Diagnosing

CORN PRODUCTION PROBLEMS

in Kansas

Kansas Corn Commission
Kansas State Board of Agriculture

Cooperative Extension Service
Kansas State University, Manhattan

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.

1

Careful inspection of plants, soil, and the general field situation is necessary in problem solving. To do the job right, you need some basic equipment, such as a short-handled shovel or spade, soil probe, pocket knife, razor blade, hand lens or magnifying glass, pencil, notebook, small bottles with and without alcohol, and an assortment of plastic bags.

Problems During Stage 1:

Planting to Three Leaves Fully Emerged

2

Frequent field inspections are required during the period of stand establishment. This requirement cannot be overstressed 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 positive answers, in part, because fewer clues remain to guide the investigation.

3

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 will help to determine the actual cause or causes of poor stands.

4

A uniform pattern of skips in dry soil suggests a clogged, jammed, or broken planter. This photograph depicts a situation where seed was placed at uneven depths in dry soil. Dry soil does not encourage quick and even germination.

5

This field has an uneven plant population, with a hole in every spot where a seed was placed.

6

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

7

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 feeding period by insects.

8

Seed corn beetles are small dark-brown insects often observed in the soil surrounding planted seed. Search around the area, moving clods, and look for these active beetles scurrying around in the area.

9

The seed corn maggot is another insect that attacks planted seed. Maggots or immature stages of this small fly can cause fieldwide problems. Frequently, several of the carrot-shaped maggots will be found feeding on each infested seed. Often, this problem occurs when the soil is high on supplemented organic matter. Problems in Kansas occur most often where large amounts of cattle or swine manure have been spread over the field or where alfalfa or brome has been turned under before the field was planted.

10

Seedlings sometimes become malformed when they cannot push through the soil surface crust. Here the seeds germinated, but the seedlings grew sideways and were unable to emerge. Driving rains or planting in too wet soil can cause crusting problems.

11

When you notice plants that emerged in good shape later die or are looking poorly 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 above-ground injury. It's time to use the shovel to dig up some plants. Look for insects in the plant's root zone. See enlargement of insect below.

12

These hard-bodied, yellow-brown, wire-like insects are wireworms. The 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 some type of grass vegetation has been torn up to plant corn.

13

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.

14

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

15

"Window feeding" is caused by small black cutworm larvae or related species. Older larvae cut plants near the soil surface. Damage may be heavy in some areas of the field and minimal in others. Cutworms feed at night and hide underground during the day. The mature larva is a plump, smooth, greasy-looking dark gray, spotted, or striped caterpillar.

16

These stunted plants were caused by the herbicide Scepter, carried over from the previous year's application to soybeans. There may be a pattern in the field where the herbicide application overlapped (was doubled) or where differences occur in soil moisture.

17

The bottle-brush appearance of these roots resulted from very severe Tri-Scept (trifluralin and Scepter) carryover.

18

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.

19

Plants in this field have a bleached and stunted appearance. Command herbicide was applied to the previous season's crop of soybeans and carryover effects are now quite evident.

20

The stunted and chlorotic (yellow) plants in this field were injured by Pursuit herbicide, applied before planting imidazolinnone-susceptible corn hybrids.

21

Early injury from flea beetles appears as scratches on the top leaf surface. Now the plant leaves are shriveled, gray and dead.

22

These plants were damaged by flea beetles. Plants are more susceptible to injury when temperatures were cold and seedling growth slow. Plants often are able to recover from flea beetle injury because the growing point remains below ground level until about the time that the fifth leaf emerges.

23

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

24

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

25

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

26

A late freeze will kill leaves. Plants damaged to this extent could recover because the growing point is still underground. Survival may be determined by the favorability of post-freeze weather condition.

27

Less severe frost damage is shown here. Think about clues that would help separate these symptoms from anhydrous ammonia fertilizer. Wheel tracks from the applicator may still be present. Anhydrous ammonia also 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.

28

The leaves on these plants have dead margins and are not fully expanded. Their roots appear sheared off or dried up. Also, note the tire tracks left next to the row by equipment recently passing through the field. This type of injury and the corresponding wheel tracks suggests fertilizer burn. Free ammonia, capable of producing this injury, is most likely to be present when side-dressing of fertilizer occurs under dry soil conditions. Plants often will recover from this type of injury.

29

Soil caked in the whorl of the plant is a reliable indication that this portion of the field experienced some high water caused by localized flooding.

30

The corn in this photograph 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 can cause seedling plants to discolor in this manner.

31

As stated in the previous explanation, stunted growth and purple leaves early in the growing season are symptoms of phosphorus deficiency. This condition can be caused by poor soil phosphorus availability, which is enhanced by cool, wet growing conditions. A soil fertility test is one of the most definitive tools used to confirm this situation.

32

Young corn plants with root damage (inhibited root growth) caused by Treflan herbicide carryover often show symptoms of phosphorus deficiency. Note the purple color of the stunted plant on the left.

33

Leaves on these plants are emerging abnormally, in a manner often described as onion-leafing. In this example, injury was caused by the herbicide Sutan. Realize, though, that similar symptoms can be induced by 2,4-D.

Problems During Stage 2:
Four-Leaf Stage to Silking

34

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

35

Plants are wilted and stressed. Problems are usually first noticeable in the 20 to 30 rows along the field margins, especially near fields of ripening grain. Chinch bugs, more typically thought of as problems for young sorghum, may cause corn plants to respond by wilting.

36

The small black bugs clustered near the base of the plant are chinch bugs. 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 on the stalk from somewhat above the soil surface to just below it.

37

The problem represented in this photograph is drought stress. Plants needing water appear dull. The upper leaves roll upward and inward.

38

This corn plant shows symptoms of Accent or Beacon injury. The plant is stunted because of poor internode elongation. Wrinkled leaves suggest disruption of cell elongation.

39

Corn leaf collars (where leaf wraps around stem) may be mildly chlorotic, perhaps caused by cool, wet weather following Accent or Beacon application. Weather conditions that reduce corn metabolism also lower the capability of the plant to withstand these herbicides.

40

Sometimes, weakened leaf whorls twist and bend over, especially in high winds in high winds. Cold weather, poor soil aeration, and interaction with certain soil insecticides all can contribute to reduced corn metabolism.

41

Accent and Beacon are foliar-applied herbicides that translocate to the growing points of the plant. This plant illustrates numerous symptoms, including poor internode elongation, chlorotic leaf collar, wrinkled leaves, and a distorted whorl.

42

Spray drift from application of soybean herbicides such as Assure, Fusilade, and Poast may severely injure corn. Check surroundings for sources of drift. Shattercane growing with the corn should die more quickly than the corn if Accent or Beacon caused the injury. Should shattercane and corn show similar symptoms, suspect Assure, Fusilade, or Poast injury.

43

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 will die. Noting that nearby broadleaf weeds are curling and twisting also helps diagnose 2,4-D as the cause of this problem rather than injury caused by corn rootworm larvae.

44

As lodged plants continue growth, they curve upward resulting in the goosenecking seen here. Note the righthand plant is slightly bent and the center plant shows more severe symptoms.

45

Another symptom of 2,4-D injury is the mild leaf rolling seen in plants on the right. Check soil moisture and symptoms on broadleaf weeds to distinguish between drought effects and 2,4-D damage.

46

Sometimes 2,4-D, Eradicane, Sutan, and even Lasso or Dual cause leaves to roll up tightly into a whip-like form.

47

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.

48

Occasionally, herbicides will inhibit root growth and limit the amount of phosphorus that plants can take up. This results in injury symptoms similar to phosphorus deficiency. This field was treated with Canopy herbicide last year when it was planted to soybeans, and now the corn is showing carryover symptoms.

49

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. Realize that damaged plants can fully recover from this injury if it occurs before the eight-leaf stage.

50

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 are to blame.

51

Severe leaf blade removal without affecting midribs is characteristic of heavy 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.

52

It looks as if an insect has been feeding in the whorl of this corn, creating a type of damage often referred to as ragworm injury. Corn earworms are a relatively common insect, capable of causing this injury. Many times, the worm will mature and leave before the damage is noticed.

53

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.

54

Older European corn borer larvae tunnel in midribs of leaves. Once weakened, the midrib often breaks at the injured point, allowing the tip of the leaf blade to drop, limiting its usefulness in gathering sunlight.

55

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 this condition, described as deadheart.

56

The deadheart injury in this example was 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.

69

The lower leaves on these plants have margins that are yellowing and dying, which indicates a soil fertility problem--potassium deficiency. Compacted soils contribute to this problem. The condition also can develop where there was a heavy demand for potassium by the previous crop, for example, alfalfa. Regular soil tests and a fertility program can prevent this problem in the future.

70

Compacted soil can induce stunting, abnormal root growth, and nutrient deficiencies. Note the row of stunted plants growing next to a row of normal plants.

71

These stems have a “gooseneck” appearance. The plants apparently fell over earlier in the season, then recovered as time passed. This could have been caused by wind, possibly combined with brittleness of the stems following foliar applications of 2,4-D or Banvel herbicides. 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

Believe it or not, the plants in this slide are the same age. In this instance, the severe stunting was caused by the Treflan carryover from the previous cropping season. Notice the uniformly short, club-shaped roots. Treflan interferes with cell division and elongation.

73

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.

74

This photograph shows a mature rootworm larva feeding on corn tissue. These insects are about one-half inch long, slender, and white, with a brown head capsule and plate at the rear, which make them appear to be “two-headed.”

75

Several species of rootworm are found in Kansas. This is a picture of an adult southern corn rootworm beetle feeding on a leaf. Adult feeding results in scratches and small holes. The bottom leaves on a plant may die if the infestation is severe.

76

Compare the southern corn rootworm adult with this picture of an adult western corn rootworm beetle. The western corn rootworm is by far the more common rootworm species in Kansas. Rootworm adults also feed on pollen and silks.

77

Plant growth across this sandy field is uneven and there are circular or elliptical patches of stunted, chlorotic plants. Nutrient deficiencies are ruled out through soil fertility testing, and the pattern is not consistent with herbicide misapplication or carryover. Nematode injury still remains a viable option.

78

In comparing these two rows of corn, you will notice that the plants in the foreground are severely stunted. There is no above-ground indication that nematodes are causing these problems.

79

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 a herbicide injury. A soil test confirms sting nematodes, microscopic worm-like organisms living in soil and plant tissue. Less common nematodes cause similar above-ground symptoms on corn. Annual soil tests through county agents will help determine management strategies.

80

Brace roots on this corn plant are short, fat, and stubby. They failed to develop properly after coming in contact with soil treated with a late post-emerge application of Treflan or Prowl. Note that the deeper roots (below the treated soil) are normal and only the shallowest of roots are affected.

81

As corn approaches maturity, grain is forming and 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 problems.

82

This problem is easy to diagnose. The damage is field-wide. Stalks are bruised and midribs are broken. There are dark bruises on the husks, and the leaves are shredded. Damage often is more severe on one side of the plants. This injury was caused by hail and high winds.

83

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

84

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.

85

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.

86

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 adults. Larvae move to corn as the grass in consumed. The injury is caused by large numbers of armyworm.

87

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, particularly Republic County, showing similar problems. Initially, the injury appears as tiny yellow or white spots on the upper leaf surface. Look at the entire plant to determine if spider mites are involved.

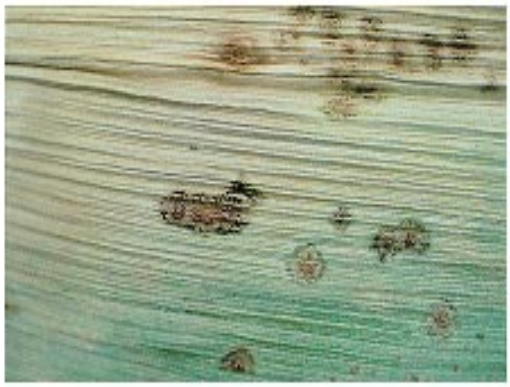
88

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 midribs. The underside may have light webbing and hundreds of mites, which appear as tiny crawling specks under a hand lens.

89

A variety of diseases cause discoloration of leaf tissue. Most corn growers recognize this disease as common rust. Above-ground portions of the plant have cinnamon brown blisters on them.

90



Southern rust symptoms are similar to those of common rust, except blisters appear on upper leaf surfaces only. Again, the blisters are full of a powdery material that will rub off on hands and clothes.

91

This disease affects the youngest leaves of a corn plant, with a mosaic pattern of light and dark green. This spotting develops into light green and yellow streaks along the leaf veins. These symptoms are characteristic of maize dwarf mosaic, which is caused by a virus. Symptoms are often difficult to discern, because frequently the mottling is not readily apparent. Infected plants may be slightly stunted, with ear set and ear size reduced.

92

Corn lethal necrosis is a disease resulting from the interaction of maize dwarf mosaic virus and maize chlorotic mottle virus. The symptoms are severe yellow mottling, followed by browning of leaves and early death of plants. Death begins at the tassel and progresses downward.

93

This soil fertility problem reflects nitrogen deficiency showing up late in the growing season. Note the V-shaped yellowing along the midrib on the bottom leaves. The stalks are thin and spindly, and the ears appear pinched, with flinty kernels. At this point, it's too late for corrective nitrogen application.

94

These stunted plants exhibit an interveinal striping and are suffering from magnesium deficiency.

95

Magnesium deficiency can be caused by compacted soil, although sandy soils low in organic matter may also contribute to these problems.

96

Small, blue-green, soft-bodied insects have coated the tassel and upper portion of this 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.

97

These insects are corn leaf aphids. Note the prominent, dark blue "tail pipes" on the aphid. White cast skins also are seen on the leaf. Upper leaves and tassels of corn plants may be densely colonized. 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.

98

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.

99

These tassels have galls covered by silvery membranes, enclosing a black and dusty interior. The disease is called smut and a trace of it usually is found in every field. Prevalence of smut is usually greatest after the field experiences hail damage or stress caused by wind-blown sand. Some hybrids are more susceptible than others.

100

Smut also can infect ears. It's the infected kernels that enlarge and form silvery galls.

101

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

102

Other insects also can produce insect-damaged ears. For instance, western bean cutworm larvae enter ears through tips or chew through husks.

103

Western bean cutworm feeds on kernels. Feeding on small ears can cause ear deformation.

104

Poorly filled ears can result from a number of reasons including high numbers of corn rootworm beetles feeding on the silks, excessive heat, and dry weather.

105

When insects, like these Northern corn rootworm beetles, feed on silks and clip them off, the result can be incomplete pollination. Grasshoppers can also clip silks. Silk clipping has to be severe, though, to prevent or limit pollination.

106

Excess 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.

107

Dry weather can slow silking and tasseling to the point of causing poorly filled ears. These plants have green silks, but the pollen has already shed, resulting in limited pollination.

108

Ears sometimes become malformed after misapplication of a herbicide--in this case Eradicane. The twisted and wrinkled leaves visible at the base of the ears indicate an unthrifty, sick plant.

109

Corn lethal necrosis-infected plants may not produce ears. If ears are produced, the seed is shriveled and the ears are severely rotted. Symptoms sometimes mimic damage caused by Eradicane.

110

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. This doubling may be inhibited when Accent or Beacon is applied late and can result in the “pinched” appearance to the ears of affected plants.

111

Most of the stalks in this photograph have lodge d or broken over in the middle. Note that some ears are lying on the ground. Closer examiniation of the stalks is required to narrow the list of causes.

112

Insect damage is noticeable inside the stalk with tunnels present at the breaking point. European corn borer larvae riddled and weakened the stalk with tunnels.

113

Mature European corn borer larva possess a dirty white body color and are covered with rows of slate-gray spots on the sides of the body. This caterpillar also 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.

114

In this lodging example, the stalks have lodged at the base of the plant. Splitting the stalk open will be necessary to confirm that the culprit is southwestern corn borer and not stalk rot. Fields with heavy infestations should be given an early harvest priority or they may become impossible to harvest.

115

Notice how this plant has been girdled. A major chamber inside the base of the plant has been excavated, leaving only a small zone of attachment to hold the plant intact. Splitting open the stalk reveals an extensive series of tunnels extending from the ear zone to the base of the plant.

116

Southwestern corn borer larvae have tunneled in stalks, girdling the bases. The larvae are white with black spots down the sides and an orange head capsule.

117

These stalks have lodged below the soil surface. Leaves are dull, and the lower internodes have softened. See the subsequent photograph and text for more information needed to confirm that stalk rot is indeed the cause.

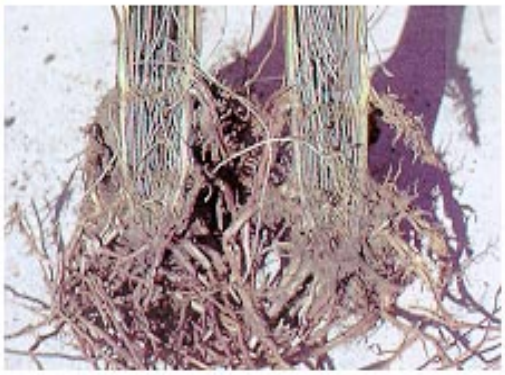
118

Dig up some plants and wash the soil from the roots. It should be evident that the roots are rotting and unable to support the plant, characteristics of root rot or stalk rot.

119

This is an example of stalk rot. The pink/red discoloration of pith indicates fusarium stalk rot. When the stalks are split, symptoms are more readily seen. The pit shreds or deteriorates and grain may ripen prematurely.

120



Notice the inside of this plant has a charred appearance from the numerous black fruiting bodies. Infected stalks shred and lodge.

121

This picture shows a close-up of the black fruiting bodies (sclerotia) of charcoal rot.

122

Various colored molds or fungi frequently grow on and between kernels. Some of these molds can produce toxins such as aflatoxin, which can cause entire loads of grain to be rejected. In the situation pictured, the grain is mature and rainfall has been above normal. Ear rots will be most prevalent following ear injury from hail or insects, or from cultural conditions such as the ear not ripening in a downward position.

123

With this publication, you have had an opportunity to view and diagnose several general types of problems that are associated with corn production. Your County Extension Agent can help you if you need additional information, a schedule of upcoming educational meetings and tours, or assistance in diagnosing troublesome problems.

You will find additional reference information on this topic in these Kansas State University publications:
Insect Management for Corn (for the current year), MF-810; *Corn Production Handbook,* C-560; and *Chemical Weed Control for Field Crops, Pastures, Rangeland, and Cropland* (for current year); and the *Kansas Agricultural Experiment Station Report of Progress.*

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