

# Crop Profile for Corn in Kansas

## General Production Information



- Kansas in 1998 was ranked the 8<sup>th</sup> in United States corn production (4.3% of the U. S. production. The cash value of corn (grain and silage) in 1997 was \$1.0 billion.
- The total production of corn for grain in Kansas in 1998 was 419.0 million bushels, up 13% from 1997 production of 37.1 million bushels.
- About 3.0 million acres of corn were planted during 1998, up 250,000 acres from 1997.
- Acres harvested for grain were 2.85 million, with a statewide average yield of 147 bushels per acre in 1998.
- Price of corn production for grain in 1997 was \$2.65 per bushel, and value of production was \$1.02 billion. Data for 1998 are unavailable at the time

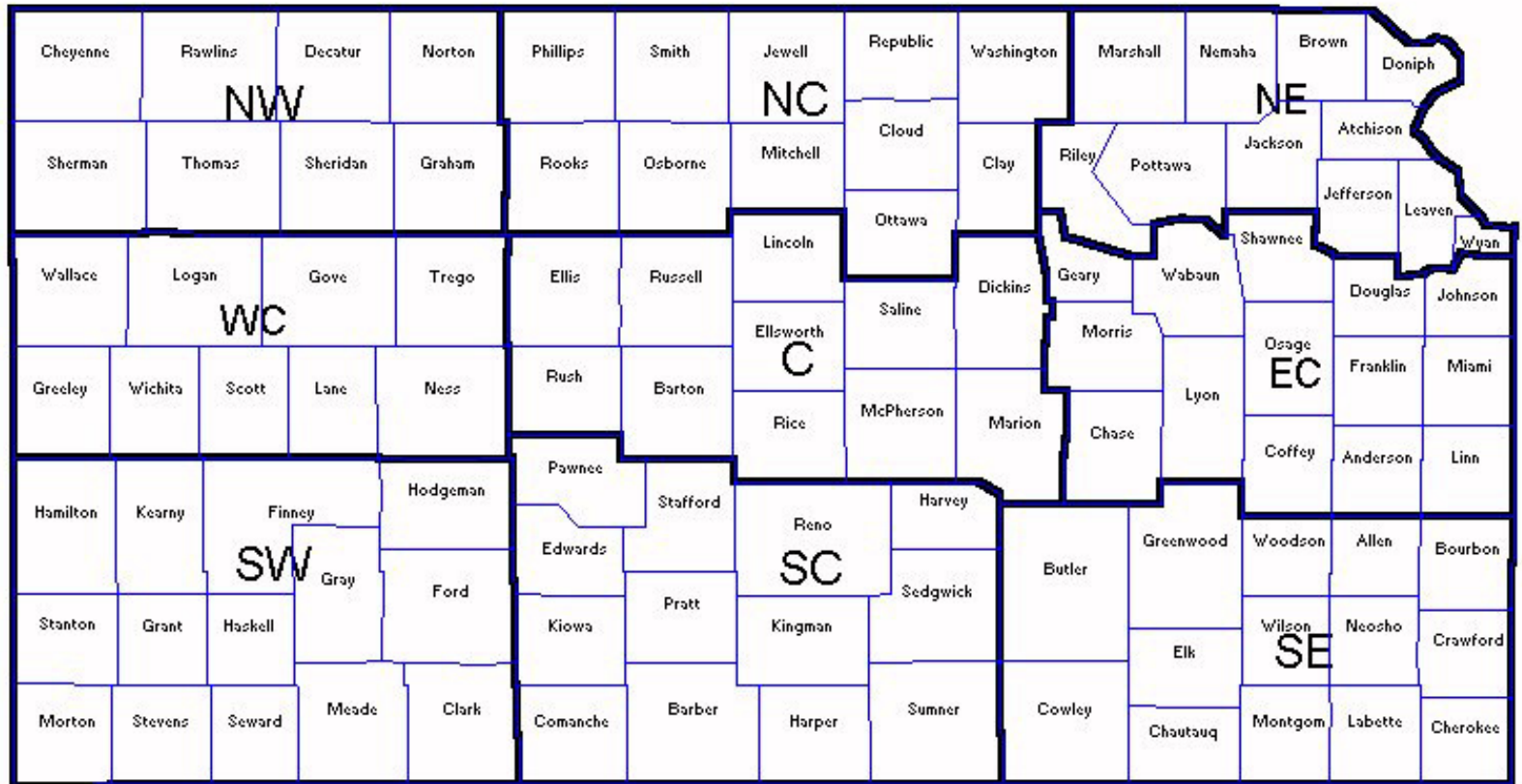
of preparing this report.

- Harvested acreage for corn silage was 120,000 in 1998 at 2.28 million tons and yield of 19 tons per acre.
- Harvested acreage and production for irrigated corn for grain in 1997 were 1.64 and 286.5 million bushels, respectively, with a yield of 175 bushels per acre.
- Harvested acreage and production for dryland corn for grain in 1997 was 1.1 and 99.6 million bushels, respectively, with a yield of 94 bushels per acre.

## Production Regions

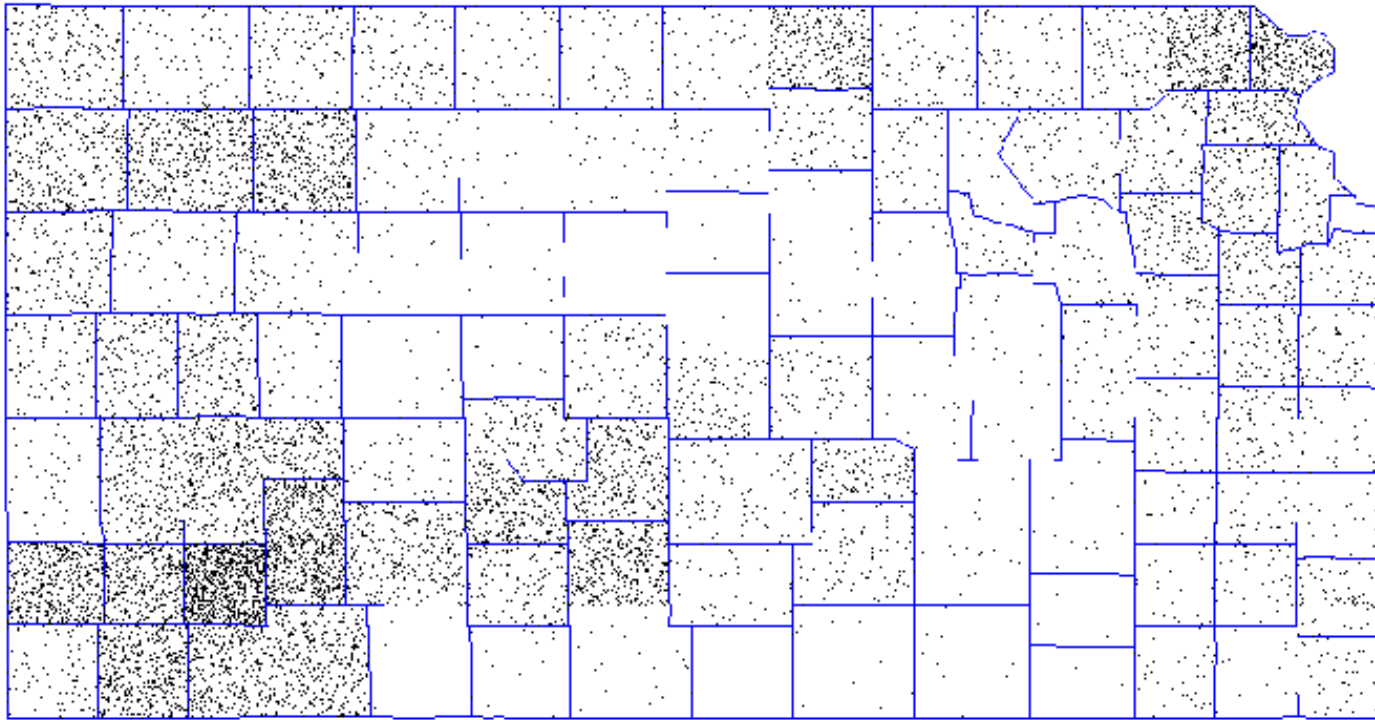
**Figure 1**

# AGRICULTURAL STATISTICS DISTRICTS



Corn Production in 1997

## Corn



Legend 1 dot = 15,000 bu.

### **Top three counties corn production in 1997:**

1. Haskell, 26.1 million bushels
2. Gray, 20.7 million bushels
3. Thomas, 18.1 million bushels

### **Major uses in Kansas:**

Yellow dent corn for feed grain production is the predominant type grown in Kansas, with some portion of yellow corn used for silage. Some white corn acreage is planted each year primarily for sale to industry for human food purpose, but can

be fed to livestock if supplemented with vitamin A. About 54 percent of the 8,017 acres of popcorn harvested in Kansas in 1997 were irrigated. Kansas had limited acreage of sweetcorn (568.5 acres) in 1994, which accounted for 13 percent of vegetable acres planted in Kansas.

## Cultural Practices

The state of Kansas is divided into nine districts as shown in Figure 1. Soil types vary within a district. In general, northwestern and most of the west is deep, dark gray-brown silt loams, except the southwest counties are silt and sandy loams, and brown loamy fine sands. A moderately deep, dark gray-brown silt loams, and gray clays dominate the central and north central districts of Kansas. Northeastern Kansas has very dark brown silt, clay and silty clay loams soils whereas, the southeastern part has shallow, very dark gray-brown silt, clay, and silty clay loam soils. Average rainfall ranges from about 21 inches in the northwest to over 38 inches in the southeast.

Corn planting dates range from late March in southeastern counties to mid-May in northwest Kansas. Corn is planted when soil temperature reaches 55 °F at 2-inch depth. Optimum planting populations for dryland corn in a wheat-corn-fallow rotation in northwestern Kansas is lower than dryland corn grown in northeastern Kansas. Most irrigated corn plant populations range from 24,000 to 30,000 plants/acre, if irrigation is limited, plant population range is from 16,000 to 25,000 plants/acre depending on soil type and amount of water available.

Corns produced for grain under irrigation represented 60.4 percent of the total harvested corn acreage in 1997, with 72.4 percent of the irrigated acres in the western region of the state. Irrigated corn production was the most dominant cultural practice in the southwest district. In comparison, total non-irrigated corn acreage in eastern Kansas was 571,000 or 55.4 percent of the states non-irrigated harvested corn acreage. Non-irrigated corn production was the most dominant cultural practice in the northeast district. Irrigated corn requires 24 to 30 inches of water use for full season hybrids grown in Kansas.

A number of different tillage and planting systems are used in corn production, including primary and/or secondary tillage, or no preplant tillage operations. Conservation tillage includes reduced till, mulch-till, ecofallow, strip-till, ridge-till, zero-till, and no-till. In Kansas, about 30 percent of the harvested corn acres will have less than 15 percent ground cover. Forty six percent of the corn acres are in reduced tillage, no-tillage or ridge-till, leaving more than 30 percent ground cover at all times. Corn can be successfully grown in conservation tillage system if rotated with other crops such as wheat and soybeans, which will reduce some of the problems encountered with conservation tillage.

## Insect Pests

Total insecticides usage in 1996 on 48 percent of the corn acres statewide was 567,000 million lb. Thirty-nine percent of the corn acres in Kansas were treated via aerial broadcast applications. Data are insufficient to report on the percent of corn acres treated using other methods. Bifenthrin was the most frequently used insecticide, applied to 22 percent of the State's acres with the average application rate of 0.06 lb a.i./A, totaling 32,400 pounds. Some insecticides were applied as broadcast without incorporation, broadcast with incorporation, in-furrow, via irrigation, injected/knifed, banded, foliar/direct, or spot treatments (insufficient data to publish). Forty-five percent of the corn acres were treated with insecticides after planting, 13 percent of corn acres had insecticides applied from 3 days before planting to 3 days after planting.

Insecticide and miticide classes are indicated as follows:

1. **Organophosphates**
2. **Biologicals**
3. **Carbamates**
4. **Organochlorines**
5. **Pyrethroids**
6. **Other**

The following are major classified insecticides and miticides used during 1996 on Kansas corn acres.

Data are reported from the Kansas Agricultural Chemical usage/corn pesticide summary publication (MF-2326), in response to the target pest list survey provided by the Kansas Agricultural Statistics (KAS) and National Agricultural Statistics Service (NASS) to the Kansas producers. An expanded explanation of product usage is provided after the KAS/NASS data summary:

### Bifenthrin

- o **Trade name and formulation:** (5) Capture®\* 2EC
- o **Average use rate:** 0.06 lb a.i./A
- o **Number of applications:** 1.0
- o **Percent acres treated:** 22%
- o **Amount applied per year:** 32,400 lb
- o **Target pests:** Moths and caterpillars.

However, Bifenthrin is mostly used to control European and southwestern corn borers and spider mites and to suppress the egg laying of western corn rootworm beetles. For more details, see the sections on spider mites and corn borers in Insect Management for Field Corn in 1999 publication (MF-810) of the Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

## Methyl parathion

- **Trade name and formulation:** (1) Penncap-M®\*
- **Average use rate:** 0.42 Ib a.i./A
- **Number of applications:** 1.0
- **Percent acres treated:** 10%
- **Amount applied per year:** 103,300 Ib
- **Target pests:** Beetles, weevils, wireworms.

Most Methyl Parathion is used to control corn rootworm adult in Kansas corn fields. For more details, see the corn rootworm section in Insect Management for Field Corn in 1999 publication (MF-810) of the Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

## Terbufos

- **Trade name and formulation:** (1) Counter®\*
- **Average use rate:** 1.08 Ib a.i./A
- **Number of applications:** 1.0
- **Percent acres treated:** 8%
- **Amount applied per year:** 223,300 Ib
- **Target pests:** Beetles, weevils, wireworms.

Most Terbufos is used to control corn rootworm larvae, however it can also be used to suppress wireworms, white grubs, and nematodes. For more details, see the corn rootworm section in Insect Management for Field Corn in 1999 publication (MF-810) of the Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

## Tefluthrin

- **Trade name and formulation:** (5) Force®\*
- **Average use rate:** 0.12 Ib a.i./A
- **Number of applications:** 1.0
- **Percent acres treated:** 6%
- **Amount applied per year:** 18,000 Ib
- **Target pests:** Beetles, weevils, wireworms.

Tefluthrin is mainly used to control rootworm larvae, however it may also be useful in controlling cutworm larvae and wireworms in Kansas corn fields. For more details, see the corn rootworm section in Insect Management for Field Corn in 1999 publication (MF-810) of the Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

## Lambda-cyhalothrin

- **Trade name and formulation:** (5) Warrior®\* T (in corn)
- **Average use rate:** 0.03 lb a.i./A
- **Number of applications:** 1.0
- **Percent acres treated:** 5%
- **Amount applied per year:** 3,900 lb
- **Target pests:** Moths and caterpillars.

Lambda-cyhalothrin is most often used as a corn borer insecticide, however it could also be used to control corn rootworm adults and cutworm larvae. For more details, see the corn borer section in Insect Management for Field Corn in 1999 publication (MF-810) of the Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

(3) Furadan\* was used by some corn growers, however reported data were insufficient to publish.

### **Major insects and the recommended insecticides (classified) and miticides for Kansas corn:**

#### **Soil Insect Problems (seed-destroying or root pruning):**

**Corn Rootworm Larvae (Western and Northern species)** (*Diabrotica virgifera* and *Diabrotica longicornis*, respectively) damage is seldom ever a problem in Kansas if corn is rotated with another crop on an annual basis. Adult corn rootworm beetles lay eggs in cornfields from late summer through early fall. The larvae feed on the roots of corn (field corn, popcorn, or sweet corn). By rotating corn annually, the expense of planting-time corn rootworm insecticides can be avoided. In areas that produce continuous corn planting-time insecticides against corn rootworm larvae or aerially applied products directed against egg-laying adults have been used. Not all continuous corn fields need to be treated every year. In some instances, the potential for damage is low enough that treatment is not necessary. In particular, corn rootworm adult scouting techniques have proven very useful in establishing when summer/fall egg laying was inadequate for damaging rootworm larvae populations to develop during the next growing season. Northern rootworm adults are about ¼ inch long and have a uniform pale green to yellow coloration. Western corn rootworm adults are about the same size as northerns or are slightly larger. Westerns are generally yellow with a black stripe running around the margin of each wing cover. The wing covers of southern corn rootworms have 11 black spots on a yellow-green background. Northerns are rare in most parts of Kansas. Although southern corn rootworms adults are commonly seen in corn fields, their eggs do not seem to overwinter in Kansas, hence damage from larvae is uncommon. However, significant problems are caused by western corn rootworms in many Kansas continuous cornfields. Larvae tunnel into and feed on corn roots causing significant lodging, reducing plant ability to take up nutrients and water, which collectively reduces grain yield. Plants may lodge, which may interfere with harvesting.

#### **Insecticides treatments:**

(Soil-applied insecticides for larvae in continuous corn production fields)

- (1 & 5) Aztec® \* 2.1%G @ 6.7 oz. per 1,000 ft. of row
- (1)Counter® \* 15G @ 8 oz. per 1,000 ft. of row
- (1) Counter® \* 20CR @ 6 oz. per 1,000 ft. of row
- (5) Force® \* 1.5G @ 8-10 oz. per 1,000 ft. of row
- (5) Force® \* 3G @ 4-5 oz. per 1,000 ft. of row
- (1) Fortress® \* 2.5G @ 6 oz. per 1,000 ft. of row
- (1) Fortress® \* 5G @ 3 oz. per 1,000 ft. of row
- (1) Lorsban™ \* 15G @ 8 oz. per 1,000 ft. of row
- (1) Phorate 20G\*/Thimet® \* 20G @ 6 oz. per 1,000 ft. of row
- (6) Regent® \* 4SC @ 0.24 fl. oz. per 1,000 ft. of row
- (1) Thimet® \* 15G @ 8 oz. per 1,000 ft. of row

**Corn Rootworm Adult** damage that prevents pollination by early silk clipping can occur in corn fields across Kansas. Foliar sprays can be used to minimize this form of damage if there are 8-10 beetles per plant and 10% of the silks are beginning to show.

#### **Insecticide treatments:**

- (5) Ambush® \*, Pounce® \* 3.2 EC\* @ 0.1 to 0.2 Ib a.i./A
- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 Ib a.i./A
- (1) Ethyl parathion\* @ 0.25 to 0.375 Ib a.i./A
- (1) Lorsban™ \* 4E-SG @ 0.5 to 1 Ib a.i./A
- (1) Malathion\* @ 1 Ib a.i./A
- (1) Methyl Parathion\* @ 0.25 Ib a.i./A
- (3) Sevin® @ 1 Ib a.i. /A
- (5) Warrior® \* T @ 0.02 to 0.03 Ib a.i./A

#### **Other practices for insect treatments:**

Adult control of corn rootworm can be employed to suppress egg laying below levels that cause economic damage by the larvae next summer if the field is scouted regularly. Fields should be scouted weekly from first beetle emergence through termination of egg laying by counting beetles, either through whole plant or ear zone counts. If beetle counts reach or exceed 1 (using the whole plant count) or 0.6 (using the ear zone count) beetle per plant and 10% of the females are swollen with eggs, a spray application of an adult control product should be made immediately. If beetle numbers return to an average of 0.3 per ear zone after spraying, immediate treatment is necessary to limit egg laying. Research in Kansas is being conducted to evaluate efficacy of Slam, a mixture of tiny concentrations of the insecticide carbaryl with a feeding stimulant/motion arrestant (cucurbitacean). Cucurbitacean keeps rootworm adults that encounter and feed on the mixture interested long enough for a lethal dose of insecticide to be ingested.

## **(6) Transgenic Corn**

As of this writing, none of the commercially available corn hybrids have genetically engineered resistance to corn rootworm larval or adult feeding. However, experimental lines with what appears to be impressive levels of transgenic rootworm-resistance have been announced and more information should become available during 1999.

**Chinch Bug** (*Blissus leucopterus*) adults are black with whitish wings. Overall body length is less than 1/8 inch. Immature bugs are reddish to blackish with a white band across the middle of the back. Bugs with no functional wings migrate on the soil surface from small grain fields that mature and dry down adjacent to corn fields. Bugs congregate in large numbers near the plant bases and withdraw plant juices. Stressed plants might die from prolonged feeding. Planting corn into standing small grain stubble may be very risky if large numbers of bugs were present in the previous crop.

### **Insecticide treatments:**

#### **Planting-time:**

- (3) Furadan®\* 4F @ 1 Ib a.i. per 13,000 linear ft. in 7-20 gal of water per acre.

#### **Post-emergence:**

- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 Ib a.i./A
- (3) Furadan® \* 4F @ 0.5 Ib a.i./A
- (1) Lorsban™ \* 4E @ 0.5 to 1 Ib a.i./A
- (3) Sevin® @ 1.5 to 2 Ib a.i./A
- (5) Warrior® \* T @ 0.03 Ib a.i./A

**Black Cutworm** [*Agrotis ipsilon* (Hufnagel)] damage is restricted to cornfields within the first two weeks after emergence. Spots in the field with transparent or notched leaves may indicate small cutworm larvae are present. Large cutworm larvae cause the plant to wilt, and damage to the growing point reduces plant stands. Preplant or planting-time treatments for cutworms are usually only used when severe perennial problems occur. Cutworm problems are more serious in eastern Kansas. Fields should be scouted frequently from the start of plant emergence until the corn is 6-8 inches high. Post-emergence treatments are almost always preferred over preventative treatments in Kansas because of the uncertain nature of the infestations. Insecticides will usually provide acceptable control of smaller larvae if environmental conditions are favorable for their action. The alternative is to wait at least two weeks to give the worms a chance to mature and pupate, then replant where necessary.

### **Insecticide treatments:**

#### **Planting Time:**

- (1) Lorsban™ \* 4E (*preplant*) @ 1-2 Ib per 10 gal water per acre ( broadcast spray )
- (5) Pounce® \* 1.5G @ 0.1-0.2 Ib a.i./A ( *preplant* ) from 5 days before planting up to crop emergence (broadcast spray )

- (5) Force® \* 1.5G @ 8 oz per 1,000 ft of row ( *planting-time* )
- (5) Pounce® \* 1.5G @ 8-16 oz per 1,000 of row ( *planting-time* )
- (5) Pounce® \* 3.2 EC, (5) Ambush® \* @ 0.1 to 0.2 Ib a.i./A ( *pre-emergence* )(between 5 days before planting and emergence of the crop (broadcast spray))

#### **Post-emergence:**

- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 Ib a.i./A
- (1) Lorsban™ \* 4E @ 1-1.5 Ib a.i./A
- (5) Pounce® \* 3.2 EC, (5) Ambush® \* @ 0.1 to 0.2 Ib a.i./A
- (5) Warrior® \* T @ 0.015 to 0.025 Ib a.i./A

**Maize Billbug** (*Sphenophorus maidis*) damage occurs early in the season in the lowlands near creeks. The adults billbugs destroy the growing point in the stalks just below or above the soil surface. The larva tunnels into the lower stem and roots. Injury has been rare in recent years, usually associated with nutsedge infested areas.

#### **Insecticide treatments:**

- (1) Counter® \* 15G @ 8 oz or Counter 20CR \* @ 6 oz per 1,000 ft of row

**Seed Corn Beetle** (*Agonoderus lecontei*) and **Seed Corn Maggot** (*Hylemya platura*). Seed corn beetles are about 1/3 inch long. Their overall coloration is dark brown with a light-brown to tan border stripes on the wing covers. Gaps in the crop stand may result from destruction of seed germ or completely hollowed seed. The seed corn maggot is a slender, pale yellowish-white larva. Full-grown maggots are legless, tapering and about ¼ inch long. Feeding maggots damage the seed so that establishment of the plant is not successful. Non-use of planting-time insecticides increases the opportunity for damage from seed-attacking insects. Seed treatments should be used where planting-time soil insecticides are not used and planting occurs before June 2 in southeastern Kansas, June 4 in south central Kansas, June 5 in southeast Kansas, June 7 in southwest Kansas, and June 12 in northwest Kansas.

#### **Insecticide treatments:**

- Special formulations of Lindane, Diazinon and Lorsban 50 SL are labeled as direct seed treatments for suppressing one or more of these pests. Some products combine Lindane, Diazinon and a fungicide in the same seed treatment (Agrox D-L Plus, Germate Plus and others).

**Southern Corn Leaf Beetle.** This insect had not been known to damage corn in Kansas for more than 80 years. However, the 3/16-1/5 inch long beetle destroyed large areas within isolated northeastern Kansas corn fields during 1997 and 1998.

In 1999, this beetle was observed in northeastern and north central Kansas. Adults are drab in color, grayish to brownish, and may be covered with soil particles. Feeding damage reduces plants to fragments and the cause of the injury can be easily mistaken as cutworms. Healthy stands can disappear in a few days if large numbers of beetles descend on a field. Experiments are underway to provide the efficacy data needed to expand labels of insecticides found to be effective against this insect. Recently, the Warrior label has been expanded. Warrior should provide suppression of southern corn leaf beetle adults when applied as a foliar spray.

**Wireworms** (*Elateridae*) are hard-shelled, smooth, cylindrical, yellowish worms. They eat into the germinating seed or burrow into the underground part of the stem. Two to six years may be required for some species to complete their life cycle. Damage in row crop fields generally is highest during the first or second year after a sod or forage was last grown.

**Insecticide treatments:**

Planting-time applications of the following insecticides give some suppression of wireworms:

- (1 & 5) Aztec® \* 2.1%G @ 6.7 oz per 1,000 row feet
- (1) Counter® \* 15G @ 8 oz, or 20CR @ 6 oz per 1,000 row feet
- (5) Force® \* 1.5G @ 8 oz or 3G @ 4-5 oz per 1,000 row feet
- (1) Fortress® \* 2.5G @ 6 or 5G @ 3 oz per 1,000 row feet (SmartBox)
- (1) Phorate 20G\*/Thimet® \* 20G @ 6 oz or Thimet® \* 15G @ 8 oz per 1,000 row feet

Better degree of control will be realized where (3) Furadan, Force 1.5G, Counter, Fortress 2.5G, Aztec are applied in-furrow rather than as over-the-row bands.

**White Grubs** (*Scarabaeidae*) are white, C-shaped worms with three pairs of legs, a tan to brown head, and a dark, subsurface zone near the rear of the body. White grubs may cause concern in the same rotations where wireworms are found. Planting time insecticides may give some reduction in grub numbers.

**Insecticide treatments:**

- (1 & 5) Aztec® \* 2.1%G @ 6.7 oz per 1,000 row feet
- (1) Lorsban™ \* @ 8 oz per 1,000 row feet
- (1) Counter® \* 15G @ 8 oz, or 20CR @ 6 oz per 1,000 row feet
- (1) Fortress® \* 2.5G@ 6 or 5G @ 3 oz per 1,000 row feet (SmartBox)
- (1) Phorate 20G\*/Thimet® \* 20G @ 6 oz or Thimet® \* 15G @ 8 oz per 1,000 row feet

Better degree of control will be realized with in-furrow rather than as over-the-row bands.

## **Post Emergence Insect Problems (leaf chewing, stalk boring, sap feeding, or silk feeding):**

**Armyworms** (*Pseudaletia unipuncta*) larvae are between 1 ½ and 2 inches in length. The head capsules have honeycomb-like markings and the body lacks hairs. Adults deposit their eggs where grassy growth is very lush, often in low lying areas on wheat or pasture ground. The larvae consume the grasses or they dry down (wheat matures) and the larvae move to corn to survive. Problems from this insect are expected to increase as more reduced tillage is practiced. Later season damage is caused when the larvae remove all the leaf tissue except the midrib and work their way up the plant, defoliating as they go. If larvae are less than 1 ¼ inch long, treatment should be applied when larvae are present on 30% of the plants with 5-6 extended leaves or when one larva per plant is present on 75% of the plants.

### **Insecticide treatments:**

- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 lb a.i./A
- (3) Lannate® \* @ 0.225 to 0.45 lb a.i./A
- (1) PennCap-M® \* @ 2-3 pt/A
- (5) Pounce® \* 3.2 EC, (5) Ambush® \* @ 0.1 to 0.2 lb a.i./A
- (3) Sevin® @ 1.5 to 2 lb a.i./A

**Fall Armyworm** (*Spodoptera frugiperda*) damage occurs at midsummer. Larvae cut large holes in whorl-stage leaves. Later, large holes may be cut in the stalks at the nodes. Treatments should be applied to silking stage corn if small larvae are detected before they have tunneled into the shanks and ears.

### **Insecticide treatments:**

- (3) Lannate® \* @ 0.45 lb a.i./A
- (1) Lorsban™ \* 4E @ 0.5 to 1 lb a.i./A

**Corn Earworm** (*Heliothis zea*) infestation during the silking period results in damage to the tip of the ear. Early planted corn often escapes heavy infestations. Although a majority of ears may contain an earworm, the use of insecticides to control ear damage is impractical in field corn. The rapid growth of silks provides unprotected areas for moths to land and lay eggs. Even if the field was sprayed recently, newly hatched larvae would be able to penetrate into the tip of the ear beneath the husk without contacting insecticides unless sprays were applied every 2-3 days.

**Corn Flea Beetles** (*Halticinae*) are very small, shiny jumping beetles that strip the upper surface from seedling corn leaves. More injury is likely to occur on two- to four- leaf stage corn when cool temperatures slow corn growth.

Carefully assess the amount of injury before applying control methods. Frequently, satisfactory results can be obtained by spot treatment or border treatment. Favorable growing conditions would eliminate or reduce the effect of this insect if the growing point has not been killed. Treatments are seldom needed unless four to five or more beetles per plant are found on two-leaf corn plants.

**Insecticide treatments:**

- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 Ib a.i./A
- (1) Lorsban™ \* 4E @ 1 to 1.5 Ib a.i./A
- (1) PennCap-M® \* @ 0.5 to 0.75 Ib a.i./A
- (5) Pounce® \* 3.2 EC, (5) Ambush\* @ 0.1 to 0.2 Ib a.i./A
- (3) Sevin® @ 1.5 Ib a.i./A
- (5) Warrior® \* T @ 0.02 to 0.03 Ib a.i./A

**Corn Leaf Aphid** (*Rhopalosiphum maidis*) infestations occur in midsummer. Aphids may feed inside the leaf sheath then congregate in the whorls and on tassels, producing large amounts of sticky material. Chemical control is rarely recommended unless plants are under severe stress from other factors.

**European Corn Borer (ECB)** (*Ostrinia nubilalis*)

**First generation:**

Control is suggested in fields where 50% of the plants are found to be infested with an average of at least one larva per plant. Insecticide treatments must be applied early in the period of infestation while the small larvae are exposed and confined to the whorl area. Applications after larvae enter the stalk will not provide control.

**Insecticide treatments:**

- (1) Lorsban™ \* 15G @ 1 Ib a.i./A
- (5) Pounce® \* 1.5G @ 0.1 to 0.2 Ib a.i./A
- (5) Pounce® \* 3.2 EC, Ambush\* @ 0.15 to 0.2 Ib a.i./A
- (5) Warrior® \* T @ 0.02 to 0.03 Ib a.i./A

**Other treatments:**

- (2) *Bacillus thuringiensis* (several trade names): see individual labels for rates

**Second generation:**

In Kansas there is greater need to control second generation ECB than first generation. Most eggs of second generation

borer are laid on silking stage corn during the July to August moth flight. Intensive scouting is necessary to determine the optimal time for application. More than one application often will be required to provide adequate suppression. Yield loss can result from various factors including physiological damage caused by larval tunneling, harvest losses represented by lodged stalks and ear droppage, and direct kernel feeding. Bottlenecks to compensation appear to occur when the damage affects leaf collar, leaf sheath, and ear shank locations. Treatment should be applied where fields have an average of 10 to 20 egg masses (both hatched and unhatched) per 100 plants.

#### **Insecticide treatments:**

- (5) Asana® \* XL (0.66) @ 0.04 to 0.05 Ib a.i./A
- (5) Capture® \* 2EC @ 0.08 to 0.1 Ib a.i./A
- (3) Furadan® \* 4F @ 1 Ib a.i./A
- (5) Pounce® \* 1.5G @ 0.1 to 0.2 Ib a.i./A
- (5) Pounce® \* 3.2EC (5) Ambush\* @ 0.1 to 0.2 Ib a.i./A
- (5) Warrior® \* T@ 0.02 to 0.03 Ib a.i./A

Chemigation may be used to apply several products: see individual labels as whether product can be chemigated and rates.

#### **The following products produce better results when applied via insectigation:**

- (2) *Bacillus thuringiensis* (various products): see labels for application
- (1) Lorsban™ \* 4E @ 1 Ib a.i./A
- (1) PennCap-M® \* @ 0.5 to 1.0 Ib a.i./A

#### **Biological control:**

U.S. researchers are experimenting with releasing hundreds of thousands of tiny (2) *Trichogramma* wasps which attack ECB egg masses. Results have been mixed to date.

#### **Other approaches to corn borer control:**

(6) **Transgenic corn** is a genetically engineered corn plant that contains an insect suppressing gene adapted from a naturally occurring soil bacterium, *Bacillus thuringiensis* (Bt). Plants possessing this gene produce an internal toxic protein that kills certain species of insects after they have fed on the plant. Several companies are marketing Bt corn hybrids. Some Bt corn hybrids are extremely effective, providing almost complete protection against European and southwestern corn borers. Resistance management strategies are believed to be essential to delay or prevent loss of this control option. Approximately, 25% of the corn acreage is currently (1999) being protected with Bt corn.

**Grasshopper** (*Acrididae*) damage can occur all summer long. Applying sprays before these insects move into the field greatly reduces the area that must be sprayed and lessens the amount of insecticide applied per land unit area.

#### **Insecticide treatments:**

- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 Ib a.i./A
- (1) Dimethoate @ 0.5 Ib a.i./A

- (3) Furadan® \* 4F\* @ 0.125 to 0.25 Ib a.i./A
- (1) Lorsban™ \* 4E @ 0.25 to 0.5 Ib a.i./A
- (1) Malathion @ 1 Ib a.i./A
- (1) Malathion ULV @ 0.6 Ib a.i./A
- (1) Parathion\* @ 0.5 Ib a.i./A
- (1) PennCap-M® \* @ 0.25 to 0.75 Ib a.i./A
- (3) Sevin® @ 1 to 1.5 Ib a.i./A
- (5) Warrior® \*T @ 0.02 to 0.03 Ib a.i./A

**Southwestern Corn Borer** (*Diatraea grandiosella*) first generation infestations are caused by dark-spotted white caterpillars that feed for 5 to 10 days on leaf tissue in the plant whorl, then move downward as they tunnel within the stalk. Such tunneling can extend far enough to kill the growing point of small plants (dead heart). Dead heart injury usually does not develop on plants greater than 30 inches in height. First generation infestations have generally been light in most fields in Kansas during recent years. The second generation is the most damaging infestation and occurs in August. Adult moths lay eggs on leaves, primarily in the ear region. Newly hatched larvae begin feeding on leaves, but prefer to feed on ear shoots, husks, and silks. Within 10 to 12 days or less, this generation begins tunneling within the stalk, generally below the ear zone. This insect overwinters successfully only in the sandyland region in south central and extreme southwest Kansas.

#### **Cultural practices:**

- Harvest before girdling begins.
- Fall tillage to break up root stubble and expose borers to natural enemies and winter hardships.
- Deep and clean plowing of corn stubble to a depth of 5 or more inches will bury larvae and prevent a high percent of moth emergence the following spring. However, this practice is usually incompatible with soil erosion management strategies.
- Early planted corn is less susceptible to lodging than late-planted corn.

#### **Insecticide treatments:**

- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 Ib a.i./A
- (5) Capture® \* 2EC @ 0.08 to 0.1 Ib a.i./A
- (3) Furadan® \* 4F @ 1 Ib a.i./A
- (5) Pounce® \* 3.2 EC, (5) Ambush\* @ 0.1 to 0.2 Ib a.i./A
- (5) Warrior® \*T @ 0.02 to 0.03 Ib a.i./A

#### **Other treatments:**

- (6) **Transgenic corn** data on the efficacy of Bt corn against the southwestern corn borer (SWCB) are more limited than for the European corn borer. However, recent Kansas research has demonstrated that some Bt hybrids are effective against first and second generation SWCB, as well as ECB. DEKALB hybrids containing DBT 418 X are not being marketed in areas that experience high southwestern corn borer infestations.

- (2) Some beneficial insects, lady beetles, lacewings, spiders, and at least one species of extremely tiny wasps (which parasitize corn borer eggs) contribute to corn borer mortality

-

**Spider Mite** (*Tetranychidae*) damage is more serious in southwest Kansas but may cause economic loss in other areas during droughty years. The presence of mites early in the season may justify pre-tassel treatments with Comite if the weather is expected to be hot and dry and corn borer pressure is expected to be heavy enough to require a broad spectrum insecticide treatment.

**Insecticide treatments:**

- (5) Capture® \* 2EC @ 0.08 to 0.1 lb a.i./A
- (6) Comite A ® @ 2.25 pt/A in a 20 gal of water by ground application or in a minimum of 2 gal of water by aerial application

**The following classified miticides are listed because they are still used in some areas of the state. In southwest Kansas, they may give only temporary suppression:**

- (1) Dimethoate @ 0.5 lb a.i./A
- (1) Di-Syston® \* 8 @ 0.5 to 1 lb a.i./A
- (3) Furadan® \* 4F @ 1 lb a.i./A may suppress Banks grass mites

-

**Stalk Borer** (*Papaipema nebris*) (**common**) damage occurs in May and June and the corn plant growing point may be killed (deadheart). Most Kansas infestations occur in the northeastern part of the state.

**Insecticide treatments:**

- (5) Ambush® \*, Pounce\* 3.2 E @ 0.1 to 0.2 lb a.i./A
- (5) Asana® \* XL (0.66) @ 0.03 to 0.05 lb a.i./A
- (1) Lorsban™ \* 4E @ 1 to 1 1/2 lb a.i./A

-

**Western Bean Cutworm** (*Loxagrotis albicosta*) damage occasionally occurs in western Kansas. Eggs are laid in group on the upper surface of the upper leaves. Scouting generally should be most intensive between July 18 and 30 in southwest Kansas and about a week later in northwest Kansas.

**Insecticide treatments:**

- (5) Asana® \* XL (0.66) @ 0.015 to 0.03 lb a.i./A

- (5) Capture® \* 2EC @ 0.08 to 0.1 lb a.i./A
- (1) Lorsban™ \* 4E @ 1 to 1.5 lb a.i./A
- (1) PennCap-M® \* @ 0.75 to 1 lb a.i./A
- (5) Pounce® \* 3.2 EC, (5) Ambush\* @ 0.05 to 0.1 lb a.i./A
- (3) Sevin® @ 2 lb a.i./A
- (5) Warrior® \* T @ 0.015 to 0.025 lb a.i./A

---

-  
®-Registered name

™ Trade name

\*Restricted-use pesticide (RUP)

-  
-

## Diseases

Corn in the Midwest is susceptible to a number of diseases that reduce corn yield and quality by 7 to 17 percent on the average, depending on the presence of the pathogen, weather and soil conditions, and the relative resistance or susceptibility of the corn. Ear and kernel rots decrease yields, quality, and feeding value of the grain. Stalk rotting diseases may minimally lower corn yield and quality, but can make harvesting difficult. Leaf diseases cause reductions in photosynthesis that in turn reduces carbohydrate accumulation, and consequently results in yield reduction and the production of chaffy ears.

Most parasitic diseases of corn are caused by fungi, but a few are caused by bacteria, viruses, and nematodes. Nonparasitic diseases result from unfavorable climatic and soil conditions. Corn diseases, in contrast to other crops, seldom become severe over wide areas.

Disease severity of corn differs from year to year and from one region or field to another, depending on the presence of the pathogen, environmental conditions, and cultural practices. Continuous cropping of corn, high plant populations, and heavy fertilizer applications to achieve maximum yield can increase corn diseases. Changes in tillage practices from conventional to no-or reduced-till systems also have allowed some pathogens to become more firmly established.

Many corn diseases are controlled by the use of disease-resistant hybrids and the application of fungicides to seeds. Using resistant hybrids is the most efficient and permanent means of controlling corn diseases. No hybrid is resistant to all diseases, and much remains to be done in developing disease-resistant hybrids.

The treatment of seed corn with fungicides may control seed rots and seedling diseases, but not other diseases. Crop rotation and destruction of diseased plant parts have been suggested as control measures for certain plant diseases. Such practices are most effective where the crop is growing in limited areas or if the specific disease-production agents are soilborne.

In 1996, reported data for disease damage in Kansas were insufficient to publish. However, the followings are the major diseases/nematodes and the recommended management practices for Kansas corn:

### Diseases Caused by Fungi:

Seed Rots and Seedling Blights can be a problem during early planting of corn in Kansas. Weather conditions determine the severity of the infection. Seedling diseases are most prevalent in cold, wet soil. Deep planting of corn, incorrect rates or placement of herbicides, and old seed can all lead to increases in the amount of disease. Even treated seeds with fungicides cannot always overcome the effects of poor germination conditions that result in delayed emergence. If seedlings survive the attack, they may be less vigorous than plants produced from healthy seedlings.

Seeds attacked by seed rot diseases often rot before germination. Above ground symptoms of seedling blight include a general lack of vigor, yellowing, wilting, and death.

### Management:

- Use seed protectant fungicides.
- Use healthy corn seed of high germination.
- Plant corn seeds when soil temperatures reach at least 55 °F.
- Follow good cultural practices to allow proper soil-seed contact and the correct placement of fertilizers and pesticides.

Stalk Rots and Root Rots are the most prevalent diseases in Kansas. Annual losses are estimated at 5 percent of the crop and in some areas the losses may approach 50 percent. Losses are either direct (poor filling of ears or light-weight and poorly finished ears) or through harvest losses (plants lodging or stalk breakage as ears lost on the ground).

The common stalk rots found in Kansas are caused by four soil-borne fungi: *Fusarium moniliforme* and *F. graminearum*, the causes of Fusarium stalk rot; *Diplodia maydis*, the cause of Diplodia stalk rot; and *Macrophomina phaseolina*, the cause of charcoal rot. In addition to fungal stalk rots, there is also bacterial stalk rot caused by *Erwinia chrysanthemi* that occasionally occurs on corn and sorghum in Kansas. Antracnoes, a foliar pathogen that resides in crop residue, causes foliar lesions but is much serious when it invades the stalk and causes stalk rot. The symptoms of these rots are very similar.

Stalk rots are favored by dry weather early in the growing season, followed by extended periods of rainfall shortly after silking. Rots are commonly found in soils high inorganic matter content with very high levels of nitrogen and low levels of potassium and chloride. Locally adapted, full-season hybrids are generally more resistant than earlier maturing hybrids. It is important to choose a hybrid with good stalk strength and stay-green characteristics.

Symptoms appear several weeks after silking as the leaves wilt, become dry, and appear grayish-green. Shredding of the internal part of the stalk in the lower internodes is the most characteristic symptom of stalk rot.

### **Management:**

- Use tolerant hybrids.
- Avoid high levels of nitrogen and low levels of potassium and chloride.
- Reduce plant populations or at least match population to fertility and water availability
- Supply sufficient water throughout the growing season and especially from silking through filling.
- Control insects, especially corn rootworm and corn borer.
- Early harvest of severely infected plants will reduce losses from ear droppage and lodged plants.
- Crop rotation with non-susceptible crops such as small grains and alfalfa will reduce but not eliminate stalk rot.

-

**Ear and Kernel Rots** attack corn, especially when rainfall is above average from silking to harvest. Corn ears that are covered by tight husks and those that mature in a downward position have less rot than ears with open husks or those that mature upright.

Several fungi are capable of inciting ear and kernel rots. Those observed in Kansas include *Diplodia*, *Fusarium*, *Penicillium*, *Trichoderma* and *Aspergillus*. The symptoms are similar. Generally, there is a discoloration of the kernels. This may be white, pink, gray, or black. A bluish-green or grayish mold also may be present. The affected ears are lightweight, poorly finished, and a portion or the entire ear may be rotted. The husks are often prematurely bleached and may be completely rotten.

### **Management:**

- Use hybrids that are resistant to ear and kernel rots.
- Harvest early.
- Corn ears and shelled grain should be stored below 18 and 15 percent, respectively, at temperatures below 50 °F.

-

**Leaf Spot and Blight** diseases attack corn during prolonged periods of rainy weather and mild temperatures. The common diseases found in Kansas are northern corn leaf blight, gray leaf spot, eyespot, and anthracnose.

Gray leaf spot of corn, caused by the fungus *Cercospora zea-maydis*, is the most serious foliar corn disease in Kansas. Yield losses between 20 and 30 percent are not uncommon on susceptible hybrids. Currently, it is most severe in northeastern Kansas and in the irrigated areas of south central and southwest Kansas. Under no-till conditions, the fungus will survive through two winters in Kansas. Temperatures of 70 to 85 °F are considered ideal for disease development.

Symptoms include necrotic lesions that can range from as little as 1/16 inch in width to as much as 2 inches in length. They may be oval, oblong or rectangular depending on the pathogen. The lesions often have a distinct border, which can vary in color from tan to red depending upon the disease.

### Management:

- Use resistant hybrids with an active scouting program before tasseling.
- Use fungicides during severe disease outbreaks.
- Fall plowing to eliminate residue will reduce early season infections.
- Use crop rotation and tillage.

-

**Common and Southern Rust** are commonly found in Kansas. Common rust is most abundant in the state, while southern rust is confined to late season infections that cause little or no damage. Losses to rust are usually less than 2 percent. Cool temperatures and high relative humidity increase common rust, whereas high temperatures and high relative humidity favor southern rust.

Cinnamon-brown pustules on the leaves are the common symptoms of rust in corn. Common pustules rust are often elliptical in shape and found on both sides of the leaf. On the other hand, southern rust pustules are found only on the upper side of the leaf. Late in the season, southern rust pustules turn black as the over wintering spores develop. Death of leaves and leaf sheaths may occur if infestation is severe.

### Management:

- Use resistant hybrids.
- Use fungicides during severe infestation.

-

**Corn Smut** losses can range from a trace to 40 percent. Losses from corn smut in Kansas are typically 1 percent. The number, size, and location of smut galls on the plant affect the amount of yield loss. Large galls on or above the ear are more destructive than galls below the ear or on the leaf. Corn plants in fields with high nitrogen from barnyard manure show more smut infestation. In addition, injuries, due to hail, insects, cultivation, or spraying increase smut incidence.

Galls are initially covered with a glistening, white membrane and, upon maturing, will burst to release millions of powdery black spores. Galls on leaves do not develop larger than pea size and become hard and dry without rupturing. The fungus over-winters as spores in crop refuse, manure, and soil. Dry conditions and temperatures between 78 and 94 °F favor corn smut. Feeding quality of corn is not affected by corn smut.

### Management:

- Use resistant hybrids.
- Reduce mechanical damage to the plant.

-

## Diseases Caused by Bacteria

**Holcus Spot** is a negligible disease found in a few fields in Kansas. The rounded to elliptical lesions are at first dark green and water soaked, but later they become dry and brown with a reddish margin. Symptoms develop in warm, rainy and windy weather.

### Management:

- Use resistant hybrids.
- Use crop rotation.

-

## Diseases Caused by Viruses

**Maize Dwarf Mosaic Virus (MDMV)** is found more in sweet corn than in dent or field corn in Kansas. There are two strains of the virus, A and B, common in Kansas. Strain A is most prevalent in the southern part of the state while strain B is found in the northern half of the state. Johnsongrass is the main overwintering host of strain A. Eastern gammagrass is an overwintering host of strain B. Corn leaf aphids and greenbugs are the primary vectors of the virus.

Symptoms are most often seen on young plants. A mottle or mosaic of irregular, light and dark green areas appear on the leaves and develop into narrow, light green or yellowish streaks along the veins. The plants are generally stunted and reduction in ear size and seed set occurs. As the temperatures increase in late season, the mosaic appearance disappears and leaves become more yellow. Early infections may predispose the plants to root and stalk rots and premature death. However, plant growth and yield are not affected by infection during the silking stage.

### Management:

- Use resistant hybrids.
- Control alternate hosts weed (Johnsongrass) in nearby fields.
- Aphid control is not feasible.

-

**Corn Lethal Necrosis** is found only in north central Kansas and south central Nebraska. Yield losses in infested areas have been estimated at 50 percent. It is caused by the combination of maize chlorotic mottle virus (MCMV) and either MDMV or wheat streak mosaic virus (WSMV).

Corn is susceptible during all stages of growth. A bright yellow mottling of the leaves or husk similar to MDMV is the first symptom, followed by leaf necrosis moving inward from the margins. In mature plants, the necrosis begins at the tassel and progresses downward. If ears are produced, generally they are small, discolored, with limited or no kernel development.

The vector of MCMV is unknown. MDMV is vectored primarily by corn leaf aphids and greenbugs and WSMV by the wheat curl mite.

### **Management:**

- Use crop rotation in fields in which MCMV or corn lethal necrosis has occurred.
- Use resistant hybrids.

### **Recommended Fungicides for Kansas corn:**

#### Mancozeb

- **Trade name:** Dithane® (M-45, DF, F-45 formulations), Penncozeb® 75DF and 80WP
- **Use rate:** 1.125 lb a.i./A
- **Application time:** at onset of symptoms
- **Primary use:** helminthosporium leaf blights, common rust.

#### Propiconazole

- **Trade name:** Tilt®
- **Use rate:** 0.10 lb a.i./A
- **Application time:** apply prior to 50% silking when thresholds are reached
- **Primary use:** gray leaf spot, eyespot
- **Comment:** on July 16, 1999 Kansas Department of Agriculture established a Special Local Need (state) registration to allow the use of propiconazole to control foliar diseases through 100% blister stage.

#### Captan

- **Trade name:** various formulations and trade names
- **Use rate:** 0.62-1.18 oz/100 lb seed
- **Application time:** seed treatment
- **Primary use:** seed rots and seedling blights.

#### Fludioxonil

- **Trade name:** Maxim® 4FS
- **Use rate:** 0.04 oz a.i./100 lb seed
- **Application time:** seed treatment
- **Primary use:** seed rots and seedling blights.

-

Mefanoxam

- **Trade name:** Apron XL™
- **Use rate:** 0.016-0.032 oz a.i./100 lb seed
- **Application time:** seed treatment
- **Primary use:** Pythium.

-

Metalaxyl

- **Trade name:** Apron™ 50W, Allegiance
- **Use rate:** 0.032-0.50 oz a.i./100 lb seed
- **Application time:** seed treatment
- **Primary use:** seed rots and seedling blights

---

-

® Registered name

™ Trade name

\*Restricted-use pesticide (RUP)

-

-

## Nematodes

Root-lesion and sting nematodes are the two major nematodes that occasionally cause problems in the very sandy soils of southwestern Kansas. Damage almost always occurs in irregularly shaped areas ranging from 100 square feet to over an acre.

The root-lesion nematode is the most common nematode parasite of corn. Infested corn plants are often stunted and yellow. The reduced root system frequently is brown to black and lacks root hairs.

The sting nematode (*Belonolaimus spp.*) is associated with the deep, sandy soils of the Arkansas River flood plain and its tributaries in the southwestern and south central regions of the state. Yield losses are generally from 60-100 percent in the infested area of the field. Root systems are reduced with a proliferation of short, stubby roots. The plants become stunted, turn yellow, and have the tendency to wilt easily.

**Management:**

- Crop rotation.
- Preplanting or planting time treatment with granular nematicides may be effective.

**Recommended nematicides for Kansas corn:**

<b>Product</b>	<b>Usage</b>	<b>Nematodes listed On label</b>	<b>Rate of application</b>	<b>Comment</b>
Counter® * 15G	Field, pop, sweet corn  seed corn	Lesion, lance, root knot, spiral, stunt, sting, stubby-root, dagger	At planting, 8 oz/1000 linear feet of row in a 7 inch band or in-furrow	Do not exceed 1.3 Ib a.i./A
Counter® * 15G Lock 'N Load	Field, pop, sweet corn  seed corn	Lesion, lance, root knot, spiral, stunt, sting, stubby-root, dagger	At planting, 8 oz/1000 linear feet of row in a 7 inch band or in-furrow	Do not exceed 1.3 Ib a.i./A
Counter® * CR	Field, pop, sweet corn  seed corn	Stubby-root, dagger, sting, spiral, lance, lesion, stunt, root-knot	At planting, 6 oz/1000 linear feet of row in a 7 inch band or in-furrow	Do not exceed 1.25 Ib a.i./A
Counter® * CR Lock 'N Load	Field, pop, sweet corn	Stubby-root, dagger, sting, spiral, lance, lesion, stunt, root-knot	At planting, 6 oz/1000 linear feet of row in a 7 inch band or in-furrow	Do not exceed 1.25 Ib a.i./A
Mocap® 10G	Field and sweet corn	Dagger, lesion, root-knot, lance, spiral, sting, ring, stunt, stubby-root	At planting, 12 oz/1000 linear feet of row in a 6-7- inch band on the row over a closed seed furrow	Incorporate with the top ½ inch of soil with drag chains, spring-tooth incorporator

-  
-  
® Registered name

™ Trade name

\*Restricted-use pesticide (RUP)

-  
-

## Weeds

Weedy plants and corn require the same resources for growth. Use of these resources by growing weeds makes them unavailable for corn growth. Therefore, It is vital that weeds be managed in the corn crop. Corn is vulnerable to weed competition for about the first four weeks, a time span that coincides with cold spring temperatures. Thus, a successful weed control strategy should assure weed-free conditions for about a month after planting. Weed germination after that time pose little threat to yield reduction, but may interfere with harvesting.

### **Integrated weed management**

Several methods are available for weed management in corn:

- Crop rotation with soybeans, forage crops, or cereal grains.
- Row-crop cultivation is a cost-effective weed management practice.
- Early planting of corn.

### **No-till and low-tillage corn**

Corn may be planted into undisturbed crop residue from previous year, as well as directly into killed alfalfa or smooth brome sods. Before planting, winter annual weeds must be controlled with tillage or with foliar-absorbed herbicides.

Enhanced water-use efficiency of no-till planted corn has expanded the range of dryland corn production in Kansas. Atrazine may be applied to wheat stubble in fields with wheat-corn-fallow (ecofallow) rotation. Weed and volunteer wheat control is necessary during the 9-month period between wheat harvest and corn planting the following spring, to enhance the soil moisture storage required for successful dryland crop production.

Some corn growers elect to perform some tillage to control weeds prior to planting corn. Preplant incorporated herbicides may then be used. The acetamide herbicides may be shallow incorporated before planting, or surface applied before, during or shortly after planting. Some herbicides should not be incorporated because serious corn injury may occur.

## Postemergence weed control in corn

About half of Kansas corn producers cultivate their corn to control weeds that have escaped previous treatments. Significant herbicide savings result from banding residual herbicides over the row at planting, and then controlling inter-row weeds with cultivation. In furrow-irrigated fields ridge-tilled corn is managed with very low herbicide inputs.

Shattercane is a serious problem in many cornfields. Recent herbicides with appropriate adjuvants provide excellent control of emerged shattercane and johnsongrass seedlings in corn.

## Special situation

- Residual herbicides may be applied at lay-by, and incorporated mechanically or with irrigation water, to extend control of grass weeds such as longspine sandbur and shattercane. These herbicides do not injure established corn or weeds therefore, emerged weeds must be controlled by other means, and corn must be at least 4 inches tall before applying these herbicides.
- Where corn and weeds differ greatly in size, non-selective herbicides may be applied postdirected. Corn should be at least 12 inches tall, with no more than the bottom 3 inches coming in contact with the herbicide.

## Followings are brief descriptions of the main weeds in Kansas:

1. Common annual grasses mostly controlled with preemergence herbicide applications:
  - **Barnyardgrass** (*Echinochloa crusgalli* L.) or **cockspur, watergrass** originally from Europe. Seeds are the only source of reproduction. It flourishes in warm conditions. Common particularly in moist area high in fertility, such as irrigated fields and old feedlots.
  - **Fall panicum** (*Panicum dichotomiflorum*) is a native weed. Seeds are the only source of reproduction. It flourishes in warm conditions. Common in cultivated fields, waste areas, roadsides, abused pastures, and disturbed areas.
  - **Witchgrass** (*Panicum capillare* L.) or **ticklegrass, panicgrass, tumbleweed grass** is a native weed. Seeds are the only source of reproduction. It flourishes in warm conditions. Common on cultivated land, roadsides, waste places, and rangeland in poor condition. It is abundant where the soil is somewhat sandy.
  - **Foxtail includes giant** (*Setaria faberi*) (**giant bristlegrass, Chinese foxtail, Chinese millet, nodding foxtail**) native of Asia; **green** (*Setaria viridis* L.) (**green bristlegrass, pigeongrass, wild millet**) native of Eurasia; and **yellow** (*Setaria glauca* L.) (**yellow bristlegrass, pigeongrass, wild millet**) native of Europe. Seeds are the only source of reproduction. Common on cultivated grounds, waste places, roadsides and degraded rangeland and pastures.
  - **Crabgrass includes large** (*Digitaria sanguinalis* L.) (**hairy crabgrass, purple crabgrass**) native of Europe; **smooth** (*Digitaria ischaemum*) native of Europe. Seeds are the only source of reproduction. Both flourish in warm conditions. Both are common in lawns, cultivated fields, gardens, roadsides, pastures, and waste places.
  - **Longspine sandbur** (*Cenchrus longispinus*) (**field sandbur, burgrass**) is a native weed. Seeds are the only source of reproduction. Flourish in warm conditions. Common in roads, waste places, cultivated fields, lawns, and rangeland in poor condition. Grows well on sandy soils, but also found on heavier soils.
  - **Shattercane** (*Sorghum bicolor* L.) (**black amber, chicken corn, wild cane**) native of Africa. Seeds are the only source of reproduction. It is a major problem in corn and sorghum because seeds are several inches deep and keep coming up through the soil throughout the summer. Flourish in warm conditions. Grown in cultivated fields of corn, grain sorghum, and soybeans. Usually requires postemergence herbicides for control.
  - **Prairie cupgrass** (*Eriochloa contracta*) (**wooly cupgrass**) (*Eriochloa villosa*) native of Asia. Seeds are the only source

of reproduction. Flourish in warm conditions. Common in roadside ditches, pond banks, corn and sorghum fields, and disturbed sites.

2. **Common small-seeded broadleaf weed** seeds are shallow and germinate after tillage. Controlled with preemergence and postemergence herbicide applications, and cultivation:
  - **Kochia** (*Kochia scoparia* L.) (**summer cypress, fireweed, belvedere, mock cypress, Mexican firebush**) native of Eurasia. Flowering season is from July to October. Seeds are the only source of reproduction. Found on rangeland, pastures, fields and disturbed sites.
  - **Lambsquarters** (*Chenopodium album* L.) (**lambsquarters goosefoot, white goosefoot**) native of Europe. Flowering season is from June to September. Seeds are the only source of reproduction. Found in cultivated crop fields, gardens, pastures, vacant lots, waste ground, and other disturbed areas.
  
3. **Pigweed Family :**
  - **Palmer amaranth** (*Amaranthus palmeri*) and **redroot** (*Amaranthus retroflexus* L.) (**rough pigweed, careless weed**) are native weeds. Flowering season is from June to October. Seeds are the only source of reproduction. Found in cultivated and fallow fields, gardens, waste ground, and roadsides. Palmer amaranthus leaf and stem surfaces are smoother with few or no hairs than redroot pigweed.
  - **Tumble** (*Amaranthus albus* L.) (**tumbleweed, white pigweed**) is a native weed. Flowering season is from June to October. Seeds are the only source of reproduction. Found in dryland, cultivated and fallow fields, roadsides, and waste places.
  - **Waterhemp** (*Amaranthus rudis*) (**common waterhemp**) is a native weed. Flowering season is from June to October. Seeds are the only source of reproduction. Found in cultivated fields, roadsides, marshes, sandbars, riverbanks and waste places.
  
4. **Common large-seeded broadleaf weed** seeds germinate near a range of soil depth, controlled with postemergence herbicide applications:
  - **Common cocklebur** (*Xanthium strumarium* L.) is a native weed. Flowering season is from July to September. Seeds are the only source of reproduction. Found in open fields, gardens, pastures, and waste areas. Common cocklebur is especially abundant in areas where reducing water has exposed previously submerged land.
  - **Common sunflower** (*Helianthus annuus* L.) (**annual sunflower**) is a native weed. Flowering season is from July to September. Seeds are the only source of reproduction. Found in cultivated fields, pastures, gardens, roadsides, waste ground, and disturbed sites.
  - **Devil's claw** (*Proboscidea louisianica*) (**unicorn plant, aphid trap**) is a native weed. Flowering season is from June to October. Seeds are the only source of reproduction. Found in sandy and loamy soils. It is most common on waste ground, overgrazed pasture, fields, and roadsides.
  - **Eastern blacknightshade** (*Solanum ptycanthum*) (**black nightshade**) is a native weed. Flowering season is from May to October. Seeds are the only source of reproduction. Found in roadsides, open woodland, stream banks, gardens row crops, and waste places.
  - **Field bindweed** (*Convolvulus arvensis* L.) (**creeping Jenny, small-flower bindweed, small bindweed, European bindweed, greenvine**) is a perennial weed originated from Eurasia. Flowering season is from June to September. Rhizomes and seeds are the source of reproduction. Found on both cultivated and uncultivated land. It is most common in small grain fields, waste places, gardens, and roadsides.
  - **Puncturevine** (*Tribulus terrestris* L.) (**goathead, caltrop**) native of Europe. Flowering season is from May to October. Seeds are the only source of reproduction. Found in waste places, roadsides, and pastures. It is most abundant in disturbed sandy and gravelly soils.
  - **Smartweed** (*Polygonum pennsylvanicum* L.) (**Pennsylvania knotweed, pinweed**) is a native weed. Flowering season is

from July to October. Seeds are the only source of reproduction. Found in wet soils or sometimes flooded soil of roadsides, ditches, cultivated ground, waste ground, waste places, and pond banks.

- **Velvetleaf** (*Abutilon theophrasti*) (**Indian mallow, butter print, buttonweed**) originated from India. Flowering season is from July to October. Seeds are the only source of reproduction. Found in soybean fields, cornfields, waste places, pastures, roadsides, and fence rows.
- **Venice mallow** (*Hibiscus trionum* L.) (**Flower-of-an-hour**) originated from Europe. Flowering season is from June to September. Seeds are the only source of reproduction. Found in gardens, cultivated fields, pastures, roadsides, railroad rights-of-way, and waste places.

5. **Common winter-annual weeds in no till planted corn** are fall germinating weeds that survive over the winter:

- Downy brome (*Bromus tectorum* L.) (**cheatgrass, wild oats, military grass**) a cool season grass, native of Europe. Seeds are the only source of reproduction. Found on rangeland, fields, disturbed sites, roadsides, and waste areas.
- Evening primrose (*Oenothera biennis* L.) is a native biennial weed. Flowering season is from July to October. Seeds are the only source of reproduction. Found in sandy soils and on roadsides.
- Henbit (*Lamium amplexicaule* L.) is annual or biennial weed native of Europe. Flowering season is from March to May. Seeds are the only source of reproduction. Found in lawns, gardens, waste places, roadsides, and cultivated fields. It is a common urban weed.
- **Horseweed** (*Conyza canadensis* L.) (**marestalk, horseweed fleabane**) is a native weed. Flowering season is from June to September. Seeds are the only source of reproduction. Found on rangeland, open cultivated fields, gardens, waste ground, and disturbed sites.
- Japanese brome (*Bromus japonicus*) (**Japanese chess**) a cool season grass, native of Europe. Seeds are the only source of reproduction. Found in wheat fields, no-till row crops, disturbed sites, waste areas, and low condition rangeland.
- Prickly lettuce (*Lactuca serriola* L.) (**wild lettuce**) native of Europe. Flowering season is from July to September. Seeds are the only source of reproduction. Found on waste areas, roadsides, fence rows, over-grazed pastures, gardens, and cultivated fields.

6. **Common perennial weeds:**

- **Johnsongrass** (*Sorghum halepense* L.) is a perennial grass originated from the Mediterranean region. Flourish in warm conditions. Rhizomes and seeds are the source of reproduction. Found in moist soil of waste places, cultivated fields, pastures, and roadsides.
- **Woollyleaf bursage** (*Ambrosia grayi*) (**bur ragweed, woollyleaf povertyweed, woollyleaf franseria, lagoonweed**) a native perennial weed. Flowering season is from August to October. Rhizomes and seeds are the only source of reproduction. Found in moist places in the fields, rangeland, and roadsides, and can grow in saline soils.

**Chemical treatments:**

Ninety-three percent of the state's corn acres in 1996 had some type of herbicide applied, totaling 5.9 million pounds. Herbicides were applied on 64 percent of the acres as broadcast treatment, 8 percent were broadcast incorporate, direct or aerial application. Herbicides were applied as band application on 19 percent of the acres. About 25, 48, and 45 percent of the acres were treated with herbicides as preplanting, at planting, and post planting, respectively.

Atrazine and metolachlor were the most frequently used herbicides applied on 79 and 34 percent of the state's corn

acres, respectively. The average application rate of atrazine and metolachlor was 1.07 and 1.61 Ib a.i./A, totaling 2.3 and 1.5 million pounds, respectively.

The followings are the active ingredients of herbicides used during 1996 on Kansas corn acres. Herbicides are classified according to the primary mode of action. Data are reported from the Kansas Agricultural Chemical usage/ corn pesticide summary (MF-2326):

### **Photosynthesis (D-1 quinone-binding protein) inhibitor**

#### Atrazine

- **Trade name and formulation:** AAtrex® \* 4L, AAtrex® \* Nine-O® available in several trade names, commonly found in 4L and 90DF formulations
- **Average use rate:** 1.07 Ib a.i./A
- **Number of application:** 1.1
- **Percent acres treated:** 79%
- **Amount applied per year:** 2.3 million Ib
- **Application time:** preplant surface-applied (up to 30-45 days prior to planting); preplant incorporated within two weeks prior to planting; postemergence before grasses, broadleaf weeds, and corn exceed 1.5, 4, and 12 inches in height, respectively
- **Target plants:** annual grasses and broadleaf weeds in corn, sorghum, and other crops
- **Component of other products (all are â \*):** Surpass 100, Fultime, Harness Xtra 5.6L, Fieldmaster, Lariat, Marksman, Bicep II, Bicep II Magnum, Bullet, Bicep Lite II, Bicep Lite II Magnum, Contour, Shotgun, Basis Gold
- **Comments:** this product is restricted due to ground and surface water concerns. It is not used in well-drained soils, particularly in areas having high groundwater tables. Not applied aerially or by ground within 66 feet of the points where field surface water runoff enters rivers or within 200 feet around lakes and reservoirs. This product should be used in combination with other herbicides to control weeds that can not be effectively controlled by this herbicide.

### **Growth regulators**

#### 2,4-D

- **Trade name and formulation:** several formulations of 2,4-D amine and ester
- **Average use rate:** 0.35 Ib a.i./A
- **Number of application:** 1.1
- **Percent acres treated:** 12%
- **Amount applied per year:** 110,600 Ib
- **Application time:** preplant (burndown) 7 to 14 days prior to planting; applied 3-5 days after planting but before corn emerges; postemergence when corn is over 8 inches high; not applied in the tassel to dough stage
- **Target plants:** annual and perennial broadleaf weeds in corn (field, sweet, and popcorn), sorghum, and other crops
- **Component of other products:** Landmaster® BW, Shotgun® \*
- **Comments:** 2,4-D is toxic to aquatic invertebrates. Not applied directly to water, or to areas where surface water is present. Drift may adversely affect nontarget plants. Not applied when weather conditions favor drift from target area. Not

used through any type of irrigation system.

## Dicamba

- **Trade name and formulation:** Banvel® , Clarity®
- **Average use rate:** 0.23 Ib a.i./A
- **Number of application:** 1.1
- **Percent acres treated:** 10%
- **Amount applied per year:** 61,900
- **Application time:** preplant and preemergence in no tillage corn; preemergence in conventional or reduced tillage corn; early postemergence in all tillage systems when corn emerges until the 5-leaf stage or 8" tall, whichever occurs first; late postemergence when corn is between 8-36" tall or 15 days before tassel emergence, whichever occurs first, and when weeds are less than 3" tall
- **Target plants:** ALS- and Triazine-Resistant Biotypes, annual, biennial, and perennial broadleaf weeds in corn, sorghum, and other crops and on noncropland
- **Component of other products:** Marksman® \*, Resolve™ SG, NorthStar
- **Comments:** not applied directly to water or to areas where surface water is present. To avoid ground water contamination, this product is not applied in areas where soils are permeable, particularly where water table is shallow.

## Seedling shoot inhibitors

### Acetochlor

- **Trade name and formulation:** Surpass® \* EC, TopNotch® \*, Harness® \*, Surpass 20G® \*
- **Average use rate:** 1.32 Ib a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 11%
- **Amount applied per year:** 347,000 Ib
- **Application time:** preplant incorporated into the top 1 to 2 inches of soil within 2 weeks of planting, or applied after planting but before corn emerges; postemergence prior to weed emergence and before corn reaches 11 inches in height
- **Target plants:** recommended for control of yellow nutsedge and the annual grasses and small-seeded broadleaf weeds in field corn, corn for seed, silage corn, and popcorn
- **Component of other products:** Surpass® \* 100, Fultime™ \*, Harness Xtra® \* 5.6L, Fieldmaster
- **Comments:** not applied directly to water or to areas where surface water is present. To avoid ground water contamination, this product is not used in areas where soils are permeable, particularly where ground water is shallow.

### Alachlor

- **Trade name and formulation:** Lasso® \*, MicroTech, Partner® \*, Lasso II® \* granules
- **Average use rate:** 2.06 lb a.i./A
- **Number of application:** 1.0
- **Percent acres treated:** 13%
- **Amount applied per year:** 670,800 lb
- **Application time:** preplant incorporate in the top 1-2 inches of soil within 7 days prior to planting; preemergence surface before crop and weed emergence and within 5 days after last preplant tillage operation
- **Target plants:** controls yellow nutsedge and the annual grasses and broadleaf weeds in corn, sorghum (milo), and other crops
- **Component of other products:** Lariat, Bullet®\*
- **Comments:** not applied directly to water, or to areas where surface water is present, especially where soils are coarse and ground water is near the surface. Not applied when conditions favor drift.

#### Metolachlor, S-Metolachlor

- **Trade name and formulation:** Dual IIG Magnum™ , Dual Magnum™ , Dual II Magnum® , Dual IIG Magnum™ SI
- **Average use rate:** 1.61 lb a.i./A
- **Number of application:** 1.1
- **Percent acres treated:** 34%
- **Amount applied per year:** 1.5 million lb
- **Application time:** preplant surface applied up to 45 days before planting corn; preplant incorporated shallowly into the top 2 inches of soil within 14 days before planting; preemergence during or after planting, but before weeds or crops emerge; postemergence to corn 40 inches tall
- **Target plants:** annual grass and small-seeded broadleaf weeds in corn (all type) and other crops
- **Component of other products ( all are â \*):** Bicep II, Bicep II Magnum, Bicep Lite II, Bicep Lite II Magnum
- **Comments:** to avoid spray drift, do not apply under windy conditions.

#### Amino acid synthesis (ALS synthase enzyme) inhibitors

##### Nicosulfuron

- **Trade name and formulation:** Accent® SP
- **Average use rate:** 0.02 lb a.i. /A
- **Number of application:** 1.0
- **Percent acres treated:** 5%
- **Amount applied per year:** 2,600 lb
- **Application time:** postemergence on corn up to 20 inches tall. Method of application is dependent upon the weed/crop height differential
- **Target plants:** 4-12-inch-tall shattercane, 8-18-inch rhizome johnsongrass, and certain annual grasses and broadleaf weeds in field corn, corn grown for seed, and popcorn

- Comments: not applied directly to water or to areas where surface water is present. Not applied when conditions could favor runoff.

### Primisulfuron

- Trade name and formulation: Beacon®
- Average use rate: 0.02 lb a.i. /A
- Number of application: 1.0
- Percent acres treated: 13%
- Amount applied per year: 6,400
- Application time: postemergence applied to approved field corn hybrids at 4-20 inches height or postdirected between the corn rows when the corn is 20 inches to tassel; applied to 10-48 inches tall popcorn plants and before tassel emergence
- Target plants: controls shattercane, johnsongrass, quackgrass, and many broadleaf weeds in corn (grown for grain, silage, or seed) and popcorn
- Component of other products: NorthStar, Exceed®, Spirit™
- Comments: applied by ground or aerial to young, actively growing weeds. Not applied directly to water or areas where water is present. Not used for sweet corn or ornamental corn.

### Amino acid synthesis (EPSP synthase enzyme) inhibitor

#### Glyphosate

- Trade name and formulation: Roundup™, Roundup Ultra™
- Average use rate: 0.55 lb a.i./A
- Number of application: 1.5
- Percent acres treated: 10%
- Amount applied per year: 189,900 lb
- Application time: preplant; applied to Roundup Ready Corn only at the growing stages from emergence through the V-6 stage (six leaf collars visible) or until plant is 24 inches tall; prior to corn harvest and after corn is physiologically matured; before corn silks and at stage of weed growth recommended on the label
- Target plants: annual and perennial broadleaf weeds in field corn, sweet corn, and popcorn
- Component of other products: Fieldmaster, Landmaster®BW
- Comments: not applied directly to water or to areas where water is present. Do not harvest or feed treated vegetation for 8 weeks following application.

Imazethpyr (Pursuit®), and pendimethalin (Prowl®) were used on corn acres, however reported data were insufficient to publish.

---

-  
® Registered name

™ Trade name

\*Restricted-use pesticide (RUP)

-

-

## Contacts

### Kansas State University:

- Sorkel Kadir, Crop Profile Coordinator  
Research Assistant Professor  
Agronomy Department  
2009B Throckmorton Hall  
Manhattan, KS 66506  
Telephone: (785) 532-5420  
Fax: (785) 532-6094  
Email: skadir@bear.agron.ksu.edu
- Donald C. Cress, Extension Pesticide Coordinator Professor  
Department of Entomology  
239 Waters Hall  
Manhattan, KS 66506  
Telephone: 785-532-5891  
Fax: 785-532-6232  
Email: dcress@oz.oznet.ksu.edu
- Douglas Jardine, Extension Plant Pathology
- Dale L. Fjell, Extension Agronomy
- David Regehr, Extension Weed Science
- Phillip E. Sloderbeck, Extension Specialist, Entomology, Southwest
- Randall A. Higgins, Extension State Leader, Entomology

-

### Kansas Department of Agriculture:

- Dale Lambley, Special Environmental Assistant to the Secretary
- Eldon J. Thiessen, State Statistician, Division of Statistics
- John K. Stamer, Special Assistant to the Secretary for Pesticide Issues

## References

1. Agricultural Research Service. 1966. Corn diseases in the United States and their control. Handbook No. 199.
2. Bauernfeind R.J. 1990. The chinch bug: questions and answers about its biology, development and methods of control. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. AF-134 Revised.
3. Brooks, L.H. and R.A. Higgins. 1998. Southern corn leaf beetle: notes on reappearance of a rare corn pest. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. LD02.
4. Corn production handbook. 1994. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. C-560 Revised.
5. Gunsolus, J.L. and W.S. Curran. 1994. Herbicide mode of action and injury symptoms. University of Minnesota College of Agriculture, Minnesota Extension Service. BU-3832-F.
6. Higgins, R. A., P.E. Sloderbeck, and L.H. Brooks. 1999. Insect management for field corn in 1999. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. MF-810 Revised.
7. Higgins, R.A. and G.E. Wilde. 1995. Corn rootworm management in Kansas field corn Kansas State University Agricultural Experiment Station and Cooperative Extension Service. 1995. MF-845 Revised.
8. Jardine, D.J. 1998. Gray leaf spot of corn. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. MF-2341.
9. Jardine, D.J. and T.C. Todd. 1992. Nematode management in Kansas: chemical and biological control. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. MF-1038.
10. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. 1996. Kansas agricultural chemical usage, corn pesticide summary. MF-2326.
11. U.S. Department of Agriculture (USDA)/Kansas Agricultural Statistics (KAS). 1998.
12. U.S. Department of Agriculture (USDA)/National Agricultural Statistics Service (NASS). 1998.

13. Regehr, D.L., D.E. Peterson, P.D. Ohlenbusch, W.H. Fick, P.W. Stahlman, and D.K. Kuhlman. 1999. Chemical weed control for field crops, pastures, rangeland, and noncropland. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. SRP 826.
14. Sloderbeck, P.E., R.A. Higgins, L. Buschman, and R. Bowling. 1995. Corn borer management using Bt corn. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. MF-2175.
15. Sloderbeck, P.E., R.A. Higgins, and L.L. Buschman. 1996. Southwestern corn borer. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. MF-845.
16. Stubbendieck, J., G. Friisoe, and M.R. Bolick. 1994. Weeds of Nebraska and the Great Plains. Nebraska Department of Agriculture, Lincoln, Nebraska.
17. Weed Control Manual. 1996. Meister Publishing Company, volume 30.

-  
Prepared August, 1999

---

Database and web development by the [NSF Center for Integrated Pest Management](#) located at North Carolina State University. All materials may be used freely with credit to the USDA.