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## Weed Control in Strawberry

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Weeds may affect strawberry growth and production in several different ways. They compete with strawberry plants for water, minerals, and sunlight; increase pressures from disease, nematodes, and insects; and reduce berry quality. Harvest efficacy can also be reduced since pickers often fail to find and pick berries that are hidden in weedy growth. In addition, weeds increase strawberry production costs, as control may cost up to several hundred dollars per acre per year.

Strawberry plants are easily overgrown by tall, rapidly growing weeds and they may be severely damaged in only a few weeks. Failure to control weeds may result in abandonment of strawberry beds after 2 to 3 years. Appropriate weed control practices can considerably extend the productive life of strawberry plants.

Both winter and summer annual weeds are considered major weed problems in strawberry. However, winter annuals are more difficult to control than summer annuals, since the former develop mainly during the rainy wet season when cultivation is impossible. Typical annual weeds include pineappleweed, shepherdspurse, chickweed, clovers, common groundsel, common lambsquarters, wild mustard, barnyardgrass, wild buckwheat, redroot pigweed, ladythumb, and annual bluegrass.

Perennial weeds are more difficult to manage in strawberry beds than annual weeds. However, they can be avoided by not planting strawberries in fields that are already infested with them. Potentially troublesome perennials in strawberries include dandelion, field bindweed, field horsetail, Canada thistle, quackgrass, and yellow nutsedge.

### **Management Methods**

Strawberry weed control is a year-round process that starts before a field is planted and continues through the life cycle of the planting. The most effective and economical weed management programs in strawberries usually combine cultural, mechanical, and chemical practices. Although several herbicides are available to control weeds in strawberries, they should be viewed as useful tools to control weeds, not as substitutes for good management practices. When one control method is used continuously, whether cultural, mechanical, or chemical, a shift in the weed population to a more tolerant or resistant species can occur. Resistant plants within a species, usually controlled by herbicides, can be selected for and can increase in number. Most commonly, tolerant species replace sensitive ones that have been controlled by herbicides. Examples include deep-rooted perennials that survive cultivation, or herbicide-resistant weeds such as common groundsel that are selected from sensitive biotypes. This problem can be avoided by integrating as many control measures as possible: crop rotation, good seed bed preparation, strong crop

competition, cultivation, using a variety of herbicides with different modes of action, and rotating herbicides from one season to another.

### **Field Selection, Seedbed Preparation, and Sanitation**

Since controlling perennial weeds is difficult in strawberries, select relatively clean fields with no history of perennial weeds and hard-to-control weeds such as quackgrass, Canada thistle, field horsetail, chickweed, common groundsel, ladythumb, and sow thistle. If possible germinate the first flush of annual weeds utilizing rainfall or irrigation before beginning tillage operations. Plow as deeply as possible to break up soil compaction and reduce risk of herbicide carryover if strawberries are planted after vegetable seed crops, ornamental bulbs, corn, and other crops. Disk and harrow the soil just before setting the plants so that germinated weeds do not have any competitive advantage.

Good field sanitation is essential for weed control. Use clean implements for planting, cultivating, and tilling to eliminate the chance of introducing new weeds. Keep field perimeters weed free because they serve as initial reservoirs for seed to infest the field. Cultivate and hoe to prevent weeds from going to seed that escape other treatments.

### **Crop Rotation**

Two years prior to planting, work to reduce the weed and weed seed population of the fields where berries will be planted. Weed infestations can be reduced by rotating with crops that have a different life cycle, or ones in which different cultural and chemical practices are used. Wheat, corn, or vegetable row crops can be grown while keeping the field weed free. Cover crops may be grown and plowed under before planting strawberries in the spring. Crop rotation changes not only the crop in each field, but also the soil preparation practices, subsequent soil tillage, and weed-control techniques. For example, broadleaf herbicides can be used in wheat or corn to control weeds which will be difficult to control in subsequent strawberry plantings.

### **Crop Competition**

Management practices which stimulate healthy and vigorous strawberry plants will reduce losses from weeds. Some of these practices include choice of proper planting date; bed renovation; selection of the correct amount, timing, and placement of fertilizer; supplying irrigation when needed; using adapted cultivars; proper plant spacing; and controlling insects and diseases. Plant only certified strawberry seedlings, which may cost more initially but are cheaper in the long run. The biggest strawberry plants are not necessarily the best. Medium size plants with large and healthy root systems are ideal.

### **Row-Crop Cultivation and Hand Hoeing**

Cultivation between the rows kills small weeds easily and effectively by burial or uprooting. Soil can be thrown over small weeds that emerge in the crop row. In new plantings, cultivate 2 to 3 weeks after planting with a rototilling cultivator, then follow that with a wiggle hoe or spike-tooth harrow. Two months after planting, when strawberry runners start to elongate, use a half disc sweep equipped with blades or other suitable cultivators to control weeds and line up the runners into the row without injury. Continue cultivating through the growing season. Cultivate 1 to 2 inches deep to avoid root injury.

In established strawberries, set up row width with a rolling disc early in the spring and make the first cultivation relatively deep (5 to 6 inches). Continue shallow

cultivation throughout the season with rotary tiller cultivators, wiggle hoe, spike-tooth harrow, shield or spring tooth gangs, or cultivator knives.

Precision cultivation and herbicide use will not eliminate all weeds. Therefore, hand weeding is necessary to remove those weeds which will hinder harvesting and if allowed to go to seed will reinfest the field. Cultivation and effective herbicides can reduce hand weeding costs.

### **Geese as Weeders**

Geese like some serious strawberry weeds. Where infestations of chickweed, field horsetail, and grasses are serious, geese may be worthwhile. When using geese, you must follow proper goose management practices. Use only enough geese to keep down the weeds they like; otherwise, they will eat buds and tender foliage. The number of geese needed varies with the amount of weeds to be grazed and the age of the geese (younger geese work better than mature ones), and usually ranges from about two to four geese per acre. As a rule, geese must be fed a supplement in addition to the pasturage they get from weeding.

### **Mulching**

Mulching is not a general practice on larger fields in western Washington. It is used mainly to save moisture, keep berries clean, suppress weeds, and make picking more pleasant. It is expensive and frequently keeps the soil too cool, which delays harvest.

Straw mulch can be used for strawberry plantings in home gardens or small areas. Use wheat or pea vine straw and put a light mulch between the rows after hoeing or cultivation in the spring. This mulch keeps rain or sprinklers from packing the soil and saves some moisture.

Several materials are suitable for mulching. Among those used to a limited extent are polyethylene plastic, sawdust, shavings, and well-rotted manure. Lawn clippings, leaves, straw, and debris of almost any sort can be used. Cover the soil with at least 2 to 3 inches of sawdust or shavings and a little deeper if other material is used.

### **Herbicides**

Herbicides are an important component of any integrated weed management program in strawberry. They should be used in conjunction with good cultural practices, cultivation, and hand weeding. Several herbicides are available to control annual weeds in both new and established strawberry plantings. However, herbicides that kill perennial weeds may also damage strawberry plants. Therefore, weeds such as quackgrass, sheep sorrel, field horsetail, Canada thistle, and others that grow from underground vegetative parts must be killed before planting strawberry.

To maintain an income while bringing perennial weeds under control, other crops that are resistant to the herbicide used to control perennial weeds can be grown. Atrazine, 2,4-D, or glyphosate in corn and 2,4-D, MCPA, dicamba, or glyphosate in cereal grains are a few of the combinations in which herbicides can be used with crop rotation to obtain perennial weed control.

Perennial weeds also can be controlled by tillage alone. Therefore, the advantages and costs of chemical application must be weighed against costs and time spent in a clean cultivation program.



## Pre-plant Soil Fumigation Treatment

Methyl bromide, methyl bromide plus chloropicrin in combination, or metham, when properly applied to the soil before planting, control most weeds, nematodes, and some soil-borne diseases and insects. However, metham is widely used in strawberry fields in western Washington because it is cost effective and provides adequate weed control.

The soil should be in good workable condition and tilled at least to the intended depth of incorporation. Soil should have adequate moisture for weed seed germination. Apply lime and fertilizer before fumigation. Apply nitrogen prior to or after fumigation from an ammonium source as fumigation reduces nitrifying bacteria. Never fumigate when soil temperature is below 50°F. Fumigating at lower soil temperatures generally results in unsatisfactory weed control

Apply 50 gallons of metham per acre with a spray blade set to 2 inches deep. Immediately after application, rototill 8 to 10 inches deep, then use a power roller (roller drum) to compact the soil and seal the surface to prevent gas release from treated soil. Seven days after treatment, cultivate the treated area to a depth of 2 inches to aerate the soil. To prevent metham injury to strawberries, plant 14 to 21 days after fumigation in light soil and 21 to 30 days in heavy soil. Split treatment of metham may control weeds better than a single application.

## New Plantings

### **Napropamide (Devrinol).**

This is a selective soil-applied herbicide that controls some broadleaf and grass weeds. Napropamide does not control emerged weeds. All weed growth in the fields must be thoroughly worked into the soil prior to application. Apply at 4 lbs ai/A (8 lbs product/A). This herbicide has good crop safety when applied after the desired number of daughter plants have become established. However, napropamide may stunt strawberry plants and reduce the number of runners when applied preplanting or immediately after planting. Rainfall or overhead irrigation following application is essential for effectiveness. The surface 2 to 4 inches of soil must be wet within one day after application.

### **Precautions:**

1	At least 1 inch of rainfall or irrigation within one day after application is necessary for weed control and to prevent herbicide breakdown by sunlight. Napropamide is sensitive to sunlight, and under high sunlight intensity in the summer, slightly over 50% loss by photodecomposition may occur 4 days after application. Under winter conditions the loss is about 30% in 8 days.
2	Weed control will be reduced when soil is heavily covered with leaves or trash.
3	Do not use on soils with over 10% organic matter.
4	Do not apply more than once per season.
5	Tolerant weed species are shepherdspurse, mustards, henbit, black nightshade, smartweed, ladythumb, and all established weeds.

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### **Sethoxydim (Poast).**

This herbicide selectively controls many annual and perennial grass weeds when applied on foliage at the optimum growth stage. Sethoxydim does not control broadleaf weeds and sedges. It is most effective on actively growing grasses before they reach the maximum size (generally 6 to 12 inches tall).

Use 0.188 to 0.478 LB ai/A ( 1.0 to 2.5 pints product/ A). Apply the lower rate on grasses up to 6 inches tall and the higher rate on grasses that are 6 to 12 inches tall.

#### **Precautions:**

1	Erratic control often occurs when grasses are stressed from drought, low fertility, or temperature extremes.
2	Repeat applications if new germination or regrowth occurs.
3	Sethoxydim does not control annual bluegrass and the fine fescues. It is also weak on quackgrass.
4	In irrigated areas, it may be necessary to irrigate before sethoxymid application to ensure weeds are growing actively.
5	Do not apply when rainfall is expected within 1 hour.

### **Clethodim (Prism).**

This is a selective postemergence herbicide for controlling annual and perennial grasses. Grass needs to be actively growing at the time of application. Clethodim does not control sedges or broadleaf weeds. Treated grasses will show symptoms in 7 to 14 days. These symptoms include reduction in vigor and chlorosis/necrosis of younger plant tissue, and are followed by a progressive collapse of the remaining foliage.

Use 0.10 to 0.25 LB ai/A ( 13 to 34 ozs product/ A). Rates depend on weed species, stage of growth, weed pressure, and environmental conditions. Apply under favorable conditions of soil moisture and humidity, which exist within a few days after rainfall or within 7 days after irrigation. Always use 1% volume by volume (v/v) crop oil concentrate containing at least 15% emulsifier (but not less than 1 pint/A) to finished spray volume.

#### **Precautions:**

1	Use only on nonbearing strawberries.
2	Do not apply when plants are under stress from drought, excessive water, extreme temperature, or low humidity. Applying clethodim under conditions that do not promote active grass growth will reduce herbicide effectiveness.
3	Do not apply if rain is expected within 1 hour of application as control may be unsatisfactory.
4	Cultivation of treated grasses 7 days prior to or within 7 days after application of clethodim may reduce weed control.

### **DCPA (Dacthal).**

Although DCPA is currently registered for use in strawberries, this herbicide has

been judged unsuitable in western Washington for several reasons: (1) high probability of strawberry injury, (2) ineffectiveness on the weed species commonly infesting strawberry, and (3) inappropriate under the usual environmental conditions and/or managerial practices common to western Washington agriculture.

## Established Plantings—Fall and Winter Applications

### **Simazine (Princep).**

It is an effective herbicide on several broadleaves and grasses, including annual bluegrass, common chickweed, fireweed, henbit, shepherdspurse, black nightshade, mouseear chickweed, smartweed, purslane, and wild mustard. It should be used only on well-established strawberry plantings.

Apply 1 lb ai/A during winter from early November through late December. Since simazine has little or no effect on emerged weeds, it should be applied before they emerge.

### **Precautions:**

1	Make only one application during the season.
2	Do not apply within 4 months after transplanting.
3	Apply only under conditions of high surface moisture.
4	Do not apply in the spring prior to harvest.
5	Do not apply to excessively loose, sandy, or coarse soil or injury may occur.
6	The strawberry varieties 'Northwest', 'Siletz', 'Totem', and 'Benton' show less tolerance to simazine than other varieties.

### **Terbacil (Sinbar).**

It is an effective herbicide at low rates on many annual weed species common in western Washington. Apply only to established plants, at least 6 months after planting. Apply during winter from late November to early January when strawberry plants are completely dormant and before weeds are 1 inch tall or wide.

Use 0.1 to 0.3 lb ai/A, depending on soil type and weed pressure. Use lower rates on coarse soils and higher rates on fine soils but avoid all use on soil containing less than 2% organic matter.

### **Precautions:**

1	Terbacil may reduce runner production or plant stand.
2	Strawberries growing in low-lying or poorly drained areas will be injured by terbacil.
3	Do not apply to strawberries under stress due to drought, insect or plant disease infestation, poor drainage, etc.
4	Do not plant any crop within 2 years of last application, as injury on subsequent crop may occur.
	To avoid development of terbacil resistant weeds, do not use terbacil continuously. Rotate terbacil with other herbicides having a different mode



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of action, such as napropamide (Simazine has the same mode of action as terbacil).

### **Napropamide (Devrinol).**

This is an effective herbicide on several grasses and broadleaves. Apply during October through March to weed free soil, preferably in November or December. Due to possible carryover in wheat rotations, use other weed control practices the final year of strawberry production or deep plow to dilute the soil residue. Use the same rate and precautions as described earlier in new planting of strawberries. Do not apply more than once per year.

### **Sethoxydim (Poast).**

This herbicide selectively controls many annual and perennial grass weeds when applied on foliage at the optimum growth stage. Follow the same rate, instructions, and precautions as in new planting of strawberries. Do not apply within 7 days of harvest, nor exceed 0.478 lb ai/A.

Sethoxydim plus oil concentrate may cause crop injury when applied within 6 weeks after terbacil (Sinbar) application. Injury is believed to be variety related. Growers should evaluate the injury potential by treating a small area first then waiting a week before treating the rest of the strawberry field. Consult label about sethoxydim application with other herbicides and pesticides.

### **Paraquat (Gramoxone extra).**

This nonselective herbicide has no residual activity. Apply 0.47 pound active ingredient per acre ( 1.5 pints product per acre) as a directed spray between rows, using a shield to prevent crop injury. Add nonionic surfactant or crop oil as specified on the label. Because paraquat is a contact herbicide, it kills only the aboveground foliage of established perennials and does not control underground reproductive parts. Rain occurring 30 minutes or more after application will not reduce activity. Any strawberry plants contacted by paraquat will be injured or killed. Since paraquat is a contact herbicide, provide complete coverage of target weeds to get good control.

### **Precautions:**

1	Improper application technique or application to large or stressed weeds usually results in unacceptable control.
2	Paraquat is a restricted-use herbicide; follow all use restrictions and precautions given on the label. Paraquat requires special safety equipment when handling, mixing, and spraying
3	Do not apply more than 3 times per season.

### **Simazine plus Napropamide.**

This combination can be used to increase the weed control spectrum. Use only on well-established strawberries. Apply 1 lb simazine and 4 lbs ai/A of napropamide. Follow all precautions as given previously for simazine and napropamide alone.

## **Established Plantings—Bed Renovation in Summer**

### **Simazine (Princep).**

This is an effective herbicide on several broadleaves and grasses. Apply in summer after harvest following renovation of the bed, but before August 1 . Irrigation or rainfall after application is essential for weed control. Use the same rate, instructions, and precautions as described earlier. However, simazine may be less effective in summer than winter application.

#### **Terbacil (Sinbar).**

Apply in summer after bed renovation but before new strawberry plants start to grow. Do not exceed 0.4 lb ai/A per season. Use same rate, instructions, and precautions as previously described.

#### **Napropamide (Devrinol).**

Apply to weed-free soil after bed renovation. Use same rate, instructions, and precautions as described earlier. Napropamide may inhibit rooting of daughter plants. Do not use more than once per year.

#### **Sethoxydim (Poast)**

This herbicide selectively controls many annual and perennial grass weeds when applied on foliage at the optimum growth stage. Follow the same rate, instructions, and precautions as in new planting of strawberries. Do not exceed 0.478 pound active ingredient per acre.

#### **Paraquat (Gramaxone Extra).**

This is a nonselective contact herbicide. Follow the same instructions as described earlier.

#### **Know your weeds.**

It is important to know which weeds are present in your field so you can select the most effective herbicide. Table 1 lists the effectiveness of registered herbicides on problem weeds found in western Washington.

#### **Method of application.**

Uniform application is absolutely necessary if herbicides are to provide the desired results. Do not miss areas and also do not overlap as crop injury may result. Calibrate your sprayer before applying herbicides.

#### **Read and follow the label.**

Always read the label and follow instructions carefully when using any herbicide. Do not trust your memory; mistakes can be costly. When you use any herbicide for the first time, it is advisable to experiment with the herbicide to learn how the compound performs under your conditions prior to applying the herbicide on large areas.

**WEED SUSCEPTIBILITY TABLE FOR SMALL FRUIT HERBICIDES**

<b>WEEDS</b>	<b>Napropamide</b>	<b>Paraquat</b>	<b>Sethoxydim</b>	<b>Clethodim</b>	<b>Simazine</b>	<b>Terbacil</b>
<b>BROADLEAVES</b>						
Bedstraw	--	P	P	P	--	P
Bittercress	G	G	P	P	F	G
Buckwheat, wild	--	G	P	P	G	F
Chickweed	G	G	P	P	G	G



Clovers	--	P	P	P	P	P
Cornspurry	G	G	P	P	G	G
Dandelion, common	G*	P	P	P	F*	F
Dandelion, false	P	P	P	P	F	F
Field Bindweed	P	P	P	P	P	P
Field Horsetail	P	P	P	P	P	P
Filaree, redstem	G	F	P	P	G	G
Fireweed	P	G	P	P	G	G
Geranium	G	G	P	P	--	G
Groundsel, common	G	G	P	P	P-F	F
Henbit	P	G	P	P	G	G
Knotweed	F	P	P	P	G	G
Ladysthumb	F	F	P	P	G	G
Lambsquarters	G	F	P	P	F	G
Mustard, hedge	P	F	P	P	G*	F
Mustard, wild	F	G	P	P	G	G
Nightshade, black	P	G	P	P	G	F
Pigweed, redroot	G	G	P	P	F	F
Pineappleweed	G	G*	P	P	F	G
Plantain	--	G	P	P	G	F
Prickly lettuce	G	G	P	P	G	G
Purslane	G	G	P	P	G	G
Shepherdspurse	P	G	P	P	F	G
Sowthistle, annual	G	G	P	P	F	F
Tansy Ragwort	P	G*	P	P	--	P
Thistle, bull	--	P	P	P	G*	P
Thistle, Canada	P	P	P	P	P	P

### GRASSES

Barnyardgrass	F	G	G	G	F	G
Bentgrass	--	P	F	G	G*	F
Bluegrass, annual	G	G	P	G	G	G
Orchardgrass	--	G*	G	G	P	P
Quackgrass	P	F	P	G	P	F
Ryegrass, annual	G*	G	G	G*	G*	G
Velvetgrass	P	F	F	P	P	F

Letter rating corresponding to the following:

G = good (85-100%), F = fair (70-84%), P = poor (0-69%)

\*seeding stage only

-limited information

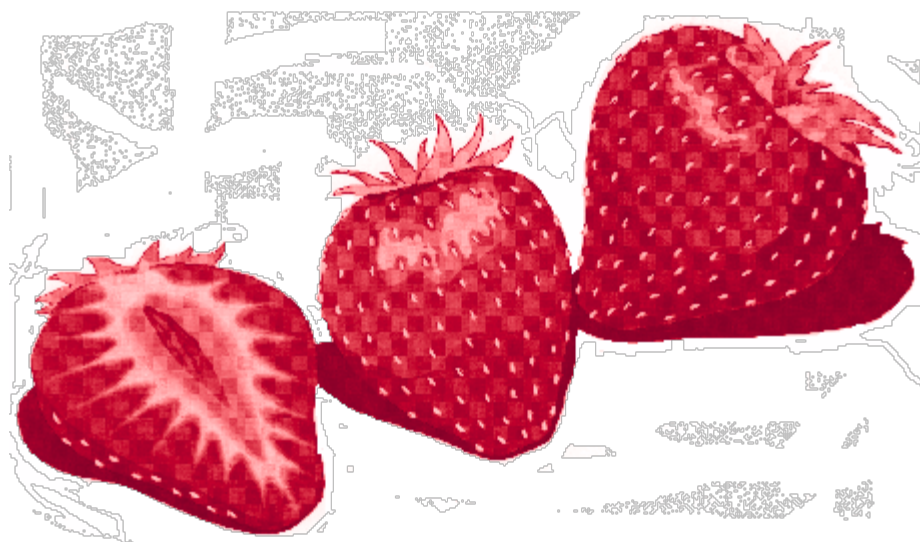
Information used in this table is based on observed control in western Washington, not on information from herbicide labels.

This table is provided as a general guide to show responses of listed weeds to herbicides. Information is based on research responses that vary according to climatic, management, soil, and cultural conditions.

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