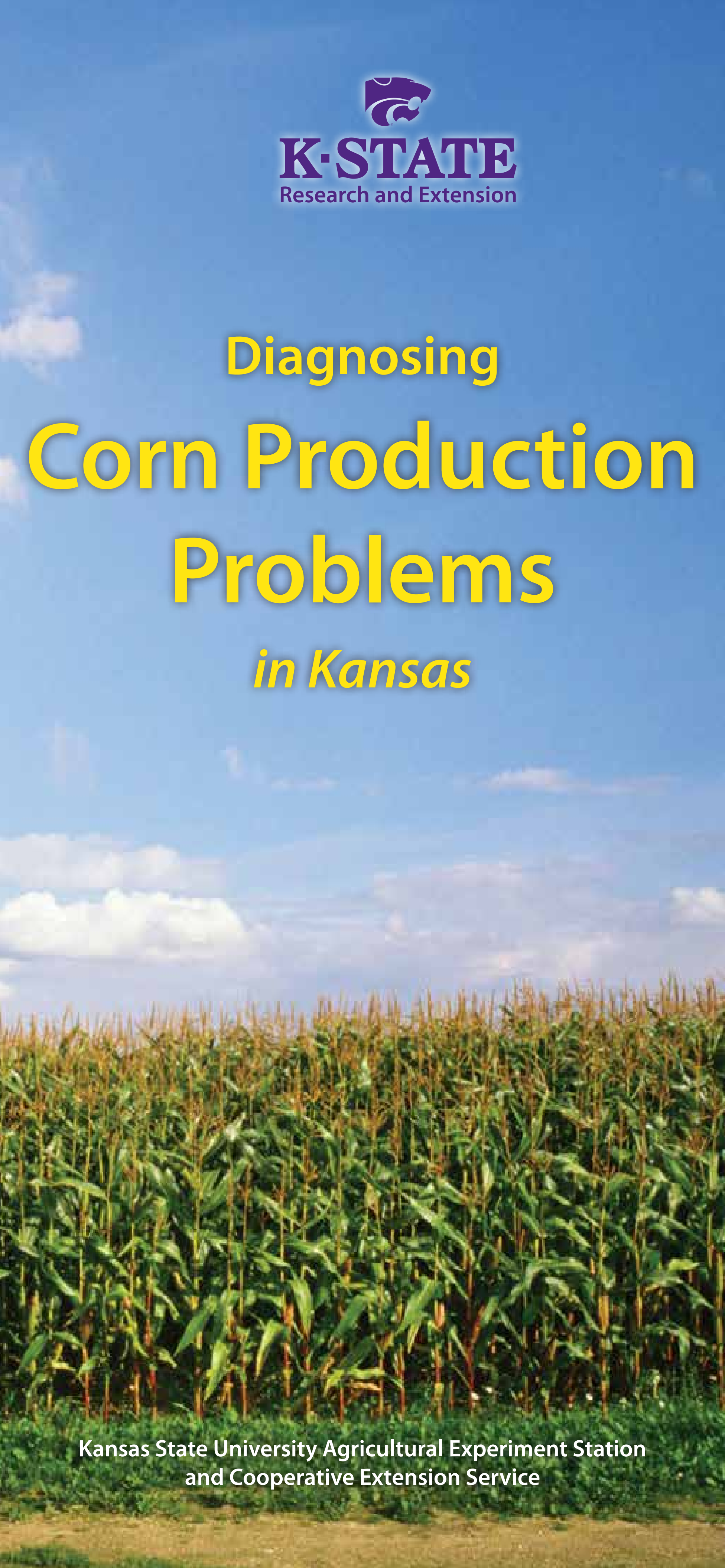


K·STATE
Research and Extension

Diagnosing Corn Production Problems *in Kansas*

Kansas State University Agricultural Experiment Station
and Cooperative Extension Service

Corn, like all crops, may suffer from a variety of insect, disease, nutritional, and environmental stresses. This publication will help in diagnosing likely causes of slow growth, distorted appearance, off-colors, injury, and death of corn plants from planting through harvest.

Contents

Careful inspection of plants, soil, and the general field situation is necessary when problem solving. To do the job right, some basic equipment, such as a short-handled shovel or spade, soil probe, knife, hand lens or magnifying glass, pencil, notebook, small bottles with and without vinegar, and an assortment of paper and plastic bags are recommended. A digital camera is useful to obtain pictures that can be sent to a diagnostician.

There are several ways to effectively use this guide. Here are a few suggestions:

- Scan images within the section corresponding with the growth stage of your corn plants.
- Scan for observed symptoms (italics) in the index, beginning on page 45, or within sections.
- Scan for suspected causes or conditions (bold) in the index, beginning on page 45, or within sections.
- Scan index beginning on page 45 for contributing conditions (normal text).
- Read entire description for each possibility to confirm diagnosis.

Problems from Planting to Six Leaves Fully Emerged

1

Fjell

Frequent field inspections are required during stand establishment. This requirement cannot be stressed enough because, in most instances, accurate diagnosis of problems is more likely if the fields are inspected when the symptoms are readily visible. Delayed inspections usually result in fewer correct diagnoses, in part, because fewer clues remain to guide the investigation.

2

Roozeboom

Poor seedling emergence is the first problem commonly encountered following planting. Take time to examine the evidence. Look for patterns. Is the stand uniformly poor? Are there *skips*? Are there stunted or dying plants? What are some of the causes that may lead to *poor stands*? Consider the overall pattern of injury along with the recent history of the field. Close examination of the situation helps to determine the actual cause or causes of *poor stands*.

Bold = Cause *Italic* = Symptom

3

A uniform pattern of *skips* in dry soil suggests a clogged, jammed, or broken planter. This photograph depicts a situation with **uneven seed depth** placement in dry soil. Dry soil does not encourage quick and even germination.

4

This field also has *skips*, with a hole in every spot where a seed was placed.

5

Notice the empty seed coat in the bottom of one hole. **Rodent damage** is suspected because soil is piled to one side of the hole. Look for *burrows* along field edges to help confirm the cause.

Bold = Cause *Italic* = Symptom

6

Davis

Several insects attack planted seed, destroying the germ or feeding on the germinating tissue. When cool temperatures delay germination, the risk of damage increases as the seed is exposed to a longer insect-feeding period. **Insecticide seed treatments** help to protect seed because they kill damage-causing insects on contact.

7

Roozeboom

Sometimes *poor stands* result when seedlings cannot push through the surface crust. Here the seed germinated, but the seedling was unable to emerge, resulting in a *malformed seedling*. Driving rains or planting in soil that is too wet can cause **crusting** problems.

8

When you notice that plants emerged in good shape but later die or look poor in isolated or widespread areas of the field, it is time to suspect *root damage*. The stand may be spotty, with some plants *wilting* and *lodging*. Frequently, there is no obvious aboveground injury. Use a shovel to dig up some plants. Look for insects in the plants' root zone. See insect in photo 9.

Bold = Cause *Italic* = Symptom

9

Davis

These hard-bodied, yellow-brown, wirelike insects are **wireworms**. *Wilting* is a result of wireworms *pruning roots* and burrowing in the base of the plant. Wireworms also will feed on germinating seed and are more frequently found where grassy vegetation has been torn up to plant corn.

10

Jardine

Yellowed, wilted plants in poorly drained or compacted areas of affected fields are sometimes observed. Typically, the stem tissue near ground level possesses *discolored, water-soaked areas*. Collectively, these symptoms indicate that **seedling blight** injury has occurred.

11

Race

This photograph shows a different type of insect damage. Small transparent areas on the leaves indicate where feeding has occurred. This *window pane feeding* caused by young **black cutworms** often is overlooked.

Bold = Cause *Italic* = Symptom

12

Sloderbeck

Older **cutworm** larvae *cut plants near the soil surface.* Damage may be frequent in some areas of the field and minimal in others.

13

Sloderbeck

Black cutworms feed at night and hide underground during the day. The mature larva (right) is plump, smooth, greasy looking, and dark gray.

14

Peterson

ALS inhibiting herbicide injury (e.g. Scepter or Pursuit) can cause *proliferation of secondary roots* resulting in a *bottle-brush* appearance as shown in this picture. Usually root function is impaired and shoots appear *stunted* and may show symptoms of *nutrient deficiency.*

Bold = Cause *Italic* = Symptom

15

Peterson

These plants are *stunted* and doing poorly where the Classic herbicide component in Canopy carried over from the preceding soybean crop. **Classic carryover** is greater in dry years and in high pH soils. In this instance, the high pH was caused by poor incorporation of lime.

16

Thompson

Callisto misapplied, using **methylated seed oil** when crop oil should have been used caused *temporary bleaching* of young corn. This corn recovered with no yield reduction.

17

Thompson

Maverick, a wheat herbicide, can carry over, resulting in *stunting, chlorosis, striping*, and sometimes *reddening*. Corn often does not recover from Maverick injury.

18

The *stunted and chlorotic (yellow) plants* in this field display **ALS inhibiting herbicide injury** from the soybean herbicide Pursuit applied before planting a susceptible corn hybrid. Clearfield corn hybrids are tolerant.

19

Thompson

Leaf burn can be caused from contact herbicides like **Aim** or **Resource,** especially when conditions are hot and humid. The injury generally is cosmetic and does not affect grain yield.

20

Sloderbeck

This is an adult **flea beetle**. Plants are more susceptible to injury when temperatures are low and seedling growth is slow. Plants often recover from flea beetle injury because the growing point remains below ground level until about the time that the fifth leaf emerges.

Bold = Cause   *Italic* = Symptom

21


Roozeboom

In diagnosing crop production problems, compare a stressed plant with a healthy plant whenever possible. Notice the plant on the left is *stunted* compared to the plant on the right. Plants also could be *wilted* or *lodged*. Often small areas within the field are affected. There are no aboveground indications of the cause, which means the problem may be originating underground.

22


Sloderbeck

Careful digging in the crop row where plants started *wilting* after emerging may reveal white C-shaped grubs *pruning the roots*. Another sign that **white grubs** may be present in high numbers is a number of plants excavated by rodents looking for these insects.

23


Roozeboom

The *leaves* on these corn plants first appeared *water soaked* and then turned *white* within a few days of **freezing temperatures**. Damage may be restricted to low-lying areas or may be fieldwide.

Bold = Cause *Italic* = Symptom

24


Roozeboom

A **late freeze** will kill leaves, but damaged plants often recover because the growing point is still underground. Survival may be determined by the favorability of postfreeze weather conditions. This plant will not recover because freezing temperatures penetrated the soil, which resulted in the *death of the growing point*.

25


Roozeboom

These plants are beginning to recover from less severe **frost damage**. Think about clues that would help separate these symptoms from anhydrous ammonia fertilizer. Wheel tracks from the applicator may still be present. Anhydrous ammonia tends to injure the roots, especially on the side of the row next to the knife, whereas freeze-damaged plants typically have healthy, intact roots.

26

Anhydrous ammonia damage occurs from high concentrations of free ammonia near or in contact with the seed. Potential damage is usually greater if corn is planted shortly after anhydrous application. Damage typically results in *uneven seeding emergence* and *slow growing plants*. In drier weather, seedlings may show *wilting* in part from damaged roots that limit water uptake.

Bold = Cause *Italic* = Symptom

27


Ruiz Diaz

Urea-containing fertilizers applied in contact with the seed can cause significant damage and *decrease seedling emergence*, affecting final plant population. Release of free ammonia from urea also can *slow root growth*. *Leaves that do not unroll* are a typical symptom caused by the presence of **biuret in urea-containing fertilizers**.

28

Nitrogen deficiency causes *pale green or yellowish discoloration* in the leaves. Nitrogen is a mobile nutrient in the plant and therefore symptoms appear in the older, lower leaves first. The yellowing appears on leaves starting from the tips and moving down the midrib. Cold or saturated conditions can favor the development of nitrogen deficiency early in the season.


Ruiz Diaz

29


Roozeboom

Soil on the leaves and caked *in the whorl* of the plant is a reliable indication that this portion of the field experienced high water caused by localized **flooding**. New leaves should not be affected if they can emerge normally.

Bold = Cause *Italic* = Symptom

30

Jardine

In some instances of flooding, the soil deposited in the whorl may contain soft-rotting bacteria that can cause the top of the plant to rot (**bacterial soft rot**). A rather *putrid odor* will be present, and the *whorl can easily be pulled out* of a plant infected with these soft-rotting bacteria.

31

Ruiz Diaz

This corn emerged to form a good stand, but there are *discolored leaves and/or stems*. The damage may be in isolated or widespread areas of the field. **Phosphorus deficiency** is typically visible in young plants with *reddish-purple leaf tips and margins on older leaves*.

32

Phosphorus deficiency can be caused by **poor soil phosphorus availability**, which is enhanced by cool, wet growing conditions. **Sunny days and cold nights** can also contribute to the development of coloration similar to phosphorus deficiency. In addition, some hybrids can naturally develop a *reddish-purple coloration* early in the season regardless of plant phosphorus status. A soil fertility test is one of the most definitive tools used to confirm this situation.

Ruiz Diaz

Bold = Cause *Italic* = Symptom

33

ALS inhibiting herbicide injury can result in *stunting* and *reddening* resembling phosphorus deficiency. ALS herbicide carryover increases with higher soil pH and lower rainfall. Symptoms may appear after the seedling stage when the root system is large enough to take up sufficient herbicide to cause injury.

34

Potassium deficiency is first seen as *yellowing and necrosis of the leaf margins*. Potassium is a mobile nutrient and tends to appear in the lower, older leaves first. Symptoms usually appear some time after emergence, close to the V5 to V6 growth stage. Cold and compacted soils can generate potassium deficiency due to poor root growth.

35

Early in the season, **anthracnose** may appear on the lower leaves of the plant. *Lesions* can be variable in shape but are usually *tan* in color with *red, reddish-brown, or yellow-orange borders*. Lesions can coalesce and *blight* the entire leaf.

Bold = Cause *Italic* = Symptom

36

Early in the season, extended periods of cold, wet weather can cause a chilling type of injury, also known as **cold weather crown stress**, to young plants (left and right plants in picture). The *crown tissue* will become *water-soaked* and *very dark* and the damage may extend up the plant for several nodes. Affected plants (left and right) typically are *stunted* compared to undamaged plants (center).

37

This plant exhibits symptoms that resemble nitrogen deficiency. The plant is *stunted* and has *yellow leaves*; however, yellowing is most pronounced in younger, rather than older, leaves. The culprit is **sulfur deficiency**.

38

Pale green to yellow seedlings may be an indication of **iron deficiency chlorosis**. Iron deficiency is most likely to occur in the western half of Kansas where erosion or leveling has exposed highly calcareous subsoil, low in organic matter. In-furrow application of iron fertilizer or manure applications are often the best options for managing iron deficient soils for corn production.

Bold = Cause *Italic* = Symptom

39


Ruiz Diaz

This situation looks like another nutrient deficiency problem. Notice the *whitish band on the side of the midrib* beginning at the base of the leaf and extending toward the tip. This characteristic indicates the problem is **zinc deficiency.** Internodes of the stalk are often shortened as a consequence of zinc deficiency, resulting in *stunting* of the plant. Zinc shortages are most prevalent in high pH and sandy soils and are often enhanced by erosion and cool, wet soils.

40


Peterson

Corn plants with *root damage (inhibited root growth)* can be caused by **Treflan, Prowl, or dinitroanalin herbicide carryover** or a misapplication of dinitroanalin. Often the symptoms resemble phosphorus deficiency, or, in dry weather, the plants will exhibit drought stress.

41


Roozeboom

The oldest leaves showing the worst damage and the youngest leaves showing no damage are clues that the cause of the *dried out, necrotic leaf tissue* likely happened several days before the picture was taken. The lack of leaf discoloration indicates that it is probably not a nutrient deficiency. The bare soil surface was susceptible to movement by strong winds occurring the week before, abrading exposed leaf tissue and causing the **windburn** evident here.

Bold = Cause *Italic* = Symptom

42

Early season lodging of scattered plants or sections of a field might be caused by **strong winds** combined with **wet soils**.

43

Digging up both lodged and standing plants revealed that the lodged plants had *limited root development*. Often referred to as **rootless** or **floppy corn**, the poor root development can have many causes. Erosion or compaction of the seedbed before the nodal roots become established may prevent the nodal roots from penetrating the hot, dry surface soil. Sidewall compaction or extremely shallow planting can elevate the crown with a similar result.

Problems from Six-Leaf Stage to Silking

44

Roozeboom

During this stage of development, corn plants are developing rapidly. Leaf area is being formed, the stalk is elongating, and tassel and ear development are started. A variety of problems may be encountered during this stage of corn development.

45

Wright

Chinch bugs tend to cluster near the base of the plant. Adults are tiny insects with a black body and white wings. Nymphs are red with a white stripe across the body and are wingless. Nymphs and adults feed by sucking juice from the stalk from somewhat above the soil surface to just below it. Plants in the first several rows along field margins are usually the first to exhibit *wilting* caused by chinch bug feeding.

Bold = Cause *Italic* = Symptom

46

The *dull, gray cast* shown by these plants instead of the normal deep green color and the upward and inward *rolling* of the upper *leaves* are typical symptoms of **drought stress**.

47

Twisted whorls and *wrinkled leaves* in V4 to V8 plants can have any of a number of causes. Some **pre-emergence herbicides** can cause these symptoms, especially with cool, wet weather soon after application. **Physical damage** from crushing or from burning caused by **post-emergence herbicides** can force new leaves to twist as they emerge from the whorl. Similar symptoms can be observed after an extended period of **cool, wet weather** with no obvious herbicide or physical damage explanation (situation in this picture).

48

This corn plant shows injury symptoms from **ALS grass herbicides** such as Basis, Resolve, Spirit, Accent, Beacon, Steadfast, Northstar, or others. The *chlorotic banding, crinkled leaves*, and *bending of new corn leaves* emerging from the whorl can occur when conditions are cold following an herbicide application or if herbicides are applied in conjunction with certain insecticides. Both situations affect the plant's ability to metabolize the herbicide.

Bold = Cause *Italic* = Symptom

49

Rapidly growing corn treated with some **ALS grass herbicides** may cause *slight stunting* (corn on the left) and *chlorosis*. Often plants recover without affecting grain yield.

50

Chlorotic banding across the leaves of grass weeds as well as corn can be caused from a **sublethal dose of ACC-ase inhibiting herbicides** (grass control only). Drift from herbicides such as Assure II, Select, Poast, Fusilade, and others will cause these symptoms.

51

Spray drift from application of soybean herbicides such as **ACC-ase inhibiting herbicides** can severely injure or kill corn. If the *whorl pulls easily from the plant* and has a *rotten base*, an ACC-ase inhibitor has killed the corn plant.

Bold = Cause *Italic* = Symptom

52


Thompson

These plants have *lodged*. **2,4-D** often causes temporary *stalk brittleness* in rapidly growing plants, making them susceptible to wind or cultivation damage. Plants broken off at the base have desiccated. Note broadleaf weeds are curled, twisted, and dead from 2,4-D application, another indication that 2,4-D is the cause of this problem rather than injury caused by corn rootworm larvae or some other factor.

53


Peterson

Brace roots may become *fused* and *twisted* after **exposure to 2,4-D**. This can be largely avoided by early cultivation to throw untreated soil into the corn row to cover the lower nodes before 2,4-D application.

54


Whitney

Plants with *shredded, bruised, and broken leaves, stems, and leaf midribs* are present everywhere. **Hail** and **high winds** have caused this fieldwide damage. Hail-damaged plants often have a deformed appearance. Damaged plants often recover from this injury if it occurs before the eight-leaf stage.

Bold = Cause   *Italic* = Symptom

55


Race

Stunted and excessively tillered plants, usually located near the edge of the field, are encountered occasionally. Insects killing the growing point can lead to the development of a condition known as *deadheart*.

56


Davis

Deadheart injury can be caused by **common stalk borer** (or simply **stalk borer**) feeding on the corn plant's growing point, but similar injury can be caused by any stalk-boring insect. Common stalk borer is easily recognized by the transverse purple band occurring near the legs.

57


Race

All the *leaf tissue* has been *removed* from these plants with the exception of the midrib. Feeding progressed upward, and damaged plants were most commonly found on the edge of the field. **Armyworms** moving in from drying, small grain fields or from lush, grassy areas may be to blame.

58

Severe leaf blade removal without affecting midribs is characteristic of armyworm feeding. The **armyworm** can be recognized by its greenish-black body with dark and orange-striped sides and a white stripe on its back.

59

One form of damage caused by **European corn borer** larvae appears as rows of *shotholes* when leaves unfurl. European corn borers chewing through developing leaves leads to this characteristic type of damage.

60

Gray leaf spot is a problem when susceptible hybrids are grown in continuously cropped, no-till fields. Symptoms start on the lowest leaves and move upward. *Lesions* are *tan to gray*, *narrow and rectangular,* and characteristically restricted by the veins with lengths ranging from ¼ to 2 inches. Lesions may coalesce and kill the entire leaf. The disease can progress up the plant until all leaves are killed. Heavily infected plants are more prone to stalk rot.

Bold = Cause *Italic* = Symptom

61

Plant growth is apparently normal, but the leaves have *bright yellow stripes* with smooth margins running along their length. Even though the plant looks like it is diseased, the cause is **genetic stripe**. Symptoms may appear only on one side of the plant, and only a few scattered plants with symptoms usually are found in any given field.

62

Local lesion mimics are caused by genetic mutations that result in the production of *spotting on the leaves* that can be easily confused with symptoms from true foliar pathogens. Environmental factors such as high light and high temperature often trigger the response. The pattern of spotting can be highly variable depending on which gene is defective.

Jardine

63

Ruiz Diaz

These plants with *stunted growth* and *pale yellow-green foliage* are growing next to rows of healthy green plants. Notice the pattern in the field. Fertilizer has not been applied to the area of the field in the foreground, and plants are suffering from **nitrogen deficiency**.

Bold = Cause *Italic* = Symptom

64

Ruiz Diaz

To confirm the diagnosis of **nitrogen deficiency**, take a close look at the lower leaves. The *V-shaped firing along the midrib* of this leaf is characteristic of plants lacking adequate access to nitrogen.

65

Leikam

Note the pattern of *firing*, starting from the tip of the leaf and progressing back toward the stalk. Severity of **nitrogen deficiency** symptoms decreases from left to right in this photo. All of these symptoms would not necessarily be found on the same plant, but are representative of the responses exhibited by plants growing in the same area of the field.

66

Sawyer

Yellowing of the foliage with *interveinal chlorosis* of the younger leaves can be a sign of **sulfur deficiency**. This deficiency is more likely in sandy soils with low organic matter. The problem can be avoided in responsive soils by adding appropriate amounts and forms of sulfur fertilizer.

Bold = Cause *Italic* = Symptom

67

The upper leaves on these plants are *pale green between the veins*. Corn is relatively tolerant to **iron deficiency**; however, under conditions of high soil pH and calcareous soils this can be a common nutrient deficiency. This can be confirmed with a soil test.

68

The older, lower leaves on these plants have *margins that are yellowing and dying*; however, younger leaves remain green, indicating **potassium deficiency**. Compacted soils contribute to this problem, and potassium deficiencies may appear even with optimum soil test potassium levels in some cases. The most common nutrient deficiency caused by compaction is potassium deficiency. The condition also can develop where there was a heavy demand for potassium by the previous crop, for example, alfalfa or silage. Regular soil tests and a fertility program can prevent this problem in the future.

69

Compacted soil can induce *stunting, abnormal root growth*, and nutrient deficiencies. Note the rows of stunted plants growing next to rows of normal plants. The pattern in this field suggests that the compaction occurred when harvesting the previous crop in wet soil conditions.

Bold = Cause *Italic* = Symptom

70

Shoup

Digging up affected plants reveals the **compaction layer**, often associated with a tillage pan.

71

Roozeboom

These stems have a *gooseneck* appearance. The plants apparently fell over earlier in the season and then recovered. This could have been caused by wind, possibly combined with brittleness of the stems following foliar applications of 2,4-D or dicamba-containing herbicides such as Banvel; or it could be caused by problems with the root system, so look below the soil surface to diagnose the cause of this problem.

72

Sloderbeck

Corn rootworm larvae can destroy most of a plant's root system, leading to *lodged plants* and *gooseneck* appearances. Affected *roots appear brown*, and *tunnels* occur in the larger roots.

73

Davis

Mature **rootworm larvae** are about ½ inch long, slender, and white, with a brown head capsule and plate at the rear, which make them appear to be "two-headed."

74

Sloderbeck

Several species of **rootworm** are found in Kansas. Adult leaf feeding results in scratches and small holes in the leaves. The bottom leaves on a plant may die if the infestation is severe. Compare the **western corn rootworm** adult (left) with the **southern corn rootworm** adult (right). The western corn rootworm is by far the most destructive rootworm species in Kansas. Rootworm adults also *feed on pollen and silks*.

75

Jackson

Stunted areas, particularly where soils are sandy, are often characteristic of a severe **nematode infestation**. The damage typically occurs in *oval to circular shaped patches* and symptoms can include *yellowing* and *severe stunting*. Soil testing can rule out nutrient deficiencies and the patterns are usually not typical of herbicide damage.

76

In comparing these two rows of corn, notice that the plants in the foreground are *severely stunted*. There is no aboveground indication that **nematodes** are causing these problems.

77

A bucket of water will help wash the soil from the *roots*. Notice their *stubby, stunted* appearance, which might be herbicide injury or a nutrient deficiency; however, the stubbiness is too *localized* on the root system to be herbicide injury. A soil test confirms **sting nematodes**, microscopic wormlike organisms living in soil and plant tissue. Less common nematodes cause similar aboveground symptoms on corn. Annual soil tests can help determine management strategies.

78

Corn plants in the rapid stem elongation phase in the two or three weeks just before silking are susceptible to **green snap**. High winds can cause the *stalk to break* completely in two just above one of the lower nodes. Hybrids differ in their susceptibility to this problem, but timing plays a large role as well. Once the plants tassel and silk, the stalks are much less brittle and do not snap as easily.

Problems from Silking to Physiological Maturity

79

Roozeboom

As corn approaches maturity and the kernels are filling, a number of problems can reduce potential yields. Correct diagnosis is still the key to selecting among available management strategies for the approach that will solve the problem.

80

Milliman

This problem is easy to diagnose, especially with knowledge of recent storms. The damage is fieldwide. The *bruised stalks, broken midribs, and shredded leaves* were caused by **hail** and **high winds**. Often, there are dark bruises on the husks and damage is more severe on one side of the plants.

Bold = Cause *Italic* = Symptom

81

When **hail** is severe, corn *ears* can be *damaged*. Hail damage also contributes to infection by stalk rots, ear molds, ear rots, and smut.

82

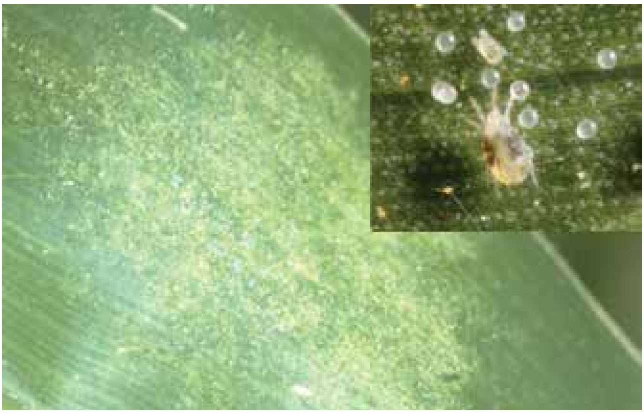
Large chunks of *tissue* have been *removed* from the margins of these leaves, giving them a *ragged appearance*. Hail is ruled out, because stems are not bruised, few midribs are broken, and damage is mostly confined to field margins. Insects such as **grasshoppers** should be suspected. Grasshoppers have been moving out of the weedy borders into this field to feed on corn plants. Grasshoppers also prune silks and feed on leaf sheaths.

83

These plants were *stripped of leaf tissue, except for midribs*. Damage began at the base of the plant and progressed upward. Feeding is most noticeable at field margins or where grass herbicide failed. Lush grasses attracted egg-laying adult **armyworms**. Larvae move to corn as the grass is consumed. The injury may be caused by large numbers of these worms.

Bold = Cause *Italic* = Symptom

84


Sloderbeck

This problem is almost always associated with hot, dry weather and is most common in western Kansas, with occasional fields in the north central area showing similar problems. Initially, the injury appears as *tiny yellow or white spots (flecking) on the upper leaf surface*. Look at the entire plant to determine if **spider mites** are involved. Look at the pattern of damage on this plant. Damage tends to be on the lower leaves and progresses up the plant, typical of spider mite infestations. Mite populations tend to be heaviest along the leaf midrib. The underside may have light webbing and hundreds of mites, which appear as tiny crawling specks under a hand lens.

85


Jardine

A frequently occurring midsummer disease on corn leaves is **common rust**. Common rust can occur anywhere in the canopy. *Lesions* are often *elongated*, with *dark cinnamon brown pustules* erupting through both the upper and lower surfaces of the leaf.

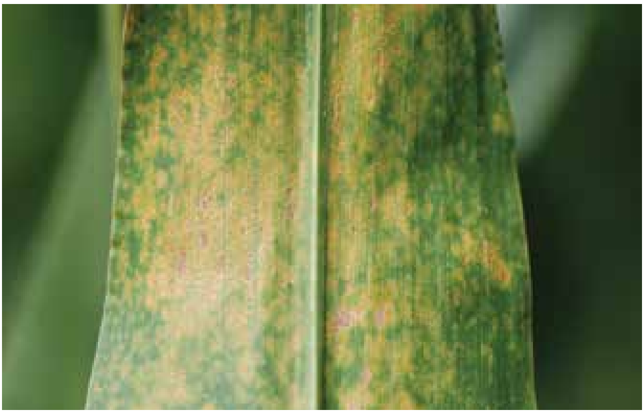
86


Jardine

Southern rust usually begins to appear in late July or early August in Kansas. *Lesions* are usually *smaller, more circular* and much more prolific than common rust. They are often *surrounded by a yellow halo*. While common rust does not limit yields under Kansas growing conditions, southern rust can result in significant yield losses when late planting of corn occurs in combination with warm, humid weather conditions in August.

Bold = Cause *Italic* = Symptom

87



Jardine

A characteristic of **southern rust** that can be used to identify it from common rust is that *lesions are generally confined to the upper leaf surface*, and do not normally erupt through the underside of the leaf.

88

Harveson

A reemerging problem in Kansas is **Goss's bacterial wilt**. The *leaf scorching* symptoms seen here can be easily confused with leaf scorch caused by the combination of high temperatures and high winds, or Stewart's wilt, another bacterial disease. Stewart's wilt is rarely seen in Kansas.

89

Goss's wilt most commonly occurs in fields that have been hail damaged. The hail creates microscopic wounds that allow the bacteria an entry point in to the plant. Lesions usually appear as *gray to light yellow stripes with wavy or irregular margins*. The characteristic symptom of Goss's wilt is the *dark green to black, water-soaked spots (freckles)* that appear *within the lesion*.

Harveson

Bold = Cause *Italic* = Symptom

90

Ruiz Diaz

Notice the *firing* of lower leaves, extending nearly to the ear on these plants. Closer examination reveals V-shaped *yellowing* along the midrib on the bottom leaves. The stalks are thin and spindly, and the ears appear pinched, with flinty kernels. These are all indicators of late-season **nitrogen deficiency**. At this point, it is too late for corrective nitrogen application.

91

Ruiz Diaz

These plants exhibit *interveinal striping* and are suffering from **magnesium deficiency**. *Older leaves may become reddish-purple and the edges and tips may become necrotic.* Magnesium deficiency can be caused by compacted soil, although sandy soils low in organic matter also may contribute to this problem.

92

Davis

Small, blue-green, soft-bodied insects may coat the tassel and upper portion of the plant. The plant also is covered with a *sticky substance*, and numerous *white cast skins* are seen on the plant and on the ground around the plant. The *leaves* appear *wilted, curl*, and show *yellow patches*. The distribution of affected plants in the field is spotty. Look closely for **corn leaf aphids** on plants with these symptoms. Note the prominent, dark blue "tail pipes" on the aphid. Aphid colonies release a sticky substance that may coat nearby plant parts. This *honeydew* sometimes takes on a blackened appearance as microorganisms use it as a food source.

Bold = Cause *Italic* = Symptom

93

Jardine

Symptoms of **crazy top downy mildew** include *rolling and twisting of the upper leaves* and a tassel or ear that resembles *a mass of leafy structures*. The plants were infected early in the growing season, when the soil was water-saturated for 24 to 48 hours.

94

bugwood.org

Common smut can occur in almost any field at any time, but is most common following hail damage or when weather conditions significantly inhibit pollination. *Galls encased by a silvery membrane* are most common on the ear, but can occur on any plant part. As the galls mature, they will rupture and spill out their *black powdery spores*.

95

Croissant

A second type of smut, **head smut**, is primarily found in the High Plains area of western Kansas. Here, the tassel has been replaced by a *smut sorus*. The sorus is initially covered by a thin membrane that eventually ruptures to release the typical *black, dusty spores*. All or only a part of the tassel may be affected.

Bold = Cause *Italic* = Symptom

96

Head smut infected plants that have a smutted tassel will have a *smutted ear.* Smutted ears do not have silks and the *cob and kernels are entirely replaced by the sorus*, which like the tassel sorus, will rupture to release the *powdery black spores*.

Jackson

97

Sloderbeck

When **corn earworms** *feed* on *kernels*, starting *near the tip*, they open the husks and provide an entry point for ear diseases and bird feeding. Larvae vary in color from brown to green to purple. The larvae have yellow lateral stripes and tiny spines on raised humps. Because larvae are cannibalistic, often just a few of them are left on an infested plant.

98

Sloderbeck

Other insects also can produce *insect-damaged ears.* For instance, **western bean cutworm** larvae enter ears through tips or *chew through husks*. Western bean cutworm feeds on kernels. Feeding on small ears can cause *ear deformation*, primarily in the western half of Kansas.

Bold = Cause *Italic* = Symptom

99

Thompson

Poorly filled ears can result from a number of causes, including high numbers of corn rootworm beetles feeding on the silks, excessive heat, dry weather, and off-label applications of some herbicides and fungicides and/or associated additives or adjuvants.

100

Sloderbeck

When insects, like this **western corn rootworm beetle**, feed on silks and clip them off, the result can be incomplete pollination. Grasshoppers and Japanese beetles also can clip silks. *Silk clipping* has to be severe to prevent or limit pollination.

101

Shroyer

Excessive heat during the pollination period caused *sterility* and *poor seed set* on these plants. **Hot, dry winds during pollination** can increase the severity of this problem.

Bold = Cause *Italic* = Symptom

102

Sbroyer

Drought stress can *slow silking and tasseling*, but silking often is slowed more than tasseling and pollen shed (anthesis). These plants have green silks, but the pollen has already shed, resulting in *limited pollination* and *poorly filled ears*. Modern hybrids are less susceptible to this condition than hybrids from 15 or 20 years ago because corn breeders have successfully selected for a shorter anthesis-silking interval (ASI).

103

Duncan

Ears sometimes become *malformed* after **misapplication of a herbicide**, in this case glyphosate and AMS (ammonium sulfate).

104

Thompson

Malformed ears from **late application of glyphosate** and **a growth regulator herbicide** can result in severe grain yield reduction.

Bold = Cause *Italic* = Symptom

105

Thompson

The *pinched* appearance of these *ears* resulted from an application of **ALS grass herbicide applied after the label-recommended stage**. During the normal growth and development of corn, the number of potential kernel rows doubles at the V9 stage, producing ears with even numbers of kernel rows. The off-label herbicide application disrupts this doubling, resulting in the symptom shown. Yields can be reduced.

106

Mock

Insect damage is noticeable inside the *stalk* with *tunnels* present at the breaking point of these *lodged stalks*. **European corn borer** larvae riddled and weakened the stalk with tunnels. Mature **European corn borer** larvae possess a dirty white body color and are covered with rows of slate-gray spots on the sides of the body. This caterpillar has a dark, mahogany-brown head. In addition to feeding in the stalk, larvae tunnel in ear shanks, causing the shanks to break and ears to drop to the ground.

107

Mueller

Zipper ears have parts of or entire rows of kernels missing, usually due to kernel abortion. The ear is often curved because kernels forming opposite the aborted kernels continue to fill and extend the axis of the ear while the aborted kernels do not. These symptoms are usually associated with some kind of **environmental stress** such as **severe drought** or **defoliation after pollination**. These ears were from plants known to be **nitrogen deficient**. In most cases, multiple factors likely interact to cause this type of deformed ear.

Bold = Cause *Italic* = Symptom

108

Southwestern corn borer larvae tunnel in stalks and *girdle* the bases, often causing severe *stalk lodging*. The larvae are white with black spots down the sides and an orange head capsule until September, when they lose the black spots.

109

These plants died prematurely and the stalks have *lodged* above the soil line. Closer inspection is needed to determine the cause.

110

When the stalk is split, the inner stalk shows symptoms of *advanced disintegration with only the vascular bundles remaining intact*. This is the common symptom of all stalk rots. If no other distinguishing characteristics are present (as seen in subsequent photographs), the most likely cause is **Fusarium stalk rot**.

Bold = Cause *Italic* = Symptom

111


Jardine

In hot, droughty years, the *interior of the stalk*, in addition to having the *shredded* appearance, may have a *black, dusty* look to it.

112


Jardine

A closer inspection reveals the presence of numerous *black fungal structures* known as *microsclerotia*. Their presence is the diagnostic symptom for **charcoal rot**.

113


Jardine

Sometimes a *shiny black color* is present on the *outer stalk*. This is characteristic of **anthracnose stalk rot.**

Bold = Cause *Italic* = Symptom

114


Belich

A *reddish discoloration* that occurs *inside the stalk* is diagnostic for **Gibberella stalk rot.**

115

The presence of *small, dark brown to black pimplelike structures* (pycnidia) embedded in the rind of the lower stem is indicative of **Diplodia stalk rot**.

116


Jardine

Various colored molds or fungi frequently grow on or between kernels. **Ear molds** often occur when there is too much rain at pollination time, drought during the grain fill period, insect damage to the ear, or consistently wet weather during the dry-down period. Some molds are more serious than others because of their ability to produce mycotoxins. The *greenish-yellow mold* on this ear indicates the presence of **Aspergillus**, the producer of aflatoxin.

Bold = Cause *Italic* = Symptom

117

Plants with *husks* that are *dry* while the rest of the plant remains green may be infected with **Diplodia ear rot**.

118

Removal of the husks and closer inspection of the ear reveals a *white mold* growing in the kernel channels starting at the base of the ear. In some cases, **Diplodia** can mummify the entire ear.

119

A *pink to reddish mold* that starts forming at the tip of the ear is symptomatic of **Gibberella ear rot**. Gibberella is capable of producing vomitoxin, also known as deoxynivalenol (DON).

Bold = Cause *Italic* = Symptom

120

Belich

Fusarium ear rot can produce a *whitish pink to lavender fungal growth* on kernels. As seen here, a *"starburst"* pattern is often present. Fusarium ear rot is associated with the presence of the mycotoxin fumonisin.

Bold = Cause *Italic* = Symptom

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Numbers in the index refer to page numbers, not picture numbers.
Italic text — Symptoms
Bold text — Cause / Condition
Normal text —Contributing Conditions

Bold = Cause; *Italic* = Symptom; Normal text = Contributing Conditions

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Bold = Cause; *Italic* = Symptom; Normal text = Contributing Conditions

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Bold = Cause; *Italic* = Symptom; Normal text = Contributing Conditions

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Bold = Cause; *Italic* = Symptom; Normal text = Contributing Conditions

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Yanel Belich, Nidera S.A. Argentina

R.L. Croissant, Bugwood.org

Holly Davis, Insect Diagnostician, Kansas State University

Stu Duncan, Northeast Area Extension Agronomist, Kansas State University

Dale Fjell, Northeast Area Extension Director, Kansas State University

Dell Gates, Entomologist, Kansas State University

Robert Harveson, Crop Specialist, University of Nebraska-Lincoln

Tamra Jackson, Corn and Sorghum Specialist, University of Nebraska-Lincoln

Doug Jardine, Plant Pathologist, Kansas State University

Dale Leikam, President, Fluid Fertilizer Foundation

Clint Milliman, Agriculture and Natural Resource Agent, Kansas State University

Don Mock, Entomologist, Kansas State University

Nathan Mueller, Assistant Professor/ Extension Agronomist, Department of Plant Science, South Dakota State University

Dallas Peterson, Weed Science Specialist, Kansas State University

Kraig Roozeboom, Crop Production/Cropping Systems Specialist, Kansas State University

S. Race

Greg Roth, Professor of Agronomy, The Pennsylvania State University

Dorivar Ruiz Diaz, Agronomist, Kansas State University

John Sawyer, Extension Soil Fertility Specialist and Professor in Agronomy, Iowa State University

Doug Shoup, Southeast Area Extension Agronomist, Kansas State University

Jim Shroyer, Crop Production Specialist, Kansas State University

Phil Sloderbeck, Southwest Area Extension Director, Kansas State University

Curtis Thompson, Weed Science Specialist, Kansas State University

Todd Whitney, Agriculture and Natural Resource Agent, Kansas State University

Bob Wright, Research and Extension Entomologist University of Nebraska

Authors

Kraig L. Roozeboom
Agronomist
Crop Production/Cropping Specialist

Dorivar Ruiz Diaz
Agronomist
Soil Fertility and
Nutrient Management Specialist

Douglas J. Jardine
Plant Pathologist

R. Jeff Whitworth
Entomologist

Curtis R. Thompson
Agronomist
Weed Specialist

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