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F R U I T J O U R N A L

Update on Pest Management  
and Crop Development

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SPRAY  
AND  
PRAY?

ORCHARD  
HERBICIDES: TOO  
MUCH OF A GOOD  
THING?

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❖❖ Most tree fruit growers in eastern North America consider herbicides an essential tool for managing ground cover beneath trees and for eliminating noxious weeds such as poison ivy. The benefits of herbicides for increasing tree growth and productivity, especially in young orchards, have been well documented. However, far too many growers view herbicides as benign tools with few negative side effects. I am increasingly concerned that overuse and misuse of herbicides have hidden costs that are being largely overlooked.

Negative side effects of herbicides may include sublethal damage to trees, increased erosion in orchards planted on slopes, and negative impacts on soil structure, especially where herbicides are used to maintain a year-round barren strip beneath trees. In addition, observations suggest that herbicides may be a contributing factor in the recent incidents of sudden/rapid apple decline in young orchards, because tree decline problems seem more common in orchards where the strip beneath trees is kept totally weed free throughout the year.

The two herbicides most commonly associated with tree damage (perhaps because they have been among the most widely used) are glyphosate (Round-Up and generics) and glufosinate (Rely and generics). These, along with gramoxone, are widely used because of their ability to kill or "burn down" growing weeds. Unfortunately, all three of them sometimes cause damage to tree trunks. Damage from glyphosate applied in apple orchards has been emphasized in the past (Rosenberger et

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al. 2013). As a result of warnings about how glyphosate can injure trees, some growers adjusted their uses of glyphosate so as to reduce the risks of injuring tree trunks or reducing winter hardiness of trees. Glyphosate is still an important tool for managing tough weeds in orchards, but it poses less risk to trees if used before midsummer and if the formulation used contains the least amount of surfactant necessary for effective weed control. Nevertheless, we still don't know if the more careful applications of glyphosate are negatively impacting winter hardiness of young trees as reported by Mathers (2010). Winter injury to young trees has been suggested as one of the contributing factors in the rapid/sudden apple decline that has emerged as a significant problem in recent years.

Because of concerns about injury from glyphosate, some growers have switched to using glufosinate or gramoxone, neither of which can be transported within trees. However, glufosinate can cause severe damage to bark where the herbicide spray contacts tree trunks, and in some cases it has caused extensive tree losses. Risks of damage from glufosinate are so great that Brad Majek, retired weed scientist in New Jersey, suggested that it should never be used on stone fruit or pome fruit trees (Majek 2014). Observational evidence suggests that Fuji (and perhaps other apple cultivars related to Fuji?) are especially sensitive to damage from glufosinate.

The potential for injury from herbicides is not limited to contact herbicides. Older growers have probably seen the leaf discoloration and/or distortion that can be caused by excessive rates of simazine, diuron, terbacil (Sinbar), and other residual herbicides. However, symptoms of tree toxicity to newer herbicides is less well known. In the Hudson Valley, one grower struggled with poorly performing young trees for several years before anyone noted the stub-

by root symptoms (**Fig. 5**) evident on some of those trees and associated that symptom with excessive rates of Prowl (pendimethelin) applied to a coarse soil. (The label for Prowl provides for rate adjustments based on soil type



**Fig. 5.** Stubby roots on apple trees in the Hudson Valley that failed to thrive after repeated applications of pendimethalin (Prowl).

for many crops, but not for tree fruits.) Another widely used residual herbicide, indaziflam (Alion), does have specific warnings about applications based on soil types. The Alion label states "Do not use on soils with 20% or more gravel content" and also indicates that rates should be adjusted based on the organic matter content of the soil. I suspect that many growers don't actually know the gravel content or the organic matter content of soils within their herbicide strips, but that lack of knowledge can lead to a failure to heed label warnings and may result in poor tree growth and/or tree losses from using above-label rates of herbicide for the specific soils involved. Of course, even those who carefully read product labels may be over-applying herbicides if their sprayers are not properly calibrated. (For more photos showing symptoms of other herbicide injury on trees, see Hanson [2014].)

Over the course of my career, tree fruit growers have gradually moved from minimal herbicide use toward keeping a totally weed-free strip beneath trees. However, there may be benefits from managing weeds with a lighter hand. Allowing some weed growth in late

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summer can help to reduce soil erosion in sloping orchards. Where bare ground is maintained through most of the year, soil will gradually erode away from the uphill edge of weed-free strips. Over time, a "curb" or drop-off will develop along the lower edge of each sodded row middle (**Fig. 6**). These curbs pose increasing problems as between-row spacings decrease because, under wet conditions, tractors and



**Fig. 6.** Erosion within the herbicide-treated tree rows in an older orchard at the Hudson Valley Lab resulted in these "curbs" on the uphill side of each row.

sprayers can side-slip off of these curbs and cause damage to trees. The rate of erosion can be decreased if ground cover is allowed to establish in spring before herbicides are applied and/or in late fall as trees approach harvest. If a few weeds or grasses become established within the herbicide-treated strips in late fall, they will prevent fall and winter winds from blowing all of the fallen leaves from beneath trees. Both the weeds and fallen leaves will add organic matter and reduce erosion beneath trees.

When I was managing research orchards at the Hudson Valley Lab, we developed a weed management system that involved delaying spring herbicide applications until the pink bud stage of tree growth, using only moderate rates

of residual herbicides, and then following up with one or two applications of a burn-down herbicide in mid- to late summer. The second summer application was often limited to spot treatments. Using this regime, we usually had a bit of weed/grass cover develop in row middles during late fall, but the real benefit was the dense annual growth of chickweed that became naturally established beneath trees in early spring. The chickweed cover was easily killed with burndown herbicides applied at pink or bloom (**Fig. 7**), and the dead chickweed vines and roots provided excellent suppression of erosion into midsummer.

A program where herbicide applications in



**Fig. 7.** Soil protection provided by spring growth of chickweed beneath trees after the chickweed was killed by a contact herbicide applied at the pink bud stage.

spring are delayed until bloom might be hard to implement on large acreages because bad weather during pink and bloom that prevents timely herbicide applications can easily result in weed cover that has grown too tall to be easily managed. However, allowing a ground cover to develop in spring before herbicides were applied worked well for us on limited acreage and may be especially useful for orchards planted on slopes where erosion is a concern.

Another benefit of allowing some weed growth in spring and fall is that the weeds, after they are killed by frost or herbicides, add significant amounts of organic matter to soils within tree rows. This benefit became evident many years ago when we removed a planting of Empire trees at the Hudson Valley Lab. For about 15 years before the orchard was removed, the research group using one half of the planting employed late fall and early spring herbicide programs to maintain a totally weed-free strip beneath trees, whereas the group using the other half of the planting employed the minimal herbicide program described above, with spring herbicides applied during bloom, lower rates of residual herbicides, and no fall applications of herbicides. No one paid much attention to what was happening beneath the trees until the entire orchard was removed. As trees were removed, it was startlingly clear that the soils beneath trees in the row where weeds had been allowed to establish in fall and spring had much higher organic matter content and was much more friable than the soil beneath trees where weeds were never allowed to establish. The section with the minimal herbicide program also had less "curbing" from erosion on the uphill side of each herbicide strip.

Other benefits, in addition to reduced soil erosion and improved organic matter accumulation, may accrue where herbicides are managed to allow some weed growth beneath trees in spring and fall. My personal impression, after looking at many orchards, is that injury problems on tree trunks are more prevalent in orchards where complete weed control is maintained throughout the year as compared with orchards where herbicides are used with a lighter touch. I am uncertain why this should be the case, but it may involve stunting effects from high rates of residual herbicides and/or more uptake of contact herbicides through tree bark when few weeds are present to intercept

or deflect herbicide droplets at the time herbicides are applied.

It is well documented that weed competition with young trees, especially in spring and early summer, can reduce tree growth, increase the time required for trees to reach full production, and therefore reduce overall orchard profitability. However, many of these studies compared the extremes of weed management or lack thereof, and few documented the long-term negative impacts of herbicides on loss of organic matter and on soil erosion on hillside orchards. Herbicides are essential tools for weed management in orchards, but they are not benign. It is critically important to read and follow product labels if tree damage is to be avoided. ❖❖

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