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G92-1097 Root and Crown Rot: Winterkill Complex of Winter Wheat

John E. Watkins
University of Nebraska - Lincoln, jwatkins1@unl.edu

Ben Doupnik, Jr.
University of Nebraska - Lincoln

Eric D. Kerr
University of Nebraska - Lincoln

Robert N. Klein
University of Nebraska - Lincoln, robert.klein@unl.edu

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Root and Crown Rot--Winterkill Complex of Winter Wheat

Root and crown rot--winterkill complex is discussed, including nature of the complex, symptoms, control, and management rationale.

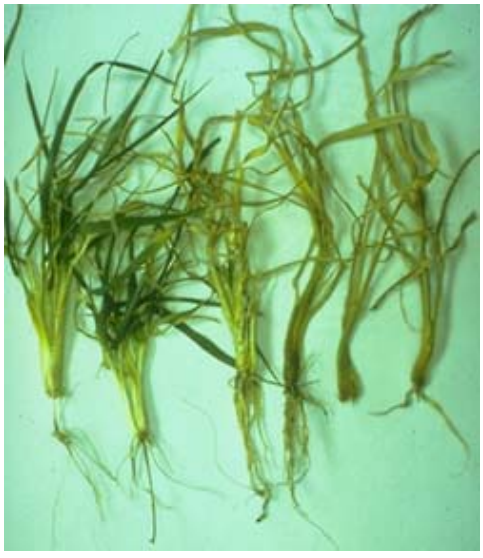
John E. Watkins, Ben Doupnik, Jr. and Eric D. Kerr, Extension Plant Pathologists;
Robert N. Klein, Extension Cropping Systems Specialist

- Nature of the Disease Complex
- Distribution and Symptoms
- Control
- Should I Leave or Destroy the Winter Wheat Crop?
- Partial Field Loss
- Government Programs

Root and crown rot of winter wheat is an interrelated disease complex caused by the interaction of infection of roots and crowns by *Bipolaris sorokiniana* and/or *Fusarium graminearum* and harsh winter conditions. It is an insidious, persistent and inconspicuous disease complex that reduces wheat yields each year. In extreme cases, entire fields or large areas within fields are killed. The ultimate effect is loss of stands, poor plant vigor, reduced yield and lower grain quality.

Nature of the Disease Complex

Winter Injury



The growth and development of winter wheat is limited by temperature, growing degree days, available water, soil fertility, and disease and pest outbreaks. Besides the cap placed on yield by climate and soils, limitations are imposed by weather-related episodes such as winterkill, freeze injury, drought, or heat stress at critical times of plant development. Although the wheat plant compensates for many of these stresses, each can lower yield.

Figure 1. Stages of crown and root rot from healthy (left) to complete deterioration.

Low temperatures kill winter wheat plants by injuring the crown.

When adequately hardened, crowns can tolerate temperatures down to -9 to -11°F. The hardening process is the key to a plant's ability to withstand low temperatures. **Plants that develop several tillers because of early seeding remain more vulnerable to low temperatures than those seeded later.** Plants in the three-leaf or four-leaf stage with good root systems are in the best position to survive the winter in the Central Great Plains. These plants are subject to desiccation due to cold, dry winds and a lack of adequate snow cover. Soil- and seed-inhabiting fungi parasitize weakened plants and limit their ability to recover in the spring. Winter wheat that remains green into December because of a long growing season may be severely injured by a rapid temperature drop in early winter. Temperatures that fluctuate from below 0°F to above 70°F during winter, undoubtedly, affect winter hardiness. Each time a plant breaks dormancy during winter it loses some of its winter hardiness.

Root and Crown Rot

A healthy root system is critical to wheat's ability to tiller and produce large heads. Healthy roots are needed to support growth; and when diseased, they fail to deliver the appropriate balance of nutrients, water, and growth factors during the early stage of growth and development. This results in the failure of tiller buds to activate or causes the formation of small leaves and heads on the main stem and on tillers already initiated. Crown and root diseases cause a reduction in the number and size of heads and/or a loss of stands.

Prolonged moisture stress coupled with relatively high soil temperature in the fall enhance early disease development on the roots. The detrimental effects of a loose seedbed, soil moisture deficiency, lack of an insulating snow cover, ice, and sustained low temperatures become apparent in the spring when affected wheat fields fail to green up uniformly. These factors predispose the plants to infection by the root and crown rotting fungi.

Distribution and Symptoms

The prevalence of root and crown rot--winterkill varies within fields and across the major wheat growing areas of the state. The disease complex is most common in western Nebraska where drought and strong winter winds predispose seedlings to root and crown rot, but it can be equally severe anywhere in Nebraska where stress conditions prevail.

Figure 2. Badly rotted crown on a winter wheat plant.

Symptoms of root and crown rot of winter wheat may first appear on the roots and subcoronal internode as early as September, but usually develop in late November. Small brown to black lesions occur on the primary and secondary roots. These lesions, which may develop on any part of the root, vary in length, ranging from less than 1/8 inch to over 1 inch.

Diseased crowns are brown to dark brown in contrast to the white color of healthy crowns (*Figure 2*). Wheat crowns rot to a greater or lesser degree, depending on the stage and severity of disease development. Plants will not recover from severe damage to the crown even with optimal weather conditions for growth. Plants with severely damaged crowns fail to develop new crown roots to meet the need of the growing plant for water and soil nutrients. Those with moderate root and crown damage tiller sparsely and yield less than plants with healthy roots and crowns.

Individual fields affected by root and crown rot contain scattered pockets of dead and dying plants (*Figure 3*). Affected areas often follow terrace ridges or occur on exposed slopes. Other fields show damage uniformly over much of the crop. To diagnose the disease, remove suspected seedlings, wash free of soil, and examine for the presence of dark brown lesions and nonfunctional roots with few or no new roots initiating from the

crown. Split the crowns at the base of stems with a sharp knife or a razor blade to detect rot.

Symptoms on the aerial parts of wheat associated with root and crown rot include wilting, stunting and chlorosis. Preemergent and postemergent damping-off of wheat seedlings caused by root and crown rot fungi is generally not a serious problem in Nebraska.

Figure 3. Severe root and crown rot. Plants killed by root and crown rot.

Control

Cultural practices greatly affect the incidence and severity of root and crown rot. They influence environmental stress which, in turn, affects the susceptibility of the plant and the viability and virulence of the pathogen.

The following are recommendations for the control of root and crown rot.

1. **Plant winter wheat at the recommended date.** Early planting favors good plant establishment that helps control wind erosion; however, heavy fall growth can seriously deplete soil moisture reserves. In the spring, root and crown rot abounds in early planted wheat because of drought stress. Late planting conserves moisture, but if there is too little soil protection due to insufficient plant growth, residues and surface roughness, serious wind erosion and winter injury result.

   A guideline for determining the best seeding date to minimize this disease was developed for western Nebraska based on elevation (*Figure 4*). With 4,000 feet as the base elevation and Sept. 10 as the base date, each 100-foot difference in elevation means one day difference in planting time. The higher the elevation, the earlier the best planting date; the lower the elevation, the later the best planting date.

2. **Plant the recommended varieties for your area.** Know the winter hardiness of a variety before you plant.

3. **Plant in a firm, mellow seedbed.** Place seed firmly in moist soil, and cover with sufficient soil to prevent rapid drying. If the soil surface is dry at planting, use a hoe drill instead of a disc drill so placement of the winter wheat seed is into firm moist soil. The openers must have proper tension to ensure that wheat seed is planted deep enough, especially in the tractor tracks. Depth of soil over the seed should be 1 to 1 1/2 inches in medium to fine textured soils, and 2 inches in coarse textured soils. Soil aggregates should be fine enough to provide good soil-seed contact, but not so fine that rain will puddle the silt and cause crusting, or wind will drift the soil.

4. **Control weeds in summer fallow land.** Weeds deplete soil moisture, hastening drought stress which in turn predisposes the plants to root and crown rot.

5. **Consider treating seed with an appropriate fungicide before planting.** Seed treatments control common bunt (stinking smut) and loose smut where the pathogens are present on or in the seed. They have only limited value for the control of cereal root and crown rot, but are an excellent defense against preemergent and postemergent damping off of seedlings.

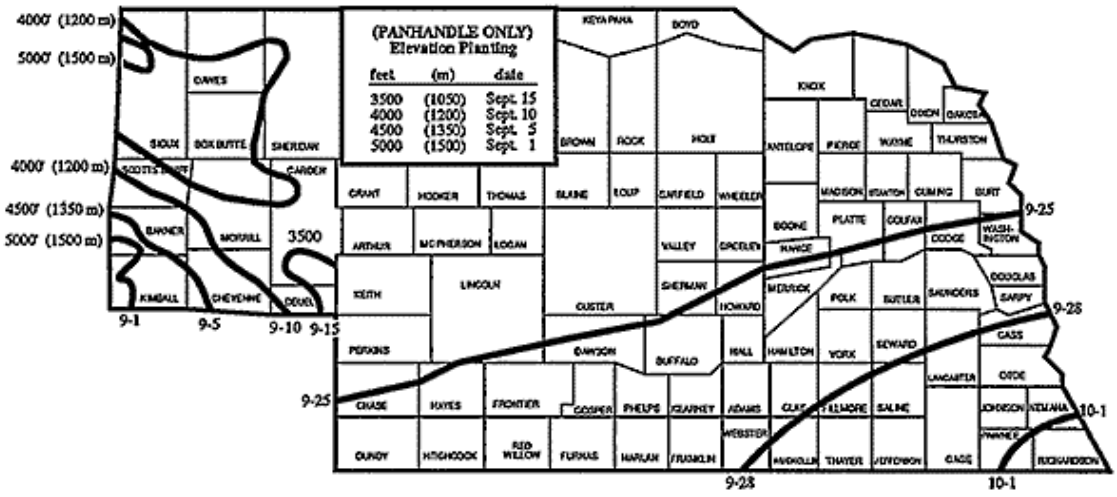


Figure 4. Suggested seeding dates for winter wheat in Nebraska.

Should I Leave or Destroy the Winter Wheat Crop?

This question always comes up in spring where fields have marginal stands. To help growers decide what to do with these fields, consider these guidelines. Many factors contribute to this decision; they include the estimated yield, soil moisture for replacement crops, other cropping options, partial field loss, government programs, soil erosion, and effect on rotations. Several of these will be discussed.

Estimating the Yield Potential of Winter Wheat

Estimating the yield of winter wheat in late winter or early spring is difficult. Winter wheat has the ability to compensate, that is if one yield component is affected, another may make up part of the yield loss. A yield estimate assumes that soil moisture and soil fertility are adequate, the recommended planting date was used, weeds and insects are controlled, and plant diseases are not a factor. *Table I* provides an estimate of the potential of winter wheat yields based on healthy plants per foot or row in various row spacings.

Table I. Estimated potential yield in bushel of winter wheat based on five tillers/plant, 22 seed/head and 16,000 seed/lb.

	Drill Row Spacing in Inches				
Healthy Plants/Foot of Row	**6**	**8**	**10**	**12**	**14**
1	10	7.7	6	5	4.3
2	20	15.0	12	10	8.6
3	30	22.5	18	15	12.9
4	40	30.0	24	20	17.1
5	50	37.5	30	25	21.4
6	60	45.0	36	30	25.7

7		52.5	42	35	30.0
8		60.0	48	40	34.3
9			54	45	38.6
10			60	50	42.9
11				55	47.1
12				60	51.4
13					55.7
14					60.0

Yield potential should be adjusted for fewer or more tillers, seeds per head, and seed size. For information on seed size of winter wheat refer to *EC-103, Nebraska Fall-Sown Small Grain Variety Tests*, which is published annually. Winter wheat ranges from about 12,000 to 20,000 seed/lb.

Soil Moisture for Other Crops

If soil moisture is limited, most replacement crops will fail unless rainfall is timely and above average. If the winter wheat is destroyed where fallow is practiced, the best alternative is to fallow the land using herbicides to maintain crop residues and reduce wind and water erosion. Plant the replacement crop on land that would have been fallowed. The key here is to check which land has more stored soil moisture. Also check with the appropriate government agency before implementing any change.

Partial Field Loss

If the stand or part of the stand is reduced, should the field be "thickened up" or replanted to spring wheat? Do not "thicken up" a stand of winter wheat with spring wheat. If the spring wheat makes a crop, the result would be a mixture of winter and spring wheat classified as mixed grade.

The best alternative, if weather permits, may be to plant winter wheat in late winter. Plant by March 1 (a week earlier in southeast Nebraska and a week later in the Panhandle) for vernalization to occur. Check with your seed dealer for the vernalization requirements since they are variety related. Winter wheat seeded in late winter has a better probability than spring wheat for making a crop, about 20 bushels, in most of Nebraska except the northern areas.

Government Programs

Before destroying any winter wheat or planting replacement crops, check with the appropriate government agency.

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