Crop Profile for Wheat in Oregon

Prepared: July 20, 1999

General Production Information

- Oregon ranks 14th nationally in wheat production.
- Farmers in Oregon grow 2.5% of U.S. wheat.
- In 1998, Oregon wheat farmers harvested 54,690,000 bushels from 842,525 acres at a value of $153,047,000.
- Production costs per acre vary. Irrigated eastern Oregon wheat costs from $480.61 to $292.94, depending on the irrigation system used (i.e., pivot, wheel-line, or furrow). Eastern Oregon’s non-irrigated wheat costs $191.51 to $168.78 per acre. Non-irrigated Willamette Valley wheat costs $366.98 per acre to grow. A break-even cost of $4.68 to $3.37 per bushel would be a better production figure. Winter wheat accounts for 87.2% of the Oregon crop; spring wheat represents the other 12.8%.

Production Regions

Eastern Oregon accounts for 92.9% of the winter wheat acreage and 92.5% of the spring wheat acreage. Umatilla County, which borders the Columbia River, has the most acres of both winter and spring wheat. Other counties with large wheat acreages are Gilliam, Morrow, Sherman, Wasco, Union, and Malheur. West of the Cascades, Washington County has the largest acreage (2).

Cultural Practices

Soft white winter wheat, Oregon’s major variety, comprises 81.9% of all wheat planted in the state. Other types include these: soft white spring wheat, 9.7%; white club, 5.3%; hard red spring wheat, 2.7%; and durum, 0.4% (2).

Wheat producers seed more acres than they harvest. In 1997, they planted 870,000 acres of winter wheat
but harvested only 840,000 acres. Sometimes, growers are unable to sell their entire harvest. In 1998, buyers purchased 98% of the crop (3,11).

### Insect Pests

Insect pests common to wheat in all regions of the United State include aphids, armyworms, grasshoppers, and wireworms. Mite and aphid damage can render a plant susceptible to a number of viral diseases (12).

The Russian wheat aphid can be a major pest in Eastern Oregon’s dryland area. Incidence is weather dependent. When growers fail to detect and control the aphid early, it can severely damage entire fields (13,14).

Growers have reported the presence of cereal leaf beetle in Oregon grains (15).

**Chemical controls:**
Growers control Russian wheat aphids chemically with imidacloprid (Admire), chlorpyrifos (Lorsban), carbofuran (Furadan), methyl parathion (Penncap), disulfoton (Di-Syston), dimethoate (Cygon), parathion (Gramoxone), endosulfan (Thiodan), and phorate (Thimet). They apply similar products to control the Hessian fly, which also feeds on Oregon wheat (13).

For more details on insect control in Oregon wheat, see the 1999 PNW Insect Control Handbook, pages 184–190. (Go to http://eesc.orst.edu/agcomwebfile/edmat/ for ordering information.)

**Alternatives:**
Lambda-cyhalothrin (Karate) is a possible replacement for the organophosphates and carbamate. However, its use would be prohibitively costly (12).

**Cultural controls:**
Delayed planting delays some insect problems but has a negative effect on yield (12).

Specialists have bred wheat varieties resistant to Russian wheat aphids and Hessian flies, but progress is slow, especially for varieties resistant to the Russian wheat aphid. Until yield levels of resistant varieties equal yield levels of treated crops, growers will continue to apply chemicals to their fields (14).

**Biological controls:**
Some farmers use predators to control Russian wheat aphids, but they have mixed results (14).
Syrphid fly larvae and ladybird beetle larvae are common predators that are valuable in checking aphid populations (13).

**Post harvest:**
Wheat growers apply aluminum phosphide to crops with post-harvest insect infestations before they initiate other control procedures (14).

After farmers have applied aluminum phosphide treatment, they may apply malathion (Cythion) and chlorpyrifos-methyl (Reldan) to control weevils and meal moths (16).

Respondents in a Texas study predict that elimination of organophosphate or carbamate use in storage would eliminate on-farm storage and result in severe grain losses at mills and elevators (12).

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**Diseases**

A number of fungi, bacterium, and viruses invade wheat (19).

Most diseases, pathogens, and nematodes known to affect wheat are economically important somewhere in Oregon, a state noted for highly variable climates, soils, precipitation zones, and combinations of pathogens. Diseases of specific concern include barley yellow dwarf, Cephalosporium stripe, common bunt, common root rot, cyst nematode, dwarf bunt, eyespot, flag smut, Fusarium crown and root rot, head scab, leaf rust, lesion nematode, loose smut, physiologic leaf spot, pink snow mold, powdery mildew, Pythium root rot, Rhizoctonia root rot, root-knot nematode, Septoria leaf and glume blotches, sharp eyespot, speckled snow mold, stem rust, stripe rust, take-all, and wheat streak mosaic (20).

See Appendix on page 9 for more disease information.

**Chemical controls:**
Chemical control of wheat diseases has focused mostly on improved seed treatments in eastern Oregon and application of foliar fungicides in western Oregon.

Before registration of carboxin (Vitavax) as a seed treatment, winter wheat cultivars became susceptible to new races of smut fungi within five years after their release. During the past 30 years, most growers treated eastern Oregon winter wheat seed (about 95%) with fungicide. Until 1995, the treatment of choice was carboxin alone or in combination with thiram, metalaxyl (Ridomil), imazalil (Bromazil), or quintozene or PCNB (Terraclor). Difenoconazole (Bardos) and tebuconazole (Folicur) were registered during the mid-1990s. Compared to carboxin, treatment of seed with difenoconazole improved seedling
establishment, crop yield, and spectrum of diseases controlled, and reduced the active ingredient application rate by 80-90%. Farmers sometimes use triadimenol (Baytan) to reduce damage from take-all, particularly in western Oregon, but inconsistent results have limited the popularity of this control strategy. Foliar-applied fungicides are used on less than 10% of irrigated and non-irrigated wheat produced in semi-arid regions of eastern Oregon, where growers apply benomyl (Benlate), propiconazole (Banner), or triadimefon (Bayleton) as a curative measure for rusts and eyespot. A positive economic response is almost always limited to a single fungicide application per crop. Multiple applications are rare. In the humid region of western Oregon, the application of foliar fungicide is mostly for controlling Septoria diseases. Fungicides used for that purpose include benomyl (Benlate), propiconazole (Banner), mancozeb (Dithane), and triadimefon (Bayleton). Multiple applications are seldom practiced, for economic reasons. Introduction and acceptance of cultivars with improved tolerance or resistance further reduce the need for foliar fungicides. NASS notes that wheat growers use propiconazole (Banner) on 8% of the acreage. Now, growers also use azoxystrobin (Abound) (22,18,20,14).

For more details on disease control in Oregon wheat, see the 1999 PNW Plant Disease Control Handbook, pages 293–300. (Go to http://eesc.orst.edu/agcomwebfile/edmat/ for ordering information.)

**Alternatives:**
Propiconazole (Banner) and triadimefon (Bayleton) are the primary non-organophosphate/carbamate fungicides. They are effective foliar fungicides but cost more than some of the other options (12).

**Cultural controls:**
Planting pathogen-free seed or resistant varieties, irrigating less frequently, rotating with less susceptible crops, controlling grass weeds, removing infested straw, and avoiding excessive nitrogen are some of the cultural control methods available to ranchers (19).

Burning residue is an effective control for certain diseases. Variety selection may effectively reduce the risk of certain diseases (15).

Crop residue and soil management strategies have a strong influence on most wheat diseases. MORECROP is a disease-predictive expert system developed to integrate climate and cropping system variables with diseases and control options for the most important Pacific Northwest wheat diseases.

Many diseases are strongly influenced by planting date. Diseases favored by early planting include barley yellow dwarf, Cephalosporium stripe, eyespot, flag smut, Fusarium foot rot, sharp eyespot, stripe rust, take-all and wheat streak mosaic. Diseases favored by late planting include common bunt, dwarf bunt, Pythium root rot, Rhizoctonia root rot and snow molds.

Much eastern Oregon’s winter wheat is produced in a wheat-fallow rotation. Disease management programs would become much more efficient if introducing profitable alternative crops could lengthen rotations. Three-year rotations with a single winter wheat crop are more effective than two-year rotations.
for reducing disease damage. However, climate, lack of adapted and profitable alternative crops, and economics of winter wheat production have restricted this option. Growers sometimes plant spring wheat annually, but it is usually more prone to root rots than cereals rotated with fallow.

Genetic resistance is available for smuts, rusts, and eyespot. Cultivars with limited tolerance reduce damage by Cephalosporium stripe and Fusarium foot rot. Growers have an increasing interest in cultivar mixtures or multi-lines that reduce the rate of disease epiphytotics. This approach to genetic diversification is particularly applicable to rusts, Septoria, and other polycyclic foliar diseases caused by pathogens that sporulate abundantly on surfaces of infected hosts during the growing season (19, 23, 24).

**Biological controls:**
Specialists are evaluating several types of bacteria for use as control agents for several fungal diseases, but results have been mixed (14).

**Post harvest:**
Smuted grain is segregated and not used for seed stocks (14).

**Other:**
Growers in all wheat growing regions have reported maneb and mancozeb (Dithane) use as seed treatments (12).

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**Nematodes**

Several kinds of nematodes live in the soil and affect the root systems of Oregon wheat. Nematode activity can predispose wheat to other diseases. However, nematode damage is of little significance compared to weed and disease problems (14, 19).

Cereal cyst nematode (*Heterodera avenae*) and root-lesion nematodes (*Pratylenchus* spp.) damage roots of Oregon wheat. Nematode damage can also predispose wheat to diseases caused by pathogenic fungi. The cereal cyst nematode is present in both western and eastern Oregon. Genetic resistance is not available in current wheat cultivars, and nematicides are not registered for commercial use on small grains. Root-lesion nematodes cause damage in the principal wheat production areas of eastern Oregon. Damage from both types of nematodes is most prevalent when wheat crops are produced without rotation to other crops, or when rotation crops or summer fallow contain grass weeds or volunteer cereals. The cereal cyst nematode reduces yield by up to 50% in annual wheat and in wheat rotated with weed-infested non-host crops. Crop rotations that space cereal crops at least 2 or more years apart reduce the nematode population and promote optimal yields if grasses and volunteer cereals are controlled throughout the rotation (19, 25).
Chemical controls:
Currently, specialists do not recommend nematicides for controlling damage from these pests. Fumigation effectively controls nematodes, but the cost is too high unless growers rotate wheat with a high-value crop. Nematode and insect control strategies applied to potato produced in irrigated circles in eastern Oregon apparently also minimize damage to cereals in the rotation (19).

For more details on nematode control in Oregon potatoes, see the 1999 PNW Plant Disease Control Handbook, page 297. (Go to http://eesc.orst.edu/agcomwebfile/edmat/ for ordering information.)

Cultural controls:
Crop rotation can reduce cereal cyst nematode damage, but it does not control damage from the root-lesion nematode (19).

Biological controls:
None

Weeds

The most troublesome weeds in wheat are downy brome, annual ryegrass, rye, jointed goatgrass, catchweed bedstraw, wild oat, field bindweed, cheat, and wild carrot (17).

Other weeds of concern to Oregon wheat farmers are Russian thistle, horned-head buttercup, mustards, China lettuce, fiddleneck, tarweed, rush skeletonweed, knotweed, pigweed, lambsquarters, yellow starthistle, bulbous bluegrass, windgrass, foxtail barley, kochia, wild onion, Canada thistle, and cereal rye (15).

Chemical controls:
NASS lists these herbicides as the primary ones growers use on Oregon winter wheat: 2,4-D, bromoxynil (Buctril), chlorsulfuron (Glean), dicamba (Banvel), diclofop-methyl (Hoelon), diuron (Karmex), MCPA (Rhomene), metribuzin (Lexone), metsulfuron-methyl (Ally, Escort), thifensulfuron (Harmony), and tribenuron-methyl (Express). Farmers applied the greatest number of pounds of 2,4-D, followed by MCPA. (Each is a phenoxy herbicide.) (18)

Reports indicate that wheat farmers use glyphosate (Roundup) and terbutryn (Igran) in addition to the above chemicals (17).

Weeds and herbicide use vary by region. Herbicides are an essential tool for control of some weeds, such as downy brome (14).

For more details on weed control in Oregon wheat, see the 1999 PNW Weed Control Handbook, pages
Alternatives:
Wheat farmers do not use organophosphates or carbamates for weed control.

Cultural controls:
Growers use a variety of tillage practices to control weeds before they plant. They also use crop rotation to reduce weed seedbanks. Delays in seeding are common to try to achieve a "kill" on weeds prior to seeding. Farmers do not use all seeding practices in all areas. While these practices tend to reduce the incidence of some annual weeds due to minimal soil disturbance, they also appear to increase perennial weed problems (14).

Growers can achieve some mechanical control in the fallow year of a dryland crop-fallow rotation. Mechanical control methods in the growing crop are not selective or crop safe (15).

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**Appendix**

Identification and Control of Oregon Wheat Diseases

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SEPTORIA LEAF AND GLUME BLOTCH – Septoria tritici blotch and Septoria nodorum blotch each cause severe damage to western Oregon wheat crops. Resistant cultivars are available for each pathogen, but only a few cultivars have partial resistance to both pathogens. Fungicide applications are a very important component of the integrated disease management strategy. Economic yield advantages are achieved by applying a fungicide to susceptible cultivars and to resistant cultivars if weather is particularly favorable for these diseases. Fungicides registered for this use include triadimefon plus benomyl, propiconazole, and mancozeb. Specialists have identified benomyl-resistant strains of \textit{S. tritici} in Oregon.

SMUTS - Smuts of wheat in Oregon include common bunt (\textit{Tilletia tritici}), dwarf bunt (\textit{T. controversa}), flag smut (\textit{Urocystis agropyri}), and loose smut (\textit{Ustilago tritici}). The fungicide difenoconazole is highly effective for controlling these smuts. Other fungicides, including carboxin and tebuconazole, are effective against common bunt, flag smut, and loose smut. Resistant cultivars are available for several of the smuts, but in the absence of chemical control, the pathogens are notorious for their ability to develop virulent new races capable of infecting newly released resistant cultivars. Control of smut diseases was stabilized by combining the use of resistant cultivars, fungicide seed treatments, and planting dates that are least favorable for infection. These diseases become highly damaging if growers plant a susceptible cultivar for several successive crops without applying a fungicide seed treatment. Many cultivars released during the past decade are susceptible to all of the smuts. As a result, common bunt, flag smut, and loose smut occur on a few plants in many crops, presumably in response to nonuniform application of the fungicide seed treatment. Growers must be vigilant so that new races or fungicide-resistant strains of the pathogens do not circumvent currently available genetic resistance and fungicides.

RUSTS - Stripe rust (\textit{Puccinia striiformis}), leaf rust (\textit{P. recondita}), and stem rust (\textit{P. graminis}) cause yield losses in Oregon. Stripe rust causes the greatest and most frequent damage, with destructive epiphytotics occurring in three of four years. Leaf rust is becoming increasingly important as a consequence of controlling stripe rust, intensive wheat management, and an increased area of irrigation. Stem rust becomes highly damaging in high-elevation locations where crops mature in late summer or in low-elevation locations during cool, moist summers that delay maturation. Plant breeding programs have attempted to breed for resistance to all three rust diseases for many decades. Breeders have made significant progress, but the ever-evolving rust pathogens remain a challenge. Growers use multi-lines and cultivar mixtures to slow the rate of epiphytotics. Applications of the fungicides triadimefon or propiconazole inhibit epiphytotics. Planting as late as practicable during autumn reduces the risk from rusts.

VIRUSES - Barley yellow dwarf is the principal virus disease on Oregon small grains. Corn is an important oversummering host for the aphid vectors of this virus, and damage in wheat is increasing as growers expand the areas of irrigated corn and plant winter wheat earlier to reduce the potential for soil erosion. Growers manage barley yellow dwarf by monitoring and reporting aphid populations, controlling volunteer plants, and planting as late as practicable during autumn to minimize exposure of young plants to high populations of aphids. Wheat streak mosaic is vectored by the wheat curl mite
(Aceria tulipae) and causes periodic damage. Wheat farmers manage streak mosaic by eradicating volunteer wheat plants in nearby fields and planting late in the autumn to minimize exposure of young plants to high populations of leaf curl mite.

FOOT ROTS - Eyespot (Pseudocercosporella herpotrichoides) is highly damaging to winter wheat but not to spring wheat. Wheat cultivars differ in tolerance to infection, and cultivars with acceptably high levels of resistance are now available. Growers have used fungicides that hydrolyze to carbendizem to reduce disease severity and increase yield for more than a decade. However, strains of P. herpotrichoides with high tolerance to these fungicides emerged, and benzimidazole fungicides are no longer effective in many fields. Growers can diminish eyespot greatly by planting wheat very late, but this practice leads to unacceptable soil erosion. Sharp eyespot (Rhizoctonia cerealis) infects small grains and is difficult to distinguish from eyespot. The importance and prevalence of sharp eyespot is currently unknown.

ROOT ROTS - Take-all (Gaeumannomyces graminis var. tritici) becomes acute in irrigated wheat and causes chronic damage in nonirrigated fields, especially where farmers plant small grains annually. Sources of genetic resistance are unavailable, and seed treatment with the fungicide triadimenol has been unreliable. Soil and crop management practices continue to be the primary means for reducing take-all damage. These practices include rotating crops; banding starter fertilizer below the seed; controlling the form in which nitrogen is absorbed by roots and maintaining soil pH in the moderately acid range; delaying planting in the autumn; and reducing the amount of crop residue remaining near the soil surface.

Rhizoctonia root rot (R. solani AG-8 and R. oryzae) constrains yield potential in wheat. A chronic form reduces plant vigor without causing visible symptoms in the crop canopy. An acute form, called "bare patch," causes stunting, patchiness, and severe yield damage. Strategies that reduce soil erosion are especially favorable to Rhizoctonia root rot. The disease is typically most damaging in fields managed without tillage or with minimal tillage. Banding fertilizer directly below the seed at planting increases plant tolerance to infection. Fungicides or genetic tolerance do not control the disease.

Pythium diseases are widespread and include seed rot, seedling damping-off, and browning root rot. P. ultimum sporangiiferum and P. irregularare are the primary species causing root rot. Pythium root rot is particularly severe in fields under minimum- or no-till management, especially when cropped annually and seeded late. Crop rotation is not useful for controlling this disease. Fungicides that are available for suppressing seed rot and damping-off stages are less effective against root rot.

VASCULAR WILT - Cephalosporium stripe (C. gramineum) causes severe damage to winter wheat and does not damage spring wheat. Root injuries from freeze/thaw cycles or high populations of wireworms enable C. gramineum to penetrate the vascular system of roots. Crop and soil management strategies have strong influence on severity of Cephalosporium stripe. Late-autumn planting dates reduce infection but may also delay plant development and reduce yield. The disease becomes severe in wheat fields in a two-year rotation with summer fallow. Growers who reduce the frequency of winter cereals in rotation (three-year rotations that include only one crop of a winter cereal) achieve excellent Cephalosporium
stripe control. Inversion tillage, burning, and eliminating susceptible grassy weeds are effective controls but have negative effects on soil sustainability. Fungicides are not useful for controlling this disease. While there are sources of genetic resistance, they are not yet incorporated into agronomically acceptable wheat cultivars. Commercial cultivars differ in tolerance to *C. gramineum* infection.

**NONSPECIFIC ROOT AND CROWN ROTS** - A complex of nonspecialized pathogenic fungi cause severe damage to Oregon wheat. The complex includes, but is not limited to, *Fusarium culmorum*, *F. graminearum* Group I, *F. graminearum* Group II (=*Gibberella zeae*), *F. avenaceum*, and *Bipolaris sorokiniana* (=*Cochliobolus sativus*). Species of *Fusarium* cause Fusarium foot rot, *B. sorokiniana* causes common root rot, and dryland foot rot is a nonspecific name for all of these pathogens. Although prevailing environmental conditions in Oregon usually restrict infections to root and crown tissues, some members of the complex are capable of infecting the culm, leaves, and head (as in Fusarium head scab). *F. graminearum* Group I occurs in nonirrigated fields throughout the region, and *F. culmorum* is the principal pathogen in some areas. *F. graminearum* Groups I and II both occur in irrigated fields. *B. sorokiniana* is the least widely distributed member of the complex and appears to cause economic damage only in localized areas. Fusarium foot rot is most damaging under conditions of early seeding dates, high nitrogen fertility, and high plant density. Fungicides and genetic resistance are not available for suppressing Fusarium foot rot. However, winter wheat cultivars exhibit modest differences in tolerance and growers can use the cultivars to reduce damage in areas heavily influenced by this disease.

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