HERBICIDES AND THEIR USE

If you use herbicides, you are responsible for their safe and proper use. The label is the law. Be aware of the potential for contamination of waterbodies, groundwater, and food. See *Pesticide Safety*, in Part II of this guide.

TYPES OF HERBICIDES

Herbicides can be separated into two broad categories: those applied to the soil before weeds have emerged (pre-emergence herbicides) and those applied directly to visible weeds (post-emergence herbicides). A few pre-emergence herbicides have some activity against emerged weeds (Table 20). Herbicides can also be categorized as being either residual or non-residual type.

Residual herbicides have a lasting effect on the soil. How long weed growth is prevented by an application of residual herbicide depends on how quickly it is broken down on the soil by sunlight, microbial activity, or soil chemistry, and whether the herbicide is volatilized or leached below the upper inch or so of soil. Non-residual herbicides have little or no effect except on weeds that are present at the time of application.

Finally, some herbicides are effective only on grasses; some only on broadleaf herbs, and others show degrees of activity against both types of vegetation. In Table 20, herbicides labeled for orchard use are categorized as pre-emergence or post-emergence types, and as to their activity against grass or broadleaf herbs or woody species. No herbicide is effective against all species in any of the 3 categories of weeds. Some herbicides are effective on certain weed species outside of the indicated category. For a list of specific weeds controlled, see product labels.

The use of residual herbicides in particular should be limited to specific needs. The routine use of residual herbicides may increase the chance of creating a bare soil environment around trees (with an increased risk of soil erosion, tree rack, and cold temperature injury to tree roots). And it may facilitate the development of weed populations that are difficult to control with currently available herbicide options.

MANAGE TO PREVENT RESISTANCE

Repeated use of a single herbicide, or herbicides with a shared specific mode of action without rotation or the use of alternative tactics such as cultivation or weed suppressing cover crops, may lead to herbicide-resistant weed populations. Herbicides for which the risk of resistance is greatest include: diuron (Karmex), oryzalin (Surflan), oxyfluorfen (Goal), paraquat (Gramoxone), and terbacil (Sinbar).

Combining pre-emergence herbicides with different modes of action is one technique that reduces the risk of weeds developing herbicide tolerance. The use of post-emergence herbicides such as glyphosate (Roundup) also helps, as do non-herbicide practices such as close-mowing and cultivation. Weed scouting before herbicide application is useful to identify which species are present. Scouting after herbicide application can reveal weed escapes or species shifts.

HERBICIDE SELECTION

No herbicide product is completely effective against weeds and always harmless to the trees. Good management requires choosing the proper product, or combination of products, to fit the situation. Give special attention to age of the trees and soil factors.

Age of the trees. Young trees have tender, green bark that can be damaged or penetrated by contact herbicides, both systemic and non-systemic. Damage to a high value, perennial crop like apples can have major and prolonged financial impact. Pay close attention to the development of corky, dead outer bark on the portion of the trunk that will be contacted by a contact herbicide. Properly applied trunk paint or vole guards will help if they completely block the spray from contacting the green bark. However,, the most important consideration is the careful application of herbicides, using shielded sprayers or wipe-on applicators where appropriate to minimize the risk of herbicide contacting the bark.

The most common and serious damage occurs on young fruit trees when unprotected bark is contacted by concentrated doses of herbicides that have both contact and systemic activity (e.g. glyphosate, sulfosate and 2,4-D). These products can be used in young orchards, but their use requires precautions to prevent significant exposure of the trees.

Non-systemic products can also damage young trees, usually by burning a dead area into the trunk within about a foot of the soil surface. This can occur if the product is overly concentrated in the spray solution, and/or mixed with higher rates of liquid nitrogen fertilizers.

Young trees have shallow root systems, and most of their roots are within the herbicide treated area. Young tree roots may be highly exposed to root active herbicides that leach into the upper foot of soil. Special attention to dosage and soil conditions is

required to use simazine, diuron, terbacil (and to a lesser extent norflurazon and dichlobenil), in young orchards, and particularly on light sandy soils.

Soil Factors. Organic matter and increased binding sites that come with finer soil texture are important soil qualities that hold potentially mobile herbicides in the upper 2–4 inches of soil where they act to control weeds rather than affect fruit tree roots. If the product label suggests that you take these factors into consideration, do so. Orchards often have bands of lighter, shallower or gravelly soils running through them. Identify and record these poor soil areas. Use products and rates that are safe on the weakest soils, not the average.

HERBICIDES CAN DAMAGE TREES

To avoid tree injury, know the potential for injury, and follow label instructions carefully. Injury can be local (affecting only tissue directly hit by spray), or it may be systemic. Systemic injury can produce symptoms some distance from the site of contact, due to the ability of some herbicides to translocate within the plant.

Note the potential for tree damage by these herbicides:

- **glyphosate, sulfosate**: Are absorbed by foliage, young-green bark and fresh pruning wounds, resulting in systemic injury. Do not apply after mid summer (August 1).
- **diuron, oxyfluorfen, terbacil**: Are absorbed by foliage and young bark, resulting in local injury. Shield bark of first- and second-leaf trees to prevent damage.
- **paraquat, glufosinate-ammonium**: Are absorbed by foliage, and bark, resulting in local injury.
- **2,4-D**: Is absorbed by foliage, bark, and roots, resulting in systemic injury.
- **dichlobenil, diuron, simazine, terbacil, and 2,4-D** can, under some conditions, be taken up by roots, resulting in injury or other symptoms. Root uptake is most likely in soils containing very little clay or organic matter. In the case of 2,4-D, the chemical is highly water-soluble, so movement to roots is possible where groundcover is insufficient to absorb (trap) the 2,4-D.
- The presence of burr knots may increase the risk of herbicide uptake by trees if herbicide comes in contact with bark tissue.

Other listed herbicides may produce injury to trees if not used at appropriate label rates and timings, taking into account tree age, soil texture, and soil organic matter.

Herbicides do not have federal residue tolerances for fruit, so direct spray and drift must be kept off fruit. If accidental spraying occurs, the exposed fruit should be removed.

LEACHING & RUNOFF POTENTIAL

Leaching (downward herbicide movement through soil) is influenced by characteristics of the soil (texture, compaction, organic content, pH, wetness, temperature). In addition, certain soil microorganisms and living weeds can sometimes metabolize absorbed herbicides, rapidly or gradually altering them to non-phytotoxic forms that may have different leaching characteristics. Leaching potential is also affected by certain characteristics of the herbicide, including water solubility, electrostatic properties, vapor pressure, and photodecomposition.

Because numerous complex interactions can occur between herbicides and the soil environment, it is impossible to accurately generalize leaching behavior for a wide range of possible soil situations. In Table 22, a designation of high leaching potential means that under conditions favorable for leaching, this chemical could be expected to move downward beyond the upper 2–3 inches of soil.

Downward movement is most likely with chemicals that do not degrade quickly and do not adsorb strongly to clay or organic matter. The potential for tree damage or groundwater contamination is greatest with such chemicals when heavy rain comes soon after application, or where spills occur. Special attention should be given to the mixing and loading operation, as spills can quickly overload detoxifying processes of soil and sunlight. See *Protecting Water Quality* for more information.

Runoff (surface loss of herbicides from treated areas) can be avoided by the same means used to avoid soil erosion. Sloping ground and absence of groundcover increase surface runoff. Living sod or other dense groundcover and organic mulches inhibit runoff. Where problems persist, grass strips and berms can be used to separate treated areas from sensitive borderlands. Practices that prevent concentration of rain water into narrow channels will help. Wheel ruts often become stream-beds during heavy rainfall, as do channels from previous rainfalls. Travel lanes should run across rather than with the slope. Maintain and operate equipment with caution to prevent spills.