PRODUCTION

Herbicide Performance During Drought no. 0.567

by P. Westra, S. Nissen and D. Shaner [1]

Quick Facts...

Prolonged drought limits the ability of crop and weed plants to absorb herbicides.

Soil-applied herbicides are not as readily absorbed from dry soil because there is not enough moisture for the herbicide to go into solution.

Drought greatly affects the degradation and dissipation processes for herbicides.

Prolonged drought increases the chance for herbicide carryover.

Deep plowing (greater than 8 inches) can mix herbicide in the soil and alleviate some carryover problems, but this may not be feasible on all soil types.

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Commercially acceptable performance of most herbicides is based on normal growing season precipitation, which promotes plant growth and provides sufficient soil moisture for its activation. When a severe drought occurs during most of a growing season, many of the normal interactions among herbicides, plants, and the environment are altered in ways that can cause serious problems for crop producers. An awareness of these altered interactions can help producers avoid serious, unintended consequences.

Herbicide Uptake

Under normal moisture conditions, herbicides are absorbed by the leaves or roots of hydrated, healthy plants. Herbicide uptake by weed or crop plants represent a significant portion of the herbicide removed from a system in a normal growing season. The herbicide is degraded by a tolerant crop while susceptible weeds die. In a drought, less moisture is available to promote healthy plant growth. Drought-stressed plants are often less responsive to herbicides, or require higher herbicide rates for effectiveness. A common plant response to drought is the formation of a thicker cuticle to reduce transpiration; this, however, makes foliar uptake of herbicides more difficult. Plants under water stress take up less herbicide and are less able to degrade an herbicide. In addition, low soil water potential means that more of the herbicide is bound to the soil and less is present in the soil-water solution for uptake by plants. The consequences of these interactions can be less activity on weeds and increased injury to the crop.

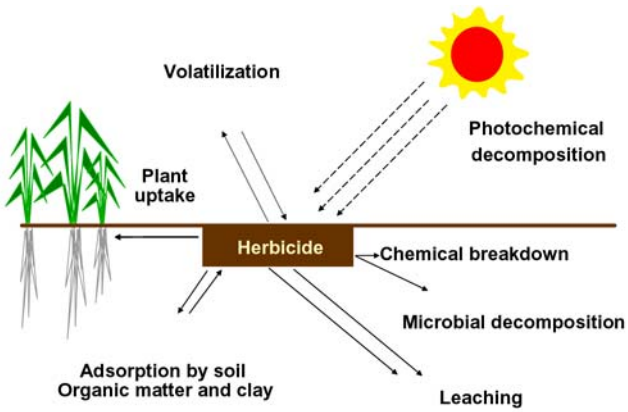

Figure 1. Processes of herbicide activation.

Absorption by Soil Organic Matter and Clay

Many herbicides interact in a process that is heavily influenced by moisture content. Herbicides are absorbed by plants from the soil water solution. The amount of herbicide available for uptake is regulated by the herbicide soil-binding characteristics and the water solubility of the herbicide. Herbicides that bind strongly to the soil are slowly released into the soil water and may persist longer than loosely bound herbicides. Under

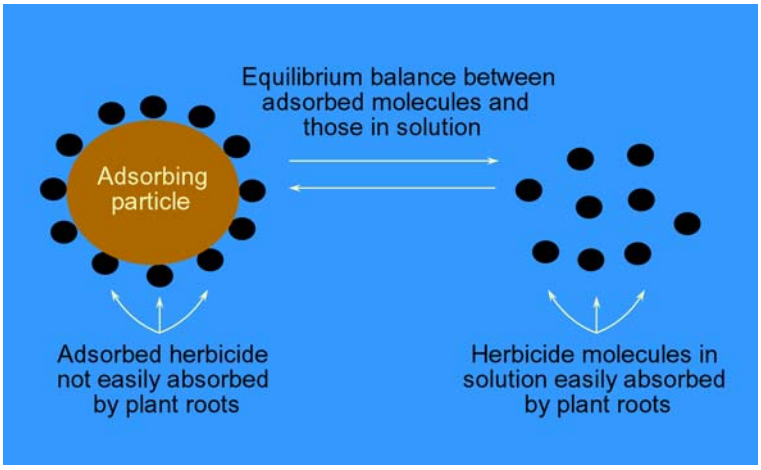

Figure 2. Plants absorb herbicide in solution more easily than on a soil particle.

drought conditions, herbicides that bind tightly to soil particles remain bound and have relatively little chance of desorbing back into the soil water solution. When moisture becomes more abundant, large-scale release of bound residual herbicide can injure sensitive follow crops. Thus, prolonged drought increases the chance for herbicide carryover in the subsequent year.

Leaching

Leaching refers to the downward movement of herbicides with water that percolates through the soil. Some of this downward movement occurs naturally and helps distribute the herbicide to different depths in the soil where weed seeds are found. New herbicides exhibit relatively little leaching. Leaching does not account for much of the herbicide lost in a field. Under drought conditions, downward movement and mixing of herbicides in the soil profile is reduced, which may leave a more concentrated layer of herbicide near the soil surface. This increased herbicide concentration may also affect carryover to sensitive crops.

Microbial Decomposition

Active herbicide breakdown by soil microbes is the primary way herbicides dissipate from a field. Microbes use the herbicide molecules as an energy source in their life cycle, but they only have access to herbicides that are in the soil solution. During a drought, herbicides bind tightly to the soil particles and there is less in the soil solution. This reduces the rate of herbicide dissipation and increases the chance of carryover to sensitive crops in the following year. Normal precipitation and good soil water promotes favorable microbial populations, which in turn help degrade herbicides. Under drought conditions, microbial populations are greatly depressed resulting in less herbicide degradation.

Chemical Breakdown

Hydrolysis and other natural chemical breakdowns can occur with herbicides in soil. However, these events require the presence of water and a moist environment. Sometimes these processes are pH dependent, but in all cases they require moisture for the breakdown to occur. During a severe drought, such chemical breakdowns cease or are greatly reduced. Again, this can contribute to the carryover of an herbicide from one season to the next.

What if carryover is a concern?

Certain herbicides are more likely to carry over in a drought. Herbicides such as atrazine or some members of the imidazolinone or sulfonylurea families can persist under these conditions. Following label plant back restrictions for such herbicides is even more important during drought. Using field collected soil samples to examine potential plant back crops can be informative, but it requires adequate sampling of fields and time for the crops to grow. Such studies are best conducted with your local Colorado State University Cooperative Extension county agent. Some small grain crops (e.g., wheat) are generally more tolerant to herbicides than oats or barley. Such information can help a producer select a crop least likely to suffer adverse effects from persistent herbicides.

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