Environmental Considerations When Choosing a Herbicide

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Herbicides, pesticides used to kill plants, are efficient products when used to control weeds in large areas or where it is difficult to use other methods of weed control such as mulching, tillage, or hand-weeding. When selecting a herbicide the user needs to consider:

- the weed species that are to be controlled
- their stage of growth
- whether the herbicide will affect desired (crop) plants
- the residual
- movement away from the site

Obviously, there are many other considerations when choosing a certain pesticide, e.g. toxicity class, formulation, ease of use, and cost. However, in my opinion, the first three items listed above are usually what drives, or at least narrows down, the choice of which herbicide to use.

Nevertheless, the last two points in the above list should be included as an important factor when selecting a herbicide. The residual or how long the product remains where placed, can affect the crop rotation, harvest interval, and off-site movement (leaching and runoff). Herbicide persistence is influenced by the physical and chemical properties of the pesticide and the soil as well as the soil's microbiology. Movement away from the site, particularly the soil, can cause groundwater and surface water pollution.

In some cases, persistence is good. A herbicide that is effective over the entire cropping period will reduce or eliminate additional weed control efforts. In the landscape, a herbicide with a long residual reduces the number of times a herbicide must be re-applied. On the other hand, if a herbicide remains in the soil after the tolerant plants are removed or harvested and a susceptible crop is planted, herbicide injure may occur.

Factors that are important in determining herbicide persistence:

Some factors that affect herbicide persistence include microbial and chemical breakdown. These are often affected by moisture and temperature. In general, herbicide breakdown occurs more rapidly when the soil is moist and at warm temperatures.

Factors that are important in determining herbicide movement:

<u>Soil adsorption</u>

Soil adsorption is the process by which a material associates with a surface ("stickiness") and is reported as a Koc value. "OC' refers to a standard test using **O**rganic

Carbon. If a herbicide is not adsorbed at all the Koc=0 while a herbicide with a Koc greater than 1000 indicates that the herbicide is very strongly adsorbed to the soil particle.

Soils texture is also important when discussing adsorption. Soils high in clay or organic matter generally will adsorb pesticides to a greater extent than sandy soils.

Water solubility

Water solubility is a measure of how easily a pesticide may be dissolved in water. This is important to know in order to determine if the herbicide will leach. It is designated in terms of parts per million (ppm) which is the same as milligrams per liter (mg/l). The higher the number, the more soluble the herbicide and consequently the more likely to leach. Herbicides with low solubilities (1 or less) tend to remain at the soil surface although they may move off-site in runoff. Pesticides with solubility greater than 30 ppm are more likely to leach.

Half-life

Half-life is a measure of how long a pesticide persists. It is the time that it takes for one half of the material to degrade. For example, if a herbicide has a half-life of 5 days and 2 oz were applied, after 5 days, only 1 oz of the original material could be recovered. The longer the half-life, the more persistent the pesticide is and therefore, has a greater the potential for pesticide movement through either leaching or runoff because it is more likely to be exposed to conditions that would favor off-site movement. Factors that affect half-life include microbial decomposition, degradation in light, and volatility,

It is important to remember that the interaction of the above factors, rather than the individual parameters need to taken into consideration when considering how long a pesticide stays in a particular environment. For example, the water solubility of glyphosate is very high (900,000 ppm or about 1 oz/qt, see table 1). Given that, one would expect it to move easily through soil. However, the Koc value is 24,000, which indicates very strong adsorption to soil. Therefore, even though it is very soluble the soil holds and "traps" it so it is unlikely to move as an active molecule.

The following table of common herbicides can be used as a guide to help determine the whether a herbicide will move off-site or persist in the soil. Remember, that many conditions will affect a herbicides activity and that these numbers will vary according to soil type, irrigation method, weather, and other factors.

Active Ingredient	Product	Use	Water Sol (ppm)	Koc	Half-life (days)	Mobility
2,4-D amine	Many names	POE	796	20	10	Mobile but degrades rapidly
Atrazine	Aatrex	PRE	33	100	60	High due to long half-life
Dichlobenil	Casoron	PRE	21.2	400	60	Low but breakdown product is high
Diquat	Reward	POE	718000	1000000	1000	None, binds strongly to clay
Dithiopyr	Dimension	PRE	1.4	1638	17	Low
Fluazifop	Fusilade	POE	1.1	5700	15	Low
Glufosinate	Finale	POE	1370000	100	7	High but due to short half-life and microbial breakdown, little found >6"deep
Glyphosate	Roundup	POE	900000	24000	47	Low due to strong adsorption to soil
Halosulfuron	Manage	POE	1630@pH7, 15@pH5	87	4-18	Low - moderate
Isoxaben	Gallery	PRE	1	190-570	50-120	V. low
Norflurazon	Predict	PRE	28	700	45-180	Low but depends on OM and clay content
Oryzalin	Surflan	PRE	2.6	600	20-128	Low under natural rainfall
Oxadiazon	Ronstar	PRE	0.7	3200	60	Low, strongly adsorbed
Oxyfluorfen	Goal	PRE/POE	0.1	100000	35	Immobile on most soils but sl. mobile in sandy soils
Pelargonic acid	Scythe	POE	low	No info	Not reported	Not reported
Pendamethalin	Pendulum	PRE	.275	17200	44	V. low
Prodiamine	Barricade, Factor	PRE	0.01	13000	69-120	V. low
Sethoxdim	Vantage	POE	257 at pH5, 4390 at pH7	100	5	Not reported
Simazine	Princep	PRE	6.2	130	60 but persists longer on high pH soils	Low
Trifluralin	Treflan	PRE	0.3	7000	45	Low due to strong soil adsorption

Use	PRE=preemergent, POE=postemergent
Water Sol (ppm)	Higher number indicates more soluble
Koc	Measure of how strongly bound to soil; high number indicates more strongly bound
Half-life (days)	Time for 1/2 of active ingredient to degrade
Mobility	Movement in soil under "normal" rainfall

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