

 UI Extension Forestry Information Series

Herbicides and Water Quality Protection

Randy Brooks

Herbicides are indispensable to forestry as well as agriculture, but there is much public concern regarding how some herbicides can run off into surface water or leach through the soil into groundwater. Some of this concern is the misconception that *all* herbicides are bad and leach into water supplies. However, some of these fears are more real than imagined, since more and more chemical contaminants are being found in surface and groundwater across the nation, for example, the state of Kansas now has herbicide management zones for specific herbicides, requiring an approved management prior to their application.

Herbicides applied to the soil are subjected to physical, chemical, and biological processes that affect their movement through soil and their potential for surface and groundwater contamination. To minimize the threat to surface and ground water, consider the following factors when selecting and applying herbicides:

- *Soil characteristics.* Soil texture and organic matter content play major roles in herbicide performance and persistence. Impervious clay soils have a tendency for a higher percentage of runoff. Herbicides tend to leach more readily in coarse-textured soils. In contrast, soils with fine texture and/or high organic matter content are highly adsorptive and therefore have less leaching and runoff potential.
- *Herbicide Characteristics.*
 - *Adsorption* - Some herbicides bind strongly (adsorb) to soil and therefore are not easily removed. Clay and organic matter favor strong adsorption. Use soil analysis information (if available) to determine soil texture and organic matter content for selecting herbicide rates for your weed management program.

- *Solubility* - Some herbicides are highly soluble in water, which can increase their leaching and runoff potential. However, herbicide leaching and runoff can be minimized by applying labeled rates at proper times, using the proper method of application. Follow directions on each herbicide label.

- *Persistence* - The rate of herbicide degradation by natural processes is highly dependent on herbicide chemistry and environmental factors. Sunlight, temperature, soil pH, microbial activity, and other soil characteristics affect the breakdown of herbicides. Some herbicides break down slowly, and therefore have a greater potential for leaching and runoff, whereas short-lived herbicides may be degraded before any leaching and runoff occurs. Choosing a short-lived herbicide can minimize leaching and runoff potential.

Microbial degradation occurs when fungi, bacteria, and other soil microorganisms use herbicides as a source of food. In addition, chemical degradation of herbicides can occur by reaction with water, oxygen, and other chemicals. High organic matter, along with other properties such as optimum moisture, aeration, temperature, and soil pH, can enhance microbial degradation.

In general, herbicides that have low water solubility, low persistence, and are adsorbed to soil have the lowest potential for leaching and runoff when erosion is controlled.

- *Surface Runoff.* Surface water (e.g. rivers, creeks, lakes, swamps, etc.) are vulnerable to

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contamination by pesticides and fertilizers due to topographical factors. A watershed with steep slopes near surface water has an increased potential for runoff as compared to a long, flat watershed. Heavy compacted clay soils without vegetation are more vulnerable to runoff than sandy-loam soils with vegetation. Avoid using herbicides in natural or artificial drains in riparian areas. Short-lived herbicides should be used in riparian woodlands and spot applied to minimize surface water contamination. Pesticide runoff can be effectively adsorbed by vegetative buffers in riparian areas which contain high amounts of leaf litter and deadwood, and by adsorption through extensive root systems. As mentioned, a soil with high organic matter will tend to adsorb herbicides more readily.

- *Water Table.* High water tables are especially vulnerable to contamination by pesticides due to the relatively short distance between the soil surface and groundwater. The potential for groundwater contamination is great in areas with coarse textured soils and high water tables.

- *Herbicide Use Patterns.* Applying the same herbicide at high rates on the same land each year increases the likelihood of herbicides leaching into groundwater or runoff into surface water. Applying minimal rates and alternating herbicides reduces potential contamination. Banding the herbicides in tree rows or using spot applications around individual trees rather than broadcast applications can greatly reduce the amounts applied, thus reducing the leaching and surface runoff potential. Care in mixing and loading to avoid spills is extremely important.

Specific application information is contained in the herbicide label. Careful adherence to application and disposal directions, combined with proper equipment calibration, provides the best methods of preventing surface and groundwater contamination.

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About the Author: *Dr. Randy Brooks* is an Area Extension Educator - Forestry and Professor at the University of Idaho.

