8 Weed Management

8.1 Calibration to Ensure Correct Herbicide Rate

Herbicide labels indicate rate of application as amount of product per acre; that is, per acre actually treated. Only if you broadcast herbicide over the entire orchard floor will the treated acreage equal the orchard acreage. Follow the instructions below to assure application of the correct herbicide rate.

8.1.1 Calculating Nozzle Flow Rate

Travel Speed:
For most situations, 2–2.5 mph is best (176–220 ft./min.).

Pressure:
Use low pressure (20–35 psi) to minimize formation of small droplets, because small droplets can drift off target.

Spray Volume per Treated Acre:
Generally, low rates (20–30 gals./acre, or less) are more suitable for postemergence herbicides, where runoff from weeds would reduce effectiveness. Higher rates, 40–50 gals./acre, may provide better coverage and control when using preemergence herbicides.

Nozzles:
Avoid nozzles that produce fine mist. Generally, hollow cone nozzles produce the finest droplets, flat sprays are second, and full cone nozzles produce the coarsest spray.

A single boomless off-center flat spray nozzle, or a flooding nozzle, may be suitable for some orchards, but one or more regular flat spray nozzles on a boom may be better where branches are close to the ground.

Use the following formula to determine nozzle flow rate in gal./min., then consult a nozzle manufacturer's chart to select the proper nozzle.

8.1.2 Definition of Terms

1. **Gallons per Treated Acre (G/TA)** = Amount of herbicide spray you want to apply per treated acre.
2. **Swath (S)** = Width of the sprayed area in feet.
3. **Travel Speed (TS)** = Feet traveled per minute.
4. **Nozzle flow rate** (gallons per minute) = (Gallons per Acre x Swath x Travel Speed) divided by 43,560

Nozzle Flow Rate = (G/TA x S x TS) / 43,560

Example 1:

What nozzle flow rate do you need to apply 25 gallons of herbicide spray mix per treated acre, using a 3-foot-wide swath and a travel speed of 220 feet per minute (=2.5 miles per hour)?

Nozzle flow rate
= (25 x 3 x 220) divided by 43,560
= (16,500) divided by 43,560
= 0.38 gallons per minute.

If using 2 nozzles, select 2 that will give 0.19 gallon per minute each at the selected pressure.

8.1.3 Checking Herbicide Sprayer Output

Spray Pattern:
Check uniformity of spray pattern, using corrugated fiberglass roofing panels as a spraying surface. Spray from the same height as will be used in the orchard. Compare liquid volume collected in each trough.

Actual Spray Volume:
With proper nozzles installed, travel a measured distance at the selected speed and pump pressure. Use this formula to determine the actual spray volume in gallons per treated acre.

Gallons per Treated Acre:
= (Gallons sprayed during trial run x 43,560) divided by (Feet traveled during trial run x Swath width in feet).

Example:

You emptied a tank containing exactly 3 gallons in a distance of 1,200 feet. The treated swath was 3 feet wide. How many gallons of spray are you applying per treated acre?

Gallons per Treated Acre
= (3 x 43,560) divided by (1,200 x 3)
= (130,680) / (3,600)
= 36.3 gallons

If you want to apply 4 lbs. of herbicide per acre, then in this case you would add 4 lbs. of herbicide to each 36 gallons of water in the tank.

Agitation:
If herbicides are allowed to settle or separate in the sprayer tank, distribution in the orchard will not be uniform. Provide constant agitation when using wettable powders, or any other insoluble formulation (emulsions, emulsifiable concentrates, dry flowables, liquid flowables, and suspensions). Use defoaming adjuvant when needed to control excessive foam.

8.2 Groundcover Management

Management of the orchard floor is an essential and often expensive piece of the overall orchard management scheme. A poorly designed and managed orchard floor will increase costs in several important ways, including increased mowing costs, reduced yield due to weed competition, and wear and tear on equipment. Several orchard floor management options to consider are:

1. Clean Cultivation/Fall Cover

This option can be effective with young trees, in particular as a management system that eliminates weed competition and encourages tree growth. These benefits do not come without cost. Soil erosion in particular is a real risk. Late summer seeding to a fall cover crop such as spring oats is essential to limit erosion. This fall cover must be planted early enough to allow ample autumn growth to protect soil from cold penetration in winter. Loss of organic matter with this system is another liability–soil organic matter is broken down quickly with repeated cultivation. In addition to these potential risks, calcium availability to trees may be reduced and soil compaction problems may develop.

2. Mulch

Mulching offers some attractive potential benefits, including improved soil moisture retention and weed suppression. Unfortunately, mulching also offers a couple of key liabilities that make it impractical as a general orchard practice. Perhaps most importantly, mulch provides an ideal habitat for voles (mice). Also, while the use of mulch will increase levels of organic matter and key nutrients including potassium and magnesium, its use will likely lead to reduced calcium levels.

The use of wood-based mulch such as wood chips and bark may be valuable on excessively drained soils

3. Permanent Sod

Permanent sod, often including an under-tree herbicide strip, is the orchard floor management system most commonly used. A permanent sod offers many important benefits. It reduces soil erosion; gives support (especially important when soils are wet) for heavy equipment needed for brush removal, pesticide application, and mowing; reduces dust and dust deposits on fruit; reduces tree rack or wobble during wind events; insulates against cold penetration in winter; increases movement of key nutrients including calcium into the tree root zone; and may provide winter refuge for a beneficial mite species.

A permanent sod also allows soil organic matter levels to increase over time, a condition which when coupled with proper soil pH management, eliminates the need to apply phosphorous throughout the life of the orchard.

The key to success with this system is establishment (preferably prior to planting) of a permanent sod floor. Combinations of slow-growing grass types such as dwarf hard fescues and perennial ryegrasses are preferable.

The process of establishing an orchard floor should include elimination of perennial weeds and grasses through use of an herbicide such as glyphosate (Roundup). In addition, correction of soil drainage deficiencies, soil pH and nutrient adjustment based on soil test recommendations, and preparation of a smooth, stone-free soil surface for seeding are all key elements for success. A 2-year soil preparation process that includes a full summer of cover cropping with a vigorous cover crop such as Sudan grass or Japanese millet is ideal. Seeding of a new orchard floor is best done in late summer or early autumn. In older plantings, the permanent sod is often a 'wild' mix of more vigorous grasses and herbaceous plants, a mix that requires extensive management including several mowings annually. In addition, the orchard floor is often rough and rutted from years of equipment traffic and dotted with rock outcroppings, adding to the management cost.

Some drawbacks are associated with permanent ground cover. Certain plant species such as alfalfa can promote pest populations (e.g., tarnished plant bug). Ground cover also provides competition for water and nutrients, especially to young trees. If not properly managed, it also provides habitat for voles. These drawbacks can be minimized with appropriate management of the orchard floor.

Mowing is the most important orchard floor management tool. Establishment of an orchard floor composed of slow growing grass species can reduce mowing requirements significantly. With an orchard floor composed of vigorous 'wild' species, several timely mowings will be required to prevent undue competition for trees and reduce vole populations by limiting their preferred habitat. A final mowing in late autumn (using a flail type mower) can reduce the potential apple scab infection risk the following spring.

Herbicides are generally used to manage groundcover around tree trunks and in that portion of the under-tree area that is difficult to mow. For mature trees on seedling or semi-dwarf rootstock, this herbicide strip may extend up to 6 feet or more out from tree trunks. With dwarf rootstock trees, the herbicide strip generally extends 2 feet or less out from the trunks. Maintaining herbicide strips as narrow as practical is important in reducing the risk of soil erosion and tree rack as well as cold penetration into the root zone of trees. In addition, narrow strips may facilitate movement of mite predators from the orchard floor into trees in summer. Less total herbicide is used per acre when these strips are narrow, reducing risk for environmental problems including herbicide leaching and runoff.

It is important to use herbicides judiciously for maintenance of these strips. Ideally, the use of herbicides will leave a living groundcover and root system or a mat of killed ground cover to protect soil from erosion and cold penetration. The overuse of herbicides, even in narrow strip systems, will lead to a barren soil strip and a high risk of erosion, tree rack, and cold temperature injury to tree root systems.

Herbicide timing should be chosen so as to assure that live groundcover, or a matting of killed groundcover will be present when soil erosion is likely, especially during the dormant season, and when thunderstorms are likely. Practices that promote extensive moss growth have not been identified, but it is evident that some herbicides inhibit moss establishment and others do not.

Maintaining or increasing soil organic matter (humus) should be an objective of orchard groundcover management in New England. Soil organic matter is much more than the dead leaves, stems, and roots produced by the groundcover and orchard trees. As plant tissues decay, through the activity of soil microorganisms (bacteria, actinomycetes, fungi, algae, protozoa, and nematodes) they produce **humus**, a complex mixture of organic compounds that gives topsoil its characteristically dark brown color. The soil microbes themselves die, contributing to the total pool of biomass that forms humus. In sod-covered soils, humus typically constitutes the bulk of soil organic matter. But humus is not permanent. Its constituents undergo a slow, but continuing process of decay. If soil is kept bare, the major food source for soil microorganisms is eliminated, and humus can then be expected to disappear faster than its is formed.

Humus is a major source of nitrogen, phosphorous, and sulfur. These three essential elements are abundant in biological tissue, the source of humus. Humus also has a controlling influence on the availability of essential micro-nutrients, not because its parent biological tissues were high in micro-nutrients, but because humus can form “chelates” with copper, zinc, manganese, etc. that are released from soil minerals. Chelated micronutrients are held against leaching from the soil, and under the right conditions, are available to plant roots.

Another value of humus derives from its electrostatic attraction for oppositely charged nutrient elements, protecting them against leaching. This property, called cation exchange capacity, is also exhibited by clay particles. Cation exchange capacity, together with chelation, allow soils to hold nutrients until picked up by plant roots. Soils in which these properties are at a low level, as in soils with little clay or organic content, are naturally low in agricultural productivity, because they cannot supply as much mineral nutrition as the crops are capable of using.

Additional benefits of soil organic matter are:

- It increases moisture-retention in sandy soils. Organic matter can hold up to 20 times its weight in water.
- It acts as “glue” to hold very small soil mineral particles together in units called aggregates. Aggregation permits a loose, open, granular condition that aids penetration by water, air, and roots, and resists erosion.
- It has the ability to absorb many organic pesticides, holding them near the soil surface, where they are more likely to be degraded by biological activity and sunlight, rather than leach to groundwater.

8.3 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.

8.3.1 Types of Herbicides

Herbicides can be separated into two broad categories: those applied to the soil before weeds have emerged (pre-emergence or ‘residual’ herbicides) and those applied directly to visible weeds (post-emergence or ‘contact’ herbicides). A few pre-emergence herbicides also have some activity against emerged weeds.

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 weeds, and others show degrees of activity against both types of vegetation. No herbicide is effective against all species in all 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.

8.3.2 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.

8.3.3 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 -- simazine, diuron, terbacil (and to a lesser extent norflurazon and dichlobenil) all have the potential to damage trees in young or dwarf orchards, particularly on light sandy soils. Use caution and low rates when using these hericides.

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.

8.3.4 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, root suckers, young-green bark and fresh pruning wounds, resulting in systemic injury. Do not apply after mid summer (July 15).
- **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. **Do not use 2,4-D near or in grapes!!!**
- **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.

8.3.5 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.

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.

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.

8.3.6 Need for Rain or Irrigation

Herbicides used for pre-emergence weed control generally require 0.5–1 inch of rain or irrigation, or shallow cultivation to initiate herbicidal action. The need for prompt incorporation varies.

Warm bright days speed surface breakdown and evaporation of certain herbicides. Some herbicides must be incorporated within 24 hours after application, while other materials can be stable for 3–4 weeks or more. Specific information is provided on product labels if rapid incorporation is necessary.

8.3.7 Persistent Weeds

Perennial and biennial species that persist where pre-emergence herbicides have been used can often be killed by one or more treatments with glyphosate, 2,4-D, or a combination of these two. Such species include bindweed, brambles, Canada thistle, dandelion, dock, evening primrose, goldenrod, horsenettle, plantain, poison ivy, and vetch. Yellow nutsedge can be killed with glyphosate, glufosinate, or paraquat, properly timed. Mid-June to mid-July is the best time for paraquat and glufosinate, while August and September are best for glyphosate. These late summer applications also carry the greatest risk of damage to the crop if foliage or green tissue is contacted by improper application. Note that preharvest interval requirements may influence choice of timing.

8.3.8 Application Method

Regardless of which herbicides are chosen, proper application is essential to insure safety and efficacy. Take the time to set up and check the mechanics of the weed sprayer. This is too often neglected. Every time an herbicide sprayer is brought out for use, it needs to be checked, both for level application across the boom and rate per sprayed acre. There are many ways to calibrate orchard herbicide sprayers: use the one you are most comfortable with. If you do not already have a good method, try the procedure outlined at the end of this section.

Most orchards are sprayed with a single sided boom sprayer, with two, three, or four flat fan nozzles placed about a foot apart, starting at the distant tip of the boom. The boom is adjusted so that the spray from each nozzle over-laps about 1/3 of the pattern from the adjacent nozzles on either side at the level of the target. The “target” can be either weed growth if you are spraying contact herbicides, or the soil surface, if you are applying soil residual products.

Some growers use single “flood-jet” style nozzles to apply contact materials on both sides of a tree row with a single pass by the sprayer. This is somewhat effective, but not without problems, including injury to tree trunks. Most single nozzle band applications wider than a foot or two distribute herbicide unevenly. Single nozzle band application should not be used with most soil residual materials, or for products that may injure the young tree if applied to the trunk.

The use of anti-drift agent(s) is recommended, particularly for contact and systemic herbicides. With some herbicides and target weeds, addition of a surfactant, spreader-sticker, and or crop oil concentrate is also recommended. See label for details

8.3.9 Rate of Herbicide

For many pre-emergence herbicides, the lower recommended rate is the best choice for coarse texture orchard soils (sandy loam or loamy sand), provided moisture conditions are suitable. Some preemergence herbicides are strongly adsorbed onto soil organic matter and/or clay particles. Therefore, on relatively high organic soils (above 3.5 percent by Walkley-Black method) and on clay loam soils, the higher label rate may be needed for pre-emergence control.

Soil texture and organic matter content can be determined by soil testing laboratories. Several different methods are used to estimate soil organic matter. For the same soil, different methods can give much different results. To properly interpret label recommendations regarding soil organic matter, ask your soil testing laboratory to indicate its estimate of organic matter as though it had been done by the Walkley-Black method.

Surface litter (non-decomposed organic tissues) can bond some herbicides, resulting in failure of the chemical to reach the soil where germinating seeds can be killed. Herbicides that are so affected will include a label recommendation for removal of surface litter, or clean cultivation prior to application of the herbicide.

Rates for post-emergence herbicides vary according to weed species and growth stage. Drought conditions that slow weed growth may make weeds more tolerant of post-emergence herbicides applied during that time.

Unless product labels suggest addition of surfactants or other adjuvants, their use is not likely to improve herbicide activity. Post-emergence herbicides should be used with enough water to avoid missing any plants or plant parts, while avoiding runoff, although systemic herbicides such as Roundup can be effective at low water volumes and incomplete plant contact.

8.3.10 Timing Herbicide Applications

Product labels limit timing of some herbicides to certain months, weed growth stage, temperatures, crop growth stage, or days to harvest. Detailed information is included on the product labels.

8.3.11 Tankmixes

- If no statement concerning tank mixing of two or more herbicides is given on product labels, mixing is legal, though a test for compatibility will be necessary.
- Do a small-scale jar test as follows: Place one pint of water in a quart jar. Add each pesticide or a pre-mix of pesticide in water, one at a time, and shake well with each addition. Use each product in about the same proportion to water as it will be in the field mixture. One half of a measuring teaspoon of herbicide in a pint of water is approximately equivalent to one pint or one pound of herbicide in 25 gallons water. Unless labels indicate otherwise, add pesticides in this order: wettable powders, followed by flowables, emulsifiable concentrates, water solubles, and recommended adjuvants. However, when compatibility enhancers are used (tankmix adjuvants or spreader/stickers) these should be added first to the water. Invert the jar 10 times, then inspect the mixture immediately and again after 30 minutes. If a uniform mix cannot be made or if non-dispersable oil, sludge, or clumps of solids form, the mixture is incompatible and should not be used. Minor separation after 30 minutes (without sludge or clumps) that remixes readily with 10 jar inversions, is tolerable if spray tank agitation is good.
- When you tankmix in volume, put 2/3 of the water in the tank first. Then add pesticides one by one, with wettable powders first. Agitate for thorough mixing after each addition, before pouring in the next. Finish filling the tank with water.
- Maintain continuous agitation until the tank is empty.

8.3.12 Established Orchard Herbicide Program

A late spring and late fall application of herbicides to herbicide strips of established orchards is recommended. Specifically:

> Late fall herbicide application should include a translocated contact herbicide (2,4-D, or glyphosate if perennial weeds are present and trees can be shielded or missed) AND a residual herbicide (Kerb, Solicam, Surflan, Prowl, Chateau).
>
> Late spring herbicide application should include a different residual herbicide (Karmex, Sinbar, Solicam, Surflan, Devrinol, Prowl, Chateau) and a contact herbicide if perennial weeds are present or annual weeds have emerged.

These two applications may give effective season-long control, improve consistency of treatment, decrease risk of crop injury, and decrease competition by weeds in early spring.

('Groundcover Management and Herbicides' adapted from original New England Apple Pest Management Guide, by William Lord, University of New Hampshire. Adapted and edited for most recent version by George Hamilton, UNH Cooperative Extension, and Jon Clements, UMass Extension.)

Table 8.3.1. Herbicides registered for use in tree-fruit orchards.

Minimum time between planting and use indicated if specified on label.
NB = Nonbearing trees only; Y= listed on label; N = not listed on label.

Product	Apple	Pear	Apricot	Tart Cherry	Sweet Cherry	Nectarine	Peach	Plum	Prune
Aim 2EC, 1.9EW	Y	Y	Y	Y	Y	Y	Y	Y	Y
Casoron 4G	4 wk	4 wk	N	4 wk	4wk	N	N	N	N
Chateau WDG	Y	Y	Y	Y	Y	Y	Y	Y	Y
Devrinol 50DF	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fusilade DX	NB	NB	Y	Y	Y	Y	Y	Y	Y
Gallery 75DF	NB	NB	NB	NB	NB	NB	NB	NB	NB
Glyphosate	Y	Y	Y	Y	Y	Y	Y	Y	Y
Goal 2XL, Galigan 2E	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gramoxone Inteon	Y	Y	Y	Y	Y	Y	Y	Y	Y
Karmex 80DF, Diuron 4L, 80DF	1 yr	1 yr	N	N	N	N	3 yr	N	N
Kerb 50 W[1]	Y	Y	Y	Y	Y	Y	Y	Y	Y
Matrix	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr
Poast	Y	Y	Y	Y	Y	Y	Y	NB	NB
Princep 4L, Simazine 4L, 90DF, Caliber 90, etc.	1 yr	1 yr	N	1 yr	1 yr	N	1 yr	1 yr	N
Prowl 3.3E	NB	NB	NB	NB	NB	NB	NB	NB	NB
Prowl H2O	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rely 200	1 yr	N	N	N	N	N	N	N	N
Select	NB	NB	NB	NB	NB	NB	NB	NB	NB
Sinbar 80WP[2]	3 yr/NB	NB	NB	NB	NB	NB	3yr/NB	NB	NB
Solicam DF	Y	1 yr	1 yr	18 mo	18 mo	6 mo	6 mo	1 yr	1 yr
Stinger	N	N	Y	Y	Y	Y	Y	Y	Y
Surflan AS	Y	Y	Y	Y	Y	Y	Y	Y	Y
Unison	Y	Y	Y	Y	Y	Y	Y	Y	Y
Weedar 64, Amine 4, *2,4-D Amine	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr

Sinbar + Karmex tank mix at lower rates - Apples and peaches established at least 2 yr..
[1] Kerb. Not less than 6 mo after fall transplanting nor less than 1 yr after spring transplanting of labeled crops.
[2] Low rate for newly planted and young, non-bearing fruit trees (except apple).

Table 8.3.2. Effectiveness of herbicides in tree-fruit crops.

Material	AG	AB	PG	PB	WBV	YN	BW	HN	CT	SB	PW	RW
carfentrazone-ethyl	—	G	—	P	—	—	P	—	—	—	G	G
clethodim (Select)	G	—	G	—	—	—	—	—	—	—	—	—
clopyralid	—	F	—	F[5]	—	—	—	F	G	—	—	F
dichlobenil (Casoron 4G)	G	G	G	G	—	G	—	G	G	—	G	G
2,4-D	—	G	—	G	F	—	G	F	F	-	G	G
diuron (Karmex)	G	G	F	—	—	—	—	—	—	—	G	G
fluazifop (Fusilade)	G	-	F	—	—	—	—	—	—	—	—	—
glyphosate (Roundup, Touchdown)	G	G	G	G	G[1]	G[2]	G	G[1]	G[1]	F	G	G
flumioxazin (Chateau WDG)	F	G	–	F	–	–	P	P	P	–	E	G
isoxaben (Gallery)	—	G	—	—	—	—	F	—	—	—	G	G
napropamide (Devrinol)	G	F	—	—	—	—	—	—	—	—	F	P
norflurazon (Solicam)	G	F	F	—	—	F	—	—	—	—	F	—
oryzalin (Surflan)	G	F	—	—	—	—	—	—	—	—	G	P
oxyfluorfen (Goal)	F	G	—	—	—	—	—	—	—	—	G	G
paraquat (Gramoxone Max)	G	G	F	F	F	G[3]	F	F	F	—	G	F
pendimethalin (Prowl)	G	F	—	—	—	—	—	—	—	—	G	—
pronamide (Kerb)	G	—	G	—	—	—	—	—	—	—	—	—
rimsulfuron (Matrix)	G	G	—	—	—	F	—	—	F	—	F	F
sethoxydim (Poast)	G	—	F	—	—	—	—	—	—	—	—	—
simazine (Princep)	F	G	—	—	—	—	—	—	—	—	G[4]	—
terbacil (Sinbar)	G	G	F	F	—	F	—	F	—	—	F	G

Key: E = excellent; **G** = good; **F** = fair; **P** = poor;.

[1] Combination with 2,4-D amine has improved effectiveness.
[2] Best results with late-summer (after August 1) applications.
[3] Best results with early mid-summer (before July 15) applications.
[4] Resistant types may require use of alternative materials.
[5] Not broadspetrum; see label for specific weed targets.

Abbreviations: AG = Annual grasses; **AB** = Annual broadleaves; **PG** = Perennial grasses; **PB** = Perennial broadleaves; **WBV** = Woody brush, vines; **YN** = Yellow nutsedge; **BW** = Bindweeds; **HN** = Horsenettle; **CT** = Canada thistle; **SB** = Smooth bedstraw; **PW** = Pigweeds; **RW** = Ragweed.