

Herbicides and Rye Mulch for Vegetable Production

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Heavy weed pressure can decrease crop yields substantially or even result in complete crop failure. In addition to competing with crops for water, nutrients and light, weeds can have other undesirable impacts in a vegetable field. Weeds can contribute to pest problems by harboring insects or pathogens. A weedy field reduces air movement and drying, thus crop leaves and fruits remain wet for a greater part of the day and are more susceptible to diseases. Also, crop harvest is a lot more difficult when many weeds are present.

Weed management in vegetable fields can be achieved through a variety of means, but 100% weed control is not necessary or even desirable. An integrated approach in which more than one strategy is employed is most likely to achieve satisfactory results. Weed management strategies include the following:

Cultural - Rotation crops and cover crops to suppress weeds; optimizing planting date and row spacing; use of plastic or organic mulches

Mechanical - Tillage; cultivation (lots of specialized cultivators available); stale seedbed approach; flame weeding

Chemical - Pre-emergence, soil-applied herbicides to prevent weeds; Post-emergence herbicides to control weeds between rows (non-selective) or within rows (selective)

Nearly all of my research experience with vegetable crops has been in pumpkins. So most of my emphasis will be on using herbicides and/or winter rye mulch for weed management in pumpkins. But much of this information is also useful for other cucurbit crops (squashes, melons, cucumbers, etc.) and some other vegetable systems.

Please refer to the latest edition of the New England Vegetable Management Guide for recommended cultural practices for all vegetable crops, and for proper selection and use of herbicides for specific crops. Of course, carefully read and follow the label directions for each herbicide product before use.

Herbicide Use Precautions:

- Most vegetable crops have few registered herbicide options.
- Most pre-emergence herbicides for vegetables are not broad spectrum (i.e. prevent grasses but not broadleaf weeds).
- Often there is only a small margin of crop tolerance. Don't exceed recommended application rate or injury may occur.
- Maintain and calibrate sprayer properly.
- Don't use a herbicide sprayer for other pesticides.
- Avoid spray drift into adjacent fields or neighbor's properties.

Herbicide Carryover Concerns:

- Check rotational crop guidelines on herbicide label to know what crops can be planted the following year.
- If atrazine was applied to corn, will it injure next year's vegetable crop? A simple soil bioassay can be done before planting to determine if significant atrazine residues remain. Collect representative soil samples from the top 3 to 6 inches of soil in early spring. Mix the samples and put into a pot in greenhouse or window sill indoors. Plant seeds of the vegetable you intend to grow (or oat seeds as a substitute) into the soil and allow seedlings to grow for at least 1 week after emergence. Check seedlings for any evidence of atrazine injury (interveinal chlorosis; yellowing or browning of leaves starting at the margins).

Control of Existing Weeds Before Crop Emergence

A stale seedbed approach is useful to eliminate many weeds by stimulating their emergence prior to planting. These weed seedlings can then be killed easily before the crop is present. Three to four weeks before you plan to plant your crop, prepare the soil as if ready to plant. Allow weed seedlings to emerge. If direct seeding, spray one of the herbicides below or flame the weeds just before or after seeding. If transplanting, apply one of these herbicides or flame weeds just before setting plants. None of these chemicals has any residual herbicidal activity in soils, and thus can not cause injury via root uptake. In either case, minimize soil disturbance to reduce subsequent weed germination. A stale seedbed works best if conditions are warm enough to stimulate weed germination, and if soils will not become too crusty in the weeks between soil preparation and planting (most commonly a problem in heavier clay-based soils).

Pre- or Post-Plant (before emergence)

Roundup UltraMax (glyphosate) and Touchdown (sulfosate) - Control most weeds, including perennial weeds. Must be applied before seeding of some crops, including pumpkins (3 or more days in advance).

Gramoxone Max (paraquat) - Rapid kill of annual weeds [Restricted Use Pesticide (Danger-Poison)]

Scythe (pelargonic acid) - Burns topgrowth of weeds; like a "herbicidal soap"

A preemergence (soil-applied) herbicide that is registered for the crop could be included in the spray tank to provide residual weed control during the growing season.

Soil-applied Herbicides for Weed Prevention in Pumpkins

For weed control within pumpkin rows, preemergence herbicides are applied to the soil surface prior to crop or weed emergence. If direct seeding, apply after planting but before pumpkin seedlings emerge. If transplanting, apply to weed-free soil before transplanting. These herbicides should not be applied over the top of pumpkin plants. Herbicidal efficacy is usually dependent on more than $\frac{1}{4}$ inch of rainfall or irrigation within a few days after application.

Pre-Plant Incorporated

Prefar 4-E (bensulide) - prevents grasses, some broadleaf weeds

Command 4EC or 3ME (clomazone) - prevents grasses, velvetleaf, lambsquarters, purslane

Post-Plant (before emergence)

Curbit 3EC (ethalfluralin) - prevents grasses, pigweed, lambsquarters, carpetweed
Strategy 2.1ME (ethalfluralin + clomazone) - prevents most annual weeds

All these herbicides are effective in preventing annual grasses such as crabgrass. On the other hand, none provide satisfactory control of ragweed and some other broadleaf weeds. Prefar is not widely used because it has to be incorporated into the soil right away and is weak on many broadleaf weeds. For jack-o-lantern pumpkins, Command 4EC is the only registered formulation of clomazone. Because of its high volatility, Command 4EC must be incorporated into the soil right after application. Drift of Command spray droplets or vapors can cause serious injury to susceptible plants and trees near a treated field. Leaves of sensitive plants turn white because Command inhibits chlorophyll and other pigments in leaves. For processing pumpkins and other cucurbit crops, Command 3ME is registered. This micro-encapsulated (ME) formulation is much less volatile and has lower risk of vapor drift than the EC formulation, thus it does not need to be incorporated. Pumpkins are generally tolerant of Command at labeled use rates. Any early whitening of leaves is usually temporary and does not affect yields. Another concern is that small grain cover crops (rye, wheat, oats) are sensitive to Command residues in soil. Thus it may be difficult to establish a good cover crop in fields treated with Command. Also check the Command label for planting restrictions on various crops to avoid carryover injury problems. Velvetleaf, lambsquarters and purslane are easily controlled by Command, so it is useful in fields with large seedbanks of these weeds.

Curbit is the most commonly used of the soil-applied herbicides for cucurbit crops. Curbit usually provides good control of pigweed, lambsquarters and some other broadleaf weeds. However, its activity is very dependent on adequate rainfall or irrigation within a few days after application. The optimal amount of water to activate Curbit is $\frac{1}{2}$ to 1 inch. If rainfall or irrigation does not occur, poor weed control will result. Pumpkin tolerance of Curbit is generally good, although injury can occur under cool, wet conditions. Injury potential is reduced if seeds are planted deeper. Strategy is a pre-mix, micro-encapsulated (ME) formulation containing the active ingredients of Curbit (ethalfluralin) and Command (clomazone). Because the volatility of clomazone is greatly reduced in the ME formulation, Strategy can be sprayed on the soil surface without incorporation. Once this product contacts soil, the risk of chemical drift is minimal. The components of Strategy make a good combination in terms of weed control spectrum. For example, pigweed is tolerant of clomazone but is controlled by ethalfluralin, and velvetleaf is tolerant of ethalfluralin but is controlled by clomazone. A disadvantage of Strategy is that its active ingredient concentrations are rather low. To get satisfactory weed control, a grower may need to apply Strategy at the high end of its rate range (2 to 6 pt/A, based on soil type). Strategy is rather expensive when applied at rates of 4 to 6 pt/A.

A New Herbicide for Pumpkins and Other Vegetables - Sandea (Halosulfuron)

Halosulfuron has herbicidal activity at extremely low use rates (less than 1 oz/A). It is registered as various trade names in corn (Permit), and turf and landscape uses (Manage). Gowan Company has recently registered its herbicide Sandea 75DF (halosulfuron, 75%) in several vegetable crops including cucurbits, tomatoes, peppers, eggplant and beans. Sandea provides control of yellow nutsedge, a troublesome perennial weed, in addition to some broadleaf weeds including pigweed, ragweed and galinsoga. It does not have activity on grasses.

Sandea has pre-emergence and post-emergence herbicidal activity. Yellow nutsedge is more susceptible when sprayed after emergence, but weeds such as lambsquarters and purslane are much more susceptible to pre-emergence treatments. Pumpkins have rather marginal tolerance of Sandea even at the labeled rate of $\frac{2}{3}$ oz/A, so proper calibration of spray equipment is especially important when using this product.

I have conducted experiments in Connecticut with Sandea (along with Curbit, Command and Strategy) in pumpkins the past two years. Experiments were conducted at two sites in 2002 and 2003. The dependence of preemergence herbicides on rainfall for activation was readily apparent. At one site in 2002, about $\frac{1}{2}$ inch of rain fell within hours after treatment application. Herbicidal efficacy was excellent. The other site received only a trace of rain (and irrigation was not available) in 10 days after herbicide application, resulting in poor weed control from all treatments.

Because Sandea does not control grasses, I applied a low rate of Curbit in all Sandea plots. Sandea was applied both pre-emergence and post-emergence at rates between 0.33 and 1.0 oz/A. Most pumpkins treated with Sandea showed some injury symptoms (growth stunting and temporary yellowing of leaves). Eventual recovery was nearly or fully complete. Control of yellow nutsedge and pigweed was excellent. Sandea applied pre-emergence provided adequate control of lambsquarters and purslane, but these two weeds were mostly unaffected by post-emergence sprays. Pumpkin yields in Sandea-treated plots were reduced, but it was unclear whether the reduction was due to plant injury or to weed competition. Sandea will be a useful option for growers having problems with yellow nutsedge, ragweed and some other broadleaf weeds. However, it is definitely not a stand-alone product; it must be used in conjunction with a herbicide that controls grasses.

Use of Herbicides with Plastic

Many vegetable growers use plastic to some extent in their fields. Black plastic will prevent weeds, but if white or clear plastic strips are used, you may want to use a pre-emergence herbicide before laying the plastic. First, be sure the herbicide is registered for use with that crop and for use under plastic. Avoid crop injury due to buildup of herbicide vapors by following these steps:

- 1) Prepare beds of pressed soil.
- 2) Apply herbicide to pressed soil beds.
- 3) Irrigate with $\frac{1}{2}$ to 1 inch of water.
- 4) Wait 2 or 3 days.
- 5) Lay plastic over beds.
- 6) Plant crop through holes in plastic.

To control weeds between plastic strips, one or more of the following can be employed:

- Cultivate between strips
- Flame weeding
- Herbicides (minimize spray contact on the plastic)
 - Before planting: Banded spray of Roundup, Gramoxone, Scythe
 - After planting: Do not use Roundup; can apply a registered preemergence herbicide between strips to prevent further weeds.

Using Rye Cover Crop As Mulch for Pumpkins

I have experimented the past several years with rye mulch systems for pumpkin production. This type of approach has been studied and used by a number of researchers and growers. Dale Riggs in New York and others have conducted studies using winter rye as mulch in pumpkins and other crops. In Connecticut, Jones Family Farm in Shelton has been using a rye mulch system successfully in pumpkins. Potential benefits include soil conservation, soil moisture conservation, weed suppression, herbicide use reduction, and keeping the fruits in a cleaner condition.

I am interested in all these impacts, but particularly the effects on weed populations. A dense stand of a cover crop can suppress weeds in two ways: a physical effect via competition (crowding out weeds), or a chemical effect (allelopathy) in which biochemicals are exuded that suppress weed seed germination. A dense stand of rye can work in both these ways.

Our basic approach is to plant rye in late September (or ASAP after harvest) at 300 to 400 lb of seed per acre (about 3 times the normal cover crop rate). In April, the rye is fertilized with nitrogen (40 to 50 lb/A). The first few years I allowed rye to grow until it produced seedheads (but seeds still in "milk" stage). At that time I sprayed the rye with Roundup (1 qt/A) to assure that it would die before seed maturation, thus avoiding volunteer rye as a weed. The next day the rye was rolled flat with a heavy roller. It is important to roll rye while it is still turgid, otherwise the stems tend to rise back up again. About 1 week later, pumpkin seeds were planted by hand in rows parallel with the rolled rye. The mulch was pulled back about 6 inches where seeds were planted, and fertilizer was applied to the soil. Early pumpkin vigor tended to be poor in the rye mulch plots. In addition, weed suppression was short lived compared to that of herbicide-treated plots.

I tried a different approach the past two years. In some plots, the rye was not sprayed with Roundup before being rolled. We found if the rye was rolled when it was far enough along in its reproductive stage (but still turgid), it died naturally on its own. Thus it is not necessary to spray rye with Roundup if it is rolled at the proper time. If many weeds emerge through the rolled rye prior to planting, Roundup or other postemergence herbicide could be used to kill these weeds. The other modification was to till a 1-ft wide strip for the planting rows. In some of these plots, Curbit was applied in a narrow band to reduce weed emergence in the disturbed planting row. Pumpkin seedling emergence and vigor was better in these tilled rows than where the rye mulch was just pulled back slightly.

With proper modifications, a rye mulch system should be useful for many different vegetable crops.