

Field Corn Production Problems: A Diagnostic Guide¹

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The field is a complex environment with many factors that can interact to influence the growth of a corn plant. These factors can be in the form of insects, diseases, nematodes and weeds (biotic); or, they can be factors such as weather, nutrients, or chemicals (abiotic). Under optimum conditions, production of field corn can exceed over 200 bushels of corn per acre; under totally unfavorable conditions, every corn plant can die.

This guide was prepared to help identify problems so the proper corrective measures can be taken to minimize or prevent yield losses. For any corrective action to be successful, early detection is essential.

The Florida Extension Plant Diagnostic Clinics can help determine disease and insect diagnostic problems that cannot be easily identified. The clinic works primarily through county extension offices in Florida. You may contact your county office with your unidentified disease or pest problem.

There are also web sites where pictures can be found such as <http://www.ent.iastate.edu/imagegal/plantpath/> or

<http://www.ent.iastate.edu/imagegal/plantpath/corn/ndeficiency/> and

<http://www.ent.iastate.edu/imagegal/plantpath/corn/kdeficiency/sawyer1mc-007.html>. Some problems (pest or nutrient) have similar symptoms and therefore observation alone as described in this document is not a definitive diagnosis, but serves as an initial guide.

Growth Stage Definitions

Before Emergence- Seed planted -Germination of seed may require from 4 to 30 days depending upon soil temperature.

Two Leaf Stage- Two leaves fully open, collar visible- Leaves have emerged but the growing point is still below the soil surface.

Early Whorl- 4-6 leaves fully emerged- Plants are in the 5 leaf stage and larger.

Mid Whorl- 8-10 leaves fully emerged -This is a period of rapid leaf formation and the beginning of rapid stalk elongation. The tassel and ear shoots are developing.

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Late Whorl- 12-16 leaves fully emerged- Leaf enlargement is complete, and brace roots are developing. The potential numbers of kernels on the ear is determined by this time. The stalk is rapidly growing and the tassel is almost full size.

Tasseling- Tassel emerging- Final stalk elongation occurs during this stage.

Early Silk- Silks emerging, pollen shedding- The tassel is fully emerged, and stalk development is complete. The ear shank and husks are growing rapidly. Ovules are enlarging and the silk from each ovule is near the tip of the ear and emerging. The number of ovules that will be fertilized and develop into kernels is being determined at this stage.

Blister Stage- Brown silk, cob full size, watery kernels-The cob, husk and shank are fully developed. Starch has begun to accumulate and the kernels are rapidly increasing in size. The plants continue to absorb soil nitrogen and phosphorus, but much of these nutrients are being supplied from other plant parts. High water uptake period for grain fill.

Soft Dough- Kernels milky with some starch- Starch is accumulating and embryo formation in each new kernel is underway.

Hard Dough- Few kernels with dents- Embryo growth is rapid, and kernels are denting.

Physiological Maturity- Black layer formed, grain mature and drying- Dry matter accumulation has ceased, and moisture loss begins. The husks and some leaves are usually no longer green. Most kernels are dented, and "black layer" formation is complete. Moisture is between 30-35%.

Table 1. Diagnosis of General Plant Problems by Growth Phase.

| General Appearance | Specific Symptoms | Possible Cause(s) |
|---|---|--|
| I. BEFORE EMERGENCE | | |
| A. Skip in rows where plants fail to emerge. | Seed not sprouted. | Seed not viable Anhydrous or aqua ammonia injury. Excessive fertilizer (nitrogen and/or potash) placed too close to seed. Soil too dry, or water logged. |
| B. Seed or sprout eaten or dug up. | Seed swollen, but not sprouted. | Mice, skunk, rats, crows, blackbirds. |
| | Rotted seed or seedlings. | |
| | Seed hollowed out. | |
| | Unemerged seedling dug up and/or entire plant eaten. | |
| II. EMERGENCE TO KNEE-HIGH | | |
| A. Scattered problem spots of dead or poorly growing plants | Plants stunted, wilted and/or discolored. | Cutworm damage. |
| | Plants cut off above or below ground. | |
| | Sudden death of leaves or plants. | |
| | Plants with rough gouged out feeding damage at or just below the soil surface. | |
| B. Wilting | Upper leaves roll and appear dull or sometimes purple; stunting of plants; plants may die. | Dry surface soil, shallow planting (1/2 inch or less), sand blasting. |
| | Whorl dead. | |
| | Crown roots not developing. Plants appear weak and sickly; wilting may occur; tunneling or girdling at or near soil surface is apparent. | Lesser corn stalk borer caused by dry weather or planting into not fully decayed or green plant material. |
| C. Plants discolored. | Leaves appear sandblasted; leaves pale-green or whitish in color. | Potassium deficiency. Excessive fertilizer or chemical uptake. |
| | Leaf edges yellow or dead. | Excessive herbicide rates-(linuron (Lorox), ametryn (Evik), post emergence with oil, atrazine and other photosynthetic inhibitors: in severe cases, plants may die). |
| | Yellowing or browning beginning from the tips. | |
| | Lower leaves dead, tips on upper leaves dying. | Fertilizer injury. |
| | General yellowing of upper leaves. | Sulfur deficiency. |
| | General yellowing of lower leaves. | Excessive moisture. Nitrogen deficiency. |
| | Purpling or reddening of leaves from tips backwards; affects lower leaves initially; leaf tips may later turn dark brown and die. | Phosphorus deficiency. |
| | Leaves slowly turn white to tan and die. | Glyphosate (Roundup), other herbicide injury. |

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| General Appearance | Specific Symptoms | Possible Cause(s) |
|-----------------------------------|---|---|
| | Irregular light and dark mottling or mosaic on the leaves. Sometimes reddening of leaves. | Maize dwarf mosaic or maize chlorotic dwarf viruses. |
| | Irregular light gray or silvery blotches on both sides of leaves on the east side of affected plants. | |
| | Light streaking of leaves which develops into a broad band of bleached tissue on each side of the midribs; leaf-midribs and margins remain green; sometimes stalks and leaf edges appear to be tinted red or brown. | Zinc deficiency. |
| | Bright yellow to white strips with smooth margins running the length of leaves; may appear on scattered plants throughout the field and sometimes, only on one side of a plant. | Genetic stripes. |
| | White or yellow stripes between leaf veins. | Excessively acidic soil; Magnesium, iron, manganese, boron or sulfur deficiencies. |
| | Distinct bleached bands across leaf blades; leaf tissue may collapse at discolored bands, resulting in the leaf folding downward at this point. | Air pollution injury; herbicides injury; cold banding. |
| D. Plants discolored and stunted. | Leaves yellow; plants spindly and stunted. | Nitrogen deficiency. Sulfur deficiency-more pronounced on younger leaves than nitrogen deficiency; Water logged soils, sting or stubby-root nematodes. Phosphorus deficiency-mild. |

Table 1. Diagnosis of General Plant Problems by Growth Phase.

| General Appearance | Specific Symptoms | Possible Cause(s) |
|--|---|--|
| E. Plants discolored and/or malformed. | Whitish striping along leaf veins. | Sulfur deficiency. |
| | Excessive tillering; stunting. | |
| | Slight yellow-green tint; severely stunted; inability of leaves to emerge or unfold-leaf tips stick together, giving plants ladder-like appearance. | Calcium deficiency; Herbicide injury-Amide herbicide (Dual, etc.). |
| | Leaves yellow and not fully expanded; roots sheared off or dried up. | Over application of anhydrous or aqua ammonia. |
| | Leaves fail to unfurl properly, often leafing out underground; plants may be bent, lying flat on the soil surface. | Excessive herbicide rates- Dicamba (Banvel) or metolachlor (Dual). |
| | Leaves stunted-twisted, and may appear knotted or hooked as with a walking cane. | Thiocarbamate herbicide injury butylate (Sutan+); EPTC (Eradicane); or Metalachlor (Dual). |
| | Shoots and roots malformed; general stunting of plants. | Excessive rates of soil applied phenoxy (2,4-D) or dicamba |
| | Onion-leafing (leaves remain wrapped in a tall spike). | High herbicide rates applied "over the top"; dicamba (Banvel), leaves may be narrower than normal; 2,4 -D injury may cause temporary (7 to 10 days) stalk brittleness. |
| | Plants bent or twisted; stunted; irregular rows of holes in unfolded leaves. | Stalk borer; Billbug. |
| F. Lesions on leaves. | Spots of dead tissue on leaves. | Paraquat-Atrazine and oil herbicide injury; with paraquat, damage occurs only where the chemical contacts the plant tissue. |
| | Circular to oval cinnamon-brown pustules. | Common and southern corn rusts. Southern corn leaf blight. |
| G. Plant tissue removed. | Whole plant cut off at ground level. | Cutworm. |
| | Leaves entirely eaten off or large chunks of leaf tissue removed. | Armyworms; Grasshoppers. |
| | Ragged holes in the leaves. | Hail damage; European corn borers; Corn earworms; Cutworms-early larval damage. |
| | Shredding, tearing of leaves. | Wind damage; Hail damage |
| | Rows of circular to elliptical holes across leaves. | |
| | "Window effect" on leaves-leaves (area between upper and lower surface) eaten out, leaving a transparent 'mine' with bits of dark fecal material scattered throughout. | Corn blotch leaf miners. |
| | Yellowed and weakened area on leaf midrib from tunneling feeding damage; often frass (sawdust-like excrement) evident around the feeding wound; the midrib will commonly break at this point, causing the leaf blade to fold down from the damage area. | European corn borers. |

Table 1. Diagnosis of General Plant Problems by Growth Phase.

| General Appearance | Specific Symptoms | Possible Cause(s) |
|---|---|--|
| III. KNEE-HIGH TO TASSELING | | |
| A. Severe wilting and/or death of plants. | Sudden death of plants. | Lightning (All plant material in an approximately circular area suddenly killed; plants along margin of affected area may be severely to slightly injured; severely injured plants may die later). |
| | Dieback of leaves wilting, then drying up of leaf tissue, beginning at leaf tips. | Molybdenum deficiency (younger leaves may twist); Air pollution |
| | Dead leaves or plants, usually at row ends. | Excessive fertilizer or herbicide rates, or soil compaction. |
| B. Plants discolored | Yellowing of plants, beginning with lower leaves. | Potassium deficiency. |
| | Yellowing of leaf margins beginning at tips; affected tissue later turns brown and dies. | |
| | Purpling or reddening of leaves from tip backward; affects lower leaves initially; leaf tips may turn dark brown and die. | Phosphorus deficiency. |
| | Yellow to white interveinal striping on leaves. | Genetic stripe-(stripes have smooth margins; may appear on scattered plants throughout the field and, sometimes, only one side of a plant). |
| | | Boron deficiency-(initially white, irregularly shaped spots develop between veins which may coalesce to form white stripes that appear waxy and raised from leaf surface; plants may be stunted). |
| | Leaves completely white. | Herbicides such as Zorial or Cotoran. |
| | Leaves turn whitish. | Spider mites. |
| | Pale green to white stripes between leaf veins, usually on upper leaves. | Iron deficiency. |
| Upper leaves show pale green to yellow interveinal discoloration; lower leaves appear olive green and somewhat streaked; severe damage appears as elongated white streaks. The center of which turns brown and falls out. | Manganese deficiency. | |
| C. Plants discolored and malformed. | Plants show stunting and/or a mottle or fine chlorotic strips in leaves. Leaves can be reddish. | Maize dwarf mosaic virus or maize dwarf chlorotic virus. |
| | Stunting, tillering; twisting and rolling of leaves. | Crazy top, plant virus. |

Table 1. Diagnosis of General Plant Problems by Growth Phase.

| General Appearance | Specific Symptoms | Possible Cause(s) |
|----------------------------------|--|--|
| | Plants darker green; stalks twisted at mid to upper half; ears often do not develop. | Herbicide injury-butylate (Sutan+) or EPTC (Eradicane). |
| | Twisting and bending at corn stalks above the ear shoot; ear may be malformed. | |
| | Plants lodge or grow up in a curved "sled runner" or gooseneck shape. | |
| | Soft, glistening white gall soon becomes black and dusty on stalks, leaves, ear or tassel. | Common smut (fungus). |
| E. Plant tissue removed. | Ragged holes in the leaves and shredding of plants. | Hail damage. |
| | Shredding, tearing of leaves. | Wind damage. |
| | Leaf tissue skeletonized or lacy in appearance. | Japanese beetles. |
| | Leaves entirely eaten off or large chunks of leaf tissue removed. | Armyworms. Grasshoppers. Fall armyworms. Corn earworms. Livestock. Wildlife. |
| | Holes bored into stalks and area within stalk hollowed out by feeding damage. | |
| F. Lesions on plants. | Oval, circular, or rectangular lesions, tan to brown in color. | Southern corn leaf blight. |
| | Circular to oval, brick-red to cinnamon-brown pustules on leaves. | Common and southern corn rust (fungi). |
| IV. TASSELING TO MATURITY | | |
| A. Silking impaired. | Delayed silking or failure to silk. | Cucumber beetles. Japanese beetles. Grasshoppers. |
| | Silks clipped off. | |
| B. Tassels malformed. | Tassels fail to emerge. | Boron deficiency-(initially white, irregularly-shaped spots develop between veins which may coalesce and form white stripes that appear waxy and raised from leaf surface; plants may be stunted). |
| | Tassels and upper stalk and foliage bleached-premature drying. | Anthracnose. |
| | Tassels develop as a mass of leaves. | Crazy top a plant virus. |
| | Broken tassel from tunnelling. | European corn borer. |
| C. Plants discolored. | Yellowing of leaf margins beginning at tips; affected tissue later turns brown and dies. | Potassium deficiency. |
| | Reddish or purple leaf. | Injury near leaf base, leaf injury; no ear on stalks and leaf is a carbohydrate sink. |
| | Irregular, purple-brown spots or blotches on sheaths. | Purple sheath spots. |

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| General Appearance | Specific Symptoms | Possible Cause(s) |
|--|---|---|
| D. Stalks malformed and/ or broken. | Lower stalk internodes and brace roots easily compressed; stalks may lodge. | Fungal stalk rots. |
| | Plants lodge, stalk may break. | European corn borer; wind; potassium deficiency-yellowing of leaf margins, beginning at tips; affected tissue later turns brown and dies. |
| E. Premature death of all or some parts of plants. | Sudden death of entire plant. | Anthracnose leaf blight (fungus). |
| | Extensive areas of leaf tissue die prematurely, resulting in leaf drying. | |
| | Top kill-premature death of all or portion of plants above ears. | Severe drought. |
| | Early death of plant. | |
| F. Leaf tissue removed. | Ragged holes in the leaves. | Hail damage. |
| | Shredding, tearing of leaves. | Wind damage. |
| | Small, irregular holes in leaves. | European corn borer. |
| | Large, irregular holes in leaves. | Grasshoppers; Fall armyworms. |
| G. Plants discolored or stunted. | Slight to severe stunting; yellowing and sometimes reddening of foliage. | Maize dwarf mosaic or Maize chlorotic dwarf viruses. |
| | Reddish or purple stalk | Barren plant. |
| H. Lesions on plants. | Tan, oval to rectangular lesions, tan to brown in color. | Southern corn leaf blight. |
| | Elongate, irregular brown water-soaked leaf stripes or spots on lower leaves. | Bacterial leaf spot. |
| | White, dried areas between leaf veins. | Air pollution. |
| | Numerous red/brown to black pustules on any above ground part, especially the leaves; leaves dry out. | Common or southern rusts. |
| I. Damage to ears. | Large chunks removed from husks and ears; kernels eaten off. | Corn earworm usually feed near the ear tip; European corn borer-bore into kernels and cobs; fall armyworms; cucumber beetles; corn sap beetles. |
| | Tunneling or chewing feeding on kernels. | |
| | Ears drop to ground. | European corn borers-(feeding damage to ear shanks and hybrid is susceptible to ear drop). |
| | Barren stalks. | Maize dwarf mosaic or maize chlorotic dwarf viruses; High temperatures during pollination causing sterility; Drought; Timing of silking not synchronized with pollen shed; Plant population too high; Low fertility; Silks clipped back by insects; Corn leaf aphids-caused delay or failure of silking; 2, 4-D herbicide injury-applied during tasseling or pollen shed stage. |
| | Excessive ear shoots which are leafy and barren. | Crazy top plant virus. |
| | Soft, glistening galls on the ear, later black and powdery. | Common smut fungus. |

Table 2. Herbicide Injury Guide.

| Herbicide U.S. Common and Trade Name | Symptoms | Remarks |
|---|--|--|
| Triazine (several products simazine (Princep), ametryn (Evik), etc. | Gradual interveinal chlorosis. Leaves may die back from tips and turn light brown. Height of plants may be highly variable. Where severe, entire plants may be killed. Ametryn applied within 3 weeks before tasseling may affect pollination. | Injury may occur on sandy soils low in organic matter or due to excessive rates. Cool, wet weather, or other factors adversely affecting plant's metabolism. |
| Acetanilides metolachlor (Dual), propachlor (Ramrod,), etc. | Injured seedlings and older plants may have stunted or malformed shoots that fail to unfurl. Plants may tend to leaf out underground; may have some "laddering". | Cool, wet weather prior to emergence is usually associated with injury, but the majority of plants will grow out of the damage. |
| Thiocarbamates products; Butylate, (Sutan), EPTC (Eptam, Eradicane), vernolate (Vernam), etc. | Extreme stunting, twisting, bending and malformation of plants. Expanding leaves may rupture and shred. Ear malformation may occur. | A "safening agent" added to formulations reduces injury to maize. Hybrids differ in sensitivity. |
| 2,4-D products. | Pre-emergence applications may produce severe stunting and malformation of roots and shoots. Post-emergence directed sprays may cause fasciation and upcurling of the brace roots. 2,4-D applied "over-the-top", especially on a hot day, may cause stalks to be brittle and break. Occasionally, a new leaf will fail to unfurl (onion-leaf). Applied near tasseling or at silking time, 2,4-D may interfere with seed set. | Do not apply 2,4-D with atrazine and oil. Temperature and humidity at or near time of application, growth stage of maize, genetic susceptibility method of application, and rate all influence amount of post-emergence injury. To avoid breakage, avoid cultivating while plants are brittle. |
| Benzoic acid products- Dicamba (Banvel), etc. | Misapplication may cause onion leafing, proliferation of inhibited roots, abnormal brace root formation or fasciation. Lodging may occur from post-emergence applications. Resembles 2,4-D injury symptoms. | Dicamba applied pre-emergence may cause injury, especially when unfavorable environmental conditions exist during seedling emergence. |
| Phenylureas products- Linuron (Lorox), etc | Injury is similar to that caused by triazine herbicides. Yellowing occurs first at leaf tips and margins followed by browning. Entire leaves may turn yellow and die. | This compound is taken up by the roots and translocated to the foliage. Can also affect plant growth if applied post-emergence. |
| Bipyridilium products- (Paraquat, Gramoxone), etc. | Leaf tissue turns brown and dies in flecks or spots where contacted by spray droplets; may superficially resemble bacterial or fungal leaf blight. | A non-selective contact herbicide with no significant soil activity. Not commonly recommended for directed post-emergence use in corn. |
| Dinitroanalin products- Pendimethalin (Prowl), trifluralin (Treflan), etc. | Reduced stand, stunting, or uneven plant height, purpling of leaves with roots somewhat pruned and "clubby" at ends. Injury from pendimethalin may result from direct pre-plant application. | Incorporation of pendimethalin increases risk of injury. May be confused with injury from nematodes. Major damage is from carryover residue; chemicals differ in their persistence. |

Table 3. Guide to Nutrient Deficiency Symptoms of Corn.

| | |
|--|----------------------------|
| I. Stunted Plant | common to all deficiencies |
| II. Loss of Green Color | common to all deficiencies |
| A. Color changes in lower leaves: | Element Deficient |
| 1. Yellow discoloration from tip backward in form of a V | Nitrogen |
| 2. Brown discoloration and scorching along outer margin from tip to base | Potassium |
| 3. Yellow discoloration between veins, finally edges become reddish-purple | Magnesium |
| 4. Purpling and browning from tip backward, waves | Phosphorus |
| B. Color changes in upper leaves: | |
| 1. Emerging leaves show yellow to white bleached bands in lower part of leaf | Zinc |
| 2. Young leaves show interveinal chlorosis along entire length of leaf | Iron |
| 3. Young leaves uniformly pale yellow, older leaves dying at the tips | Copper |
| 4. White, irregular spots between veins | Boron |
| 5. Young leaves show pale green to yellow discoloration between veins | Manganese |
| 6. Young leaves wilt and die along the margins | Molybdenum |
| 7. Upper leaves usually paler than lower leaves but can be uniform. Often develops stripping between the veins | Sulfur |