

Changes in seed crop management – the Oregon experience, 1990-2009

W.C. Young III
Department of Crop and Soil Science
Oregon State University
127 Crop Science Building
Corvallis, OR 97331

Abstract

Oregon has continued as a major producer of cool-season forage and turf grass seed over the past 20 years. However, seed production technologies have not remained static. Indeed, several significant challenges have confronted Oregon seed growers, as well as new opportunities. Clearly, the most daunting affront to growers' traditional production system was legislation to reduce reliance on open-field burning of post-harvest crop residues. In the absence of burning, straw marketing opportunities emerged, but not without concern for anti-quality alkaloids present in endophyte-infected turfgrasses. In addition, an appreciation for the nutrient value of grass straw left on the fields challenged other producers to manage the full straw load in their cropping system. In the late 1990s, a new generation of plant growth regulators (PGRs) became available. These foliar-applied chemicals reduce growth through a reduction in plant level of gibberellins, and have become widely used on several species for providing lodging control and increased seed yield. Other production inputs, such as nitrogen, weed, disease and insect management have been "fine-tuned" to avoid environmental risks and to maintain profitability for growers. Although the Willamette Valley is by far the most important area of grass seed production in the state, the Umatilla / Morrow county area (in the lower Columbia Basin of north central OR) has significantly expanded production of cool-season grasses in the last 20 years, and currently has more acreage than Union county (northeast OR) and Jefferson county (central OR) areas combined. Collectively, Oregon's Willamette Valley produces almost two-thirds of the total production of cool-season grasses in the United States of America (USA).

Introduction

Oregon is a major producer of cool-season forage and turf grass seed and has long been recognized as a center of expertise in seed production. Most of the state's acreage is located in the Willamette Valley, an area known as the "grass seed capital of the world." Mild and moist winters with dry summers favoring seed development and harvest make the Valley an ideal place to produce high quality seed. Grass seed is produced on family-owned farms, with more than 60% of the total labor requirements provided by family members. Although an exact tally of seed farms and the acreage of each is unknown, it is assumed there are slightly fewer, but larger farms today than 20 years ago. These trends have been shown in recent USDA Census of Agriculture data.

Production trends

Farm gate value of Oregon's grass seed industry has increased approximately 125% over the last 20 years. In an attempt to "soften" the somewhat cyclical nature of production and prices

received by growers, the above percentage increase in value was computed by comparing the average value from 1990, 1991 and 1992 to the average value from 2007, 2008 and 2009. The dollar amount of those two means is US\$184,480,000 and US\$412,750,000, respectively. The range in value of Oregon's grass seed crop production over the last 20 years was US\$169,030,000 (1991) US\$480,060,000 (2007).

Comparing the current year's production with 1990's data shows an increase of 12% (approximately 20,000 hectares) over the last 20 years (Table 1). However, not all species have shown similar changes. For example, tall fescue (+72%), rough bluegrass (+59%) and hard fescue (+29%) have all increased significantly more than the average. Conversely, colonial bentgrass (-71%), Chewings fescue (-43%), creeping bentgrass (-38%) and Kentucky bluegrass (-30%) have all decreased significantly over the last two decades.

Seed yields for most grass species grown have seen significant increases in the last 20 years (Table 1). Only colonial bentgrass and orchardgrass are shown to yield less today than in 1990. Annual ryegrass has made a modest gain of 5%, but all other species show a double-digit percentage increase in kilograms per hectare with a range from +29% (perennial ryegrass) to +64% (Chewings fescue).

Table 1. Hectares of grasses grown for seed and seed yield in Oregon, 1990 and 2009, and percent change over 20 years.

	Hectares of production			Seed yield (kg/ha)		
	1990	2009	Percent change	1990	2009	Percent change
Annual ryegrass (<i>Lolium multiflorum</i> Lam.)	44,218	48,001	+9	2,117	2,215	+5
Perennial ryegrass (<i>Lolium perenne</i> L.)	43,878	43,505	-1	1,333	1,721	+29
Tall fescue (<i>Festuca arundinacea</i> Schreb.)	37,062	63,816	+72	1,355	1,906	+41
Kentucky bluegrass (<i>Poa pratensis</i> L.)	10,376	7,278	-30	885	1,182	+34
Rough bluegrass (<i>P. trivialis</i> L.)	488	774	+59	924	1,310	+42
Orchardgrass (<i>Dactylis glomerata</i> L.)	8,080	6,905	-15	952	874	-8
Chewings fescue (<i>F. rubra</i> L. var. <i>commutate</i> Gaudin)	7,173	4,113	-43	818	1,340	+64
Red fescue (<i>F. rubra</i> L.)	3,592	3,443	-4	784	1,166	+49
Hard fescue (<i>F. brevipila</i> Tracey)	871	1,122	+29	672	927	+38
Colonial bentgrass (<i>Agrostis capillaris</i> L.)	3,151	911	-71	437	388	-11
Creeping bentgrass [<i>A. stolonifera</i> L. var. <i>palustris</i> (Huds.) Farw.]	2,900	1,794	-38	504	784	+56
Total Grass	161,787	181,661	(+12)	--	--	--

Oregon State University plays an important role assuring seed quality. Certification activities began in Oregon in 1916, and in 1937 it was legislatively directed that the Oregon Seed Certification Service would be coordinated through the OSU College of Agriculture Science. The certification program helps assure buyers that Oregon seed is quality seed. To meet certification standards, a grower's field must pass a seedling inspection and a crop inspection prior to harvest, and cleaned seed must meet germination and purity requirements. Over 390

seed conditioning plants are located in Oregon to prepare the seed for market once the harvest operation is complete.

In 2009, 44% of Oregon's grass seed production was certified; however, the percentage of each species that was certified ranged from 99% (rough bluegrass) to 4% (annual ryegrass) (Table 2). Data used in the calculations for Table 2 are from Oregon Seed Certification Service's annual summary reports for 1990 and 2009, and the total Oregon production data collected by the OSU Extension Economic Information Office for the same years. Over the last 20 years a greater proportion of red fescue (+60%), colonial bent (+21%) and Kentucky bluegrass (+16%) is being certified. However, overall, there has been a decrease (-9%) in the percentage of grass seed crops certified (Table 2). This decline has been led by tall fescue and perennial ryegrass (both -17%), and orchardgrass (-13%).

Table 2. Change in percentage of Oregon certified seed crops relative to total acreage produced, 1990 and 2009.

Species	Percent certified		Percent change
	1990	2009	
Hard fescue	100	94	-7
Rough bluegrass	100	99	<1
Creeping bentgrass	92	85	-7
Chewings fescue	89	82	-8
Colonial bentgrass	68	82	+21
Red fescue	49	79	+60
Tall fescue	80	66	-17
Kentucky bluegrass	50	58	+16
Orchardgrass	55	48	-13
Perennial ryegrass	52	43	-17
Annual ryegrass	4	4	0
Total	49	44	-9

Field burning

Certainly the most dramatic change in Oregon's seed crop management in the last 20 years has been the limitation of fire (open-field burning) as the dominant means of handling post-harvest straw residue. The practice of open-field burning of grass seed fields began in the late 1940s, and was widely used into the 1980s. Between 1980 and 1985 growers registered to burn essentially every hectare in production, and 75-80% of those hectares were permitted to be burned. Between 1985 and 1990, the percentage of total hectares in production that were allowed to be burned fell to 40%. However, in this same time period hectares grown in the Willamette Valley increased from 119,920 to 160,400 (+34%). Thus, growing frustration over smoke emissions continued to be voiced by an increasingly urban, non-agricultural population, and in 1991 the

Oregon Legislature imposed a phase down in the practice of open-field burning. A final limit to only 26,325 hectares of allowed burning by 1998 was established in this law.

Prior to 1992, hectares were identified by species when registered for burning; however, once a permit was issued it was not restricted to which field (i.e., species) was burned. Thus, in 1990 one can see that only 64,538 of the 108,402 hectares (60%) registered were actually burned (Table 3). This level of burning accounted for 40% of the Willamette Valley grass seed acreage that year. Twenty years later only 11,868 hectares were burned – just 7% of production.

Table 3. Hectares of Willamette Valley (WV) grass seed crops registered for open-field burning (1990) and actual acreage burned (1990 and 2009) in Oregon.

Species	1990		2009	
	WV hectares registered	WV hectares burned	WV hectares burned	Percent of hectares grown
Annual ryegrass	34,807	--	5,700	11.96
Perennial ryegrass	22,291	--	622	1.50
Tall fescue	25,477	--	26	0.04
Fine fescue	17,250	--	5,371	81.86
Orchardgrass	4,321	--	45	0.65
Bentgrass	3,878	--	104	0.62
Kentucky bluegrass	378	--	--	--
Totals	108,402	64,538	11,868	7.08

Between 1992 and 1998 growers rapidly began adopting non-thermal post-harvest residue management cropping systems (Table 4). The industry actually achieved the legislatively allowed limit of 26,325 hectares two years prior to the 1998 deadline. Today, only the fine-leaf fescue species utilize open-field burning as a significant portion of the acreage grown.

Table 4. Hectares of open-field burn post-harvest residue management used by Willamette Valley grass seed growers for each species, 1992-98.

Species	Open burn hectares ¹						
	1992	1993	1994	1995	1996	1997	1998
Bluegrass	62	98	70	68	37	19	54
Bentgrass	2,248	1,297	1,264	1,026	1,204	1,000	761
Fine fescue	9,260	8,901	8,829	7,301	6,773	5,522	5,736
Orchardgrass	495	263	241	394	388	172	206
Per. ryegrass	2,776	3,670	3,745	4,208	4,097	2,642	1,979
Tall fescue	5,905	4,142	3,378	3,784	3,127	2,513	1,845
Ann. ryegrass	12,864	11,268	14,655	16,221	14,887	10,863	7,550
TOTAL	33,610	29,639	32,182	33,002	30,513	22,731	18,131

¹Oregon Department of Agriculture annual summaries of field burning

Nevertheless, foes of open-field burning have continued to push for greater regulation of this practice. Hence, the 2009 Oregon Legislature imposed further restrictions that banned open-field burning in Linn, Lane and Benton counties (in the southern Willamette Valley) and limits the practice to only 6,075 hectares of “Identified Species” and seed fields on “Steep Terrain.” (“Identified Species” are colonial bentgrass, and Chewings and creeping red fescue, and “Steep Terrain” are fields with highly erodible slopes.)

Straw markets

Concomitant with reduced open-field burning was the availability of approximately 888,850 to 1,029,325 Mg (tonne) of grass seed straw from Willamette Valley fields. Prior to 1990, a small export market for grass straw had been developing through the efforts of the Agricultural Fiber Association (a non-profit association of straw merchants). Volume had grown from <3,000 Mg in 1980 to approximately 200,000 Mg in 1990. The export of grass straw was almost exclusive to Japan where straw was being used as a source of roughage in the dairy industry. While grass seed straw is generally considered a low-quality forage source, the ruminant animal and its microbial population can utilize it with proper nutritional management.

Through the 1990s the straw export market grew rapidly as increased availability of unburned crop residues were removed from seed fields by baling. During the phase-down period for field burning, straw was offered to contract balers and straw merchants as no cost; thus, the price of straw offered to end-users relative to other livestock feeds was competitive. Seed growers constructed straw storage barns to hold product until straw merchants needed to move bales to compressors used to process bales for efficient containerized shipping via deep-water freighters.

The Oregon Department of Agriculture (ODA) first began record-keeping on tonnage of grass straw exports in the 1997-98 market year; that year, 300,000 Mg was exported. Grass straw species exported were perennial ryegrass (58%), tall fescue (37%), orchardgrass (3%) and bentgrass (2%). Destination of these exports was Japan (89.5%), Korea (6.7%) and Taiwan (3.8%). The most recent grass straw statistics from ODA (2008-09) report 565,400 Mg of straw exported to Japan (45%), Korea (54%) and Taiwan (1%), and the percentages by grass species were tall fescue (49%), perennial ryegrass (39%), annual ryegrass (8%), orchardgrass (3%) and bentgrass (1%). Thus, in the last 20 years grass straw exports have increased approximately 183%, or to the point that over one half (52%) of the estimated total production is shipped off-shore.

Tall fescue and perennial ryegrass comprise most of the Oregon's straw exports. Most of the grass seed varieties grown today are turf-type, which in recent years have been developed with high levels of fungal endophyte infection. Concern for the safe use of these grass straw residues has led to a routine analysis by the OSU College of Agricultural Science's Endophyte Service Laboratory for toxin content prior to shipment to consuming markets. This testing service is now used by Oregon straw exporters to insure that ergovaline and lolitrem B levels are below the thresholds known to produce clinical signs in livestock. These chemical analyses provide assurances against deleterious effects to livestock fed Oregon grass straw.

Post-harvest residue management

As previously noted, growers currently burn only 7% of the total seed crop acreage in the Willamette Valley. Thus, the majority of post-harvest residues are managed without fire. Management of the post-harvest residues is an important practice in grass seed production as crop residues impact certain diseases, weeds and insects, and can adversely affect seed yield in some grass species. A broad range of grasses are grown for seed production in Oregon – these species can differ markedly in their seed yield response to post-harvest residue management. Currently, perennial grass seed fields not burned are either managed using a clean, non-thermal cropping system, or managed with the full straw load.

Clean, non-thermal. This method is based on straw removal by baling, and removal from the field. Stubble reduction following straw removal with a flail mower may or may not be employed. The goal in this system is to remove large volumes of straw and stubble that might interfere with subsequent crop development and other management operations. This option is widely used in perennial ryegrass, tall fescue, and to a lesser extent Chewings fescue.

Full straw load. This method involves no straw removal as the straw is allowed to decompose in the field. Straw length may be reduced by using a straw chopper on the combine and/or by a flail mower after harvest. The straw composts in place in the seed field thereby allowing nutrients in grass straw to recycle and improve several beneficial characteristics of the soil. This option is widely used in orchardgrass, tall fescue, and to a lesser extent perennial ryegrass.

Cropping systems for annual ryegrass seed production have changed significantly from the time when open-field burning and no-till planting was a common and important practice. Prior to the 1990, over 50% of the acreage was burned. Currently, a majority of the annual ryegrass seed crop acreage is successfully managed with conventional tillage and planting systems. However, alternative no-till and volunteer systems are being used to a limited extent. In the volunteer

system, a seed crop is produced from seed shattered from the previous crop and is essentially a no-till and no-plant system of production for un-certified seed production. When no-till planting is used, a sprout of annual ryegrass volunteers and other weed seedlings are first sprayed with glyphosate herbicide before seeding. These systems offer a way to reduce tillage and fuel expenses, and reduce concerns about dust and air quality.

Plant growth regulators

In the late 1990s, a new generation of plant growth regulators (PGRs) became available. These foliar-applied chemicals reduce growth through a reduction in plant level of gibberellins, and are applied to fields to reduce crop lodging, facilitate swathing, and to increase seed yields. Two PGRs are currently registered for use on grass seed crops in Oregon: Palisade[®] (trinexapac-ethyl) and Apogee[®] (prohexadione-calcium), both foliar applied products with similar modes of action in plant species.

The use of these two PGRs has become an accepted crop production program for many Oregon seed producers. OSU and private researchers have conducted many experimental trials with PGRs on perennial grass seed species and have shown consistent results from applications to perennial ryegrass, tall fescue, and fine-leaf fescue species with seed yield increases ranging from 15 to 40%.

Current industry estimates from Syngenta Crop Protection, Inc. (Palisade[®]) and BASF Corporation (Apogee[®]) suggest that between 60 to 70% of grass seed acres were treated with PGRs in 2009. These estimates, based on recent product sales, indicate that three-fourths of the fine-leaf fescue acreage is treated; two-thirds of the perennial ryegrass acreage is treated; one-half of the tall fescue acreage is treated; and one-third of the orchardgrass acreage is treated.

Conclusion

Grass seed production was introduced in the Willamette Valley in the 1920s as an alternative crop for the south valley. Ryegrasses were especially well adapted to the wet soils and soon became an important crop. Grass seed also established itself as an excellent alternative crop for the highly erodible foothill soils found on the valley's eastern flank. Since the 1940s the industry has made steady growth, with many national and international seed companies located in the Willamette Valley. Today, grass seed crops are grown on more than one half of all cropland in Willamette Valley counties. Consistent production at current levels is anticipated in the future assuming demand for forage and turf grass seed products does not significantly change in the global economy.