

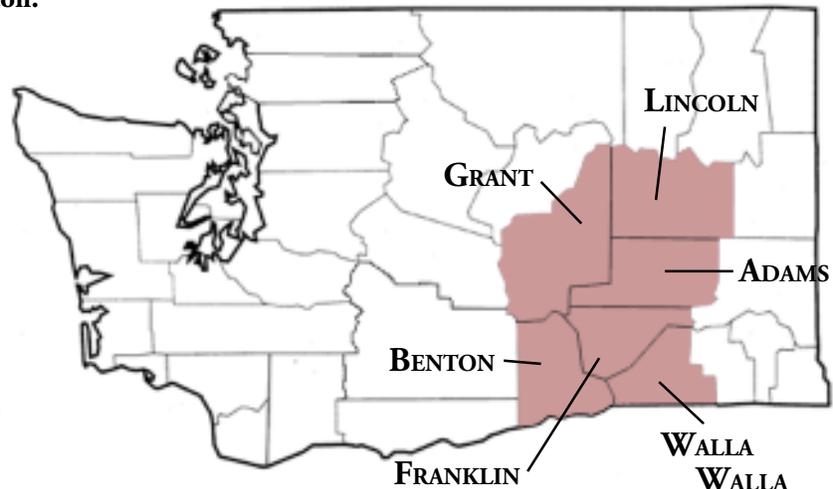
# Crop Profile for Sugar Beets in Washington

## Production Facts

- ❖ Washington ranked 25<sup>th</sup> in the nation for sugar beet production in 1997.
- ❖ 21,000 acres of sugar beets were grown in the Columbia Basin in 2000.
- ❖ The Washington State sugar beet crop has a farmgate value of \$22 million.
- ❖ Production costs average between \$750 to \$850 per acre.
- ❖ The price of sugar beets, based on average yield and average sugar content, is approximately \$31.75/ton. Sugar content averages about 17.5% and yields range from 30 to 40 tons/acre.
- ❖ Sugar beet processing provides seasonal employment for 300 to 400 people in Washington State during the processing year or campaign.
- ❖ Beet pulp, a by-product of the industry, is valued as a feed source by livestock operators.

## Production Region

Most Washington State sugar beet production takes place in the central Washington region known as the Columbia Basin. Counties producing sugar beets include Grant, Adams, Franklin, Lincoln, Walla Walla, and Benton.



## General Information

Information for this profile was gathered with cooperation from the Pacific Northwest Sugar Company LLC. The Washington sugar beet producers covered in this profile contract their crop to the PNW Sugar Company. Seventy-five hundred acres of the sugar beets produced in Benton County are grown under contract to Amalgamated Sugar; that acreage is covered in the Idaho sugar beet profile (<http://pestdata.ncsu.edu/cropprofiles/docs/IDSugarbeets.html>).

Sugar beets are grown in Washington as both a cash crop and a rotation crop. Growers are paid based on the amount of sugar extracted from the sugar beet. Sugar beet rotations might include field corn, potatoes, sweet corn, dry bulb onions, carrots, dry beans, alfalfa and wheat in different combinations. Rotations are devised by growers, field men and cooperative extension agents, and are carefully chosen based on pest management strategies, difficulties in seed bed preparation for subsequent crops (crop residue management), soil fertility issues (nitrogen levels), and economic returns.

An example of a rotation devised strictly for pest management



*Sugar beets are stored in large piles until they can be transported to processing plants.*



*Beet field (Seedex Blazer variety) about a week before lay-by.*

would be one Telone fumigation prior to planting potatoes, followed the next season by a sugar beet planting followed the next season by wheat. The cost of a Telone application would be offset for two years by controlling organisms that limit both the potato and sugar beet crops. Planting wheat would break disease cycles common to potatoes and sugar beets.

Growers try to avoid sugar beets within three years in the same fields to prevent pest build up.



*Digger loading trailer with sugar beets in the field.*

## Cultural Practices

Washington's Columbia Basin offers sandy loam soil, favorable weather, and a long growing season, providing ideal conditions for sugar beet production.

The current trend in field preparation is to shape the ground into steep rows in the fall that will be leveled off for planting in the

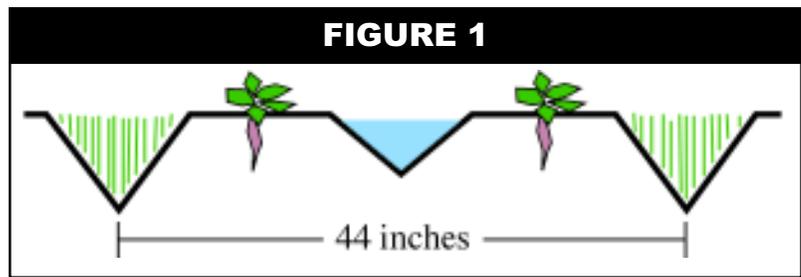
spring. This method helps reduce wind erosion and, because the row top holds winter moisture, results in more rapid seed germination when the fields are planted in the spring.

Sometimes fall cover crops are planted as part of a best management practice. The most common crop for this purpose is low-germination winter wheat. The wheat is sheared off when the rows are leveled in the spring, which leaves the cover crop in the furrows where it does not compete with the seed for moisture in the row tops.

During March and early April, the sugar beet crop is direct-seeded in 22-inch rows using 1.25 pounds of treated seed per acre. All sugar beet production is cultivated for weed control, soil tilth, and, where applicable, to remove winter cover crops. Post-plant and pre-(beet) emergence herbicides are traditionally applied to control early-germinating weeds. Low-rate sequential banded application of post-emergence herbicides is practiced for control of later weed flushes. Use of post-emergence low-rate herbicides is fast becoming a best management practice in the industry.

Nearly all beets in the Columbia Basin are planted to stand and require no hand thinning. Frequently hand hoeing may be required once, later in the year, to remove large weeds that escaped herbicide applications. Cost for hoeing crews can range up to \$100/acre.

Under the arid conditions of this region,



**Diagram of furrows, alternating deep and shallow, with water in every other furrow (the shallow one).**

irrigation is required to produce a sugar beet crop. Center-pivot irrigation is the predominant system, although some sugar beets are irrigated by wheel lines and furrows. Twenty-five to thirty inches of irrigation water are required to produce a sugar beet crop. When rill irrigated, the beets are watered on 44-inch rows (i.e., every other row) for fertilizer management purposes. Chemical applications that require water incorporation are therefore placed on the “water-furrow” side of the rows (see Figure 1).



**Above: Six-row beet defoliator in action. Rotating drums remove foliage and a scalper takes a thin slice from the top of each beet. This topping must occur within a day of digging, or beets will start to regrow, using up their stored sugar. Below: Topped beets in the field.**



Sugar beet harvest begins in late September and continues into November. Harvest begins by removing the beet tops (topping) and then digging the roots and loading them onto trucks to be hauled to the processing plant or stockpiled for processing later. Following harvest, the beet tops and small beets remaining in the field may be utilized as livestock forage. At present a small number of producers in Washington use a top saver to remove the tops and place them in a windrow for fall and winter livestock grazing. This operation slows harvesting and can result in up to three tons per acre loss in yield.



**Trailer loaded with sugar beets unloads its contents, which are conveyed to the top of a storage pile.**

The Southern Minnesota Sugar Cooperative maintains a web site with a description of how sugar is made from sugar beets (<http://www.sbreb.org/brochures/SugarCoop/index.htm>).

Integrated Pest Management (IPM) practices are key to sugar beet management. Weed, insect, and disease pests, in order of importance, are discussed in the following sections. Where several pesticides are registered for use against the same pest, the one selected is dependent upon other pests present and the activity range of the pesticide. This results in reduced pesticide usage. Industry leaders expect pest pressures to change in the coming years as this is only the third year of sugar beet production in the Columbia Basin after an absence of twenty years.

## Weeds

Weeds compete with sugar beets for nutrients as well as serving as hosts for insects, disease organisms and nematodes. The weed spectrum in sugar beet production is so varied that weed control programs must be tailored to fit the individual grower's needs. Major weeds found in the growing area include annual grasses, nightshade (*Solanum* spp.), pigweed (*Amaranthus* spp.), lambsquarters (*Chenopodium album*), Kochia (*Kochia scoparia*), Canada thistle (*Cirsium arvense*), lady's thumb or smartweed (*Polygonum* spp.), and Russian thistle (*Salsola kali*). Volunteer potatoes are also a prob-

lem in fields where sugar beets follow potatoes in rotation, particularly when winter temperatures are not severe enough to kill potatoes left in the field after harvest, as in recent years. Stinger is the only herbicide producers have found adequate for control of these difficult volunteers.

The first flush of weeds in the spring is often controlled with mechanical tillage before planting. Depending on the weed spectrum present, chemical control can include pre-plant or pre-emergence herbicide(s) and/or post-emergence herbicide(s). Almost all treatments are broadcast at micro rates in combination with a methylated seed oil at 20 ounces per acre. These micro rates allow the grower to observe weed flushes and time applications for maximum efficacy; if necessary, herbicides can be applied every seven to ten days or up to four times per season. These lower rates usually result in less phytotoxicity to the beets as well. Between the row, weed control is achieved through cultivation prior to the crop reaching full canopy cover. The combination of micro-rate herbicide application and between-row cultivation reduces grower costs and minimizes the quantity of herbicide used on the field. Most herbicide applications are post-emergence. All of the sugar beet acres are treated.

## Controls

### *Cultural*

Since fall cover crops are often planted in sugar beet fields to control erosion (see *Cultural Practices*, above), the fields are cultivated to remove the cover crops and to control weeds and aid soil tilth. Tillage during seedbed preparation controls many early-germinating weeds. Weeds are controlled between the rows by cultivation prior to the crop reaching full canopy cover. The last cultivation prior to canopy closure is called "lay-by." Occasional hand hoeing may be required to remove weeds that escape herbicide applications.

### *Chemical*

Pre-emergence herbicides have traditionally been applied to control early germinating weeds, but low-rate, sequential, banded application of

post-emergence herbicides is rapidly becoming the weed control norm. Producers rotate herbicide chemical families to reduce the development of herbicide resistance in weeds. As sugar beets are distantly related to the weed lambsquarter, any herbicide that efficiently controls lambsquarter causes damage in beets. For this reason, lambsquarter is an extremely difficult weed to control in sugar beet production.

As beets emerge rapidly, usually within 6 days following seeding, a grower's typical weed control program would include one Roundup application before seeding or one application within 4 days following seeding. The first tank mix spray would typically contain Betamix, crop oil, Upbeet and Assure II. The second spray would include Progress, crop oil, Upbeet and Assure II, followed by a cultivation and a Frontier application close to lay-by.

### **Timing of Application:** **Pre-(beet) Emergence Herbicides**

**Glyphosate (Roundup Ultra and Roundup Ultra RT)** is a broad-spectrum herbicide applied to about 20% of the acres at the broadcast rate of 12 to 16 fluid ounces per acre. Used to control ground cover vegetation, volunteer grain, and other weeds prior to beet emergence. Apply 3 to 4 days after planting, before sugar beets emerge, to control wheat cover crops.

**Cycloate (Ro-Neet 6E)** is a broad-spectrum herbicide applied to 15-20% of the acres at a rate of 3 to 4 lbs. ai/A or one-half to two-thirds gallon per acre. Ro-Neet is applied broadcast and incorporated immediately by mechanical tillage. It can also be applied at lay-by, when a full crop canopy has developed, at a rate of 0.5 gallons per acre through center pivots. Fall applications are not allowed by label in Washington State, which decreases the utility of this herbicide for spring applications where a cover crop is still growing in the furrows.

**Ethofumesate (Nortron SC)** is a broad-spectrum herbicide applied to 15-20% of the acres at a banded rate of 1 to 1.5 pints per acre. Application is made at planting by banding over the row followed by one-half inch of irrigation water to

incorporate. Banding at these lower rates reduces the potential residue carryover.

### **Timing of Application:** **Post-(beet) Emergence Herbicides**

**Desmedipham+phenmedipham+ethofumesate (Progress).** This broad-spectrum herbicide is replacing Betamix in many applications. The addition of ethofumesate to Betamix makes the latter a little more effective on some of the harder-to-kill weed species such as Kochia and nightshade. It seems to be a little more phytotoxic on the beets so straight Betamix is preferred if weed species permit. Applied to 90-100% of the acres at a rate of 5 to 10 fluid ounces per acre in a 7-inch band per treatment. 75 days PHI. 70% of the applications are micro rate, applied 4 to 5 times during the season. A tank mix of Progress, Upbeet and Stinger is providing excellent weed control.

**Desmedipham + phenmedipham (Betamix)** is a broad-spectrum herbicide that is usually applied in 2 to 3 sequential applications of 7 to 12 fluid ounces in a 7-inch band per treatment. 75 days PHI. Applied to 10-12% of the acres 1 to 3 times.

**Clopyralid (Stinger)** This broadleaf herbicide is applied to about 30% of the acres. Stinger is normally used in conjunction with Betamix or a tank mix of Betamix and Progress to enhance control of some harder-to-kill weed species such as Canada thistle, nightshade, cocklebur (*Xanthium strumarium*), smartweed, and others. It is applied at a rate of 1.33 to 2.67 fluid ounces per acre in a 7-inch band per treatment. 105 days PHI. Stinger is the only effective control for volunteer potatoes when sugar beets follow potatoes in the crop rotation. Multiple applications of up to 4 oz. each (not to exceed 0.66 pint/acre/year or 10.56 oz.) have controlled potatoes. This treatment is phytotoxic to sugar beets, resulting in injuries resembling those from 2,4-D. However, the beets recover and will produce a good crop.

**Triflurosulfuron-methyl (Upbeet)** is a broad-leaf herbicide applied to about 50% of the acres. Upbeet is used to improve control of weeds missed by Betamix. The main target weed is Kochia. It is usually applied with Betamix in two sequential

band applications at rates of 0.17 to 0.33 fluid ounces per acre in a 7-inch band.

**Sethoxydim (Poast)** This grass herbicide is applied to about 20% of the acres at a rate of 5.33 to 13.33 fluid ounces per acre in a 7-inch band. This is not a micro-rate application. Grasses, wild oats, and volunteer grain are the main target weeds. 60 day PHI.

**Clethodim (Prism)** is a grass herbicide applied to about 5% of the acres at the rate of 4.33 to 5.67 fluid ounces per acre in a 7-inch band. Wild oats (*Avena fatua*) and volunteer grains are the main target weeds. 100 days PHI.

**Quizalofop-P-ethyl (Assure II)** is a grass herbicide applied to 15-20% of the acres at the rate of 2 to 3.33 fluid ounces per acre in a 7-inch band. This is not a micro rate application. Grasses, wild oats, and volunteer grains are the main target. 45 days PHI.

### **Timing of Application: Lay-by**

**Trifluralin (Treflan EC)** is broadcast applied and lightly incorporated on 10-15% of the acres for lay-by weed control of broadleaf and grass weeds. Used at the broadcast rate of 1.0 to 1.5 pints per acre.

**EPTC (Eptam 7 E)** is applied to 15-20% of the acres at the broadcast rate of 2.25 to 3.5 pints per acre. Usually used post-thinning as a lay-by treatment to control annual grasses and nightshade.

**Dimethenamid (Frontier 6.0)** is a non-selective herbicide used under a section 18 amendment (00-WA-28) in 2000, which allowed application only by ground or chemigation in sugar beets. Application should be made post emergence at lay-by. Herbigation using 1.5 pints per acre was used to treat 20% of the sugar beet acreage.

## **Insects**

Sugar beet growers monitor insects throughout the growing season and apply insecticides only as economic threshold levels (when known) are reached. The usage numbers reported below are for the current crop situation; changes occur from

year to year. Treatment for one pest may provide control of another; for example, an application for root maggot may also control aphids, cutworms, armyworms, wireworms, webworms, white grubs, and/or crown borer. Where several insecticides are registered for use against the same pest, the one selected is dependent upon other pests present, the activity range of the insecticide, and economics.

---

## **SUGAR BEET ROOT MAGGOT**

*Tetanops myopaeformis*

---

This is the most serious insect pest throughout the growing area of Idaho and Oregon. Although not a problem in Washington at this time, Washington producers sanitize equipment coming into the area to prevent root maggots from invading Columbia Basin farms. If not controlled, root maggot causes very serious economic loss each year. The insect larvae overwinter in the soil and emerge as adult flies when the soil warms in the spring. The adults disperse to sugar beet fields where eggs are laid around newly emerging beet plants. The eggs hatch and resulting larvae feed on the young beets' tap roots, damaging the root and often killing the plant, thus reducing plant population and yield potential. Even by following the best practices available to control this pest, its seriousness is such that without pesticide control when needed, sugar production in this region would conservatively be cut in half.

## **Controls**

### **Integrated Pest Management (IPM)**

Sticky stakes are placed in sugar beet fields to trap and monitor the emerging adult flies. Insecticide treatments are normally made after fly populations have reached the economic threshold level of fifty flies caught in a twenty-four-hour period. However, fly populations have been known to build so rapidly that waiting until the economic threshold is reached to apply insecticides has resulted in crop losses. Therefore, upon early detection, treatment may be indicated. Occasion-

ally, on a localized basis, storms or disruptive weather patterns can kill enough flies or stretch out the emergence period such that insecticide treatment can be delayed or eliminated entirely. As with herbicides, insecticides for root maggot control are applied in a band over the row resulting in treatment of only one third of the total field area.

### **Chemical**

**Terbufos (Counter CR)** is applied once per year using either the modified in-furrow method at planting or when flies reach the economic threshold level. Either method utilizes 4.5 to 9 pounds per acre; more for severe infestation. Terbufos controls sugar beet root maggot, white grubs, and crown borers, and is a critical use to the industry.

**Terbufos (Counter 15G)** is applied as modified in-furrow treatment at planting or, when flies reach the economic threshold level, in a 5 to 7-inch band lightly incorporated into the row. Application rates vary from 6 to 12 pounds per acre; more for severe infestation. Terbufos controls sugar beet root maggot, white grubs, and crown borers, and is a critical use to the industry. (Figure 1 illustrates furrows.)

**Aldicarb (Temik 15G)** is applied by soil injection at planting or at first cultivation at the rate of 8 to 13 pounds per acre (1.2 to 2 pounds active ingredients). 90-day PHI. Also controls leafminers.

**Phorate (Thimet 20G)** is applied post-emergence, over the row, when flies reach the economic threshold level, then lightly incorporated. Rate is 5 to 7.5 pounds per acre. 30-day PHI. There are phytotoxicity issues if this material comes in close proximity (one-quarter inch) with the beet seed.

**Chlorpyrifos (Lorsban 4E)** is applied, after flies reach the economic threshold level, in a 5 to 7-inch band over the row followed by light incorporation. Application rate is 1.33 to 2 pints per acre. 30-day PHI. There are phytotoxicity issues if this material comes in close proximity (one-quarter inch) with the beet seed.

---

## **ARMYWORMS**

Various, including  
Western Yellowstriped Armyworm,  
*Spodoptera praefica*, and  
Beet Armyworm, *Spodoptera exigua*

---

Armyworms are often a major problem in sugar beet. They overwinter as adults. At the first hatch, larvae do not attract much attention, as they feed on a variety of crops and weeds. A second major hatch occurs in late August and early September and must be monitored to determine if major infestations will occur. If left unchecked, armyworms can completely defoliate beet fields. About 40% of the sugar beet acreage is treated annually.

### **Controls**

#### **Integrated Pest Management (IPM)**

IPM practices are employed by monitoring insect populations (early or late hatch) and treating only when populations justify treatment relative to harvest time.

### **Chemical**

**Chlorpyrifos (Lorsban 4E)** is applied at a rate of 1 to 2 pints per acre to the foliage when insects reach economic threshold levels. 30-day PHI. First infestation sprays also control aphids.

**Methomyl (Lannate LV)** is applied at a rate of 0.75 to 3 pints per acre to the foliage when insects reach economic threshold levels. 7-day PHI. First infestation sprays also control aphids.

**Carbaryl (Sevin XLR)** is applied at a rate of 1 to 1.5 quarts per acre to foliage when insects reach damaging levels. Application can be repeated up to four times if necessary. 28-day PHI. First infestation sprays also control aphids.

---

## LEAFHOPPERS

Beet Leafhopper, *Circulifer tenellus*

---

Sugar beet leafhoppers do very little direct damage to the crop but are a serious pest because they vector the curly top virus. Leafhoppers overwinter as adults. The curly top virus survives the winter in the bodies of leafhoppers and then becomes the source of infection the following year. Leafhoppers are the only source of curly top virus transmission as they feed on crop and weed hosts. Three generations of leafhoppers occur each year making chemical control difficult. Therefore, curly top resistant varieties have been developed, and these cultivars are planted throughout the growing area eliminating the need for chemical control. Insecticides used for controlling other insects frequently control leafhoppers.

### Controls

#### ***Integrated Pest Management (IPM)***

The Pacific Northwest Sugar Co., a growers organization, maintains control on sugar beet varieties allowed under contract. The Seed Committee of this organization screens varieties and only allows those with curly top resistance to be planted.

---

## APHIDS

Various, including  
Black Bean Aphid, *Aphis fabae*

---

Aphids are important economic pests of sugar beet because they transmit viruses causing beet yellows, beet western yellows, and beet mosaic. The most serious aphid on beets is the Black Bean Aphid. These aphids overwinter as eggs on winter host plants. The eggs hatch in the spring, producing stem mothers, which later give birth to female aphids, the first summer generation. These first-generation aphids fly to summer host plants

and crops on which numerous generations of wingless female aphids are produced throughout the summer. As aphid populations increase, the predator population also increases. Application of non-systemic insecticides may be hazardous to predator insects. However, when systemic insecticides are used, predator insects are not killed and aphids and other sucking insects are controlled.

This aphid tends to colonize in spots in the fields and is not a serious problem every year. During years with high populations, substantial yield losses can be incurred if the insect is not controlled. At this time, it has not been a problem in Washington.

---

## CUTWORMS

Varigated Cutworm, *Peridroma saucia*  
Redbacked Cutworm, *Euxoa spp.*

---

Cutworm infestations are very spotty, usually occurring near field borders or circle corners. Cutworms are general feeders with a wide host range and many species are known to damage sugar beets. The most severe damage occurs in the spring by first-generation cutworms, which cut young plants at or just below the soil surface. Since many cutworm species are attracted to small grains and alfalfa, damage to beets is more severe when they are planted following these crops. Cutworms, depending upon species, overwinter in different stages: egg, larva, pupa. Larvae feed underground and move along the drill rows feeding on the young plants in much the same manner as wireworm. About 10% of the sugar beet acreage is treated each year with an insecticide.

### Controls

#### ***Integrated Pest Management (IPM)***

IPM practices are employed by monitoring populations and treating when the first damage is seen. As this pest is a voracious feeder, damage will be widespread if growers wait to treat.

### **Chemical**

**Chlorpyrifos (Lorsban 4E)** is applied as a spot treatment when insects appear. The rate is 0.5 to 2 pints per acre. 30-day PHI.

**Methomyl (Lannate LV)** is applied at a rate of 1.5 pints per acre in areas where insects appear. 7-day PHI.

**Carbaryl (Sevin XLR Plus)** is applied at a rate of 1.5 quarts per acre. Agricultural consultants report that control is frequently less than desired with carbaryl.

---

### **LOOPERS**

Alfalfa Looper, *Autographa californica*

---

Loopers are the larvae of nocturnal moths. These chewing larvae devour leaves and stems and spin silken threads which create webbing. As with armyworms, the later generations are the most damaging. Although not as damaging as armyworms, loopers can still create some economic losses if left uncontrolled. In most cases, since both loopers and armyworms are moth larvae, they may be controlled with the same treatments. Looper damage is minor in Washington. About 1% of the acreage or 200 acres is treated annually.

### **Controls**

#### ***Integrated Pest Management (IPM)***

Integrated with insecticide treatments by population monitoring.

### **Chemical**

**Chlorpyrifos (Lorsban 4E)** is applied as a spot treatment when insects appear. The rate is 0.5 to 2 pints per acre. 30-day PHI.

**Methomyl (Lannate LV)** is applied at a rate of 1.5 pints per acre in areas where insects appear. 7-day PHI.

---

### **LEAFMINERS**

Various, including  
*Pegomya betae* and *Psilopa levostoma*

---

Leafminers lay eggs on the undersides of the leaves of small beets. After hatching, the larvae enter the leaf and mine out its inner portion, rendering it useless for photosynthesis, and necessitating a systemic insecticide for control. Normal insect life cycles, which allow the beets to outgrow the insect damage, result from temperatures of 80 to 85°F. Temperatures are reduced in fields under circle irrigation however, allowing leafminers to remain in fields for an extended period of time, as much as 4 to 6 weeks longer. This pest has seldom constituted a problem in Washington due to weather conditions that keep insect lifecycles short. However, it has the potential to become an economically important pest in years with cooler temperatures.

### **Controls**

#### ***Integrated Pest Management (IPM)***

IPM is utilized by only treating when sugar beet leaves show more than 50% infestation.

### **Chemical**

**Chlorpyrifos (Lorsban 4E)** is applied as a spot treatment when insects appear. The rate is 0.5 to 2 pints per acre. 30-day PHI.

**Diazinon (Diazinon AG 500)** is applied at a rate of 0.75 to 1 pint per acre by spraying on foliage when insect populations reach economic threshold levels. 14-day PHI.

Leafminers are also controlled by at-plant applications of **Aldicarb (Temik 15G)** **Phorate (Thimet 15G)** or **Phorate (Thimet 20 G, Phorate 20G)** applied for control of other insects such as sugar beet root maggot.

---

## MITES

*Tetranychus* spp.

---

Mites overwinter as adults in protected places and under plant debris. In the spring, they migrate to the undersides of leaves and lay eggs. Both the young nymphs and adults feed on leaves. Numerous generations are produced each year. Crop damage occurs in heavy infestation as plant leaves turn yellow and die.

The two-spotted and red spider mites are sporadic problems in some locations when hot, dry, dusty conditions occur, particularly near field borders under rill irrigation. Sprinklers eliminate dust and thereby reduce mite problems.

It has been reported that mites may prefer other hosts to sugar beets. Also, mites have numerous natural enemies including predatory mites that may keep populations in check. Chemicals applied to control other insect pests may also kill mite predators however.

### Controls

#### ***Integrated Pest Management (IPM)***

IPM is utilized by monitoring populations of both mites and predators and only treating if predator control is inadequate.

#### ***Chemical***

**Naled (Dibrom 8)** is applied at a rate of 1 pint per acre by ground or air. 2-day PHI.

**Chlorpyrifos (Lorsban 4E)** is applied at a rate of two-thirds to one pint per acre by spraying on foliage when insects are present. 30-day PHI.

**Oxydemeton-Methyl (Metasystox R)** is applied at a rate of 1.5 to 3 pints per acre by spraying on foliage. 30-day PHI. Can be applied by chemigation if regulations are followed.

**Phorate (Thimet 15G)** is applied at a rate of 6 ounces per 1,000 feet row (8.9 pounds per acre). Post-emergence applications can be made by applying to foliage when plants are dry. 30-day PHI.

**Phorate (Thimet 20G, Phorate 20G)** is applied at a rate of 4.5 ounces per 1,000 feet of row (6.7 pounds per acre). Post-emergence applications can be made by applying to foliage when plants are dry. 30-day PHI.

**Malathion (Malathion 8EC)** is applied at a rate of 1 to 1.25 pints per acre by spraying on foliage. 3-day PHI. Growers report this is a weak control for mites.

---

## WEBWORMS

Various, including  
Beet Webworm, *Loxostege sticticalis*

---

Webworm larvae consume leaves rapidly; they can defoliate a beet field in a very short time. In heavy infestations, crop yields may be reduced. Weed control is extremely important since webworms prefer weedy fields; they deposit their eggs on such weeds as lambsquarters and Russian thistle.

Webworms overwinter either as pupae or larvae in silk-lined tubes in the soil. The adult moths emerge and lay eggs on the underside of beet leaves. Two to three generations are produced each year. Heavy infestations are usually localized. With the development of new insecticides, webworms are no longer a major threat, although they are still potentially destructive. Numerous predators and parasites have also been reported preying upon webworms. Webworms are seldom a problem in Washington.

### Controls

#### ***Integrated Pest Management (IPM)***

IPM is followed by monitoring populations and treating only as needed to prevent losses.

#### ***Chemical***

**Chlorpyrifos (Lorsban 4E)** is applied to foliage at the rate of 1 to 2 pints per acre when insects appear in damaging numbers. 30-day PHI.

**Carbaryl (Sevin XLR)** is applied to foliage at a rate of 1 to 1.5 quarts per acre when insects are present. 28-day PHI.

**Endosulfan (Thiodan 3EC)** is applied to foliage at a rate of 1 to 1.3 quarts per acre when insect damage is noticed. 30-day PHI.

---

## WIREWORMS

Various, including *Limonius* spp.

---

Wireworms have become a greater problem in recent years since the loss of chlorinated hydrocarbon insecticides. These pests live deep within the soil, making them very difficult to eradicate. Sugar beets in a crop rotation following potatoes, alfalfa, field corn, sweet corn, or crops with residue are more likely to be infected with wireworms, particularly if the field was not fumigated prior to sugar beet planting. Sugar beet fields adjacent to CRP or desert habitat have a higher risk for wireworm invasion. Wireworms, the larvae of click beetles, live in the soil for several years and feed on germinating seeds, seedlings, and developing roots. They also tunnel through larger roots. Damage to the beet crop is usually more severe during cool, moist spring weather.

## Controls

### ***Integrated Pest Management (IPM)***

IPM practices are employed by only treating fields that have been identified as having sufficient wireworm populations to cause crop loss. This level is identified when four to six-leaf seedlings are seen dying in the field.

### ***Chemical***

**Terbufos (Counter 15G)** is applied at a rate of 4 to 8 ounces per 1,000 feet row (6 to 12 pounds per acre). Application is made by using the modified in-furrow method at planting time. This is the primary control method in Washington and is a critical use to the industry.

**Terbufos (Counter CR)** is applied at a rate of 3 to 6 ounces per 1,000 feet row (4.5 pounds per acre). Application is made by using the modified in-furrow method at planting time.

**Fonofos (Dyfonate II 15G)** is applied at a rate of 27 pounds per acre. Application is made by broadcasting on soil before planting and incorporating with tillage equipment.

**Diazinon (Diazinon 50W)** is applied at a rate of 6 to 8 pounds per acre. Application is made by broadcasting with immediate incorporation just before planting.

**Diazinon (Diazinon AG500)** is applied at rate of 3 to 4 quarts per acre. Application is made by broadcasting on soil just before planting and incorporating immediately 4 to 6 inches deep. 14-day PHI.

---

## GRASSHOPPERS

Various, including

Migratory Grasshopper, *Melanoplus sanguinipes*, and Red-Legged Grasshopper, *M. femurrubrum*

---

Grasshoppers can be a problem in some areas, especially in fields adjoining desert, rangeland, or CRP. Eggs are deposited in the fall and overwinter in these sites. Hatching occurs during May and June, and nymphs begin feeding on weeds and other vegetation. As these areas dry up, grasshoppers move into beet fields and begin feeding on the beets. In years when things dry up early in the season, grasshoppers are more likely to be an economic problem.

## Controls

### ***Integrated Pest Management (IPM)***

Chemicals are only applied when a significant number of grasshoppers move off the range and into the beets. Often only a side or part of the field containing the advancing grasshopper front is sprayed.

### **Chemical**

**Diazinon (Diazinon 50W)** is applied at a rate of 1 pound per acre. Application is made to foliage when insects are present. 14-day PHI.

**Diazinon (Diazinon AG500)** is applied at a rate of 1 pint per acre. Application is made to foliage when insects occur. 14-day PHI.

**Chlorpyrifos (Lorsban 4E)** is applied at a rate of 0.5 to 1 pint per acre. Higher rates are used for adult hoppers. Application is made by spraying on foliage when insects are present. 30-day PHI.

**Malathion (Malathion 8EC)** is applied at a rate of 1.25 pints per acre. Application is made by applying to foliage when insects are present. 3 day PHI.

---

### **FLEA BEETLES**

Various, including  
Potato flea beetle, *Epitrix cucumeris*

---

Flea beetles overwinter as adults or larvae under crop residues and in other protected places. They emerge early in the spring and feed on a wide variety of crop and weed hosts. One or two generations occur per year. They feed on germinating seeds, small seedlings, and small leaves early in the spring. The flea beetle is sometimes a pest of newly emerging beets in the early stages of growth.

### **Controls**

#### **Integrated Pest Management (IPM)**

IPM is employed in the control of this pest by field survey and treatment is indicated only when each beet leaf has a serrated edge indicating flea beetle feeding activity.

### **Chemical**

**Chlorpyrifos (Lorsban 4E)** is applied at a rate of 1.3 to 2 pints per acre by spraying on foliage when insects are present. 30-day PHI. Growers indicate this ingredient provides quick control of this pest.

**Methomyl (Lannate SP)** is applied at a rate of 0.25 to 1 pound per acre by spraying on foliage when insects are present. 7-day PHI.

**Carbaryl (Sevin XLR)** is applied at a rate of 1 to 1.5 quarts per acre by spraying on foliage when insects occur. 28-day PHI.

---

### **GARDEN SYMPHYLAN** *Scutigerella immaculata*

---

Symphylans spend their entire life in the soil where they can be found in all stages at any time of the year. They are most damaging when feeding on germinating seed. Feeding may occur throughout the growing season on both the taproot and feeder roots. Plant stands and yields can be greatly reduced in areas with a high symphylan population. Infestations are highly variable, spotty and unpredictable. Soil fumigation, the best control method, is usually cost prohibitive for sugar beet production.

### **Controls**

#### **Chemical**

**Fonofos (Dyfonate 4EC)** is applied at a rate of 2 quarts per acre. Application is made prior to planting by broadcasting on soil and mechanically incorporated. The industry has identified this as a critical use.

---

### **LYGUS BUGS** *Lygus* spp.

---

Lygus overwinter in crop residue and protected areas. They emerge as temperatures warm in the spring. Plant injury occurs as they puncture leaf surfaces with their beaks and suck the plant juice from new succulent leaves. Injured plants wilt more easily than healthy plants. Occasionally, lygus kill heart leaves and damage crown regions,

so that multiple crowns are produced. Adults can readily move in and out of beet fields, and their movement often coincides with the cutting of hay. Annually, 3,000 acres require treatment.

## Controls

### *Integrated Pest Management (IPM)*

IPM is utilized by only treating when monitored populations reach economic threshold levels. The destruction of all overwintering sites along banks, ditches, fence rows, roadsides and crop residues will reduce lygus bug populations.

### *Chemical*

Producers report that they have best control when using **Dibrom** or **Lorsban**.

---

## WHITE GRUBS

---

White grubs, like wireworms, are widely distributed and live in the soil for several years. They have a wide host range and are among the most destructive of the soil insects. Adult beetles prefer pasture or grassland for egg deposition. The insect overwinters as eggs and emerges as larvae or grubs in the spring. They chew off small roots and eat into larger roots. Taproots may be severed, causing plants to wilt and eventually to die.

## Controls

### *Integrated Pest Management (IPM)*

IPM is utilized by only treating monitored populations. Plowing grasslands in the fall helps to destroy grubs. White grubs have many natural enemies including birds, skunks and other insect parasites and predators. When planting sugar beets following pasture or grassland, consultants recommend chemical treatment.

### *Chemical*

**Terbufos (Counter 15G)** is applied 0.6 to 1.2 oz. ai/1000 feet row in a 5 to 7-inch band over

the row and lightly incorporated, or applied in furrow 2 to 3 inches behind seed drop zone after some soil has covered the seed.

**Terbufos (Counter CR)** is applied 0.6 to 1.2 oz ai/1000 feet row in a 5 to 7-inch band over the row and lightly incorporated, or applied in furrow 2 to 3 inches behind seed drop zone after some soil has covered the seed.

**Chlorpyrifos (Lorsban)** is sprinkler applied at 1 qt./A, twice during the growing season.

---

## CROWN BORER

*Hulstia undulatel*

---

The crown borer is considered a minor pest of sugar beets and when it attacks beet crowns it generally causes minor injury. Crown borers overwinter as pupae in the soil. Adult moths emerge in the spring and lay eggs around the beet crowns or on the leaves and petioles. Two generations are produced per year. The most severe damage occurs about thinning time, when first-generation larvae cut off leaves and kill young plants. At this time it is too late to replant a field that has been decimated by this pest. Surviving plants have superficial feeding scars around the crown.

## Controls

### *Integrated Pest Management (IPM)*

IPM is utilized by only treating when monitored populations reach economic threshold levels. Crown borers have one natural insect parasite, the calcid fly. It is an effective parasite at low borer population levels but not effective in controlling high population levels.

### *Chemical*

Growers report **Counter**, applied at-plant for sugar beet root maggot, or **Lorsban** applied post-emergence for borer, works well on this pest.

## Diseases

---

### RHIZOCTONIA ROOT AND CROWN ROT

*Rhizoctonia solani*

---

Rhizoctonia root and crown rot, caused by the soil fungus *Rhizoctonia solani*, is one of the major causes of loss in sugar beets. The fungus overwinters in soil as bulbils, or thickened hyphae, in plant debris. During spring and summer, the fungus resumes growth through the soil and infects beets through leaf petioles, crowns, or roots. Any damage to the beet epidermis, such as caused by nematode feeding, will allow easy entry of this pathogen. Certain cultural practices can also enhance disease incidence. High-speed cultivation pushes soil into the crowns, creating a damp warm pocket that encourages disease occurrence. Pitting equipment, which scoops “pockets” out of the water rows in order to decrease water flow on sloped fields, can aid disease progression by providing small water pockets in the field. Close rotations, that is rotating sugar beets back into ground previously cropped to sugar beets, can build up inoculum levels and may result in up to 25% yield loss in extreme conditions.

### Controls

#### *Cultural*

No fungicides are registered for Rhizoctonia root rot control. The disease is managed through a strict program of long rotations with non-host crops, critical irrigation management, and cultural practices that reduce soil compaction and improve soil tilth and drainage. These modified cultural measures are the only means available to all producers at this time for reducing the likelihood of serious loss.

Cultural practices used for Rhizoctonia Root and Crown Rot control are:

- Maintain a minimum three-year rotation with non-host crops.
- Practice good weed control throughout the rotation.
- Avoid practices that push soil into the plant crowns.
- Eliminate high-speed cultivation.
- Avoid operating pitting equipment too rapidly.
- Avoid crop injury.
- Eliminate soil compaction.
- Maintain optimum soil moisture for sugar beet growth.
- Avoid over irrigation.
- Improve plant density.
- Eliminate sugar beet cyst nematode when present.

Resistant varieties are not yet used extensively because the resistance is only partially effective and the varieties are weak in several other important agronomic characteristics such as yield, sugar content, purity, and curly top virus resistance.

Registration of an effective fungicide to control Rhizoctonia root rot is a critical need of the sugar beet industry.

---

### POWDERY MILDEW

*Erysiphe polygoni*

---

Powdery mildew is a selective host plant disease that infects only *Beta* spp. Microscopic spores are carried to the beet plant by air currents. The spores on the beet leaf multiply and, under ideal conditions, a powdery film or mold can be visible in four to five days following infection.

Inoculum from over-wintered beets, primarily contaminated tops that were not disced under, is probably the major source for infection. Fungal growth is enhanced by favorable light, temperature, and relative humidity.

## Controls

### *Integrated Pest Management (IPM)*

Partially resistant varieties are used and fields are monitored so that treatments are used when economic threshold levels appear imminent. Sulfur formulations (dusts, wettable powders, or flowables) effectively control the disease. The timing of the first application is critical. Sulfur should be applied at the first sign of the pathogen, when it is first observed as an occasional small weft of mycelium on older leaves. If the occurrence of the disease can be predicted in a given area, a lay-by application two or three weeks before the first sign of the pathogen can be prophylactic. Repeat applications are necessary at three to six-week intervals if the disease reappears. Mite control may be enhanced should the life cycles overlap.

### *Chemical*

**Sulphur (liquid formulations, various trade names)** is applied as an overhead spray (chemigation) to fields under circle irrigation at a rate of 3 to 6 pounds per acre. Applications are repeated at two to four-week intervals if needed.

**Sulphur (Sulphur Dust)** is applied by aircraft as an overhead dust treatment to fields under rill irrigation at a rate of 30 to 40 pounds per acre.

---

## BEET CURLY TOP VIRUS

---

Curly top is a viral disease transmitted and spread by the sugar beet leafhopper. Curly top resistant varieties, used throughout the growing area, virtually eliminate the need for chemical control. For a discussion of chemical control, see the *Insect* section.

---

## SEEDLING DISEASES

---

Sugar beets are susceptible to numerous seedling diseases. Most of the seedling pathogens are soilborne. These diseases are expressed as seed decay, preemergence damping-off, postemergence

damping-off, and infection of the roots or hypocotyl of emerged plants. The severity of the diseases are influenced by the susceptibility of the host; the inoculum potential of the pathogen; environmental factors, including temperature, moisture and soil characteristics; and the effectiveness of control measures.

Losses from seedling diseases are primarily caused by the fungi, *Pythium ultimum*, *Phoma betae* and *Rhizoctonia solani*. The average seeding rate is 1.25 pounds per acre, and all seed planted in the area is treated with a combination of **Thiram 50W** at 8 ounces per 100 pounds of seed plus **Apron FL** at 1.5 fl. oz. per 100 pounds of seed. All seed is treated by the seed companies outside the region then sold within the region for planting.

---

## RHIZOMANIA

---

While IPM practices have kept this disease from occurring thus far in Washington State, Rhizomania is considered the most serious disease of sugar beets worldwide. It is caused by beet necrotic yellow vein virus (BNYVV) and is vectored by the primitive soil fungus, *Polymyxa betae*. Both the primary pathogen and the vector are obligate parasites. The fungus spreads by movement of windblown particles of infested soil and by movement of contaminated farm equipment. The only chemical registered for control is the fumigant 1, 3-dichloropropene (Telone II), but it is not used commercially because it is cost prohibitive and adequate disease management is achieved at present using stringent sanitation practices.

## Controls

### *Cultural*

Growers have placed a heavy emphasis on prevention, primarily by keeping inoculum out of the area. The disease is currently managed through strict sanitation (steam cleaning) of farm equipment particularly equipment brought in from areas with known infestations.

---

**APHANOMYCES**  
*Aphanomyces cochlioides*

---

Aphanomyces root rot is frequently present in fields with sugar beets in close rotation. A minimum of 3 to 4 years between sugar beet crops is required to keep from building up heavy infestations. This disease comprises two phases, an acute seedling blight and a chronic root rot which occurs from late June to the end of the growing season. This disease organism will also build up in the soil over a course of years under long rotations of host crops (e.g. sugar beets, alfalfa, peas).

### Controls

#### ***Integrated Pest Management (IPM)***

- Rotate with crops resistant to *Aphanomyces*, such as wheat or corn.
- Control weed hosts especially lambsquarters and pigweed.
- Improve soil aeration by rotating with wheat crops.
- Be aware that excessive irrigation and cold spring temperatures enhance *Aphanomyces* development, whereas warm weather and aeration help beets overcome disease pressure.

---

**CERCOSPORA LEAF SPOT**  
*Cercospora beticola*

---

Cercospora leaf spot, a foliar disease caused by a fungus, has thus far been of minor importance in this region but is expected to become a major pest depending upon climatic conditions. Hot humid conditions are ideal for this fungus. Spores travel by air. Once the disease has infected the beet plant it causes necrotic spots on the leaves. While fungicides can prevent further leaf infections and spread of necrotic spots, the affected leaves will not produce as much photosynthate and thus sugar content will drop in the resulting crop.

This 2% yield loss will translate into a three to five ton/acre decrease in sugar production. In a few isolated locations where the disease has caused loss, growers follow an integrated pest management program to control this disease.

### Controls

#### ***Integrated Pest Management (IPM)***

Growers use the following IPM program when the disease has caused losses:

- Maintaining a minimum three-year crop rotation.
- Planting more than 100 yards from fields infected the previous year. This may mean not being able to plant sugar beets in a contiguous field as frequently contiguous fields are less than 100 yards apart.
- Reducing inoculum by fall plowing in order to bury infected plant material before planting winter cover crops.
- Applying protective fungicides only when disease is increasing and an average 0.5% (12 spots/leaf) of the leaf surface is infected.

During 2000, three hundred acres are treated once each year with either **Super Tin 80WP** (150 acres) at 5.0 ounces per acre or **Dithane M-45** (150 acres) at 2.0 pounds per acre. Growers rotate these two fungicides in order to avoid resistance build up. An effective fungicide treatment is essential for keeping the necrotic spots from enlarging and for preventing further infection and thus yield loss.

---

**BACTERIAL VASCULAR NECROSIS  
AND ROT (ERWINIA ROOT ROT)**  
*Erwinia carotovora* subsp. *betavascularum*

---

This is the only important bacterial pathogen of sugar beets. Losses are infrequent and sporadic, and the disease is controlled solely through use of IPM practices. *Erwinia* can be present in areas where excess water and warm temperatures are present. Water accumulates in the hole in the beet crown. As this water warms, ideal conditions are established for bacterial activity. Black streaks

may be found on petioles and crowns may be blackened or frothy. Vascular bundles are brown and adjacent tissue turns pink when cut or exposed to air. Rot may become extensive as either a soft or dry rot.

## Controls

### *Integrated Pest Management (IPM)*

The following IPM practices are utilized by growers to control this bacterial pathogen:

- Avoiding excessive irrigation.
- Avoiding close rotations of sugar beets.
- Avoiding plant injury.
- Avoiding excessive nitrogen applications.

---

## NEMATODES

Root-Knot Nematode, *Meloidogyne* spp.  
Stubby-Root Nematode, *Trichodorus* spp.

---

At least twenty-nine species of nematodes within sixteen genera are parasitic on sugar beets. The sugar beet cyst nematode, *Heterodera schachtii*, is the most damaging, but it is not present in the Columbia Basin. Yield losses in the Columbia Basin come from root-knot and stubby-root nematodes. Nematodes feed on plant roots, causing “hairy” roots and sprangling, and can predispose to



*"Sprangled" roots such as these can be caused by the stubby-root nematode.*

diseases such as *Rhizoctonia* root rot. Many weeds, particularly lambsquarter and red root pigweed, are hosts for nematodes. Root-knot nematodes may affect sugar beets when planted in rotations following mint or alfalfa. The stubby-root nematode is found more frequently in the lighter soils of the Columbia Basin, when present, beets with sprangled roots result.

## Controls

### *Integrated Pest Management (IPM)*

Crop rotation is practiced. Nematode populations may decrease as much as 20% for each year wheat is grown in continuous plantings. Populations levels can quickly rebound however once a susceptible crop is planted, particularly if weedy hosts have been present in non-host crop plantings.

No economic thresholds have been established for nematodes. If soil sampling reveals their presence, growers will most often apply Temik for control.

### *Chemical*

**Aldicarb (Temik 15G)** is applied at a rate of 27 to 33 pounds per acre total. Treatment is usually made in split applications of 14 to 20 pounds in a band pre-plant and incorporated into the soil followed by a second application applied by side-dressing into the soil on the water furrow side of the row preceding irrigation. The total of the two applications is not to exceed 33 pounds per acre. This is the preferred method of chemical control since the cost of Telone II is prohibitive for sugar beet production although it is not as effective as Telone. Many insects are controlled with this treatment however.

**1,3-Dichloropropene (Telone II)** is applied at a rate of 18 to 20 gallons per acre. Fall applications are made by either plowing down or injecting the material to a depth of 8 inches and sealing the soil immediately. This will control 90% of the pest population.

## Acknowledgements

The format of the *Crop Profile for Sugar Beet in Idaho* was used as a text and guide. The authors express their gratitude to each contributor acknowledged in the Idaho profile.

---

## Contacts

### *Author and Agronomist*

Elvin L. Kulp, Area Agent, Agronomy  
WSU Cooperative Extension  
Courthouse, P.O. Box 37  
Ephrata, WA 98823  
(509) 754-2011 - Phone  
(509) 754-0163 - Fax  
[elkulp@wsu.edu](mailto:elkulp@wsu.edu)

### *Co-Author*

Catherine H. Daniels, Pesticide Coordinator  
Washington State University  
2710 University Drive  
Richland, WA 99352  
(509) 372-7495 - Phone  
(509) 372-7491 - Fax  
[cdaniels@tricity.wsu.edu](mailto:cdaniels@tricity.wsu.edu)

### *Industry Contacts and Co-Authors*

Don Bowers  
Agricultural Manager  
Pacific Northwest Sugar Company L.L.C.  
13583 Wheeler Rd NE, P.O. Box 1939  
Moses Lake, WA 98837  
(509) 764-2000, ext 277 - Phone  
(509) 765-3925 - Fax  
(509) 750-7204 - Cell

Jay and Eric Bair  
Bair Farms  
5558 Rd E NW  
Ephrata, WA 98823  
(509) 787-3168 - Phone  
(509) 750-8980 - Jay Cell  
(509) 760-8980 - Eric Cell

---

## References

Washington Agricultural Statistics, 1997-1998. Washington Agricultural Statistics Service, Washington State Department of Agriculture, Olympia, WA

Compendium of Beet Diseases and Insects. 1986. Whitney, E.D. and Duffus, J.E., eds. American Phytopathology Press. 76 p.

January 2001



## College of Agriculture and Home Economics

**Use pesticides with care.** Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Copyright 2001 Washington State University

WSU Cooperative Extension bulletins contain material written and produced for public distribution. You may reprint written material, provided you do not use it to endorse a commercial product. Alternate formats of our educational materials are available upon request for persons with disabilities. Please contact the Information Department, College of Agriculture and Home Economics, Washington State University for more information.

You may order publications from the WSU Bulletin office, 1-800-723-1763, or <http://pubs.wsu.edu>.

Issued by Washington State University Cooperative Extension and the U.S. Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Cooperative Extension programs and policies are consistent with federal and state laws and regulations on nondiscrimination regarding race, sex, religion, age, color, creed, national or ethnic origin; physical, mental or sensory disability; marital status, sexual orientation, and status as a Vietnam-era or disabled veteran. Evidence of noncompliance may be reported through your local Cooperative Extension office. Trade names have been used to simplify information; no endorsement is intended. Published January 2001. (Publication number MISC0366E.)