

# Crop Profile for Corn in Nebraska

**Prepared: June, 2000**

## General Production Information

- **Acres Planted:** 8,800,000
- **Acres Harvested for Grain:** 550,000
- **Acres Harvested for Silage:** 190,000

### CORN FOR GRAIN

- **US Rank:** Third
- **Average yield (bushels per acre):** 145
- **Total bushels produced:** 1,239,750,000
- **Value of production:** \$2,417,513,000

### CORN FOR SILAGE

- **Yield (avg. tons/acre):** 17
- **Tons produced:** 3,230,000

### General

Although grown throughout the state, corn is the predominant row crop in the Eastern third and southern half of Nebraska. Blessed with the Ogallala aquifer, and large surface irrigation impoundments, approximately 70% of the corn acreage are irrigated. During the last 15-20 years, the seed corn industry has recognized the advantages of a dependable water supply. Thousands of acres of seed production are annually planted by numerous seed companies in East Central and Central Nebraska irrigated areas.

While the rolling hills of Eastern Nebraska produce bountiful corn crops many years, they are largely rain-fed. Occasional cornfields can be found in the range country of the Nebraska Sandhills, but they are few, and largely irrigated. The south-central counties bordering Kansas lie along the southern edge of the Ogallala aquifer, making irrigation from subsurface sources very spotty. Rainfall in the area is also a limiting factor in producing corn.

Some years corn planting may begin as early as the first week of April. The bulk of the acreage is planted the last week of April and the first week of May, reaching nearly 100% by May 20. Most years corn harvest has been completed by early November.

In general, corn is planted in rows 30 inches apart, to a population of 25,000 to 30,000 plants per acre. Planters usually are equipped for herbicide banding, starter fertilizer and soil insecticide application

The "dust bowl" years of the 1930s showed farmers that reduced tillage would reduce wind-blown soil erosion. Thus began the revolution in Nebraska's tillage practices, beginning with the "lister". Currently a plow is seldom seen outside a museum. No-till and reduced tillage practices predominate. Approximately half of the corn acreage is rotated annually with soybeans, since the government controls were changed to eliminate the requirement of protecting a "corn base".

### **Soil Fertility And Natural Resources**

State legislation divided Nebraska into 16 Natural Resource Districts (NRD). Each NRD has a director and an elected Board. It has taxing authority, and a responsibility to develop regulations within its boundaries to protect the natural resources of the district. Many of the NRD's have adopted, or are proposing, regulations that provide limits on maximum allowable amounts of irrigation water and fertilizer elements that may be applied per acre. This is absolutely necessary to reduce depletion of the aquifer and prevent contamination with nitrates and other chemicals.

The Ogallala aquifer is very close to the surface in many areas, such as the Platte River valley. While this reduces costs of pumping the water for irrigation, it increases the possible contamination of the water with chemicals. Not only is the water close to the surface, it underlies a very sandy soil, often classified as loamy sand. Thus leaching of chemicals can readily occur, especially if they are water-soluble.

Nitrogen is increasingly being regulated, with some NRDs prohibiting any nitrogen being applied before spring. Then only part of the soil test indicated amount might be applied before planting. The remainder must be side-dressed or irrigation water applied. Nitrates present in the water of a well must be taken into account, reducing the amount to be applied to meet the soil test prescription.

Even where regulation does not require it, fertilizer elements are often applied after soil testing provides a prescription for the needs of a field. Various methods of application may provide the elements. In many pivot-irrigated fields, the required nitrogen is applied in a "spoon fed" manner, with irrigation water. This allows for efficient utilization by the plant with less likelihood of nitrogen waste.

## **Insect Pests**

Nebraska sits astride the 100th meridian. Old timers claim this is the demarcation of insect and mite pest problems east and west. Whether true or not, there are approximately 25 species of insect and mite pests that may cause serious injury to Nebraska corn any year. Weather conditions will help or hinder pest populations.

Pioneer history describes locust and grasshopper invasions in these Great Plains. The Western corn rootworm launched its invasion of the Corn Belt from almost exactly on the 100th meridian. Mite problems of corn are primarily west of the meridian. The Western bean cutworm centers its activities west of the meridian. The chinch bug seldom strays east of the Missouri River, confining its activities to Nebraska and Kansas.

### **Primary Problems include:**

**Western and Northern corn rootworms** (*Diabrotica virgifera virgifera* and *D. barberi*): The most consistent cause of economic loss to Nebraska corn farmers is the cost of controlling corn rootworm larvae before they severely damage the roots. Although rotations between corn and soybeans prevent a rootworm problem, approximately one-third of Nebraska's corn acreage is planted to corn year after year. Thus, 30% of the corn is treated with a soil insecticide at, or just after planting time. Alternatively, aerial application of a rootworm adult-killing insecticide is used to prevent egg laying by the beetles on about 0.8% of the corn Appendix table A lists the acreage treated, estimated insecticide used and application method for corn rootworms.

**European corn borer** (*Pyrausta nubilalis*): The European corn borer has 2 generations each year under Nebraska conditions. Occasionally a partial third generation may occur in the southern part of the state. This insect can cause severe economic loss to Nebraska corn producers some years. Their numbers are cyclical because of naturally occurring diseases such as *Nosema pyraustae*, and the influence of weather conditions on corn borer survival.

The adults from the overwintering corn borer population lay their eggs during whorl stages of the crop's growth. Hatching larvae survive in large numbers only on varieties which have little or no resistance (tolerance) to their feeding. Larvae mature, pupate and the second generation moths oviposit on the later flowering corn.

It is a rare corn field that experiences an economic infestation from both generations in one season. Data from approximately 700 fields of corn were accumulated each year for 15 years. (1). Using economic thresholds for determining need, any one field required a treatment one year out of three. In outbreak years, as much as 50% of the corn might receive an insecticide treatment. On the other hand less than 1% was treated in the 1999 season. That year approximately 20% of the corn planted consisted of GMO varieties containing the gene which carries the *Bacillus thuringiensis* toxin. Appendix table A contains estimates of average acreage of insecticide use, and application methods, for ECB in the most recent 4

years.

**Spider Mites:** Two-spotted (*Tetranychus urticae*) and Banks Grass Mite ( *Oligonychus pratensis* ) are most frequently problems in the central and western irrigated corn fields of the state. Chemical treatments are often needed following insecticidal treatments that eliminate the natural enemies of the mites. Such treatments as are frequently used against first generation corn borer, or silking period applications to kill corn rootworm beetles, can dramatically reduce the mite predators.

In the most recent five years, only an average of 2% of the acres has needed treatment with miticides. Appendix A contains estimates of the average acreage, insecticide used, and application methods used in treating for mites.

**Cutworms:** Various cutworms species can attack Nebraska seedling corn Dingy, Dark Sided, Sandhills and Black Cutworms are the most frequent pests. The moths of all species but the Black Cutworm (*Agrotis ipsilon*) lay their eggs in the fall and generally are full grown, or nearly so, by the time corn sprouts.

The Black Cutworm moths lay their eggs in the spring, after migrating from the south. They may arrive in the Midwest as early as late February, or throughout the spring months. In Nebraska, moth flights are most likely to provide problem infestations in the Eastern third of the state, rarely causing outbreaks west of the 100th meridian. Most common problem infestations occur in counties that border the Missouri river.

Less than 1% of the acreage requires emergency cutworm treatments in average years. Appendix A contains estimates of the average acreage, insecticide used, and application methods used in treating for cutworms

**Wireworms:** Several species of the family Elateridae are pests of corn. The larvae of beetles, known as click beetles, feed in the soil on plant seeds, seedlings and by tunneling into the base of plants. The larval stages of various species require from 2 to 5 years to complete. Thus, when an infestation is present one year, it is likely to remain for several years. Problems with this insect appear to have become more widespread with the increasing adoption of reduced and minimum tillage.

Nebraska corn production profile page 5.

Control practices range from seed treatments to in-furrow use of insecticides. Less than 0.5% of corn acres require the in-furrow treatment. Generally a corn rootworm or a seed treatment handles the problem. See Appendix for acreage treated, insecticides used, and method of application.

**Western Bean Cutworm** ( *Loxagrotis albicosta*): A stranger to many entomologists, this cutworm pest feeds on the ears of corn. The name was given to this species when it was supposedly restricted as a problem to field beans. As corn moved westward, the insect quickly adapted, and is a potential problem

each year in the sandy soil areas west of the 100th meridian. It occasionally appears briefly in some eastern counties bordering the Republican, Platte and Elkhorn rivers.

Overwintering as a pre-pupa in the soil, in a cell below frost line, the only generation of moths emerges about the beginning of July. A very sluggish flier, it tends to stay within the field where it emerges, laying eggs on leaves surrounding the pre-tassel whorl. Newly hatching larvae feed on pollen in the tassel and gathered in leaf axils. They then migrate to the ear where feeding begins on the ear tip. Occasionally as many as 6 or 8 feeding larvae may be found on a single ear.

Although many insecticides will kill the young larvae before they penetrate through the silk and enter under the husk, timing is extremely important. Once protected by the husks the larvae can't be controlled by insecticides. The insect requires treatment on less than 0.1% of the corn acreage most years. See the Appendix for acreage treated, insecticides and application methods used.

**Corn earworm** (*Heliothis zea*): Although not considered a serious pest of commercial corn, specialty corns such as food grade and seed production fields can be severely damaged. Not known to overwinter in Nebraska, early moth migrants usually appear in May. These early moths lay their eggs on young corn, where the larvae survive by feeding in the rolled up whorl leaves.

The insect becomes a problem by moths ovipositing single eggs primarily on green corn silks. Hatching larvae immediately travel down the silk to the tip of the ear and begin to feed, growing to nearly two inches long during two to three weeks of feeding. Dropping to the ground to pupate, moths then emerge for another cycle.

Being cannibalistic, frequently only one larva will be found on an ear. Damage to food grade corn obviously makes it unfit for human food, except for sweet corn which may have damaged portions removed. Seed corn can sustain some tip damage without major loss. The ear must be protected from the time silks emerge until pollination is complete and silks are brown. One or 2 insecticide applications may be necessary.

Twenty years of pheromone use in earworm traps in Nebraska have shown a remarkable synchrony of cyclic moth flight from one year to the next. (2). Considering the fact that the insect doesn't overwinter in the state, arrival of flights apparently are partially synchronized by the moon phase. Because of this, when planting weather will allow, varieties with known periods of time from emergence to flowering can be planted so flowering occurs during lows in the moth flight cycle.

All of the estimated 50,000 acres of seed corn grown in Nebraska will receive an average of 3 insecticide treatments every year for earworm and corn borers. See Appendix A for acreage treated, insecticides used and methods of application.

**Other Corn Insect Problems:** In addition to those previously described, when ecological conditions are favorable the following insects can become economically important. They are listed in alphabetical

order of the common name.

- **Armyworm:** *Pseudaletia unipuncta*
- **Grasshoppers:** several species
- **Billbug:** several species
- **Seed beetles:** two species
- **Chinch bug:** *Blissus leucopterus*
- **Seed Maggot:** *Delia platura*
- **Corn flea beetle:** *Chaetocnema pulicaria*
- **Stalk borer:** *Papaepema nebris*
- **Corn leaf aphid:** *Rhopalosiphum maidis*
- **Webworms:** several species
- **White Grub:** several species

Rarely will treatment exceed a total of 25,000 corn acres for these species.

## Diseases

**Seedling blight, root rots, stalk rots, and ear rots** generally are a problem when ecological conditions cause stress on the crop and favor the causative organisms. The most common fungi involved are species of Pythium, Fusarium, Diplodia, Helminthosporium, Phytophthora, Colletotrichum, and Exerohilum. Protection against these diseases is provided with tolerant varieties, or by seed treatments applied by the seed company.

**Gray leaf spot** has increased dramatically during the last few years, moving into the state and westward. When moisture and temperature conditions are conducive, it can attack sufficiently early in the season to severely reduce seed corn production.

Since about 1996, many corn seed production fields are routinely treated to prevent susceptible inbreds from being ravaged by gray leaf spot. While most commercial hybrids carry tolerance or resistance to this disease, even they can benefit from a fungicide application in outbreak years. The practice has not yet become widespread for commercial corn. Appendix B contains acreages, fungicides, and application methods .

**Maize dwarf mosaic, maize chlorotic mottle and corn lethal necrosis** are virus problems that exist in Nebraska. The etiology of these virus diseases starts considerable discussion, when two or more corn virologists get together. Methods of disease transmission, why one or more are severe in some locations and not others, methods of control or alleviation of losses, and the uses of tillage and rotation as aids in

control are fair game. No practice has been generally recommended for control of these diseases.

**Soil nematodes**, while not microbial, cause disease-like symptoms in corn. Returns for corn under Nebraska's excellent irrigation availability have caused many producers to plant corn following corn, year after year. In Nebraska's sandy soils the practice allows the gradual buildup of several species of nematodes that feed on and in the roots of corn.

Soil fumigation to control nematodes has been the only totally successful method of control, but the expense is too great for frequent use. Counter soil insecticide has provided only minor reductions in the problem. Rotation from corn into several years of alfalfa or other legume is the only dependable, economically feasible, method of reducing the problem. After 3 to 5 years of alfalfa, corn can return to the field for several years, before the nematode population again forces rotation. Less than 10,000 acres is treated with Counter for nematode control in corn.

## Weeds

Nebraska's widely variable climate, soil types, and water availability allow for considerable variation in which weeds are the most problem in corn in any one area. The following are the principal problem weeds of the state, listed in alphabetical order.

Quack grass

*Elytrigia repens*.

### **Broadleaf Weeds**

Black Nightshade *Solanum ptycanthum*

Cocklebur *Xanthium pennsylvanicum*

Field Bindweed *Convolvulus arvensis*

Hedge Bindweed *Convolvulus sepium*

Hemp Dogbane *Apocynum cannabinum*

Honeyvine Milkweed *Cynanchum laeve*

Kochia *Kochia scoparia*

Lambsquarter *Chenopodium album*

Milkweed *Asclepias syrica*

Pigweed sp. *Amaranthus spp.*

### **Grasses**

Crabgrass *Digitaria sp.*

Foxtails (3 sp.) *Setaria sp.*

Johnson grass *Sorghum halepense*

Shattercane *Sorghum bicolor*

Sandbur *Cinchrus longispinus*

Woolly cupgrass *Eriochloa villosa*

Smartweed sp. *Polygonum spp.*

Sunflower *Helianthus annuus*

Velvetleaf *Abutilon theophrasti*

Changes in tillage practices over the years, leading to increasing use of no-till and minimum tillage, have increased the prevalence of perennial weeds, such as the milkweed family. These practices have also given rise to increasing the use of chemical weed control methods. Also of concern is possible contamination of the aquifer in areas where it lies close to the surface, as in much of the Platte River valley

About 40% of the herbicides are applied by commercial applicators using large ground sprayers. The remaining herbicides are applied by the farmer, increasingly as banded over the row at planting, or with 8- to 10- row sprayers prior to the 8-leaf stage of growth. Appendix Table A contains estimates of herbicides used, acreage treated and application method and timing.

## Pesticides

The only definitive quantitative data available on pesticide use in Nebraska are in a survey report (3) The following summarizations are from that publication.

**Table 1:** Total Pesticide Use on Corn in Nebraska - 1994

Pesticide category	Pounds active ingredient applied total corn	Acres treated	% corn acres treated
Herbicides	29,281,160	8,938,000	97
Insecticides	3,644,319	5,452,000	59
Fungicides/nematicides	164,592	194,000	2
<b>Totals</b>	<b>33,090,072</b>		

Herbicides There were 23 basic herbicides applied to Nebraska corn, in various formulations according to the 1994 survey. The most common on irrigated corn were metolachlor, atrazine and alachlor, in that order. The most common on non-irrigated corn were metolachlor, atrazine, cyanazine and alachlor.

Insecticides There were 12 synthetic insecticides and one biological (*Bacillus thuringiensis*) applied to Nebraska corn in 1994. Terbufos, chlorpyrifos, and the biological (Bt) made up nearly two thirds of the

3,644,319 pounds of active ingredient applied. Corn rootworm larvicides, cutworms, European corn borer and wireworms were the major recipients of the insecticides used.

Fungicides/Nematacides. Five synthetic chemicals were applied to Nebraska corn in 1994. Captan and Terbufos made up 92% of that use. Mancozeb, metalaxyl and propiconazole made up the remaining 8% treatment.

### **Integrated Pest Management(Integrated Crop Management)**

IPM or ICM imply that the entire cropping unit of an agricultural producer is managed in a fashion that will minimize environmental insult but produce an economic return. To do this, any practice to be put in place on the cropping unit must be compatible with every other practice, as nearly as possible. It must be a system, and flexible enough to allow changes as problems develop through each season..

*A true-life example: Mite problems were developing annually on a large corporate farm Upon investigation, minor changes in irrigation practices reduced temperatures within the canopy of corn leaves by a couple of degrees. This reduction was less favorable for mite reproduction and more favorable for the predators of those mites.*

*Previously, insurance pesticide applications had been made. Concurrently with the change in irrigation practice, no insecticide was applied unless a pest insect had reached an economic threshold. When such an application was needed, the insecticide with the least impact on predators and parasites was chosen. If possible a biological insecticide was used. The slightly higher cost of the biological was more than offset by the reduction or elimination of miticide applications. The need for miticide applications on this nearly 10,000 acres of corn was almost totally eliminated.*

This is the kind of change possible, if crop management practices are integrated. More crop consultants and farmers are beginning to make decisions on the integrated approach. Agriculturists, more than anyone, recognize the need for protecting the environment.

### **Summary Of Pesticide Use In Nebraska Corn**

Herbicides. Approximately 85% of Nebraska corn fields receive one pre-plant or at-plant herbicide application. With approximately 25% of them receiving a post emergence herbicide, too. The remaining 15% receive only a post-emergence herbicide application.

Increased use of herbicides has brought about the development of herbicide resistant weed species. The advent of genetically modified crops that tolerate certain herbicides, allowing the same herbicides to be

used on rotated crops such as corn and soybeans, will likely increase the speed of the development of resistance in some annual weeds. As of this writing (spring 2000) there are four weed genera, with at least 5 species, known to have developed resistance to one or more herbicides in Nebraska. The pigweed genus, *Amaranthus*, includes water hemp (*Amaranthus rudis*). Kochia (*Kochia scoparia*), Lambsquarter (*Chenopodium album*), and shattercane (*Sorghum bicolor*) complete the known list at this time. Resistance management planning is becoming essential.

Insecticides. A Soil insecticide application is made annually to about 30% of the Nebraska corn. It is intended to control corn rootworms, cutworms and wireworms. Properly scouted, at least one-half of the corn currently treated would not need the outlay of \$12 to \$20 per acre to control corn rootworms. The environment would be better protected, and chemical resistance in the rootworm population would be delayed or prevented.

One post emergence insecticide application for European corn borer control, on the average is made to one-third of the corn fields, when economic thresholds are followed. An average of approximately 10% of the fields of commercial corn will receive an insecticide for the control of some other insect or mite.

Fungicides/Nematacides. At this time, seed treatment is the primary consumer of commercial corn fungicides. About 50,000 acres of seed production corn will receive an average of 2 fungicide applications as Gray Leaf Spot progresses across the state. Terbufos is the primary nematacide used in Nebraska. It is used on less than 10,000 acres annually.

Re-entry intervals. REIs and PPIs are followed by most farmers. They are strictly adhered to by most commercial applicators. This educational effort by the Land Grant Institutions, and the applicator certification program have been responsible for that. It has been enhanced by safer products, allowing shorter REI and less restrictive PPIs.

Resistance Management. This is a topic largely being ignored by commercial interests, if research and marketing activities are any indication. Developing crop varieties resistant to specific herbicides is just asking for the development of weed resistance to those herbicides. Short-term gain seems to be the guiding principal.

Government has only begun to react to its role in the Management of Resistance with the concept of *REFUGE* in the approval of Bt corn varieties. To many, it appears that a moratorium should be placed on the approval of GMO varieties until a comprehensive plan is developed to consider such approvals. Piecemeal action asks for influence pedaling.

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## Appendices

**Table A:** Principle Herbicide Chemicals Applied To Nebraska Corn

*(Estimated for the period 1995- 1999)*

Chemical	Application		Acres Treated	Comment
	AI/acre	Time of Year		
Atrazine	1.6	PRE, PPI	80	
Acetochlor	2.0	PRE	30	
Metolachlor	2.0	PRE	30	
Glyphosate	0.75	PRE, Post	25	
Dicamba	0.25	PRE, Post	22	
Cyanazine	1.0	PRE, PPI	20	Phasing out
Bromoxynil	0.25	Post	10	
2,4-D	0.75 pint	Post	10	
Bentazon	0.4	Post	10	
Sulfanyl ureas	see comment	Post	5 Multiple formulations	
EPTC	4.0	PPI	2	Phasing out
Alachlor	2.2	PRE	2	

**Key:**

PRE OR PPI - 40% applied by commercial applicator

PRE, PPI, OR POST - 60% applied by grower

**Table B:** Principle Insecticides/Miticides Used On Nebraska Corn

	Formulation		Treated Annually	% of	
Name	Per acre	When applied	Acres (X1000)	Method	Total com
CORN ROOTWORM (estimated for 1997-1999)					<b>31</b>
Aztec 2.1G	7 lb	May	880	Banded	
Lorsban 15G	8 lb	May	792	Banded	
Force 3G	4.2 lb	May	792	Banded	
Regent 4SC	0.24 oz	May	176	In furrow	
Counter 15G	6 lb	May	88	In furrow	
Penncap M	0.5 pt (x2)	July/Aug	70	Aerial	
CUTWORMS (INCLUDING WESTERN BEAN) (estimated for 1995-1999)					<b>1%</b>
Pyrethroid emul.	**	May	70	Aerial or banded	
Pyrethroid emul.	** WBC	July/Aug.	10	Aerial	
EUROPEAN CORN BORER. 1ST generation. (estimated for 1995-1999)					<b>15</b>
Dipel 10G	10 lb	June	400	Banded	
Pyrethroid Gr.	**	June	400	Banded	
Pyrethroid Gr.	**	June	200	Aerial	
Pyrethroid emuls.	**	June	200	Aerial	
Lorsban 4E	1 Qt.	June	80	Pivot	
Dipel 4L	1 Qt.	June	50	Pivot	
EUROPEAN CORN BORER 2nd generation (estimated for 1995-1999)					<b>18</b>
Pyrethroid emuls	**	July/Aug	1220	Aerial	
Penncap M	1.5pint	July/Aug	365	Aerial	
Lorsban 4E	1 Qt.	July/Aug	50	Pivot	
Capture	5 oz.	July/Aug	50	Aerial	
Dipel 4L	1 Qt.	July/Aug	25	Pivot	
TWO-SPOTTED & BANKS GRASS MITE (estimated for 1995-1999)					<b>2</b>
Capture	5 oz	July/Aug	120	Aerial	
Dimethoate 4E	1 pt	July/Aug	43	Aerial	
Di-Syston 8	1 pt	July/Aug	13	Aerial	
Comite		June/July	negligible	Ground sprayer	
WIREWORMS (estimated for 1995-1999)					<b>0.5</b>

Aztec 2.1G	7 lb	May	24	in planter furrow	<b>0.6</b>
Regent 4SC	0.25oz	May	10	in planter furrow	
Counter 15G	6 lb	May	10	in planter furrow	
CORN EARWORM (Seed Production Only. est. for 1995-1999)					
Pyrethroid Em	**	July/Aug	30	Directed ear zone	
Pyrethroid Em	**	July/Aug	20	Aerial	

\*\*Warrior, Pounce or Ambush.

**Table C: Fungicides/Nematacides Used On Nebraska Corn**

(Estimates averaged from 1995-1999)

				Treated Annually		% of
Name	Formulation	Per acre	When applied	Acres (X1000)	Method	Total com
GRAY LEAF SPOT						
Tilt 4	1.8%	4 fl oz	June/July X 2	50	Aerial	0.005
NEMATODES						
Counter CR		6 lb	May	10	in planter furrow	0.001