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Controlling Root and Crown Diseases of Small Grain Cereals

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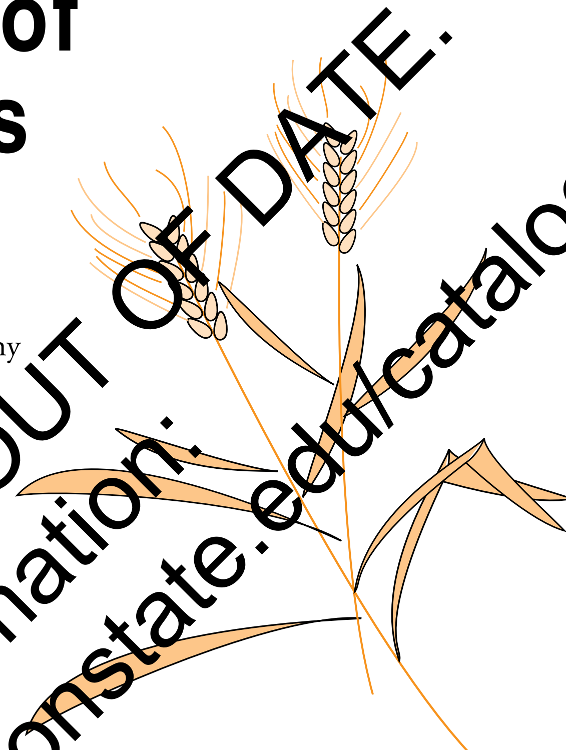

Farming systems, equipment, climate, and topography vary widely in the Pacific Northwest. Simple prescriptions for managing root diseases are not possible with so much diversity. However, certain general practices can help reduce economic damage from diseases. By applying as many of the following principles as possible, growers can minimize the impact from yield-robbing diseases that attack roots, crowns, and lower stems.

This publication is designed specifically for wheat and barley producers using direct-seed technologies in advanced resource-conservation systems. However, most of the principles also apply to conventional tillage systems involving various styles of plows and disks as primary tillage implements.

Spread chaff and straw

Disease management begins during harvest. Concentrations of chaff and straw create cool, moist areas that favor root-infecting pathogens. Equip the combine with a straw chopper and chaff spreader, and try to spread residues to the full width of the header.

Rotate crops

For a disease to occur, three conditions are required:

- Presence of a virulent pathogen in adequate population and level of energy
- Presence of a susceptible crop species and variety
- A favorable environment

Crop rotations reduce economic damage by minimizing one or more of these requirements. In fact, rotation of field crops can reduce the pathogen

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population almost as effectively as chemical fumigants applied to high-value crops.

Most pathogens damage only certain groups of plants, such as winter cereals, spring cereals, legumes, or brassicas. Crop rotations minimize the possibility that susceptible plants will be planted into a field infested with a damaging amount of a pathogen. For some combinations of plants and pathogens, it is important to avoid planting the same plant species or type (such as winter wheat) more frequently than once every 3 years.

Plant the most resistant species and variety

Small grain crops differ in their susceptibility to pathogens. To reduce disease problems, plant the most resistant crop species and varieties.

For instance, Cephalosporium stripe and strawbreaker foot rot rarely cause economic damage on spring wheat, and winter wheat is more susceptible than winter barley. Winter wheat varieties with useful levels of resistance are available for Cephalosporium stripe. Excellent resistance is available for strawbreaker foot rot.

Fusarium foot rot occurs on both spring and winter cereals. It can be more damaging to barley and oats than to wheat. Winter wheat varieties differ in their susceptibility to damage.

Take-all and Pythium root rot occur on both spring and winter cereals. There are no known differences in genetic resistance among varieties to these two diseases.

Rhizoctonia root rot is more damaging to spring cereals than to winter cereals, and to barley than to wheat. The highest risk crop is spring barley, and the lowest risk crop is winter wheat.

Control grass weeds and volunteer cereals

Grass weeds and volunteer cereals are excellent hosts for root-infecting pathogens. They allow pathogens to survive a potentially sanitizing break from the cereal crop, such as a rotation crop, summer fallow, or over-wintering stubble.

Wheat and barley yields can be increased significantly by keeping grass weeds out of broadleaf rotation crops. Weeds and volunteer cereals in fallow usually don't improve pathogen survival because they are killed quickly by rod-weeding (conventional fallow) or spraying (chemical fallow).

Grasses and volunteer cereals often are allowed to grow in stubble during the winter. These plants almost always are infected by root pathogens of wheat and barley. It is important to kill grass weeds and volunteer crop species during the autumn rather than allowing the plants to grow through the winter. This is important in both conventional tillage and direct-seed systems. In a wheat-fallow rotation, overwintering weeds reduce the sanitizing potential of the 12- to 14-month harvest-to-planting period to an actual host-free interval of only 4 months. In annual spring crop systems, the 7-month harvest-to-planting period is reduced to an effective interval of several weeks if grass-type plants are allowed to overwinter.

Spring cereal yields can be increased dramatically in direct-seed systems when seed is planted into fields kept free from grass-type plants during the winter. If possible, apply a split application of herbicide, one in late autumn and the second in early spring. If a kill is not possible during the autumn, apply the herbicide at a full rate at least 2 to 3 weeks before direct-seeding a spring cereal. Intervals shorter than 2 weeks allow root pathogens to grow from the roots of dying weed and volunteer plants to seedlings of the emerging and highly vulnerable new crop. The transfer of pathogens and insects from dying or recently killed plants to living plants is called the "Green Bridge" effect.

The Green Bridge

Visualize the following scenes. How are they alike?

A time sequence on a single field

Cheatgrass and volunteer wheat became established in wheat stubble after a rain in October. You plan either to direct-drill spring cereal or prepare conventional summer fallow followed by another winter wheat crop. You must decide whether to kill the new growth in November or let it grow until you spray or plow in March or April.

A spatial relationship between two fields

There is a deep, steep-sided chasm between two fields. In one field, green weeds and volunteer cereals are growing in the stubble. A newly planted wheat crop is growing in the other. It is very difficult to cross the chasm to get from the weedy field to the newly planted field. It is much easier and faster to cross a bridge over the chasm. But what if the chasm becomes twice as wide? The bridge then extends only halfway across the chasm. The journey again becomes very difficult or even deadly if one falls off the end of the too-short bridge.

Now consider how this spatial symbolism relates to the spray timing situation described first. It describes the dilemma or opportunity faced by pathogens and insects as they attempt to move onto vulnerable seedlings from plants dying after a spray application or tillage.

The most effective way to stop diseases and insects from moving from one living plant to another is to extend the time interval when host plants are not present without also extending a bridge across the interval.

Treat seed with protectant chemicals

All small grain seed planted in the Pacific Northwest should be treated with a seed protectant. The most important reason is to control common bunt, dwarf bunt, flag smut, and loose smut. During the 1999–2000 crop year, winter wheat varieties susceptible to common bunt were planted on 82 percent of the acreage in Oregon and 26 percent of the acreage in Washington. Winter wheat varieties susceptible to flag smut were planted on 96 percent of the acreage in Oregon and Washington. Many spring wheat and barley varieties also are susceptible to smut diseases.

Smut epidemics prior to the 1950s could not be controlled by genetic resistance alone. They were brought under sustained control only when hexachlorobenzene (HCB®) and then carboxin (Vitavax®) allowed a combined strategy of genetic resistance plus chemical seed treatment.

Fungicide seed treatments are relied upon more heavily now than at any time in the history of small grain production in the Pacific Northwest. Pathogens causing bunt and smut diseases still are present in the Pacific Northwest, and many profitable varieties are susceptible to one or more of these pathogens. However, these diseases cause economic damage only in rare instances where untreated seed of susceptible varieties is planted in the same field several years in a row.

The most common fungicides used for controlling smut diseases at the present time include carboxin (Vitavax®), difenoconazole (Dividend®), tebuconazole (Raxil®), and triadimenol (Baytan®). Seed treatments in the Pacific Northwest typically include one of these smut-control fungicides plus other chemicals to reduce damage from seed rot, seedling damping-off, root rot, and insect pests. Fungicides include captan (Captan®), fludioxonil (Maxim®), imazalil (Flo-Pro IMZ® or Nu-Zone®), metalaxyl (Apron® or Allegiance®), mefenoxam (Apron XL®), pentachloronitrobenzene (PCNB®), thiabendazole (Mertect®, TBZ®, Agrosol®), and thiram (Thiram®).

Insecticides for reducing damage from wireworms include benzene hexachloride (Lindane®), imidacloprid (Gaucho®), and thiamethoxam (Cruiser®). The latter two insecticide seed treatments also control aphids, including those that transmit barley yellow dwarf virus.

Band starter fertilizer below the seed

Grain yields in direct-seed systems often are improved by banding a balanced "starter" fertilizer directly below the seed at the time of planting. Mixing fertilizer with the seed is a less effective but still worthwhile way to help crops grow and yield in spite of root diseases.

Starter fertilizers are intended to supplement the main supply of fertilizer, which is banded either beneath or between rows at the time of planting, or applied through shanks or by broadcasting before planting. An example of a dry fertilizer used as a starter fertilizer is super phosphate (16-20-0) mixed with potassium chloride (0-0-60). Apply at a rate of 10 pounds each of nitrogen and potash per acre.

Starter fertilizer provides several yield-improving benefits. Nutrients become available to seedlings before they develop an extensive network of feeder roots. Seedlings with immediate access to nutrients are more vigorous and more capable of tolerating early infections by root pathogens. Diseased roots are less efficient in reaching nutrients banded several inches to one side of the seed row.

Equipment that places starter or all the fertilizer at least 1 inch directly below the seed also loosens soil and allows the first roots to grow better. Roots growing in compacted soil generally are more susceptible to infection, because they grow and mature more slowly in areas where pathogens are present. Changes in their physiology also affect leakage of organic substances from the roots in compact soil, making them more attractive to infection by pathogens.

Move infected residue from the seed zone when planting

Root pathogens survive mostly in root and crown tissues infected while this tissue was still part of a live green plant. The amount of surviving inocula of these pathogens declines over time. The rate of decline depends on complex interactions among specific pathogens, soil moisture, soil temperature, soil chemistry, and rate of decomposition of the dead host tissue. If seed is planted directly into areas harboring high levels of a surviving pathogen, or if the roots or shoot must grow through such an area, the new seedlings are at high risk of infection while young and vulnerable.

The disease risk can be reduced at the time of planting by using a drill designed to move residue away from the seed zone and to create an area with less plant residue directly over the seed. Most direct-seed drills create a row of dark soil with little or no residue above the seed in an otherwise high-residue, no-till surface. This technique sometimes is known as the "black ribbon effect." Drills with shovel-type openers are more efficient at moving residue away from the seed row than are those with disk-type openers. For disk-type openers, a similar effect can be achieved by placing an opening coulter at an angle in front of the opener that deposits seed and fertilizer.

Another method for reducing contact between new seedlings and infested root and crown debris is to plant between or diagonal to rows of standing stubble.

Promote seed germination and healthy seedling growth

Yield can be less when seedling vigor is permanently impaired. Low vigor can occur when seed is planted into soil that is too cold or too warm, too wet or too dry, or when surface crusting occurs between the time of planting and emergence. Seedling vigor also can be low when seed is damaged, either mechanically during harvest and handling, physiologically during storage (stored for too long or under hot, moist conditions), or chemically by excessive or uneven application of seed treatments. Use of new (fresh) seed, rather than seed 2 or more years old, is probably the single most important factor affecting seed quality when planting into cool, wet seedbeds.

Plant spring cereals when the seed-zone temperature is above 50°F. Planting earlier increases the risk of take-all, Rhizoctonia root rot, and Pythium root rot. Plant winter cereals when the soil temperature at seeding depth is between 45°F and 60°F and the soil is not too dry or wet. Planting winter wheat when the seed zone is warmer than 60°F increases the risk of Cephalosporium stripe, strawbreaker foot rot, Fusarium foot rot, and several virus diseases.

Seed germination and seedling growth are optimized when the moisture content of silt loams is between 12 percent and 18 percent. If you must plant into wetter soil, it is important to reduce the pressure on the packer wheels or to remove them entirely. Packer wheels are designed to improve seed germination in drier soils. Packing wet soil over newly planted seed reduces the amount of oxygen available to the seed. This creates a condition highly favorable for seed decay and Pythium root rot.

For more information

OSU Extension publications

Combatting Take-All of Winter Wheat in Western Oregon, EC 1423 (1993). 75¢

Dwarf Bunt of Winter Wheat in the Northwest, PNW 489 (reprinted 1996). $1.00

Pacific Northwest Insect Management Handbook (2002). $35.00

Pacific Northwest Plant Disease Management Handbook (2002). $35.00

Recognizing and Controlling Cephalosporium Stripe, FS 308 (reprinted 1993).

Viral Diseases of Barley, PNW 493 (reprinted 1997). $1.50

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