



IDENTIFYING SOYBEAN HERBICIDE INJURY

What You'll Learn...

- Environmental and other factors typically interact to cause herbicide injury symptoms on soybeans.
- Herbicides have characteristic injury symptoms that can aid in investigating the cause of soybean symptoms.
- Symptoms of seedling disease, environmental damage, or herbicide injury may look similar.
- Proper application timing, use rates, and tank mixtures help reduce the risk of herbicide injury.

Factors Affecting Injury

Soil-applied, residual herbicides are an integral part of integrated weed management systems. In most cases, target weeds are controlled without compromising crop safety. Sometimes multiple circumstances occur that create situations where herbicides may injure soybean plants. Some of the factors affecting soybean herbicide tolerance include:¹

- Environmental conditions play a significant role that can influence potential herbicide injury.
- Individual soybean products may have different sensitivity to herbicide active ingredients.
- Some herbicide active ingredients have a greater potential to injure soybean plants, such that the rate, timing, and method of application may contribute to the severity of herbicide injury.
- Soil properties such as texture, organic matter, clay content, and pH have different effects on the behavior of herbicide active ingredients.
- Herbicide pre-mixtures, tank mixtures, and additives can contribute to or compound herbicide injury.

Soybean symptomology may be the result of one or more primary or secondary factors that are interactions between pesticides, diseases, insects, crop residue, and environmental conditions which may delay soybean emergence, interfere with soybean metabolism, create wounds for secondary infections, or exacerbate an injury condition.

An example of the compounding effect of stress and herbicide injury occurs around soybean planting and emergence. Cool, wet soil conditions during soybean emergence can favor seedling diseases such as *Pythium* (Figure 1). These conditions may reduce plant metabolism and crop tolerance of soil-applied herbicides such as the



Figure 1. Brownish water-soaked lesion on the hypocotyl and disintegrated secondary roots, *Pythium* damping-off.



Figure 2. Frost or cold temperature injury. Photo courtesy of B. Young, Purdue University.

PPO inhibitor group (saflufenacil, flumioxazin, sulfentrazone). The soybean hypocotyl or cotyledons may be exposed to high concentrations of the herbicides on the surface or close to the soil surface or if rainfall occurs, herbicide may be splashed on the emerging seedlings.

Symptoms include necrotic lesions on the hypocotyl or cotyledons which may not kill seedlings but may damage tissue, increasing the risk for stem breakage or secondary infections and stand reduction. Frost can also cause necrosis of hypocotyls or cotyledon tissue (Figure 2). Application of soil-applied herbicides immediately before or after planting, coupled with stressful conditions, may result in a high concentration of the herbicide near emerging seedlings and increase the probability for injury. In contrast, applications made several days or weeks prior to planting may allow the herbicides to be more evenly distributed in the soil profile.¹

Estimates of herbicide injury potential are provided by various seed companies and University Extension sources. Local agronomists and product representatives can provide pertinent additional information to help diagnosis problems.

Herbicide Symptoms

Soybean symptoms in the field may be the result of environmental conditions, fertility deficiencies, pest injury, or pesticide injury. Herbicides can be grouped by site of action (SOA). Each herbicide SOA group has different injury symptoms that can be used to narrow the search for causal factors for soybean symptoms.² Soybean plants frequently outgrow the effects of herbicide injury without having a noticeable impact on yield potential.

Soybean injury at emergence may be the result of a pre-emergence (PRE) herbicide application or herbicide carryover from the previous crop, and an interaction with application methods and environmental conditions. Potential symptoms associated with various herbicide groups used before or at planting are summarized on the next page.



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ALS Inhibitors (Group 2)

chlorimuron, imazethapyr, cloransulam

These herbicides alter the function of the ALS enzyme, affecting root and shoot growth and development. Soybean injury can show up as reduced root systems, often described as “bottle-brush” roots. Other symptoms include plant stunting, chlorosis, tissue death, and purple or red veins on the underside of leaves.



injury when heavy rains occur as they are breaking through the soil surface. Herbicide application during hot, humid conditions or before a long period of cool weather can result in crop injury. Drift injury can occur if application takes place under windy conditions. Tank contamination issues may be more of a problem with certain products.



Microtubule Inhibitors (Group 3) pendimethalin, trifluralin

These herbicides inhibit root and shoot growth. Soybean injury includes root pruning and hypocotyl swelling. Roots that do develop may be thick and short. Limited root growth can lead to stunting of aboveground plant parts. Symptoms in the field include drought stressed plants in the presence of adequate moisture due to root damage and may be scattered due to localized concentrations of the herbicide.

Growth Regulators (Group 4)

2,4-D, dicamba, clopyralid

Synthetic growth hormone herbicides are translocated to new tissue and interfere with cell formation resulting in abnormal root and shoot growth. Soybean plants are particularly sensitive to dicamba and injury symptoms include cupping and crinkling of leaves. Early season injury, if limited to leaf symptoms, rarely affects yield potential. Growing conditions are a factor in damage expression. Soybean plants can develop symptoms similar to dicamba injury in the absence of this herbicide during periods of rapid growth or following stress from a post-emergence herbicide application.



Photosystem II Inhibitors (Group 5) atrazine, metribuzin, simazine

These products inhibit photosynthesis, which leads to yellowing and browning along the leaf margins and tip. The whole leaf may turn yellow, but veins usually remain fairly green. Lower leaves tend to be most affected and new leaves may be symptom-free. Symptoms are more common on sandy soil where an excessive rate was applied. Unfavorable growing conditions may accentuate plant injury.

Long-chain Fatty Acid Inhibitors (Group 15)

acetochlor, metolachlor, dimethenamid, pyroxasulfone

Amides, acetanilides, or acetamides are meristematic growth inhibitors that are translocated to the shoot and leaves. Typical soybean injury symptoms include cupped or crinkled leaves. Leaflet mid-veins can be shortened, resulting in crinkled, heart-shaped leaves. Damage is more likely to take place with cool, wet weather occurring immediately before emergence.



Pigment Inhibitors (Groups 13 and 27) mesotrione, tembotrione, isoxaflutole, topramezone, clomazone

Shallow planting or stress conditions that slow seedling metabolism can increase the potential for injury. Affected plants are distinctly white or bleached due to the destruction of chlorophyll in new and old tissue. These herbicides move upwards within the xylem tissue. Volatility injury can occur if isoxazolinone and isoxazole herbicides are not incorporated immediately following application. Soybean injury from Balance and Callisto can appear similar to atrazine injury.

PPO Inhibitors (Group 14) sulfentrazone, flumioxazin, saflufenacil, fomesafen, lactofen

Symptoms range from leaf speckling to browning and death of entire leaves. In severe cases, death of the terminal growing point can occur. This results in short, bushy soybean plants. Soybean seedlings are most susceptible to

In summary, most soybean residual herbicides labeled for soybean must be applied before emergence. Warrant[®] Herbicide can be applied early pre-plant, at-planting, pre-emergence, and post-emergence (up to R2 growth stage soybean) before weeds emerge in soybean. Dual II Magnum[®], Zidua[®], Outlook[®], Prefix[®], FirstRate[®], and Pursuit[®] are some PRE herbicides that can be applied to emerged soybeans but may need a tank mix partner for emerged weeds.³ Consult the individual product labels for instructions and precautions for use. Products listed under each group are examples, the list is not comprehensive. **Sources:** ¹Hagar, A. 2014. Soybean injury from soil-applied herbicides. The Bulletin, University of Illinois. ²Boerboom, C. 2005. Herbicide mode of action key for injury symptoms. University of Wisconsin. ³Jhala, Amit. 2013. Tips for applying residual herbicides after soybean emergence. University of Nebraska.

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