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WEED MANAGEMENT SOLUTIONS

Corn Growth Stage Affects Response to POST-Emergence Herbicides

Variable environmental conditions that result in uneven corn stands can create challenges for the proper timing of post-emergence (POST) herbicide applications, and a greater potential for crop injury. Understanding the process required for movement of an herbicide into the leaf and plant will help assist with POST decision-making[1]. Warm, humid conditions promote rapid herbicide absorption, while cool conditions may slow crop development, herbicide uptake, and crop selectivity. Crops under stress may not metabolize herbicides quickly enough to avoid crop injury.

Accurate assessment of corn growth stage is critical for effective herbicide performance and crop safety[2]. Growers should scout fields prior to POST applications to accurately determine the growth stage of the crop and the degree of variability that may exist across the field. Most herbicide labels define the maximum growth stage, and in some cases the minimum[3] growth stage for applications, to prevent crop injury and facilitate good weed control. Typically, a corn growth stage is identified by the leaf stage or plant height. If a label has leaf stage and plant height restrictions, it is best to follow the more restrictive of the two recommendations. When using a tank mixture, follow the recommendations for the most restrictive label language of the products in the tank mixture.

Corn Growth Staging

Agronomists generally agree that counting leaf collars is the most consistent and accurate means of determining corn leaf stages. The collar is a visible, light colored band at the base of the leaf blade, separating the blade from the leaf sheath[4]. Leaf stages are designated using a "V" (vegetative) to represent each leaf during vegetative development. The first true leaf on corn is the short, rounded leaf at the soil surface and is counted as V1. Each successive, visible leaf collar is counted as V2, V3, to VT (tasseling). The accepted practice is to count the first true leaf, but some herbicide labels ignore it. The herbicide label description of crop staging method should dictate decision-making.

As corn plants age, the lower leaves die or are torn away. To stage older plants, dig up the plant without breaking the stalk, and then split the stalk down into the root ball. Find the triangular "woody" base of the stalk and locate the first internode above the base. The woody, horizontal node is the point of attachment for the fifth leaf[4]. Stalk splitting for staging is useful when wind-blown soil or hail has removed leaves and can help determine the exact stage of growth based on nodes rather than just visible leaves.

A field of corn is staged as a specific V stage when at least 50% of the plants sampled are in that stage. Variation in corn growth stage will occur throughout the field based on soil characteristics, drainage, residue coverage, fertility, planting depth and uniformity, and crop emergence.

Plant height is frequently used to define application timing on many herbicide labels but is not usually consistently defined. The generally accepted practice is to measure the height from the soil surface to the arch of the uppermost leaf that is at least 50% emerged from the whorl[5]. There are other benchmarks that are used to determine plant height, but they can lead to different plant measurements. Adverse environmental conditions, such as cool air or soil temperatures, hail, and other stresses can retard corn height, resulting in plants that are physiologically older than their height would indicate.

Figure 1. Leaf burn from a POST applied herbicide.

Importance of Growth Staging

Proper application timing is critical to remove weeds before they interfere with corn yield potential and to prevent potential problems with crop sensitivity to various herbicides. There are physical and physiological reasons that make proper growth staging of a corn field, prior to the application of an herbicide, important for crop safety and good weed control. Larger plants have more leaf area, which can shield weeds or intercept the herbicide spray, potentially reducing efficacy or exposing corn to a

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higher dose of herbicide and potential crop injury. From a physiological perspective, staging is important because at the V5 stage of growth the tassel and primary ear are initiated and can be sensitive to herbicides taken up by the corn plant[4,6].

The leaf cuticle changes during early corn development. From emergence to V4, under normal conditions, corn leaves have crystalline deposits of wax on the surface of the cuticle, which reduce herbicide spray retention and leaf wet-ability by trapping air under the spray droplets. There is rapid change in the cuticle from V5 to V8 as the wax becomes a smooth film on the leaves. Spray retention increases from approximately 30% at V4 to about 80% at V6 as a result of wax changes on the leaf surface[7]. Changes in leaf surface characteristics have been shown to correlate well with corn tolerance of post-emergence herbicides. Thin cuticles can cause corn to be more susceptible to leaf burn from contact herbicides, formulation emulsifiers, additives, or nitrogen based carriers (Figure 1). Enhanced absorption of systemic herbicides can also occur with thin cuticles. Increased absorption combined with conditions for slow growth, can slow the recovery rate from typically safe herbicide applications. This response is commonly associated with herbicides in the ALS family, although it can also occur with other types of herbicides (Figure 2).

Figure 2. Crop response to a premix of ALS and PGR herbicides.

After the V4 stage of growth, rapid stalk elongation begins[6]. Warm, humid growing conditions can enhance the growth rate, increasing susceptibility to brittleness. Application of growth regulator herbicides during these conditions can increase the risk of stalk breakage. Growth regulator and other herbicides can have multiple formulations that may affect crop sensitivity. Ester formulations of 2,4-D tend to be absorbed more quickly than amine formulations[8]. Additives, such as crop oil concentrate, can enhance plant uptake and risk for crop injury under some conditions[8]. It is critical to consult individual product labels to determine the right products and additives to use during different environmental conditions.

While it is not pleasant to view burned corn leaves, the potential for recovery from this crop response is highly likely. Emerged corn with these injury symptoms will often recover with favorable weather and loss of yield potential is not common. This is because new whorl leaves without visual symptoms will emerge as the plant continues to grow.

If an herbicide is applied during ear initiation, or girth or length determination, enhanced absorption can increase crop sensitivity and affect ear development. If the crop cannot tolerate a herbicide application at V7, while girth is being determined, a reduction in kernel rows can occur (Figure 3).

Figure 3. Reduction in kernel rows due to stress around V7. This is often considered an injury symptom of ALS herbicide applications.

POST Application Considerations

POST herbicide tank mixtures are an important element of integrated weed management of tough-to-control broadleaf weeds in corn. There are several factors to be aware of when deciding on the application timing of POST herbicides that may affect crop sensitivity to herbicides:

- Some corn labels have precautionary statements regarding individual hybrid response to post-emergence herbicides.
- Environmental conditions influence the absorption of post-emergence herbicides and potential crop tolerance. Warm, humid conditions promote rapid absorption, while cool conditions may slow crop development, herbicide uptake, and crop sensitivity. Crops under stress may not metabolize herbicides quickly enough to avoid crop injury.
- Spray additives may increase the rate of herbicide uptake by the crop. Herbicide label precautionary statements describe how different stress conditions or herbicide tank mixtures will influence when to use a spray additive.

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- Herbicide residues from previous applications may remain in the spray tank causing contamination. This contamination may cause unwanted interaction with the herbicides applied to corn.

Other factors to consider include[9]:

- Stage of growth restrictions for herbicides that can be applied pre- and post-emergence.
- High soil pH affects the persistence and degradation of many herbicides (sulfonylurea and triazine).
- Soil moisture is important for the activation, efficacy, and degradation of soil-applied herbicides.
- Herbicide residues of several herbicides can interact negatively on the crop if herbicides from a similar family or with a similar site of action are applied POST. Some insecticides used in corn have label precautions for use with some herbicides.
- Herbicide residues from the previous year or applied pre-emergence to corn may interact with some POST herbicides.

Sources:

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