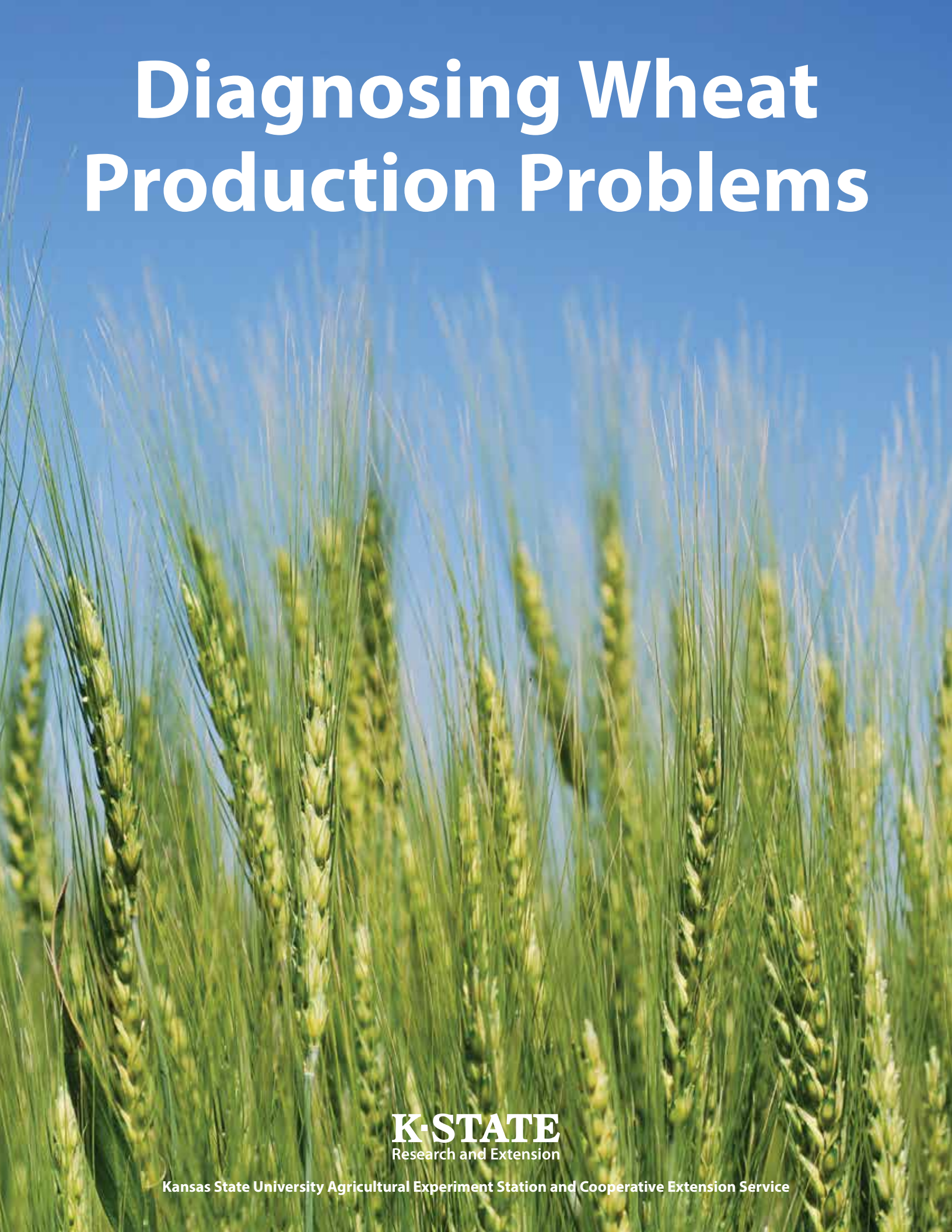
Diagnosing Wheat Production Problems



K-STATE
Research and Extension

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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Rare Problems

Poor stand establishment can be caused by a number of problems, such as a plugged drill, poor seed quality, dry soil, deep planting, soil crusting, diseases, or insect damage.

Dry soil can delay germination or stop emergence. Shallow seed placement often predisposes plants to this problem. Regrowth is unlikely if the seed becomes soft and spongy. Dry soils also restrict crown root development.

Deep planting can reduce seedling emergence if the coleoptile fails to reach the soil surface. Plants trapped below the soil surface often develop a yellow, crinkled leaf. Hot soils at planting or varieties with short coleoptiles are more likely to result in emergence problems.

Soil crusting can reduce emergence when the coleoptile is unable to break through the upper layers of soil. Leaves that develop while still below ground become yellow, with an accordion-like shape. Plants trapped below the soil surface will not emerge.

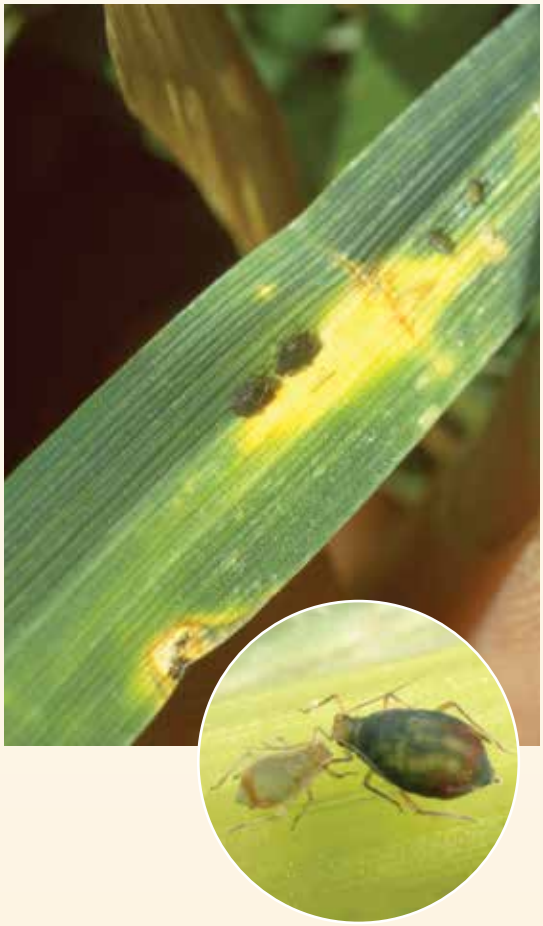
Insect injury and **seedling blight** are two major causes of postemergence seedling death. Seedling blight causes distinct brown lesions and is often worse with early planting. **False wireworms** are soil-inhabiting, yellowish-colored worms (up to 1½ inches long) that often follow the drill row in dry soils, feeding on the seeds before germination. **White grubs** also may feed on roots. These grubs often assume a "C" shape when disturbed.

Color banding is an environmental problem caused by rapid temperature change. The discoloration will fade as the plants grow and become more cold tolerant.

Armyworms, fall armyworms, and army cutworms all may feed on leaves and stems of young plants, or chew off plants at ground level. Small larvae leave a thin, clear layer of leaf tissue in the damaged areas; larger larvae may destroy plants until cold weather reduces worm activity. Army cutworms will continue to feed whenever temperatures are higher than 45 degrees Fahrenheit.

Greenbugs are light green and have transparent cornicles ('tailpipes') and are often found on the undersides of leaves in the fall. Greenbug feeding causes small, dark red specks on the upper surface of leaves. Affected leaves may turn yellow, and plant growth may be reduced. Heavily damaged plants might die in the fall or winter.

Bird cherry-oat aphids are usually dark green-colored with long, dark cornicles, and have a dark-red pattern on the abdomen. They may be found in wheat fields at any time in the fall. While feeding damage is usually irrelevant, they may transmit barley yellow dwarf virus.



Grasshoppers may feed around edges of wheat fields. Grasshoppers move into fields from adjacent weedy or grassy areas. Feeding usually is negligible and grasshoppers will decrease feeding and eventually die.

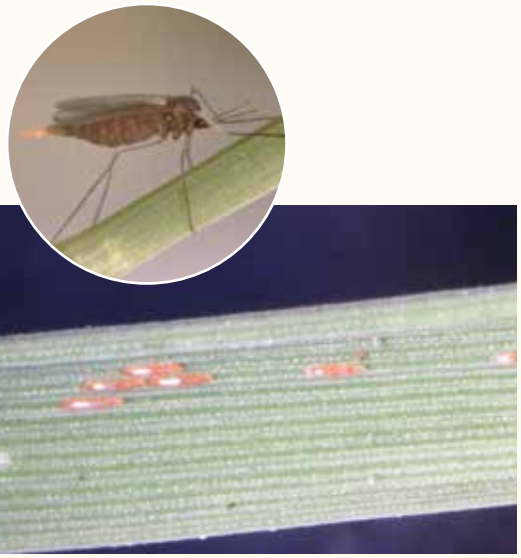
Herbicide carryover can injure or kill wheat, and often shows up where the sprayer turned or overlapped because these areas received a greater dose of herbicide. This condition is most likely after periods of dry weather and in soils with pH extremes.

Atrazine carryover causes dieback of the leaf tips. Symptoms occur on the oldest leaves first. It is most likely with high application rates, high soil pH, coarse-textured soils, and dry weather.

Winter grain mites are a perennial concern when there are unfavorable growing conditions. They are easily distinguished from other mites due to their red-orange legs. They may cause yellowing and silvery plants. They hide in the soil during the day and feed during cool nights or on cool, cloudy days. Warm weather and/or heavy rain dissipates them.

Standing water or ice may kill wheat, and some low areas of the field may not green up in the spring.

Hessian fly can cause stunting, and affected plants often have unusually large, broad, greenish leaves in the fall. Weakened tillers may die over the winter. Hessian fly maggots are pale and legless, and later the maggots become dark-colored, hard-shelled "flaxseeds." These flaxseeds are often found behind the lower leaf sheath just below the soil line. Hessian fly adults are tiny flies that lay eggs on wheat leaves.



Early season drought can cause thin stands and poor root development. Plants growing in dry soils often have fuzzy roots. This fuzzy appearance is a normal reaction to dry soil conditions when root hairs are retained longer as the plant searches for water.

Winterkill can occur when soil temperatures at a 2-inch depth are 10 degrees Fahrenheit or lower. Damage is more likely on terrace tops and north-facing slopes. Loose, dry soil, excessive fall growth, or a rapid drop in temperature increase the risk of winter injury.

Shallow planting predisposes plants to injury caused by cold temperatures and dry soils. When seed is planted too shallowly, the resulting plants often have poorly developed root systems and form crowns near the soil surface within the residue layer. Heavy residues remaining after the harvest of a previous crop often aggravate this problem.

Crown rot can infect plants that have winter injury. Crown rot causes dark brown discoloration in the base of the plant, destroys the connection between roots and tillers, and eventually kills the plant. Common root rot causes browning of roots, especially the subcrown internode.

Pink snow mold can attack wheat during cold, wet periods, or under snow cover. Lesions are initially light brown with a dark brown border, and later leaves become matted down and have a light tan appearance. A pinkish orange fungus can appear on the dead leaves.

Heaving is caused by shrinking and swelling of the soil during the winter that may force the crown out of the soil, leaving only a few roots in the soil. Affected plants may fail to green-up in the spring. Heaving is common in soils with high clay content.

Army cutworms and pale western cutworms can destroy wheat after spring green-up. The larvae feed aboveground or hide just under the soil surface, causing patches of brown plants within a field. These patches may expand over time as the army cutworms move outward and the larvae are often more abundant on the edges of affected areas. Pale western cutworm damage is often concentrated in spots where loose or windblown soil occurred in the fall, but the damage can be uniform within a field.

Soilborne mosaic virus, or **spindle streak mosaic virus** can cause yellowing of plants in low-lying areas during early spring. Wheat soilborne mosaic causes a mosaic pattern with green islands on a yellow background. Wheat spindle streak mosaic causes a mosaic pattern on leaves with short, spindle-shaped yellow streaks on a dark-green background. Both diseases cause stunting. Foliar symptoms of these viral diseases fade as the weather warms. Plants infected by soilborne mosaic often remain more stunted than those infected with spindle streak mosaic. Varieties have large differences in their reaction and this information can help confirm the diagnosis.

Sprayer contamination from glyphosate causes wheat to turn yellow, then reddish brown, and finally die. Feathered field patterns from spray boom clean out or priming, and greener wheat in wheel tracks are possible indicators of glyphosate contamination.

Iron chlorosis causes a yellow striping of wheat leaves. The leaf veins remain green longer than other areas of the leaf. Symptoms are most severe on newly emerging leaves. Calcareous soils with a high pH, or sidehills where soil erosion exposed the subsoil are prone to iron chlorosis.

Winter annual brome grasses have narrow, erect leaves with a clockwise twist, red stems, and "hairs" covering the leaf blades and sheaths. They usually emerge in the fall and mature about the same time as wheat. Cheat and Japanese brome often are taller than wheat, while downy brome is shorter. Downy brome has longer awns than other brome grasses. It also has a drooping seed head, and often has gray or purple colored stems. The leaves and sheaths of cheat are sparsely hairy, while those of Japanese brome and downy brome have a dense covering of hairs. The hairs of downy brome are shorter than those of Japanese brome.

Jointed goatgrass is a winter annual grass with a similar height and maturity as wheat. The heads of this grass shatter during wheat harvest, spreading seed within a field. The cylindrically shaped joints are about ½ inch long and may contain as many as four seeds.

Volunteer rye has longer kernels and heads than wheat, and usually is more bluish in color. Rye is generally taller and heads earlier than wheat.

Henbit emerges in the fall, has round cotyledons (¼ inch in diameter), square stems, and scallop-shaped leaves. Henbit is only a few inches tall and produces purple blossoms in March.

Bushy wallflower or **treacle mustard** emerges in the fall and forms rosettes with long narrow leaves and irregular leaf margins. Its rosettes bolt in the spring and bear bright yellow flowers. These plants are 1 to 1½ feet tall with long, narrow seedpods.

Tansy mustard and **flixweed** are two mustard species that emerge in the fall to form rosettes with finely lobed compound leaves. They bolt in the spring and produce yellow flowers. These plants are about 3 feet tall. Seed pods are narrow and ½ inch long (tansy mustard) to 1½ inch long (flixweed) and bear small, orange seeds.

Field pennycress is a winter annual weed that germinates and forms a rosette in the fall. Leaves are club-shaped and have a waxy surface. If bruised, the leaves have a garlicky odor. These plants bolt in the spring and bear white flowers near the top. Field pennycress is 1 to 2 feet tall with ½ inch diameter flattened seed pods. The small, brown seeds have a "thumb print" pattern on the side.

Blue mustard is a winter annual that germinates in the fall and produces a rosette similar in appearance to a dandelion. It bolts in the spring and bears purple or blue flowers at the top of the plant, which may grow from 1 to 1½ feet tall. Seed pods are narrow and 1 to 2 inches long.

Kochia is a summer annual weed that germinates in early spring. Kochia seedlings have long, narrow, "hairy" leaves attached directly to the stem. Leaves are linear and up to 2 inches long. These plants branch as they grow, producing a globe-shaped plant several feet tall. Plants break off at ground level in the fall and blow across the landscape as "tumbleweeds," spreading seed as they go.

Russian thistle has narrow needlelike leaves. Young seedlings emerge early in the spring and resemble a miniature pine tree. The plants branch as they grow, resulting in globe-shaped plant with sharp, spiny-tipped leaves. In the fall, Russian thistles spread their seed when they break off at ground level and are blown as "tumbleweeds" from field to field by the wind.

Wild buckwheat is an early-spring-germinating summer-annual weed. It has two crescent-shaped cotyledons, red stems, heart-shaped leaves, and an alternating leaf arrangement. It has small green flowers and black pyramid-shaped seed. Plants have a vining growth habit that causes them to wrap around wheat and may complicate harvest.

Field bindweed is a perennial plant that can grow from seed or established roots. Seedlings have kidney-shaped cotyledons, and arrowhead-shaped true leaves with alternating stem attachment. Field bindweed has a vining growth habit and produces white or pink flowers (1 inch in diameter). The seed has two flattened sides and one rounded side.

Greenbug infestations during early spring may cause yellowish spots in fields, and are usually worse in one corner of the field. Symptoms are more pronounced on the lower leaves. When severe, plants may be stunted or killed.

Wheat that is **nitrogen deficient** has a pale green color and reduced vigor. Symptoms of nitrogen deficiency appear first in older (lower) leaves, with yellowing starting at the tip and extending back along the midrib forming an inverted "V." Fertilizer spread patterns can help distinguish nitrogen deficiency from other problems. In grazed wheat fields that are nitrogen deficient, the added nitrogen supplied through the animals' urine results in spots with a darker green color and more vigorous growth.

Phosphorus deficiency results in a lack of vigor and poor tillering, and it can cause purpling of leaves. Fertilizer applied to previous crops can result in banded or striped field patterns. Leaf and soil analyses can help confirm the diagnosis and plan the following year's fertility program.

Aluminum toxicity occurs in low pH soils resulting in thin stands. The affected plants are less vigorous and have poorly developed root systems. Roots are often shorter than healthy roots and have brown, shriveled tips. A soil pH of less than 5.5 and KCl-extractable aluminum greater than 25 ppm increase the risk of damage to sensitive wheat varieties.

Nontreated

2,4-D applied at 2 leaf, nontreated behind

2,4-D applied to wheat seedlings can inhibit tillering and reduce plant vigor. 2,4-D should not be applied in the fall or until wheat is fully tillered in the spring.

Nontreated

2,4-D applied at 2 leaf

Liquid nitrogen fertilizer can cause leaf damage, resulting in a brownish cast in early spring. Symptoms are masked as new leaves develop, and generally have only minor consequences for yield during the early growth stages.

Freezing temperatures can cause leaf damage as wheat loses its cold hardiness and greens up in the spring. These symptoms have little or no effect on yields, although a more severe freeze can kill tillers.

Wireworms can cause death of individual tillers. Symptoms include a circular hole cut by the larva. Feeding often destroys the growing point as the insect tunnels within the stem. Wireworm larvae are hard-shelled, segmented, and yellow to orange. Their antennae are not readily visible, and the head area appears flattened.

Brown wheat mites are most noticeable during dry conditions. These mites feed on leaf surfaces, causing speckles resembling white pinpricks. Severe damage may cause leaf tips to turn brown. The dark-colored mites can be difficult to find because they drop to the ground when disturbed. Mite populations are greater in continuous wheat fields or where volunteer wheat was present. Their white eggs are often observed on the lower surface of soil clumps.

Winter grain mites are tiny, dark-bodied mites with red legs. Infestations cause wheat to have a silver-gray appearance, sometimes with stunting, rolled leaves, and death of leaves beginning at the tip. Good growing conditions or a hard rain dissipates mites.

Chinch bug feeding may stunt or kill plants. These bugs are most common in sparse wheat stands and in drier parts of the field. The black-and-silver-winged adults or reddish nymphs are often found on the soil surface around the base of affected plants.

Drought stress often becomes obvious around the jointing stages of growth. Affected plants may develop a blue discoloration and roll their leaves during the hottest part of the day. If the dry conditions persist, plants may abort lower leaves and tillers. Drought stress during jointing may reduce head size and yield potential.

Dicamba applications after wheat starts to joint causes tillers to grow prostrate and may result in head abnormalities and reduced grain yield.

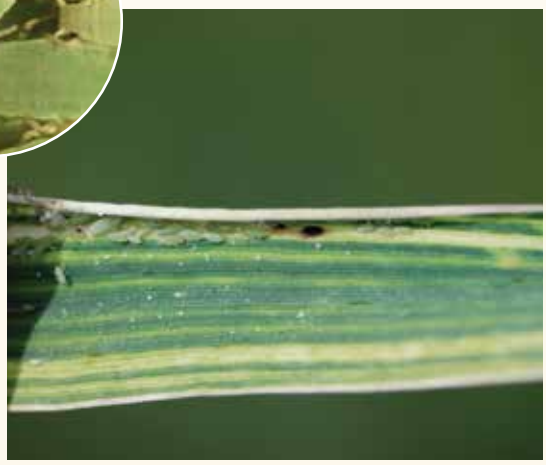
Wheat curl mites may spread wheat streak mosaic, High Plains mosaic, and Triticum mosaic viruses. They are white, very small, and have cigar-shaped bodies. Their feeding causes the edge of wheat leaves to roll inward, creating an ideal habitat for mites.

Wheat streak mosaic symptoms consist of long, yellow streaks that are concentrated at the leaf tips. As leaves become progressively more yellow with time, the leaf veins often remain green. Leaves may die at the tips and infected plants are often stunted. The disease is typically most severe close to volunteer wheat but fades with distance. Triticum mosaic virus and High Plains mosaic symptoms are similar to wheat streak mosaic but have a blotchier appearance. These diseases are frequently found together.

Barley yellow dwarf often occurs in patches within a field. The leaves of infected plants have yellow or purple tips, but the leaf bases tend to remain green. Plants infected as seedlings are often stunted. Several species of aphids including the greenbugs and bird cherry-oat aphids spread this viral disease.

Powdery mildew causes white lesions on the surface of wheat leaves that resemble tiny tufts of cotton. The small, black dots on the mildew lesions are reproductive structures that help the fungus survive the winter. On highly susceptible varieties, it can attack the heads and cause significant yield loss.

Russian wheat aphids cause a reddish discoloration and rolling of leaves. Infested leaves often have long, white streaks. The aphids are light green, with cigar-shaped bodies and no cornicles. Winged or wingless forms may be present within rolled leaves, boot, or on heads trapped within the rolled leaves.



Sulfur deficiency causes yellow and stunted wheat. The problem occurs in patches within fields, especially in areas with a history of soil erosion or low organic matter. Unlike nitrogen deficiency, where the lower leaves show firing and yellowing, sulfur deficiency is most visible on the upper leaves.

Soil pH above 8 can limit the availability of micronutrients and cause poor growth. The problem is more common where the topsoil was eroded, exposing the high pH, low organic matter subsoil. Zinc deficiency can result in yellow, stunted, and poorly tillered plants. Over time, adding manure can increase soil organic matter and decrease the incidence of micronutrient deficiencies.

Aluminum toxicity that damaged plants at the seedling stage can stunt growth throughout the growing season. The problem is most common in soils with a pH below 5 and greater than 25 ppm KCl-extractable aluminum. Liming the soil addresses this problem.

Trapped heads, missing florets, and **twisted awns** can be caused by application of 2,4-D, MCPA, dicamba, or picloram (Tordon) at the wrong growth stage. The safest time to apply 2,4-D, MCPA, or dicamba is when the wheat is fully tillered, but before jointing.

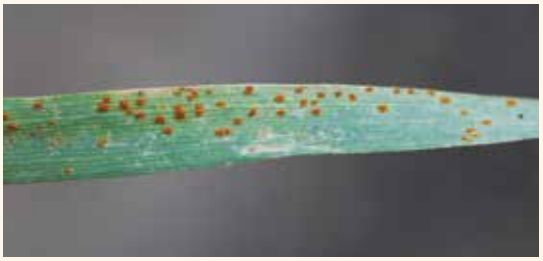
Bacterial leaf blight causes greenish-gray, water-soaked spots or large blotches that later dry and turn white. It occurs when several days of cool, rainy weather coincide with flag leaf emergence. Usually, symptoms are first seen on the flag leaf at boot stage. In severe cases, the entire leaf dies.

Hail can cause shredded leaves and broken stems. Damage can range from slight leaf damage to a total crop loss when stems are broken near the soil surface. Hail at the boot stage may cause the heads to become trapped in the boot resulting in misshaped heads. Hail may damage sections of the head or cause the entire head to turn white where the hailstones struck.

Freeze damage at the late boot and heading stages can cause white awns and sterilize sections of heads resulting in poor kernel set. Damaged florets often contain shriveled, whitish-brown anthers. The feathery, whitish stigmas will not open and become whitish brown and water soaked. Freeze damaged leaves often appear scorched and stems may develop brown, shriveled sections likely reflecting areas where ice formed within the stems.

Physiological leaf speckling is common in some wheat varieties. This disorder tends to appear after periods of warm, damp weather and may resemble early leaf disease symptoms. The symptoms of physiological leaf speckling are more uniformly distributed across the leaf surface than those caused by disease.

Leaf rust symptoms include small, orange blister-like lesions containing dusty, reddish-brown spores. Lesions may be aggregated in areas of a leaf or randomly scattered across the leaf blade. The lesions may have a yellow halo on varieties with intermediate levels of genetic resistance. Leaf rust does not normally infect heads and stems. Infections of the leaf sheath are rare.



Stripe rust causes tiny blister-like lesions and forms long stripes as the fungus grows inside the plant. Stripe rust produces dusty, yellowish-orange spores. As the lesions age, stripe rust produces dark-brown spores signaling that the fungus is becoming dormant. Stripe rust is most common on leaves, but heads may also become infected. Stems are not infected by stripe rust.

Chloride deficiency can cause leaf spotting that resembles disease. Symptoms appear uniformly and suddenly after flag leaf emergence, typically on soils low that have low chloride levels. Varieties differ in their reaction to chloride deficiency.

Loose smut is a seedborne disease that replaces the floral parts of the wheat head with brownish-black, powdery fungal spores. It is most noticeable soon after heading. The spores are easily removed by wind and rain, leaving behind the central stem of the head.

Excess water (flooding) may cause areas of a field to die prematurely. Plants that die early turn white and often have shriveled grain. The problem appears first in low-lying areas of a field, or terrace channels. In extreme situations, entire crops in fields with poorly drained soils may be lost.

Take-all root rot causes patches of wheat to die prematurely. Plants are often stunted and have severely damaged roots. The lower stems have a black, shiny appearance. The fungus survives in wheat residue and grassy field margins. Take-all is favored by high soil moisture.

Dryland root rot (Fusarium root rot) is often first noticed as patches of white heads. The stems of infected plants are dark brown at the base and have a pink discoloration of the lower nodes. Splitting the diseased stems may reveal a pinkish-white fungal growth. The disease occurs in low-rainfall areas and is favored by drought stress.

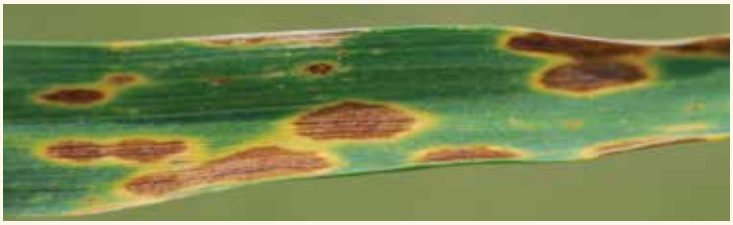
Sharp eyespot damages wheat stems and causes heads to turn white prematurely. Lower stems have lesions with light tan centers and dark brown margins with ends tapering to a point. This disease generally does not affect all the tillers on a plant and rarely causes significant yield loss.

Wheat stem maggots can cause individual, scattered white heads. The leaves of infested plants normally remain green, while the head and stem just below the head turn white. Damaged heads are easily removed from the leaf sheath by pulling on them, and stems show clear chewing damage at the base.

Cephalosporium stripe causes broad yellow stripes with brown leaf veins in the center. Stripes run the length of the leaf down into the leaf sheath and even into the stem nodes. This vascular disease causes stunting of tillers and can cause heads to turn white prematurely.

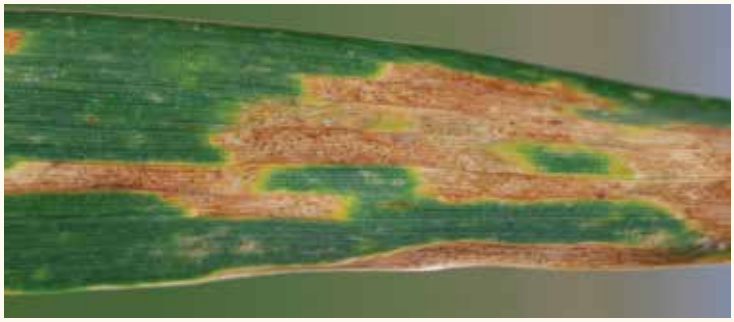
Spray drift from glyphosate at the heading growth stages causes wheat heads and peduncles to turn white. White and green heads can be intermixed due to differences in developmental stages when the damage occurred. The injury is generally most severe along field edges closest to adjacent applications.

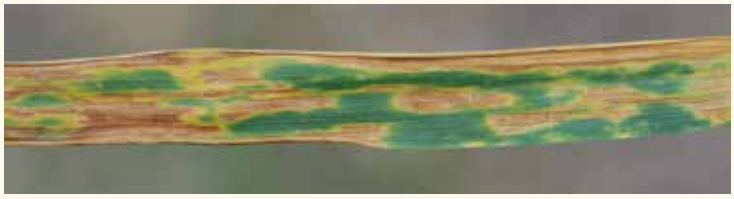
Tan spot often becomes established on the lower leaves during the jointing stages of growth but spreads to upper leaves during grain development. Symptoms include tan lesions with a small dark spot in the center and thin yellow border. The fungus survives in wheat residue, and the disease is most common in fields planted into residue of a previous wheat crop. The dark-colored reproductive structures may be visible in early spring.



Stagonospora blotch is similar to tan spot, but the lesions tend to be longer, more variable in shape, and a darker brown color. The lesions often have tiny, caramel-colored fungal structures that are difficult to see without magnification.

Septoria tritici blotch, also known as **speckled leaf blotch**, causes tan lesions that resemble tan spot or stagonospora blotch. The presence of black fungal structures easily seen without magnification, helps distinguish septoria tritici blotch from other diseases.





Bacterial streak causes tan or brown streaks with wavy, yellow margins. As the disease progresses, lesions merge to form large areas of dead tissue giving leaves a scorched appearance. The bacteria ooze out of the lesions when the leaves are wet, leaving a clear, flaky residue on the leaf surface.

Stem rust attacks leaves, leaf sheaths, stems, and heads of wheat. The blister-like lesions caused by stem rust are longer, more ragged, and darker brown than leaf rust. As pustules age, they turn black. Stem rust requires higher temperatures than the other rusts, so it is more common after heading.

Purple discoloration of chaff or stems is caused by accumulation of sugars in the plant. This generally occurs when a warm period of high photosynthetic activity is followed by low temperatures that slow crop growth. These excess sugars may accumulate at a particular level resulting in discoloration of leaf sheaths or portions of heads.

English grain aphids are relatively large, reddish-green aphids with long legs and cornicles, and visible antennae. They are often detected first on leaves but may feed on wheat heads where they can be found in large numbers between the spikelets. These aphids may produce a shiny honeydew on the head.

Wheat head armyworm feeds on developing heads and may damage kernels before hard dough stage of kernel development. These armyworms vary in color from green to tan and have light-colored stripes running the length of their bodies. Their bodies are slender and noticeably tapered toward the rear.

Basal glume rot is a bacterial disease that attacks wheat heads when rainy weather coincides with heading. Dark-brown lesions start at the base of the glumes and extend into the rachis. Often, only one spikelet or a small portion of the head is affected. Affected spikelets may die and turn white, but the discoloration at the base of the glumes remains visible.

Glume blotch symptoms start as small brown spots on the glumes or awns that expand to dark blotches. As lesions age, they become tan and contain very small caramel-colored fungal reproductive structures. This fungus also causes Stagonospora leaf blotch.

Black chaff is a bacterial disease that causes dark blotches on glumes and chaff. The symptoms are similar to glume blotch; however, heads infected with black chaff generally have dark lesions on the awns and stem just below the head. The bacteria also cause bacterial streak on leaves.

Growth regulator herbicide injury can cause pronounced twisting of stems and heads. The stems might turn red due to an accumulation of sugars. The heads may darken and become black as the plant matures. Deformed heads may be sterile especially if the herbicide was applied too late, at excessive rates, and if dry conditions prevail following application.

Melanization or dark-colored heads occur when environmental stress or disease disrupts the flow of sugars in the plant, causing dark pigments to accumulate in the glumes. The symptoms are more pronounced in bronze-chaff varieties and some genetic backgrounds. Melanization resembles black chaff or glume blotch.

True armyworms are often found in lodged wheat. They feed primarily on leaves and awns; however, they rarely cut wheat heads or damage the kernels. True armyworms can be yellow, green, or black, and have various-colored stripes. The armyworm's head is prominent and a shiny, light brown.

Lodging is often caused by wind and heavy rains after the heading stages of growth. Many factors influence lodging, including the variety's straw strength and height, excess nitrogen, and high seeding rate. **Hessian fly** also can cause lodging, with plants falling in random directions. Stems affected by Hessian fly often break over above the first or second node and have pupae, "flaxseeds," near the point of damage. **Wheat stem sawfly** larvae feed within wheat stems and cause lodging as they girdle stems. **Eyespot** (strawbreaker) can cause lodging with stems breaking just above the soil line. This disease causes dark, eye-shaped lesions on lower stems that later appear charred.

Premature ripening can cause some areas of the field to develop an off-white color and is often caused by soil moisture and/or temperature extremes. During periods of hot, dry weather, symptoms often appear first in areas with lighter or shallower soils. Heat stress may interfere with pollination, cause florets to gape and, in extreme cases, scorch the tip of heads. Symptoms caused by saturated soils tend to occur in lower areas and heavy soils causing entire plants to turn white prematurely. Areas of the field that mature early generally have shriveled grain and low test weights.

Scab, also called **Fusarium head blight**, causes large tan or white lesions that encompass one or more spikelets on a wheat head. In some cases, the entire head is diseased. Diseased spikelets may have masses of pinkish-orange fungal growth at their base. The Fusarium fungus survives on corn and wheat residues and forms small, black reproductive structures.

Sprouting may occur when harvest is delayed, and mature grain is exposed to frequent rainfall and heavy dew. Varieties differ in susceptibility to sprouting.

Sooty mold fungi are opportunistic colonists of dead plant material and invade mature wheat heads when wet weather delays harvest. Typical symptoms include a black or olive-green fungal growth on the surfaces of heads and awns.

Bunt is a type of smut that damages the grain but leaves other portions of the head unaffected. Bunted kernels are generally shorter and wider than healthy kernels, causing the florets to gape open before harvest. The diseased kernels may break open and shed black, powdery spores while still in the head. The bunt fungus produces a strong fishy odor that is often detected before the disease is actually seen.

Ergot is characterized by the presence of large (¼ to ½ inch long) purple-black fungal structures that replace the developing grain and protrude from the head. Ergot is most common on the margins of wheat fields where the fungus persists in many types of grassy weeds.

Seedborne diseases may reduce germination of wheat seed and spread disease to new locations. Seed lots damaged by **scab** contain kernels with a white, chalky appearance or a pink discoloration. Kernels infected by **black point** or **black tip** are characterized by a discoloration on the embryo end of the mature kernels. Seed lots contaminated with **bunt** contain kernels full of black, powdery spores of the bunt fungus. These bunted kernels produce a strong fishy odor and break open during handling contaminating healthy seed. The survival structures of **ergot** also may contaminate seed lots. These fungal structures are larger than wheat seed and have a solid white or gray interior.

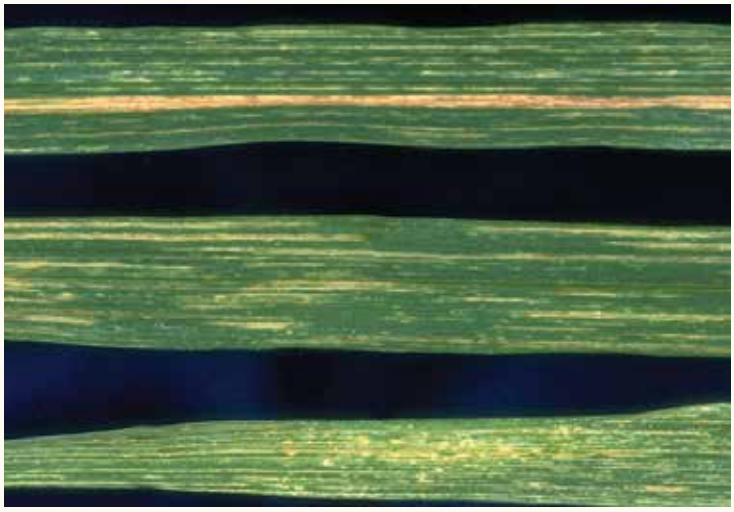
Volunteer wheat can harbor diseases and insect pests. Volunteer wheat often results from inefficiencies in grain harvest that leave seed behind in fields following grain harvest. Volunteer wheat is particularly problematic when hail or other storm damage cause shattering of the wheat heads before harvest. Abnormal amounts of viable seed may also follow outbreaks of scab when the shriveled, diseased kernels are separated from healthy grain during harvest. Volunteer wheat is most common in wheat stubble, but it also can occur as weeds in cover crops and other crops planted after wheat harvest.

Flea beetle feeding causes whitish streaks on the upper surfaces of leaves. If streaking is severe, the plants may die. Older injuries can be confused with wind damage or dry weather. Injury is often concentrated along one side of the field.

Clomazone (Command) carryover causes a chlorotic or bleached appearance in wheat. Plants often recover from early-season injury.

Banks grass mites are small, nearly transparent mites with brownish spots. Their feeding resembles yellow pinpricks that may merge to form yellow spots. Delicate webbing might occur on the underside of leaves. Severely damaged plants may die, resembling winterkill, with most severe damage adjacent to wheat stubble. The affected areas often enlarge during mild weather.

American wheat striate mosaic causes thin, white striations parallel to the leaf veins, most prominent on the leaf's underside. Symptoms resemble mite or thrip damage. The heads of infected plants may develop dark-brown stripes or blotches on some varieties. This viral disease is carried by leafhoppers and tends to be randomly scattered through the field.



Plants infected by **wheat yellow head** produce heads that are more slender than healthy heads and have a pale-yellow discoloration. This viral disease also causes a faint mosaic symptom primarily on the upper leaves.

Downy mildew may occur in low, wet areas of fields. Plants are stunted and have yellow, thickened, leathery leaves. Heads are often distorted, causing a symptom called "crazy-top," which may resemble herbicide injury.

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