Weed Control in Greenhouses:
How We Learned to Love Herbicides

Bob Webb and Toni Yocum

We hate weeds. Weed (n): A plant considered undesirable, unattractive, or troublesome, especially one growing where it is not wanted. At our nursery, it seemed as if we had 20,000 square feet of space with weed-filled pots. Those varied from out-of-control succulents, such as a Talinum our nursery introduced long ago, and a Kalanchoe that is simultaneously useless, unattractive, and unwanted. In addition, native Sonoran Desert annuals, particularly an aster that attracts whitefly, started proliferating. Of course, a couple species of Oxalis and several species of the ubiquitous Chamaesyce (spurge) seemed to be everywhere. We began to believe the Oxalis and spurge were rapidly evolving in our greenhouse and poised to stage a phytocoup. They had to go.

Ever try eliminating weeds by repotting a whole nursery? Well, we did. And a funny thing happened when we tried repotting and direct pulling of weeds – we actually spread some of them around. We learned that our salvation was contained in bottles and bags of herbicides, which simultaneously drastically reduced our weed problem while eliminating any claim that we are an organic nursery (we still claim we're vegan). Our experience may be useful to you, although we hope your problem is at a smaller scale than was ours

We learned many lessons from pulling weeds and repotting plants. Our Talinum would prosper if we broke off the stem, but it was fairly easy to eliminate if we got the tuberous root. Spurge is pretty easy to pull, but it is able to produce new seeds within seemingly milliseconds of sprouting, which meant no end to pulling weeds out of spiny plants and then pulling the spines out of our hands. Because spurge is naturalized in the Sonoran Desert, it seems to have a long residence time in soil seed banks. The Kalanchoe established from each leaf; leave one behind, and it quickly reestablished.

Oxalis (mostly Oxalis corniculata) was probably our most serious problem and certainly the one weed that forced drastic action on our part. It clearly spread by seed, at least initially, but we came to learn that its roots remained viable unless exposed to dry air for perhaps a day. Because we reuse soil at our nursery, typically mixed with fresh soil, any Oxalis roots, even the most minute ones, could produce new plants if introduced into new pots. We found that pulling Oxalis merely encouraged it, and that we spread it like wildfire if we used recycled soil in repotting. Pulling weeds, while somewhat momentarily satisfying, was clearly not the answer to our problem.

Repotting plants to eliminate the Oxalis in them wasn't necessarily the answer either, because Oxalis appears to have some properties attributable to a parasite. Oxalis roots wrapped around the roots of our plants, which would seem to be a competitive disadvantage unless Oxalis was stealing water and nutrients from those plants. The more Oxalis we found in pots, the fewer roots of the plants we wanted to grow, and we literally could not untangle all those Oxalis roots from the roots of our plants during repotting, meaning Oxalis would regrow and our bare-rooted plants would be set back. Say Oxalis "has a competitive advantage," if you will, but we think it is a stinking parasite that could be killing our plants by robbing water and nutrients from their roots.

Of all groups, the U.S. Environmental Protection Agency has what we think is the best, most comprehensive information on herbicides. Of course, their interest in these compounds has to do with pollution control and regulation of potentially harmful substances, but their information is invaluable to anyone who wants to understand how modern herbicides work. The EPA website summarizes four classes of herbicides: amino acid inhibitors, photosynthesis inhibitors, synthetic auxin growth inhibitors, and cell-division inhibitors. Yes, we're a long ways down the road from, say, "diesel fuel and black plastic," the old standby for ensuring death of Bermuda grass back in the bad old days. You can conceptualize herbicides into three easily understood classes: contact killers, systemic killers, and preemergent inhibitors. Flame throwers and diesel fuel are good contact killers, not to mention your hands or hoes, but most of today's herbicides work differently.

So, you might be asking, what is the difference between contact and systemic herbicides? Some people interpret the word "systemic" to mean something that affects the entire plant – say, a compound taken up by the roots that ultimately kills the leaves. It might be easier to broaden that interpretation to any compound absorbed by foliage or roots that affects growth at the cellular level. A current advertisement touts an expensive vitamin supplement because "emerging research shows that cell health is vital to your health," a duh! statement if there ever were one. Therefore, all of the major herbicides currently available, and probably most future ones, can be considered as systemic because they are absorbed by the plant and taken up at the cellular level, jeopardizing the weed's "cell health."

Turns out that the most commonly used herbicide in the US, glyphosate, is associated with those extremely scary GMOs, or genetically modified organisms. You've probably heard of the most common brand of this type of herbicide, produced by Monsanto, called various names, particularly Roundup. We knew its early formulation as Doomsday, and it also has other formulations, one the enigmatic Rodeo and another the stump-killer Garlon. Glyphosate salts are taken up in foliage, transported to metabolic sites in the cells, and cause big problems with production of amino acids, thereby slowly killing the plant and its roots. How slow? Well, we've seen results in timeframes ranging from a few minutes to days, but the EPA says weeks. The only trick to glyphosate is the plant has to be growing to take it up, as well as willing to "ingest" it. That last one is one key to greenhouse weed control and, by the way, one thing that many GMOs are designed not to do.

Why not stop the seeds from germinating in the first place? Well, that wouldn't solve our Oxalis problem, at least not root regeneration, but it could take out the ubiquitous spurge before it even got started. The fourth class of herbicides, the cell-division inhibitors, does that job. Trifluralin is the most common of these compounds, and it acts as an inhibitor of root growth, thereby killing seeds that try to germinate. It is available as an extremely expensive liquid (e.g., Surflan) that a little bit goes a long ways or as an inexpensive granular substance (e.g., Snapshot) that a large amount goes a short way. Either way, trifluralin is absorbed by organic material and fine soil particles (e.g., clays) near the soil surface and has a preventative capability of up to six months. Disturb the soil by repotting, and that chemical gets mixed in and doesn't disrupt seed growth but may impact root growth of your plants deeper in the pots.

Then, of course, there are cocktails of two or more of these herbicide types, such as one that includes a cell-division inhibitor (trifluralin) with a synthetic growth regulator (2, 4-D) for that double whammy, longer lasting effect. We consider these to be somewhat like the tendency of big pharma in the US to package all kinds of compounds into that allergy formulation they want you to buy even though all you really need is an antihistamine. That unnecessary decongestant will raise your blood pressure and that pain reliever could damage your liver, and both were probably necessary only to increase the profit margin of the manufacturer. It's a nuclear option that may have unintended consequences if used too enthusiastically, sort of the equivalent of using a sledgehammer to kill ants while breaking the concrete on the sidewalk. We wanted our herbicides applied sparingly and with single purposes in mind. We started with Snapshot and had some limited effects. But root-growth inhibitors lurking near the soil surface won't affect already germinated plants with roots down deep, and the amount of this granular material needed is astronomical (I calculated it would take 350 pounds or so to just get started with a one-time whole-nursery application). We tried what, in retrospect, was an ill-advised option: treating repotted plants before applying the gravel topcoating. This needlessly exposed workers to a potentially harmful chemical and didn't affect those stray Oxalis roots, so we needed something else.

Turns out that one not-so-secret trick-of-the-trade involves glyphosate, particularly in the form of Roundup. Cacti do not appear to take it up, while the surrounding weeds definitely do. Perhaps it is the difference in photosynthetic pathway between CAM (cacti and succulents) and C3/C4 (most trees, shrubs, and grasses), or maybe it is just the waxy coatings on the epidermis of most cacti: cacti don't seem to react to glyphosate, at least not during the cool season when their growth and CAM photosynthetic pathway is at low activity. We bought concentrated Roundup at our local big-box store, mixed it according to directions, and oversprayed a large number of species of cacti and Gasteria. The weeds died, the plants we wanted were not affected. Eureka! We have found it! Well, maybe not so fast because after all, we have around 4,000 species and around 100,000 plants at our nursery, many extremely rare, and we could ill afford to take the chance of overspraying everything, not to mention how expensive that would be for a one-time herbicide application.

Our answer came in the form of those little one-quart spray bottles commonly available seemingly everywhere (e.g., the Dollar Store). We mix up small batches of Roundup, put the setting on stream for accurate targeting, and just spray the weeds with minimal collateral contact with nearby plants. Many gallons sprayed and hours of effort spent later, we can summarize our results as extremely good news. Oxalis may well become endangered at our nursery owing to extremely negative response to glyphosate (i.e., those suckers die quickly). Spurge, aster, and Talinum are dead dead dead, but the Kalanchoe isn't reacting. Our closely targeted applications were in the cool season, so we don't know if certain species (e.g., Adenium and Euphorbia) can take up glyphosate from their trunks, particularly while in full growth mode. The only definite collateral damage we have observed so far is severe damage on an Agave nizandensis, a rare species, and leaf dieback on Zamioculcas zamiifolia, which commonly occurs on this species anyway and is not life-threatening. We've heard that the winter-growing Euphorbia resinifera is damaged by glyphosate, and that may be the big lesson here: target weeds in the off season for growth of your plants.