue, and dryland bentgrass, but not in creeping red fescue. Clean nonthermal management is more difficult in species with a creeping-type growth habit. Rhizome forming grass seed crops are perhaps the most difficult to manage crop residues without the use of fire. Chastain et al. (1997a) found that Kentucky bluegrass seed yield averaged across a three-year period was reduced 38% when managed with full straw loads and 10% when managed by baling compared to burning. Crop regrowth, fertile tiller production, and seed yield resulting from rake and vacuum treatments were equivalent to burning. Rake and vacuum treatments reduced stubble height and removed at least 90% of the straw. High seed yield and quality can be maintained in Kentucky bluegrass without open-field burning when straw removal is thorough and stubble height is reduced prior to crop regrowth.

Low stubble height may be an important aspect of post-harvest management in rhizome forming grass seed crops. Results show that highest seed yields with nonthermal management of Kentucky bluegrass and creeping red fescue will generally be obtained by reducing stubble height to less than 1.5 inches (Chastain and Young, 1999). Stubble removal tended to improve seed yield in Kentucky bluegrass more in young stands than in old stands. Thompson and Clark (1989) reported that fertile tiller production and seed yield in Kentucky bluegrass was greater when straw was removed and stubble height was reduced to 2.5 cm than with only straw removal. Kentucky bluegrass seed yields with nonthermal management are equivalent to burning when stubble and straw removal is thorough, but may not be as economical as open-field burning. Nonthermal management is not a reliable method for seed production of creeping red fescue regardless of stubble height.

c) Full Straw Management

Management of crop residue without removal by baling has become a common practice in grass seed production in Oregon's Willamette Valley. This form of residue management is commonly known as full straw management. Several forms of chopping a full straw load in place have evolved as seed growers seek low-cost residue management alternatives. Full straw management is a reasonable alternative that allows producers to forego baling when straw might not meet quality standards. Moreover, some growers object to the potential loss of important plant nutrients when straw is removed by baling and instead desire the benefits of nutrient cycling associated with the decomposition of the straw. Other growers have used the full straw load as a mulch to aid in the suppression of troublesome weeds. Despite the growing acceptance of full straw management, several potential risks have been identified.

The quantity of straw remaining on the field after harvest differs among the species. Full straw loads often exceed 6000 lbs. per acre in perennial ryegrass, tall fescue, and orchardgrass. In Chewings fescue and Kentucky bluegrass, the full straw load usually ranged from 4000 to 5000 lbs. per acre.

Full straw management often increased the height of tillers and reduced tiller numbers at the end of fall regrowth. These negative impacts on crop regrowth in fall sometimes caused reductions in fertile tiller number in the following spring.

Seed yields in tall fescue and perennial ryegrass are dependent on stand age. Full straw loads tend to reduce seed yield in tall fescue during the 4th year and during the 3rd and 4th year in perennial ryegrass. Chewings fescue and Kentucky bluegrass will not tolerate full straw load management as seed yield is consistently low regardless of stand age.

Crop cultivar also affects seed yield responses to full straw management. Some cultivars of tall fescue and perennial ryegrass are tolerant of full straw management over the entire stand life. Other cultivars of both species exhibit reduced seed yield in old stands managed with a full straw load but not in young stands.

Full straw management can be a profitable practice for grass seed production, but this practice is not without risks. Some pest problems may be increased by full straw management. There is also a potential for increased costs in cleaning the seed when the crop is managed with a full straw load.

d) Pest and Fertility Management Considerations

Growers have noted that premature losses in stand have been widespread and have been accompanied by herbicide-induced crop damage. Restrictions on herbicide availability and use, and reductions in open-field burning have resulted in increased volunteer crop contamination of seed fields and some increases in weedy grass species have been reported. Control of volunteer perennial ryegrass plants and tall fescue plants is essential for maintaining seed yield in the absence of field burning.

Full straw loads can increase the incidence of some weeds and volunteer crops in fields, but the mulch effect can reduce the incidence of other weeds (Mueller-Warrant, 1999). Full straw loads have been observed to reduce annual bluegrass infestations; this weed is one of the hardest to control in grass seed production. Foliar diseases do not appear to have increased in incidence or severity as a result of full straw management though rodents, including the gray tailed vole, and slugs have become more prominent.

Decomposition of the straw layer over time from full straw loads has been found to result in a marked improvement in several important soil characteristics and in nutrient levels.

3.1.1.8 Production Economics

Information on the economics of grass seed production is largely limited to enterprise budgets that have been constructed to estimate the costs and returns on typical farms in major growing areas. Enterprise budgets are available for perennial ryegrass, tall fescue, and Kentucky bluegrass in Oregon and for Kentucky bluegrass in Washington and Idaho. While the budgets for Kentucky bluegrass have been developed within the past two or three years, the budgets for perennial ryegrass were developed in 1995 and the budgets for tall fescue date back to 1992. Thus, they are somewhat dated both in terms of the monetary value of inputs and the practices and techniques of production. Nonetheless, those budgets are illustrative of the economics of producing grass seed.

Summaries of budgets for the production of perennial ryegrass and tall fescue in the South Willamette Valley appear in the table below. Separate budgets are shown for the year in which the crops are established and the remaining years of the stand. For perennial ryegrass, it was assumed that a seed crop was harvested in Year 1 and in each of two additional years. For the tall fescue crop, it was assumed that no crop was harvested in the establishment year and that crops were harvested in each of three succeeding years. The costs of establishing a grass seed crop generally exceed the value of returns in the first year, even with harvest of a normal crop. Thus, the net cost of production in Year 1 is amortized across the remaining production years. In the case of the tall fescue budget, since no revenue was generated in the establishment year, the entire cost of Year 1 must be amortized across the remaining three years of production.

In constructing these budgets, the authors assumed a constant yield throughout the life of the stand. In practice, average yields are often lower in the first year, peak in the second and/or third years, and then decline somewhat. It will be noted that average yields have continued to rise since these budgets were constructed. In 2002, the average yield of perennial ryegrass in Oregon was 1,400 lbs/acre (down from a high of 1,490 in 1999), while the average yield of tall fescue reached a record 1,550 lbs/acre. In 2003, the final year for which survey data were collected in this study, average yields of both crops declined: to 1,256 lbs/acre for perennial ryegrass and to 1,442 lbs/acre for tall fescue.

Table 6. Enterprise Budgets for Production of Perennial Ryegrass and Tall Fescue, South Willamette Valley, Oregon, 1992-95. ($/acre)

	Perennial Ryegrass, 1995		Tall Fescue, 1992	
	Est. year	Years 2-3	Est. year	Years 2-4
VARIABLE COST				
Seed Establishment				
Soil preparation	20.65	---	18.68	---
Lime application	47.00	---	80.00	---
Planting	80.64	---	21.68	---
Herbicide	59.92	---	45.82	---
Slug control	2.92	---	8.60	---
Certification	.50	---	---	---
Total	211.63	---	174.78	---
Pre-harvest				
Fertilizer	43.94	70.24	---	58.91
Herbicide/fungicide	66.92	110.34	---	55.32
Certification	2.00	2.00	---	2.00
Harvest	112.84	112.84	---	106.21
Post harvest	6.54	6.54	---	10.90
Miscellaneous	60.91	55.03	52.07	45.41
Total variable	504.30	356.99	238.64	278.75
FIXED COST				
Insurance	5.13	3.47	3.06	1.75
Land	70.00	70.00	65.00	65.00
Amortized Establishment	---	63.31	---	116.89
Depreciation	67.55	45.05	48.31	29.88
Total fixed	142.68	181.82	116.37	213.52
Grand Total	646.99	538.82	355.00	492.27
Breakeven	$.45/lb.	$.45/lb	---	$.40/lb.
Yield/acre	1,200	1,200	0	1,200

Source: Oregon State University Extension Service

3.1.2 Marketing Practices

Most grass seed crops grown in the Pacific Northwest are produced under contract with seed companies. Essentially all Kentucky bluegrass and creeping bentgrass are produced under contract and an estimated 90 to 95 percent of perennial ryegrass and tall fescue are grown under contract. There are 55 seed companies operating in Oregon; 12 of them are considered industry leaders. Each company has its own contract form, though terms are similar among all of them.

Under terms of these contracts, seed growers are obligated to plant the seed stocks provided by the company and to manage and harvest the crop, all of which must be delivered to the contracting company. Ownership of seed and plants growing in the farmer's field remains with the seed company. Both growers and seed company representatives describe the contracts as "loose". A substantial portion of the price risk would appear to be borne by the grower. Growers continue to be responsible for securing needed financing and for all production risks. The companies offer some technical advice to growers, though it is not extensive. The contracts are multi-year, generally 2-3 years. At the end of this period, the farmer must plow-out the field.

A variety of pricing techniques are used. Most commonly, the grower and company agree on a minimum price with an additional amount to be determined by market price after harvest. Some growers defer any price determination until time of delivery. Since most of the crop is contracted, the spot market is very thin and is essentially determined by the leading companies and their day-to-day assessment of the market. There are no published price reports.

An exception to this is the pricing of perennial ryegrass. In 1999, the Oregon legislature authorized creation of the Oregon Perennial Ryegrass Bargaining Council, a body composed of growers and companies with approval to negotiate price for the industry. In recent years, the price of perennial ryegrass in Oregon has been negotiated through the Council.

The relationship between yield and price for the principal species of lawn seed is generally weak. While weather is an important determinant of year-to-year variations in yield, the influence of steadily higher yielding seed varieties and new production practices is even more important. This is documented by results of the regression analysis discussed in Section 4.1.1. With the continuing introduction of new seed varieties, the average yield of most species has exhibited a pronounced upward trend.

Lawn seed prices, on the other hand, are governed largely by the balancing of seed company contracts for supply against demand for the product. It is therefore not surprising that yield and price are not closely correlated and that the relationship is sometimes positive. Using statewide averages for Oregon and Washington, we calculated price/yield correlation coefficients as follows:

State	Species	Period	Correlation coefficient
Oregon	perennial ryegrass	1969-2005	+.69
	tall fescue	1969-2005	+.67
	Kentucky bluegrass	1979-2005	+.26
	creeping bentgrass	1985-2005	-.59
Washington	Kentucky bluegrass	1991-2004	-.72

Grass seed is also marketed through seed brokers, acting either as individuals or companies. Seed brokers have contracts with growers and seed dealers and have good knowledge of the availability of seed. Seed brokers act as agents of the buyer. For their services, sellers pay the broker a brokerage fee. Fees at the time we conducted our on-site interviews ranged from $15 per 1,000 pounds of seed for annual ryegrass to $50 per 1,000 pounds of seed for tall fescue.

Seed conditioning prepares harvested seed for marketing. The harvested seed as it comes in from the field is not ready for sale as it contains contaminants such as inert matter, other crop seeds, and weed seeds that need to be removed prior to marketing. The seed can also be size-graded for precision planting where this practice is desirable. The primary reasons for seed conditioning include:

- Remove weeds and other contaminants from the harvested seed.
- Upgrade seed quality by removing broken, shriveled, or light seed.
- Size-grade for better plantability.
- Apply seed treatments.

The common steps in the seed conditioning process include:

1. Seed receiving and storage.
2. Precleaning operations.
3. Seed cleaning.
4. Seed separating and upgrading.
5. Seed treating and other specialized processing.
6. Bagging or packaging.
7. Shipping or storage.

In the Pacific Northwest, seed conditioning is done at grower-owned facilities or in plants maintained by custom cleaners or seed companies. In Oregon, most seed conditioning plants involved in preparation of grass seed for marketing are owned by individual seed growers or by small groups of growers. Most grass seed crops in Washington and Idaho are conditioned in facilities owned and operated by the seed companies.

Seed conditioning of perennial ryegrass removes 10 to 20 % of the initial harvested weight of seed in the form of inert straw, nonviable flower parts, weed seeds, and good crop seed. Typical cleaning costs range from $4 to $5 per 100 lbs of seed. Re-cleaning to remove annual bluegrass seed contamination typically costs the producer about 75% of the original cleaning cost plus the additional loss of crop seed. The grower may lose another 7 to 10 % of the good crop seed during this cleaning operation.

3.2 Warm-Season Grasses

Two warm-season grasses are investigated in this study: Bermuda grass and bahia grass. In comparison to the cool-season grasses described in section 3, seed production of these grasses is conducted on a far smaller scale resulting in a substantially smaller volume of output. In 2002, the Census of Agriculture reported fewer than 200 producers of Bermuda grass and around 440 producers of bahia grass. In part because of their relatively limited scale, information on these crops is much more limited than for the cool-season grass seed crops grown in the Pacific Northwest. Given the substantial differences between Bermuda grass and bahia grass, we discuss the production and marketing practices of the two species separately.

3.2.1 Production Practices

Bermuda Grass[4]

3.2.1.1 Production History

Bermuda grass has been grown under irrigation for many years in the very arid portions of Arizona and California, largely in the Wellton-Mohawk Valley of Arizona and in the Imperial Valley of California. Over time, the locus of production has gradually shifted away from Arizona and toward California. This has been prompted, at least in part, by the beneficial impact that the propagation of Bermuda grass has had on reducing the salinity of Arizona soils. The salinity of some of these soils has been reduced to levels that make it possible to cultivate more profitable vegetable crops. Thus, Bermuda grass seed production has migrated to California's Imperial Valley.

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[4] This section is based in part on material prepared by Dr. Charlie Rodgers of Seeds West, Inc., a consultant to this study.

A review of the last four Censuses of Agriculture indicate that national production of Bermuda grass declined slightly in the 1990s but rose sharply by 2002 (Table 7). Between 1997 and 2002, the number of farms growing Bermuda grass seed and the acreage harvested more than doubled. In 2002, the Census of Agriculture estimated that 184 farms harvested 16.8 million pounds on 42,617 acres.

Data for Imperial County, California, the leading source of production, reveals a substantial year-to-year variation in both harvested acreage and average yield.[5] Between 2001 and 2003, harvested acreage first rose by 30% between 2001 and 2002, then fell by 29% the following year. Yields have followed an equally erratic course. In 1998, average yields were 688 lbs (hulled)/acre and in 2003 they fell to 327 lbs/acre.

The share of seed production that is proprietary and grown under contract has increased dramatically in recent years. Five years ago, less than 5 percent was proprietary. Today, approximately 30 percent is proprietary and the share is continuing to rise.

3.2.1.2 Production Practices

Bermuda grass is a perennial crop and once a field is planted it is generally kept in production for 5 to 7 years. It commonly takes two years for a grower to recover planting costs and start making money on a field. Fields can be planted in the spring (May) all the way through fall (September). Once a field is established, producers have several options in producing seed and /or hay. Two seed crops can be harvested per year, though most producers harvest only one. The summer crop is started in late February to mid-March and can be harvested from late-June to mid-July. The fall crop is started in August and harvested in December. It is sometimes possible to obtain a hay harvest between summer and fall crops. Seed can be produced for a summer crop, and approximately two or three hay harvests can be obtained in the fall (most common scenario), or the field can be cut for hay in the summer (up to 4 harvests) and a fall seed crop can be harvested (not a very likely scenario).

[5] It will be noted that there are some inconsistencies in the estimates of the Census and those of Imperial County. For example, Imperial County estimates production of 18.1 million pounds for the county in 2002 while the Census of Agriculture reports California production of 14.5 million pounds.

Table 7: Bermuda Grass Seed Production, Census Years 1987-2002

Item	2002	1997	1992	1987
Quantity harvested (1,000 lbs)				
California	14,499	7,746	6,046	8,194
Arizona	1,566	1,085	2,171	2,527
Other states	692	93	na	41
Total	16,757	8,924	na	10,762
Acreage harvested (acres)				
California	34,281	17,186	18,747	17,332
Arizona	4,487	2,827	5,779	6,397
Other states	3,849	441	na	268
Total	42,617	20,454	na	23,997
Number of farms				
California	105	55	53	50
Arizona	18	22	38	42
Other states	61	13	1	4
Total	184	90	93	96

Source: USDA, NASS, Census of Agriculture

Table 8. Bermuda Grass Seed Production in Imperial County, California, 1997 - 2003

Year	Acres	Production	Average yield	Average price
		(1,000 lbs.)	(lbs. hulled/acre)	($/lb)
2003	25,089	8,204	327	1.58
2002	35,244	18,115	514	1.48
2001	27,153	9,422	347	1.50
2000	29,383	12,458	424	1.48
1999	23,488	10,734	457	1.29
1998	21,865	15,043	688	1.40
1997	18,710	11,020	589	1.62

Source: Imperial County Agricultural Commissioner's Reports and University of California Cooperative Extension, *Imperial County Field Crops Guidelines*, September 2002

3.2.1.3 Planting Practices

To prepare for planting Bermuda grass, the ground is typically ripped (2-3 foot depth), plowed, disced (2 times), laser leveled, pre-irrigated, and then disced (2 times), harrowed, or roto-mulched. Seed is typically planted at a rate of 15-20 lbs/acre. Bermuda grass is broadcast planted rather than seeded in rows. No preemergent herbicides can be used; weeds are controlled after planting by mowing, hand pulling, and post-emergent herbicides, depending on the types and severity of weeds.

If seed is planted in the spring (May), usually the field is harvested for hay, and a seed crop is harvested that fall, or the next summer. If the field is planted in the fall (September), it can be harvested the following summer.

3.2.1.4 Fertility Management

Urea and anhydrous ammonia are the forms of nitrogen commonly applied. If a soil test indicates levels of soluble phosphorous below 10 parts per million, phosphorous should be added as well. Fertilizer is typically applied in two or three applications, usually one application of a dry granular fertilizer and then liquid fertilizer is applied one or two times with irrigation water. The crop is flood irrigated between raised borders. Thus, it is important that the fields are precisely leveled before planting to ensure an even water distribution. Irrigations are typically performed at 12-14 day intervals with 6 acre inches per application.

Table 9. Typical Activity in the Management of Bermuda Grass Seed Production

Activity	Summer Crop	Fall Crop
Fertilizer	200 lbs. actual N/Acre	150 lbs. actual N/Acre
Herbicide	1 preemergent appl. 1 postemergent appl.	0-1 preemergent appl. 0-1 postemergent appl.
Rouging*	1-2 times	1-2 times
Hand weeding	0-1 time	0-1 time
Insecticide	0-2 applications	0-2 applications
Fungicides	0-1 applications	0-1 applications
Irrigation	7-9 irrigations 48-54" water	6-8 irrigations 36-48" water
Swath	1 time	1 time
Combine	1 time (plus rerun)	1 time (plus rerun)
Rake & Bale Straw	1 time	1 time

*Necessary for proprietary seed production, not necessary for non-proprietary production.
Source: Personal communications with Charlie Rodgers, July 8, 2003

3.2.1.5 Harvest and Storage

There are normally two harvest periods per year. Summer seed crops are normally harvested during the period June 21- July 14 while fall crops are harvested during December 1- 21. To harvest, fields are cut with a swather, wind-rowed, and left in the field to dry for 3 to 5 days. Once sufficiently dry, the seed is harvested with a combine and transported to seed mills for cleaning and conditioning.

Seed yields are typically lowest in the first year the field is harvested, reach their highest yields in years two and three, and decline slightly in the years that follow. Seed yields vary widely depending on variety. Typical yields for nonproprietary seed are 300-600 lbs/acre for a summer crop and 150-250 lbs/acre for a fall crop. Proprietary varieties typically yield 500- 700 lbs/acre for a summer crop and 250-350 lbs/acre for a fall crop.

Seed mills generally charge from $0.05 to $0.10 per pound of thresher run Bermuda grass to condition the seed. Bermuda grass typically cleans out at 50% unhulled seed. Then unhulled seed is further processed and turned in to hulled seed by having the glumes removed. The clean out for hulling is typically about 67%.

Some nonproprietary and most proprietary seed is coated before being sold. Most coatings contain inert fertilizer and fungicide. Coated seed hold its germ for less than 1 year. Stored seed tends to hold its germ well. Unhulled seed holds its germ the best, generally for 2-3 years depending on storage. Bermuda grass seed stores well in the dry desert southwestern US. Seed is typically stored in metal buildings, metal bins, or in bulk bags in warehouses.

3.2.1.6 Production Economics

Land costs can vary widely depending on the quality of the land. Bermuda grass is generally grown on poorer quality soil, and fields can typically be rented for $100 per acre. However, some of the newer proprietary varieties are grown on better quality land that can rent for as much as $600 per acre. Weed control costs typically go down after the first year. Non-proprietary fields are typically $20-$25 less per acre than proprietary fields because rouging is not necessary, and no crop inspection fees are paid. Crop inspection fees for certified seed are typically $10-$15 per acre.

Total revenue for seed production averages around $400/acre for common Bermuda grass and around $680/acre for proprietary varieties.

As in the Pacific Northwest, Bermuda grass seed budgets typically amortize the cost of establishing a stand over the period of time the stand remains in production. The budget that appears below assumes a spring seed crop in each of five years. Beyond the revenue generated through the sale of the harvested grass seed, it is also assumed that this stand provides two hay cuttings each year plus the value of the straw that is produced during harvest of the Bermuda grass seed. Since this straw is of lower feeding value than the hay, it commands a somewhat lower per unit price ($30/ton versus $75/ton).

Table 10. Enterprise Budget for Bermuda Grass Seed Production, Imperial County, California, 2002-03

Operation		Establishment cost/acre	Annual cost/acre
Stand establishment			
Land preparation		138.00	
Seed		36.25	
Irrigation		53.88	
Herbicides		44.50	
	Total	272.63	
Annual cost of seed production			
Irrigation			129.63
Fertilizer			95.00
Insecticide			35.75
Rent			90.00
Amortization of establishment			54.53
Overhead			52.64
	Total		457.55
Summer hay harvest costs			113.80
Seed harvest/post harvest costs			197.10
	Total all costs		768.45
Value of straw			60.00
Value of hay			300.00
Total costs less straw + pasture value			408.44

Assumes 800 lb. (uncleaned) spring seed crop and two summer hay harvests.
Source: University of California Extension Service

Bahia Grass

3.2.1.7 Production History

What would later be called "Pensacola" bahia grass was discovered on a sodded sand bank in Escambia, Florida in 1938. Native to eastern Argentina, it is thought to have been brought to the U.S. on a fruit boat from Central or South America. It was released for use in 1944 and soon became one of the major forage grasses of the Southeastern United States. It has also been extensively used along highways in this region. Pensacola is the predominant variety of bahia grass seed now accounting for an estimated 70 to 80 percent of production.

Another variety of bahia grass, Argentine, was released in 1950 by the University of Florida. This variety has the advantages of having a more abundant root system and is lower growing than Pensacola. However, it also winter kills more readily than Pensacola. As a result it is grown primarily in Florida.

As a turf grass, bahia's principal use is in covering large areas. Its principal advantages are that it requires little or no irrigation, even in well-drained sands, requires minimal fertilization, and has few important pest problems.

Our principal source of information on the production of bahia grass seed is the Census of Agriculture. Florida's agricultural statistical service collects no information on this crop. As indicated in Table 11, more than half of all bahia grass seed is grown in Florida. It is not a high yielding seed crop with the average yield ranging between 78 and 112 pounds/acre in recent Census years. Of the four Census years, production and average yield were lowest in the most recent year, 2002.

3.2.1.8 Cultivation Practices

As with the production of tall fescue seed production in Missouri, the production of bahia grass seed in Florida is often a by-product of cow/calf operations. Bahia pastures are widely maintained in the Southeast for grazing. When cattle prices are low or seed prices are high, seed harvest offers a secondary source of income. To the extent good management practices for the production of bahia grass seed and cattle coincide, there is no problem. However, these practices don't always coincide.

For example, a typical practice of cattlemen is to apply nitrogen fertilizer in the early spring (February-March) followed by grazing until June or until a sign of inflorescence. While fertilizing in the early spring contributes to improved forage for grazing, it is not optimal timing for seedhead development. Instead, to maximize seed production it is recommended that producers close-graze (or burn) their fields (to <3 inches) up to about mid-April for Pensacola bahia grass and to late-May for Argentine. At this point, it is recommended that cattle be removed and that they apply 50 lbs of nitrogen per acre.

As with fescue production in Missouri, many bahia grass seed producers are "sometime" producers. However, there is a minority of growers who are committed producers of bahia grass and systematically include the harvesting of bahia grass seed in their rotation.

Table 11: Bahia Grass Seed Production, Census Years 1987-2002

Item	2002	1997	1992	1987
Quantity harvested (1,000 lbs.)				
Florida	1,304	1,905	3,481	3,163
Texas	338	291	231	298
Alabama	406	198	167	259
Other states	227	165	194	162
Total	2,275	2,559	4,073	3,882
Acreage harvested (acres)				
Florida	19,916	19,027	34,452	29,298
Texas	4,265	1,804	1,539	1,807
Alabama	3,104	1,714	1,218	1,980
Other states	1,736	1,367	1,301	1,507
Total	29,021	23,912	38,510	34,592
Number of farms				
Florida	167	158	204	183
Texas	139	44	27	30
Alabama	84	52	31	41
Other states	53	40	17	29
Total	443	294	279	283

Source: USDA, NASS, Census of Agriculture

3.2.2 Marketing Practices

Bermuda Grass

Bermuda grass seed is marketed through a network of seed brokers. Seed West, a subsidiary of Pennington Seed, is the largest buyer of Bermuda grass seed. Given the relatively small size of the market and the small number of participants, the price of seed is informally established and is reflective of what the last unit of seed sold for. Proprietary varieties are produced under contract with pricing determined in part by the terms of the contract. Contracts are generally written with both floor and ceiling prices specified and are tied to the price of non-proprietary seed, usually at a premium of about 10 percent above the non-proprietary price.

Bahia Grass

Many producers of bahia grass seed contract with seed companies to both harvest and market their seed. In return for harvesting, hauling, cleaning, storage, and merchandising of the seed, these companies take ownership of a share of the crop. Traditionally, a 50-50 sharing of the crop has occurred. Some of the larger growers do their own harvesting and processing.

The market for bahia grass seed has weakened substantially in recent years. Increasingly, both highway and housing construction has substituted sod for seeding in new areas. Neither is there much demand for seeding new pasture. A combination of soft demand and large crops has caused wholesale prices to fall into the range of $.80-$1.00/lb. during 2000 - 2002. As a result of short crops in 2003, however, prices have since risen.

SECTION 4: PRODUCTION AND REVENUE RISKS

In this section we examine the major sources of risk confronting lawn seed growers. This includes climatic factors, diseases, weeds, and lodging. As in the previous section, cool-season grasses and warm-season grasses are treated separately. Much of the information reported here is based on research conducted in Oregon's Willamette Valley, though it has applications in other cool-season grass growing regions as well.

4.1 Cool-Season Grasses

4.1.1 Climate

The dry summer climate that is characteristic of the western USA was primarily responsible for the shift in forage, turf, and vegetable seed production enterprises from the eastern regions of the country to the west. In the Pacific Northwest, rainfall subsides as forage and turf seed crops mature during the early summer. Irrigation can be applied to crops grown in the dry regions when needed. Rainfall prior to harvest of the crop can often result in pre-harvest sprouting, a condition that can reduce seed quality. Since winters are mild in the Pacific Northwest, winter injury is lower, resulting in greater seed yield the following summer. Because of the low rainfall and low relative humidity in the region, seed crops grown in the western US can be windrowed for field drying. The dried windrows are later threshed by a combine equipped with a header pick-up attachment. By comparison, seed crops in the eastern US are often direct combined and then artificially dried before storage. Thus, production costs are lower in the comparatively dry western region of the USA.

The climate of the Willamette Valley is uniquely well suited for the production of cool-season grass seed crops. Even in this ideal climate, however, weather events can have substantive impacts on the yield of grass seed crops. Rainfall events and short-term rainfall patterns appear to have much greater influence on seed yield than do temperature events or patterns. Furthermore, the majority of the Willamette Valley's grass seed acreage is grown without the aid of irrigation, although there has been an increase in irrigated grass seed production in recent years. There has not been a systematic investigation of seed yield responses to precipitation.

The specific timing of rainfall is critical in determining the impact on grass seed yield. In Oregon, the overall or annual precipitation in a given year has virtually no effect on seed yield as some of the area's best seed yields have been harvested in very dry years (1985; 27.15 inches) or in very wet years (1996; 73.21 inches). Precipitation during the November through February period has little or no impact on yield unless the crop stand is lost due to flooding. The crop is usually dormant during this period and is not actively consuming much water. Rainfall during March and April can have minor effects on seed yield during a protracted drought.

The three major rainfall periods during the crop production cycle that affect seed yield of perennial grasses in the Willamette Valley are as follows:

1. September-October (autumn regrowth)
2. May-June (flowering, pollination, early seed filling)
3. July-August (late seed filling, and harvest)

These periods are important because they occur during critical phases of the growth and development of the seed crop, or during harvest operations.

Low rainfall during September-October plays an important role in the manifestation of die out, a stand loss disorder in perennial ryegrass seed fields. Losses in tiller production in perennial ryegrass are proportional to the amount of rainfall received. Tiller production at the same rainfall level in the first-year stands has been found to be greater than in second- or third-year stands (Figure 6). In other words, perennial ryegrass seed crops are less responsive to rainfall in older stands than in young stands. As plants become older, they are increasingly more susceptible to stress conditions. Therefore, the ability to replace the older tillers as they die is markedly reduced. Continual summer and early-fall water stress may be a major contributing factor to the onset of die out. Stand cover is affected by autumn water stress and in some cases losses exceeded 50% of the original stand. No rain in this period produces the lowest amounts of plant cover, and contribute most to decline of the stand.

Flowering and seed yield are not always affected by autumn drought, however. Although stand loss and reduction in crop regrowth can be substantial under conditions of post-harvest summer drought stress, fertile tiller production the following spring is not necessarily affected. Plants growing in drought-thinned stands often produce more fertile tillers per plant than those receiving adequate rainfall after harvest, accounting for the lack of impact on seed yield. Nonetheless, there is a threshold fertile tiller population density below which seed yields will be significantly less because the seed crop can no longer compensate for losses in stand density. When that fertile tiller population is reached, seed yield will decline.

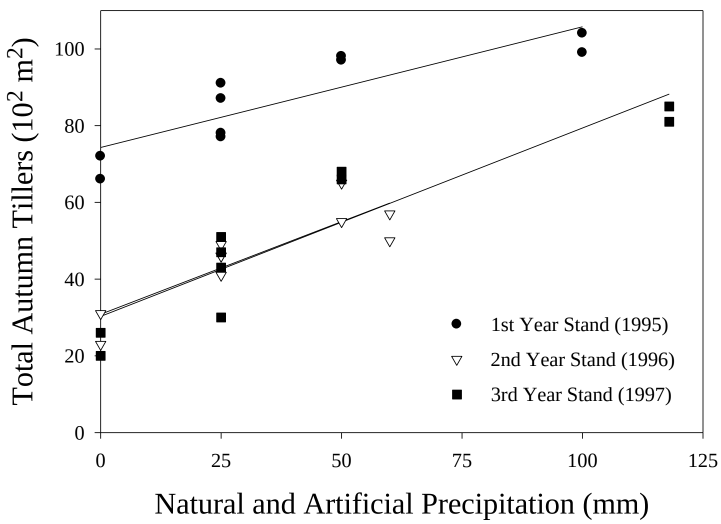


Figure 6. Effect of Rainfall on Development of Tillers.

Still, the innate ability of perennial ryegrass to compensate for great losses in stand is evident in study results. In contrast, drought during this period reduces fall regrowth, which in turn, results in fewer fertile tillers produced in the following spring in both Chewings fescue and in tall fescue.

Precipitation extremes during May – June, whether too wet or too dry, can reduce yield. Drought during the May-June period can result in lower fertile tiller numbers because fewer fail to fully develop. The number of spikelets and individual flowers is also reduced. If the crop is maturing early due to warm and dry conditions, then the seeds that are produced are often lighter in weight. High May-June rainfall often leads to poor conversion of flowers to seed, as pollination is restricted. This situation is exacerbated by early lodging of the stand during high rainfall in this period, which further restricts pollination and seed filling processes. Perennial ryegrass, Chewings fescue, and tall fescue yields are all adversely affected by either extreme in May-June rainfall.

High rainfall during July-August can cause reductions in the weight of late-maturing seed, but can also cause the premature sprouting of the seed in the windrow. Pollination of late-maturing varieties can also be restricted by rainfall events in this normally dry period. Harvest operations can be impeded directly by moisture in the crop or by regrowth stimulated in the windrows of wet fields. Removal of straw from fields after harvest by baling or by burning is often delayed by wet weather, which can affect seed yield in the following season. In the Willamette Valley, high rainfall events are infrequent during these months but when they do occur, problems often arise since field operations are based on dry weather during July and August.

Nearly all the major fluctuations in grass seed yield in Oregon are explained by rainfall events and short-term rainfall patterns that have taken place during these three critical periods. September-

October rainfall is associated with seed yield only when the period is very dry. May-June rainfall causes low seed yields when the amounts are either high or low. High seed yields have been recorded when rainfall during this period was normal to slightly below normal. Very high rainfall in July-August is associated with low seed yields. Chewings fescue and tall fescue are affected more by rainfall than is perennial ryegrass.

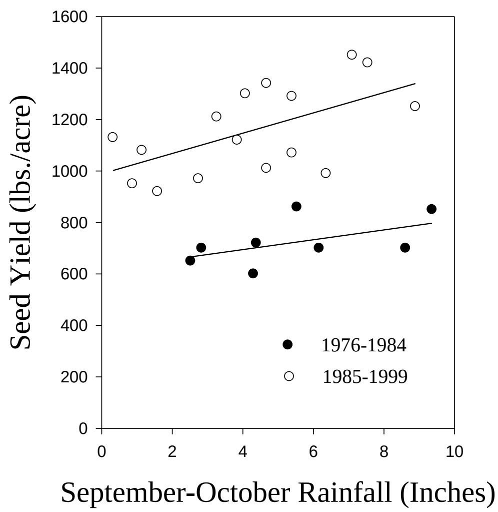


Figure 7. Effect of September-October rainfall on seed yield in tall fescue in the Willamette Valley.

Relationships between rainfall in the September-October and May-June periods and seed yield have been identified and are similar to the one shown here for tall fescue in the Willamette Valley (Fig. 7). It is interesting to note that grass seed yields have become more sensitive to rainfall over the years. It is unclear whether the varieties themselves are more sensitive to rainfall or that the farming practices employed today make the crops more sensitive to rainfall. One possible explanation is that modern varieties of these crops generally are later maturing than older varieties. Late maturing varieties flower and produce seed during periods with lower probability of precipitation than do varieties that mature earlier in the season.

Maximum seed yield in Chewings fescue was attained when May-June rainfall at Silverton, Oregon was about six inches in older varieties and about seven inches in modern varieties (Fig. 8). Rainfall higher or lower than these amounts resulted in lower seed yields. One major exception among these relationships is that perennial ryegrass seed yields do not seem to be influenced by rainfall in the previous September-October period. However, the manifestation of stand die-out in older fields of perennial ryegrass is likely to be dependent on early autumn drought conditions. This progressive loss of stand might contribute to lower yields in older stands.

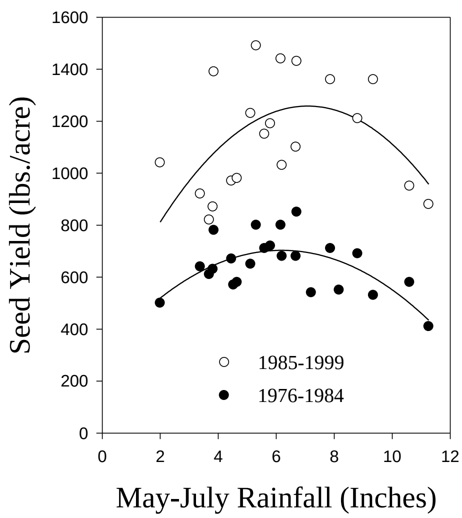


Figure 8. Effect of May-July rainfall at Silverton on seed yield of Chewings fescue in the Silverton Hills region of the Willamette Valley.

To examine the impact of precipitation on average annual yield, two multiple regression models were developed using weather and yield data from Oregon's Willamette Valley. Three independent variables, each representing precipitation during a different two-month period of the year, were used in the first model. The absolute deviation from mean precipitation during May and June at the Corvallis weather station during 1983-2003 was represented by X_1. The X_2 variable represented total precipitation during July and August at the same weather station during the same period. The final independent variable, X_3, represented total precipitation at the same location in September and October of the previous year. These variables were regressed against the average annual state-wide yield of perennial ryegrass and tall fescue seed.

A second regression model was applied incorporating an additional independent variable (X_4) representing time.

Results of these regressions appear in the box shown below. They generally confirm expected relationships. Extreme precipitation during May-June, whether too much or too little, was associated with smaller yields. July-August precipitation (during harvest) was also negatively associated with yields. And, finally, September-October precipitation in the previous year (when tillers are produced and the coming crop becomes established) was positively associated with yield.

The results suggest that precipitation levels during these critical periods have accounted for roughly one-third of the variation in state-wide annual yields of these crops during the period studied.

Addition of a variable representing time substantially increased the explanatory power of the equation. The independent variables in model 2, principally the variable representing time, explain roughly three-quarters of the variation in average annual yields of both crops. A third model (not shown in the box below) containing only time as an independent variable "explains" nearly as much of the variation in average annual yield as model 2, suggesting that the effects of precipitation (at least at the state-wide level) are overshadowed by those factors correlated with time, e.g., new seed varieties, new management practices, and increased use of irrigation.

Regression Results

Perennial ryegrass

Model 1: $Y = 1{,}359.7^{***} - 77.7X_1^{**} - 119.1X_2^{***} + 27.73X_3^{*}$

Adjusted $R^2 = .41$

Model 2: $Y = 1{,}071.1^{***} - 31.9X_1 - 39.0X_2 + 12.6X_3 + 22.7X_4^{***}$

Adjusted $R^2 = .76$

Tall fescue

Model 1: $Y = 1{,}298.6^{***} - 74.2X_1^{*} - 117.6X_2^{***} + 34.0X_3^{*}$

Adjusted $R^2 = .35$

Model 2: $Y = 914.4^{***} - 22.9X_1 - 27.9X_2 + 17.1X_3\ 25.4X_4^{***}$

Adjusted $R^2 = .74$

Where: Y = annual average yield (1983-2003)
X_1 = May-June precipitation (absolute deviation from mean)
X_2 = July-August precipitation
X_3 = September-October precipitation (previous year)
X_4 = time

* significant at .10 level
** significant at .05 level
*** significant at .01 level

4.1.2 Pests

Controlling pests is an important aspect of grass seed production. Pests reduce the yield and quality of grass seed crops. Maintaining control of pests is challenging in grass seed production since these crops are not the primary focus of development efforts by agrichemical manufacturers. Furthermore, restrictions on the use and availability of pesticides and the development of pesticide resistance complicate the control of pests in grass seed crops. The loss of field burning as a management tool in the Pacific Northwest has encouraged the development of alternative pest management practices, but at greater financial costs to the producer. Harvest of the region's grass seed crops is now accomplished by equipment having higher capacity and efficiency, yet the loss of seed and the resultant volunteer crop is a continuing problem.

4.1.2.1 Diseases

Plant diseases can affect seed production of grasses in three areas of the plant: (i) diseases of the seed, (ii) foliar and stem diseases, and (iii) diseases of the root system. Of the three, diseases of the root system are the most poorly understood in their impact on grass seed production.

Diseases of the seed in cool-season grasses include several that are not well known outside the world of grass seed producers and one that has been important throughout human history, ergot. **Ergot** is a fungal disease. Plants are infected by wind-borne ascospores at flowering. Eventually, the fungus produces a sclerotium that replaces the seed. A high ergot incidence (5% of potential seed sites) has been found to cause a 20% reduction in seed yield. Ergot increases seed cleaning costs and causes lost international marketing opportunities as many countries will not accept ergot sclerotia infested seed. Control measures for ergot include planting sclerotia-free seed, and fungicides. Ergot is a problem in all grass seed crops in the Pacific Northwest except orchardgrass and is most severe in Kentucky bluegrass.

Blind seed is another disease of the seed that is important in grass seed production. Blind seed kills the seed embryo and reduces germination. Blind seed is a problem in perennial ryegrass and tall fescue seed production. This disease can be a major problem and was one of the primary reasons for the implementation of field burning in Oregon.

Grass seed endophyte is found in tall fescue and perennial ryegrass. Infected seed produces plants that are also infected. Alkaloids produced by the pathogen cause poor performance and sickness in grazing livestock and abortion in horses, though they also may impart insect and drought resistance in infected plants. So endophyte is desirable in turf seed, but to be avoided in forage seed.

There are several important foliar and stem diseases that influence seed production in grasses. Foliar and stem diseases in grass seed crops are not controlled by crop rotation or field burning, only fungicides and genetic resistance of the crop are effective against these pests. Among these diseases, the rusts cause the greatest problems for grass seed producers in the Pacific Northwest. **Stripe rust** is found in Kentucky bluegrass and orchardgrass. **Stem rust** is found in perennial ryegrass, tall fescue, and Kentucky bluegrass. Rust infestations continue in fields from one season to the next by over wintering on infected plants. The infestation can expand to epidemic proportions with warming temperatures in the spring. Early warm springs tend to favor development over cool, wet springs, which tend to retard development of a rust epidemic.

Seed yield can be reduced when rust lesions appear on the leaves and especially when the flag leaf is not protected by fungicides. Stem rust was not observed in tall fescue seed production in the Willamette Valley until 1989, but is now a widespread disease that needs to be controlled with fungicides. Seed yield in tall fescue can be increased under stem rust pressure with the incorporation of resistance genes.

Crown rust is another important rust disease that is found in perennial ryegrass, tall fescue, and Kentucky bluegrass. Crown rust is controlled by the same fungicides that are effective in the control of stem rust. There are also rust diseases found in creeping red fescue and Chewings fescue.

There are several other foliar and stem leafspot diseases. **Eyespot** is found in orchardgrass. **Scald** is a leafspot disease found in orchardgrass and tall fescue. The disease known as **Leafspot** is found in perennial ryegrass and tall fescue. These diseases can reduce seed yield through the reduction in photosynthetically active leaf area. **Powdery mildew** is often found in the spring on leaf sheaths and blades of grass seed crops grown in areas east of the Cascade range. This disease can be controlled with one of several fungicides.

Choke is a fungal disease found in the fine fescues.

4.1.2.2 Weeds

There are several reasons for controlling weeds in grass seed crops:

1. **Seed quality**. Weed-free seed can command a premium price. Seed certification prohibits seeds of certain weed species whereas a limited number of seeds of other weed species are sometimes allowed in the harvested and cleaned seed.
2. **Competition.** Weed plants compete with the seed crop for water, light, and nutrients and can reduce seed yield.
3. **Seed conditioning costs**. Weed-contaminated seed costs more to clean. Re-cleaning further increases costs.
4. **Marketability**. Marketability is reduced by weed seeds.

The volunteer crop and off-types of the same species are the most difficult to control weeds in grass seed crops. Grass seed crops are often damaged by herbicides applied to control volunteer crop plants because of the limited selectivity between the crop and the volunteer plants. Failure to control volunteers can result in the loss of eligibility for certification. Control of volunteer perennial ryegrass and tall fescue plants is essential for maintaining seed yield in the absence of field burning. Failure to control volunteer plants often results in reduced seed yield in perennial ryegrass seed fields.

Broadleaf weeds are easier to control because of increased herbicide selectivity and crop safety. Nevertheless, there are several broadleaf weed species that are considered to be problem weeds in grass seed crops.

Weed management strategies for grass seed crops include:

1. **Herbicides.** Several broadleaf herbicides are available to control these weeds in grass seed crops. Selective herbicides must be used to control grass weeds in grass seed crops. Registration and availability of herbicides for grass seeds crop change each year. Herbicide application techniques include broadcast spraying, weed wiper, and charcoal banding.
2. **Field burning.** Field burning (to the extent permitted) destroys weed seeds and seedlings.
3. **Good crop management.** Maintaining vigorous, competitive crop growth is required to aid in the suppression of weeds. Nutrient and irrigation management are important aspects of general crop management that assist other methods of weed control.
4. **Crop rotation.** Rotation can be an effective weed management tool where suitable rotation crops are available.
5. **Tillage/mechanical.** While the approach is not widely practiced at this time, it might increase in the future.

Crop competition can aid in the suppression of weeds in grass seed fields. Early canopy closure increases shading that can decrease weed seed germination, and also leaves fewer open niches for weeds. Vigorous growth and early closure of the crop canopy can be manipulated through changes in stand establishment practices.

Herbicides are applied in Willamette Valley grass seed fields in the wet season by using specially-designed sprayers equipped with high flotation tires. The sensitivity of grass seed crops to herbicides vary with stage of crop development and with age of the stand. Certain weeds can be controlled in grass seed crops based on a difference in height between the crop and weed at one or more stages of development. A device known as a weed wiper can be used to deliver a non-selective herbicide such as glyphosate to the taller weed by contact without causing injury to the crop. Spot spraying of individual weeds is also widely practiced in fields to control individual weeds or small groups of weeds in the field. Row spraying of non-selective herbicides by shielded sprayer is sometimes practiced to control weeds between the rows of grass seed crops.

4.1.2.3 Other Pests

Several insect and mite species cause economic damage in Pacific Northwest grass seed fields. Included among these pests are: sod webworm, billbug, grass gelechild, crane flies, larvae, wireworms, silvertop, and the winter grain mite.

Integrated pest management strategies have been developed for insects and mite pests. Monitoring pest populations is an important component of insect and mite pest management strategies. This includes setting pheromone traps, conducting sweeps of fields to determine pest population levels. Insecticide and biological control measures are used when applicable to prevent these pest populations from causing economic injury.

4.1.3 Lodging

Lodging is an impediment to achieving higher seed yields, especially in the Willamette Valley. Lodging of the crop during flowering is generally thought to restrict pollination, reduce the rate of fertilization, and can later inhibit seed filling due to self-shading of the lodged crop. Control of lodging increases seed yield more than any other agronomic practice in grass seed crops, including weed control, rust control, and nitrogen fertilizer application. This is generally accomplished through application of a plant growth regulator.

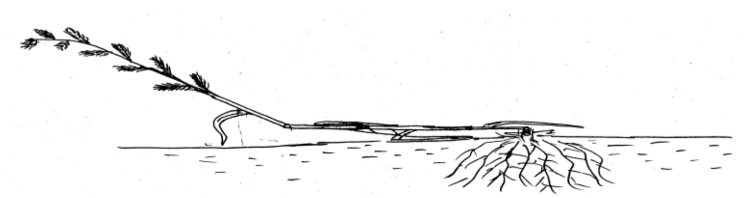


Figure 9. Lodged perennial ryegrass plant.

4.2 Warm-Season Grasses

Information on the perils of producing warm-season grasses is much more limited than for cool-season grasses. In part this is due to the relatively small size of these crops. It might also be due to the joint-product nature of the crop. In the case of Bermuda grass, the crop is grown for seed as well as for hay and/or grazing. Many bahia grass producers, particularly smaller growers, are primarily engaged in cattle production and do not view seed production as their primary enterprise.

4.2.1 Bermuda Grass

4.2.1.1 Weather

Essentially all of the Bermuda grass grown in California and Arizona is irrigated. Nevertheless, a variety of weather factors can adversely affect crop yields. A late spring combined with early summer heat can reduce the yields of summer crops while an early frost can have a similar impact on fall crops. Rain and high wind accompanying the monsoon season that begins around July 4 can periodically disturb summer harvest, particularly in Arizona. After swathing while crops are in wind-rows they are vulnerable to rain and wind. Rain can shatter seed and cause mold to grow, making it necessary to re-rake the rows. High winds can disturb wind-rows as well.

4.2.1.2 Under-Fertilization/Over-Fertilization

Under-fertilization or over-fertilization with nitrogen can cause yield reductions. Under-fertilization results in a weak non-productive stand of Bermuda grass, resulting in low seed yields. Over-fertilization encourages excessive vegetative growth and can create an environment where insect populations can explode making "honeydew" a problem. Over-watering can likewise cause the stand to become excessively vegetative, resulting in injury similar to over-fertilizing.

4.2.1.3 Insects

Cutworm, spider mites, thrips, and mealy bugs must be monitored. Grass whiteflies and the fulgorid (Toya propingua) can cause extensive damage in the fall by contaminating seed heads with honeydew. Seed contaminated with honeydew must often be set aside until winter for further processing. The plant bug (Trigenotylus tenuis) can cause stunting, delayed flowering, and reduced yields. Rust (Puccinia cynodontis) is common and is sometimes severe enough to merit control with fungicides following periods of high humidity and heavy dews. Irrigating during normal dew periods to avoid having plants wetter than normal and removing straw by burning or baling are means of prevention. The needle nematode (Longidorus africanus) and the root knot nematode (Meloidogyne spp.) are occasional pests, but control is not economically feasible.

4.2.1.4 Weeds

Most weed control efforts occur when the stand is becoming established. Once the Bermuda grass is established, weeds are seldom a problem due to the competitive nature of a healthy stand, except in the winter. Some broadleaf weeds and wild oats are problems in the winter. Various chemicals are available for control of these pests.

Given that a vigorously growing crop is very competitive against annual weeds, cultural practices play a particularly important role in weed management. Preplant cultural practices are especially important because, as noted earlier, Bermuda grass is broadcast planted rather than seeded in rows. As a result, mechanical cultivation is not possible for postplant weed control. Applying adequate phosphorous fertilizer before planting and monitoring nitrogen levels once established helps promote proper growth. Cleaning harvest equipment before it enters or leaves a field helps prevent the spreading of weeds. While field burning after harvest isn't thought to kill many weed seeds, by getting rid of thatch and harvest residues, it makes weed monitoring easier.

Infestations of fields with native common Bermuda grass or giant Bermuda grass can cause fields to be failed in seed certification programs, or necessitate taking fields out of production before the end of their productive economic life. Also, if proper isolation distances are not maintained, seed certifying agencies can refuse to approve fields for seed certification.

4.2.2 Bahia Grass

4.2.2.1 Weather

The principal perils of producing bahia grass seed are those associated with weather conditions during the critical phases of seed development. Most bahia grass seed producers do not irrigate. Wet soil conditions that delay residue removal can result in premature seed ripening, reduced seed size, low seed yield, and poor seed quality. In one study at the University of Florida, average total seed germination declined from 58 percent when residue was removed during dormancy or in the early vegetative stage to only 17 percent when residue removal was delayed until the first inflorescence appearance stage of plant development.

4.2.2.2 Disease

Another threat is from ergot, the fungal disease described earlier. Ergot has become a more serious problem, particularly in the production of the Argentine variety of bahia grass. There are reports of "clean-out" rates as high as 75 percent in fields that are heavily infected by ergot.

SECTION 5: SURVEY RESULTS

As described in Section 1, grass seed producers in California, Florida, Minnesota, and Oregon were surveyed in spring 2005. Growers were asked to provide information on a variety of topics including: annual production records for crop years 1999 through 2003, production and marketing practices, the economic performance of their grass seed enterprises, and their attitudes toward risk management.

As reported in Table 1, the response rate of growers in California, Florida, and Oregon averaged around 26 percent while nearly all (99 percent) of the Minnesota growers receiving the survey responded. A comparison of the volume of grass seed production reported by survey respondents with the overall level of production reported by secondary sources appears in Table 12. This offers a general indication of the share of production represented by survey respondents. As indicated, this share ranges from a low of 8.1 percent for creeping bentgrass in Oregon to a high of 74.0 percent for Kentucky bluegrass in Minnesota. For six of the nine state/species combinations, the share exceeded 20.0 percent.

Table 12: Comparison of Production of Grass Seed as Reported in Secondary Sources and by Survey Respondents, by State, by Species

State/species	Year	Source	Secondary Source	Survey	Percent
			(000 pounds)		
Oregon	2003	Oregon Ext. Svc.			
Perennial ryegrass			209,950	29,399	14.0
Tall fescue			203,340	25,528	12.6
Chewings fescue			4,400	1,034	23.5
Red fescue			6,129	1,399	22.8
Kentucky bluegrass			20,097	4,748	23.6
Bentgrass			4,571	370	8.1
California	2003	Imperial County			
Bermuda grass			8,204	2,431	29.6
Florida	2002	Census of Agr.			
Bahia grass			1,304	431	33.1
Minnesota	2002	Census of Agr.			
Kentucky bluegrass			5,369	3,975	74.0

Source: USDA, NASS, 2002 Census of Agriculture; Oregon Extension Service; Oregon State University; Imperial County California, 2003 Agricultural Crop and Livestock Report; and RMA Lawn Seed Feasibility Study – Spring 2005 Survey.

The remainder of this section is devoted to an analysis of survey results. The analysis is divided into three parts, beginning with those findings related to production and marketing practices. This is followed by a review of what growers had to say about the principal threats to economic returns from grass seed production. The final part examines the respondents' use of and attitude toward risk management practices. Findings for each of the four states are compared on each topic. An actuarial analysis of production information gathered through the survey appears in Section 6. A summary of the production data collected through the grower survey can be found in Annex 1.

5.1 Production and Marketing Practices

5.1.1 Dependence on Grass Seed

A first indication of the diversity of production practices among growers in the four states can be found by comparing how dependent grass seed growers are on revenue from grass seed sales (Table 13). While some growers in all four production areas are heavily dependent on the sale of grass seed (and residual straw) for their farm sales revenue, growers in Oregon are substantially more dependent than growers in any of the other three states. In Oregon, 62.4 percent of the responding growers said that they were dependent on seed sales for 60 percent or more of their gross sales. The next most dependent production area was the Imperial Valley of California where 31.0 percent of growers looked to seed sales for at least 60 percent of farm sales. Growers in Florida were least dependent with only 4.5 percent reporting that seed sales accounted for at least 60 percent of gross revenue.

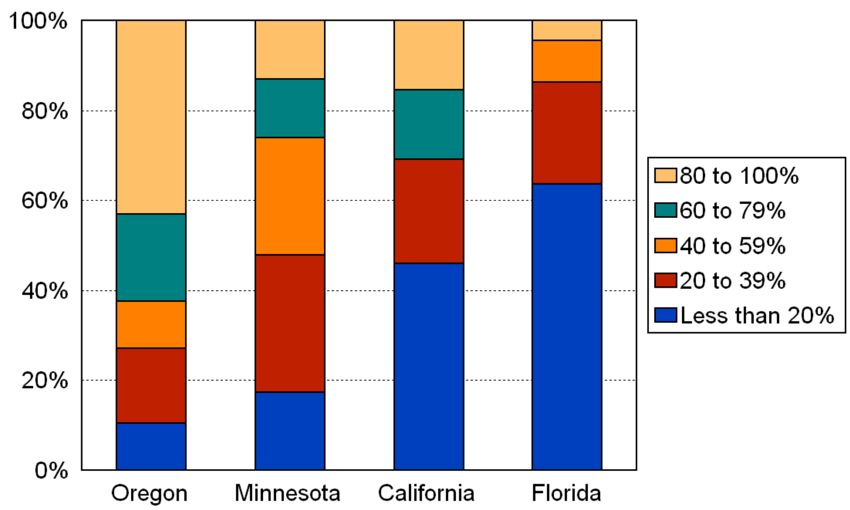
There are several reasons for variation in shares among states. Many Oregon growers are dependent on the production of grass seed as their principal source of livelihood. As a result, many are highly specialized in this enterprise. This contrasts with many growers of warm-season grasses who either divide their attention between the production of hay and seed (California) or between cattle grazing and seed production (Florida). As noted earlier in this report, these joint-enterprises can result in instances where best management practices are in conflict. It would appear from the distribution for California that there is a relatively small group of growers who specialize in the production of Bermuda grass seed while a somewhat larger group produces seed as a sideline to other farm enterprises. The responses of Florida growers indicate that most are not very dependent on the production of bahia grass seed for their livelihood. The level of dependence of Minnesota growers on revenue from the sale of grass seed is more highly varied. This would appear to be a function of the relatively diversified small-grain farms found in this region. Wheat is the major crop, with some oats and barley. Thus, while Kentucky bluegrass is the principal crop for some Minnesota growers, for many others it is a secondary crop.

Table 13: Average Share of Grass Seed Grower Gross Revenue Resulting from the Sale of Grass Seed and Residual Straw, 1999 – 2003, by State

Share of gross revenue	Share of growers in: Oregon	California	Florida	Minnesota
(percent)	(percent)			
80 to 100	43.0	15.5	4.5	13.0
60 to 79	19.4	15.5	0.0	13.0
40 to 59	10.5	0.0	9.1	26.1
20 to 39	16.6	23.2	22.7	30.5
0 to 19	10.4	46.3	63.6	17.4
N	144	13	22	46

Source: *RMA Lawn Seed Feasibility Study – Spring 2005 Survey*

Figure 10. Percent of Growers by Share of Gross Revenue from Sale of Grass Seed, 1999-2003



Source: Producer Survey, 2005

5.1.2 Contracted Production

Survey respondents were asked to report what share of their 2004 crop was contracted. Contracting is somewhat more extensively used by producers of cool-season grasses than it is among warm-season grass growers. In Oregon, every one of the 177 growers responding to the question said that they contracted at least part of their production. And most contracted their entire output. In Minnesota, 75.0 percent of Kentucky bluegrass seed producers contracted output while 88.9 percent of those growing perennial ryegrass seed reporting doing so. However, only about half of the Kentucky bluegrass seed growers in Minnesota contracted their entire output in 2004. This brought the mean share of output contracted down to 50.2 percent.

Producers of warm-season grasses, both in California and Florida, were much less likely to contract their output. This was particularly evident in Florida where only about one-quarter (26.1 percent) of all respondents indicated that they had contracted any of their production the previous year. Very few growers in California and Florida contract only a portion of their crops. They either contract their entire production or, more likely, none of it.

Experience with the Forage Seed pilot crop insurance program suggests there are some important advantages in restricting insurance coverage to seed crops that are grown under contract and/or are grown for certified seed. Seed grown under contract or for certification must be grown using specified production practices and must meet crop quality standards. This helps provide discipline to the production process thereby limiting risk.

5.1.3 Growing Certified Seed

In Oregon, survey respondents reported that most of their seed was grown for certified seed with the mean share ranging between 73.5 percent and 98.6 percent, depending on the species. All Oregon producers grew at least some certified seed. Of the 161 responding Oregon producers, 84 (52.2 percent) grew their entire crop for certified seed. The profile on Minnesota growers is similar with 73.6 percent of responding growers indicating that they marketed their entire crop in 2004 as certified seed.

In warm-season grass seed production areas, in contrast, producing certified seed is the exception rather than the rule. In both California and Florida, only about one-quarter of the respondents said that they grew certified seed in 2004 (27.3 percent and 26.1 percent, respectively).

Table 14: Share of Grass Seed Harvested by Oregon Growers in Crop Year 2004 Grown Under Contract and Share Grown for Use as Certified Seed, by State, by Species

	Grown under contract				Grown for certified seed			
		Percent				Percent		
State/Species	N	Min	Max	Mean	N	Min	Max	Mean
Oregon								
Tall fescue	63	10	100	90.4	59	5	100	84.5
Perennial ryegrass	73	25	100	90.8	62	5	100	73.5
Kentucky bluegrass	14	75	100	94.6	15	5	100	85.9
Chewings fescue	10	25	100	85.0	10	25	100	79.0
Red fescue	10	24	100	84.4	7	90	100	98.6
Creeping bentgrass	7	100	100	100.0	8	75	100	96.8
California								
Bermuda grass	12	0	100	40.7	11	0	85	14.8
Florida								
Bahia grass	23	0	100	22.6	23	0	100	26.1
Minnesota								
Kentucky bluegrass	20	0	100	50.2	38	0	100	88.8
Perennial ryegrass	18	0	100	84.4	15	0	100	74.4

Source: *RMA Lawn Seed Feasibility Study – Spring 2005 Survey*

5.1.4 Other Production Practices

Growers were asked if they interplanted their grass seed crops with other crops. None of the California growers and very few of those in Oregon (3.4 percent) reported using this practice. A somewhat higher share in the other two states said they used this practice. In Florida, 25.0 percent of all growers planted other crops, mainly other grasses and small grains. The practice is followed most widely in Minnesota where 38.3 percent of all growers interplanted other crops, mainly wheat.

Seed crops can be used for other purposes than harvesting seed and the residual straw. Most notably, they can be mowed to produce hay or they can be grazed by livestock in the field. While this practice is occasionally followed in cool-season production regions, it is infrequent. Only 11.4 percent of Oregon growers and 2.0 percent of Minnesota producers reported doing so in 2004. In contrast, a majority of the producers of warm-season grasses reported harvesting hay or grazing livestock on their seed crops, or a combination of the two. All but 2 of the 12 California respondents reported harvesting hay on their seed acreage. Among Florida producers, grazing was more than twice as prominent as haying, though both practices are widespread.

Not surprisingly, Bermuda grass seed production in the Imperial Valley of California is totally dependent on irrigation. While Oregon grass seed growers are not nearly as dependent on irrigation as those in California, an increasing share is using it to supplement rainfall. Approximately half (52.3 percent) of the Oregon respondents said they used some irrigation in 2004. When asked what share of their grass seed crop was irrigated, on average they reported irrigating 66.1 percent of their crop. None of the responding Minnesota growers reported using irrigation while only one Florida grower irrigated about one-fifth of the farm's bahia grass seed acreage.

Table 15: Production Practices by Grass Seed Growers in Crop Year 2004, by State

	Oregon		California		Florida		Minnesota	
Practice	N	%	N	%	N	%	N	%
Interplanted grass seed crops with other crops	149	3.4	13	0.0	24	25.0	47	38.3
Seed crops used for purposes other than seed and straw	149	11.4	12	83.3	24	79.2	49	2.0
Irrigated grass seed crops in 2004	149	52.3	13	100.0	24	4.2	50	0.0
If irrigated, mean share of crop irrigated	76	66.1	13	100.0	1	20.0	---	---

Source: *RMA Lawn Seed Feasibility – Spring 2005 Survey*

5.2 Factors Affecting Economic Returns

5.2.1 Causes of Lowest Profitability

Surveyed growers were asked to identify the single most important cause for their lowest profit seed crop over the past five years. They were also asked to indicate in which year between 1999 and 2003 they experienced the lowest profit per acre for their principal seed crop. In 3 of the 4 states, low yields were cited with greatest frequency as the cause for their low profit. Oregon was the one exception, with a majority (59.5 percent) reporting low price as the principal cause. To some extent, these low prices were a function of abundant supplies of grass seed, tall fescue and perennial ryegrass in particular, pressing hard against demand that was growing at a slower pace. The price of perennial ryegrass in Oregon sagged during 2000-2002 while the price of tall fescue fell in 2002, rebounding only modestly during 2003 and 2004. A severe flood in Minnesota in 2002 was cited by around one-quarter of that state's growers as the main cause of their low profitability.

In identifying their year of lowest profit, grower responses were widely scattered with each of the five years between 1999 and 2003 identified by a portion of the growers. In other words, low profitability does not appear to be a state-wide phenomenon but instead is driven by factors operating at a lower level.

Table 16: Main Cause of Low Profitability from Grass Seed Production, 1999 – 2003, by State

Cause	Oregon (N=126)	California (N=13)	Florida (N=22)	Minnesota (N=51)
	(percent)			
Low per acre yield	29.4	92.3	63.6	45.1
Poor quality	1.6	0.0	4.5	5.9
High input costs	3.2	7.7	0.0	2.0
Low price	59.5	0.0	18.2	19.6
Other[1]	6.3	0.0	13.6	27.4
All causes	100.0	100.0	100.0	100.0

[1]Most respondents indicating "other" reported weather phenomenon, including widespread flooding in Minnesota in 2002.
Source: *RMA Lawn Seed Feasibility Study - Spring 2005 Survey.*

Table 17: Share of Grass Seed Growers by Reported Year of Lowest Profit per Acre, by State, by Species, 1999 – 2003

State/Species	N	1999	2000	2001	2002	2003
		percent				
Oregon						
Tall fescue	47	12.8	10.6	17.0	23.4	36.2
Perennial ryegrass	49	18.4	18.4	28.6	20.4	14.3
Kentucky bluegrass	16	12.5	6.3	37.5	25.0	18.8
Chewings fescue	5	40.0	20.0	0.0	0.0	40.0
Red fescue	4	0.0	25.0	25.0	25.0	25.0
California						
Bermuda grass	9	0.0	22.2	22.2	33.3	22.2
Florida						
Bahia grass	18	0.0	22.2	22.2	33.3	22.2
Minnesota						
Kentucky bluegrass	43	4.7	10.4	27.1	22.9	20.8
Perennial ryegrass	1	0.0	0.0	0.0	0.0	100.0

Source: *RMA Lawn Seed Feasibility Study – Spring 2005 Survey*

5.2.2 Factors Impacting Net Farm Income

On the basis of their experience in producing grass seed, growers were asked to identify those factors that have significantly affected their net farm income. Of the factors identified, they were asked to rank them from 1 to 3 with "1" as most important and "3" as least important.

To interpret grower responses, it is helpful to look both at the share of growers who identified the individual factors as significantly impacting net farm income as well as the factor's level of importance. Economic factors (i.e. product price and production cost) rank high among growers in all four states, though particularly so in Oregon and California. Weather related factors are important in all four states too, though they are somewhat more important for growers in Florida and Minnesota. Of the weather-related factors, extreme temperature was most frequently assigned greater importance in Oregon and California while in Florida "drought' topped the list of all factors and "flooding" did the same in Minnesota.

A range of other factors (e.g. disease, pests, changes in public laws, and the availability of irrigation water) are viewed by some growers as having a significant impact on net farm income, though they are generally viewed as being of secondary importance. Of these factors, crop disease was most frequently mentioned with from nearly one-quarter to over one-third of the growers identifying disease as having had a significant impact.

Table 18: Factors Having a Significant Impact on Net Farm Income as Identified by Grass Seed Growers, by State, 2005

Factor	Oregon (N=145)	California (N=13)	Florida (N=24)	Minnesota (N=50)
	(percent of growers reporting)			
Product price	94.5	100.0	79.2	76.0
Production costs	89.0	100.0	50.0	76.0
Extreme temperature	37.9	69.2	45.8	44.0
Drought	35.2	0.0	100.0	40.0
Flooding	4.1	0.0	33.3	82.0
Hail	6.9	0.0	12.5	22.0
Crop disease	31.0	23.1	25.0	38.0
Crop pests	18.6	23.1	16.7	26.0
Availability of irrigated water	12.4	7.7	4.2	6.0
Changes in govt. laws/regs.	17.9	15.4	8.3	10.0
Other[1]	13.8	7.7	0.0	10.0

[1]Factors identified as "other" included frost and weeds.
Source: *RMA Lawn Seed Feasibility Study - Spring 2005 Survey.*

Table 19: Top Ranked Factors Impacting Net Farm Income as Identified by Grass Seed Growers, by State, 2005

Rank	Oregon	California	Florida	Minnesota
1	product price (1.29)	production costs (1.50)	drought (1.60)	flooding (2.00)
2	production cost (2.05)	product price (1.67)	product price (1.89)	product price (2.28)
3	extreme temperature (6.33)	extreme temperature (3.80)	extreme temperature (3.28)	production cost (2.63)

Note: Weighted mean value, appears in parenthesis below each factor. Respondents were asked to rank factors from "1" (most important) to "3" (least important). Mean values for each factor were weighted on the basis of share of growers identifying factor as having a significant impact on net farm income. Thus, the smaller the mean value, the higher the ranking and the larger the share of growers assigning it a high ranking.
Source: *RMA Lawn Seed Feasibility Study - Spring 2005 Survey*

5.3 Risk Management Practices

Survey respondents were asked to select from a list those risk management measures they have used and then to rank these measures by their relative importance. As indicated in Table 20, there are both similarities and differences among growers in the four regions in the use of these measures. Of the ten measures listed, controlling debt was at or near the top of the list (in terms of frequency of mention) in all four states. Enterprise diversification is the next most frequently used measure in three of the four areas and ranks high in all four. Even in Oregon where growers are heavily dependent on the sale of grass seed for farm revenue, nearly two-thirds (64.3 percent) of all producers report use of enterprise diversification. This possibly includes diversification among species and varieties of grass seed, which is common in this area. (Of the Oregon respondents providing production information on the survey, around one-third reported growing more than one species in the same year during the period of study.)

Of the differences among the production regions in risk management measures used, two stand out in prominence. One is the use of crop insurance. It is well down the list in Oregon (21.4 percent) and California (23.1 percent) and only slightly higher in Florida (30.4 percent). In Minnesota, in contrast, it tops the list with 87.0 percent of responding growers reporting its use. In part, this is a function of Minnesota growers farming in a region where crop insurance has been widely used for many years in the production of grain crops.

The other prominent difference among the production areas is in their use of other Federal programs. Growers in Oregon and California make comparatively little use of Federal commodity programs and almost no use of Federal disaster assistance. In comparison, 70 percent or more of growers in Florida and Minnesota have used Federal disaster assistance and 63 percent of Minnesota growers report use of Federal commodity programs. The use of Federal disaster assistance in these states is largely a function of the vulnerabilities of these producing areas to weather extremes and their recent experiences in suffering losses from these causes. The use of Federal commodity programs in Minnesota stems from its production of small grain crops, notably wheat, that have long-established Federal programs.

Table 20: Incidence of Use of Risk Management Measures by Grass Seed Growers, by State, 2005

Risk management measures	Oregon (N=140)	California (N=13)	Florida (N=23)	Minnesota (N=46)
	(percent of growers reporting)			
Control debt	82.1	69.2	69.6	84.8
Enterprise diversification	64.3	61.5	52.2	65.2
Keep extra cash on hand	47.9	38.5	52.2	52.2
Off-farm employment income	34.3	30.8	30.4	43.5
Forward contracting	29.3	23.1	13.0	50.0
Crop insurance	21.4	23.1	30.4	87.0
Diversified marketing	20.7	23.1	8.7	26.1
Govt. commodity programs	20.0	15.4	17.4	63.0
Federal disaster assistance	7.1	0.0	69.6	78.3
Futures or options hedging	2.1	0.0	0.0	21.7
Other[1]	1.4	0.0	4.3	2.2

[1] "Other" measures included: hail insurance, delayed marketings, partnerships, and joint ventures.
Source: *RMA Lawn Seed Feasibility Study - Spring 2005 Survey.*

A summary of the ranking of risk management measures by their perceived importance is compared by production area in Table 21. With minor exception, these rankings mirror their frequency of use. Control of debt and enterprise diversification rank high in all areas, supplemented by use of disaster assistance in Florida in particular and crop insurance in Minnesota.

Table 21: Ranking by Importance of Risk Management Measures Used by Grass Seed Growers, by State, 2005

Rank	Oregon (N=140)	California (N=13)	Florida (N=23)	Minnesota (N=46)
1	control debt	control debt	control debt	crop insurance
2	enterprise diversification	enterprise diversification	disaster assistance	control debt
3	extra cash on hand	forward contracting	enterprise diversification	enterprise diversification
4	off-farm employment	extra cash on hand	extra cash on hand	disaster assistance
5	forward contracting	off-farm employment	off-farm employment	commodity programs
6	diversified marketing	commodity programs	crop insurance	off-farm employment
7	crop insurance	crop insurance	commodity programs	extra cash on hand
8	commodity programs	diversified marketing	forward contracting	forward contracting
9	disaster assistance		diversified marketing	diversified marketing
10	hedging			hedging

Note: Mean ranking for each variable weighted on the basis of the share of producers using measure to yield an adjusted mean ranking. Measures not used by growers in California (hedging and disaster assistance) and Florida (hedging) not included in rankings for those states.
Source: *RMA Lawn Seed Feasibility Study - Spring 2005 Survey.*

Beyond asking survey respondents to identify risk management measures that were used, they were also asked if they had purchased crop insurance during 1999-2003 and if they responded affirmatively, why they bought it and what hazards they were protecting against. The share of growers buying crop insurance during this period ranged from 38.5 percent in the Imperial Valley of California to 86.3 percent in Minnesota. Interestingly, the share of growers reporting that they had bought crop insurance was substantially higher than the share reporting its use as a risk management measure in every producing area but Minnesota where it was essentially the same. The most frequent peril against which growers were insuring varied among the producing areas. In some areas it was fire (Oregon and California). In other areas (Minnesota and California) it was hail while in Florida it was flooding.[6]

[6] It should be noted that the size of the sample of respondents who purchased crop insurance is particularly small in California (5) and Florida (13).

The reasons cited for buying crop insurance also varied, though in most producing areas risk of crop loss headed the list. Another frequently cited reason by growers in three of the four areas was that purchase of insurance was a requirement for a Federal program.

Table 22: Experience of Grass Seed Growers with Purchased Crop Insurance, by State, 1999 – 2003

Item	Oregon	California	Florida	Minnesota
	(N=149)	(N=13)	(N=24)	(N=51)
Share of growers buying crop insurance during 1999-2003	40.9%	38.5%	54.2%	86.3%
	(N=61)	(N=5)	(N=13)	(N=44)
Of respondents buying crop insurance, share purchased to protect against:				
- fire	82.0%	60.0%	15.4%	40.9%
- frost or freeze	9.8	40.0	23.1	20.5
- flood	3.3	40.0	30.8	20.5
- hail	19.7	60.0	15.4	77.3
- other[1]	14.7	20.0	23.1	13.6
- no response	3.3	---	---	---
	(N=61)	(N=5)	(N=10)	(N=42)
Of respondents buying crop insurance, share indicating insurance purchased for following reasons:				
- risk of crop loss high	72.1%	40.0%	80.0%	88.1%
- required for federal program	24.6	80.0	70.0	81.0
- required by lender	16.4	---	30.0	52.4
- expected low prices	16.4	---	30.0	52.4
- expected low input supplies	13.1	---	40.0	64.3
- other[1]	13.1	20.0	10.0	2.4

[1] Other perils protected against included: wind, disease, and drought

[2] Other reasons for buying insurance included: weather and processor required.

Source: *RMA Lawn Seed Feasibility Study – Spring 2005 Survey.*

SECTION 6: ACTUARIAL ANALYSIS

6.1 Selection of Crop Insurance Plan

We selected an Actual Production History (APH) plan after careful analysis of other insurance plans. In the survey data, growers in Oregon identified price as the biggest risk to them, however, we would not recommend a revenue type program. After reviewing the current revenue programs and income protection, we felt there were two significant obstacles to recommending these plans:

1. Grower prices of lawn seed are not publicly available as with other crops; and

2. Current revenue plans do not allow "optional units."

We believe the first obstacle is the most significant. Lawn seed producers typically have private contracts with one or more seed companies. While the Oregon State University Extension office produces a compilation of prices ex post, it is not a market listing. Without objective and consistent price information, there is a strong possibility for abuse.

We understand that current revenue programs do not allow for insuring optional units. We believe this would be a barrier to participation in a pilot program for lawn seed.

6.2 Selection of Pilot Program Counties

We believe that if offered, the pilot program should begin with selected counties in Oregon and Minnesota. This is due to the significant amount of lawn seed grown in Oregon and the increasing amount grown in Minnesota. The growers in Minnesota exhibited a strong desire for crop insurance in lawn seed. In Oregon, there would be at least half a dozen counties from which to choose. Production in Minnesota is more highly concentrated with a single county presently accounting for the bulk of output, though production is spreading to adjoining counties.

6.3 Preliminary Rate Analysis

In this section, we describe our approach for developing a preliminary set of rates for an APH program.

We have developed a set of rates for the following species:

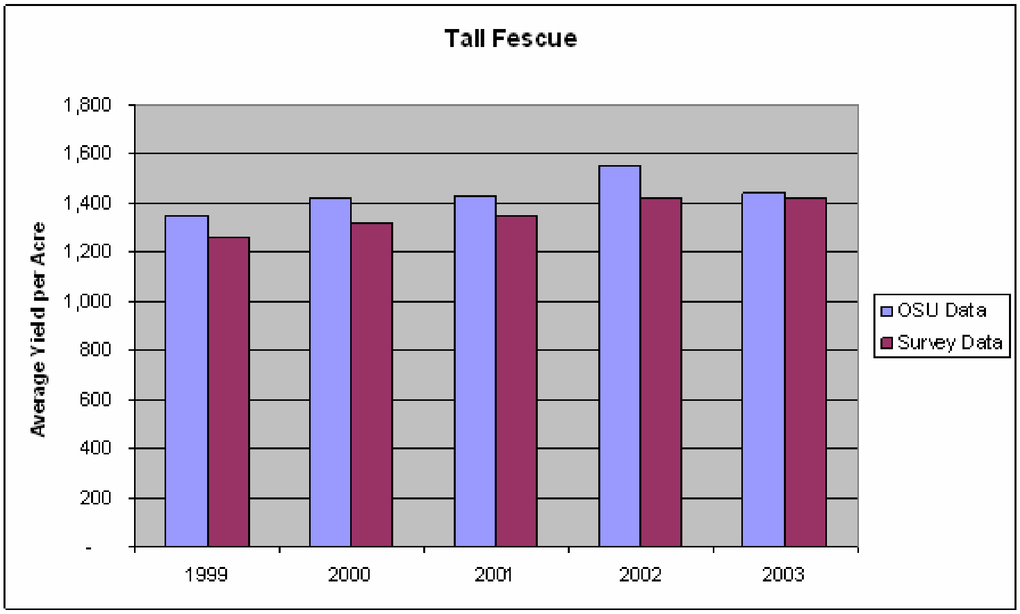
- Oregon – tall fescue
- Oregon – perennial ryegrass

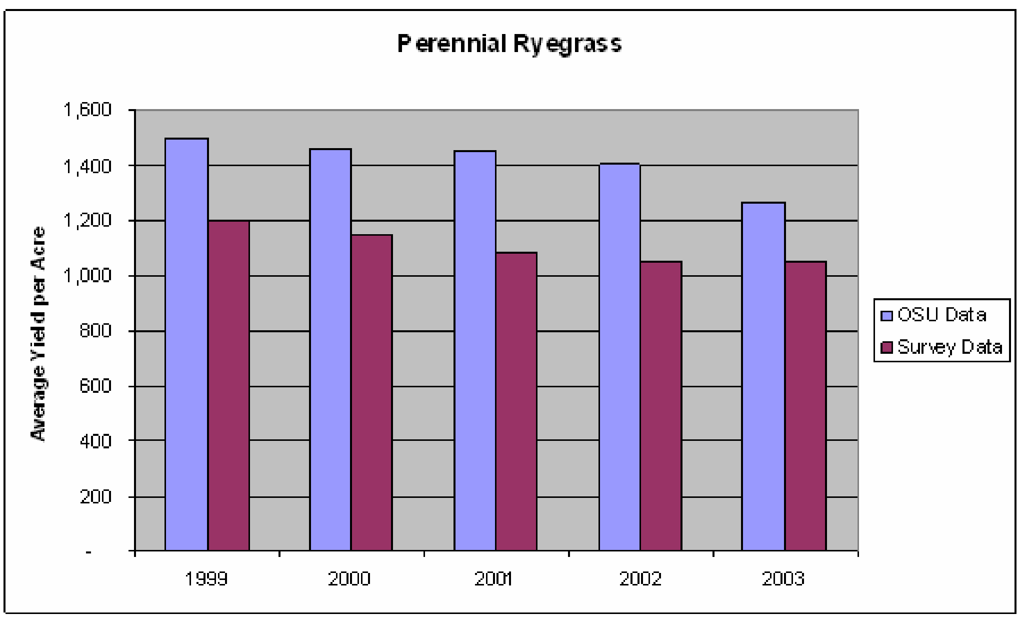
- Minnesota – Kentucky bluegrass

We selected these species and regions because of the significant amount of lawn seed grown from these species in Oregon. In Minnesota there has been an increase in the amount of Kentucky bluegrass grown and based on the surveys there is a high demand for crop insurance. Though production of perennial ryegrass in Minnesota is growing rapidly, there was insufficient production history at the time the survey data was collected for analysis.

While our initial intent was to develop a rate structure from the producer survey data, this data did not provide a credible base. One limitation was the limited number of years of data provided. The survey requested five years of production history. This is not enough to reflect the full extent of variability that exists in seed production. In addition, the number of producers responding represented a small subset of the producers in three of the four regions. Less than 15% of Oregon's production of perennial ryegrass and tall fescue was represented in the responses while about one-third of bahia grass in Florida and Bermuda grass in California was represented. The exception was Minnesota with about 74% of that state's production of Kentucky bluegrass represented. While this is a good response for a survey of this nature, and allows for some generalizations to be made with respect to producers' needs and interests, it does not provide sufficient data from which to develop crop insurance rates.

While the survey data does not provide sufficient information from which to develop rates, we have extracted certain information to use in the rate simulation (described below). Before doing so, however, we tested whether the survey data can be expected to be representative. The following tables compare the average yields from the survey data to the statewide yields reported by Oregon State University Extension. (We were unable to obtain a time series of statewide yield data for Minnesota.)





For tall fescue, survey yields are very close to the statewide averages. For perennial ryegrass, while about 20% lower, the year-to-year variability is consistent with the statewide estimates.

Based on the comparison above, we concluded that the survey respondents were representative of the population of producers for the two species in Oregon.

Our next step was to use the survey data, together with appropriate data from other sources, to develop rates. The main determinant of APH rates is the variability in individual producer yields. Crops/areas with higher variability in yields from year-to-year will require higher rates than those with more stable yields.

The variability measure we have used in our analysis is the Coefficient of Variation (CV), which is the Standard Deviation divided by the Mean.

We considered two components to the variability of a producer's yield. The first is variability in the overall (state or county) yield. The second is variability in an individual producer's yield.

By considering it this way, we were able to estimate the CV of producer yields as follows:

a. Compare CV of producer yields to CV of total yields from survey data;
b. Calculate CV of Statewide yields from OSU data over 10 and 20 year periods; and
c. Calculate adjusted producer CV from the combination of a. and b.

Our rationale for the above approach is that, while the survey data does not contain enough years from which to examine the total variability that can be expected in producer yields, it can provide a measure of the relationship between variability in producer yields and variability in the overall yield.

We then used this relationship to estimate the producer yield CV corresponding to statewide data from a longer time period.

This is illustrated as follows:

a. Compare producer CV to total CV (from survey data)

Table 23	**Coefficient of Variation**	
	Tall Fescue	**Perennial Ryegrass**
a) Producer[1]	0.138	0.112
b) Total[2]	0.051	0.059
c) Ratio (a)/(b)	2.7	1.9

[1] Average CV of individual producers.

[2] CV of annual average yields.

b. Calculate CV of total yields from OSU data

Table 24	**Coefficient of Variation**	
	Tall Fescue	**Perennial Ryegrass**
a) OSU – 10 years	0.097	0.062
b) OSU – 20 years	0.161	0.139

In reviewing the above, we chose to select a total CV which was near the midpoint of the 10- and 20-year totals. Thus, we selected a CV of 0.125 for tall fescue and 0.100 for perennial ryegrass.

c. Calculate adjusted producer CV

For the individual producer CV, we considered it likely that the survey data did not fully reflect the variability. As such, we selected ratios that were somewhat higher than those calculated above.

Table 25	**Tall Fescue**	**Perennial Ryegrass**
Selected Total CV	0.125	0.100
Selected Ratio	3.0	3.3
Calculated Producer CV	0.375	0.330

For Minnesota we used the relationship between NASS statewide yields between Oregon and Minnesota for Barley and Wheat since there are no published yields for lawn seed in Minnesota. We recognize that there are important differences between the crops and that wheat and barley grown in Oregon is grown in different regions than the majority of lawn seed. However, we felt the relationship between these measures of variation might be appropriate. The following table displays the NASS data for 1985-2005:

Table 26				
NASS Yield Per Acre				
	Oregon		**Minnesota**	
	Wheat	**Barley**	**Wheat**	**Barley**
Average	57.80	63.71	40.29	56.55
Std Dev	9.28	9.64	9.59	10.66
CV	0.160	0.151	0.238	0.189

The ratios of the Minnesota CVs to the Oregon CVs are 1.25 (barley) and 1.5 (wheat). From this data, we chose Minnesota CVs that are 1.5 times those we selected for Oregon Tall Fescue.

Table 27	**Oregon**		**Minnesota**
Total	0.125 x 1.5	=	0.188
Producer	0.375 x 1.5	=	0.563

Using the CV's derived in the previous section, we then developed a model to simulate loss experience under an APH coverage program. We utilized an inverted lognormal distribution to simulate each yield. The simulation proceeded as follows:

a. Select the overall annual statewide yield using the statewide average yield and selected CV.
b. Using this yield, simulate each producer's yield for the year using the selected producer CV.
c. Calculate the amount of loss under each coverage level (50%-75%).
d. Keep the results of each trial and calculate the indicated rates at various percentiles for each species.

The results are presented in the following tables:

Table 28
Oregon – Tall Fescue

Indicated Rates Coverage Level						
	50%	**55%**	**60%**	**65%**	**70%**	**75%**
Rate Per Liability						
Mean	0.049	0.055	0.061	0.069	0.077	0.086
75% Percentile	0.060	0.066	0.073	0.081	0.090	0.100
95% Percentile	0.079	0.088	0.097	0.108	0.121	0.137

Table 29
Oregon – Perennial Ryegrass

Indicated Rates Coverage Level						
	50%	**55%**	**60%**	**65%**	**70%**	**75%**
Rate Per Liability						
Mean	0.035	0.040	0.046	0.052	0.060	0.069
75% Percentile	0.044	0.050	0.056	0.064	0.072	0.082
95% Percentile	0.062	0.069	0.077	0.087	0.099	0.112

Table 30
Minnesota – Kentucky Bluegrass

Indicated Rates Coverage Level						
	50%	**55%**	**60%**	**65%**	**70%**	**75%**
Rate Per Liability						
Mean	0.1005	0.1071	0.1143	0.1219	0.1301	0.1389
75% Percentile	0.1257	0.1330	0.1406	0.1487	0.1574	0.1669
95% Percentile	0.1765	0.1861	0.1967	0.2087	0.2225	0.2368

The rates above do not include any expense or catastrophic loading. As a test of reasonableness of the above rates, the following is a comparison to several other small grain crops.

Table 31			
Lawn Seed Pilot Program Feasibility Comparison to Other Crop Rates			
Crop	**Oregon Tall Fescue Rate @ 75% Coverage Level APH**	**Oregon Perennial Ryegrass Rate @ 75% Coverage Level APH**	**Minnesota Kentucky Bluegrass Rate @ 75% Coverage Level APH**
Barley	0.0641	0.0641	0.2800
Alfalfa Seed	0.0705	0.0705	N/A
Wheat	0.0938	0.0938	0.2992
Indicated Rates for Lawn Seed			
Simulation – Mean	0.0861	0.0689	0.1389
Simulation – 75% Percentile	0.1004	0.0820	0.1669
Simulation – 95% Percentile	0.1365	0.1122	0.2368

The table above shows that the indicated rates for tall fescue and perennial ryegrass in Oregon are within the ranges of other small grain crops. The indicated rates for Minnesota Kentucky bluegrass are lower than both the barley and wheat APH rates.

As noted earlier, because of the limited data from which they are developed, these rates should be considered largely as a "ballpark" measure of the rates for an APH program. More comprehensive data would be recommended for refining the analysis above. As experience develops, these rates are likely to require adjustment.

As a measure of conservatism, we would suggest considering the higher percentile values until sufficient data can be obtained.

6.3.1 Subsequent Test – Minnesota

Subsequent to developing the rates above, we received additional grower yield data from seed companies in Minnesota. While the data is not sufficient to develop rates (only three years were available) it does allow us to test the assumptions underlying the indicated Minnesota rates above.

Specifically, as noted above, the indicated Minnesota rates (Table 31) were based on a CV of 0.563, which was derived from relationships to other crops. The Minnesota data allows us to test this assumption. The following is a summary of the CV's reflected in the Minnesota data.

	Number of Growers	Usable Growers[1]	Average Yield	Average CV
Kentucky Bluegrass	79	53	302	0.52
Perennial Ryegrass	126	10	730	0.20
Timothy	28	13	341	0.40
[1] Growers with two or three years of yield records				

Based on the above, we conclude that the CV underlying the indicated rates (0.563) is reasonable.

6.4 Expected Pilot Results

Based on our observations, we have constructed expected pilot results. The following table shows our expected participation rates for each species by coverage level. Note that we expect a higher demand in Minnesota based on discussions with the industry and the survey data.

Table 32					
State Species	**Participation**			**Percentage of 50% Coverage Level**	**Percentage of 75% Coverage Level**
	Low	**Mid**	**High**		
Oregon Perennial Ryegrass	10%	25%	50%	50%	50%
Oregon Tall Fescue	10%	25%	50%	50%	50%
Minnesota Kentucky Bluegrass	25%	50%	75%	25%	75%

Based on the expected mid participation rates, we can calculate the expected liability and premium by year for each species. The following table displays our expected industry production, yield and price by species and state. To estimate the number of insured growers, we divided the number of insured acres by the average farm size from the survey. Note that this was used in constructing the confidence levels and low/high scenarios. The fewer insureds there are, the more variability in the results due to the law of large numbers.

It should be noted that this assumes that the pilot has state-wide coverage, rather than being limited to selected counties within each state. To the extent the pilot is limited to growers in a few selected counties, the estimates that appear below would be reduced proportionately. In Oregon, it would be possible to select counties that would collectively account for no more than 30 percent of production. In Minnesota however, given the high concentration of Kentucky bluegrass production in one or two counties, that would not be feasible.

Table 33				
State/Species	**Expected Production Acres**	**Average Yield**	**Price Per Pound**	**Insured Growers**
Oregon Perennial Ryegrass	170,000	1,105	$0.60	110
Oregon Tall Fescue	148,000	1,440	0.40	150
Minnesota Kentucky Bluegrass	30,000	300	0.70	47

The following table displays the estimates of liability and premium corresponding to the "mid" participation estimate. The liability is calculated as the expected overall harvest multiplied by the coverage level, participation rate, price per pound, and percentage of the coverage level selected. The premium is calculated as the mean loss cost derived above times the liability.

Table 34				
State/Species	**Liability**	**Total Premium**	**Subsidy Premium**	**Producer Premium**
Oregon Perennial Ryegrass	$17,617,670	$974,475	$565,485	$408,989
Oregon Tall Fescue	13,315,828	949,859	553,886	395,973
Minnesota Kentucky Bluegrass	2,168,733	286,173	162,152	124,020
Total	**$33,102,231**	**$2,210,506**	**$1,281,524**	**$928,983**

Next, we estimated various outcomes of losses based on our simulations. Total expected losses over 30 years, as requested in the RFP, would be 30 times the expected losses in one year. It should be noted that the simulation measured the variability of our assumptions (process variance) and not the assumptions themselves (parameter variance). Therefore, if our assumptions are significantly incorrect or if the pilot does not perform as expected due to adverse selection, poor management of underwriting or loss adjustment, or fraud, the results may be significantly different than our illustrated results.

Table 35		
Scenario	**Loss Ratio**	**Underwriting Loss***
Low - 25% Percentile	74.8%	$(558,023)
Mid - Mean	100.0%	0
High - 95% Percentile	164.0%	1,415,437
Very High**	212.3%	2,482,924

* Losses minus premium

** Mean times 3 standard deviations

Using the different participation rates, we constructed the table of possible outcomes for one year.

Table 36						
Participation Rate	**Insured Liability**	**Total Premium**	**Low UW Loss**	**Mid UW Loss**	**High UW Loss**	**Very High UW Loss**
Low	$13,457,766	$912,820	$(230,300)	0	$584,272	$1,024,983
Medium	33,102,231	2,210,506	(558,023)	0	1,415,437	2,482,924
High	65,120,096	4,277,926	(1,080,592)	0	2,740,389	4,806,780

Please note that the ranges above do not indicated all possible scenarios under a pilot program but rather reasonable scenarios based on our assumptions. Actual experience could be significantly different.

6.5 Developing T-Yields

The survey data collected in this study did not provide sufficient history to develop T-yields, particularly given the possibility of yield differences by age of stand and variety discussed earlier. We had hoped that with the cooperation of some of the major seed companies, we would be able to assess these differences. However, we were unable to secure the cooperation of the seed companies in Oregon and were able to collect only three years of data from the seed companies in Minnesota.

A possible way to sidestep this problem would be to require four years of yield history as a requirement for insurance, thereby eliminating the need for T-yields. This should work particularly well in Oregon where the growers are highly specialized and well established. A four year production history should be available for a majority of these growers. This approach would be somewhat less appropriate in Minnesota given the recent expansion of production in that state.

As for yield differences due to age of stand, we suggest that the procedures used in the forage seed program, whereby reference yields and rates vary between new plantings and established stands, be applied. Our earlier evaluation of the forage seed program concluded that this procedure was performing satisfactorily.

6.6 Variability

It is important to realize that all actuarial projections of future contingent events are subject to a high degree of variability. This is particularly true for highly volatile coverages such as crop insurance. In general, crop insurance rates are based on analyses of many years of data, because of the variability that exists in yields, and therefore insurance costs, from one year to the next.

In addition to the normal variability that exists in the evaluation of crop insurance experience, additional uncertainty exists in the evaluation of rates for a lawn seed pilot because of the very limited amount of data that is available. While the analysis herein reflects our best professional judgment, using the limited information available, substantial variance from the projected results is possible.

SECTION 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This study has examined the feasibility of developing and applying crop insurance to the production of seeds of seven turf grasses, five cool-season grasses and two warm-season. On the basis of this examination, we have concluded that there is merit in the further development of a pilot crop insurance for three of the seven grasses: tall fescue, perennial ryegrass, and Kentucky bluegrass. They are the leading turf seed grasses, collectively accounting for 93 percent of the national acreage planted in 2002 to the grasses included in this study.

We have concluded that it would not be feasible to develop crop insurance products for the other four grasses (fine fescue, creeping bentgrass, Bermuda grass, and bahia grass) for a variety of reasons. Very small quantities of the fine fescue and creeping bentgrass are grown and in declining quantity. As a result, there is a paucity of data available for use in establishing production history and rate analysis. In our survey of Oregon grass seed growers, the number of growers reporting production in 2003, the final crop year for which we collected production data, was very small: Chewings fescue – 10, red fescue – 8, and creeping bentgrass – 9. While the universe of growers of these species is somewhat larger than this, it is still very small.

Our reasons for excluding Bermuda grass and bahia grass from further consideration are somewhat different. While these grasses are grown on a larger scale than the fine fescues and creeping bentgrass, for many producers of Bermuda grass seed and bahia grass seed, seed production is not the principal reason they grow the crop. In the case of Bermuda grass, growers have several options in producing seed and/or hay. Growers can choose to have as many as two seed harvests and four hay harvests in a given crop year. If they harvest seed twice, yields on the second harvest are typically one-half or less than the first harvest. Given the movement back and forth between the production of seed and the production of hay in varying combinations, it would be difficult to establish a reliable production history. Further complicating the picture, only about 30 percent of Bermuda seed is produced under contract. Absent the requirements and close supervision of contracting seed companies, there is less assurance that growers are following best management practices.

For many producers of bahia grass, their principal enterprise is calf production. While there are some bahia grass seed growers who specialize in the production of seed, they are relatively few. Most are cow/calf operators who grow bahia grass for the forage it provides their livestock. For them, seed production is therefore incidental to livestock production. If conditions are favorable and prices attractive when the seed matures, it is harvested. Otherwise the crop is cut for hay. As a result, the crop is managed for its value as forage, not for its value as seed. Not surprisingly, most bahia grass seed is neither grown under contract nor for use as certified seed. As noted above, this potentially adds further risk to insuring the crop since there is a reduced incentive to apply best management practices.

The production of Kentucky 31 tall fescue in Missouri is similar to bahia grass in that its production is usually incidental to the production of calves. Although Missouri is a leading producer of fescue seed (ranking a distant second behind Oregon in 2002), most of the crop is sold on the spot market with less than 5 percent grown under contract. As with bahia grass, the crop is managed by most growers strictly for its value as livestock forage rather than for its value as seed.

In our opinion, therefore, none of these crops offers a reasonable opportunity for the application of crop insurance.

The remaining grass seed crops – tall fescue, perennial ryegrass, and Kentucky bluegrass – were found to be viable candidates for a pilot crop insurance program. As a start, we suggest a pilot program for tall fescue and perennial ryegrass in Oregon and one for Kentucky bluegrass in Minnesota.[7] We have come to this conclusion for the following reasons:

- These crops are the leading lawn seed crops, in combination accounting for over 90 percent of national lawn seed production.
- Oregon is by far the leading producer of all fescues and ryegrass, accounting for nearly 90 percent of the national total in 2002. While Minnesota trailed Washington, Idaho, and Oregon in the production of Kentucky bluegrass in 2002, grass seed production in the state has been growing rapidly in recent years and there is strong interest in a crop insurance program among growers in the state.
- These crops are subject to the usual range of pest, disease, and weather risks found among field crops.
- The universe of growers of these crops is large enough to provide a basis for developing an actuarially sound insurance program.
- While these crops are demanding in terms of the intensity of management and sophistication of technique required, the main parameters of best management practices are reasonably well documented, particularly for production in Oregon.

[7] Kentucky bluegrass production in Washington is also a viable option, though we lack sufficient data to conduct actuarial analysis for production in that state. In Minnesota, the production of perennial ryegrass has grown rapidly over the past two or three years and is also an option for RMA to consider, though here again we lacked sufficient production history to develop rates.

- A large share of production is contracted and/or grown as certified seed, thereby benefiting from the management requirements and supervision associated with production for these purposes.
- A preliminary rate analysis suggests that estimated rates for lawn seed varieties in Oregon and Minnesota are close to or lower than the rates of established small grain crop insurance programs operating in these states.
- Interest in the possibility of a crop insurance program has ranged from indifference in Oregon to enthusiasm in Minnesota. In part, these reactions are thought to be a reflection of past experience (or lack of experience) with Federal farm programs in general and crop insurance in particular.

In the Draft Research Report submitted on March 30, 2006, we recommended that three or four of the larger seed companies in Oregon and Minnesota be asked to share customer records to provide us access to a larger pool of production history that could be used in deriving a more definitive rate analysis. With RMA's approval, we undertook negotiations with the seed companies in both states.

In Oregon, we took our request to the Oregon Seed Trade Association (OSTA), as the representative of seed companies operating in the state. The President of the Association said they would comply with the request if it met with the approval of the growers. After numerous conversations with the heads of OSTA and the Oregon Seed Council (OSC), representing the growers, the growers gave their collective approval to share records, though without much enthusiasm. By this time, however, the seed company representatives had concluded that it wasn't worth the effort to help us, given the lack of producer interest. As a result, we abandoned our effort to obtain additional data on production in Oregon.

We had substantially greater success in Minnesota. All three seed companies operating in this region agreed to cooperate. While all three companies provided grower records, for a variety of reasons they were of limited value. One company does no contracting and therefore could provide no acreage data. The other two companies could provide only three years of records, one because it had been in operation only since 2003 and the other because its records prior to 2003 were not automated. Despite these limitations, we were able to use the records of two of the companies to further test our previous findings.

These follow-up activities have reconfirmed two of our earlier conclusions, namely that:

- On the basis of our preliminary rate analysis, insurance rates for Minnesota could be set close to or lower than the rates of established small grain crop insurance programs operating in that state.

- On the whole, at least at the leadership level, Oregon grass seed growers are indifferent to the prospect of a crop insurance program while growers in Minnesota are enthusiastic.

7.2 Recommendations

We believe the findings reported here provide sufficient basis to recommend going forward with development of a modest-scale lawn seed pilot program. While we would have preferred a more extensive pool of production history on which to base our analysis, as noted earlier, we believe a carefully designed pilot program is justified.

We suggest that RMA consider proceeding in two stages. First, that the Agency develop the general outline of a proposed pilot program. The outline should be developed to the point that producers can reasonably evaluate its value for their operations. Our recommendations for the major features of this program are listed below. The second stage would be to take this proposed program to producers in the targeted areas to get their reactions. The most appropriate forums for determining grower interest and for obtaining feedback would be the Oregon Seed Council and the Minnesota Association of Wheat Growers. Both organizations have been very cooperative with this study. Only after RMA is satisfied that there is a market for the product, would we suggest proceeding to further develop and implement the pilot.

Our suggestion for proceeding in two stages stems from our recognition that both of these growing areas have their own unique constraints to the adoption of a new insurance product and that further examination could find that the program is not feasible in one or both areas.

In the case of Oregon, the issue is grower indifference due to a perceived lack of production risk. While we believe there could be a significant number of Oregon lawn seed producers attracted to participation in an insurance program, once they are told how it would operate, that remains to be seen.

The potential constraints in Minnesota are somewhat different. As noted earlier, the production of Kentucky bluegrass in Minnesota is highly concentrated within two counties (Roseau and Lake of the Woods) accounting for nearly all of the state's output. Thus, RMA will probably have to relax its 30 percent rule to offer a pilot program in Minnesota. More importantly, these two counties tend to have high loss ratios for their existing crop insurance programs. Their average annual combined loss ratios for the period 1997 – 2005 was 1.66 for Lake of the Woods and 1.89 for Roseau. It is partly for this reason that we have suggested a conservative approach to rate setting, at least until the Agency has had an opportunity to develop a track record. As with Oregon growers, it will be important for Minnesota growers to know the probable terms of the pilot before gauging their interest in it.

On the basis of our recent experience in evaluating the Forage Seed Pilot Program, we recommend that any program for lawn seed be patterned after several features in the Forage Seed Program. The two crops share many of the same characteristics. In brief, we recommend offering a pilot program with the following features:

- Multi-peril insurance.
- Base on actual production history (APH).
- Offer in a small number of counties in Oregon and Minnesota.
- Offer coverage on perennial ryegrass and tall fescue in Oregon and Kentucky bluegrass in Minnesota.
- Offer participants an opportunity to choose from variable percentages of their approved annual yield and to choose a price from a percentage of base price with the base price to be the contract price, if under contract, or a price established by RMA.
- Initially apply the higher percentile rates calculated in the actuarial analysis (Table 31). Thereafter monitor the experience closely to determine if rate adjustments are required.
- Cover only those crops grown under contract to a seed company and/or grown as certified seed.
- Require that crops meet adequate stand requirements, differentiating by age of stand.
- Consider establishing a maximum age of stand.

ANNEX 1: SURVEY PRODUCTION DATA

Summary of Production Data Reported by Growers in Spring 2005 Survey

Table A-1: Tall Fescue Production Reported by Oregon Grass Seed Growers, by Crop Year, 1999 - 2003

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	49	11,726	239.3	49	15,200.0	310.2	49	6,731.0	137.4
2000	55	13,048	237.2	55	17,690.0	321.6	55	8,668.0	157.6
2001	63	15,517	246.3	63	21,421.0	340.0	63	10,423.0	165.5
2002	67	18,410	274.8	67	27,019.0	403.3	67	11,814.0	176.3
2003	63	15,927	252.8	63	23,535.0	373.6	63	9,820.0	155.9

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-2: Perennial Ryegrass Production Reported by Oregon Grass Seed Growers, by Crop Year, 1999 - 2003

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	48	19,947	415.6	48	31,634.7	659.1	48	15,789.1	328.9
2000	51	21,125	414.2	51	31,939.9	626.3	51	13,997.8	274.5
2001	51	19,491	382.2	51	28,731.1	563.4	51	12,092.2	237.1
2002	49	18,675	381.1	49	26,880.5	548.6	49	11,886.9	242.6
2003	50	17,393	347.9	50	24,679.5	493.6	50	13,685.2	273.7

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-3: Kentucky Bluegrass Production Reported by Oregon Grass Seed Growers, by Crop Year, 1999 - 2003

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	16	3,239	202.4	16	3,612.9	325.8	16	3,032.7	189.5
2000	15	3,187	212.5	15	3,853.7	256.9	15	3,208.2	213.9
2001	15	3,529	235.3	15	3,639.4	242.6	15	2,707.7	180.5
2002	14	3,651	260.8	14	3,777.4	269.8	14	3,024.2	216.0
2003	15	3.651	260.8	15	4,382.3	292.2	15	3,536.2	235.7

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-4: Chewings Fescue Production Reported by Oregon Grass Seed Growers, by Crop Year, 1999 - 2003

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	11	1,418	128.9	11	1,307.6	118.9	11	877,005	79.7
2000	9	1,393	154.8	9	1,529.0	169.9	9	801.8	89.1
2001	9	1,631	188.2	9	1,973.5	219.3	9	882.3	98.0
2002	11	1,277	116.1	11	1,402.5	127.5	11	644.2	58.6
2003	10	940	94.0	10	931.0	93.1	10	453.7	45.4

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-5: Red Fescue Production Reported by Oregon Grass Seed Growers, by Crop Year, 1999 - 2003

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	9	1,438	159.7	9	1,313.1	145.9	9	1,015.7	112.9
2000	8	1,552	193.9	8	1,366.9	170.9	8	974.9	121.9
2001	11	2,003	182.1	11	1,854.0	168.5	11	895.0	81.4
2002	11	1,441	130.9	11	1,319.5	119.9	11	583.1	53.0
2003	8	1,375	171.9	8	1,254.5	156.8	8	621.7	77.7

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-6: Creeping Bentgrass Production Reported by Oregon Grass Seed Growers, by Crop Year, 1999 - 2003

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	11	932	84.7	11	647.7	58.9	11	1,803.2	163.9
2000	10	1,054	105.4	10	634.9	63.5	10	1,743.8	174.4
2001	9	874	97.1	9	586.7	65.2	9	1,509.8	167.8
2002	9	679	75.4	9	400.6	44.5	9	948.9	105.4
2003	9	481	53.4	9	292.8	32.5	9	779.3	86.6

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-7: Kentucky Bluegrass Production Reported by Minnesota Grass Seed Growers, by Crop Year (1999-2003)

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross Revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	32	8061	252.0	32	2,447.9	76.5	32	2,060.7	64.4
2000	32	10046	314.0	32	2,886.1	90.2	32	1,734.7	54.2
2001	33	11593	351.3	33	3,552.2	107.6	33	1,959.3	59.4
2002	35	11806	337.3	35	3,821.4	109.2	35	2,625.7	75.0
2003	38	14140	372.1	38	4,545.7	119.6	38	3,377.3	88.9

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-8: Perennial Ryegrass Production Reported by Minnesota Grass Seed Growers, by Crop Year (1999-2003)

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross Revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	1	151	151	1	93.4	93.4	1	46.7	46.7
2000	1	356	356	1	268.7	268.7	1	121.0	121.0
2001	3	294	98	3	116.3	38.8	3	39.2	13.1
2002	4	283	70.1	4	118.9	29.7	4	67.8	17.0
2003	14	1916	136.9	14	1,438.6	102.8	14	580.1	41.4

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-9: Bermuda Grass Production Reported by California Grass Seed Growers, by Crop Year (1999-2003)

		Acres harvested			Pounds of clean seed harvested			Gross Revenue		
Crop Year	Season	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	Summer	6	4,400	733.3	6	1,639.2	273.2	6	2,426.8	404.5
	Fall	2	730	365.0	2	98.5	49.2	2	125.1	62.5
2000	Summer	5	3,870	774.0	5	1,069.7	214.0	5	1,650.2	330.0
	Fall	3	333	110.8	3	37.6	12.5	3	64.8	21.6
2001	Summer	8	6,299	787.3	8	2,128.0	266.0	8	2,732.6	341.6
	Fall	3	530	176.7	3	65.2	21.7	3	110.5	36.8
2002	Summer	9	5,269	585.4	9	2,078.6	231.0	9	2,999.1	332.2
	Fall	4	465	116.3	4	83.8	21.0	4	132.1	33.0
2003	Summer	8	5,835	729.3	8	2,129.9	274.0	8	3,055.7	382.0
	Fall	3	300	100.0	3	106.0	35.3	3	134.5	44.8

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

Table A-10: Bahia Grass Production Reported by Florida Grass Seed Growers, by Crop Year (1999-2003)

Crop Year	Acres harvested			Pounds of clean seed harvested			Gross Revenue		
	N	Total	Mean	N	Total (000)	Mean (000)	N	Total (000)	Mean (000)
1999	10	2,225	222.6	10	289.4	28.9	10	294.6	29.5
2000	11	2,269	206.3	11	278.3	25.3	11	237.0	21.5
2001	13	3,212	247.1	13	352.8	27.1	13	318.1	24.5
2002	13	3,239	249.1	13	359.0	27.6	13	330.3	25.4
2003	12	3,365	280.4	13	379.8	31.6	12	358.4	29.9

Source: RMA Lawn Seed Feasibility Study – Spring 2005 Survey

Note: Table includes information for only those respondents who provided a complete response for the year, including acres harvested, pounds of production, and gross revenue.

ANNEX 2: SURVEY INSTRUMENT

(Instrument for each production region modified to reflect grass seed species grown in that region.)

Approved OMB Number: 0563-0072
Expiration: 02/29/2008

U.S. Department of Agriculture
Survey of Oregon Grass Seed Producers

PLEASE NOTE

This survey is being conducted on behalf of the Risk Management Agency of the U.S. Department of Agriculture. It is being sent to all Oregon grass seed producers of record. Results of the survey will be used to evaluate the feasibility of developing a crop insurance program for producers of grass seed. If determined to be feasible, results of this survey will be used in developing a risk management program, in consultation with Oregon growers.

All information provided will be treated in strictest confidence. At no point in the analysis will the information you provide be identified with you or your farm. For analytic purposes, data will be aggregated across farms.

Name of person completing survey: ______________________________
Name of farm (if applicable): ______________________________
Address: ______________________________
____
____

Telephone number: (____) ____________________

In what county (or counties) is this farm located? ______________________________

1. Have you grown one or more of the following grass seed species for the purpose of harvesting seed for sale in at least one year during the period 1999-2003?

- tall fescue
- perennial ryegrass
- Kentucky bluegrass
- Chewings fescue
- red fescue
- creeping bentgrass

YES ☐
NO ☐

If **NO**, there are no further questions. Please return form in the enclosed envelope. Thank you for your time.

If **YES**, please proceed to question 2.

2. For each of the grass seed species identified, please provide the requested information by crop year. Please be as accurate as your records permit. If estimates are required, indicate with an asterisk (*).

A. Number of acres harvested

	tall fescue	perennial ryegrass	Kentucky bluegrass	Chewings fescue	red fescue	creeping bentgrass
1999						
2000						
2001						
2002						
2003						

B. Pounds of clean seed harvested

1999						
2000						
2001						
2002						
2003						

C. Gross revenue

(in dollars)

1999						
2000						
2001						
2002						
2003						

CROP YEAR 2004

The following questions relate only to crop year 2004.

3. For the grass seed you harvested in crop year 2004, approximately what percentage share of your total production of each of the indicated species was:

(A) grown under contract?

(B) grown for use as certified seed?

Species	**(A)** percent under contract	**(B)** percent certified seed
tall fescue		
perennial ryegrass		
Kentucky bluegrass		
Chewings fescue		
red fescue		
creeping bentgrass		

4. In crop year 2004, did you interplant any of the six grass seed crops listed above with any other crops?

YES ☐

NO ☐

If YES, what crop (or crops) were interplanted?

____

____

____

5. In crop year 2004, aside from the sale of seed and the sale of straw resulting from the residue following harvest, were any of your seed crops used for other purposes (e.g. livestock grazing, hay crops, etc.)?

YES ☐
NO ☐

If **YES**, describe purposes:

____

____

6. In crop year 2004, were any of your grass seed crops irrigated?

YES ☐
NO ☐

If YES, about what percentage of your grass seed crops were irrigated in 2004? ___________%

crop years 1999-2003

7. On average over the period 1999-2003 approximately what share of the total gross revenue of this farm has resulted from the sale of grass seed and residual straw?

_____________%

8. Of the six grass species listed in question 1 above, which one do you consider to have been your PRINCIPAL SEED CROP over the last five years?

	(Check one)
tall fescue	__________
perennial ryegrass	__________
Kentucky bluegrass	__________
Chewings fescue	__________
red fescue	__________
creeping bentgrass	__________

For this, your PRINCIPAL SEED CROP, looking back over the period 1999-2003, in which year between 1999 and 2003 did you experience the lowest profit per acre (revenue less cash expenses)?

Year: ________

What was your approximate profit per acre from your PRINCIPAL SEED CROP that year?

$________/acre.

What has been your average profit per acre for this species over the past five years?

$________/acre.

What was the main cause of your lowest profit from your PRICIPAL SEED CROP over the last five years?

	(check only one)
Low per acre yield	______________
Poor quality	______________
High input cost	______________
Low price	______________
Other (specify) ____________________	______________

9. On the basis of your overall experience as a producer of grass seed:

(A) Which of the factors listed below have had a significant impact on your net farm income?

(B) Of those identified in A, which ones are of greatest significance ("1" for most important to "3" for least important)?

Factors	**(A)** Have had significant impact on net farm income (check all that apply)	**(B)** Most important factors (rank 1 to 3)
Product price	_________	________
Production costs	_________	________
Extreme temperature	_________	________
Drought	_________	________
Flooding	_________	________
Hail	_________	________

Crop disease	________	________
Crop pests	________	________
Availability of irrigation water	________	________
Changes in governmental laws/regulations	________	________
Other (specify) ______________	________	________

10. Of the alternative methods of risk protection listed below, please indicate in column (A) the ones you have used. Of those methods of risk protection you have used, in column (B) rank each as to its relative importance with "1" for the most important, "2" for the next most important, and so forth.

Risk management measures	**(A)** Have used (check all that apply)	**(B)** Rank (1-most important, etc)
Keep extra cash on hand		
Control debt		
Off farm employment/income		
Crop insurance		
Enterprise diversification		
Hedging with futures or options		
Forward contracting		
Diversified marketing		
Government commodity programs		
Federal disaster assistance		
Other (specify) ______________		
______________		

11. Have you purchased crop insurance from any source during the period 1999-2003?

YES ☐
NO ☐

If YES, in how many of the past five years?

__________ years

If YES, have you purchased private crop insurance to protect against damage from:

	(check all that apply)
Fire	_______
Frost or freeze	_______
Flood	_______
Hail	_______
Other causes (specify) _________________	_______

If YES, please rank the reasons why you purchased crop insurance. (Assign "1" to most important, "2" to next most important, etc.)

Reason	Rank
Risk of crop loss high	_____
Insurance required to qualify for Federal program	_____
Insurance required by lender	_____
Expected prices to be low	_____
Expected input supplies to be limited and/or input prices to be high	_____
Other (specify) ________________________	_____

This completes the survey. Thank you very much for taking time to help. Please return in the enclosed envelope.

Return to:
Lynn M. Daft
Promar International
1101 King Street, Suite 444
Alexandria, VA 22314

Telephone: (703) 838-0635
Fax: (703) 739-9098
E-mail: LDaft@promarinternational.com

ANNEX 3: HISTORICAL OREGON DATA

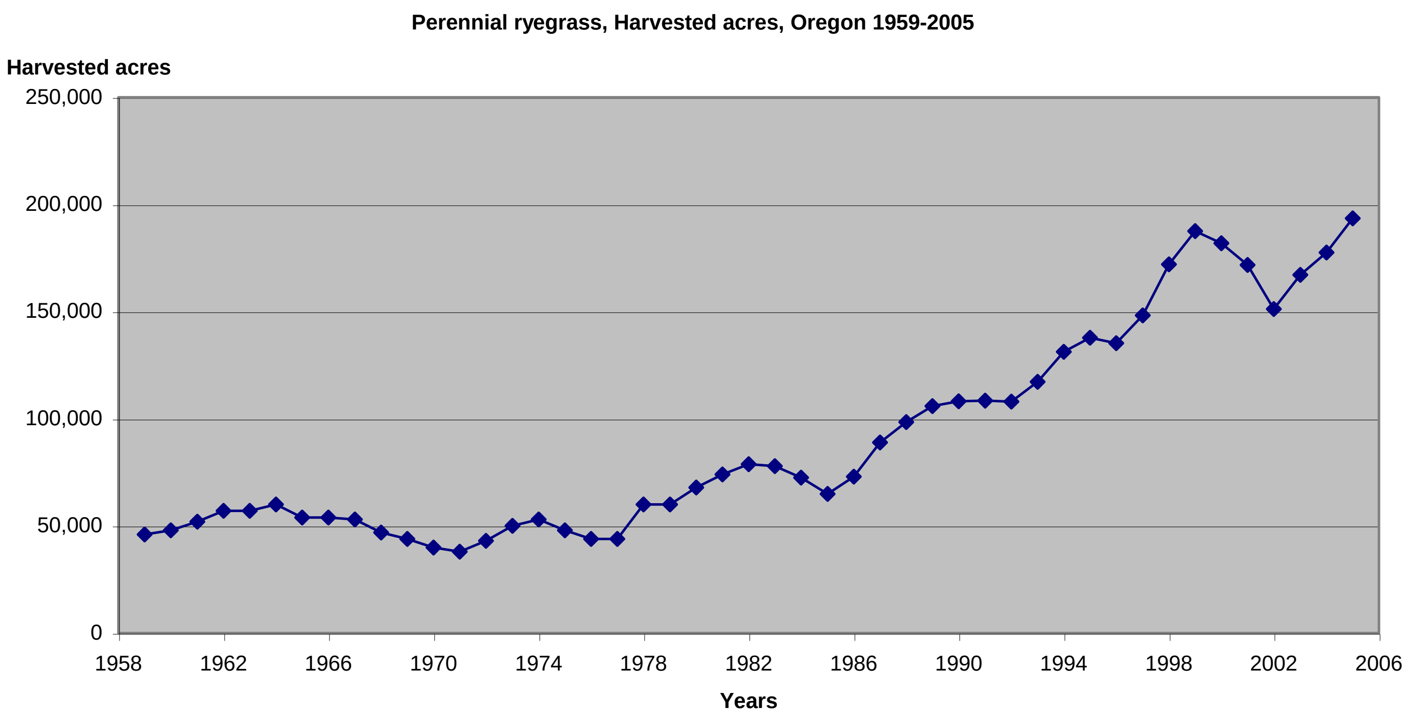
Historic Data on Grass Seed Production in Oregon

Perennial ryegrass, Oregon 1959-2005

Year	Harvested acres	Yield (lbs/acre)	Production (000lbs)	Price ($/cwt)
1959	46,000		45,080	
1960	48,000		43,010	
1961	52,000		46,320	
1962	57,000		57,380	
1963	57,000		48,450	
1964	60,000		56,385	
1965	54,000		46,980	
1966	54,000		39,420	
1967	53,000		45,580	
1968	47,000		41,360	
1969	44,000	835	36,740	$11.50
1970	40,000	800	32,000	$11.00
1971	38,000	1,080	41,040	$11.50
1972	43,000	810	34,830	$16.50
1973	50,000	800	40,000	$28.00
1974	53,000	800	42,400	$25.00
1975	48,000		43,200	
1976	44,000	800	35,200	$26.00
1977	44,000	900	39,600	$33.00
1978	60,000	750	45,000	$33.00
1979	60,000	830	49,550	$43.60
1980	68,000	930	63,200	$38.49
1981	73,995	890	66,220	$43.45
1982	78,745	870	68,437	$34.00
1983	77,860	870	68,029	$30.08
1984	72,500	970	70,180	$28.74
1985	65,000	980	63,417	$40.89
1986	73,000	980	71,435	$50.43
1987	89,000	1,030	91,560	$49.48
1988	98,500	1,100	108,695	$51.86
1989	106,000	1,150	121,512	$48.57
1990	108,200	1,190	129,000	$47.87
1991	108,400	1,210	131,156	$42.44
1992	108,000	1,040	112,127	$46.24
1993	117,240	1,350	158,631	$43.97
1994	131,240	1,390	182,176	$42.99
1995	137,750	1,240	170,365	$48.36
1996	135,330	1,440	195,197	$60.68
1997	148,223	1,440	212,878	$60.49
1998	172,026	1,360	234,453	$60.26
1999	187,628	1,490	280,490	$55.61
2000	181,940	1,460	264,987	$42.41

2001	171,800	1,450	248,928	$39.41
Year	**Harvested acres**	**Yield (lbs/acre)**	**Production (000lbs)**	**Price ($/cwt)**
2002	151,200	1,400	211,622	$42.05
2003	167,130	1,256	209,950	$60.27
2004	177,630	1,448	257,208	$59.78
2005	193,470	1,386	268,220	$54.76

Source: Oregon State University Extension Service


Perennial ryegrass, Harvested acres, Oregon 1959-2005
Harvested acres
250,000
200,000
150,000
100,000
50,000
0
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
Years

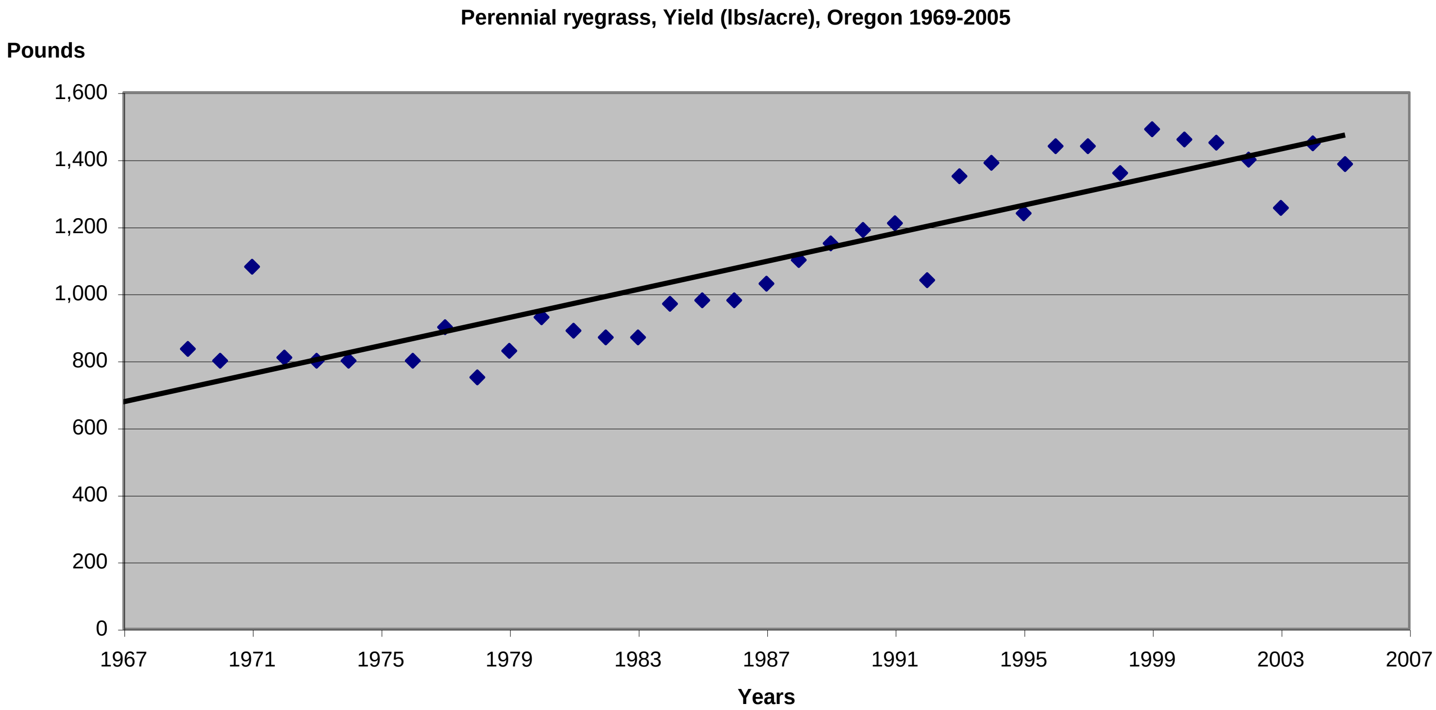
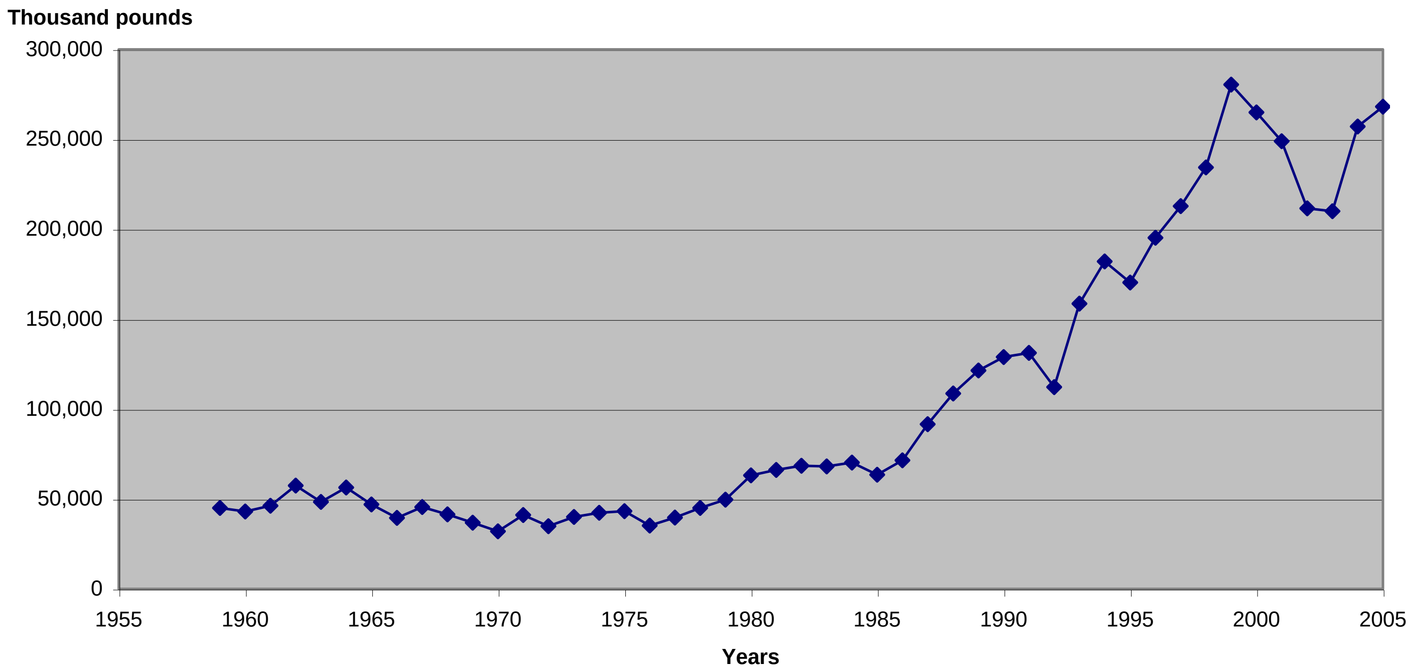
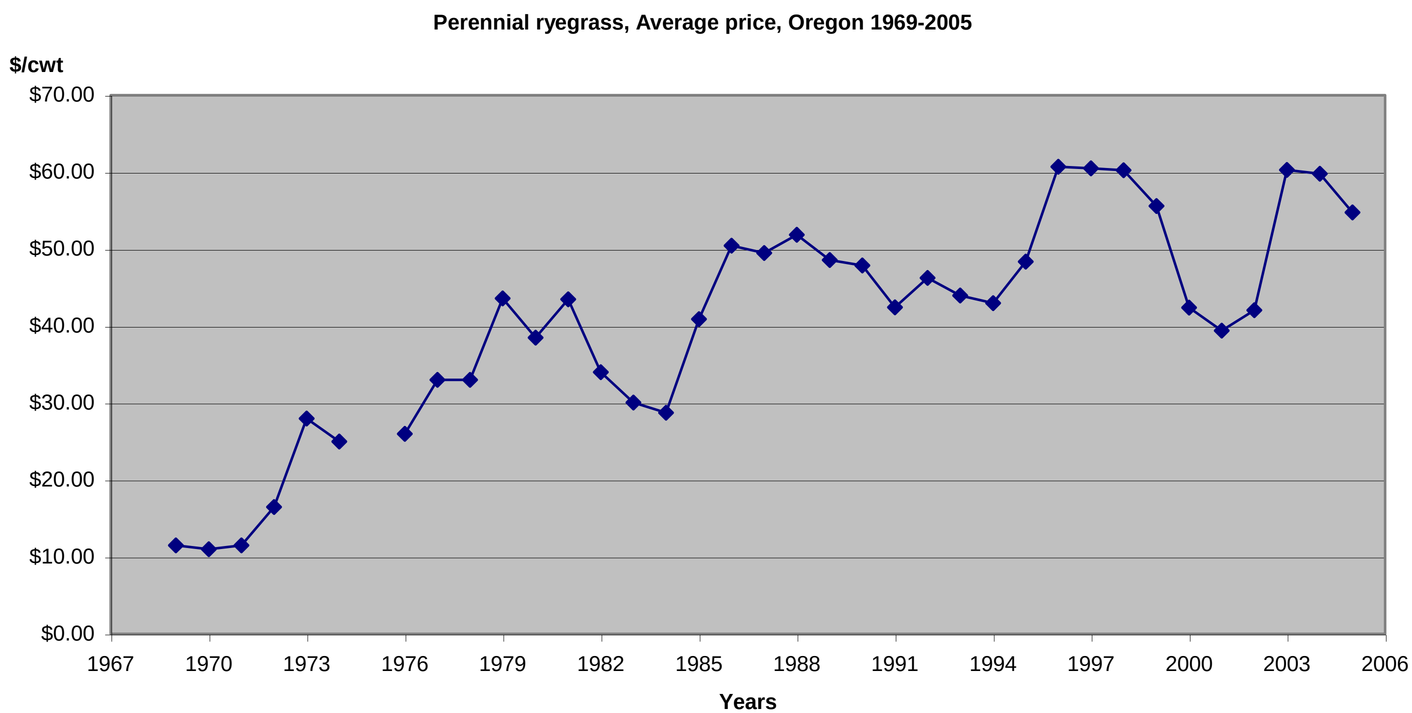

Perennial ryegrass, Yield (lbs/acre), Oregon 1969-2005
Pounds
1,600
1,400
1,200
1,000
800
600
400
200
0
1967
1971
1975
1979
1983
1987
1991
1995
1999
2003
2007
Years

Figure 2. Perennial ryegrass, Production (000lbs), Oregon 1959-2005




Perennial ryegrass, Average price, Oregon 1969-2005
$/cwt
$70.00
$60.00
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
Years

Perennial Ryegrass, Acreage Harvested, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	8,200	8,860	10,900	10,500	10,000	9,300	7,000	10,100	10,000	9,400
Clackamas	4,000	4,400	4,900	5,000	5,000	4,700	4,000	4,100	4,500	4,800
Lane	7,500	8,100	10,370	9,000	8,800	8,200	7,500	8,800	9,000	9,000
Linn	64,000	68,000	72,000	72,800	69,800	66,000	60,500	62,300	62,100	62,700
Marion	38,000	41,000	43,000	47,000	45,500	43,000	39,000	42,100	43,000	48,000
Polk	6,000	7,800	13,600	14,500	16,000	14,000	11,500	17,200	20,000	22,000
Washington	1,500	1,300	1,500	9,000	5,000	6,000	3,600	4,100	6,000	7,600
Yamhill	5,000	7,000	12,800	15,000	15,700	15,000	13,500	14,000	18,000	19,700
Umatilla	1,130	1,763	2,956	3,332	3,370	3,370	2,500	2,500	4,690	8,700
Morrow				372		500	420	1,420		1,500
Crook					400					
Jefferson					2,320	1,160	1,480	420		
Other						300	200	90	340	70
Oregon Total	135,330	148,223	172,026	186,504	181,890	171,530	151,200	167,130	177,630	193,470

Source: Oregon State University Extension Service

Perennial Ryegrass, Production (000 lbs.), Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	10,496	11,518	13,952	14,175	12,800	11,625	8,400	9,595	13,900	11,938
Clackamas	6,200	7,040	7,105	8,250	8,250	7,285	6,400	6,355	6,750	6,720
Lane	9,750	10,370	13,740	12,600	11,440	10,250	9,000	8,888	12,150	11,700
Linn	83,200	87,040	91,440	101,920	90,740	85,800	72,600	58,562	84,456	79,629
Marion	64,600	67,650	62,350	77,550	75,075	66,650	61,230	65,255	64,500	67,200
Polk	8,700	12,480	19,584	20,880	24,000	22,400	18,400	25,800	28,000	28,600
Washington	2,476	2,145	2,475	15,300	7,500	9,600	5,760	6,150	9,000	11,400
Yamhill	7,750	11,550	18,560	21,600	23,550	25,500	22,950	21,000	27,000	29,550
Umatilla	2,025	3,085	5,247	5,998	7,751	6,740	4,250	5,000	10,787	18,270
Morrow				698		1,100	714	2,840	575	3,150
Crook					560					
Jefferson					3,256	1,624	1,613	420		
Other						360	305	85	90	63
Oregon Total	195,197	212,878	234,453	278,971	264,922	248,934	211,622	209,950	257,208	268,220

Source: Oregon State University Extension Service

Perennial Ryegrass, Average Yield, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	1280	1300	1280	1350	1280	1250	1200	950	1390	1270
Clackamas	1550	1600	1450	1650	1650	1550	1600	1550	1500	1400
Lane	1300	1280	1325	1400	1300	1250	1200	1010	1350	1300
Linn	1300	1280	1270	1400	1300	1300	1200	940	1360	1270
Marion	1700	1650	1450	1650	1650	1550	1570	1550	1500	1400
Polk	1450	1600	1440	1440	1500	1600	1600	1500	1400	1300
Washington	1651	1650	1650	1700	1500	1600	1600	1500	1500	1500
Yamhill	1550	1650	1450	1440	1500	1700	1700	1500	1500	1500
Umatilla	1792	1750	1775	1800	2300	2000	1700	2000	2300	2100
Morrow				1876		2200	1700	2000		2100
Crook										
Jefferson								1000		
Other						1200	1525	944	265	900
Oregon Total	1442	1436	1363	1496	1456	1451	1400	1256	1448	1386

Source: Oregon State University Extension Service

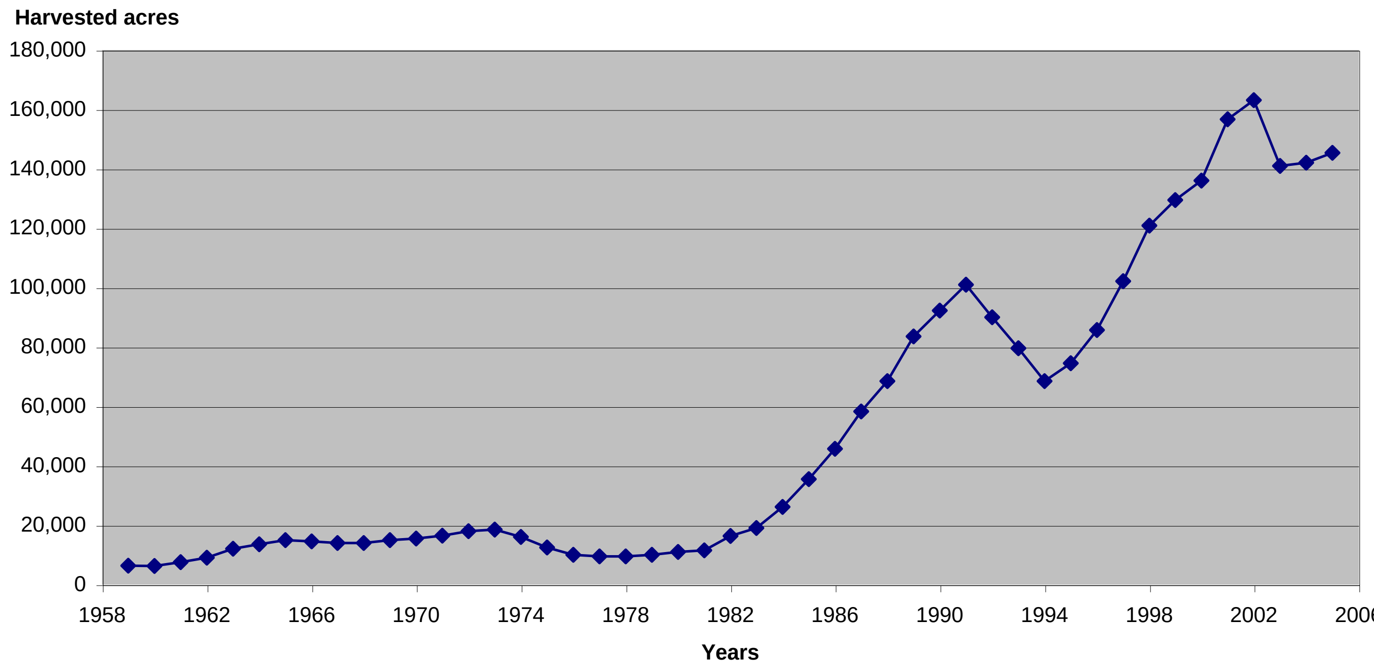
Tall fescue, Oregon, 1959-2005

Year	Harvested acres	Yield (lbs/acre)	Production (000lbs)	Price ($/cwt)
1959	6,300		3,402	
1960	6,200		3,596	
1961	7,500		3,750	
1962	9,000		5,670	
1963	12,000		7,260	
1964	13,500		10,058	
1965	15,000		10,050	
1966	14,500		10,513	
1967	14,000		10,430	
1968	14,000		8,960	
1969	15,000	720	10,800	$18.50
1970	15,500	610	9,455	$12.20
1971	16,500		13,695	$10.60
1972	18,000	580	10,440	$18.00
1973	18,500	720	13,320	$25.00
1974	16,000	630	10,080	$15.00
1975	12,500		9,500	$13.00
1976	9,995	600	6,000	$23.50
1977	9,500	650	6,175	$32.00
1978	9,500	700	6,650	$27.01
1979	10,000	720	7,200	$26.00
1980	11,000	850	9,350	$28.00
1981	11,500	700	8,050	$33.01
1982	16,300	700	11,385	$41.99
1983	19,015	860	16,341	$45.25
1984	26,180	920	24,061	$35.98
1985	35,473	1,070	37,931	$37.60
1986	45,650	1,010	46,025	$56.52
1987	58,240	990	57,402	$51.79
1988	68,500	1,130	77,307	$63.63
1989	83,500	950	79,672	$52.91
1990	92,300	1,200	111,132	$49.99
1991	101,000	1,280	129,086	$42.84
1992	90,000	970	87,284	$40.38
1993	79,610	1,300	103,339	$35.96
1994	68,480	1,080	73,801	$38.00
1995	74,520	1,120	83,733	$49.99
1996	85,710	1,450	124,224	$70.88
1997	102,202	1,430	145,890	$58.39
1998	120,888	1,250	151,471	$55.65
1999	129,463	1,350	174,397	$47.73
2000	135,970	1,420	193,168	$56.17

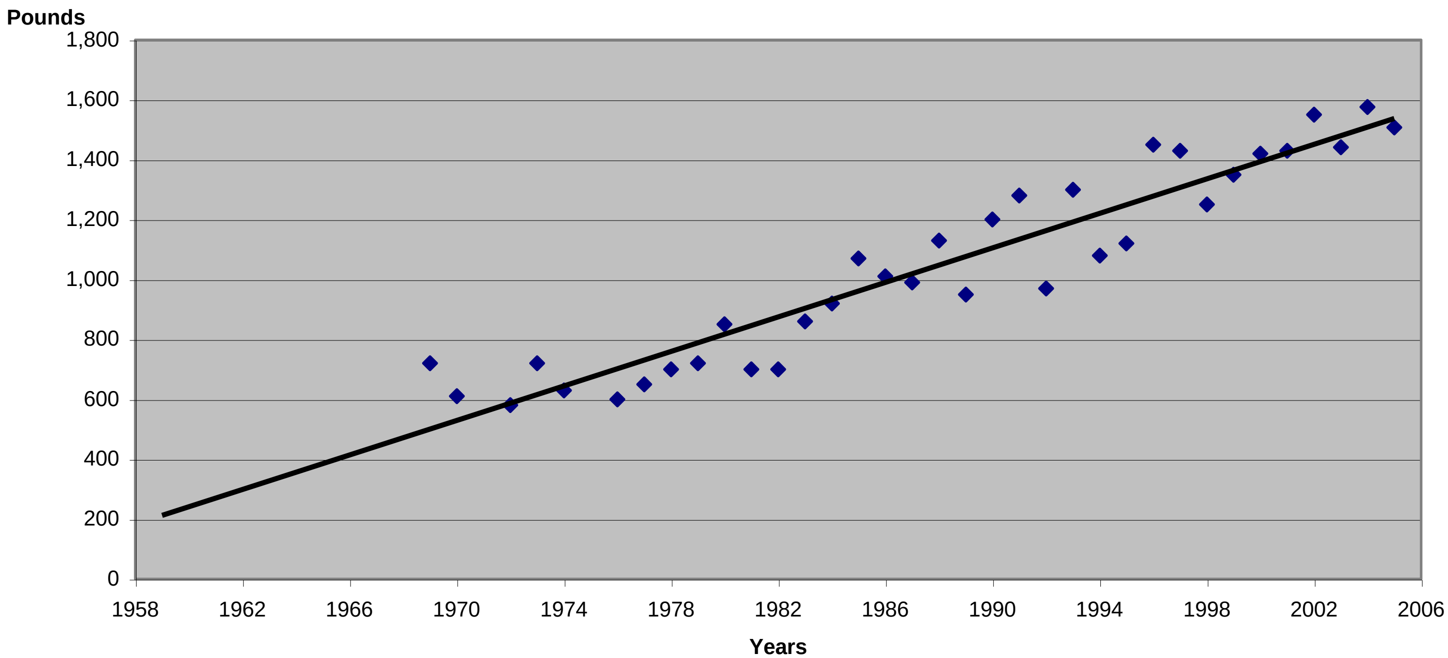
Year	Harvested acres	Yield (lbs/acre)	Production (000lbs)	Price ($/cwt)
2001	156,700	1,430	224,084	$51.14
2002	163,070	1,550	252,808	$34.48
2003	140,990	1,442	203,340	$37.45
2004	142,050	1,576	223,803	$38.86
2005	145,330	1,508	219,158	$49.83

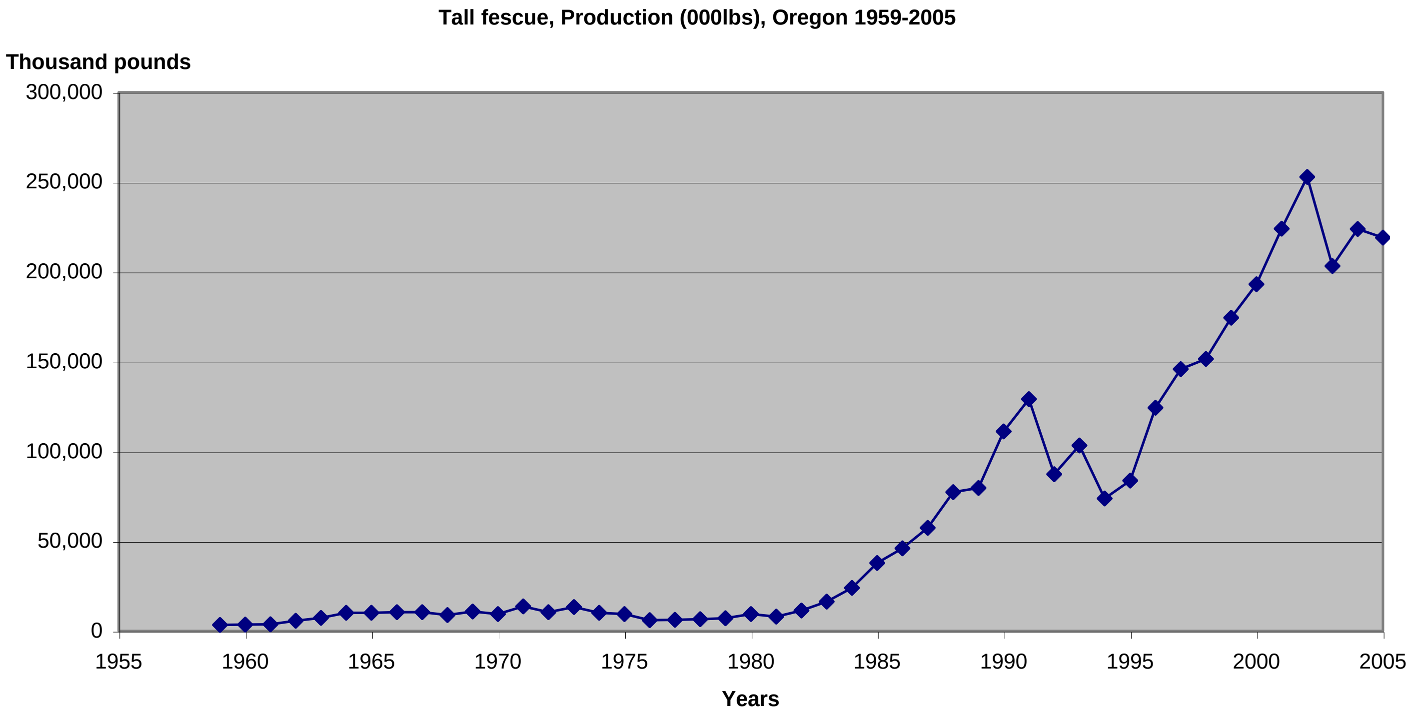
Source: Oregon State University Extension Service

Figure 1. Tall fescue, Harvested acres, Oregon 1959-2005



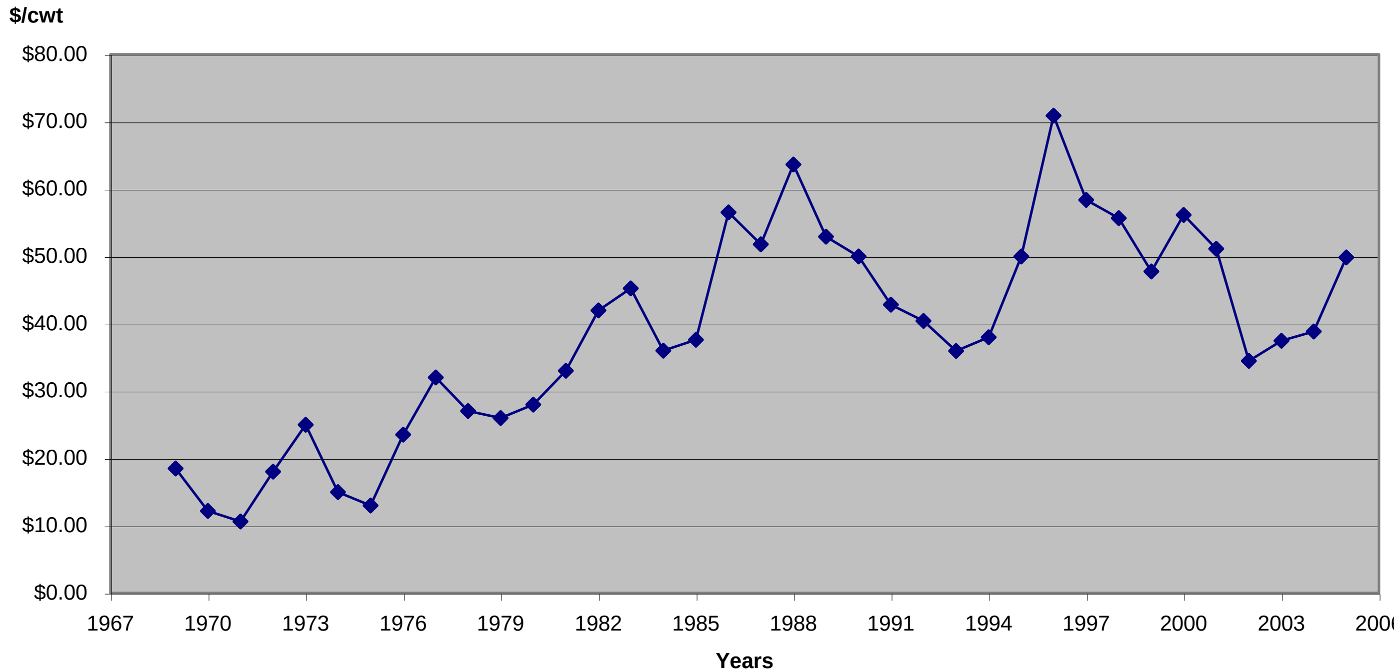
Tall Fescue, Yield (lbs/acre), Oregon 1969-2005





Tall fescue, Production (000lbs), Oregon 1959-2005
Thousand pounds
300,000
250,000
200,000
150,000
100,000
50,000
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Years

Tall fescue, Average price, Oregon 1969-2005



Tall Fescue, Acreage Harvested, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	8,300	8,800	11,050	11,200	11,800	13,000	14,350	10,000	9,600	10,000
Clackamas	1,800	1,800	1,950	2,000	1,900	2,500	3,000	2,700	2,700	2,800
Lane	5,900	6,100	7,808	7,900	8,350	9,400	10,900	8,100	8,100	8,250
Linn	29,000	30,700	31,900	32,800	34,000	36,700	40,000	34,000	34,050	35,100
Marion	11,000	15,000	15,400	16,500	16,500	17,000	17,900	15,700	15,000	15,000
Polk	14,200	16,700	23,000	29,000	22,500	30,800	27,000	24,300	25,000	25,600
Washington	5,000	7,200	7,200	6,500	15,000	15,000	18,000	15,500	17,500	19,000
Yamhill	9,000	12,800	20,000	21,000	22,000	27,000	26,500	25,500	26,000	26,500
Umatilla	1,150	2,249	2,295	2,136	3,220	4,030	4,030	4,030	3,210	2,510
Union	60	173	185	207	470	220				
Jerfferson										
Morrow						800	600	600	600	
Douglas	150	50	20					300		
Other	150	630	80	220	230	250	790	260	290	570
Oregon Total	85,710	102,202	120,888	129,463	135,970	156,700	163,070	140,990	142,050	145,330

Source: Oregon State University Extension Service

Tall Fescue, Production (000 lbs), Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	11,620	11,704	13,260	13,440	14,750	16,640	20,090	12,000	13,728	13,000
Clackamas	2,880	2,790	2,730	2,900	2,983	3,750	4,650	4,455	4,590	4,480
Lane	7,670	7,800	9,370	9,875	10,020	13,160	15,260	9,720	10,935	10,725
Linn	40,600	40,217	37,961	41,000	40,800	46,609	56,000	43,180	48,692	47,034
Marion	18,150	23,250	21,560	23,925	26,070	26,350	29,356	26,219	25,500	25,500
Polk	19,880	24,215	27,370	40,600	36,000	46,200	43,200	36,450	41,250	38,400
Washington	7,550	11,160	11,160	9,425	19,500	19,500	30,600	23,250	26,250	30,400
Yamhill	13,500	19,840	24,000	29,400	35,200	40,500	45,050	38,250	44,200	43,725
Umatilla	1,958	3,598		3,418	7,084	9,269	6,846	8,060	7,062	5,271
Union	14	189	208	189	531	176				
Jefferson										
Morrow						1,680	1,020	1,200	1,332	
Douglas	150	50	20							
Other	252	1,077	3,832	225	230	250	736	556	264	623
Oregon Total	124,224	145,890	151,471	174,397	193,168	224,084	252,808	203,340	223,803	219,158

Source: Oregon State University Extension Service

Tall fescue, Average yield, Oregon

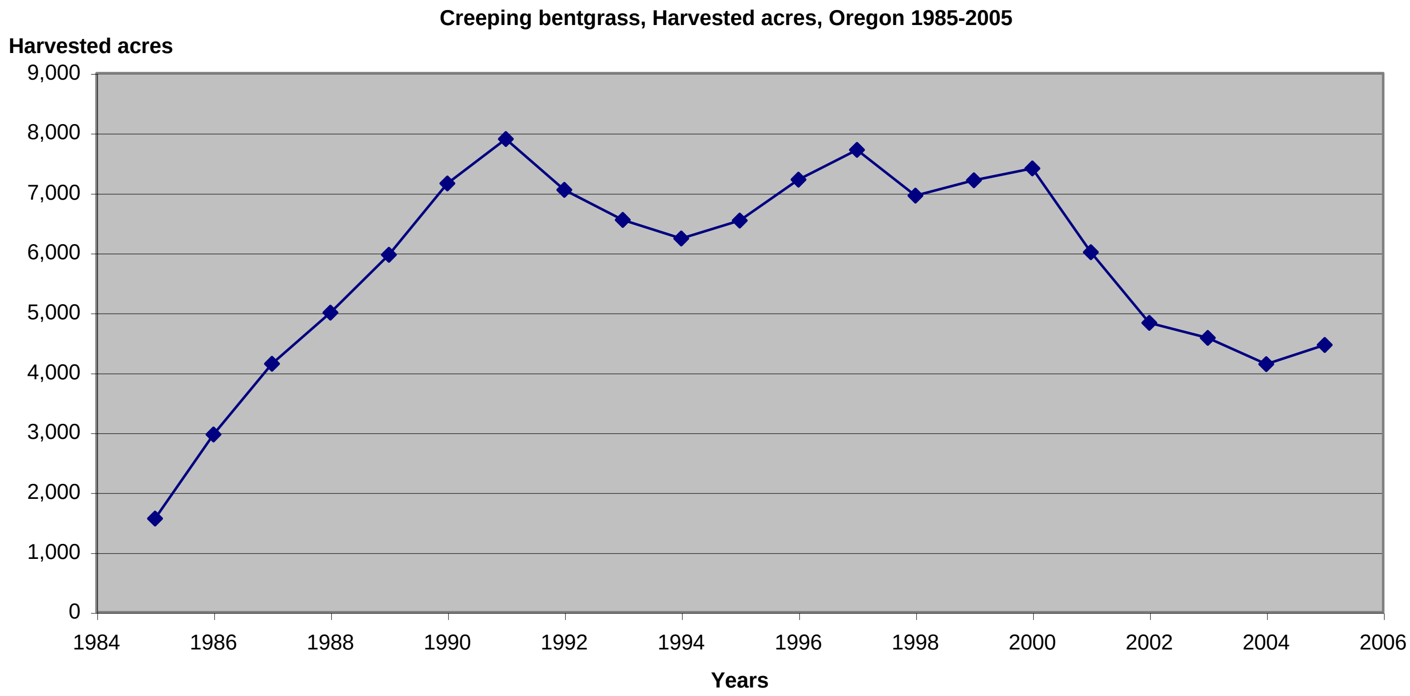
Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	1400	1330	1200	1200	1250	1280	1400	1200	1430	1300
Clackamas	1600	1550	1400	1450	1570	1500	1550	1650	1700	1600
Lane	1300	1279	1200	1250	1200	1400	1400	1200	1350	1300
Linn	1400	1310	1190	1250	1200	1270	1400	1270	1430	1340
Marion	1650	1550	1400	1450	1580	1550	1640	1670	1700	1700
Polk	1400	1450	1190	1400	1600	1500	1600	1500	1650	1500
Washington	1510	1550	1550	1450	1300	1300	1700	1500	1500	1600
Yamhill	1500	1550	1200	1400	1600	1500	1700	1500	1700	1650
Umatilla	1703	1600	0	1600	2200	2300	1699	2000	2200	2100
Union	233	1092	1124	913	1130	800				
Jefferson										
Morrow						2100	1700	2000	2220	
Douglas	1000	1000	1000					0		
Other	1680	1710	47900	1023	1000	1000	932	2138	910	1093
Oregon Total	1449	1427	1253	1347	1421	1430	1550	1442	1576	1508

Source: Oregon State University Extension Service

Creeping bentgrass, Oregon 1985-2005

Year	Harvested acres	Yield (lbs/acre)	Production (000lbs)	Price ($/cwt)
1985	1,566	390	614	$339.41
1986	2,970	410	1,213	$357.05
1987	4,150	380	1,576	$378.05
1988	5,000	370	1,858	$401.67
1989	5,970	450	2,691	$380.49
1990	7,160	450	3,219	$329.76
1991	7,900	420	3,298	$327.65
1992	7,050	410	2,912	$290.21
1993	6,550	450	2,962	$282.04
1994	6,240	470	2,933	$279.65
1995	6,540	530	3,478	$282.72
1996	7,225	540	3,896	$294.38
1997	7,720	590	4,552	$290.93
1998	6,956	580	4,037	$274.68
1999	7,211	660	4,737	$298.42
2000	7,410	690	5,127	$299.92
2001	6,010	590	3,520	$291.16
2002	4,830	690	3,348	$295.58
2003	4,580	703	3,222	$302.76
2004	4,140	672	2,783	$301.31
2005	4,460	547	2,440	$302.24

Source: Oregon State University Extension Service


Creeping bentgrass, Harvested acres, Oregon 1985-2005
Harvested acres
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
Years

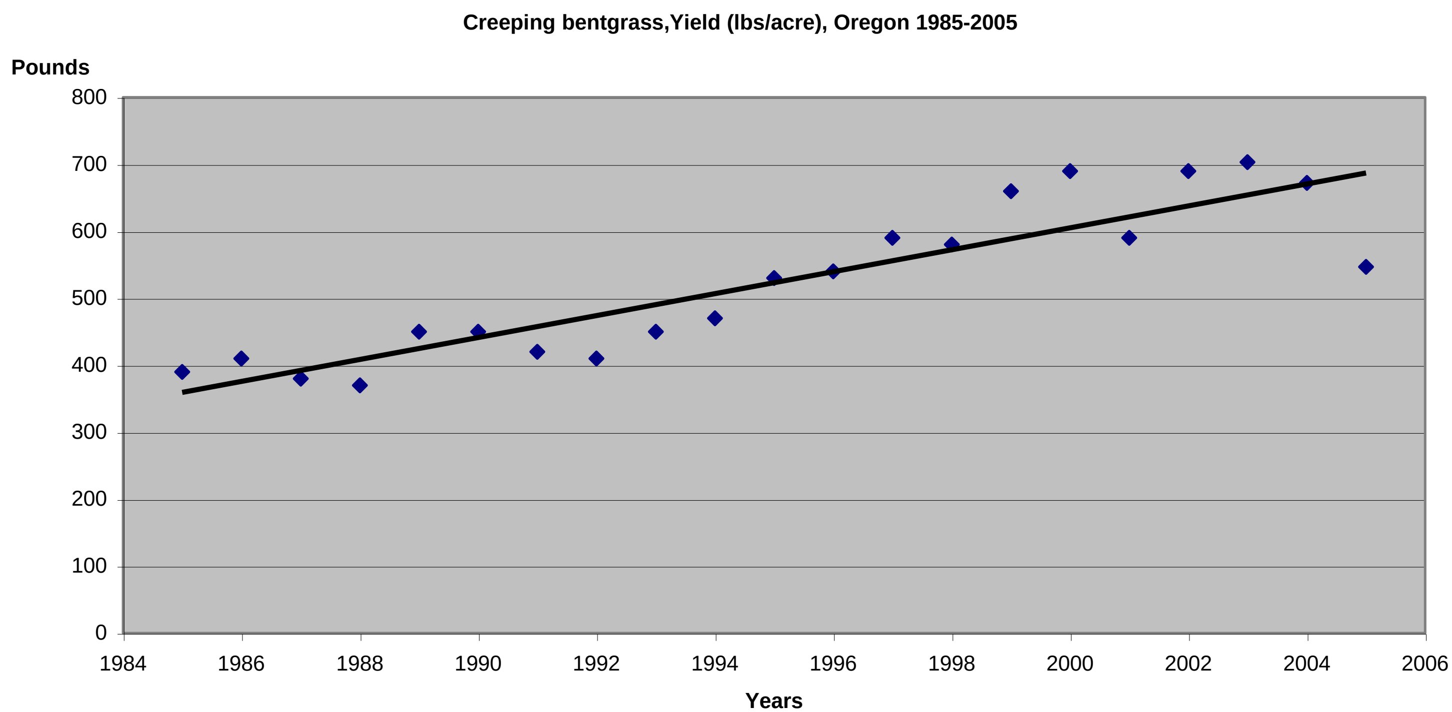
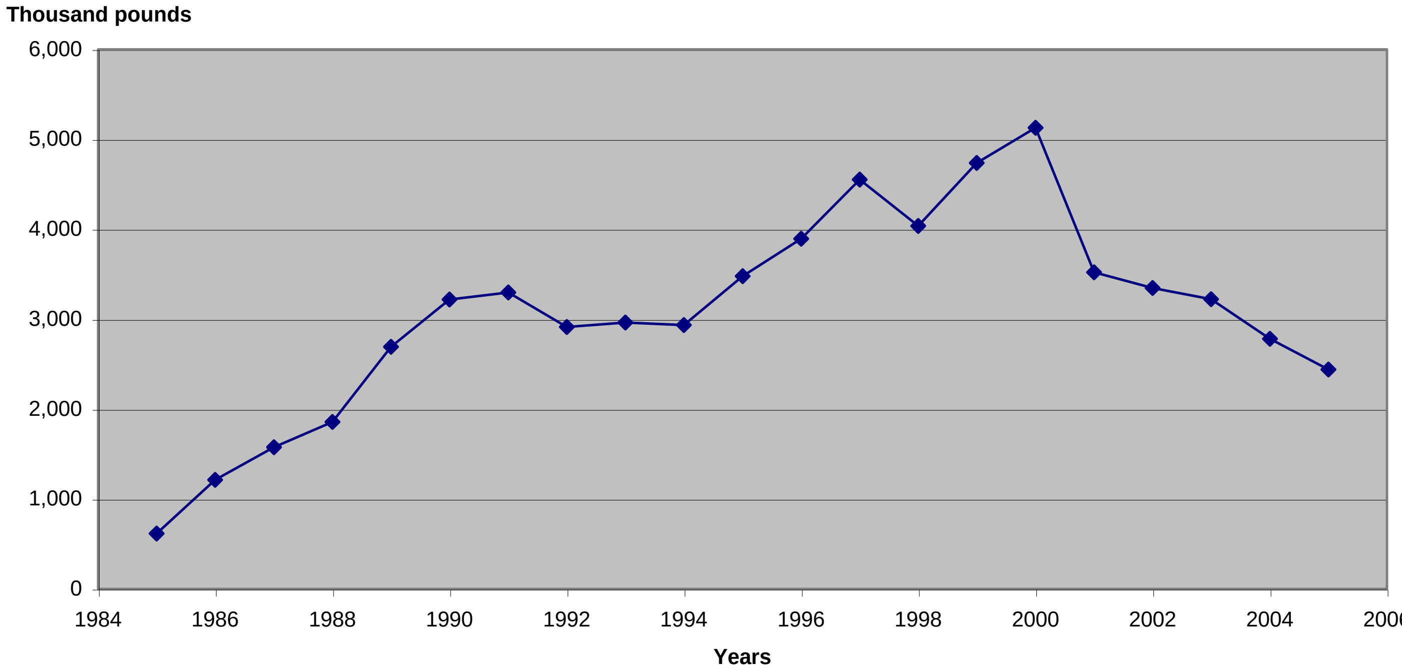
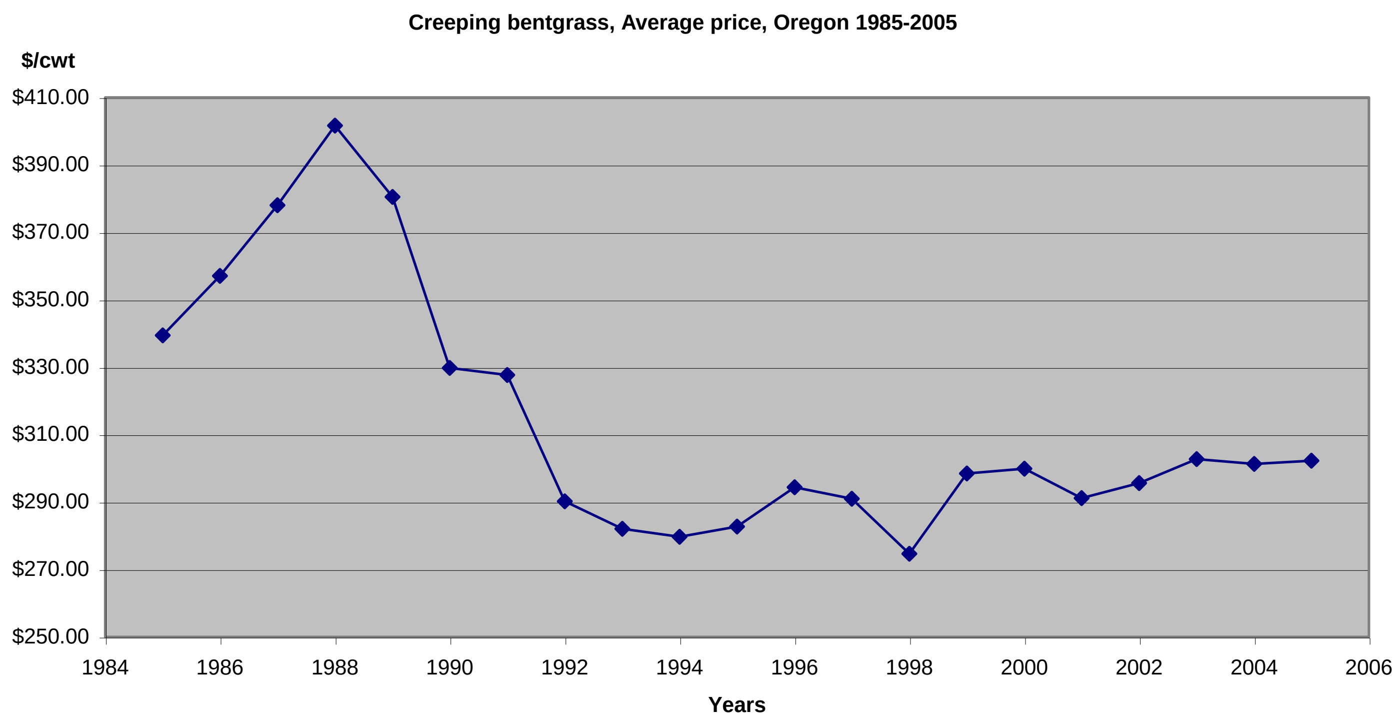

Creeping bentgrass,Yield (lbs/acre), Oregon 1985-2005
Pounds
800
700
600
500
400
300
200
100
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
Years

Figure 3. Creeping bentgrass, Production (000lbs), Oregon 1985-2005




Creeping bentgrass, Average price, Oregon 1985-2005
$/cwt
$410.00
$390.00
$370.00
$350.00
$330.00
$310.00
$290.00
$270.00
$250.00
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
Years

Creeping Bentgrass, Acreage Harvested, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	930	970	900	950	950	730	680	700	650	650
Clackamas	770	770	650	650	800	600	350	350	350	350
Lane	400	550	525	550	550		500	500	500	500
Linn	1,450	1,520	1,420	1,400	1,400	1,200	1,100	900	900	1,020
Marion	3,000	3,400	3,150	3,460	3,500	2,650	1,900	1,520	1,600	1,760
Polk							120			
Washington										
Yamhill	70	90	25							
Umatilla										
Union										
Jefferson	500	245	111					350		
Jackson	105	175	175	175	180	180	180			
Other				26	30	650		260	140	180
Oregon Total	7,225	7,720	6,956	7,211	7,410	6,010	4,830	4,580	4,140	4,460

Source: Oregon State University Extension Service

Creeping Bentgrass, Production (000 lbs.), Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	490	582	531	618	665	402	442	525	585	
Clackamas	443	462	390	455	560	360	280	300	300	
Lane	200	319	289	344	358		275	675	540	459
Linn	754	874	781	952	980	720	770	1,110	1,040	1,144
Marion	1,725	2,040	1,890	2,249	2,450	1,590	1,425			
Polk							66			
Washington										
Yamhill	37	54	14							
Omatilla										
Union										
Jefferson	191	128	49							
Jackson	56	93	93	105	99	90	90			
Other				14	15	358		612	318	837
Oregon Total	3,896	4,552	4,037	4,737	5,127	3,520	3,348	3,222	2,783	2,440

Source: Oregon State University Extension Service

Creeping bentgrass, Average yield, Oregon

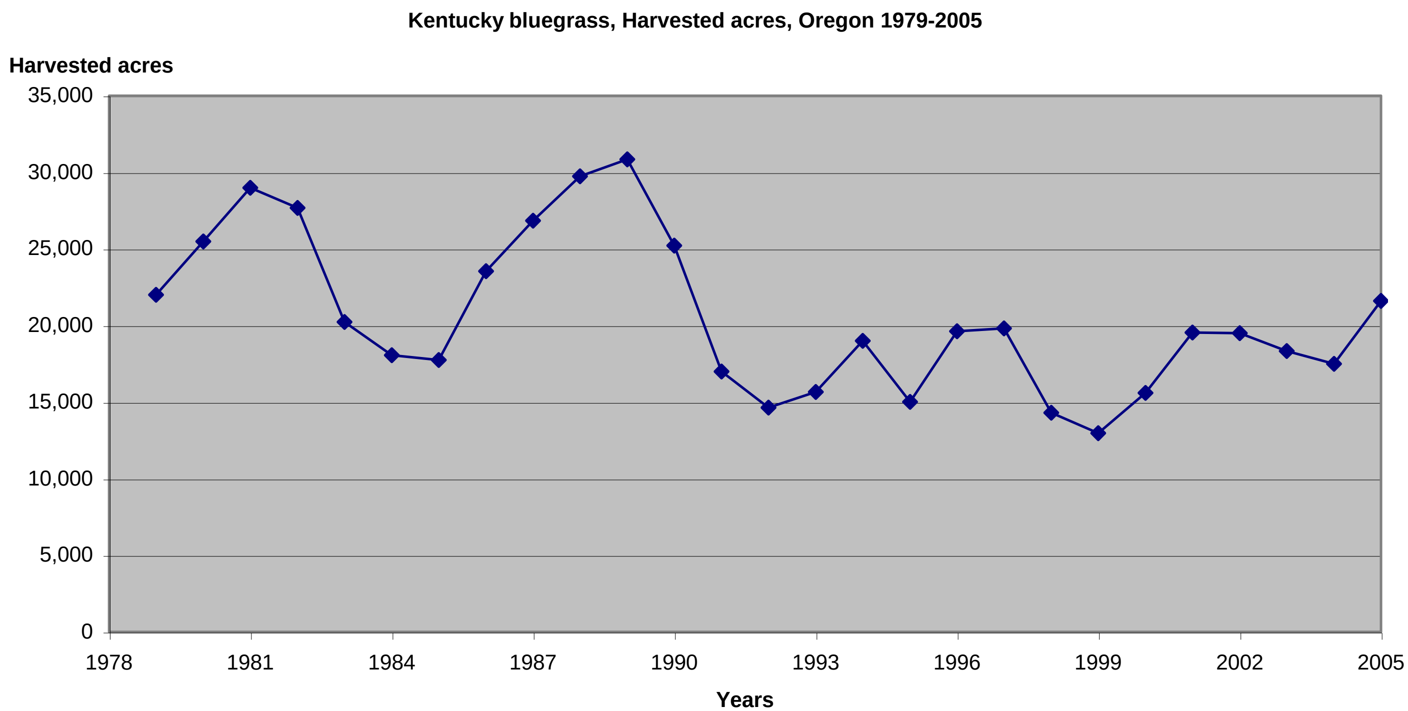
Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton	527	600	590	651	700	551	650	750	900	0
Clackamas	575	600	600	700	700	600	800	857	857	0
Lane	500	580	550	625	651		550	1350	1080	918
Linn	520	575	550	680	700	600	700	1233	1156	1122
Marion	575	600	600	650	700	600	750	0	0	0
Polk							550			
Washington										
Yamhill	529	600	560							
Omatilla										
Union										
Jefferson	382	522	441					0		
Jackson	533	531	531	600	550	500	500			
Other				538	500	551		2354	2271	4650
Oregon Total	539	590	580	657	692	586	693	703	672	547

Source: Oregon State University Extension Service

Kentucky bluegrass, Oregon 1979-2005

Year	Harvested acres	Yield (lbs/acre)	Production (000lbs)	Price ($/cwt)
1979	22,000	560	12,238	$83.46
1980	25,495	690	17,700	$65.77
1981	28,995	680	19,730	$56.71
1982	27,675	720	19,921	$48.65
1983	20,235	610	12,293	$50.90
1984	18,060	730	13,117	$52.69
1985	17,755	640	11,393	$93.13
1986	23,540	630	14,825	$104.73
1987	26,850	720	19,306	$106.45
1988	29,750	690	20,622	$102.42
1989	30,840	690	21,395	$62.92
1990	25,220	790	19,928	$66.57
1991	16,990	970	16,414	$69.00
1992	14,650	830	12,116	$90.49
1993	15,670	860	13,493	$94.58
1994	19,010	700	13,244	$88.87
1995	15,010	930	13,920	$85.76
1996	19,620	870	17,113	$91.85
1997	19,815	920	18,251	$102.39
1998	14,304	930	13,255	$86.45
1999	12,971	950	12,259	$99.52
2000	15,610	990	15,461	$102.84
2001	19,540	810	15,878	$99.82
2002	19,500	830	16,191	$102.89
2003	18,340	998	18,312	$74.85
2004	17,510	880	15,410	$80.15
2005	21,600	867	18,718	$77.87

Source: Oregon State University Extension Service


Kentucky bluegrass, Harvested acres, Oregon 1979-2005
Harvested acres
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
Years

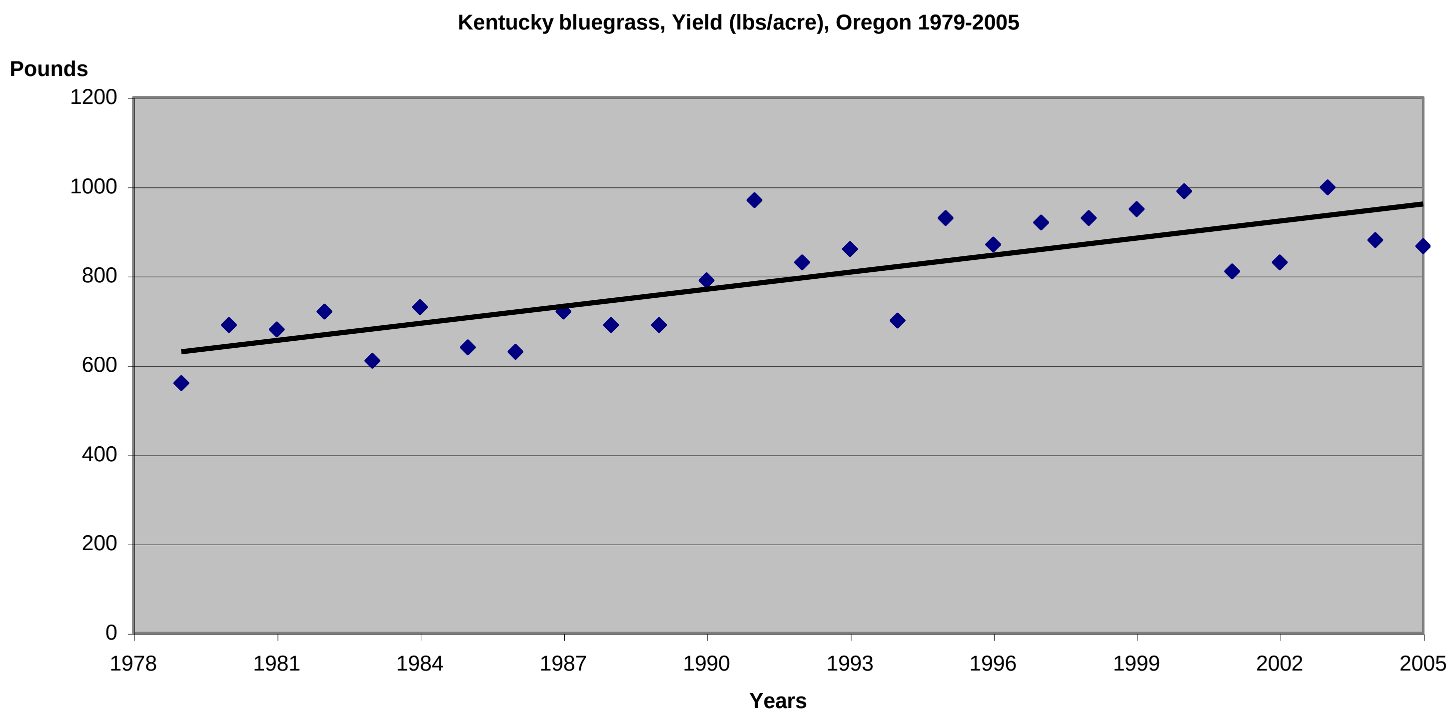
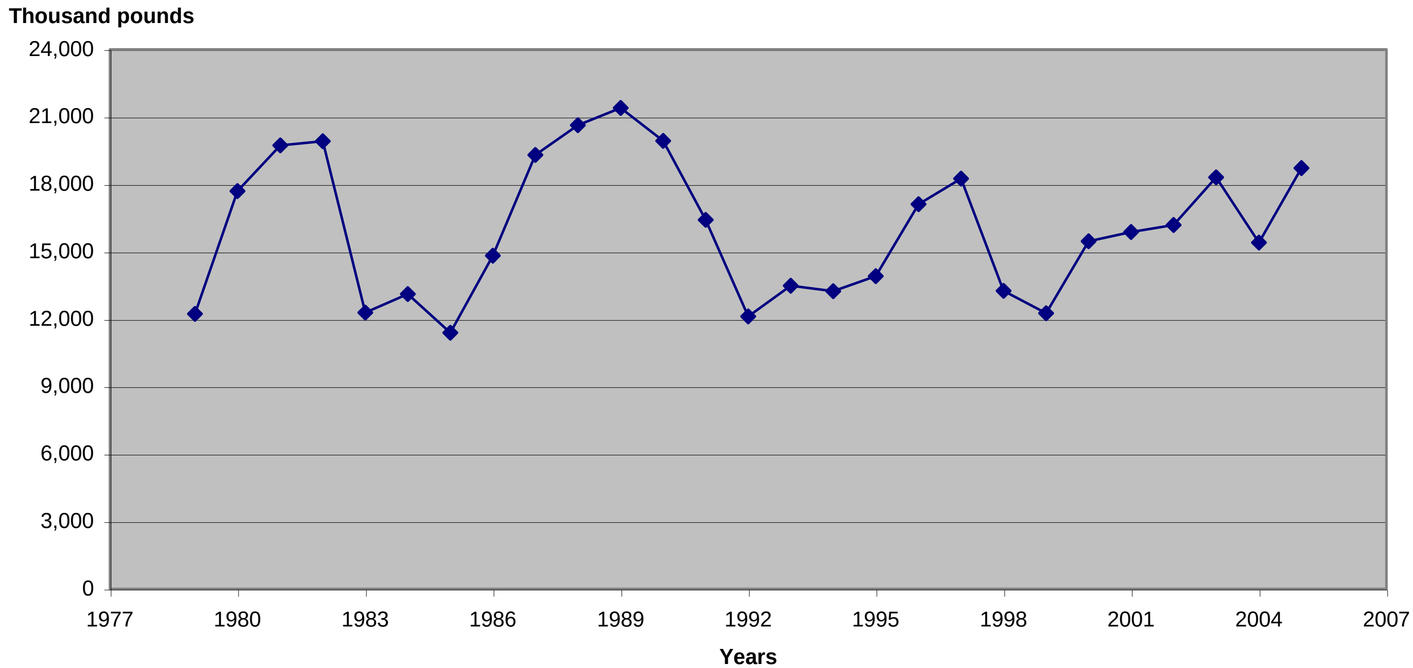
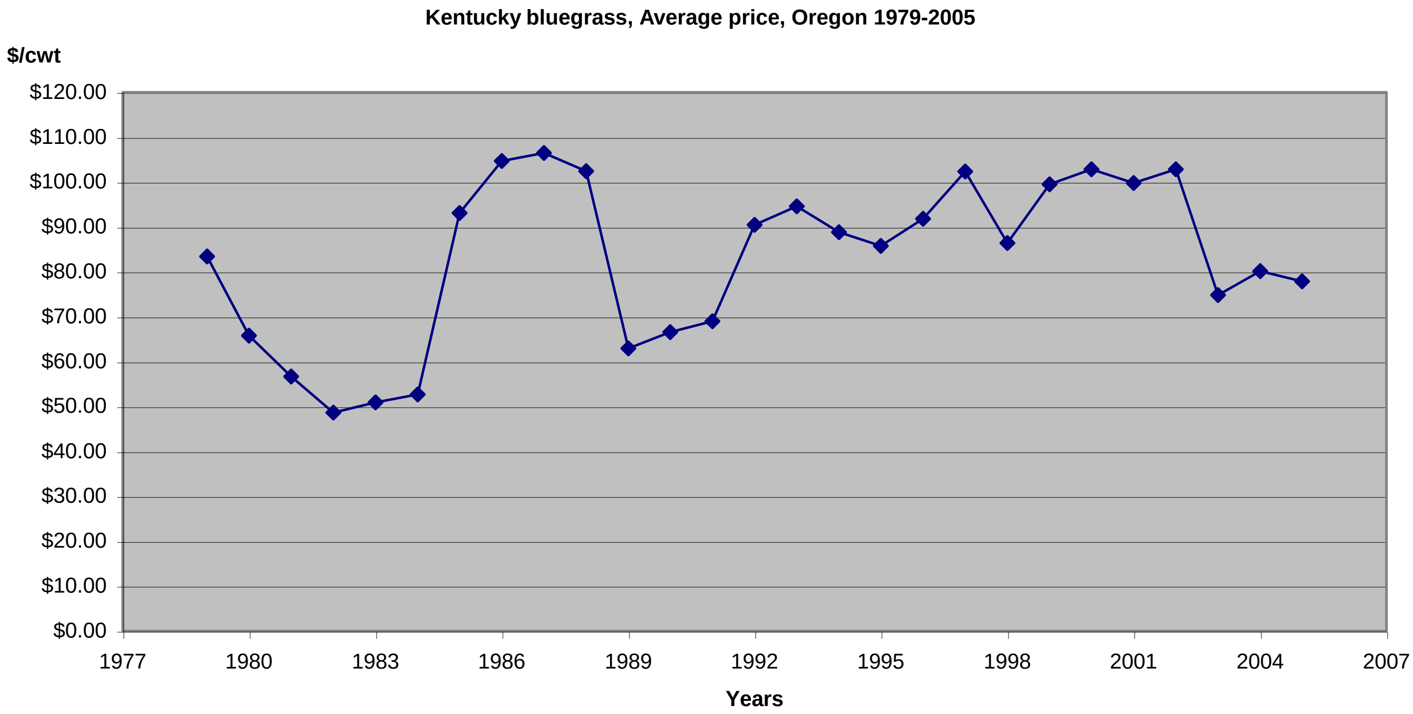

Kentucky bluegrass, Yield (lbs/acre), Oregon 1979-2005
Pounds
1200
1000
800
600
400
200
0
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
Years

Figure 4. Kentucky bluegrass, Production (000lbs), Oregon 1979-2005




Kentucky bluegrass, Average price, Oregon 1979-2005
$/cwt
$120.00
$110.00
$100.00
$90.00
$80.00
$70.00
$60.00
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
Years

Kentucky Bluegrass, Acreage Harvested, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton										
Clackamas						100	70			
Lane										
Linn										
Marion	500	400	400			70				
Polk										
Washington										
Yamhill										
Umatilla	3,080	3,258	2,699	3,285	4,860	6,200	6,200	5,200	4,570	7,500
Union	4,650	5,762	5,185	5,269	6,490	7,240	7,700	6,500	6,000	6,340
Jefferson	7,006	5,414	5,307	6,412	3,860	5,130	5,130	5,620	5,760	6,390
Morrow						800	400	400	660	1,200
Crook										
Deschutes										
Other	660	560	713	789	400			620	520	170
Oregon Total	15,896	15,394	14,304	15,755	15,610	19,540	19,500	18,340	17,510	21,600

Source: Oregon State University Extension Service

Kentucky Bluegrass, Production (000 lbs.), Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton										
Clackamas						50	39			
Lane										
Linn		550								
Marion	300	320	300			35				
Polk										
Washington										
Yamhill										
Umatilla	2,769	3,258	2,726	3,285	5,346	4,960	5,580	6,240	4,113	6,000
Union	3,774	4,978	4,068	3,846	5,646	5,285	5,544	5,850	4,380	5,199
Jefferson	6,670	4,905	5,588	6,284	4,119	4,668	4,668	5,283	5,875	6,454
Morrow						880	360	480	594	960
Crook										
Deschutes										
Other	436	310	573	644	350			459	448	105
Oregon Total	13,949	14,321	13,255	14,059	15,461	15,878	16,191	18,312	15,410	18,718

Source: Oregon State University Extension Service

Bluegrass, Average yield, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton										
Clackamas						500	557			
Lane										
Linn										
Marion	600	800	750			500				
Polk										
Washington										
Yamhill										
Umatilla	899	1000	1010	1000	1100	800	900	1200	900	800
Union	812	864	785	730	870	730	720	900	730	820
Jefferson	952	906	1053	980	1067	910	910	940	1020	1010
Morrow						1100	900	1200	900	800
Crook										
Deschutes										
Other	661	554	804	816	875			740	862	618
Oregon Total	878	930	927	892	990	813	830	998	880	867

Source: Oregon State University Extension Service

Chewings Fescue, Acreage Harvested, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton										
Clackamas	550	450	500	550	550	500	450	300	330	350
Lane										
Linn	850	820	800	850	1,500	1,400	1,200	900	950	1,070
Marion	6,200	5,900	6,100	7,000	7,000	6,300	4,500	3,200	3,300	4,300
Polk						510				
Washington										
Yamhill										
Umatilla	380	512	375	476	1,350	1,350	690			
Union	950	804	1,308	1,542	1,950	1,100	1,100			
Jefferson										
Other	550	550	550	320	420	230	230	520	800	1,370
Oregon Total	9,480	9,036	9,633	10,738	12,770	11,390	8,170	4,920	5,380	7,090

Source: Oregon State University Extension Service

Chewings Fescue, Production (000 lbs.), Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton										
Clackamas	440	383	350	440	550	475	428			
Lane										
Linn	595	685	632	680	1,395	1,190	1,140	702	760	856
Marion	5,115	5,015	4,270	5,600	7,000	6,174	4,410	2,880	2,640	4,300
Polk						367				
Washington										
Yamhill										
Umatilla	573	742	553	524	1,485	1,485	759			
Union	705	654	1,129	712	1,931	803	429			
Jefferson										
Other	400	455	385	256	388	184	176	818	944	1,438
Oregon Total	7,828	7,934	7,319	8,212	12,749	10,678	7,342	4,400	4,344	6,594

Source: Oregon State University Extension Service

Chewings fescue, Average yield, Oregon

Counties	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Benton										
Clackamas	800	851	700	800	1000	950	951	0	0	0
Lane										
Linn	700	835	790	800	930	850	950	780	800	800
Marion	825	850	700	800	1000	980	980	900	800	1000
Polk						720				
Washington										
Yamhill										
Umatilla	1508	1449	1475	1101	1100	1100	1100			
Union	742	813	863	462	990	730	390			
Jefferson										
Other	727	827	700	800	924	800	765	1573	1180	1050
Oregon Total	826	878	760	765	998	937	899	894	807	930

Source: Oregon State University Extension Service