PREEMERGENCE HERBICIDE STEWARDSHIP

The advent of herbicide-resistant (HR) weeds has increasingly led to the recommendation that producers should use preemergence (PRE) or soil-applied herbicides to increase the mode-of-action variability in the battle to control these weeds.

PRE herbicides are applied to the soil to prevent weed seeds from germinating and emerging. Thus, the soil is the interceptor of these herbicides vs. the plant which is the interceptor of herbicides that are applied to emerged and growing weeds either before or after crop planting and emergence.

Dr. Bob Hartzler of Iowa State University published an article titled "Absorption of soil-applied herbicides" that provides details about how PRE herbicides will react with soil and perform based on that reaction. A summary of his presentation follows. His complete article is appended below.

Soil-applied herbicides become associated with soil in two ways: 1) they are bound to soil particles (adsorbed), and 2) they are dissolved in soil water and move into weed seeds or seedlings as these plant parts absorb water from the soil.

The herbicide that is adsorbed to soil particles is less available to germinating seeds and emerging plants of the targeted weed species. Thus, conditions that enhance the herbicide's movement into the soil solution will enhance its absorption into seeds and plants.

The balance between adsorbed and soil-solution herbicide will affect both herbicide performance against the targeted weed species and the availability of the herbicide to be transported by water away from the intended zone of action. That is, PRE herbicides will be more active when they readily move into the soil solution, but this also makes them more susceptible to offsite transport in ground and/or surface water.

PRE herbicides vary in their solubility in water; greater solubility means more of the herbicide will dissolve in water. The best case scenario is for the majority of the herbicide to be bound or adsorbed to soil particles, with a small amount remaining in the soil solution. This will prevent its rapid leaching through the soil profile and/or leaving the field with rainfall runoff. Generally, a herbicide's solubility in the soil solution and its adsorption to soil particles are inversely related; i.e., the greater the solubility of a herbicide, the lower its adsorptivity.

Soil properties influence the activity of PRE herbicides.

- **Cation exchange capacity (CEC)**. CEC is an indicator or measure of the soil's adsorptive capacity. As the CEC increases, more of the PRE herbicide is bound to soil particles. Thus, since sandy soils have a lower CEC than clayey soils, recommended rates for PRE herbicides are higher for the clayey soils. Therefore, knowledge of soil series and its texture is important for determining the proper rate of a PRE herbicide to apply. Furthermore, high CEC soils have the increased potential for herbicide carryover that can injure susceptible rotation crops.
- **Soil pH**. This soil property can affect the adsorption and persistence of herbicides. The amount of a herbicide that is in solution vs. adsorbed can be affected by pH of the soil solution, thus affecting the amount available for uptake by targeted plants.
- **Soil moisture**. The amount of herbicide available in solution decreases as soil dries. Thus, there is less exposure of targeted weed

species to herbicide in dry soil and weed control failures are likely to occur when soil moisture is limited. This is why PRE herbicide labels stipulate the herbicides generally needs at least 0.5 in. of rainfall following application to be effective.

All of the above raise an important issue. The increased use of PRE herbicides for weed control should be tempered with concern of how to minimize their effect on both ground and surface water in agricultural settings. The following points should be considered as the use of PRE herbicides is increased in agricultural fields.

- Be aware of soil type and texture in the field of PRE application. This will affect the soil's adsorptive capacity, its water holding capacity, and the rate of PRE herbicide application.
- Be knowledgeable of the soil profile properties in the field of PRE application. This will affect the leaching potential of the applied herbicide. For instance, a site with a clay subsoil will be less prone to leaching of the herbicide than will a site with a subsoil composed of coarse material.
- Have a good knowledge of the runoff capacity of the field where PRE herbicides are applied. Is it affected by compaction or low organic matter?
- Know the soil pH of the site, and follow the label when applying a PRE herbicide to a site with either an acid or alkaline soil pH.
- Use conservation tillage and increased crop residues to reduce erosion and runoff. However, be aware that excess crop residues will intercept the herbicide and reduce its effectiveness.

There is no doubt that using PRE herbicides is now or should be part of a weed control program that is designed to prevent, delay, or manage HR weeds. However, producers must ensure that this component of weed control is used with good stewardship so that the quality of ground and surface water systems is preserved.

Composed by Larry G. Heatherly, updated May 2020, larryheatherly@bellsouth.net