Corn Growth & Development Related to Herbicide Use

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Post-Emergence Herbicides

- The application of many of these is restricted beyond certain corn plant heights or leaf stages.
  - Where both height & leaf stage are listed on a label, the more restrictive of the two should be used for decision-making.
  - The reasons for these label restrictions are both physical and physiological.
Crop & Weed Canopies

- Large corn canopies may intercept more of a broadcast herbicide application than will that of the intended "victims" (i.e., the weeds).
- Larger corn plants often also means larger weeds that are more difficult to kill.
Ever Larger Leaf Area

- With every subsequent stage of corn development,
  - Leaf area per corn plant increases.
  - With broadcast applications, herbicide interception per corn plant increases.
  - Risk of herbicide injury increases.

Physiological Reasons for Label Restrictions:
Sexual Development

- Beginning at about leaf stage V5, the uppermost (and eventually harvestable) ear is initiated, as is the tassel.
- These reproductive structures are often quite sensitive to herbicides absorbed by the plant.

Leaf stage V5 = Lowermost five leaves with visible leaf collars
Ear Shoots on V6 Plant

Ear shoot at stalk node #4 near base of stalk of a V6 corn plant

Ear shoot at stalk node #5 near base of stalk of a V6 corn plant

Ear shoot at node #4 near base of stalk of a V6 corn plant

Ear shoot at stalk node #6
Ear Shoots on a V9 Plant

Ear shoots at nodes #3 and #5 of a V9 corn plant

Uppermost ear shoots and tassel of a V9 corn plant

Node #10  #11  #12  #13  Tassel
Leaf Cuticle Changes Over Time

- From VE (emergence) to V4:
  - “Leaves of corn…had crystalline deposits of wax on the surface of the cuticle.”
  - “These crystals reduced [herbicide] spray retention and leaf wettability by trapping air under the spray droplets.”

- Rapid changes from V5 to V8:
  - “…smooth wax film on the leaves”
  - “Spray retention increased from about 30% at the V4 stage to about 80% at the V6 stage.”

Source: http://www.weeds.iastate.edu/mgmt/2001/corncuticle.htm
Many labels do not clearly explain...

- How plant height should be measured or
- What is meant by a particular leaf stage.
Corn Plant Height

- Most agronomists agree that corn plant height should be that of free-standing plants.
  - Measure height from the soil surface to the arch of the uppermost leaf that is at least 50% emerged from the whorl.

Herbicide Labels?
Usually not clear whether plant height refers to free-standing plants
Corn Leaf Staging

Corn leaf staging is technically quite simple.

- All it requires is the ability to identify the right parts of a leaf and to be able to count.
Identifying Leaf Parts

- A corn leaf consists of three distinct morphological components:
  - The leaf blade
  - The leaf collar
  - The leaf sheath
Leaf Staging Methods

- Leaf collar method
  - Count only leaves with visible leaf collar
  - Begin with lowermost leaf that is shorter than the others and has a rounded tip.
  - End with uppermost leaf with visible leaf collar.

Source of Digital Image:
http://maize.agron.iastate.edu/corntitle.html
Leaf Staging Methods

- **Droopy leaf method**
  - Begin with lowermost leaf that is shorter than the others and has a rounded tip.
  - End with uppermost leaf that is at least 50% emerged from whorl.
  - Leaf tip often points down, but not always

Source of Digital Image:
http://maize.agron.iastate.edu/corntitle.html
Compare The Two Methods

- Leaf collar method:
  - Stage late V3
- Droopy leaf method:
  - Stage between late V4 & early V5

Source of Digital Image:
http://maize.agron.iastate.edu/corntitle.html
Herbicide Label Uncertainty

- Older labels ignored the first, rounded tip, leaf and ended with the uppermost leaf that was at least 50% exposed from whorl.
- A bastardized “droopy leaf” method that results in roughly the same numerical leaf stage as the leaf collar method.

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http://maize.agron.iastate.edu/corntitle.html
Herbicide Label Uncertainty

- Older labels ignored the first, rounded tip, leaf and ended with the uppermost leaf that was 50% exposed from whorl.
  - A bastardized “droopy leaf” method that results in the same numerical leaf stage as the leaf collar method.
- Newer labels purport to define leaf stages according to the leaf collar method.
  - Is some question about whether the first, rounded tip, leaf is counted, however.

**Bottom Line:**
Check with your chemical technical representative to verify which definition is appropriate for the herbicide you intend to use.
Pop Quiz!

- Using the leaf collar method, what is the leaf stage of this plant?

**ANSWER:** Late stage V6 to early V7

When Lower Leaves Go Kaput

- Determining growth stages on older plants is often more difficult because lower leaves naturally wither away as the plant develops.
  - But the missing leaves must still be accounted for when staging the plant.
Stalk Elongation to the Rescue

- Stalk elongation is increasingly evident after growth stage V4.
  - From VE to V4, stalk elongation is very insignificant. During this time, all the above-ground plant tissue consists of leaves and rolled-up leaves.
Recognizing Stalk Nodes

- After growth stage V4, the pace of stalk elongation picks up.
  - Individual stalk nodes can easily be detected after splitting a stalk down the middle.
Identifying Individual Nodes

- Stalk nodes serve as the point of origin for roots, leaves, tillers, and ears.
  - Careful stalk splitting will verify that Node #5 is usually the first individually recognizable stalk node.

Key Trivia for Staging Corn:
Stalk node #5 is the point of attachment for Leaf #5.
Help in Identifying #5 Node

The internode length between Node #4 and Node #5 is usually less than \( \frac{1}{2} \) inch, whereas that between Node #5 and Node #6 is 1 inch or longer.
Once #5 Node is Identified...

- Identify which leaf sheath connects to that node, then count upward to uppermost leaf with visible leaf collar to determine leaf stage of plant.
Stress, Corn, & Herbicides

Effects of severe stress can include...

- Shorter than expected plants for growth stage due to stunted stalk elongation.
- Altered plant metabolism that increases sensitivity to herbicides or decreases the plants’ ability to detoxify herbicides.
- Excellent growing conditions may increase risk of injury by increasing rate of herbicide uptake.

Final Thoughts:
Symptomology & Diagnostics

- Sometimes, the morphological symptomology of herbicide injury points to the time of application.
  - By which plant parts are affected
  - By recovery, or lack thereof, subsequent to damage

Final Thoughts:
Plants can confirm...

- Plant injury by Hornet™ + 2,4-D herbicides
  - Lower 9 to 10 leaves appeared normal in color and size
  - Remainder of leaves, stalk, and tassel severely stunted and malformed
- Plant appearance + GDD data supported V9 or V10 as timing of application.
  - Beyond V5 or V6 label limits
Hungry for More?

- Check out one of these fine Web sites...

- [KingCorn.org](http://www.kingcorn.org/)

- [Chat 'n Chew Café](http://www.kingcorn.org/cafe)