Crop Profile for Corn (Field) in West Virginia

Prepared: March, 2004

General Production Information

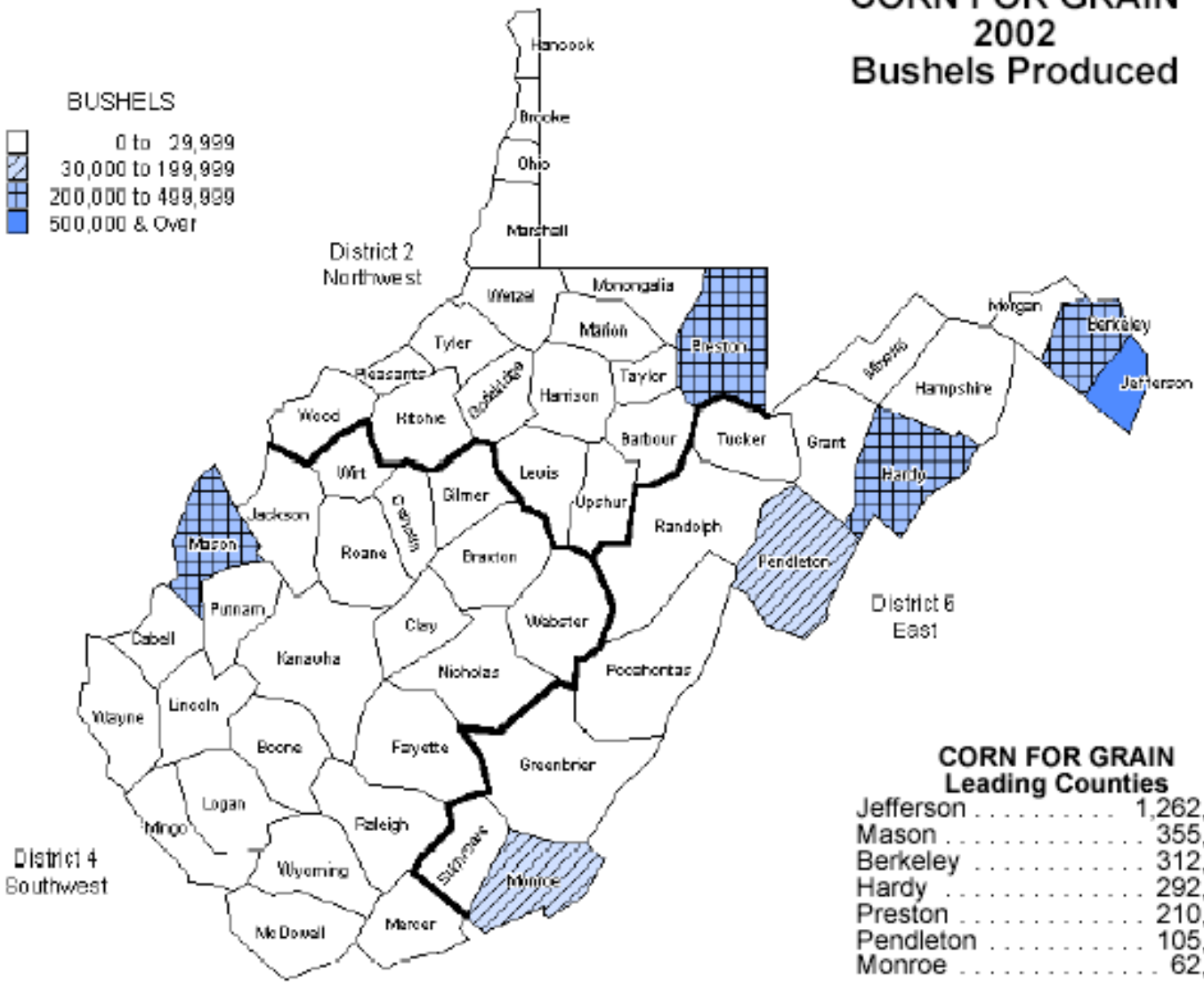
- West Virginia's rank 38th in corn production in the nation's agriculture-2002
- Area planted to corn for all purposes in 2002 totaled 50,000 acres.
- Harvested area for grain totaled 30,000 acres.
- The average yield was 105.0 bushels per acre.
- Total corn production for grain was 3.15 million bushels.
- Price per Bushel is $2.9, and a total production value of $9,135,000.
- Corn for silage area harvested was 19,000 acres in 2002.
- Yields averaged 16.5 tons per acre.
- Silage production was estimated at 314,000 tons.

Production Regions

Farms planted for corn are distributed in pockets throughout regions of the state with Jefferson county as the largest area planted in corn (Please see the following maps for distribution and ranking by county).

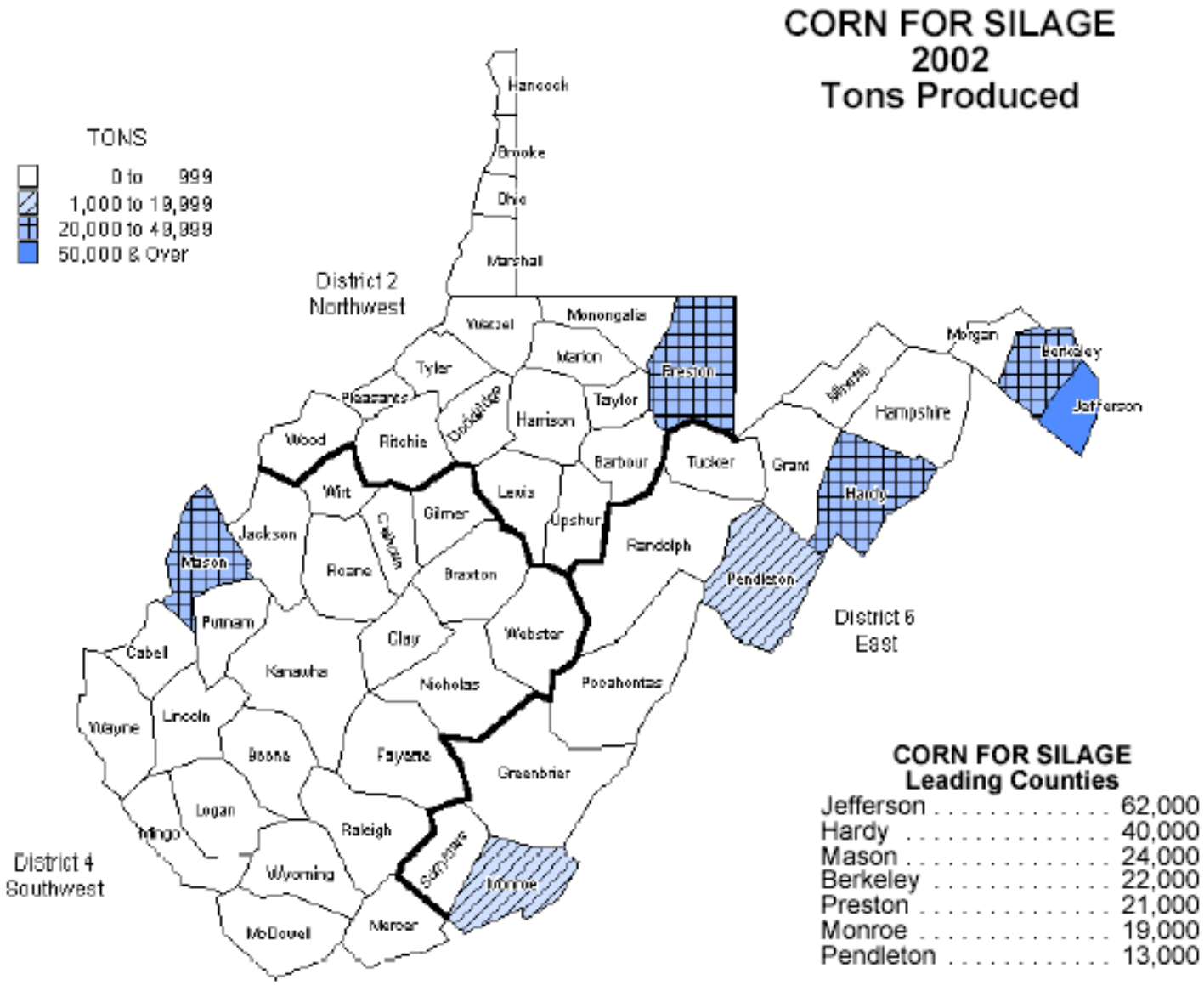
The Crop Profile/PMSP database, including this document, is supported by USDA NIFA.

CORN FOR GRAIN
2002
Bushels Produced



CORN FOR GRAIN
Leading Counties

Jefferson	1,262,000
Mason	355,000
Berkeley	312,000
Hardy	292,000
Preston	210,000
Pendleton	105,000
Monroe	62,000



Several corn varieties are available to West Virginia growers (i.e., Pioneer, Doebler, Southern States, and Asgrow). Variety selection depends on length of growing season (i.e., 105, 95, and 85 days), need for silage or grain, soil conditions, weed pressure, and producer preference.

Cultural Practices and Worker Activities

Cultural Practices

Field corn grows in most soil types. General cultural practices for field corn production include: selection of reliable hybrid seed, conventional ground preparation, minimum till soil preparation, or no-till planting. Planting to a population of 25,000 to 30,000 depending on variety is recommended. Fertilization should be based on soil test recommendations. Herbicide applications usually require a pre-emergence application and a possible post-emergence treatment depending on weed species and weed populations. Insecticide usage may include seed

treatments for seed corn maggots, wire worm and root worms. Other insecticide treatments for such insects as armyworms, corn bores, etc should be based on proper scouting procedures. Harvesting time for silage or for grain should be based on the crop maturity and moisture content. Corn storage facilities should be treated for insects before storing. All pesticides should be selected and used based on label recommendations.

Worker Activities

Workers will be involved in most, if not all, field activities throughout the season. Plowing, disking and leveling the soil where conventional tillage is used. Chisel plowing and disking when using minimum tillage will be necessary. Transporting, handling and applying fertilizers may include granules, liquids, and gaseous forms. Transporting, mixing, and applying insecticides and herbicides on a regular time schedule is recommended. Harvesting by machinery to make silage or for picking is standard procedure. Workers are subject not only to pesticide exposure, but to other chemicals as well. Reading the label and using proper protective equipment needs to be implemented on site in order to minimize risk of chemical exposure.

It would be anticipated that workers in field corn production would probably devote the following amount of time per acre for the growing season

- 1a. Conventional tillage
  - Plowing .49 hrs/A
  - Disking .17 hrs/A
  - Harrowing .22 hrs/A
  - Planting .34 hrs/A
- 1b. Minimum tillage
  - Chisel Plowing .29 hrs/A
  - Disking .17 hrs/A
  - Planting .50 hrs/A
- 1c. No till Planting .50 hrs/A
- 2. Spreading fertilizer .25 hrs/A
- 3. Pre-emergence herbicide spraying .10 hrs/A
- 4. Post-emergence herbicide spraying .10 hrs/A
- 5a. Combining for grain .35 hrs/A or
- 5b. Chopping for silage 1.71 hrs/A

(**Personal Contact**: Rodney Wallbrown, Extension Associate Professor-Mason County, West Virginia University)

Insect Pests

The most economically important insect pests in corn production in the state are European corn borer, root worms, aphids, black cutworm, and Japanese beetle. Other insect pests that invade corn plants and cause noticeable damage include army worms, wireworms and seed corn maggots.

European Corn Borer

Adult moths of European corn borer spend the day in weeds and grasses bordering the host plants, then flying to the host in the evening to lay eggs on the undersides of leaves. After hatching, the larvae crawl to the plant and feed for about five to seven days before boring into the stalks and stems. Once the larvae are in the plant, damage can't be prevented. Larvae overwinter in the stalks and stems of host plant.

Chemical Control:

Bacillus thuringiensis (Dipel 10G.): Very effective when larvae are young. Applied as a band over whorl or broadcast by air at a rate of 0.5-1.0 lb. active ingredient per acre.

Chlorpyrifos (Lorsban 4E): Restricted use, applied as a band over whorl at a rate of 1.0 lb. active ingredient per acre.

Carbaryl (Sevin 80S): Applied directly into whorl at a rate of 2.0 lb. active ingredient per acre.

Works best when larvae are young and exposed.

Pest Management:

To reduce the risk of infestation, do not rotate corn with potatoes. Chisel plowing, moldboarding, or disking prior to moth emergence can kill more than 50 percent of the larvae. Insecticides applied as the eggs hatch and before the larvae penetrate the plant will aid in control. Control is usually aimed at first generation.

Corn RootWorm (several Species)

Northern and Western species lay eggs in the fall, and eggs hatch and infest corn the following spring. Southern corn rootworm eggs are laid in spring. Mexican corn rootworm eggs are laid in summer and fall. Larvae tunnel into roots and, if feeding is severe, cause root pruning and potential for lodging occur.

Chemical Control:

Aztec (2.1% G): Restricted use, applied as a band or in furrow at a rate of 6.7 oz a.i./1000 feet of row.

Carbofuran (Furadan 4F): Soil insecticide applied as band or broadcast at a rate of 0.5 lb. active ingredient per acre.

Chlorpyrifos (Lorsban 15G): Applied in a band over the row behind the planter at a rate of 1.2 oz/1,000 ft. row.

Phorate (Thimate 15G): Applied in a band at a rate of 1.2 oz/1,000 ft. row.

Tefluthrin (Force 3G): Applied in a band or in furrow at a rate of 1.2-1.5 oz/1,000 ft. row.

Pest Management:

Scouting--Examine roots of two plants in at least 10 locations on a regular basis. If tow larvae per plant are found in late May or early June, treatment with a soil insecticide may be justified. A labeled soil insecticide at planting provides the most effective control. Crop rotation may reduce populations under normal conditions.

Aphids

Aphids are one of the most economically damaging insects growers face. They can overwinter on the other hosts and then fly into corn fields. Aphids feed on plant juices, reducing plant vigor and possibly increasing water stress. They also carry viruses to the plant, so that even a low population of aphids can cause severe economic damage.

Chemical Control:

Esfenvalerate (Asana XL): Restricted use, applied at a rate of 0.03-0.05 lb. active ingredient per acre.

Malathion (Cythion 57% EC): Applied at a rate of 1.25 lb. active ingredient per acre.

Microencapsulated methyl parathion (Penncap-M 2F): Restricted use, applied at a rate of 0.5 lb. active ingredient per acre.

Pest Management:

Allow predators and parasites of aphids to do their job. Maintain weed control to prevent host plants.

Black Cutworm

Large worms cut and notch plants and can cause extreme stand losses in a short period. Damage occurs April through June. Fields that are planted late or minimum-till with heavy spring weed growth or poorly drained soils are the most likely to encounter cutworms.

Chemical Control:

Aztec (2.1% G): Restricted use, optimum control of cutworms is achieved when it is applied as a band or a T-band at a rate of 6.7 oz a.i./1000 feet of row.

Chlorpyrifos (Lorsban 4E and 15G): Restricted use for the 4E formulation, applied at a rate of 0.5-1.0 lb. active ingredient per acre. Lorsban 15 G is applied at 1.0 lb. active ingredient per acre.

Esfenvalerate (Asana XL): Restricted use, applied at a rate of 0.03-0.05 lb. active ingredient per acre.

Tefluthrin (Force 3G): Restricted use, applied in a band or in furrow at a rate of 1.2-1.5 oz, a.i./1,000 ft. row.

Permethrin (Pounce 3.2 EC): Restricted use, applied in band or broadcast at a rate of 0.1-0.2 lb. active ingredient per acre.

Permethrin (Ambush 2E): Restricted use, applied in band or in furrow at a rate of 0.1-0.2 lb. active ingredient per acre.

Pest Management:

Low to moderate infestation can be treated with a labeled soil insecticide applied at planting. Heavy infestations may require a broadcast application of soil insecticide after infestation occurs. Using of preplant "burndown" herbicide at least 2 weeks before planting may reduce cutworm populations by eliminating food and egg-laying sites. Scouting – close examination of 20 plants in five locations in the field. If six percent or more plants are cut or tunneled, and larvae are less than one inch long, a chemical treatment may be warrant.

Japanese Beetle

The Japanese beetle is the adult of one species of white grub. Its larvae are soil-feeding insects. The adults begin emerging around July 4 and move to many species of plants to feed on the foliage. Corn fields that are silking can be extremely attractive to the beetles. When populations of the pest are extremely high, the number of beetles feeding on corn silks can reduce pollination, resulting in poor kernel set. In many cases, however, damage is restricted to the field margin. Consider control only if the feeding is spread throughout the field. In West Virginia, Japanese beetle populations are found in most corn fields, however, attributable yield loses are about 1% annually.

Chemical Control:

Zeta-Cypermethrin (Mustang 1.5EW): Restricted use, applied by air or ground at a rate of 0.034-0.05 lb. active ingredient per acre.

Pest Management:

Begin scouting in mid-July before pollination. Examine 20 plants in five locations in the field to determine the stage of pollination, the number of beetles present per plant, and percentage of plants with silks cut back to 0.5 inch or less. If silks are wilted and turned brown, pollination is complete and further silk feeding will not affect yields. An insecticide treatment may be necessary if 50% of plants have silks cut back to 0.5 inch or less.

Integrated Pest Management:

Building a good soil, improving general plant health, using certified seeds, and properly using control measures are the main emphasis needed for an Integrated Pest Management program.

Corn growers in West Virginia were asked the following question "List the most important pesticides to your IPM program and if these pesticides are banned, how will they affect your crop production?"…….. Table 1

summarizes the growers' responses to the aforementioned question.

Table 1. Pesticides and their importance in an Integrated Pest Management Program.

Insecticide	% Crop treated	Estimated % crop loss (if banned)
Aztec*	>70	75
Lorsban*	50	50
Force*	30	25

*** Restricted-Use Pesticides**

Stakeholders Comments:

- "Government needs to monitor mergers and consolidation of chemical companies, which continues to push for open market access and adoption of sound science. Competition must continue to drive the free market based economy."
- "We "farmers" tend to rotate crops to pesticides."
- "Without the benefit of these pesticides, we will not be able to maintain an economically viable operation."

Diseases

From 1960 to the present, the predominant corn diseases have been maize dwarf mosaic virus and maize chlorotic dwarf virus. These diseases have affected a major corn production area along the Ohio river valley in West Virginia. Management of these diseases have been through the use of resistant varieties. Southern corn leaf blight was a serious problem in the early 1970's. Management was through use of corn varieties. Cercospora gray leaf spot initially occurred in 1979 as a problem in the eastern panhandle of the state. The disease has since been sporadic with corn varieties showing resistance.Almost all corn growers in West Virginia tend not to use fungicides in field corn production, however they relay on the use of disease resistant varieties.

Corn diseases cause yearly losses from 2 to 7%, but, in some localized areas; one or more diseases may become acute and destroy a larger percentage of the crop. Ear and kernel rots decrease yield, quality, and feeding value of the grain. Stalk diseases not only lower yield and quality, but also make harvesting difficult. When leaves are damaged by disease, the production of carbohydrates to be stored in the grain is decreased; immature, chaffy ears result. Corn diseases may be classified as parasitic and non-parasitic. Fungi, bacteria, or viruses cause most parasitic (infectious) diseases of corn.

Non-parasitic disorders result from unfavorable climatic and soil conditions. Nitrogen, phosphorus, or potassium deficiencies cause some of the most frequently observed non-parasitic corn disorders. Occasionally, corn may suffer from lack of essential minor elements in the soil such as zinc or sulfur.

Maize Dwarf Mosaic Virus

Symptoms -- Symptoms first appear on the youngest leaves as an irregular, light and dark-green mottle or mosaic, which may develop into narrow streaks along the veins. As plants mature, the leaves become yellowish-green. Plants with these symptoms are sometimes stunted with excessive tilling, multiple ear shoots, and poor seed set. Early infection may predispose maize to root and stalk rots and premature death. Symptoms can appear in the field within 30 days after seedling emergence.

People, animals, machines moving through the fields, and at least 12 species of aphids, including the corn leaf aphid, the green bug, and the green peach aphid transmit the virus. Johnsongrass is believed to be a major overwintering host for one strain of maize dwarf mosaic virus; insect carriers acquire the strain from johnsongrass in the spring and summer and infect maize plants. Another strain does not infect johnsongrass, but overwinters in other perennial susceptible grasses.

Management-- Maize varieties differ in their resistance to the virus. Varieties resistant to strain B of the virus are also resistant to strain; however, those resistant to strain may be susceptible to strain B. Johnsongrass or other overwintering hosts should be destroyed.

Maize Chlorotic Dwarf Virus

Symptoms--The earliest symptom caused by maize chlorotic dwarf virus is a yellowing of the young leaves in the whorl. As infected leaves unfurl, a distinct yellow striping becomes apparent. Leaf yellowing or reddening and moderate to severe stunting of internodes are common.

Maize Chlorotic Dwarf Virus is transmitted by the leafhopper *Graminella nigrifrons* and *G*. (*Deltocephalus*) *sonora*. The main overwintering host is Johnsongrass. Other hosts include broomcorn millet, milo, grain sorghum, Sudangrass, wheat, crabgrass, and foxtails.

Management—Maize varieties differ in their resistance to the virus. Johnsongrass management with herbicides is important.

Cercospora or Gray Leaf Spot

This disease occurs in warm to hot humid areas of the United States. It was first reported in West Virginia in Hardy County in 1980.

Symptoms -- Lesions on maturing maize leaves are pale brown or gray to tan, long (1/4 to 2 inches), narrow and rectangular, and characteristically restricted by the veins. The lesions may coalesce, killing the leaves. The fungal disease is usually first noticed attacking the lower leaves. Extensive leaf blighting may occur until all the

leaves are killed, finally resulting in stalk breakage and lodging. Total loss may occur if gray leaf spot infection occurs early and favorable environmental conditions exist following infection.

Environmental Conditions: The fungus causing this disease is most prevalent within the United States in untilled or minimally tilled fields.

Management: Hybrids differ greatly in their tolerance. Reduction in disease losses can occur by planting hybrids with partial resistance or tolerance. The use of hybrids with some resistance to gray leaf spot is important in a no-till, continuous corn production system. When corn is produced no-till for silage one year, the next year's level of disease in not as high as if corn were taken for grain. Hybrids should be planted at recommended seeding rates to promote rapid stand establishment and optimal plant development. Late planting dates increase the risk of greater gray leaf spot problems.

Fusarium Stalk Rot

Rotting commonly affects the roots, plant base, and lower internodes. It normally begins soon after pollination and becomes more severe as the plant matures. The fungus is commonly seedborne.

Symptoms --Whitish-pink/salmon discoloration of pith, stalk breakage and pre-mature ripening.

Optimal Environmental Conditions -- The factors affecting the prevalence of this disease are not fully known, but dry weather in the early growing season followed by ample rainfall for two to three weeks after silking appears to favor the development of this disease. Severe infection by any of the leaf diseases or destruction of leaves by hail or insects predisposes stalks to infection. Soil fertility may affect the severity of stalk rot. Observations have shown that more stalk rot occurs where soils are excessively high in nitrogen and low in potassium than where fertility is ample and balanced.

Management-- The use of resistant hybrids is one way to reduce rot. Full-season hybrids generally are more resistant than those maturing early in a given area. Properly balanced soil fertility tends to reduce the abundance and severity of stalk rot. When the soil is infertile, potassium-deficient or too rich in nitrogen, the disease often is severe. The application of the proper kinds and amounts of fertilizer based on soil and tissue tests may help minimize stalk rotting and breakage.

Weeds

A total of 16 problem weed species, 10 hard-to-control weeds, and four herbicide resistant weeds were reported in corn fields. Of these, Johnsongrass was the most reported problem weed in corn followed by velvetleaf and pigweed spp. (Table 2).

Table 2. Corn Weed Species and Their Ranking in West Virginia

Weed species	**Ranking***
Johnsongrass	1
Velvetleaf	2
Pigweed spp.	3
Burcucumber +	3
Common Lambsquarters	3
Foxtail spp.	3
Fall panicum	7
Bindweed spp.	7
Ragweed spp.	7
Yellow nutsedge +	10
Common purslane	10
Thistles spp.	10
Common Cocklebur	10
Morningglory spp.+	10
Runningbriers +	10
Goosegrass	10
Herbicide -Resistant Weeds	1
Pigweed spp. (triazine)	2
Lambsquarters (triazine)	3
Velvetleaf (triazine)	3
Johnsongrass (triazine)	

* Ranking #1: the most frequently reported problem weed in West Virginia.
+ Hard-to-control weed species. Also, sumac, mulberry, ryegrass, kudzu, Japanese bamboo, and wild chrysanthemum were reported as hard-to-control weed species.

Chemical control:

The following herbicides were reported to be used for weed control in corn: Aatrex, Accent, Axiom, Banvel, Basis, Bicep, Broadstrike, Bullet, Dual, Exceed, Gramoxone, Lightning, Princep, and 2,4-D. Other herbicides registered or used in low quantities to manage weeds in West Virginia include Bicep Magnum, Callisto, Cinch, Degree, Distinct, Harmony GT, Keystone (RUP), Lumax, Outlook, and Python.

Nonchemical control:

Two nonchemical methods were reported for weed control in corn: cultivation (i.e., chisel plow and heavy disk) and crop rotation. Other reported methods of weed management include integrated pest management and planting Roundup-ready corn.

Table 3. Pesticides and their importance in an Integrated Pest Management Program.

Insecticide	**% Crop treated**	**Estimated % crop loss (if banned)**
Aatrex	100	80
Accent	100	60
Banvel	100	< 70
Beacon	100	< 70
Clarity	90	30
Exceed	100	< 70
Glyphosate	65	55
Harness*	100	50
Lightning	25	55
Option	90	60
2-4, D	75	< 70

*** Restricted-Use Pesticides**

Stakeholders Comments:

- "Without the pesticide Aatrex we would have to cut acreage because man power for this type of work is too hard to find."
- "GMO products help with weed control."
- "We need more selection and availability of herbicides in the state. For example, farmers in Ohio noted a good weed control using the herbicide Balance, which is not currently registered in West Virginia. We would like to see the herbicide balance registered in our state and be able to use it."
- "Farmers don't abuse pesticides because of the cost. We don't throw money away for the hick of it. There must always be a large variety of pesticides available to lesson resistance by weeds and insects."
- "Do not limit availability of chemicals, the more choices available the better decisions we can make."
- "I experienced allergy to the herbicide Lasso and would like to know if it is safe to use."

Nematodes

A variety of plant-parasitic nematodes occur in West Virginia corn fields. Lesion nematode (*Pratylenchus* spp.), Dagger nematode (*Xiphinema* spp.), Stunt nematode (*Tylenchorhynchus* spp. and *Quinisulcius* spp.), Lance nematode (*Hoplolaimus* spp.), and Spiral nematode (*Helicotylenchus* spp.) are the most commonly occurring nematode pests. Lesion nematode occurs in the majority of West Virginia corn fields and is of greatest concern when pre-plant population densities exceed 100 per 100 cc soil. Southern root knot nematode (*Meloidogyne incognita*) is found mainly in the southernmost parts of the state, and does not tolerate cold winters. Other root knot species identified in West Virginia do not damage corn significantly. Needle nematodes (*Longidorus* spp.) occur in the state, and may be damaging in light sandy soils, but are rare elsewhere.

At high population densities, nematodes will damage corn roots, stunt plants and suppress corn yield, with effects being most severe in sandy soils. Management practices specific to nematode control are seldom applied; however, various indirect management practices often contribute to suppression of plant-parasitic nematodes in corn production. In addition, nematode management on corn may provide benefits to higher-value crops grown later in the rotation.

Chemical Control:

Farmers tend not to rely solely on nematicides because the yield response seldom justifies the cost of the nematicide. However, farmers may select combination insecticide-nematicides that suppress nematode populations as part of their rootworm management program. Terbufos (Counter) combines both nematode and corn rootworm control activity and may be useful where damaging levels of both pests occur. In a few cases, soil fumigants (e.g., Telone) may be used, but this is seldom justified economically due to the high cost and difficulty of application to West Virginia fields. Use of fumigation tends to be restricted to sites where high value crops (e.g., apple or peach orchards) follow corn in a rotation.

Non-Chemical Pest Management:

Corn cultivars are known to vary in their resistance to different nematode pests, however, little information is available on cultivars commonly grown in West Virginia. More research is needed before cultivar selection will be a useful management practice

Crop rotation of corn with most common agronomic crops is only moderately effective against Lesion and other nematodes because nematodes may attack most crops used in rotations. A few crops are suppressive to nematodes (e.g., marigolds, sudan grass, tall fescue); however, these may not be economically feasible for inclusion in crop rotations. Use of green manure crops (brassicas, sudan grass) provides a measure of nematode suppression in some cases, but is not widely practiced in West Virginia corn production.

Naturally occurring biological control agents for nematodes occur in many soils; however, none are commercially available, and more research is needed to evaluate practices that enhance effectiveness of indigenous biocontrol organisms.

(**Personal Contact:** Dr. James Kotcon, Nematologist, West Virginia University)

Vertebrate Pests

Deer are, by far, the most injurious vertebrate pest of filed corn in West Virginia. Birds and raccoons also cause considerable damage. Electric fence (1-wire 30" high) and a 7-foot high fence were noted as effective methods for deer control in the state.

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- Rakesh Chandran, Ph.D., Extension Specialist, Integrated Pest Management, West Virginia University
- James Kotcon, Ph.D., Nematologist, West Virginia University
- David J. Workman, Extension Associate Professor-Hardy County, West Virginia University Extension Service
- Joyce Bower, Office of Extension Communications, West Virginia University
- Survey questionnaires were sent to field corn producers in West Virginia. Personal interviews also were made with major field corn growers in the state. Survey responses and interview comments were summarized and reported accordingly.

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