

SECTION O. SMALL FRUITS

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Blackberry and raspberry Including boysenberry; loganberry; Marion, evergreen and other cultivars; and red and black raspberry

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Revised March 2019

Site Preparation

glyphosate (numerous product names)

Rate Consult labels

Remarks Apply to weeds at least 10 days before planting crop. Use highest rate on field bindweed. Do not apply if weeds are stressed by drought, weather, or maturity. Rain within 6 hours after application may reduce effectiveness. Inhibits production of three amino acids and protein synthesis.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

New Plantings and Nonbearing Crops

clethodim (Select Max)

Rate 0.07 to 0.12 lb ai/a (9 to 16 oz/a Envoy Plus)

Time Apply postemergence to actively growing annual or perennial grasses as listed on label.

Remarks Consider environmental and plant growth conditions that affect leaf uptake (see label). Add 0.25% v/v nonionic surfactant to improve efficacy. Use higher rates to control perennial grasses. For repeat applications make on a minimum of a 14 day interval. PHI 7 days.

Caution Do not exceed 64 fl oz/a per season. Do not apply over top of plants. Do not apply within 1 year of harvest.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

fluzifop (Fusilade DX)

Rate 0.25 to 0.375 lb ai/a (16 to 24 oz/a Fusilade DX) depending on target species and growth stage

Time Apply to actively growing grasses, or within 7 days after irrigation, as a directed spray with 1% crop oil or 0.25% nonionic surfactant.

Remarks Identify grasses and adjust rates depending on susceptibility and stage of weed growth, according to label instructions. Results often are erratic on grasses stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses

and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment. Inhibits fatty acid production, cell membranes, and new growth. PHI 1 day

Caution Grazing is prohibited.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Aryloxyphenoxy propionate

glyphosate (numerous products)

Rate See label

Time Apply to actively growing weeds.

Remarks Avoid contact with green foliage or suckers of crop. Preharvest interval is 14 days.

Caution Do not exceed 12.8 pints/a per year. Follow all precautions on label.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

isoxaben (Gallery 75DF or Trellis SC)

New plantings and nonbearing crops in alternate-year systems

Rate 0.5 to 1 lb ai/a (0.66 to 1.33 lb/a product) depending on target weed species

Time Apply after transplanting to firm soil, or during the non-bearing year of alternate-year production. Apply before weeds germinate and emerge. Requires sprinkler irrigation or rain (0.5 inch or more) to activate.

Remarks Controls several broadleaf weeds but no grasses. Partially suppresses field bindweed and curly dock at 1 lb ai/a.

Caution Do not apply within 1 year of harvest.

Site of action Group 21: inhibits cell wall biosynthesis Site B

Chemical family Benzamide

trifluralin (2%) + isoxaben (0.5%) (Snapshot 2.5TG)

New plantings and nonbearing crops in alternate-year systems

Rate 2.5 to 5 lb ai/a (100 to 200 lb/a Snapshot 2.5TG), depending on target weed species, length of control desired, and soil conditions.

Time Apply after transplanting to firm soil or during the non-bearing year of alternate-year production. Apply before weeds germinate. Requires sprinkler irrigation or rain (0.5 inch or more) to activate. Results are best if activated within 3 days of application.

Remarks Controls several broadleaf weeds and grasses. Partially suppresses field bindweed and curly dock at 200 lb/a.

Caution Do not apply within 1 year of harvest.

Site of action (isoxaben) Group 21: inhibits cell wall synthesis Site A; (trifluralin) Group 3: microtubule assembly inhibitor

Chemical family (isoxaben) benzamide; (trifluralin) dinitroaniline

napropamide (Devrinol DF-XT, Devrinol 2-XT)

Rate 4 lb ai/a (8 lb/a Devrinol DF-XT, 8 quarts/a Devrinol 2-XT)

Time Apply after transplanting to a firm, weed free soil surface. Apply in fall through spring for early weed emergence control.

Remarks The day of treatment, wet soil 2 to 4 inches deep to reduce degradation by sun and to activate herbicide. If convenient, shallow mechanical incorporation appears to improve activation. Inhibits root growth.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

oryzalin (Surflan AS, Fugitive)

Rate 2 to 6 lb ai/a (2 to 6 quarts/a product) Maximum allowed per season: 12 lb ai/a (12 quarts/a product)

Time Apply after transplanting to firm soil, before weeds germinate.

Remarks Do not allow transplant roots to contact treated soil. Requires sprinkler irrigation, rain, or shallow cultivation (1 to 2 inches) for activation. Inhibits cell division or mitosis, primarily in roots.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

sethoxydim (Poast)

Rate 0.47 lb ai/a (2.5 pints/a Poast) Maximum allowed per season: 0.94 lb ai/a (5 pints/a Poast)

Remarks Identify susceptible grasses and apply at optimum growth stage listed on the label. Add 2 pints/a of a nonphyto-toxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual

bluegrass and all fine fescues, but quackgrass can be suppressed. Inhibits fatty acid production, cell membranes, and new growth. Preharvest interval is 45 days.

Caution Do not allow livestock to graze or feed in treated field.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

simazine (Princep 4L)

Rate 2 to 4 lb ai/a (2 to 4 quarts/a Princep 4L) Maximum allowed per season: 4 lb ai/a (4 quarts of Princep 4L)

Time Apply in spring within 2 weeks after transplanting if soil is settled around plant roots. Apply before weeds are established. In plantings less than 6 months old, use half the above rate.

Remarks Requires sprinkler irrigation or rain to activate.

Caution Do not apply on sandy or gravelly soils.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazine

Established Plantings—Applications that Persist in the Soil**dichlobenil (Casoron CS and 4G)**

Rate 1.96 to 3.92 lb a/a (1.4 to 2.8 gal/a CS formulation); 4 lb ai/a (100 lb/a Casoron 4G)

Time Apply midwinter, immediately before a cold rain to reduce volatility and enhance weed suppression.

Remarks Weigh and distribute uniformly exact quantities over precisely measured areas to ensure accurate applications. The CS formulation (liquid) may allow more precise application rates. In thornless evergreen blackberries, apply November 15 through February 15, but never on light-texture, sandy soils. Oregon results over 9 years suggest perennial weeds can be suppressed with 4-, 3-, and 2-lb ai/a rates applied during 3 consecutive years. Inhibits cellulose and cell wall formation. In new production areas, do not apply until 1 year after transplanting.

Caution Grazing livestock is prohibited. Do not apply during shoot emergence.

Site of action Group 20: inhibits cell wall synthesis Site A

Chemical family Nitrile

diuron (several products)

Rate 1.6 to 2.4 lb ai/a (2 to 3 lb/a of the 80% formulation or 1.6 to 2.4 quarts of 4L formulation)

Time Apply in winter as single application, or apply half-doses in October and March.

Remarks Reduce rate or rotate to other herbicides after weed control is achieved. Sprinkler irrigate if applied before fall rains begin. Spray soil around base of plant avoiding crop foliage. Can be rotated with simazine or other herbicides (except terbacil) to reduce weed shifts. (Inhibits photosynthesis.)

Caution Do not use within 1 year after planting. Do not use on plants being tip layered. Do not apply on very sandy or gravelly soils.

Site of action Group 7: photosystem II inhibitor

Chemical family Substituted urea

flumioxazin (Chateau SW)

Rate 0.19 lb ai/a (6 oz/a product) Maximum allowed per season: 0.19 lb ai/a (6 oz/a product)

Time Preferred timing is fall, to maximize potential of rain to activate the herbicide. In spring, apply no later than 7 days before harvest.

Remarks Supplemental label allows use west of the Cascades in specified counties of Oregon and Washington only. Apply to a weed-free surface. Flumioxazin has limited postemergence activity that can be enhanced by adding surfactants. Add 0.25% v/v nonionic surfactant or 1% crop oil concentrate to enhance postemergence burndown activity. Tank mix with herbicides such as glyphosate, glufosinate, or paraquat to kill large weeds. Residual weed control will be reduced if vegetation prevents the spray from reaching the soil. Moisture is necessary to activate the herbicide for residual weed control. Dry weather after application may reduce effectiveness. Do not exceed 12 oz/a per application and 24 oz/a per year. Use the 6 oz/a rate if soil has significant amounts of sand or gravel.

Caution Do not apply to caneberrries established less than 1 year. Avoid direct or indirect spray contact with foliage or green bark, particularly if using surfactants. Do not apply to soils that are susceptible to dispersal by wind. This herbicide can move to susceptible crops on soil particles and cause damage. Do not apply within 300 yards of nondormant pome fruit or stone fruit. Do not mow treated areas between budbreak and final harvest; dust created by mowing may injure susceptible plants.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family N-phenylphthalimide

halosulfuron-methyl (Sanda)

Rate 0.035 to 0.06 lb ai/a (0.75 to 1.33 oz/a Sanda) Maximum allowed per season: 0.094 lb ai/a (2 oz/a product)

Time Pre- or postemergence (nutsedge control)

Remarks For nutsedge control, make a single postemergence application of at least 0.75 oz/a to nutsedge that has 3 to 5 leaves. Two applications are permissible if additional nutsedge plants emerge, but allow 45 days between applications. Do not irrigate for 3 to 4 days after application to maximize efficacy. Add a nonionic surfactant to improve activity. Preharvest interval is 14 days. Sanda also can be applied preemergence to control annual weeds including maretail and common groundsel. If small weeds are present, tank mix Sanda with a postemergence broad-spectrum herbicide. For good preemergence weed control, do not apply Sanda if excessive weed growth prevents contact with the ground. Preemergence control of nutsedge is poor.

Caution Minimize contact with raspberry and blackberry stems or foliage. Applications of Sanda should be made prior to primocane emergence or after cane burning. Do not apply more than 2 oz/a per year. Do not apply to plants less than 1 year old, or concentrate the spray in the crop row.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

indaziflam (Alion)

Rate 0.045 to 0.13 lb ai/a (3.5 to 5 fl oz/a Alion) Maximum allowed per season: 0.09 to 0.13 lb ai/a (7-10 fl oz/a product) depending on soil organic matter content

Time Apply late fall or early spring prior to bud swell. Apply as a directed application to the soil beneath the bushes.

Remarks For control of broadleaf and grass weeds. Do not allow spray to contact green stems or foliage, or unacceptable injury may occur.

Caution Do not apply more than 10 fl oz per year. Apply only to plants that have been in the ground one year or more. Rate is based on soil organic matter content. Do not apply to sandy soils or soils with greater than 20% gravel.

Site of action Group 29: disrupts cellulose biosynthesis

Chemical family Alkylazine

mesotrione (Callisto)

Blackberry and raspberry only

Rate 0.09 to 0.19 lb ai/a (3 to 6 fl oz/a Callisto) Maximum allowed per season: 0.19 lb ai/a (6 fl oz/a of product).

Time Apply prebloom or as a split application at 3 fl oz/a, no closer than 14 days apart.

Remarks For control of broadleaf weeds only. Consult labels for tank-mix suggestions. The use of a 1% v/v crop oil concentrate is recommended, but avoid adjuvants that may injure leaves.

Caution Do not apply after the onset of bloom stage or illegal residues may occur. Do not apply more than 6 fl oz per year.

Site of action Group 27: pigment synthesis inhibitor

Chemical family Triketone

napropamide (Devrinol DF-XT, Devrinol 2-XT)

Rate 4 lb ai/a (8 lb/a Devrinol DF-XT, 8 quarts/a Devrinol 2-XT)

Time Apply in fall through spring before weeds germinate, or apply foliar-active herbicide to control existing vegetation.

Remarks Irrigation or shallow incorporation is recommended for treatments made November through February, if no rain falls within 2 weeks after applying. Irrigate within 24 hours to wet soil 2 to 4 inches deep when applied March through October. Excessive plant residues on soil surface reduce performance. Inhibits root growth.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

norflurazon (Solicam DF)

Blackberry and raspberry only

Rate 1.96 to 3.93 lb ai/a (2.5 to 5 lb/a Solicam DF)

Time Apply as directed spray from fall to early spring, before weeds emerge and when crop is dormant.

Remarks Soil surface must be weed free and relatively free from plant residues or debris. Apply only once per year. Temporary bleaching or chlorosis may occur. Inhibits yellow pigment formation and bleaches green chlorophyll. Preharvest interval is 60 days.

Caution Do not apply to nursery stock.

Site of action Group 12: bleaching; inhibits carotenoid biosynthesis

Chemical family Pyridazinone

oryzalin (Surflan AS)

Rate 2 to 6 lb ai/a (2 to 6 quarts/a Surflan AS)

Time Apply late fall or early spring to bare soil or after existing vegetation has been destroyed by tillage or use of a foliar-active herbicide.

Remarks Use higher rates or split treatments and apply in fall and spring for longer residual control. Irrigate with at least 0.5 inch water or rain to activate herbicide. Shallow cultivation can control newly germinated weeds without reducing herbicide activity. Allow 24 months before planting vegetables after berries. Inhibits mitosis, primarily in roots.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

pronamide (Kerb 50-W, Kerb SC)

Blackberry, raspberry, and boysenberry only

Rate 1 to 3 lb ai/a (2 to 6 lb/a Kerb 50-W; 2.5 to 7 pints/a Kerb SC)

Time Apply in fall or winter, preferably October to December when ground is not frozen.

Remarks ID-020020 SLN is for Kerb 50-W. Use lower rates on annual grasses, higher rates on perennial grasses such as quack-grass. Requires moisture from rain or irrigation for activation. Use only in berries established at least 3 months. Degraded by microorganisms at higher temperatures. Inhibits root growth.

Caution A restricted-use pesticide. Do not exceed one application per year.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Benzamide

rimsulfuron (Matrix SG)

Blackberry and raspberry only; Oregon and Washington only

Rate 0.0625 lb ai/a (4 oz/a Matrix SG)

Time Apply in spring or fall. Preemergence or early postemergence to actively growing weeds.

Remarks Supplemental label. Use a directed spray application and minimize spray contact with caneberry plants. Use only in berries that have gone through one growing season and are in good health. Matrix will cause chlorosis and/or stunting if applied to emerged primocanes. Avoid injury by applying before primocanes emerge or by directing the spray to avoid the growing points after canes are 3 ft or longer (and not lying on the ground). Tankmixing Matrix with other cane-burning herbicides such as Aim or Goal may lessen the effect of Matrix on primocanes. Preharvest interval is 21 days.

Caution Do not exceed one application per year. When applied as a banded treatment (50% band or less), Matrix SG may be applied twice per year.

Site of action Group 2: Acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

S-metolachlor (Dual Magnum)

Blackberry and raspberry only; Oregon and Washington only

Rate 0.95 to 1.90 lb ai/a (1 to 2 pints/a Dual Magnum)

Time Apply in early spring before weeds emerge.

Remarks Special local needs labels OR-110005 and WA-120002. Apply as a banded application to both sides of the plant row. Lower rates are suggested for canes established less than one year. Requires rainfall or irrigation to activate.

Caution Do not apply more than once at 1.90 lb ai/a rate per season. Preharvest interval is 28 days.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

simazine (Princep 4L)

Rate 2 to 4 lb ai/a (2 to 4 quarts/a Princep)

Time Apply in winter as single application, or apply half-doses in October and March.

Remarks Reduce rate or rotate with other herbicides after weeds are controlled. Requires surface moisture to activate. Apply half-rate on plants less than 6 months old. Can be rotated with diuron or other herbicides (except terbacil) to reduce weed shifts. Do not apply when fruit is present, or illegal residues may result.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazine

sulfentrazone (Zeus XC and other product names)

Rate 0.25 to 0.375 lb ai/a (8 to 12 fl oz/a of product)

Time Apply as a dormant application in the fall or spring to bare soil before weeds emerge.

Remarks Apply only to plants that have been in the ground at least 3 years. A hooded or shielded sprayer is required if application is made after petal fall. Requires 0.5 to 1.0 inch of water to activate; if adequate rainfall or irrigation is not received within 7 to 10 days after application, a shallow incorporation may be needed to obtain desired weed control.

Caution Do not apply to frozen ground. Do not apply more than 12 fl oz/a product (0.375 lb ai/a) per season. Avoid direct contact with stems or foliage.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazinone

terbacil (Sinbar)

Rate 0.8 to 1.6 lb ai/a (1 to 2 lb/a Sinbar)

Time Apply higher rate on fine-texture soils or soils high in organic matter, in fall or early spring before fruit set, while weeds are small.

Remarks Sprinkler irrigate if rain does not follow application in 2 weeks. Reduce rates by as much as half or rotate with other herbicides after weeds are controlled. Calibrate sprayer and apply with tractor-mounted, fixed-boom sprayer using a constant speed and delivery rate. Preharvest interval is 70 days.

Caution Do not apply on gravelly soils or soils containing less than 1% organic matter. Do not apply to weak plants or eroded areas with exposed roots. Treat only plantings that have been established for 1 year or more. Avoid use for 2 years if replanting is anticipated. Can be rotated with diuron or other herbicides (except simazine) to reduce weed shifts.

Site of action Group 5: photosystem II inhibitor

Chemical family Uracil

Established Plantings—Directed Applications in Berry Rows

acetic acid (Weed Pharm Weed and Grass Killer)

Rate 15 to 30 gal product/a

Remarks 20% acetic acid. Apply as a directed application to actively growing small weeds. Application equipment must be hooded or shielded. Any contact with the crop will cause crop injury. Weed Pharm can be applied up to and including the day of harvest. Approved for organic production.

Caution This product is a contact, nonselective, herbicide. Avoid contact with desirable caneberry foliage, green bark, or fruit.

bentazon (Basagran)

Non-bearing only

Rate 0.75 to 1 lb ai/a (1.5 to 2 pints/a Basagran)

Time Spring to early summer, depending on growth stage of weeds.

Remarks Supplemental label (Arysta LifeSciences) for nonbearing crops. Useful for suppression and control of yellow nutsedge, Canada thistle, and musk thistle. For Canada thistle apply 2 pints/a when plants are between 8 inches tall and bud stage. Apply a second application 2 weeks later if needed. For nutsedge, apply 1.5 to 2 pints/a when plants are 6 to 8 in tall, and make a second application 7 to 10 days later if needed. Always add a crop oil concentrate. Use no more than 2 lb ai/a per year. Irrigate to make sure plants are actively growing before applying bentazon. Do not cultivate or mow for 5 days after application. Weeds growing under drought conditions may not be adequately controlled.

Caution Apply as a directed spray, away from the crop. Do not allow contact with foliage. Do not apply within one year of crop harvest.

Site of action Group 6: photosystem II inhibitor

Chemical family Benzothiadiazole

clethodim (Select Max)

Rate 0.07 to 0.12 lb ai/a (9 to 16 oz/a Select Max)

Time Apply postemergence to actively growing annual or perennial grasses as listed on label.

Remarks Consider environmental and plant growth conditions that affect leaf uptake (see label). Add 0.25% v/v nonionic surfactant to improve efficacy. Use higher rates to control perennial grasses. Preharvest interval is 7 days.

Caution Do not exceed 64 fl oz/a (0.5 lb ai/a) per season. Do not apply over top of plants.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

clove or clove leaf oil (Matratec)

Rate 5 to 8% dilution in 25 to 100 gal of water, depending on weed size, temperature, and sunlight intensity.

Time Before weeds are 6 inches tall.

Remarks OMRI listed and WSDA approved herbicide for in-crop use. Apply before crop emerges, or between rows after emergence; avoid contact with desirable foliage. Directed sprays or hooded sprayers are recommended to protect desirable foliage. Works best on annual weeds less than 6 inches. Performance

may be erratic depending on environmental conditions. Bright sunlight improves efficacy. No preharvest or reentry interval.

d-limonene (lemongrass oil) (Green Match EX)

Rate 7% to 15% depending on weed size and species; 14% dilution rate, 20% for spot treatment of difficult to control weeds.

Time When weeds are less than 6 inches tall and up to fruit set.

Remarks Broad-spectrum, nonselective contact herbicide that does not translocate. Spot treatments allowed in bearing crops up to one week before harvest. Do not exceed 8.5 gal/a per application in bearing crops. OMRI listed, NOP compliant, and WSDA approved organic burndown herbicide for use in crop and noncrop sites. Foliage contacted by Green Match will be damaged. Directed sprays or hooded sprayers are recommended to protect desirable foliage. Coverage is very important. Leaf damage is visible within hours. Cool weather may slow activity. No reentry interval. Causes fast wilting or necrosis of the leaves due to removal of waxy cuticle

fluazifop (Fusilade DX)

Rate 0.25 to 0.375 lb ai/a (16 to 24 oz/a Fusilade DX) depending on target species and growth stage

Time Apply to actively growing grasses, or within 7 days after irrigation, as a directed spray with 1% crop oil or 0.25% nonionic surfactant.

Remarks Identify grasses and adjust rates depending on susceptibility and stage of weed growth, according to label instructions. Results often are erratic on grasses stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment. Inhibits fatty acid production, cell membranes, and new growth. PHI 1 day.

Caution Grazing is prohibited.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Aryloxyphenoxy propionate

glyphosate (numerous products)

Blackberry only

Rate Consult labels

Time Apply to actively growing weeds.

Remarks Avoid treatments in late summer when sugars move toward crown. Select application equipment to prevent crop injury by directing spray, or use low-pressure hand-held sprayers or selective applicators. Adjust concentration depending on equipment. Consult label about rate and time of application, especially for perennial weeds. Mixing additional surfactant or ammonium sulfate as label instructs may improve control of slightly stressed weeds. Preharvest interval is 14 days. If repeat applications are necessary, do not exceed a total of 10.6 lb ai/a per year. Inhibits production of three amino acids and protein synthesis.

Caution Grazing is prohibited. In raspberries, the herbicide moves throughout the plant; excessive injury prevents labeling and nondormant use in this crop. Repeated glyphosate applications have created resistant biotypes of ryegrass in Australian and Oregon orchards. To avoid weed resistance, rotate weed control practices and use products from different herbicide groups.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

glyphosate (several products)

Blackberry only

Rate Wiper: 33% solution

Remarks Mix 1 gal product with 2 gal water and wipe weeds, avoiding contact with desirable vegetation. In severe infestations, reduce equipment ground speed or apply in two directions to ensure contact with wiper. (See remarks above.)

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

paraquat (Gramoxone Inteon, Parazone)

Rate 0.5 to 1 lb ai/a (2 to 4 pints/a Gramoxone Inteon; 1.3 to 2.7 pints/a Parazone)

Time Apply late winter or early spring before new shoots emerge, or late summer or fall after training new canes.

Remarks Adjust spray volume to thoroughly wet weeds. Add a nonionic surfactant or crop oil concentrate as label specifies, taking care to avoid anionic formulations that react in the tank to form insoluble precipitates. Acts as a contact herbicide; absorbs energy produced by photosynthesis, forming peroxides that disrupt living cells.

Caution A restricted-use herbicide. Do not ingest or inhale spray mist. Wear protective face shields, respirators, and clothing.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyridilium

sethoxydim (Poast)

Rate 0.47 lb ai/a (2.5 pints/a Poast)

Time Apply at optimum growth stage listed on the label; add 2 pints/a nonphytotoxic crop oil concentrate to improve leaf absorption.

Remarks Identify susceptible grasses. Control often is erratic if grasses are stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues, whereas quackgrass can be suppressed. Inhibits fatty acid production, cell membranes, and new growth. Preharvest interval is 45 days.

Caution Do not exceed 5 pints/a per season.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

Weed Control and Cane Suppression for Mechanical Harvesting

carfentrazone (Aim EC)

Raspberry, blackberry, and boysenberry only

Rate 0.1 lb ai/a (6.4 oz/a Aim EC); consult labels

Time Apply when primocanes are about 6 inches tall. In alternate-year blackberries, do not apply to new canes during nonbearing year.

Remarks Apply as directed application in band to bottom 18 inches of canes. Apply in at least 40 gal/a water. Can reapply at 14- to 21-day intervals. Follow calculations for banded applications. Minimize drift or spotting of crop foliage with large-orifice nozzles and low pressure while directing spray toward base of canes. Preharvest interval is 15 days.

Caution Do not treat caneberries stressed by drought, poor growth, or disease. Do not exceed 0.4 lb ai/a (16 oz/a) per season.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazinone

oxyfluorfen (Goal 2XL)

Rate Raspberry: 0.2 to 0.75 lb ai/a (0.75 to 3 pints/a Goal 2XL broadcast); Blackberry: 0.4 to 0.8 lb ai/a (1.6 to 3.2 pints/a Goal 2XL broadcast); Blackberry (alternate-year blackberries during nonbearing year): 0.5 to 1 lb ai/a (2 to 4 pints/a Goal 2XL broadcast rate)

Time Apply when primocanes have emerged 4 to 6 inches.

Remarks Use a minimum spray volume of 50 gal/a broadcast (see label for conversion from broadcast to banded rate). Adding 2 pints 80% active nonionic surfactant per 100 gal spray solution is suggested. Primocane suppression may last 3 to 6 weeks; adjust timing, rate, and number of applications according to plant vigor and desired degree of primocane suppression. Cool, overcast conditions may enhance activity or potential injury to the crop. Preharvest interval is 15 days for blackberries and 50 days for raspberries.

Caution Do not exceed 5 pints/a broadcast per season for raspberry; 6 pints for blackberry; and 8 pints for alternate-year blackberries. For alternate-year blackberries, apply after desired number of canes have been bundled and trained to trellis wire; otherwise, next year's crop potential may be harmed and control of basal growth will be diminished. A second treatment may be required to suppress new growth at base of plant.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Diphenylether

pelargonic acid (Scythe)

Rate For annual weeds, a 3 to 5% solution; for burndown or sucker control, a 5 to 7% solution

Time Apply in 75 to 200 gal/a water broadcast when temperatures exceed 45°F. Apply to weeds or primocanes shorter than 6 inches.

Remarks Cool weather after treatment may slow activity and delay or reduce visible effects. Adding a surfactant may enhance control. Preharvest interval is 1 day.

Site of action Unknown

Chemical family Unknown

Kiwifruit

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Weed and Vegetation Management

General strategy The type of vine support structure and the method of irrigation influence weed management. Shade from pergolas reduces light available for weed germination and growth. A T-bar trellis may facilitate growth of perennial sods or winter cover crops between the kiwi rows for soil conservation. Drip irrigation reduces weed germination and growth within rows and in aisles. Minimize weed competition and interference within rows. (See “Section L: Orchards and Vineyards” in this handbook.)

Cultivation Tillage controls annual weeds while suppressing perennials, depending on tilling frequency (every three weeks as necessary to eventually deplete perennials). Adverse effects include soil erosion from sloping sites, soil compaction, and reduced water infiltration during winter rains (except in very sandy soils).

Mowing or flailing Mowing or flailing grass sods or weedy vegetation in aisles improves trafficability, prevents erosion, and improves soil conditions. Improved turfgrasses, combined with water and fertilizer management for both the crop and sod, offer long-term advantages in soil management.

Herbicides Kiwifruit roots proliferate in undisturbed, competition-free strips, representing a third to half the area depending on moisture availability. New plantings may benefit from nearly vegetation-free conditions during three years of establishment. Choose combinations of practices that act together to achieve your desired level of vegetation management.

Site Preparation

diquat (Reglone)

Nonbearing crop only

Rate 0.375 to 0.5 lb ai/a (1.5 to 2 pint/a of product)

Remarks Add a nonionic surfactant or crop oil concentrate according to label. Weeds 1 inch to 6 inches in height are the easiest to control.

Caution Use a shield or wrap plant when spraying around young trees or vines.

Action in plant Acts as contact; absorbs energy produced during photosynthesis and forms peroxides that disrupt living cells.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyrilidilium

glyphosate (several products)

Rate Consult labels.

Time Apply to weeds at least 10 days before planting the crop.

Remarks Use highest rate on field bindweed. Rain within 6 hours after application for any weed species may reduce effectiveness.

Caution Do not apply if weeds are under stress from drought, weather, or maturity.

Action in plant Causes ammonium ions to accumulate, disrupting photosynthesis.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

New Plantings

diquat (Reglone)

Nonbearing crop only

Rate 0.375 to 0.5 lb ai/a (1.5 to 2 pint/a of product)

Remarks Add a nonionic surfactant or crop oil concentrate according to label. Weeds 1 inch to 6 inches in height are the easiest to control.

Caution Use a shield or wrap plant when spraying around young trees or vines.

Action in plant Acts as contact; absorbs energy produced during photosynthesis and forms peroxides that disrupt living cells.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyrilidilium

fluazifop (Fusilade DX)

Rate 0.25 to 0.375 lb ai/a (16 to 24 fl oz/a Fusilade DX)
Maximum rate per season: 1.125 lb ai/a (72 fl oz/a of product)

Time Apply to actively growing grasses, or within 7 days after irrigation, as a directed spray with 1% crop oil or 0.25% nonionic surfactant.

Remarks Identify grass weeds and adjust rates depending on susceptibility and stage of growth as label instructs. Results often are erratic on grasses stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment.

Caution Preharvest interval is 50 days for hardy kiwi; 1 year for fuzzy kiwi. Grazing is prohibited.

Action in plant Inhibits fatty acid production, cell membranes, and new growth.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitors

Chemical family Aryloxyphenoxy propionate

isoxaben (Gallery 75DF and Trellis)

Nonbearing crop only

Rate 0.5 to 1.0 ai/a (0.66 to 1.33 lb/a product), depending on weed species

Time For preemergence control of certain broadleaf weeds, apply to weed-free soil surface.

Remarks Activate herbicide within 21 days, either using shallow cultivation or irrigation with at least 0.5 inch water.

Caution Preharvest interval is 1 year.

Action in plant Appears to disrupt root and hypocotyl development. Susceptible plants die before emerging.

Site of action Group 21: inhibits cell wall synthesis Site B

Chemical family Benzamide

trifluralin + isoxaben (Snapshot)

Nonbearing crop only

Rate 2.5 to 5 lb ai/a (100 to 200 lb/a Snapshot) depending on weed species

Time For preemergence control of certain broadleaf weeds and grass weeds, apply to weed-free soil surface.

Remarks Activate herbicide within 3 days, either using shallow cultivation or irrigation with at least 0.5 inch water.

Caution Preharvest interval is 1 year.

Action in plant (isoxaben) Appears to disrupt root and hypocotyl development. Susceptible plants die before emerging. (trifluralin) Inhibits mitosis in shoots and roots.

Site of action (isoxaben) Group 21: inhibits cell wall synthesis
Site B; (trifluralin) Group 3: microtubule assembly inhibitor

Chemical family (isoxaben) benzamide; (trifluralin) dinitroaniline

napropamide (Devrinol DF-XT, Devrinol 2-XT)

Rate 4 lb ai/a (8 lb/a Devrinol DF-XT, 8 quarts/a Devrinol 2-XT)

Time Apply after transplanting to firm soil, before weeds germinate.

Remarks Water the day of treatment to wet the soil 2 to 4 inches deep, to reduce degradation by sun and to activate the herbicide. Where convenient, shallow mechanical incorporation appears to improve activity.

Caution Do not apply within 35 days of harvest.

Action in plant Inhibits root growth.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

oryzalin (Surflan A.S. or Oryzalin 4 A.S.)

Rate 2 to 6 lb ai/a (2 to 6 quarts/a product)

Time Apply after transplanting to firm soil, before weeds germinate. Requires sprinkler irrigation, rain, or shallow cultivation (1 to 2 inches) to activate.

Remarks Rate depends on duration of weed control desired.

Caution Do not use on soils with more than 5% organic matter. Avoid exposing transplant roots to contact with treated soil.

Action in plant Inhibits mitosis, primarily in roots.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

pendimethalin (Satellite HydroCap)

Rate 3 to 4 lb ai/a (3.2 to 4.2 quarts/a Satellite HydroCap)

Time Apply after transplanting to firm soil, before weeds germinate.

Remarks Most effective if rain or irrigation incorporates herbicide into weed emergence zone.

Caution Contact with the kiwi plant by the spray mixture may cause injury.

Action in plant Inhibits mitosis, primarily in roots.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

Established Plantings—Preemergence Applications

napropamide (Devrinol DF-XT, Devrinol 2-XT)

Rate 4 lb ai/a (8 lb/a Devrinol DF-XT, 8 quarts/a Devrinol 2-XT)

Time Apply fall through spring, before weeds germinate, or apply foliar-active herbicide to control existing weeds.

Remarks Irrigation or shallow incorporation is recommended following treatments made November through February if no rain falls within 2 weeks of application. If applied March through October, irrigate within 24 hours to wet soil 2 to 4 inches deep. Shallow mechanical incorporation seems to enhance activity. Performance is reduced with excessive plant residue on soil surface.

Caution Do not apply within 35 days of harvest.

Action in plant Inhibits root growth.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

oryzalin (Surflan A.S. or Oryzalin 4 A.S.)

Rate 2 to 6 lb ai/a (2 to 6 quarts product/a)

Time Apply late fall or early spring to bare soil or after existing vegetation has been destroyed by tillage or by using a foliar-active herbicide.

Remarks For longer residual control use higher rates, or split treatments and apply in fall and spring. Irrigate with at least 0.5 inch of water or rain to activate herbicide. Shallow cultivation can control newly germinated weeds without reducing herbicide activity.

Caution Do not use on soils with more than 5% organic matter. Wait 24 months before planting vegetables after kiwi.

Action in plant Inhibits mitosis, primarily in roots.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

pendimethalin (Satellite HydroCap)

Rate 3 to 4 lb ai/a (3.2 to 4.2 quarts/a Satellite HydroCap)

Time Apply to weed-free soil any time after fall harvest, during winter dormancy, and in the spring.

Remarks Most effective if rain or irrigation incorporates herbicide into weed emergence zone. Preharvest interval is 60 days.

Caution Contact with leaves, buds, or fruit by the spray mixture may cause injury.

Action in plant Inhibits mitosis, primarily in roots.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

sulfentrazone (Willowood Sulfentrazone 4SC)

Rate 0.125 to 0.375 lb ai/a (4 to 12 fl oz/a Sulfentrazone 4SC)

Time Apply to bare soil in fall through spring, before weeds emerge.

Remarks Apply only to plants that have been in the ground at least 1 year. Apply to moist soil. Herbicide requires a minimum of 0.5 of water within two weeks of application to activate. If

weeds are present at time of application, tank mix with a burn-down herbicide. Preharvest interval is 3 days.

Caution Do not apply to frozen ground. Avoid direct or indirect contact with stems or foliage, particularly new emerging shoots from the crown. Do not apply more than 12 fl oz/a product (0.375 lb ai/a) per season. Do not tank mix with other Group 14 herbicides. Do not apply after petal fall unless using a hooded or shielded sprayer to avoid contact with foliage and fruit.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazinone

Established Plantings—Directed Applications in Kiwifruit Rows

acetic acid (Weed Pharm Weed and Grass Killer)

Rate 15 to 30 gal/a product (20% acetic acid)

Remarks Apply as a directed application to actively growing, small weeds. Application equipment must be hooded or shielded. Any contact with the crop will cause crop injury. Weed Pharm can be applied up to and including the day of harvest. Approved for organic production.

Caution This product is a contact, nonselective, herbicide. Avoid contact with desirable kiwi foliage, green bark, or fruit. Wear safety glasses.

carfentrazone (Aim EC)

Rate 0.031 lb ai/a (2 fl oz/a Aim)

Remarks Apply as a directed application to actively growing weeds not beyond the six-leaf stage. Allow at least 14 days between applications. Preharvest interval is 3 days.

Caution This product is a contact, nonselective, broadleaf herbicide. Avoid contact with desirable kiwi foliage or green bark.

Action in plant Disrupts cell membranes.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

glyphosate (several products)

Rate Spray: consult labels

Remarks Select application equipment to prevent crop injury by directing spray, or use selective applicators. Adjust concentration depending on equipment. See label for rate and application time, especially for perennial weeds. Adding surfactant or mixing ammonium sulfate according to label directions may improve control of slightly stressed weeds.

Caution Do not allow drift or mist to contact green foliage, green bark, suckers, or vines and renewals less than 3 years old. Preharvest interval is 14 days. If applications are repeated, check label for the maximum amount of glyphosate allowed per season.

Action in plant Causes ammonium ions to accumulate, disrupting photosynthesis.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

glyphosate (several products)

Rate Wiper: 33% solution

Time Mix 1 gal product to 2 gal water, and wipe weeds.

Remarks Avoid contact with desirable vegetation. In severe infestations, reduce equipment ground speed, or apply in two directions to ensure contact with wiper. (See remarks above).

Caution Do not contact green foliage, green bark, suckers, or vines and renewals less than 3 years old. Preharvest interval is 14 days. If applications are repeated, check label for the maximum amount of glyphosate allowed per season.

Action in plant Causes ammonium ions to accumulate, disrupting photosynthesis.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

oxyfluorfen (GoalTender or Galigan H₂O)

Rate 0.5 to 1.5 lb ai/a (1 to 3 pints/a product)

Time Apply only to healthy vines.

Remarks Direct spray toward base of vines; avoid direct plant contact. Dormant application only; do not apply oxyfluorfen between bud swell and completion of final harvest. Oxyfluorfen can be applied upon completion of final harvest. Controls broadleaf weeds preemergence and postemergence, depending on application rate and weed species. For preemergence control of susceptible weeds, use 2.5 to 3 pints/a product on a weed-free soil surface. For postemergence control of susceptible weeds, use 1 to 3 pints/a product, depending on stage of growth.

Caution Do not apply to established plants less than 3 years old unless vines are trellised a minimum of 3-ft above soil. Do not exceed 1.5 lb ai/a (3 pints/a) per season.

Action in plant Acts as a contact-type herbicide, either directly on broadleaf weeds or at soil surface as weeds emerge.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family Diphenylether

paraquat (Gramoxone Inteon, others)

Rate 0.625 to 1.0 lb ai/a (Gramoxone Inteon: 2.5 to 4.0 pints/a; other brands: 1.7 to 2.7 pints/a)

Time Apply as a directed, shielded spray toward base of vines when weeds are growing vigorously and new weeds are 1 to 6 inches high.

Remarks Add a nonionic surfactant or crop oil concentrate according to label; avoid anionic formulations that react in the tank to form insoluble precipitates.

Caution **A restricted-use pesticide.** Do not ingest or inhale spray mist. Wear protective face shields, respirators, and clothing. Do not let spray contact green stem, fruit, or foliage. Avoid windy conditions. Do not treat more than three times per year. Preharvest interval is 14 days.

Action in plant Acts as contact; absorbs energy produced during photosynthesis and forms peroxides that disrupt living cells.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyridilium

pelargonic acid (Scythe)

Rate For annual weeds, a 3% to 5% solution; for perennial herbaceous weeds and sucker control, a 5% to 7% solution.

Remarks Apply in 75- to 200-gal/a water broadcast; agitation is required. Cool weather may slow the product's activity, and delay or reduce visible effects. This product is a contact, nonselective herbicide and controls only actively growing, emerged green vegetation.

Action in plant Control or burndown of a broad spectrum of weeds on contact.

Site of action Group 26: unknown

Chemical family Carboxylic acid

pyraflufen (Venue)

Rate 0.001 to 0.005 lb ai/a (1 to 4 oz/a Venue)

Remarks Apply as a directed application to actively growing broadleaved weeds less than 4 inches high, or rosettes less than 3 inches in diameter. Use lower rate for small weeds and higher rate for larger weeds. Do not exceed 6.8 fl oz/a or three applications per season. Allow at least 30 days between applications. Apply only at prebloom or postharvest, or during dormancy. Mixing this herbicide with another herbicide increases the weed spectrum and is highly recommended.

Caution This product is a contact, nonselective, broadleaf herbicide. Avoid contact with desirable kiwi foliage, green bark, or fruit. Do not exceed 6.8 oz/a Venue per season.

Action in plant Inhibits protoporphyrinogen oxidase (PPO) that disrupts cell membranes.

Site of action Group 14: protoporphyrinogen oxidase inhibitor

Chemical family Phenylpyrazole

Blueberry, gooseberry, currant, and elderberry¹

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Quick Reference Guide to Herbicides Labeled for Use in Northern Highbush Blueberry

Active ingredient [WSSA #] ¹ (trade name)	Rate pounds ai/a (product)	Max seasonal per acre per year (product)	Re-apply (Month)	Minimal Age (Month)	Replant (Month)	PHI (day)
Soil active herbicides						
dichlobenil [20] (Casoron CS)	1.96 - 3.92 lb ai (1.4 to 2.8 gal)	3.92 lb ai 2.8 gal	12	12	12	30
diuron [7] (Direx 4L)	1.6 - 2.4 lb ai (1.6 to 2.4 quarts)	3.2 lb ai (3.2 quarts)	5	12	24	NA
Hexazinone [5] (Velpar L CU)	1.0 to 2.0 lb ai (4.0 to 8.0 pints)	2.0 lb ai (8.0 pints)	12	36	24	50
indaziflam [29] (Alion)	0.04 - 0.06 lb ai (3.5 to 5 fl oz)	0.09 - 0.13 lb ai (7.0 to 10.3 fl oz)	3	12	12	14
isoxaben [21] (Trellis SC)	0.5 - 1 lb ai (16 to 31 fl oz)	1.0 lb ai (31 fl oz)	0	0	0	60
napropamide [15] (Devrinol 50DF)	4 lb ai (8 lb)	4 lb ai (8 lb)	12	0	12	NA
norflurazon [12] (Solicam DF)	1.95 - 3.93 lb ai (2.5 to 5 lb)	3.93 lb ai (5 lb)	0	0/6	12	60
oryzalin [3] (Surflan)	2 - 6 lb ai (2 to 6 quarts)	12 lb ai (12 quarts)	2.5	0	0	NA
pronamide [3] (Kerb SC)	1 - 2 lb ai (2.5 to 5 pints)	2 lb ai (5 pints)	12	12	0	NA
simazine [5] (Princep 4L)	2 - 4 lb ai (2 to 4 quarts)	4 lb ai (4 quarts)	3	0	12	21
s-metolachlor [15] (Dual Magnum)	0.64 to 1.27 lb ai (0.67 to 1.33 pints)	1.27 lb ai (1.3 pints)	12	12	12	28
sulfentrazone [14] (Zeus XC)	0.25 - 0.375 lb ai (8 to 12 fl oz)	0.375 lb ai (12 fl oz)	2	36	1	3
trifluralin + isoxaben [3+21] (Snapshot 2.5 TG)	2.5 to 5 lb ai (100 to 200 lb)	15 lb ai (600 lb)	2	0	0	365
Soil and foliar active herbicides						
clopyralid [4] (Stinger)	0.06 - 0.12 lb ai (2.66 to 5.33 fl oz)	0.25 lb ai (10.6 fl oz)	-	12	18	30
flumioxazin [14] (Chateau SW)	0.18 - 0.38 lb ai (6 to 12 oz)	0.76 lb ai (24 oz)	1	24	2	7
halosulfuron [2] (Sanda)	0.023 - 0.031 lb ai (0.5 to 0.66 /1 oz)	0.062 lb ai (2.0 oz)	1.5	12	9	14
rimsulfuron [2] (Matrix)	0.03 - 0.06 lb ai (2 to 4 oz)	0.06 lb ai (4 oz)	1	12	12	21
mesotrione [27] (Callisto)	0.09 - 0.18 lb ai (3 to 6 fl oz)	0.18 lb ai (6 fl oz)	0.5	12	18	NA
Quinclorac [4] (Quinstar 4L)	0.37 lb ai (12.6 fl oz)	0.74 lb ai (25.2 fl oz)	1	-	10	30
¹ For information on weed control efficacy of products listed in this article, see the publication "Pest Management Strategic Plan for Blueberries in Oregon and Washington" (DeFrancesco and Murray, 2011): http://www.ipmcenters.org/pmsp/pdf/ORWABlueberry.pdf						

Active ingredient [WSSA #] ¹ (trade name)	Rate pounds ai/a (product)	Max seasonal per acre per year (product)	Re-apply (Month)	Minimal Age (Month)	Replant (Month)	PHI (day)
Foliar active herbicides						
carfentrazone [14] (Aim EC)	0.01 - 0.03 lb ai (1 - to fl oz)	0.097 lb ai (6.1 fl oz)	0.5	0	0	1
clethodim [1] (Select max)	0.07 - 0.12 lb ai (9 to 16 fl oz)	0.24 lb ai (32 fl oz)	0.5	0	0	14
diquat [22] (Reglone)	0.37-0.56 lb ai (1.5 to 2 pints)	0.56 lb ai (2 pints)	0.5	0	0	365
fluzifop [1] (Fusilade DX)	0.25 - 0.375 lb ai (16 to 24 fl oz)	0.75 (48 fl oz)	0.5	0	0	1
glufosinate [10] (Rely 280)	0.88 - 1.5 lb ai (48 to 82 fl oz)	3 lb ai (164 fl oz)	0.5	0	6	14
glyphosate [9] (Roundup Powermax)	0.38 - 3.69 lb ae (11 to 105 fl oz)	7.87 lb ae (224 fl oz)	0.5	3 days	3 days	3
paraquat [22] (Gramoxone SL)	0.625 - 1 lb ai (2.5 to 5 pints)	4 lb ai (20 pints)	0.5	0	0	0
pelargonic acid (Scythe)	3- 10 % v/v		NA	NA	NA	1
sethoxydim [1] (Poast)	0.19 - 0.47 lb ai (1 to 2.5 pints)	0.94 lb ai (5 pints)	0.5	0	0	30
¹ For information on weed control efficacy of products listed in this article, see the publication "Pest Management Strategic Plan for Blueberries in Oregon and Washington" (DeFrancesco and Murray, 2011); http://www.ipmcenters.org/pmsp/pdf/ORWABlueberry.pdf						

Weed and Vegetation Management

Mulches contribute significantly to weed control if constructed and maintained properly. Even without the benefit of weed control, blueberries grow well under mulch because they are shallow rooted and lacking root hairs. A layer of mulch over the soil conserves soil moisture for blueberries. Gooseberries, currants, and elderberries are less likely to benefit directly from mulches compared to blueberries, but given the dearth of herbicides labeled for use in these crops, mulches may be essential to achieve weed control goals.

Mulches are usually constructed from sawdust, bark, wood chips, wood shavings, compost, and woven fabrics. Mulches made from these plant materials or compost are usually applied in a 2 to 4 (sometimes 6) inch layer after planting and will suppress emergence of most annual weeds. As the mulch matures, it may eventually become a haven for annual weeds. Perennial weeds will soon dominate if only using plant material mulches; therefore, it is imperative that perennial weeds be controlled before the crop is planted. An alternative is fabric weed barriers. These are costly, but if amortized over 10 to 12 years, may prove cost effective when considering accrued benefits, particularly in organic systems. Polyethylene mulches are less expensive but are not recommended because they restrict water movement to the roots and may promote surface rooting, making blueberry plants more susceptible to drought stress.

Flailing or mowing Frequently mowing improved turf grasses or perennial sods improves water infiltration and drainage in blueberry aisles. Vegetation between rows of other berries is mowed or flailed.

Herbicides Choose combinations of practices including herbicides that act together to achieve your desired level of vegetation management within berry plantings. Herbicides must be applied as directed on the label (time and rate), otherwise excessive herbicide residues may be present on fruit and jeopardize marketability, or crop injury may occur. DO NOT increase delivery rates of herbi-

cides by slowing tractors or walking speed when there is a large patch of weeds. Slowing or stopping to wet-down the foliage of weeds (for example, Stinger herbicide applied to thistles) may cause excessive herbicide rates that may damage the crop.

Site Preparation

glyphosate (numerous products)

Rate Consult labels

Time Apply to weeds at least 10 days before planting the crop.

Remarks Use highest rate on field bindweed. Inhibits production of three amino acids and protein synthesis.

Caution Do not apply to weeds stressed by drought, weather, or maturity. Rain within 6 hours after applying may reduce effectiveness.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

New Plantings

clethodim (Select Max, Arrow, Envoy Plus, and others for nonbearing crops)

Rate 0.07 to 0.12 lb ai/a (9 to 16 fl oz/a Select Max for annual grasses; 12 to 16 oz/a Select Max for perennial grasses). Consult label for rates of other products.

Time Apply to actively growing grass weeds, including annual bluegrass, at labeled growth stage.

Remarks Read label carefully for adjuvant instructions, and for information about effects of rain within 1 hour, applications of other pesticides, or cultivation.

Caution Do not broadcast spray. Direct spray at base of the plant where grassy weeds are growing. Do not exceed 64 fl oz/a

Envoy or Select Max, or 32 fl oz/a Arrow, per season. Do not apply to nonbearing crops grown for rootstock.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

fluazifop (Fusilade DX)

Rate 0.25 to 0.38 lb ai/a (16 to 24 oz/a Fusilade DX) depending on target weed species

Time Apply to actively growing grasses, or within 7 days after irrigation, as a directed spray with 1% crop oil or 0.25% nonionic surfactant.

Remarks Identify grasses and adjust rates depending on susceptibility and stage of weed growth as label instructs. Results often are erratic on grasses stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses and quack-grass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment. Inhibits fatty acid production, cell membranes, and new growth.

Caution Preharvest interval is 1 day. Grazing is prohibited.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Aryloxyphenoxy propionate

glyphosate (numerous products)

Rate Consult label

Time Apply to actively growing weeds.

Remarks Avoid contact with green foliage or suckers of crop. Preharvest interval is 14 days.

Caution Do not exceed 12.8 pints/a product per year. Follow all precautions on label.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

isoxaben (Trellis SC)

Rate 0.5 to 1.0 lb ai/a (0.66 to 1.33 lb/a product)

Time Apply late summer to early fall, in early spring, or immediately after cultivation to debris-free soil surface. Activate with 0.5 inch water or shallow cultivation before weeds begin to emerge.

Remarks Identify weeds and adjust rates according to charts listed on label for broadleaf control. Chemical stability remains adequate when left on soil surface for 21 days. Preharvest interval is 60 days.

Caution Do not apply to newly transplanted crops until the soil has settled and cracks disappear.

Site of action Group 21: inhibits cell wall synthesis Site B

Chemical family Benzamide

isoxaben + trifluralin (Snapshot 2.5 TG)

Nonbearing only

Rate 2.5 to 5.0 lb ai/a (100 to 200 lb/a product) depending on target weed

Time Apply during dormant season to crops that will not bear fruit for at least 1 year.

Remarks Apply evenly with drop or rotary-type spreader to avoid crop injury. Apply to weed-free soil. Controls many broadleaf and grass weeds that grow from seeds but will not control weeds that emerge from existing stolons, rhizomes, or root pieces. Control

existing weeds with cultivation or postemergence herbicides. Activate within 3 days using 0.5 inch of water before weeds begin to emerge. See label for repeat treatments. PHI 365 days.

Caution Do not make repeat applications at 150 lb/a or greater within 60 days of a previous application. Do not apply when wind favors drift of granule from the target area.

Site of action (isoxaben) Group 21: inhibits cell wall biosynthesis Site B; (trifluralin) Group 3: microtubule assembly inhibitor

Chemical family (isoxaben) benzamide; (trifluralin) dinitroaniline

napropamide (Devrinol DF-XT, Devrinol 2-XT)

Rate 4 lb ai/a (8 lb/a Devrinol DF-XT, 8 quarts/a Devrinol 2-XT)

Time Apply after transplanting to firm soil, before weeds germinate or sawdust is spread.

Remarks On day of treatment, wet soil 2 to 4 inches deep to reduce degradation by sun and to activate herbicide. Where convenient, shallow mechanical incorporation appears to improve activation (inhibits root growth).

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

norflurazon (Solicam DF)

Blueberry only

Rate 1.95 to 3.93 lb ai/a (2.5 to 5 lb/a Solicam DF) depending on soil type

Time West of the Cascades, immediately after planting. East of the Cascades, wait 6 months after planting before applying.

Remarks Soil surface must be weed free and relatively free of plant residues or debris. Inhibits yellow pigment formation, bleaching green chlorophyll. Preharvest interval is 60 days.

Caution Do not use on nursery stock.

Site of action Group 12: bleaching; inhibits carotenoid synthesis

Chemical family Pyridazinone

oryzalin (Surflan AS and Fugitive)

Rate 2 to 6 lb ai/a (2 to 6 quarts/a product)

Time Apply after transplanting to firm soil, before weeds germinate or sawdust is spread.

Remarks Requires sprinkler irrigation, rain, or shallow cultivation (1 to 2 inches) for activation. Avoid exposure of transplant roots contacting treated soil. Inhibits mitosis, primarily in roots.

Caution Do not apply to lowbush blueberries.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

paraquat (Gramoxone SL 2.0)

Rate 0.625 to 1 lb ai/a (2.5 to 4 pints/a Gramoxone SL 2.0)

Time Apply up to 5 times per season as a directed spray toward plant base; ensure complete wetting when weeds are small. Avoid spray contact with foliage and new shoots.

Remarks Add a nonionic surfactant or crop oil concentrate as label specifies; take care to avoid anionic formulations that react in the tank to form insoluble precipitates. Acts on contact; absorbs energy produced by photosynthesis, forming peroxides that disrupt living cells.

Caution A restricted-use herbicide. Do not ingest or inhale spray mist. Wear protective shields, respirators, and clothing. Do not let spray contact foliage, fruit, or young tree trunks. Do not graze treated areas.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyridilium

sethoxydim (Poast)

Blueberry only

Rate 0.19 to 0.47 lb ai/a (1 to 2.5 pints/a Poast) depending on target weed species

Time Identify susceptible grasses and apply at optimum growth stage listed on the label.

Remarks Add 2 pints/a of a non-phytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic if grasses are stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues; quackgrass can be suppressed. Inhibits fatty acid production, cell membranes, and new growth.

Caution Do not exceed 5 pints/a per season. Pre-harvest interval is 30 days.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

simazine (Princep)

Blueberry only

Rate 2 to 4 lb ai/a (2 to 4 quarts/a Princep)

Time Apply in spring within 2 weeks after transplanting to firm soil before weeds are established. A split application of 2 quarts/a Princep 4L in the spring plus 2 quarts/a Princep 4L in the fall is also permitted.

Remarks Use lowest rate possible. Mix with low rates of other herbicides that have other types of action. On plantings less than 6 months old, use 1/2 the rate listed.

Caution Do not use on light-texture soils. Requires surface moisture to activate. Do not apply if berries are present.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazine

Established Plantings—Winter or Dormant Applications that Persist in Soil

dichlobenil (Casoron 4G)

Rate 4 to 6 lb ai/a (100 to 150 lb/a granular product)

Time Apply midwinter immediately before a cold rain to reduce volatility and enhance weed suppression.

Remarks Weigh and distribute exact quantities over precisely measured areas. Adjust rates on light, sandy soils and treat at least 4 weeks after transplanting or preferably the next winter. Use 150-lb rate for perennial weeds. Precision application of the higher rate over 3 consecutive years suggests adequate crop tolerance under the following conditions. Oregon results over 9 years suggest perennial weeds can be suppressed with 4-, 3-, and 2-lb

ai/a rates applied in 3 consecutive years. Inhibits cellulose and cell wall formation.

Caution Grazing livestock is prohibited.

Site of action Group 20: inhibits cell wall synthesis Site A

Chemical family Nitrile

dichlobenil (Casoron CS)

Blueberry only

Rate 1.96 to 3.92 lb ai/a (1.4 to 2.8 gal/a Casoron CS)

Time Apply midwinter immediately before a cold rain to reduce volatility and enhance weed suppression.

Remarks Liquid formulation of encapsulated crystals of dichlobenil improves potential to apply evenly. Controls most germinating seeds and seedlings of annual and perennial grasses, and broadleaf weeds. Controls Canada thistle but will only suppress growth of field bindweed. Do not use on light sandy soils. Do not apply with high or gusty wind, high temperatures, low humidity, or temperature inversions. Inhibits cellulose and cell wall formation.

Caution Use only around well-established plants; typically wait until 1 year after transplanting. Grazing livestock is prohibited.

Site of action Group 20: inhibits cell wall synthesis Site A

Chemical family Nitrile

diuron (Direx 4L, Diuron 80DF and several other products; check labels for specific crops)

Blueberry and gooseberry only

Rate 1.6 to 2.4 lb ai/a (1.6 to 2.4 quarts/a 4L) Maximum seasonal use: 3.2 lb ai/a (3.2 quarts of product/a)

Time Apply in winter as single application, or apply 3.2 pints/a in October and again in March.

Remarks Reduce rate or rotate to other herbicides after achieving weed control. Sprinkler irrigate if applied before fall rains begin. Spray soil around base of plant, avoiding crop foliage.

Caution Do not use within 1 year after planting or on plants being tip layered. Do not apply on very sandy or gravelly soils. Can be rotated with simazine or other herbicides to reduce weed shifts. For use in western Oregon and western Washington.

Site of action Group 7: photosystem II inhibitor

Chemical family Substituted urea

flumioxazin (Chateau, Warfox)

Rate 0.19 to 0.38 lb ai/a (6 to 12 oz/a product)

Time Preferred timing is fall, to maximize potential of rain to activate the herbicide. In spring, apply no later than 7 days before harvest.

Remarks Supplemental label allows use west of the Cascades in Oregon and Washington, in specified counties, only. Apply to a weed-free surface. Flumioxazin has limited postemergence activity that can be enhanced by adding surfactants. Add 0.25% v/v nonionic surfactant or 1% crop oil concentrate to enhance postemergence burndown activity. Tank mix with herbicides such as glyphosate, glufosinate, or paraquat to kill large weeds. Residual weed control will be reduced if vegetation prevents the spray from reaching the soil. Moisture is necessary to activate the herbicide for residual weed control. Dry weather after application may reduce effectiveness. Do not exceed 12 oz/a per application

and 12 oz/a per year. Use the 6 oz/a rate if soil has significant amount of sand or gravel.

Caution Do not apply to blueberries established less than 2 years. Avoid direct or indirect spray contact with foliage or green bark, particularly if using the 12 oz rate with surfactants. Do not apply to soils that are susceptible to dispersal by wind. This herbicide can move to susceptible crops on soil particles and cause damage. Do not apply within 300 yards of nondormant pears. Do not mow treated areas between budbreak and final harvest; dust created by mowing may injure susceptible plants.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family N-phenylphthalimide

hexazinone (Velpar DF)

Blueberry only

Rate 0.975 to 1.95 lb ai/a (1.3 to 2.6 lb/a Velpar DF) depending on blueberry type and soil type

Time Plants should be established for 3 years. Apply to pruned blueberry plants before leaves emerge in spring.

Remarks This herbicide can injure other crops in western Oregon. Consult label for all precautions including blueberries established at least 3 years or more. Preharvest interval is 90 days.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazinone

indaziflam (Alion)

Rate 0.045 to 0.13 lb ai/a (3.5 to 5 fl oz/a Alion)

Time Apply late fall or early spring prior to bud swell. Apply as a directed application to the soil beneath the bushes.

Remarks For control of broadleaf and grass weeds. Do not allow spray to contact green stems or foliage, or unacceptable injury may occur.

Caution Do not apply more than 10 fl oz per year. Apply only to plants that have been in the ground one year or more. Rate is based on soil texture. Indaziflam is a persistent herbicide that may impact follow-crops if blueberries are taken out of production.

Site of action Group 29: disrupts cellulose biosynthesis

Chemical family Alkylazine

napropamide (Devrinol DF-XT, Devrinol 2-XT)

Rate 4 lb ai/a (8 lb/a Devrinol DF-XT, 8 quarts/a Devrinol 2-XT)

Time Apply fall through spring before weeds germinate, or apply foliar-active herbicide to control existing vegetation.

Remarks Irrigation or shallow incorporation is recommended for treatments made November through February if no rain falls within 2 weeks after application. Irrigate within 24 hours to wet soil 2 to 4 inches deep when applied March through October. Excessive plant residues on soil surface reduce performance (inhibits root growth).

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

norflurazon (Solicam DF)

Blueberry only

Rate 1.95 to 3.93 lb ai/a (2.5 to 5 lb/a Solicam DF) depending on soil type

Time Apply as a directed spray from fall to early winter before weeds emerge.

Remarks Soil surface must be weed-free and relatively free of plant residues or debris. Multiple or sequential applications can be made, but total amount applied in any 12 months must not exceed the maximum rate listed on the label for that crop and soil texture. Inhibits yellow pigment formation, bleaching green chlorophyll. Preharvest interval is 60 days.

Caution Do not use on nursery stock.

Site of action Group 12: bleaching; inhibits carotenoid synthesis

Chemical family Pyridazinone

oryzalin (Surflan AS and Fugitive)

Rate 2 to 6 lb ai/a (2 to 6 quarts/a product)

Time Apply late fall or early spring to bare soil or after existing vegetation has been destroyed by tillage or by a foliar-active herbicide.

Remarks Use higher rates, or apply split treatments in fall and spring for longer residual control. Irrigate with at least 0.5 inch of water or rain to activate herbicide. Shallow cultivation can control newly germinated weeds without reducing herbicide activity. Inhibits mitosis, primarily in roots.

Caution Do not apply to lowbush blueberries.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

pronamide (Kerb 50W, Kerb SC)

Blueberry only

Rate 1 to 2 lb ai/a (2 to 4 lb/a Kerb 50W; 2.5 to 5 pints Kerb SC) depending on target weed species

Time Apply once in fall or winter, preferably October to December when ground is not frozen.

Remarks Use lower rates on annual grasses, higher rates on perennial grasses such as quackgrass. Requires moisture from rain or irrigation to activate. Use only in berries established at least 3 months. Degraded by microorganisms at higher temperatures. Inhibits root growth.

Caution A restricted-use herbicide.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Benzamide

simazine (Princep)

Blueberry only

Rate 2 to 4 lb ai/a (2 to 4 quarts/a Princep 4L)

Time Apply in winter as single application, or split application with 2 quarts/a in spring and 2 quarts/a in the fall.

Remarks Reduce rate or rotate with other herbicides after achieving weed control. Requires surface moisture to activate. Can be rotated with diuron or other herbicides (except terbacil) to reduce weed shifts. Inhibits photosynthesis.

Caution Do not use on light-textured soils. Requires surface moisture to activate. Do not apply when berries are present because illegal residues may result.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazine

S-metolachlor (Dual Magnum)

Highbush Blueberry only; Oregon and Washington

Rate 0.64 to 1.26 lb ai/a (0.67 to 1.33 pints/a Dual Magnum)

Time Prior to weed emergence, up to 28 days before harvest.

Remarks Special Local Needs labels OR-110005 and WA-120002. For control of grasses, small seeded annuals, and nutsedge. Applications should be directed to the soil surface in a 3 foot band on each side of the blueberry row. Avoid direct contact with the crop foliage or crop injury may occur. Use the lower end of the Dual Magnum rate range for soils that are relatively coarse textured and higher rates on fine textured soils. Dual Magnum will not control emerged weeds.

Caution Not all blueberry cultivars have been tested so injury may occur on some types of blueberry. Growers are encouraged to treat a few plants as a test and evaluate crop injury. Blueberry plants that have been established for less than one year may be more sensitive to applications of Dual Magnum than those plants established for more than one year.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

sulfentrazone (Zeus XC)

Rate 0.25 to 0.375 lb ai/a (8 to 12 fl oz/a Zeus XC)

Time Apply as a dormant application to bare soil in fall through spring, before weeds emerge.

Remarks Apply only to plants that have been in the ground at least 3 years. Requires 0.5 to 1.0 inch of water to activate within 14 days after application. If weeds are present, tank mix with a burndown herbicide.

Caution Do not apply to frozen ground. Avoid direct or indirect contact with stems or foliage, particularly new emerging shoots from the crown. Do not apply more than 12 fl oz/a product (0.375 lb ai/a) per season. Do not tank mix with flumioxazin or other products containing sulfentrazone.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazinone

terbacil (Sinbar)

Blueberry only

Rate 1.6 to 2.4 lb ai/a (2 to 3 lb/a Sinbar) depending on soil texture and organic matter content

Time Apply in fall after harvest or in spring to blueberries established at least 1 year and to seedling or emerging weeds.

Remarks Some growers have reported injury. Use product on small areas until you are satisfied with the results. Sprinkler irrigate if rain does not fall within 2 weeks. Reduce rates by as much as half, or rotate with other herbicides after achieving effective weed control. Calibrate sprayer and apply with tractor-mounted, fixed-boom sprayer using a constant speed and rate of delivery.

Caution Do not apply on gravelly soils, soils with less than 1% organic matter, or on weak plants or eroded areas with exposed roots. Avoid use for 2 years if replanting is anticipated. Can rotate with diuron or other herbicides (except simazine) to reduce weed shifts.

Site of action Group 5: photosystem II inhibitor

Chemical family Uracil

Established Plantings—Directed Applications in or between Berry Rows with Soil Residual

clopyralid (Stinger)

Blueberry only; Oregon and Washington

Rate 2.66 to 5.33 fl oz/a (0.063 to 0.125 lb ae clopyralid/a) depending on weed species present. Make a maximum of two applications with total usage not to exceed 10.6 fl oz/a or 2/3 pints/a per season.

Time Up to 30 days before harvest, or after last harvest.

Remarks Blueberry plants are most sensitive to Stinger when applied in the spring, during the crop's annual flush of growth and prior to bloom. Blueberries are less sensitive after bloom has ended. Canada thistle, clover, and weeds of the *Asteraceae* family (dandelion, sowthistle) are controlled. Directed Spray Treatment: Apply Stinger uniformly as a spray at 2.67 to 5.3 fl oz/a directed to the soil, and away from the blueberry plants to the row middle without contacting the foliage or woody portions of blueberry plants. Apply with ground broadcast equipment, backpack sprayer, or wipe applicator in a total spray volume of a minimum of 10 gal/a. Spot Treatment: Hand-held sprayers may be used for spot applications, but care should be taken to apply Stinger at the proper rate per unit area. Do not concentrate the herbicide on the soil. Wipe Treatments: For wipe treatments, apply 2% solution of Stinger in water (2.5 fl oz or 75 mL/gal).

Caution Consult SLN labels OR-100011 and WA-100005 before applying to become familiar with situations that will increase the chance of injury to blueberries. Do not permit Stinger to contact desirable foliage because crop injury will result. Apply spray uniformly over the area to be treated, rather than concentrating the spray onto targeted weeds. Do not apply Stinger during the time from one week prior to bloom until one week after bloom. After bloom, apply Stinger up until 30 days prior to harvest. Do not apply within 30 days of harvest.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

halosulfuron-methyl (Sanda)

Blueberry only

Rate For plants 1 to 4 years old: 0.023 to 0.031 lb ai/a (0.5 to 0.67 oz/a Sanda); for plants 4 years or older: 0.023 to 0.047 lb ai/a (0.5 to 1 oz/a Sanda)

Time Preemergence or postemergence (nutsedge control)

Remarks For nutsedge control, make a single postemergence application of 0.75 oz/a minimum to nutsedge that has 3 to 5 leaves. Two applications are permissible if additional nutsedge plants emerge, but allow 45 days between applications. Do not irrigate for 3 to 4 days after application to maximize efficacy. Add a nonionic surfactant to improve activity. Preharvest interval is 14 days. Sanda also can be applied preemergence to control annual weeds including marehail and common groundsel.

Preemergence control of nutsedge is poor. Do not apply to 'Elliott' variety bushes established less than four years.

Caution Do not let spray contact blueberry bushes. Do not apply more than 2 oz/a per year. Do not apply to plants less than 1 year old, or concentrate the spray in the crop row.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

mesotrione (Callisto)

Blueberry and currant only

Rate 0.094 to 0.188 ai/a (3 to 6 fl oz/a Callisto)

Time Prebloom, post-directed spray.

Remarks May be applied as a split application (3 fl oz/a each), but no more than 6 fl oz/a per year. Use crop oil concentrate at 1% v/v to enhance weed control. Separate applications by 14 days. Has both burndown and soil-residual activity. Controls many broadleaf weeds, but controls few grasses and no perennial weeds.

Caution Applying after the onset of bloom may result in illegal residues.

Site of action Group 27: inhibits 4-hydroxyphenylpyruvate-dioxygenase (4-HPPD)

Chemical family Triketone

rimsulfuron (Matrix SG)

Blueberry only in Oregon and Washington

Rate 0.0625 lb ai/a (4 oz/a Matrix SG)

Time Apply in spring or fall, preemergence or early postemergence, to actively growing weeds.

Remarks Use a directed spray application and minimize spray contact with blueberry plants. Use only in berries that have gone through one growing season, and are in good health. Preharvest interval is 21 days. Use adjuvants for improved postemergence control.

Caution Do not exceed one application per year. When applied as a banded treatment (50% band or less), Matrix SG may be applied twice per year.

Site of action Group 2: Acetolactate synthase (ALS) inhibitor

Chemical family Sulfonylurea

Established Plantings—Burndown and Directed Applications in or between Berry Rows without Soil Residual

acetic acid (Weed Pharm Weed and Grass Killer)

Rate 15 to 30 gal product/a

Remarks 20% acetic acid. Apply as a directed application to actively growing small weeds. Application equipment must be hooded or shielded. Any contact with the crop will cause crop injury. Weed Pharm can be applied up to and including the day of harvest. Approved for organic production.

Caution This product is a contact, nonselective, herbicide. Avoid contact with desirable foliage, green bark, or fruit. Causes irreversible eye damage. Wear goggles or face shield.

bentazon (Basagran)

Non-bearing, blueberry only

Rate 0.75 to 1 lb ai/a (1.5 to 2 pints/a Basagran)

Time Spring to early summer, depending on growth stage of weeds.

Remarks Supplemental label (Arysta LifeSciences) for nonbearing crops. Useful for suppression and control of yellow nutsedge, Canada thistle, and musk thistle. For Canada thistle apply 2 pints/a when plants are between 8 inches tall and bud stage. Apply a second application 10 to 12 days later if needed. For nutsedge, apply 1.5 to 2 pints/a when plants are 6-8 in tall, and make a second application 7 to 10 days later if needed. Always add a crop oil concentrate. Use no more than 2 lb ai/a per year. Irrigate to make sure plants are actively growing before applying bentazon. Do not cultivate or mow for 5 days after application. Weeds growing under drought conditions may not be adequately controlled.

Caution Apply as a directed spray, away from the crop. Do not allow contact with foliage. Do not apply within one year of crop harvest.

Site of action Group 6: photosystem II inhibitor

Chemical family Benzothiadiazole

carfentrazone (Aim)

Hooded spray between rows

Rate 0.016 to 0.031 lb ai/a (1 to 2 fl oz/a product in at least 10 gal/a water)

Time Apply to weeds less than 4 inches tall for best results.

Remarks Apply with hooded sprayers between rows at speeds less than 5 mph. Use nonionic surfactants, crop oil concentrates, or methylated seed oils combined with liquid nitrogen fertilizer to improve efficacy. Aim can be applied up to and including the day of harvest.

Caution Must prevent spray from contacting green stem tissue, foliage, blooms, or fruit. Hooded sprayers must totally enclose the spray pattern. Newly planted fields should be treated with shielded sprayers.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazinone

clethodim (Select Max, Arrow, and others)

Rate 0.07 to 0.12 lb ai/a (9 to 16 fl oz/a Select Max for annual grasses; 12 to 16 oz/a Select Max for perennial grasses) See label for rates of other products.

Time Apply to actively growing grass weeds, including annual bluegrass, at labeled growth stage.

Remarks Preharvest interval is 14 days. Read label carefully for adjuvant instructions, and for information about effects of rain within 1 hour, applications of other pesticides, or cultivation. Minimum of 14 days between applications.

Caution Do not broadcast spray. Direct spray at base of the plant where grassy weeds are growing. Do not exceed 64 fl oz/a Select Max or 32.0 fl oz/a Arrow per season.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

fluazifop (Fusilade DX)

Rate 0.25 to 0.38 lb ai/a (16 to 24 oz/a Fusilade DX) depending on target weed species

Time Apply to actively growing grasses, or within 7 days after irrigation, as a directed spray with 1% crop oil or 0.25% nonionic surfactant.

Remarks Identify grasses and adjust rates depending on susceptibility and stage of weed growth as label instructs. Results often are erratic on grasses stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment. Inhibits fatty acid production, cell membranes, and new growth.

Caution Preharvest interval is 1 day. Grazing is prohibited.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Aryloxyphenoxy propionate

glufosinate (Rely 280, Lifeline, and other brands)

Rate 0.88 to 1.5 lb ai/a (1.5 to 2.5 quarts/a Rely 280) depending on target weed species and size

Time Apply to small, actively growing weeds

Remarks Apply as a directed spray to weeds, avoiding contact with blueberry foliage. Avoid direct spray or drift to desirable vegetation.

Caution Do not apply to green bark on young bushes, or injury will occur. Do not allow glufosinate to contact new emerging shoots. Do not exceed 3 lb ai/a of glufosinate (5.1 quarts/a) to berry bushes in a 12-month period. Preharvest interval is 14 days.

Site of action Group 10: inhibits glutamine synthase

Chemical family Phosphinic acid

glyphosate (several products)

Rate Broadcast or directed spray: Consult labels

Remarks Select application equipment to prevent crop injury by directing spray or by using selective applicators. Adjust concentration depending on equipment. Consult label about rate and time of application, especially for perennial weeds. Additional surfactant, or mixing ammonium sulfate as label instructs, may improve control of slightly stressed weeds. Inhibits production of three amino acids and protein synthesis. Preharvest interval is 14 days.

Caution Do not allow drift or mist to contact green foliage or bark, suckers, or vines and renewals less than 3 years old. When repeat applications are necessary, do not exceed 10.6 lb ai/a per year. Repeated glyphosate applications have created resistant biotypes of annual ryegrass in Oregon orchards. To avoid weed resistance, rotate and mix weed control practices.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

glyphosate (several products)

Rate Wiper: 33% solution

Time Apply 1 gal product with 2 gal water and wipe weeds; avoid contact with desirable vegetation.

Remarks In severe infestations, reduce equipment ground speed or apply in two directions to ensure contact with wiper. (See remarks above.) Preharvest interval is 14 days.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

paraquat (Gramoxone SL 2.0)

Rate 0.625 to 1 lb ai/a (2.5 to 4 pints/a Gramoxone SL 2.0)

Time Apply up to 5 times per season as a directed spray toward plant base; ensure complete wetting when weeds are small. Avoid spray contact with foliage a new shoots.

Remarks Add a nonionic surfactant or crop oil concentrate as label specifies; take care to avoid anionic formulations that react in the tank to form insoluble precipitates. Acts on contact; absorbs energy produced by photosynthesis, forming peroxides that disrupt living cells.

Caution A restricted-use herbicide. Do not ingest or inhale spray mist. Wear protective shields, respirators, and clothing. Do not let spray contact foliage, fruit, or young tree trunks. Do not graze treated areas.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyridilium

pelargonic acid (Scythe)

Rate For annual weeds, a 3 to 5% solution; for burndown or sucker control, a 5 to 7% solution

Time Apply in 75 to 200 gal/a water broadcast when temperatures exceed 45°F. Apply to weeds or primocanes shorter than 6 inches.

Remarks Cool weather after treatment may slow activity and delay or reduce visible effects. Adding a surfactant may enhance control. Preharvest interval is 1 day.

Site of action Unknown

Chemical family Unknown

sethoxydim (Poast)

Blueberry only

Rate 0.19 to 0.47 lb ai/a (1 to 2.5 pints/a Poast) depending on target weed species

Time Identify susceptible grasses and apply at optimum growth stage listed on label.

Remarks Add 2 pints/a of a nonphytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues; quackgrass can be suppressed. Inhibits fatty acid production, cell membranes, and new growth. Preharvest interval is 30 days.

Caution Do not exceed 5 pints/a per season.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

Cranberry

Kim Patten

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Preplant weed control All major weed problems can be prevented by starting with a clean field and avoiding reinfestation. For proper preplant management, growers should consider spraying perennial weeds with several applications of an appropriate systemic herbicide, using sand free from weed seeds, fumigating soil, planting weed-free vines, cleaning equipment when moving between beds, and seeding dikes with cover crops effective in preventing weed infestation (e.g., dwarf perennial ryegrasses and some creeping fescues).

Year-round weed management in bogs Successful weed management in cranberries requires a comprehensive, year-round approach that alternates a combination of weed control practices over several years. Developing these strategies requires knowledge of each weed and weed control practice. First, identify weeds and gather information about the effectiveness of each weed control practice. Consider costs and select herbicide combinations that may be applied together or in split applications that control most weeds in the beds. Note each herbicide's action within the plant (site of action). Then combine and alternate these products and other weed control practices to reduce the chance of developing resistant species or biotypes. Map the precise locations of different weeds in the bed to allow for spot application of herbicides. Removing weeds (especially perennial weeds) and seed heads by hand is often necessary, and should be done regularly. Mow dikes and other areas surrounding the beds periodically, to prevent weeds from spreading or reproducing by seed. Shape dikes to accommodate mowing equipment.

Applying herbicides Herbicides must be applied at the correct rate and time to control weed growth with minimal chance for injuring the cranberries. Recalibrate your herbicide applicator every year. For spot applications make sure that your tank-mix is based on spray volume. Follow guidelines in this handbook for backpack sprayer calibration. Results will be more consistent if you read the herbicide label and other information about the proper application and timing of each herbicide. Rates suggested in this guide are stated as pounds of active ingredient per acre (lb ai/a) or pounds of acid equivalent per acre (lb ae/a). Numerous products with the same active ingredient are labeled for cranberries. These products may have different concentrations of active ingredient. To avoid rate problems, be sure cranberry is on the label and follow the rate listed on the label. Avoid applying herbicides when water is standing on the soil surface. To minimize phytotoxicity and improve weed control, apply preemergence herbicides to dry vines, then water them in after application. At the beginning of each season, check with your Extension specialist to see whether a Section 18 for a new herbicide, or a SLN for a modification in the use of a currently registered herbicide has been granted. Also consult your handler for maximum residue limit (MRL) restrictions for export fruit.

Warning Using 2,4-D or similar materials on horticultural farms involves risk not only to the crop to which it is applied but also to crops in nearby fields. In some instances, however, careful use of 2,4-D enhances weed control with minimal chance for crop injury. Be careful to clean all 2,4-D from your equipment, otherwise use separate sprayers before applying another product to other horticultural crops. Never use a volatile formulation of 2,4-D or similar material. Buy only a product that lists the intended crop on the label.

New Plantings

clethodim (Intensity, Intensity One and other product names)

Rate 0.094 to 0.125 lb ai/a (6 to 8 oz/a of 2 EC formulation)

Time Apply to actively growing grasses, including annual bluegrass, at growth stage listed on label, using 0.5% to 1% nonphytotoxic crop oil or 0.25% nonionic surfactant.

Remarks Carefully read label about adjuvants, effects of rain within 1 hour, application of other pesticides, and cultivation. 'Intensity' and 'Intensity One' have Special Local Needs labels: WA-180004 and WA-180005, for chemigation application.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

clopyralid (Stinger)

Rate 0.1 to 0.25 lb ai/a (0.25 to 0.66 pint/a product)

Time Apply only when cranberries are not actively growing. In new plantings, this begins when cranberry vines go dormant in late fall and ends with early bud break.

Remarks Newly growing vines are very sensitive to Stinger. Identify susceptible weed species (legume and composite families), and apply postemergence when weed canopy becomes visible. Do not add surfactant or crop oil. Special local needs labels: WA-030006 and OR-030009.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

mesotrione (Callisto)

Rate 0.125 to 0.25 lb ai/a (4 to 8 oz/a product)

Time Apply only after bud break but less than 45 days before flooding.

Remarks Use with a nonionic surfactant at 0.25% v/v or crop oil at 1% v/v as recommended by the label. Callisto may be applied in cranberries at a rate up to 8 fl oz/a. Do not exceed 16 fl oz/a, or two applications per year. Allow at least 14 days between treatments. Callisto may be applied through irrigation systems (chemigation) including center pivot or solid set.

Caution Avoid using crop oils that injure cranberry vines.

Site of action Group 27: inhibits 4-hydroxyphenylpyruvate-dioxygenase (4-HPPD)

Chemical family Triketone

napropamide (Devrinol DF-XT, 2XT)

Rate 3 lb ai/a (6 lb/a Devrinol DF-XT)

Time Apply to weed-free soil surface after planting.

Remarks Use lower rate on sandy soils. Requires irrigation or rain to activate. Results are best when applied just before weed seeds germinate. Devrinol may be applied through the sprinkler irrigation systems.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

norflurazon (Evital 5G)

Rate 1 to 1.5 lb ai/a (20 to 30 lb/a product)

Time Apply after newly planted vines have rooted, but preferably in late winter or early spring, before weed growth begins.

Remarks 1 to 1.5 lb ai/a have performed adequately on new beds with low organic matter and high sand; 2.5 lb ai/a are required for new beds with high organic content.

Caution Do not exceed 2.5 lb ai/a total on new beds in 1 year. Hybrid varieties such as “Stevens” and “Pilgrim” are more prone to injury than “McFarlin.” Injury is likely in areas where water puddles. Avoid use in consecutive years if crop phytotoxicity was noted in year one. Use lower rates and alternate with other herbicides as soon as labels permit.

Site of action Group 12: bleaching; inhibits carotenoid biosynthesis

Chemical family Pyridazinone

sethoxydim (Poast)

Rate Spray: 0.28 to 0.47 lb ai/a (1.5 to 2.5 pints/a product). Spot treat: 2 oz or 4 Tbsp/gal water + 2.5 oz or 4 Tbsp crop oil concentrate

Time Apply at optimum growth stage listed on the label.

Remarks Identify susceptible grasses and add 2 pints/a of a nonphytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues. Inhibits fatty acid production, cell membranes and new growth.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

Established Beds

2,4-D low-volatile ester (Riverdale 2,4-D Granules)

Rate 2 to 4 lb ae/a (10 to 20 lb/a product)

Time Apply in early spring, while cranberries are dormant and leaves are completely dry.

Remarks Use higher rates as spot treatments on certain perennial weeds only; use lower rates in combination with other herbicides. Early winter applications may be effective against several broadleaf biennial species. Mimics natural plant hormones.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

chlorimuron (Curio)

Rate 0.008 to 0.016 lb ai/a (Washington: 0.5 to 1 oz/a, Oregon: 0.5 oz/a product)

Time Apply any time after March 1 but no later than 60 days before harvest. Use lower rate (0.5 oz/a) from the hook stage of development to bud set.

Remarks Requires waiver of liability signature prior to use. Controls creeping buttercup and several other perennial weeds. Optimal control of creeping buttercup can be achieved from a March to April timing. Requires the use of a spray adjuvant. Special Local Needs labels: WA-100004 and OR-120001.

Site of action Group 2: acetolactate synthase (ALS) inhibitor

Chemical family sulfonyleurea

clethodim (Intensity, Intensity One, and other products and formulations)

Rate 0.094 to 0.125 lb ai/a (6 to 8 oz/a of 2EC formulation)

Time Apply to actively growing grasses, including annual bluegrass, at growth stage listed on label using 0.5% to 1% nonphytotoxic crop oil or 0.25% nonionic surfactant. Preharvest interval is 30 days.

Remarks On label, carefully read about adjuvants, effects of rain within 1 hour, application of other pesticides, and cultivation. ‘Intensity’ and ‘Intensity One’ have Special Local Needs labels: WA-180004 and WA-180005, for chemigation application.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitors

Chemical family Cyclohexanedione

clopyralid (Stinger)

Rate 0.09 to 0.25 lb ai/a (0.25 to 0.66 pints/a product)

Time Apply only when cranberries are not actively growing. This begins when cranberry vines go dormant in late fall and ends with budbreak. The second application period is after fruit set, up to 60 days before harvest.

Remarks Vines growing under the weed canopy may be sensitive to Stinger. Identify susceptible weed species (legume and composite families), and apply postemergence when weed canopy becomes visible. Results are best when applied before weeds mature. Do not exceed 0.67 pint/a per season. Do not add surfactant or crop oil. Special local needs labels WA-030006 and OR-030009.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

dichlobenil (Casoron 4G)

Rate 1.2 to 4 lb ai/a (30 to 100 lb/a product)

Time Apply from midwinter to early spring, before bud break.

Remarks Results on sandy soils usually are best with split applications in midwinter to early spring. Allow 3 to 6 weeks between treatments. Do not exceed 4 lb ai/a (100 lb/a) total per year. Irrigation or rain should follow applications to minimize vaporization and loss of chemical. Use higher rates only on very weedy beds and organic soils. Plants will temporarily redden after spring applications.

Caution Do not apply at or beyond popcorn stage, or on newly sanded or new beds. Injury may occur where applications overlap or where water stands in low wet areas. Use lower rates (1.2 to 2.3 lb ai/a) on soils low in organic matter. Continued use at medium to high rates on sandier soils will result in a gradual but significant decline in production and plant health. Sanding is recommended to remediate the negative impacts of long term use of dichlobenil.

Site of action Group 20: inhibits cell wall synthesis Site A

Chemical family Nitrile

mesotrione (Callisto)

Rate 0.33 to 0.67 lb ai/a (4 to 8 oz/a product)

Time Apply only after budbreak but less than 45 days before flooding.

Remarks Use with a nonionic surfactant at 0.25% v/v or crop oil at 1% v/v as recommended by the label. Callisto may be applied in cranberries at a rate up to 8 fl oz/a. Do not exceed 16 fl oz/a

or two applications per year. Allow at least 14 days between treatments. Callisto may be applied through irrigation systems (chemigation) including center pivot or solid set.

Caution Avoid using crop oils that injure cranberry vines.

Site of action Group 28: inhibits 4-hydroxyphenylpyruvate-dioxygenase (4-HPPD)

Chemical family Triketone

napropamide (Devrinol DF-XT, 2-XT)

Rate Sand beds: 4 to 6 lb ai/a (8 to 12 lb/a of DF 2-XT formulation); Peat beds: 6 to 9 lb ai/a (12 to 18 lb/a of DF-XT formulation)

Time Apply before weeds begin to germinate and before spring growth begins, in mid-February to mid-March.

Remarks Requires ample rain or irrigation to activate. On 1-year-old beds, use lower rates. Crop may be injured at high rates. Control may lessen with repeated use. Inhibits root and shoot growth. Devrinol may be applied through the sprinkler irrigation systems.

Caution Do not apply after buds begin to swell.

Site of action Group 15: inhibits very long chain fatty acid synthesis

Chemical family Acetamide

norflurazon (Evital 5G)

Rate 1 to 6 lb ai/a (20 to 100 lb/a product)

Time Apply midwinter to early spring, before new vine growth begins.

Remarks Use lower rates not exceeding 3 lb ai/a on: sandy soils low in organic matter; on sensitive hybrid varieties such as "Stevens," "Pilgrim," or "Crimson Queen"; on young plants; or on beds with weak vines. Higher rates are required on older beds with higher organic content. Some growers and researchers report reduced crop yields when the product is applied in consecutive years, especially with new hybrids. Injury may occur if applications overlap, or if water stands in low, wet areas. Use lower rates and alternate with other herbicides to reduce possibility of injury.

Site of action Group 12: bleaching; inhibits carotenoid biosynthesis

Chemical family Pyridazinone

quinclorac (Quinstar 4L)

Rate Up to 0.25 ai/a (8.4 oz/a product)

Time Quinstar 4L is most effective on actively growing cranberry weeds listed on the label, when applied at the early post-mergence stage of development.

Remarks Apply as a foliar application using a crop oil concentrate at a rate of 2 pints/a. A second application may be made at least 30 days after the first application. Do not exceed more than two applications per year. Quinstar 4L may also be applied with chemigation. Prior to application, consult your handler for MRL restrictions on export fruit.

Site of action Group 4: synthetic auxin

Chemical family Quinoline carboxylic acid

sethoxydim (Poast)

Rate Spray: 0.28 to 0.47 lb ai/a (1.5 to 2.5 pints/a product).
Spot treat: 2 oz or 4 Tbsp/gal water + 2.5 oz or 4 Tbsp crop oil concentrate

Time Apply at optimum growth stage listed on the label. Preharvest interval is 60 days.

Remarks Identify susceptible grasses and add 2 pints/a of a nonphytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues. Inhibits fatty acid production, cell membranes, and new growth.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitors

Chemical family Cyclohexanedione

Swab or Wick Treatment

2,4-D, dimethylamine salt (Weedar 64)

Rate 33% solution for wick wiper

Time Apply after fruit set. Preharvest interval is 30 days. Apply when weeds are actively growing and at least 6 inches taller than cranberries.

Caution Preharvest interval is 30 days. Apply only once per year. Do not exceed 2.5 pints per acre per application.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

clopyralid (Stinger)

Rate 2% solution for wick wiper

Time Use after bud break to control late-emerging weeds.

Remarks Apply to target weeds, avoiding any contact with vines. Special local needs labels WA-030006 and OR-030009.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

glyphosate (several products)

Rate 20% solution for wick wiper

Time Apply after fruit set. Preharvest interval is 30 days. Apply when weeds are actively growing and at least 6 inches taller than cranberries.

Remarks See label for growth stage of specific weeds. Re-treatment may be necessary. Slower ground speed and/or application with wick to both sides of dense infestations may improve results. Avoid drips or contact with desirable foliage. Inhibits three amino acids and protein synthesis.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

glyphosate (several products)

Rate Apply a 50% solution for woody brush control in and around cranberry bogs

Time Cut stump treatments

Caution Preharvest interval is 30 days.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted

Strawberry

Marcelo L Moretti and Joe DeFrancesco

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Weed control practices in strawberries must be timed to coincide with the crop's nonreproductive phases, or when minimal herbicide uptake can be expected. Strawberries can be induced into a nonreproductive "summer dormancy" by withholding water and fertilizer after harvest. Beds can be renovated by mowing old leaves, cultivating row middles, and sometimes by applying a herbicide. In mid-August, plants are fertilized and watered to enhance flower bud development. Soil-applied herbicides can be applied at full rates in the fall. Sometimes, a foliar-active herbicide can be applied during the "summer" or "winter" dormancy when plants are completely inactive, if the grower is willing to accept the risk of crop injury.

Weed shifts Although strawberries are rotated with other crops every 2 to 4 years, some weed species may persist or increase with repeated use of the same or similar weed control practices, causing shifts in weed populations. Examples include deep-rooted perennials that survive cultivation, or weeds such as common groundsel that either resist the herbicide or are selected from a natural population of susceptible biotypes.

Preventing weed shifts Weeds that survive cultivation, specific herbicide treatments, or other routine cultural practices must be eliminated before the tolerant species or biotypes become established. Combine a variety of weed control practices or treatments, rotate practices and herbicides, and spot-treat with a hoe or registered herbicide when a new weed first appears. Also, clean equipment when moving from an infested field.

Managing weeds in strawberry fields Successful weed control in strawberry fields requires a comprehensive or year-round approach employing and alternating a combination of weed control practices over several years. Developing these strategies requires knowledge of each weed and weed control practice. Weeds must be identified and information gathered about the effectiveness of each weed control practice. Consider costs and select herbicide combinations that can be applied together or in split applications that control the weeds in the field. Note the action of each herbicide or how the chemical works in the plant. Then tank-mix and alternate use of these products to reduce the chance of developing resistant species or biotypes. Often, a combination of mechanical methods, herbicide treatments, and sometimes hand removal or spot treatment with herbicide sprays will provide the most effective year-round control.

Managing soil erosion Band treatments of soil-active herbicides within the row. Planting annual cover crops such as spring barley or oats in row middles reduces water runoff and soil erosion on sloping land. Reduce herbicide amounts proportionately to the area of soil actually treated.

Soil-active herbicides Persistent, soil-active herbicides can be applied in early fall through early spring, and activated with rain or sprinkler irrigation if dry conditions persist. Apply lower rates on sandy soils having lower clay or organic matter contents, to reduce or avoid possible injury symptoms. Existing vegetation between rows can be controlled with cultivation.

Postemergence herbicides Contact herbicides, or plant growth regulator herbicides such as 2,4-D, can be used to control existing broadleaf weeds. 2,4-D controls many broadleaf weeds, but must be applied when weeds are actively growing. Strawberries must be completely inactive during the "summer" or "winter" dormancy to reduce the chance of crop injury from 2,4-D.

Warning Using 2,4-D, clopyralid (Stinger), or similar materials involves risk, not only to the crop to which it is applied but also to other crops in nearby fields. However, there may be instances where guidance in using these products will enhance weed control with minimal chance for crop injury. Be careful to clean all herbicide from your equipment, otherwise use separate sprayers before applying another product to other horticultural crops. Under no conditions should you use volatile formulations of 2,4-D or similar materials. Purchase only a product that lists strawberries on the label.

Note Herbicides must be applied at the correct rate and time to selectively control weed growth with minimal chance for injury to strawberries. Obtain more consistent results by reading the herbicide label and other information about the proper application and timing of each herbicide. Suggested rates listed in this guide are stated as pounds of active ingredient per acre (lb ai/a) or pounds of acid equivalent per acre (lb ae/a). For band applications over berry rows, reduce the amount of herbicide applied proportionately to the area within the row actually sprayed.

New Plantings

acetic acid (Weed Pharm Weed and Grass Killer)

Rate 15 to 30 gal product/a

Remarks 20% acetic acid. Apply as a directed application to actively growing small weeds in row middles only. Use application equipment that is hooded or shielded. Any contact with the crop will cause crop injury. Approved for organic production.

Caution This product is a contact, nonselective, herbicide. Avoid contact with desirable foliage, green bark, or fruit.

carfentrazone-ethyl (Aim EC)

Row middles only

Rate Up to 0.031 lb ai/a (2 fl oz/a Aim EC) broadcast per application in at least 10 gal/a of finished spray. See label for rate based on target weed species.

Time Apply postemergence to actively growing broadleaf weeds, as listed on label.

Remarks Controls listed broadleaf weeds up to 4 inches tall. Will not control grass weeds. A nonionic surfactant, methylated seed oil, or crop oil concentrate is required. Consult label for adjuvant selection and instructions.

Caution Apply to row middles only, using a shielded or hooded sprayer that prevents any spray from contacting strawberry plant tissues. Crop will be injured if spray contacts green stem tissues, leaves, blooms, or fruit. See label for hooded or shielded sprayer directions. Do not exceed 6.1 fl oz/a broadcast (0.096 lb ai/a) per season as a row-middle application.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazolinone

clethodim (Select 2EC and others)

Rate 0.09 to 0.125 lb ai/a (6 to 8 oz/a Select 2EC)

Time Apply postemergence to actively growing annual or perennial grasses, including annual bluegrass, as listed on label.

Remarks Consider environmental and plant growth conditions that affect leaf uptake; see label for guidelines. Limited observations suggest that April treatments may cause slight cupping and browning of petals or blossoms. Add crop oil concentrate as described on label.

Caution Do not exceed 32 oz/a Select 2EC per season.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

DCPA (Dacthal Flowable)

Rate 9 lb ai/a (12 pints/a)

Time Apply soon after transplanting, or preplant incorporate.

Remarks Applications west of Cascades usually perform erratically. Inhibits mitosis.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Phthalic acid

fluazifop-p-butyl (Fusilade DX)

Rate 0.09 to 0.25 lb ai/a (6 to 16 fl oz/a product)

Time Apply to actively growing grasses or within 7 days after irrigation as a directed spray with 1% crop oil or 0.25% nonionic surfactant. Pre-harvest interval 14 days.

Remarks Identify grasses and adjust rates depending on susceptibility and stage of weed growth as label instructs. Results often are erratic on grasses stressed from lack of vigor, high temperature, low fertility, or drought. More mature grasses and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment. Inhibits fatty acid production, cell membranes, and new growth.

Caution Do not exceed 16 fl oz/a per season. Do not apply after fruit set or when fruit is present.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Aryloxyphenoxy propionate

flumioxazin (Chateau and Warfox)

Rate 0.096 lb ai/a (3 oz/a product)

Time Apply a minimum of 30 days prior to transplanting strawberry if planting through a plastic mulch. Can be applied broadcast over the top of dormant and newly transplanted crowns.

Remarks May provide some burnback of existing broadleaf weeds. Adding an adjuvant enhances weed burnback but may lead to crop spotting.

Caution Do not exceed 3 oz/a at this timing. Do not apply after fruit set or when fruit is present.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family N-phenylphthalimide

glyphosate (several products)

Rate Consult label

Time Apply to weeds at least 3 days before transplanting.

Remarks Do not apply after transplanting. Inhibits production of three amino acids and protein synthesis.

Site of action Group 9: inhibits EPSP synthase

Chemical family None generally accepted.

napropamide (Devrinol 2-XT, Devrinol DF-XT)

Rate 4 lb ai/a (8 quarts/a Devrinol 2-XT, 8 lb/a Devrinol DF-XT)

Time Apply before weeds germinate, or after cultivating to remove growing weeds.

Remarks Requires sprinkler irrigation the same day to wet soil 2 to 4 inches deep. Applications during the growing season may delay or inhibit rooting (pegging) of runners. Some growers apply 2 lb ai/a at planting to minimize root pruning and pegging problems, then an additional 2 lb ai/a in fall. Inhibits root growth.

Caution Do not apply from bloom through harvest.

Site of action Group 15: inhibits very-long-chain fatty acid synthesis

Chemical family Acetamide

pendimethalin (Prowl H₂O)

Rate 0.71 to 1.4 lb ai/a (1.5 to 3 pints/a Prowl H₂O)

Time Apply preemergence as a broadcast spray to the soil surface before or within 7 days after transplanting strawberries.

Remarks Most effective if rain or irrigation incorporates herbicide into weed emergence zone within 7 days. Do not apply to strawberry bed if bed is later to be covered with plastic.

Caution Stunting, reduced growth, or reduction in daughter plants may result. Refer to main labels for crop rotation restrictions.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

sethoxydim (Poast)

Rate 0.47 lb ai/a (2.5 pints/a Poast)

Time Apply at optimum growth stage listed on label.

Remarks Identify susceptible grasses and add 2 pints/a of a nonphytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stunted or stressed by drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues, but quackgrass can be suppressed. Inhibits fatty acid production, cell membranes, and new growth.

Caution Do not exceed 2.5 pints/a per season.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

S-metolachlor (Dual Magnum)

Oregon only

Rate 0.95 lb ai/a (1 pint/a Dual Magnum)

Time Apply post-transplant prior to weed emergence, dormant before new growth, or after renovation.

Remarks Special Local Needs Label OR-180010

Caution Application to strawberry plants with adjuvants and nitrogen sources (ammonium sulfate) may increase crop injury. Do not exceed 0.95 lb ai/a (1 pint/a) per application, or two applications per season or 2 pints/a (1.9 lb ai/a). Irrigate within two days after application. Irrigate 0.5 inch on coarse-texture soils and 1 inch on fine-texture soils. Pre-harvest interval is 30 days.

Site of action Group 15: inhibits very long chain fatty acid synthesis (VLCFA)

Chemical family Acetamide

sulfentrazone (Spartan 4F)

Rate 0.125 to 0.25 lb ai/a (4 to 8 oz/a Spartan)

Time Apply preplant or post-transplant, prior to weed emergence.

Remarks Preemergent applications must be activated by sufficient irrigation (0.5 to 1 inch) within 7-10 days. Strawberries are listed on the federal Spartan 4F label but Oregon and Washington SLN labels (OR-110009 and WA-110007) provide use pattern and directions more appropriate to Oregon and Washington production systems.

Caution Application to strawberry plants with newly emerged growth is not recommended due to leaf burning and possible stand loss. Do not exceed 0.25 lb ai/a (8 oz/a) per application, or a maximum of 0.375 lb ai/a (12 oz/a) per season. Do not use on coarse, sandy soils with less than 1% organic matter. For use only by those certified and/or licensed as pesticide applicators.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazolinone

terbacil (Sinbar WDG)

Rate 0.1 to 0.15 lb ai/a (2 to 3 oz/a Sinbar)

Time After transplanting but before new runner plants start to root.

Remarks If strawberry transplants are allowed to develop new foliage prior to Sinbar application, the application must be followed immediately by 0.5 to 1 inch of irrigation or rainfall to wash the herbicide off the strawberry foliage.

Caution Do not use on sandy, loamy sands, gravelly soils, or soils with less than 2% organic matter. Inhibits photosynthesis.

Site of action Group 5: photosystem II inhibitor

Chemical family Uracil

Established Plantings—Early Fall or Winter Applications

Cereal Interplant On sloping land, spring cereals such as barley or oats are sown between rows to reduce or slow runoff and possible erosion. The cereals are killed in spring with cultivation or herbicides before excessive growth.

carfentrazone-ethyl (Aim EC)

Rate May be applied only to row middles at rates up to 0.031 lb ai/a (2 fl oz/a Aim EC) broadcast per application in at least 10 gal/a of finished spray. See label for rate based on target weed species.

Time Apply postemergence to actively growing broadleaf weeds, as listed on label.

Remarks Controls listed broadleaf weeds up to 4 inches tall. Will not control grass weeds. A nonionic surfactant, methylated seed oil, or crop oil concentrate is required. See label for adjuvant selection and instructions.

Caution Apply only to row middles, using a shielded or hooded sprayer that prevents any spray from contacting strawberry plant tissues. Crop will be injured if spray contacts green stem tissues, leaves, blooms, or fruit. See label for hooded or shielded sprayer directions. Do not exceed 6.1 fl oz/a broadcast (0.096 lb ai/a) per season as a row-middle application.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazolinone

clethodim (Select 2EC and others)

Rate 0.09 to 0.125 lb ai/a (6 to 8 oz/a Select 2EC). Consult label for rate required to control different grasses.

Time Apply to actively growing grasses at recommended heights.

Remarks Add crop oil concentrate as described on label.

Caution Do not exceed 8 fl oz/a per treatment or 32 fl oz/a per season. Preharvest interval is 4 days.

Site of action Group 1: acetyl CoA carboxylase (ACCCase) inhibitor

Chemical family Cyclohexanedione

clopyralid (Stinger)

Oregon and Washington only

Rate 0.125 to 0.25 lb ai/a (0.33 to 0.66 pint/a Stinger)

Time Apply after harvest, from September 15 to November 15.

Remarks SLN labels OR-030031 and WA-030035. Preharvest interval is 30 days.

Caution Do not exceed a total of 0.25 lb ai/a (0.66 pint/a) per year. Do not use with surfactants or tank mix with other herbicides. May cause minor leaf cupping. Do not compost vegetation treated with Stinger.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

DCPA (Dacthal Flowable)

Rate 6 to 9 lb ai/a (8 to 12 pints/a Dacthal Flowable)

Remarks Applications west of Cascades usually perform erratically. Elsewhere, apply in fall or early spring to control late summer weeds. Do not apply after first bloom. Inhibits mitosis.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Phthalic acid

flumioxazin (Chateau and Warfox)

Rate 0.096 lb ai/a (3 oz/a product)

Time Apply during winter dormancy for preemergence weed control.

Remarks May provide some burnback of existing broadleaf weeds. Experience indicates 2.2 oz/a is sufficient for preemergence weed control. Crop oil concentrate at 1% v/v or nonionic surfactant at 0.25% v/v may be added to help control emerged broadleaf weeds.

Caution Do not exceed 3 oz/a at this timing.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family N-phenylphthalimide

napropamide (Devrinol 2-XT, Devrinol DF-XT)

Rate 4 lb ai/a (8 quarts/a Devrinol 2-XT, 8 lb/a Devrinol DF-XT)

Time Apply fall through early spring before weeds emerge, preferably in November or December.

Remarks If rainfall is not available, requires sprinkler irrigation to wet soil 2 to 4 inches deep to reduce herbicide degradation. Because of possible carryover in wheat rotations, use other weed controls the final year of strawberry production, or plow deeply to dilute soil residue. Inhibits root growth.

Caution Do not exceed 4 lb ai/a per year.

Site of action Group 15: inhibits very-long-chain fatty acid synthesis

Chemical family Acetamide

pendimethalin (Prowl H₂O)

Rate 0.71 to 1.4 lb ai/a (1.5 to 3 pints/a Prowl H₂O)

Time May be applied to strawberries in fall or winter dormancy, but prior to onset of new seasonal growth from crowns.

Caution Do not apply if new leaves have emerged or are exposed. Stunting, reduced growth, or reduction in daughter plants may result. Refer to main labels for crop rotation restrictions. Preharvest interval is 35 days.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

sethoxydim (Poast)

Rate 0.47 lb ai/a (2.5 pints/a)

Time Apply at optimum growth stage listed on label.

Remarks Identify susceptible grasses; add 2 pints/a of a nonphytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues; quackgrass can be suppressed. Note special precautions on Sinbar applications, based on crop injury experienced in other regions. Never tank mix Sinbar with Poast; wait at least 2 weeks between applying these herbicides.

Caution Do not exceed 2.5 pints/a per season. Preharvest interval is 7 days. Inhibits fatty acid production, cell membranes, and new growth.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

simazine (Princep 4L)

Oregon and Washington only

Rate 1 lb ai/a (1 quart/a Princep 4L)

Time Apply after harvest at time of bed renovation where overhead irrigation is available for activation, or apply in October or November and activate with rain. Apply only once per year and do not use on sandy or coarse soils.

Remarks Established weed seedlings will not be controlled.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazine

sulfentrazone (Spartan 4F)

Rate 0.125 to 0.25 lb ai/a (4 to 8 oz/a Spartan)

Time Apply to established plantings during dormancy. SLN labels OR-110009 and WA-110007.

Remarks Rainfall or irrigation needed to activate herbicide within 14 days of application. Do not apply within 70 days of harvest.

Caution Application to strawberry plants with new emerged growth is not recommended due to leaf burning and possible stand loss. Do not exceed 0.25 lb ai/a (8 oz/a) per application, or a maximum of 0.375 lb ai/a (12 oz/a) per season. Do not use on coarse, sandy soils with less than 1% organic matter. For use only by those certified and/or licensed as pesticide applicators.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazolinone

terbacil (Sinbar)

Rate 0.1 to 0.3 lb ai/a (2 to 6 oz Sinbar/a)

Time Apply during winter dormancy, before weeds are 2 inches tall or wide. Apply split treatments of up to 0.3 lb ai/a during bed renovation and again in winter; do not exceed 0.4 lb ai/a (8 oz/a) per year. Apply to strawberries established at least 6 months.

Caution Do not use on sandy, loamy sands, gravelly soils or soils containing less than 2% organic matter. Avoid use for 2 years if replanting is planned, and consult label for recropping information.

Site of action Group 5: photosystem II inhibitor

Chemical family Uracil

Established Plantings—Weed Control in Late Winter and Spring**2,4-D (Formula 40 and others)**

Rate 0.9 to 1.4 lb ae/a (1 to 1.5 quarts/a Formula 40)

Time Apply in late winter when crops are dormant, in 20 to 25 gal/a water. Apply before February to mitigate potential injury to fruit.

Remarks Make sure label includes strawberries; follow directions carefully. Triple-rinse and wash spray tank with appropriate cleaners before applying herbicides to other crops.

Caution Do not use unless possible crop injury is acceptable. Avoid using under conditions that favor drift or movement to susceptible crops.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

acetic acid (Weed Pharm Weed and Grass Killer)

Rate 15 to 30 gal product/a

Remarks 20% acetic acid. Apply as a directed application to actively growing small weeds in row middles only. Use application equipment that is hooded or shielded. Any contact with the crop will cause crop injury. Weed Pharm can be applied up to and including the day of harvest. Approved for organic production.

Caution This product is a contact, nonselective, herbicide. Avoid contact with desirable foliage, green bark, or fruit.

carfentrazone-ethyl (Aim EC)

Rate Apply only to row middles at rates up to 0.031 lb ai/a (2 fl oz/a Aim EC); broadcast per application in at least 10 gal/a of finished spray. See label for rate based on target weed species.

Time Apply postemergence to actively growing broadleaf weeds, as listed on label.

Remarks Controls listed broadleaf weeds up to 4 inches tall. Will not control grass weeds. A nonionic surfactant, methylated seed oil, or crop oil concentrate is required. Consult label for adjuvant selection and instructions. Can be used up to and including day of harvest.

Caution Apply only to row middles, using a shielded or hooded sprayer that prevents any spray from contacting strawberry plant tissues. Crop will be injured if spray contacts green stem tissues, leaves, blooms, or fruit. See label for hooded or shielded sprayer directions. Do not exceed 6.1 fl oz/a broadcast (0.096 lb ai/a) per season as a row-middle application.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazolinone

clopyralid (Stinger)

Oregon and Washington only

Rate 0.125 lb ai/a (0.33 pint/a Stinger) in Washington, and 0.25 lb ai/a (0.66 pint/a Stinger) in Oregon

Time Apply in spring, before first bloom.

Remarks SLN labels OR-030031 and WA-030035.

Caution Do not exceed a total of 0.25 lb ai/a (0.66 pint/a) per year. Do not use with surfactants or tank mix with other herbicides. May cause minor leaf cupping. Do not compost vegetation treated with Stinger. Preharvest interval is 30 days.

Site of action Group 4: synthetic auxin

Chemical family Pyridine

flumioxazin (Chateau, Warfox)

Rate 0.096 lb ai/a (3 oz/a product)

Time Apply in early spring before weed emergence and fruit set.

Remarks Apply only to row middles using a hooded or shielded sprayer. May give some burnback of existing broadleaf weeds. Adding an adjuvant enhances weed burnback but may lead to crop spotting. Apply only prior to fruit set.

Caution Do not exceed 3 oz/a per application. Do not apply after fruit set. Do not apply over the top of strawberries. Do not let spray drift contact fruit or foliage.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family N-phenylphthalimide

pendimethalin (Prowl H₂O)

Rate 0.71 to 1.4 lb ai/a (1.5 to 3 pints/a Prowl H₂O)

Time May be applied to strawberries in winter dormancy prior to onset of new seasonal growth from crowns, or in spring as a band between rows.

Caution Do not apply if new leaves have emerged or are exposed. Stunting, reduced growth, or reduction in daughter plants may result. Refer to main labels for crop rotation restrictions. Preharvest interval is 35 days.

Site of action Group 3: microtubule assembly inhibitor.

Chemical family Dinitroaniline

Established Plantings—Weed Control during Bed Renovation in Summer

Cultivation After harvest, withhold irrigation to induce “summer dormancy” in strawberries before treating perennial weeds. Cultivate row middles to reduce runners and control weeds.

2,4-D (Formula 40 and others)

Rate 0.9 to 1.4 lb ae/a (1 to 1.5 quarts/a Formula 40)

Time Apply immediately after last harvest, in 20 to 25 gal/a water.

Remarks Make sure the label includes strawberries, and follow directions carefully. Triple-rinse and wash spray tank with appropriate cleaners before applying herbicides to other crops.

Caution Do not use unless possible crop injury is acceptable. Avoid use under conditions that favor drift or movement to susceptible crops.

Site of action Group 4: synthetic auxin

Chemical family Phenoxy acetic acid

acetic acid (Weed Pharm Weed and Grass Killer)

Rate 15 to 30 gal product/a

Remarks 20% acetic acid. Apply as a directed application to actively growing small weeds in row middles only. Use application equipment that is hooded or shielded. Any contact with the crop will cause crop injury. Approved for organic production.

Caution This product is a contact, nonselective, herbicide. Avoid contact with desirable foliage, green bark, or fruit.

carfentrazone-ethyl (Aim EC)

Rate Apply only to row middles at rates up to 0.031 lb ai/a (2 fl oz/a Aim EC) broadcast per application in at least 10 gal/a of finished spray. See label for rate based on target weed species.

Time Apply postemergence to actively growing broadleaf weeds, as listed on label.

Remarks Controls listed broadleaf weeds up to 4 inches tall. Will not control grass weeds. A nonionic surfactant, methylated seed oil, or crop oil concentrate is required. Consult label for adjuvant selection and instructions.

Caution Apply only to row middles, using a shielded or hooded sprayer that prevents any spray from contacting strawberry plant tissues. Crop will be injured if spray contacts green stem tissues, leaves, blooms, or fruit. See label for hooded or shielded sprayer directions. Do not exceed 6.1 fl oz/a broadcast (0.096 lb ai/a) per season as a row-middle application.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazolinone

clethodim (Select 2EC and others)

Rate 0.09 to 0.125 lb ai/a (6 to 8 oz/a Select 2EC)

Time Apply to actively growing grasses at recommended weed heights.

Remarks Add crop oil concentrate as described on label.

Caution Do not exceed 8 fl oz/a per treatment or 32 fl oz/a per season.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

napropamide (Devrinol 2-XT, Devrinol DF-XT)

Rate 4 lb ai/a (8 quarts/a Devrinol 2-XT, 8 lb/a Devrinol DF-XT)

Time Apply to weed-free soil after bed renovation.

Remarks Prevents daughter plants from rooting.

Caution Do not exceed 4 lb ai/a per year. Inhibits root growth.

Site of action Group 15: inhibits very-long-chain fatty acid synthesis

Chemical family Acetamide

paraquat (Gramoxone Inteon)

Rate 0.5 lb ai/a (2 pints Gramoxone Inteon/a)

Time Apply as a directed spray between rows, using shields to prevent spray contact with crop.

Remarks Add nonionic surfactant or crop oil concentrate as label directs; avoid anionic formulations that react to form insoluble precipitates. Acts as contact; absorbs energy produced by photosynthesis, forming peroxides that disrupt living cells.

Caution **A restricted-use herbicide.** Do not inhale or ingest spray mist. Wear protective face shields, respirators, and clothing. Do not exceed three applications a year. Preharvest interval is 21 days.

Site of action Group 22: photosystem I electron diversion

Chemical family Bipyridilium

pendimethalin (Prowl H₂O)

Rate 0.71 to 1.4 lb ai/a (1.5 to 3 pints/a Prowl H₂O)

Time During renovation when no foliage is exposed.

Caution Do not apply if new leaves have emerged or are exposed. Stunting, reduced growth, or reduction in daughter plants may result. Refer to main labels for crop rotation restrictions.

Site of action Group 3: microtubule assembly inhibitor

Chemical family Dinitroaniline

sethoxydim (Poast)

Rate 0.47 lb ai/a (2.5 pints/a)

Time Apply at optimum growth stage listed on label.

Remarks Identify susceptible grasses; add 2 pints/a of a nonphytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues; quackgrass can be suppressed. Inhibits fatty acid production, cell membranes, and new growth.

Caution Do not exceed 2.5 pints/a per season. Note special precautions on Sinbar applications based on crop injury experienced in other regions; never tank mix Sinbar with Poast; wait at least 2 weeks between applying these herbicides.

Site of action Group 1: acetyl CoA carboxylase (ACCase) inhibitor

Chemical family Cyclohexanedione

simazine (Princep 4L)

Oregon and Washington only

Rate 1 lb ai/a (1 quart/a Princep 4L)

Time Apply after bed renovation and first irrigation followed with additional 0.5 inch irrigation to activate the herbicide. Apply only once per year.

Remarks In summer, simazine is only about half as active as in winter applications.

Caution Do not apply on sandy soils.

Site of action Group 5: photosystem II inhibitor

Chemical family Triazine

sulfentrazone (Spartan 4F)

Rate 0.125 to 0.25 lb ai/a (4 to 8 oz/a Spartan)

Time Apply after harvest, and after mowing at bed renovation.

Remarks Strawberries are listed on the federal Spartan 4F label but Oregon and Washington SLN labels (OR-110009 and WA-110007) provide use pattern and directions more appropriate to Oregon and Washington production systems. Water is required to activate sulfentrazone.

Caution Avoid contact with newly emerged strawberry growth, as leaf burning and stand loss may occur. Do not exceed 0.25 lb ai/a (8 oz/a) per application, or a maximum of 0.375 lb ai/a (12 oz/a) per season. Do not use on coarse, sandy soils with less than 1% organic matter. For use only by those certified and/or licensed as pesticide applicators.

Site of action Group 14: inhibits protoporphyrinogen oxidase (PPO)

Chemical family Triazolone

terbacil (Sinbar)

Rate 0.2 to 0.4 lb ai/a (4 to 8 oz/a Sinbar)

Time Apply to strawberries established at least 6 months.

Remarks Avoid use for 2 years if replanting is planned; consult label for recropping information. Split applications at lower rates are preferred after bed renovation in summer, before new strawberry growth begins, and before weeds are more than 2 inches tall or wide.

Caution Do not exceed 0.4 lb ai/a (8 oz/a per year) or use on sandy, loamy sands, gravelly soils, or soils with less than 2% organic matter. Inhibits photosynthesis.

Site of action Group 5: photosystem II inhibitor

Chemical family Uracil
