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GREENHOUSE WEED CONTROL

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Weeds such as creeping woodsorrel (*Oxalis corniculata*), hairy bittercress (*Cardamine hirsuta*), prostrate spurge (*Euphorbia humistrata*), and others are persistent problems in greenhouses. Not only do these weeds detract from the perceived quality of plants produced, but some also are known to harbor insects, such as whitefly and thrips, and other pests such as mites, slugs and snails. Therefore the removal of weeds from greenhouse pots, benches and floors is important for aesthetic and pest management reasons. There are a number of options available to the greenhouse manager for controlling these pests.

The first and most important control measure is sanitation. Keep weed propagules out of the greenhouse by using sterile substrates (soils), introducing only "clean" plant materials, and practicing weed control outside of the greenhouse. Where possible, screen vents and other openings to limit the introduction of wind blown seed as well as flying pests. Concrete or mulched floors will also limit weed establishment. Some weeds will get into the greenhouse in spite of these

measures. These weeds should be removed manually or by herbicide treatments before they go to seed.

If the weeds are already established in the greenhouse they can be killed by:

- ① manual removal
- ② emptying the range and allowing the weeds to dry up (solarization)
- ③ emptying the range and fumigating
- ④ using a postemergence herbicide

Each method (except fumigation) will only remove the vegetation which is present but does nothing to prevent reestablishment from seed that will be present. Even solarization rarely produces sufficient heat to effectively kill weed seed. Continuous removal is expensive and time consuming. Currently there are no residual herbicides labeled for greenhouse use. Where weeds are a continual problem, clean up the area, remove the soil or cover it with a mulch. Geotextile fabrics covered by gravel (or other mulches) have been successfully used in many greenhouses. Only under extremely rare circumstances would fumigation be recommended for weed control.

However, if fumigation is considered for other reasons, be sure the conditions are right for weed seed control as well. Before fumigating, kill existing weeds and wash the interior walls, benches, and glass or plastic to remove and moisten weed seed. The soil and media should be moist but not wet and between 50 and 80 °F. The most effective, but most hazardous, fumigant is methyl bromide. If methyl bromide is to be used, it is advisable to contract out this work to a qualified fumigation specialist. In plant beds or under benches, steam pasteurization can be effective. Soil/substrate temperature must remain at or above 180 °F for at least 30 minutes to kill most weed seed. For more detailed guidelines on the use of fumigants in greenhouses consult the NCSU Plant Pathology Information Note #140, "Soil Treatments for Plant Beds and Greenhouse – Vegetable and Ornamental Crops."

Chemical Control of Greenhouse Weeds

Only four herbicides are labeled for use inside greenhouses. There are very specific restrictions on the use of herbicides in greenhouses. Read the label and carefully observe any precautions. Always wear personal protective equipment when applying pesticides in a greenhouse.

Reward (diquat) is a postemergent contact-type, non-translocated weed killer. It is good for killing small annual weeds. Large weeds will be burned but not killed. Reward is relatively toxic to people. Always use the recommended safety equipment when spraying Reward. Chief advantages of this product include rapid kill of seedling weeds; it may be used when a crop is present in the house; a relatively low cost; and small amounts of spray drift will cause only cosmetic damage to the crop but will not translocate to kill entire plants. The chief disadvantage is the relatively high mammalian toxicity and lack of control of perennial or well established weeds.

Scythe (pelargonic acid) is also a contact-type, non-translocated herbicide which controls small seedling weeds. Scythe works better when

air temperatures are relatively high (>80 °F). Large weeds will be burned but not killed. Chief advantages of Scythe include lower toxicity (compared to Reward) and it may be used while a crop is in the house. Also, Scythe is the only herbicide which can be used to control weeds growing in woody plant production benches, such as rose benches. [The other herbicides are for use only under benches, in walk ways, or around the foundation]. In all applications, avoid contact with desirable vegetation. Chief disadvantages of Scythe are cost and it is somewhat less effective than Reward on larger weed seedlings. Additionally, the odor can persist and be offensive to some people.

In contrast to Scythe and Reward, **Roundup** or **Roundup-Pro** (glyphosate) is a systemic weed killer that kills annual and perennial weeds. It also has a lower mammalian toxicity than Reward. However, when applying any pesticide in a closed environment like a greenhouse, one should wear protective clothing, eye protection, and a respirator. The chief advantages of glyphosate products are the systemic kill of annual and perennial weeds and low mammalian toxicity. The chief disadvantage is that small amounts of spray drift can severely injure greenhouse crops. Therefore, it is advisable to use Roundup only in empty greenhouses (between crops) or to shut off ventilation and circulation fans to reduce drift. If drift occurs, wait six hours then wash the benches and sides of the house; otherwise, condensation containing Roundup may drip on plants.

Finale (glufosinate-ammonium) is also a nonselective, systemic, postemergent herbicide that may be used to control weeds on greenhouse floors, under benches, and around the foundation. Air circulation fans must be turned off during the application of Finale. Avoid aerial drift by using a low pressure, large droplet type nozzle. Finale is similar to Roundup, in that it is a translocated, nonselective herbicide with no soil activity in clay soils. However, in contrast to Roundup, Finale produces symptoms more rapidly (often within 48 hours) but may not control rhizomatous

Table 1. Herbicides labeled for use inside greenhouses.

Herbicide	Mode of action	Time for symptoms	Use with crops in the house?	Use in soil beds or in benches?	Toxicological properties	REI*
Reward	contact	2 to 12 hr	yes	no	eye & skin irritant LD ₅₀ : 230 mg/kg	24 hr
Scythe	contact	1/2 to 2 hr	yes	yes, directed in roses & other woody crops	severe eye irritant LD ₅₀ : >5000 mg/kg	24 hr
Finale	systemic	≅ 2 days	yes	no	may cause eye or mild skin irritation LD ₅₀ : 3570 mg/kg	12 hr
Roundup-Pro	systemic	≅ 7 days	no	no	may cause mild skin or eye irritation LD ₅₀ : >5000 mg/kg	4 hr

*REI: Worker protection standard prescribed restricted-entry intervals. For this time interval following a herbicide application, workers are not to enter treated areas without wearing personal protective equipment (PPE) for activities that would bring them in contact with treated surfaces. Depending upon the herbicide, the PPE required may be as simple as shoes, socks, coveralls, and rubber gloves. Check the AGRICULTURAL USE REQUIREMENTS section of the product label for required PPE.

perennial weeds as well as Roundup. Do not use Finale in greenhouses containing edible crops.

Weed Control Outside of the Greenhouse

The primary objectives of weed control outside the greenhouse is to eliminate a major source of air borne weed seed and to prevent perennial weeds such as quackgrass or bindweed from growing under the foundation and into the greenhouse. Additionally, weed control around the greenhouse may also serve to reduce populations of flying insect pests. Many options are available for controlling these weeds. Mowing will prevent the majority of weed seed formation. However, a vegetation-free strip is recommended immediately adjacent to the foundation. Use a geotextile fabric covered with gravel or other inorganic mulch. As an alternative to the geotextile or as a supplement when weeds grow in the mulch, postemergent and soil residual herbicides may be used outside the greenhouse. Surflan (oryzalin) has been used successfully for residual weed control. Apply Surflan with a calibrated sprayer to achieve a dosage of 2 to 4 lb

ai/A. Surflan may be mixed with Reward, Finale or Roundup for post and preemergent weed control. Do not use auxin-type herbicides, such as those labeled for broadleaf weed control in turf, near greenhouses. When spraying weeds around the greenhouse, close windows and vents to prevent spray drift from entering the greenhouse. Vents and windows may be opened almost immediately after spraying.

No herbicide controls all weeds, so some escapes will occur. Supplement the herbicide treatments with manual removal to keep the greenhouse clean. When sanitation, mulching, postemergence herbicides, and manual weed removal are combined into a comprehensive weed management program, the weed pressure will be reduced, thus resulting in less time spent removing weeds. This means lower costs for weed control and more grower time available for other jobs. In addition, the control of weeds under the benches will prevent weed introduction to plants growing on the benches, and reduce other weed-related pest problems such as whiteflies, mites, thrips, slugs, and snails.