Common name (trade name)	Amount per acre	R.E.I.‡ (hours)	P.H.I.‡ (days)

The following materials are listed in the order of usefulness in an IPM program, taking into account efficacy and impact on natural enemies and honey bees as well as the environmental impact. Not all registered pesticides are listed. Always read the label of the product being used.

A. INSECTICIDAL SOAP#
(M-Pede) 1% solution or less 12 NA
MODE OF ACTION: A contact insecticide with smothering and barrier effects.

B. NARROW RANGE OILS#
(Sunspray) 1% solution or less 4 NA
MODE OF ACTION: A contact insecticide with smothering and barrier effects.
COMMENTS: Do not exceed 2 gal product/acre.

‡ Restricted entry interval (R.E.I.) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

Acceptable for use on organically grown produce.

NA Not applicable.

WIREWORMS (1/10)

Scientific Names: *Agriotes* spp. and *Limonius* spp.

DESCRIPTION OF THE PESTS

Wireworms are beetle larvae that are found in soil where they feed on roots. They are yellowish brown, thin worms that have a shiny, tough skin. Adults of the wireworms are click beetles, so named because their elongated bodies are capable of producing a clicking sound. Only the larval stage causes damage.

DAMAGE

Wireworms feed on roots of emerging plants, killing the seedlings and reducing the stand. As plants mature, wireworms may girdle the stem. Be sure to dig around the plant and look for wireworm larvae to confirm that they are the cause of injury.

MANAGEMENT

Cultural Control

In fields known to contain wireworm larvae, fallow during summer with frequent tillage (springtooth or disk). Damage from wireworm infestations to the crop when it is in the seedlingstage can sometimes be reduced by replanting. Rotate to nonhost crops if possible; contact your county farm advisor for information regarding nonhosts. Do not plant a susceptible host crop following a crop that has had a heavy infestation of wireworm without fallowing,tilling, or applying a pesticide.

Monitoring and Treatment Decisions

Wireworm infestations are difficult to detect before visible plant injury occurs. They are most likely to be found in a sugarbeet field when sugarbeet follows a long-term legume crop or natural or temporary pasture.

Chemical controls are ineffective or impossible to apply to wireworms attacking a standing crop. If used, chemicals must be applied as preplant or seed treatments.

Common name (trade name)	Amount per acre	R.E.I.‡ (hours)	P.H.I.‡ (days)

The following materials are listed in the order of usefulness in an IPM program, taking into account efficacy and impact on natural enemies and honey bees as well as the environmental impact. Not all registered pesticides are listed. Always read the label of the product being used.

A.	CHLORPYRIFOS (Lorsban) 15G	8 oz/1000 row ft	24	30
	MODE OF ACTION GROUP NUMBER[1]: 1B COMMENTS: Offers suppression only. Apply in-furrow at planting time. T-band or band at planting or postemergence.			

‡ Restricted entry interval (R.E.I.) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

1 Rotate chemicals with a different mode-of-action Group number, and do not use products with the same mode-of-action Group number more than twice per season to help prevent the development of resistance. For example, the organophosphates have a Group number of 1B; chemicals with a 1B Group number should be alternated with chemicals that have a Group number other than 1B. Mode of action Group numbers are assigned by IRAC (Insecticide Resistance Action Committee). For more information, see www.irac-online.org..

Diseases

(Section reviewed 11/05)

APHID-BORNE VIRUSES (1/10)

Pathogens: Beet yellows virus (BYV), Beet western yellows virus (BWYV), Beet chlorosis virus (BChV) and Beet mosaic virus (BtMV)

SYMPTOMS AND SIGNS

Symptoms of *Beet yellows virus, Beet western yellow virus* and *Beet chlorosis virus* are very similar and typically first observed on older leaves that begin to yellow in the area between the veins where small reddish brown spots often appear, giving the leaves a distinct bronze cast. Eventually leaves become thick, leathery, and brittle. Severe strains of *Beet yellows virus* first cause a vein etching of the heart leaves, followed by yellowing of entire leaf blades or sectors of older leaves. The vein-etching symptom is only apparent for a brief period, but its presence is a strong indicator of *Beet yellows virus* infection, because the other aphid-transmitted viruses do not produce this symptom. When leaves are infected with *Beet mosaic virus*, young leaves are infected first and show a mosaic or mottled pattern that may disappear or fade as the leaves mature. Infections involving more than one aphid-transmitted virus have been observed in the field, and co-infections by *Beet yellow virus* and *Beet mosaic virus* can lead to increased disease severity if plants are infected as seedlings.

COMMENTS ON THE DISEASES

These viruses were common problems when sugarbeets were produced in the Central Valley, but they are not as common in the Imperial Valley, which is the sole remaining area of sugarbeet production in California. These viruses are vectored primarily by the green peach aphid, *Myzus persicae*, and the black bean aphid, *Aphis fabae*. Other aphids, including the bird cherry-oat aphid and blue alfalfa aphid, have been shown to vector *Beet yellows virus*, but their significance in the spread of the disease is still unclear.

The aphids obtain *Beet yellows virus* and *Beet mosaic virus* primarily from overwintering beets; *Beet western yellows virus* and *Beet chlorosis virus* have a very wide host range, however, including plants in the crucifer and composite families. Disease potential is greatest in years when aphids are able to colonize beets early in spring and multiply rapidly; crop losses can be considerable, ranging up to 2% or more per week of infection when plants are infected with *Beet yellows virus*. Plants infected at early stages of development suffer the heaviest losses; late infections (4–6 weeks before harvest) may not cause significant yield loss.

MANAGEMENT

To control this disease, eliminate overwintering hosts (beet-free periods) and plant to avoid migrating aphids (vector-free period generally in May and June). Fields planted 10 to 20 miles from old plantings generally avoid economic losses, and a barrier of even 5 miles significantly reduces infection. This is especially true for *Beet yellows virus*, which has the most severe effect on yield when it infects the crop during the seedling stage. For additional information see the section on green peach aphid.

Tolerant and resistant varieties are being developed and may be commercially available for areas where aphid vectors and serious virus infections are endemic; check with your field representative or farm advisor for the most up-to-date information.

Comments on Control

Because of the closure of sugarbeet factories in Woodland and Tracy, the threat of beet yellowing viruses is limited to an area immediately south of the Delta where crops are planted in spring and then overwintered. The source of the virus in this area may be naturalized populations of wild beet in the Delta region. The disease-free program, postponing planting in spring until after the most significant danger from aphid flights, still applies in this area. Monitor overwintered fields in spring, and analyze samples for yellowing viruses before planting beets on nearby land. If *Beet yellows virus* is not detected, earlier planting dates are allowed.

CERCOSPORA LEAF SPOT (1/10)

Pathogen: *Cercospora beticola*

SYMPTOMS AND SIGNS

Symptoms of Cercospora leaf spot first appear as individual, circular spots that are tan to light brown with reddish purple borders. As the disease progresses, individual spots coalesce. Heavily infected leaves first become yellow and eventually turn brown and necrotic. Blighted leaves soon collapse and fall to the ground, but remain attached to the crown. Heart leaves are usually less severely affected and remain green.

COMMENTS ON THE DISEASE

This disease was primarily a problem on sugarbeets grown in the southeastern portion of the San Joaquin Valley and is not common in the Imperial Valley.

Warm nights combine with high humidity in irrigated fields to provide an ideal environment for disease development. Optimum daytime temperatures for disease development are 77° to 95°F (25°–35°C) with night temperatures above 61°F (16°C) and a relative humidity of 90 to 95%. The primary source of inoculum is residue from a previously infected crop, but the fungus can be carried on seed and is also hosted by numerous weeds. Spores produced by the fungus are dispersed by splashing rain and may also be carried by wind to susceptible sugarbeet leaves.

MANAGEMENT

This disease is not generally a problem in the Imperial Valley and is not normally treated for there. Varieties vary considerably in resistance, with the highest-yielding current varieties having the least resistance. Growers planting sugarbeets in late fall or early spring for an early fall harvest are most likely to be affected by Cercospora and should use a more resistant variety if possible.

To effectively eliminate inoculum from a field, plant sugarbeets in a3-year rotation with nonhosts and plow to incorporate crop residues. Avoid planting a new sugarbeet field adjacent to fields planted to beets the previous season. When sprinkler irrigation is used, run sets so that windblown mist does not keep leaves wetfor longer than 24 hours.

CURLY TOP (1/10)

Pathogens: Beet curly top virus (BCTV), Beet severe curly top virus (BSCTV), Beet mild curly top virus (BMCTV)

SYMPTOMS AND SIGNS

Leaves are dwarfed, crinkled, and rolled upward and inward. Veins on the lower side of infected leaves are irregularly swollen with bumps. If large roots are cut crosswise, dark rings of vascular tissue can be seen. Young roots of infected plants are dwarfed, and rootlets tend to become twisted and distorted and are often killed. Death of rootlets is followed by production of new rootlets, leading to a "hairy root" symptom that can resemble symptoms of the unrelated disease, rhizomania.

COMMENTS ON THE DISEASE

Beet curly top virus is vectored by the beet leafhopper, *Circulifer tenellus*, which has an extensive host range, a high reproductive capacity, and can migrate long distances from its breeding grounds in the coastal foothills and desert areas to cultivated areas. The leafhopper overwinters on a wide range of annual and perennial weeds and readily acquires the virus when it feeds on infected plants (for more information, see BEET LEAFHOPPER). Once acquired,the vector can usually transmit the virus for the rest of its life. In spring, beet leafhopper migrates to agricultural lands when the overwintering host plants dry out. Severity of curly top disease in sugarbeet depends on climatic factors that influencethe prevalence of weed hosts of the virus and the reproductive capacity and migration of the leafhopper vector. *Beet curly top virus* also can cause significant losses in tomatoes, beans, peppers, and occasionally cucurbits.

MANAGEMENT

Curly top is not generally a problem in the Imperial Valley. In other areas, grow resistant varieties in virus-prone areas, especially along the west side of the San Joaquin Valley. In addition, control overwintered weeds and other plants that serve ashosts for the leafhopper vector or the virus.

ERWINIA SOFT ROT (11/05)

Pathogen: *Erwinia betavasculorum*

SYMPTOMS AND SIGNS

The disease is not easy to detect until the rot is well advanced. The vascular tissue of the root becomes discolored and a pinkish to red brown rot develops. Root symptoms vary from a soft rot to a dry rot; the root may become hollow without dying. As the disease progresses, plants wilt. Occasionally brown, oozing lesions occur on petioles and crown.

COMMENTS ON THE DISEASE

Erwinia soft rot can cause serious damage. Disease potential is greatest when temperatures are in the range of 77° to 86°F (25° to 30°C). The bacterium is soilborne and infects plants if infested soil gets into the beet crown from dirty farm machinery, splashing water, insects, or other means. It invades the plant through an injury or wound to the crown or leaves and enters the vascular vessels of the root and petioles.

MANAGEMENT

Beet varieties vary widely in their resistance or susceptibility to this pathogen. Commercial varieties in California are tested for soft-rot resistance: whenever possible, use resistant varieties. Excessive amounts of nitrogen fertilizer encourage *Erwinia.* Use the minimum amount of fertilizer necessary to achieve yield goals. Follow cultural practices that promote good soil structure. Avoid throwing soil and plant debris into beet crowns during cultivation, and adjust implements to minimize injury to crown and tops.

PHYTOPHTHORA AND PYTHIUM ROOT ROTS (11/05)

Pathogens: *Phytophthora drechsleri* and *Pythium aphanidermatum*

SYMPTOMS AND SIGNS

Symptoms for Phytophthora and Pythium root rots are different, but management of the two diseases is the same. Plants with Phytophthora root rot appear wilted in the early stages of disease development and eventually wilt permanently, especially when hot, dry conditions prevail. Initial infection occurs at the base of lateral roots, causing a small necrotic lesion. As the disease progresses, it appears as a wet root rot and advances upward toward the crown. Rotted tissue turns brown with a distinguishing blackish margin adjacent to healthy tissue.

Pythium root rot is a wet rot that causes the taproots of mature beets to become brown to black. As the disease progresses foliage wilts, leaves yellow, and older lower leaves die. Older leaves may have blackened water-soaked lesions at the base of the petiole.

COMMENTS ON THE DISEASE

Phytophthora drechsleri and *Pythium aphanidermatum* are soilborne fungi. The disease is most common in fields where sugarbeets are exposed to excessive soil moisture, particularly following heat or moisture stress. Optimum temperatures for disease development are 82° to 88°F (28° to 31°C). Stand reduction can occur if seedlings are infected and stressed or when older plants are infected later in the season. Heavily infected sugarbeet crops have a low sugar concentration and high level of impurities at harvest.

MANAGEMENT

Provide adequate field drainage and prevent excessive seepage from irrigation canals. Most importantly avoid overirrigating, especially during periods of high temperatures. In soils where drainage is a problem, plant in raised beds, use sprinkler irrigation, and rotate to nonsusceptible crops toreduce inoculum potential. Carefully adjust cultivating and thinning equipment to reduce mechanical injury to feeder roots.

POWDERY MILDEW (1/10)

Pathogen: *Erysiphe polygoni*

SYMPTOMS AND SIGNS

The first signs of powdery mildew are small, white powdery spots that appear usually on the under surface of older leaves when sugarbeet plants are 2 to 6 months old. Under suitable conditions, the fungus spreads rapidly over the entire surface of the leaf, and eventually to all leaves on affected plants. Older leaves may yellow and eventually become necrotic and die.

COMMENTS ON THE DISEASE

Powdery mildew is an annual problem on sugarbeet in California. The fungus overwinters on sugarbeet and other *Beta* species such as swiss chard, table beets and wild *Beta* species that grow throughout the winter. Ideal conditions for disease development are warm, dry weather; optimum temperatures for growth of the fungus are between 60° and 86°F (15° and 30°C). Very high daily temperatures of 100°F (38°C) or higher tend to arrest disease development. Following initial infection, the fungus grows over the surface of the leaf and produces asexual spores (conidia), which give the leaf a powdery appearance. The conidia are airborne and can be carried considerable distances to start new infections. If the disease is not controlled, 20 to 35% loss in sugar yield can occur.

MANAGEMENT

Currently, varieties with moderate resistance are available. Use these varieties in combination with chemical control measures. Apply a fungicide before, if possible, or when the first small, white powdery spots appear on the undersurface of leaves. Repeated applications are necessary at 3- to 6-week intervals if the disease reappears. Good coverage of the beet leaf surfaces is essential.

	Common name (trade name)	Amount per acre	R.E.I.‡ (hours)	P.H.I.‡ (days)
	The following materials are listed in order of usefulness in an IPM Program, taking into account efficacy. Also, consider information relating to environmental impact. Not all registered pesticides are listed. Always read the label of the product being used.			
A.	SULFUR#			
	(Dust)	30 lb	24	0
	(Micronized wettable)	10 lb	24	0
	MODE OF ACTION GROUP NAME (NUMBER[1]): Multi-site contact (M2)			
	COMMENTS: Other types of sulfurs may be used.			
B.	PYRACLOSTROBIN			
	(Headline)	9–12 fl oz	12	7
	MODE OF ACTION GROUP NAME (NUMBER[1]): Quinone outside inhibitor (11)			
	COMMENTS: Maximum use per year is 48 oz/acre, but do not reapply. Alternate use with other mode of action fungicides to avoid the rapid development of resistance by the disease organism.			
C.	AZOXYSTROBIN			
	(Quadris)	9.2–15.4 fl oz	4	0
	MODE OF ACTION GROUP NAME (NUMBER[1]): Quinone outside inhibitor (11)			

‡ Restricted entry interval (R.E.I.) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

\# Acceptable for use on organically grown produce.

1 Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode of actionGroup numbers 1,4,9,11, or 17 before rotating to a fungicide with a different mode of action Group number; for fungicides with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode of actionGroup number. For more information, see www.frac.info.

RHIZOCTONIA ROOT AND CROWN ROT (11/05)

Pathogen: *Rhizoctonia solani*

SYMPTOMS AND SIGNS

Aboveground symptoms on older plants include sudden yellowing and wilting of foliage. Leaf petioles die near the crown and wilted leaves collapse and die, forming a dry, brown rosette that persists throughout the growing season. Exposed areas of infected roots are often covered with masses of brown mycelium. The fungus causes a characteristic dry rot that is brown with deep fissures at or near the crown. The root and crown are partially or completely destroyed.

Rhizoctonia solani also attacks sugarbeet in the seedling stage, causing damping-off (see section on Seedling Diseases).

COMMENTS ON THE DISEASE

Rhizoctonia root and crown rot, caused by a soilborne fungus, is a common root disease of sugarbeet. The fungus is widespread, has many crop hosts, and survives on plant debris in soil as small, resting structures called sclerotia. This disease ismost common during spring and summer when conditions are warm (77° to 92°F, 25° to 33°C) and soils are moist. The fungus grows through the soil and infects the root and crown of plants. Rhizoctonia occurs in most soil types, but is most severe in heavy, poorly drained soils where water collects.

MANAGEMENT

Check with your farm advisor or field representative on the latest information concerning the availability of resistant varieties in California; if available, use them. Follow good tillage, irrigation, and fertilization practices to promote good crop growth and adequate soil drainage. Plant sugarbeet in rotation with corn or small grains, and when cultivating, avoid throwing dirt into plant crowns.

RHIZOMANIA (1/10)

Pathogen: Beet necrotic yellow vein virus (BNYVV)

SYMPTOMS AND SIGNS

Rhizomania is characterized by root stunting and a proliferation of lateral rootlets on the main taproot that give the root a bearded appearance. The storage root is often constricted (turnip-shaped) below the soil level and rotted. The vascular tissue of the taproot becomes discolored and appears as darkened rings when the taproot is cross-sectioned. These symptoms can resemble those caused by curly top disease, but the two are unrelated. Leaves of infected plants often exhibit a pale to bright yellowing of the leaves that can mimic a nitrogen deficiency. The necrotic yellow vein symptom associated with the virus name is rarely observed in the field. Leaves on the plant wilt, especially in periods of high water demand or following irrigation when the fungal vector of the disease is most active. At the beginning of summer, some leaves on plants may crinkle and bleach along veins, but these symptoms can disappear after a few weeks.

COMMENTS ON THE DISEASE

Rhizomania is one of the most destructive diseases of sugarbeet. The causal agent, *Beet necrotic yellow vein virus*, is transmitted by the soilborne fungus *Polymyxa betae.* Disease development is influenced by the fungus, which is enhanced by saturated soil conditions from rain, irrigation, or poor soil drainage and the warming of soil temperatures in spring. In infested fields, most sugarbeets are affected: roots are usually small, sugar yields are poor, and losses can be as high as 100%. Recent studies suggest that additional losses in fields with infected beets may be the result of secondary invasion by other root pathogens, such as *Phytophthora* or *Pythium*.

MANAGEMENT

It is assumed that all commercial sugarbeet fields in California now have rhizomania. Only plant rhizomania-resistant varieties. Current resistant varieties are very high yielding and have provided protection over the last decade; however, a resistance-breaking pathotype was observed in the Imperial Valley in 2003 and is slowly spreading. It may appear in the San Joaquin Valley in the future. Sources of resistance to the new pathotype have been identified and in time may be required in some areas. Consult with seed sales representatives for varietal recommendations. Avoid planting sugarbeets 2 years in a row in the same field, and avoid fields known to contain the new strain until effective new resistant varieties are available.

RHIZOPUS ROOT ROT (11/05)

Pathogens: *Rhizopus stolonifer* and *Rhizopus arrhizus*

SYMPTOMS AND SIGNS

This disease first appears as a temporary wilting of foliage during periods of stress; as the disease advances wilting becomes permanent. After death of the beet, the foliage and root become very brittle and dry. Infected root tissue appears gray brown with darker vascular rings. The disease generally progresses downward with the infected tissue becoming dark and spongy. The taproot can eventually be completely consumed with white mycelium. Black sporangia (spores) are produced on the white mycelium, giving the fungal mass a dark appearance. Often the fungus will decay the internal tissue creating a cavity filled with a clear fluid. The roots may have an odor of acetic acid.

COMMENTS ON THE DISEASE

Rhizopus stolonifer and *R. arrhizus* are common in most agricultural soils throughout the world; in California, *R. arrhizus* is the more common species. In spite of their widedistribution, both fungi are weak sugarbeet pathogens and tend to only be a problem when the crop is compromised by some other factor such as excess soil moisture, crown injuries, or insect injury (cutworms, armyworms) to roots. While the symptoms caused by these species are identical, the optimum temperatures for disease development are different: *Rhizopus stolonifer* causes disease at low temperatures of 57° to 61°F, while high temperatures, 86° to 104°F, favor *R. arrhizus*.

MANAGEMENT

Avoid conditions that cause injury to the taproot. Control insects, see insect section for specific control measures for cutworms and armyworms.

SCLEROTIUM ROOT ROT (1/10)

Pathogen: *Sclerotium rolfsii*

SYMPTOMS AND SIGNS

Sclerotium root rot or southern root rot can be a very destructive disease of sugarbeet in some areas but is not generally a problem in the Imperial Valley. Symptoms appear as poor top growth with wilting occurring as the taproot is decayed by the fungus. Under high temperatures, plants will eventually wilt permanently. The pathogen is characterized by cottony mycelial growth on the surface of the tap root with small (1-3 mm) spherical sclerotiathat are tan to dark tan when mature.

COMMENTS ON THE DISEASE

Sclerotium rolfsii is a soilborne fungus that survives in the soil as sclerotia, and has a host range of over 200 plant species. The disease is favored by moist soil conditions and high temperatures, 77° to 95°F. The fungus is spread through irrigation water and by cultivation equipment. Although the disease has been reported to occur in seedlings, temperatures are not generally conducive to disease development until later in the season. Frequently, *S. rolfsii* can cause significant disease losses that may occur just prior to harvest, late August to early September.

MANAGEMENT

There are no chemical control methods for managing this disease. Management can be best achieved by reducing inoculum buildup through crop rotation. Suggested crops to include in a rotation are alfalfa, wheat, barley, corn, or susceptible crops that do not require irrigation during warm weather conditions. Do not rotate beets with beans or other highly susceptible crops and avoid frequent irrigations during hot weather. Yield losses can be reduced through application of nitrogenous fertilizers that promote vigorous growth. Additionally, in fields where Sclerotium root rot has been identified, harvest early.

SEEDLING DISEASES (1/10)

Pathogens: *Pythium ultimum, P. aphanidermatum, Rhizoctonia solani, Aphanomyces cochlioides*

SYMPTOMS AND SIGNS

Seedling diseases can appear as seed decays, preemergence damping-off, or postemergence damping-off. Depending on the pathogen, most of the seed tissue is susceptible to infection, including nongerminated seed, germinating radicle, and emerging seedling up through the four- to six-leaf stage. Preemergence damping-off appears as darkened lesions on the emerging radicle and causes death of the radicle and seedling. Postemergence damping-off appears as a lesion on the seedling root or crown tissue, and causes the seedling to wilt, and possibly die. Plants that survive infection will not grow vigorously, resulting in greatly reduced yields.

COMMENTS ON THE DISEASE

The four pathogens that cause seedling diseases of sugarbeet are soilborne. *Pythium ultimum* is widespread in soil and attacks many crops. It infects unprotected seedlings at temperatures favorable for germination of beet seed (75° to 86°F), especially in winter and spring under conditions of warming soils with a high moisture content. It primarily causes a preemergence damping-off, but under moist conditions a postemergence damping-off may occur. *Pythium aphanidermatum* attacks seedlings only in warm soils (86° to 95°F, 30° to 35°C) with abundant soil moisture. *Rhizoctonia solani* and *Aphanomyces* spp. are problems primarily on emerged seedlings when temperatures are above 68° to 86°F.

MANAGEMENT

To minimize the potential for seedling diseases, use methods that favor rapid seedling emergence, including planting seeds as shallowly as practical and managing soil moisture (preplant irrigate, seed into moist soil and delay second irrigation until seedlings are beyond susceptible stages). Where *Rhizoctonia* is a problem, avoid planting beets following beans and other legumes, or cotton.

Buyseeds treated with protective fungicides that are effective against the pathogens in the soil to be planted. Seed treated with chloroneb has protection against *Rhizoctonia solani.* Mefenoxam-treated seed protects against *Pythium.* Currently, there are no registered fungicides in California that provide effective protection against *Aphanomyces* spp. In fields where *Aphanomyces* spp. are present, follow practices that enhance rapid germination, plant when the weather is cool, avoid saturated soil conditions in the seedbed, and rotate the crop with nonhost crops.

WHITEFLY-BORNE VIRUSES (1/10)

Pathogens: *Lettuce chlorosis virus* (LCV); *Lettuce infectious yellows virus* (LIYV)

SYMPTOMS AND SIGNS

Symptoms of these viruses are similar to those caused by aphid-transmitted *Beet yellows virus*. Early symptoms are a very mild mottle that later develop into interveinal yellowing or reddening. Affected plants are stunted. Vascular rings in roots are brown and mature taproots often appear to be pithy.

COMMENTS ON THE DISEASE

Lettuce infectious yellows used to be a problem on sugarbeets grown in the Imperial Valley. It was transmitted by the sweetpotato whitefly, *Bemisia tabaci*, which has been displaced by the silverleaf whitefly, *Bemisia argentifolii* (aka *B. tabaci*, Biotype B– a nonvector of this virus). Currently, lettuce infectious yellows is not a major concern and has not been observed in the field since the early 1990s. *Lettuce chlorosis virus* is not uncommon in the Imperial Valley, but it has not been associated with yield loss in sugarbeet.

MANAGEMENT

Lettuce infectious yellows is no longer a field problem in sugarbeets, and controls are not deemed necessary for lettuce chlorosis.

Nematodes

(Section updated 1/13)

Scientific Names: Sugarbeet cyst: *Heterodera schachtii*
Root knot: *Meloidogyne incognita, M. javanica, M. arenaria M. hapla,* and *M. chitwoodi*

DESCRIPTION OF THE PESTS

Plant-parasitic nematodes are microscopic roundworms that feed on plant roots. They survive in soil and plant tissues and several species may exist in a field. They have a wide host range, and vary in their environmental requirements and in the symptoms they induce. Apart from the nematodes listed above, several other species that occur in California, such as stubby root, sting, needle, spiral, sheath, stem and bulb, false root knot, and potato rot nematodes, have been reported as pests on sugarbeet in other parts of the world but are not known to be a factor in California sugarbeet production.

DAMAGE

Infestations of sugarbeet cyst nematode may be localized or spread over an entire field. In heavily-infested soils, seedling emergence may be delayed or seedlings may be killed before emergence, resulting in a reduced stand. Seedlings infested with sugarbeet cyst nematodes may be predisposed to secondary infection by soilborne fungi. This nematode is widespread in all former and present California sugarbeet growing areas, especially the Imperial Valley, central regions of the Central Valley, the Salinas Valley, and Monterey, Santa Barbara, and Ventura counties.

Meloidogyne incognita and *M. javanica* are the most damaging of root knot nematode species found in sugarbeet. *Meloidogyne hapla* is widely distributed, but not reported as a major problem on sugarbeet in California. *Meloidogyne chitwoodi* is found in Modoc and Siskiyou counties in northern California where its reproductive levels on sugarbeet are similar to those found on barley and less than those found on wheat, but no yield reductions have been reported.

SYMPTOMS

Symptoms described below are indicative of a nematode problem, but are not diagnostic as they could result from other causes as well. Infestations may occur without causing any aboveground symptoms.

Seedlings infested by sugarbeet cyst nematode may have longer petioles than normal, with green or yellow leaves depending on the severity of infestation. Plants are likely to be stunted and wilted. Typically, storage roots will not be well developed, and will have excessive fibrous roots. Mature female nematodes can be seen on the root surface as tiny, pinhead size, lemon-shaped bodies that are white in the earlier stages and turn into brown, egg-filled cysts on aging.

Heavy infestation by root knot nematodes in sandy soils may cause plants to wilt and collapse. Swellings (galls) can be seen on fibrous roots and the tap root, which may have a warty appearance.

FIELD EVALUATION

To make management decisions, it is critical to know the nematode species present and their population estimates. If a previous crop had problems caused by nematodes that are also pests of sugarbeet, population levels may be high enough to cause damage to an ensuing sugarbeet crop. If nematode species have not been identified previously, take soil samples and send them to a diagnostic laboratory for identification.

Before planting sugarbeet, take soil samples from within the root zone after harvest of the previous crop or preferably just before harvest. Divide the field into sampling blocks of 10 to 20 acres that are representative of cropping history, crop injury, or soil texture. Take several subsamples randomly from a block, mix them thoroughly and make a composite sample of about1 quart (1 liter) for each block. Include roots in the sample if possible. Place the samples in separate plastic bags, seal them, and place a label on the outside with your name, address, location, and the current or previous crop and the crop you intend to grow. Keep samples cool (do not freeze), and transport as soon as possible to a diagnostic laboratory. Farm advisors and PCAs can help you find a laboratory for extracting and identifying nematodes, and help in interpreting sample results.

MANAGEMENT

Sanitation

Thoroughly clean machinery and equipment with water between fields to mitigate the risk of spreading plant-parasitic nematodes to non-infested fields. This is especially important for *H. schachtii* as eggs in cysts are well protected against adverse environmental conditions.

Crop Rotation

Sugarbeet cyst nematode

The main host crops of *H. schachtii* are in the families Chenopodiaceae (e.g. garden beets, Swiss chard, spinach, mangold) and Brassicaceae (e.g. broccoli,radish, Brussels sprouts, rapini, cauliflower, kale, bok choy, mustard, canola, kohlrabi, and others). Several common weeds are also hosts such as common lambsquarters, shepherd's purse, pigweed, chickweed, dock, and others.

Rotation with nonhost crops is widely used to control sugarbeet cyst nematode. The interval between sugarbeet and other crops in rotation depends on the severity of infestation and local conditions influencing the nematode. In the Imperial Valley, fields are considered infested with *H. schachtii* if three or more cysts are found in a pint-size dump sample that is collected at the sugarbeet factory. Non-infested fields cannot be cropped to sugarbeets more than two years in a row and not more than four out of ten years. In infested fields, sugarbeets can be grown only once every four years.

This cropping program has been used effectively for half a century. The reason for the success is the natural decline in the population density of *H. schachtii* in the absence of host plants. Contact your farm advisor for help in developing a crop rotation program for sugarbeet cyst nematode. Be sure to destroy weed hosts during crop rotations.

Root knot nematode

Control of root knot nematodes by crop rotation is very difficult because of their wide host ranges. Nematode-resistant tomatoes can be grown if *Meloidogyne incognita*, *M. javanica,* or *M. arenaria* are present.

Planting Date

Planting when soil temperatures are below 50°F for *H. schachtii* and 65°F for *M. incognita* reduces damage and slows nematode population buildup.

Fallow

Weed-free fallow, which deprives nematodes of food, reduces most nematode populations. Fallow is most effective if soil is plowed and exposed to sun. Irrigation during the dry period further reduces nematode populations ifproper weed control is maintained. The importance of the time of year in which to fallow as it relates to rate of decline of the nematode population is not well understood at this time.

Chemical Control

The damage threshold in the Imperial Valley for *H. schachtii* is one to two cyst nematode eggs per gram of soil. Thresholds have not been established in other areas of the state or for root knot nematodes, but consider treatment if nematodes are present and have caused problems in the past.

Common name (trade name)	Amount per acre	R.E.P.‡ (hours)	P.H.I.‡ (days)
A. METAM SODIUM* (Vapam, Sectagon 42)	50–75 gal	See label	NA

COMMENTS: Fumigants such as metam sodium are a source of volatile organic compounds (VOCs) but are minimally reactive with other air contaminants that form ozone. Fumigate only as a last resort when other management strategies have not been successful or are not available. Contact your farm advisor for advice on the most effective application method for a particular situation.

Common name (trade name)	Amount per acre	R.E.P.‡ (hours)	P.H.I.‡ (days)

‡ Restricted entry interval (R.E.I.) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Fumigants no longer have an R.E.I., but a Restricted Entry Period (R.E.P.). REP can fluctuate, depending whether tarps are used or not and when tarps are cut and removed. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI or REP exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

* Permit required from county agricultural commissioner for purchase or use.

NA Not applicable.

Weeds

(Section reviewed 11/05)

INTEGRATED WEED MANAGEMENT (1/10)

Sugarbeet is not a very competitive crop, thus weed control is mandatory, especially where sugarbeets are planted at final stand density and will not be thinned. Uncontrolled weeds can reduce sugarbeet yield by over 90%; even one barnyardgrass in 10 feet of row can cause about a 5 to 15% yield loss. Dense weeds make hoeing, the use of electronic thinners, cultivation, and harvest difficult.

In California, sugarbeets are planted from September through June. Weed populations in sugarbeet fields differ by season and location in the state. From October to February, during stand establishment until layby, winter annual weeds such as mustard species and annual bluegrass can be troublesome. Winter annual weeds die out in summer, but summer annuals begin germinating in March and continue throughout the summer growing season. Troublesome summer annual weeds include barnyardgrass, cocklebur, pigweed, velvetleaf, and knotweed. In some areas curly dock, a deep-rooted perennial, can be a problem. Overwintered beets can become infested with winter annuals again in fall.

Selection of the best weed management program is governed by several factors:

1. Geographic location, which determines planting date, weed spectrum, and irrigation or rainfall
2. Date of planting, which determines weed spectrum and irrigation or rainfall
3. Weed species present (or anticipated to be present), which determines choice of weed control method and choice of herbicides
4. Availability and cost of hand labor for weeding, which determines if hand weeding can be considered within the program
5. Availability of equipment, which determines how well cultivation can be conducted and if herbicides can be applied accurately and properly incorporated into soil, if required
6. Method of irrigation, which determines choice of herbicide and influences cultivation choices

Economically acceptable weed control can only be achieved with a management program that integrates several methods as no currently available weed control practice provides complete weed control in a sugarbeet crop. Band applications of an herbicide in the crop row, combined with between row cultivation(s), form the mainstay of a sugarbeet weed management program. This combination reduces the amount of herbicide used and minimizes the need for labor, which results in lower production costs and less herbicide being placed in the environment.

Herbicides

Because sugarbeet is a long-season crop that requires many months to grow, season-long weed control is difficult because early-season weed control may not last until harvest. Overwintering of sugarbeets complicates this problem. A typical weed management program may include a preplant incorporated herbicide or a preemergence herbicide at planting, an early postemergence herbicide, possibly a layby herbicide application, and one to several cultivations coupled with hand hoeing**.** The actual sequence of herbicides used in the program and the timing of the applications will vary by region, and by planting and harvest date.

Several herbicides are registered for selective weed control in sugarbeet, but no single chemical will control all weeds that infest beet fields. Frequently two or more herbicides may have to be combined sequentially or as tank mixes to achieve adequate broad-spectrum weed control. The weed species present will to a large degree determine the choice of herbicides in such combinations. The necessity for correct weed identification cannot be overemphasized. The best weed management program can only be devised when knowledge of the weed species present is coupled with the herbicide activity type and weed susceptibility to the herbicide.

Most sugarbeet herbicides are applied as bands centered on the crop row. Width of the band applied depends to a considerable degree on the capability to conduct close cultivation. Narrower herbicide bands can be utilized if close cultivation can be achieved. This has advantages in cost reduction and also places less herbicide into the

environment. It may be useful to increase the width of the band for herbicides used in late fall and winter plantings if cultivation is likely to be delayed because of wet soil conditions.

Poor or erratic weed control can occur with any herbicide used in sugarbeets. Unsatisfactory herbicide performance may be the result of several factors, such as poor land preparation, faulty herbicide timing and application, the presence of resistant weed species, wrong soil moisture conditions, or adverse weather before or after application. In addition, sugarbeet herbicides are not 100% selective and can, under certain conditions, cause stunting, death of leaf tissue (necrosis), or even kill sugarbeet seedlings. Some beet growth retardation can be tolerated provided the stand is not reduced, but it may lead to increased problems with seedling pests. Minimize herbicide injury to the crop as much as possible.

MONITORING

Ideally, sugarbeet fields should be monitored for weeds in the winter, spring, summer, and fall. If this is not feasible, monitor fields at least twice per year: in late winter to determine the cool season weed population and in late summer to determine the warm season weed population. While monitoring, it is particularly critical to note any weeds that have escaped control in the previous crop(s) and were able to set seed. Because seeds can remain viable in soil for years, monitoring done over a period of years, can provide the means to predict which species are likely to be present.

If no weed history is available for a field, take a soil sample from the field and germinate weed seeds to determine which species are present. It is critical to know this information before planting so that correct weed management decisions can be made, especially if postplant or preemergence herbicides are to be used.

WEED MANAGEMENT BEFORE PLANTING

Management of weeds in sugarbeets requires a combination of control strategies. Cultural, including rotation, and mechanical controls are considered the core of a weed management program. Reliance solely on herbicides for weed control is not sound management. Before planting a sugarbeet crop considerfield selection, sanitation, crop rotation, land preparation, and preirrigation as they relate to weed management.

Field Selection

Choose fields known to be free of perennial weeds such as johnsongrass, field bindweed, and curly dock, annual weeds such assunflower, cocklebur, velvetleaf, and wild beets, or other weeds that are difficult or impossible to control economically in the sugarbeet crop.

Strict adherence to plantback intervals is critical to follow because small amounts of selective herbicides used in a previous crop may remain (carryover) in the soil long enough to affect a sugarbeet crop planted the following season. Sugarbeets are very sensitive to substituted dinitroaniline herbicides such as trifluralin (Treflan) or pendimethalin (Prowl), which are used for weed control in cotton, safflower, beans, tomatoes, and alfalfa. Avoid planting sugarbeets in fields where these herbicides were used the previous year. Benefin (Balan) used in lettuce, napropamide (Devrinol) in tomatoes and peppers, or atrazine (Aatrex) in corn or sorghum may also carry over and injure sugarbeets if the interval between crops is too short. Do not plant sugarbeets in fields previously treated with halosulfuron (Sandea) for at least 36 months following treatment.

Sanitation

Many weeds and volunteer sugarbeets from previous crops may host diseases (e.g., beet yellows virus, curly top virus), insects (e.g., green peach aphid), and nematodes (e.g., sugarbeet cyst nematode), and thus act as sources of infestation for the sugarbeet crop. To reduce the risk of infestation, control weeds and escaped volunteer beets in or around sugarbeet fields. In addition, do not allow weeds to grow in irrigation ditches because seeds can float and be carried back onto the field.

Clean all field equipment before entering a field if the last field in which the equipment operated was weedy. Land planes and sugarbeet diggers have great potential to carry seeds, tubers, etc., from field to field. Prevention is often easier than controlling an established weed problem.

Rotation

Do not plant beets in the same field more than once every 4 or 5 years to minimize disease, nematode, and weed problems. Weeds are less troublesome if beets are planted following tilled row crops and are more troublesome following pasture, alfalfa, broadcast-planted safflower, sorghum, or any other crop in which weeds were allowed

to mature and set seed. Rotation allows reduction of weed populations that are difficult to control in sugarbeets, such as velvetleaf.

Land Preparation

Uniform beds with accurate row spacing are essential for precision cultivation and permit application of narrower bands of postemergence herbicides. The degree to which precision cultivation can be performed is established at the time of initial bed preparation.

A well-prepared seedbed that is free of large clods permits precision planting with more rapid and uniform emergence of beet seedlings. Uniform seeding depth is critical when using preplant incorporated herbicides as increased depth of seeding can result in increased phytotoxicity to the seedlings. Well-prepared seedbeds also permit proper and accurate incorporation of preplant incorporated herbicides, leading to improved weed control. Soil that is too finely cultivated, however, may crust and inhibit germination.

Preirrigation

Unless winter rains occurred, preirrigate before seedbed preparation. Preirrigation followed by cultivation improves the tilth of the seedbed and permits better mechanical incorporation of preplant herbicides. A preirrigation can also be applied following initial bed preparation if there is not enough rainfall to germinate weed or carryover crop seeds. Preirrigation is particularly useful following barley, wheat, oats, sorghum or safflower crops. After the weeds and volunteer seedlings emerge, shallowly cultivate the beds. Paraquat or glyphosate may be used in place of cultivation on preshaped beds. In sprinkler-irrigated fields where preemergence herbicides are used, preirrigation reduces the amount of water needed to germinate the crop. This can improve the activity and selectivity of herbicides because less water is needed and, thus, the herbicide is not leached too far into the soil.

Herbicides

Before the crop is planted, there are two major types of herbicides for weed control. The first group kills existing weeds that have emerged after the beds were formed; these herbicides are referred to as preplant foliar herbicides. The second group, preplant incorporated, controls weed seeds as they germinate. As the name implies,the latter herbicides must be incorporated into the soil soon after application to prevent volatization of the chemical and to move the herbicide into the soil zone where weed seeds germinate.

Preplant foliar

Postemergence herbicides such as paraquat (Gramoxone Inteon) and glyphosate (Roundup) are used to kill existing weeds on preformed beds before planting sugarbeets. Paraquat has contact action only and is thus most effective on young seedlings. Be careful that the chemical does not drift off the targetfield. Glyphosate has systemic action and is thus effective on established weeds. A few species, such as mallows (*Malva* spp.) and nettles (*Urtica* spp.), are tolerant to this herbicide and are not well controlled by it.

Preplant Incorporated

Preplant incorporated herbicides perform best when incorporated with a power driven rotary tiller with L-shaped tines. Observe label directions regarding depth of incorporation as not all of these herbicides require the same depth. Incorporating herbicides like pyrazon (Pyramin), and ethofumesate (Nortron) too deeply dilutes them and decreases weed control. Too shallow incorporation of cycloate (Ro-Neet) results in poor weed control because of volatization of the herbicide and lack of exposure of the seedling's underground shoot to the chemical. A 1- or 2-inch error in depth of incorporation can lead to substantial loss of performance. If beds have not been shaped accurately, precise depth of incorporation may not be possible and herbicide performance will be erratic. Preplant incorporation does not work well in cloddy soil and herbicide performance will usually be poor under such conditions. Excessive speed (over about 2 mph) with a power incorporator results in poor incorporation. The soil should be dry at incorporation in order to obtain optimum results.

Cycloate (Ro-Neet) must be incorporated immediately after application to reduce losses to volatility; this is particularly critical if the soil is moist. Disc incorporation of cycloate (Ro-Neet) can provide adequate control of grass weeds but often results in only partial control of broadleaved species; consequently, another herbicide is often required to obtain adequate broadleaf weed control. Disc incorporation also runs the risk of mixing the herbicide too deeply in the soil, thus increasing the risk of injury to the crop.

WEED MANAGEMENT AFTER PLANTING

Proper fertilization, irrigation, and insect and disease control measures promote good crop growth. A healthy, vigorous crop provides substantial competition that suppresses weed growth and acts as part of the weed control program. A healthy, vigorous beet is also better able to tolerate herbicides.

Crop Stand

Final beet stands should be uniform with skips not over 18 inches. Weed-free beets closer than 18 inches apart will compensate for such skips. A uniform stand will help to compete with weeds, but even with 12- to 18-inch gaps, weeds can invade and become established in the space that exists before the crop canopy fills in.

Biological Control

No specific systems of biological control have been introduced for control of weeds in the sugarbeet crop. Many weeds are attacked, however, by endemic insects and pathogens. Such attack weakens the weeds and makes them less competitive with the crop, and reduces seed production. Examples of insects that attack weeds include leafminers on purslane, fleabeetles on groundcherry and nightshade, various lepidopteran larvae on pigweed, and carabid beetles eating weed seeds. Pathogens attack johnsongrass, barnyardgrass, and purslane among others. Insect and disease control practices should be used so that they minimize impacts on organisms providing natural biological control of weeds.

Cultivation

Cultivation is an effective method of weed control, especially in fields with low weed infestations. It is essential that bed shaping and planting be accurate in order to permit close, or precision, cultivation. Repeated shallow cultivations will dislodge small weed seedlings that emerge after each irrigation and can be performed until the beet leaf canopy closes over the furrow.

Weed control by cultivation must be coordinated with irrigation scheduling. Wet soil can prevent the use of cultivation equipment at the optimum stages of weed growth. Timing of irrigation following cultivation can also be critical. Irrigation too soon after cultivation can lead to rerooting of weeds. Wet soil in winter may delay, or even preclude, cultivation for weed control; this possibility should be considered when designing a weed management program for fall-planted beets.

Many different types of cultivation implements are available. Each should be adjusted to disturb only a shallow layer (ideally not over 2 to 3 inches) of soil to minimize pruning of the beet roots and bringing weed seeds up from deeper layers. Timeliness in cultivation is essential. Seedling weeds are much easier to kill than older established weeds. Random or synchronous thinning also reduces weed populations. Some tools that aid in removing weed seedlings in beets older than the 4-leaf stage are the Bezzerides row weeder, the Texas rod weeder, and various spyder wheels.

Hand hoeing

Include hand hoeing as part of a long-term weed management program, especially when weeds such as wild beets, sunflower, velvetleaf, and tolguacha, which are resistant to most of the currently registered herbicides, are present. Although hand hoeing is relatively expensive and has no long-term effect, it may be useful for situations where weeds have escaped control by other techniques or are too large to control with other methods. Hand hoeing is easiest when the weeds are small; large weeds are difficult to remove and their removal may damage the crop.

Herbicides

Following planting of the crop, there are three periods in which herbicides may need to be applied, depending on the weed species present. Preemergence treatments are applied after planting but before the first irrigation; postemergence treatments are applied when sugarbeets are in the seedling stage; and layby treatments may be useful after the crop has been thinned if continued emergence of weeds is anticipated.

Preemergence

Preemergence pyrazon (Pyramin) treatments are not effective unless incorporated by light rainfall or sprinkler irrigation (less than 0.5 inch). Apply less than 0.75 inch of sprinkler irrigation per set following preemergence application of pyrazon until the beets have four true leaves or the herbicide may be leached into the seedling root zone and cause injury to the crop. If significant rainfall occurs following treatment, the risk of crop injury is increased. Under furrow irrigation physical incorporation of the herbicide is required.

Postemergence

Inadequate control following postemergence applications of pyrazon (Pyramin) has occurred when weeds were beyond the 2- to 4-leaf stage, or when applied in warm weather (over 70°F) and not irrigated within 2 or 3 days. Irrigation following application is essential for best results because the herbicide must be moved into the weed root zone. The likelihood of crop injury increases in warm weather.

Phenmedipham plus desmedipham (Betamix) gives erratic control when applied to weeds larger than cotyledon to 2-leaf stage of growth. Poor weed control has occurred when weeds were stressed for moisture at application, and low soil moisture also increases injury to sugarbeets. Temperatures above about 85°F on application day may lead to increased injury to the beets. When temperatures are high, or rising, applications made in the morning cause more injury; spraying after 3 p.m. will reduce injury to the beets. Injury is also less if temperatures are decreasing.

Split applications about 7 to 12 days apart (shorter split in spring and summer, longer split in late fall and winter) with the first application to cotyledon stage beets and weeds. This usually increases weed control and reduces injury to sugarbeets; the first application must not exceed 0.5 lb/acre. If pigweed is the predominant broadleaf weed present, application of desmedipham (Betanex) will provide slightly greater control than phenmedipham plus desmedipham (Betamix). The combination of phenmedipham, desmedipham, and ethofumesate (as a tank mix of Betamix plus Norton or a premix of Progress) can improve control of difficult-to-control weeds such as common knotweed.

Sethoxydim (Poast) must be applied with an oil concentrate adjuvant to obtain satisfactory activity. Repeat applications if perennials such as johnsongrass are present. This herbicide should not be mixed with any other herbicide; mixtures with phenmediphamplus desmedipham (Betamix) have resulted in decreased grass control. Soil moisture must be adequate at application in order to obtain high levels of grass control; low soil moisture reduces control substantially. High spray volume leads to reduced activity; follow label restrictions in relation to spray volume.

Layby

Neither trifluralin (Treflan) or EPTC (Eptam) have any activity against established weeds; it is thus essential that the field be weed free prior to application of these herbicides. Both herbicides must be physically mixed into the soil (incorporated) immediately after application, or they must be applied in the irrigation water.

SPECIAL WEED PROBLEMS (11/05)

All broadleaf perennial weeds pose a difficult problem for sugarbeet production because all herbicides that control such perennials also kill sugarbeets. The best approach is to control the weeds in rotational crops and only plant sugarbeet if populations of the problem weed are low.

Several annual broadleaf weeds that grow in fall and winter are not well controlled by phenmedipham plus desmedipham (Betamix), including redmaids, miner's lettuce, dogfennel, and knotweed. It is necessary to use other herbicides to control these weeds.

VELVETLEAF

The most widespread problem weed in spring- and summer-sown beets is probably velvetleaf. Control this weed in rotational crops because the only herbicide registered for use in sugarbeets in California that will give more than partial control is triflusulfuron methyl (UpBeet), which requires 2 sequential applications for control. Close cultivation and hand hoeing when velvetleaf is small provides control in sugarbeets. If velvetleaf has not yet become established in a field, a program that prevents seed production should be followed.

KNOTWEEDS AND SMARTWEEDS

These weeds can be a problem at times. Preemergence combinations of pyrazon (Pyramin) and ethofumesate (Nortron) early in the season can control them. Split applications of Progress or a tank-mix of Betamix plus Nortron has also provided high levels of control. Partial control of later emerging weeds can be anticipated from the Nortron.

DODDER

The parasitic plant dodder can invade sugarbeets. The majority of dodder emerges from the soil from mid-March through mid-May, so close monitoring during this period is essential. None of the registered herbicides for use in sugarbeets control this weed. It is probably best to kill the individual infested sugarbeet plants rather than let the weed set seed.

CEREALS

Volunteer cereals are best controlled with timely application of sethoxydim (Poast) when they are young. Otherwise, applying EPTC (Eptam) during the season via water run irrigation can provide preemergence control.

COCKLEBUR

Cocklebur is commonly associated with fields near rice fields and ditches where water can be used to move the seed. Cocklebur is only partially controlled with current preplant or preemergence herbicides. For effective control, apply clopyralid (Stinger) or split applications of triflusulfuron methyl (UpBeet) plus Progress when weeds are no larger than the cotelydon stage. When using Progress plus UpBeet, it is critical that both applications be made at 5-10 day intervals or control will be significantly reduced.

CURLY DOCK

Postplant, preemergence treatment with ethofumesate (Nortron), pyrazon (Pyramin), or a combination of the two can give effective control of germinating weeds. Seedy plants can be controlled with combinations of Betamix plus Nortron, or the premix Progress, as split applications. Once well established, most herbicides are not effective and hand hoeing is required. Clopyralid (Stinger), however, can give partial control of established plants.

COMMON AND SCIENTIFIC NAMES OF WEEDS (11/05)

Common Name	Scientific Name
Barley, hare	*Hordeum murinum* subsp. *leporinum*
Barnyardgrass	*Echinochloa crus-galli*
Bluegrass, annual	*Poa annua*
Bromegrasses	*Bromus* spp.
Canarygrasses	*Phalaris* spp.
Chickweeds	*Stellaria* spp.
Clovers	*Trifolium* spp.
Cockleburs	*Xanthium* spp.
Crabgrass, large	*Digitaria sanguinalis*
Cudweeds	*Gnaphalium* spp.
Datura, sacred	*Datura wrightii*
Dock, curly	*Rumex* spp.
Fescues	*Festuca* spp.
Fiddlenecks	*Amsinckia* spp.
Filarees	*Erodium* spp.
Fleabane, hairy	*Conyza bonariensis*
Foxtails	*Setaria* sp.
Goosefoot, nettlefoot	*Chenopodium murale*
Groundcherries	*Physalis* spp.
Groundsels	*Senecio* spp.
Henbit	*Lamium amplexicaule*
Johnsongrass	*Sorghum halepense*
Knotweed, common	*Polygonum arenastrum*
Lambsquarters, common	*Chenopodium album*
Lettuce, prickly	*Lactuca serriola*
Lovegrass	*Eragrostis* spp.
Mallow, little (cheeseweed)	*Malva parviflora*
Marestail	*Hippuris vulgaris*
Miner's lettuce	*Claytonia perfoliata*
Mustards	*Brassica* spp.
Nettles	*Urtica* spp.
Nightshades	*Solanum* spp.
Nutsedges	*Cyperus* spp.
Oat, wild	*Avena fatua*
Orach, halberdleaf	*Atriplex triangularis*
Pigweeds	*Amaranthus* spp.
Pineapple-weed	*Chamomilla suaveolens*
Polypogon, rabbitfoot	*Polypogon monspeliensis*
Popcorn flower	*Plagiobothrys* spp.
Povertyweed, Nuttall	*Monolepis nuttalliana*
Puncturevine	*Tribulus terrestris*
Purslane, common	*Portulaca oleracea*
Radish, wild	*Raphanus raphanistrum*
Redmaids (desert rockpurslane)	*Calandrinia ciliata*
Rocket, London	*Sisymbrium irio*

(continued next page)

Common Name	Scientific Name
Ryegrasses	*Lolium* spp.
Sandburs	*Cenchrus* spp.
Shepherd's-purse	*Capsella bursa-pastoris*
Sowthistles	*Sonchus* spp.
Speedwells	*Veronica* spp.
Spurge, spotted	*Chamaesyce maculata*
Thistle, Russian	*Salsola tragus*
Velvetleaf	*Abutilon theophrasti*

SUSCEPTIBILITY OF WINTER WEEDS IN SUGARBEET TO HERBICIDE CONTROL (1/10)

	Preplant Foliar		Preplant Incorporated or Postplant Preemergence				Postplant Postemergence									Layby		
	GLY	PAR*	CYC	ETH	PYR	PYR ETH	DES	CLE	CLO	P/D	PYR	P/D ETH	P/D[2] ETH	SET	TRS	EPT	PYR	TRI
Barley, hare	C	C	C	C	N	C	N	C	N	N	N	P	C	C	N	C	N	C
Bluegrass, annual	C	C	C	C	N	C	N	C	N	N	N	C	C	N	N	C	N	C
Bromegrasses	C	C	C	C	N	C	N	P	N	N	N	P	C	P	N	C	N	C
Canarygrasses	C	C	C	C	N	C	N	C	N	N	N	P	C	C	N	C	N	C
Chickweeds	C	C	C	C	C	C	C	N	P	C	C	C	C	N	C	C	C	C
Clovers	C	P	P	P	P	C	P	N	C	P	P	P	P	N	P	N	P	N
Cudweeds	C	N	P	P	C	C	C	N	C	C	P	C	C	N	—	C	P	N
Docks (seedling)	C	C	P	C	C	C	C	N	C	C	P	C	N	N	C	C	P	C
Fescues	C	P	C	C	N	C	N	P	N	N	N	P	C	P	N	C	N	C
Fiddlenecks	C	C	C	C	C	C	C	N	N	C	P	C	C	N	C	C	P	C
Filarees	P	P	N	—	P	P	P	N	P	P	P	P	C	N	N	P	P	P
Groundsels	C	C	C	C	C	C	C	N	C	C	P	C	C	N	N	C	P	N
Henbit	P	P	C	P	C	C	C	N	N	C	P	C	C	N	N	C	P	N
Knotweed, common	C	C	P	P	P	C	P	N	N	P	P	C	P	N	C	P	P	C
Lettuce, prickly	C	C	C	C	C	C	C	N	C	C	P	C	C	N	N	C	P	N
Mallow, little (cheeseweed)	P	N	P	P	P	P	P	N	N	P	N	P	P	N	C	N	P	N
Miner's lettuce	C	C	C	C	C	C	P	N	—	P	P	P	C	N	N	C	P	C
Mustards	C	C	N	P	C	C	C	N	N	C	C	C	C	N	C	N	C	N
Nettles	C	C	P	P	C	C	C	N	—	C	C	C	C	N	—	C	C	N
Oat, wild	C	C	C	C	N	C	N	C	N	N	N	P	C	C	N	C	N	N
Pineapple-weed	C	C	C	P	C	C	P	N	C	P	P	P	C	N	N	C	P	N
Povertyweed, Nuttall	—	—	C	C	C	C	C	N	—	C	P	C	—	N	—	C	P	C
Polypogon, rabbitfoot	C	C	C	C	N	C	N	C	N	N	N	P	C	C	N	C	N	C
Popcorn flower	C	C	C	C	C	C	C	N	—	C	P	C	—	N	—	C	P	C
Radish, wild	C	C	N	N	C	C	C	N	N	C	C	C	C	N	C	N	C	N
Redmaids (desert rockpurslane)	C	C	C	C	C	C	P	N	—	P	P	P	C	N	—	C	P	C
Rocket, London	C	C	N	N	C	C	C	N	P	C	C	C	C	N	C	P	C	N
Ryegrasses	C	C	C	N	N	N	N	C	N	N	N	N	C	C	N	C	N	C
Shepherd's-purse	C	C	P	P	C	C	C	N	P	C	C	C	C	N	C	P	C	N
Sowthistles	C	C	C	C	C	C	C	N	P	C	C	C	C	N	C	C	C	N
Speedwells	C	C	C	C	C	C	C	N	—	C	P	C	—	N	—	C	P	C
Volunteer cereals	C	C	N	C	N	C	N	C	N	N	N	P	C	C	N	P	N	N

C = control N = no control P = partial control — = no information

CLE = clethodim (Select Max)
CLO = clopyralid (Stinger)
CYC = cycloate (RoNeet)
DES = desmedipham (Betanex)
EPT = EPTC (Eptam)
ETH = ethofumesate (Nortron)
GLY = glyphosate (Roundup)
PAR = paraquat* (Gramoxone)
PYR = pyrazon (Pyramin)
P/D = phenmedipham/desmedipham (Betamix)
P/D[2] = phenmedipham/desmedipham/ethofumesate (Progress)
SET = sethoxydim (Poast)
TRI = trifluralin (Treflan)
TRS = triflusulfuron methyl (UpBeet)

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SUSCEPTIBILITY OF SPRING AND SUMMER WEEDS IN SUGARBEET TO HERBICIDE CONTROL (1/10)

	Preplant Foliar		Preplant Incorporated or Postplant Preemergence				Postplant Postemergence									Layby		
	GLY	PAR*	CYC	ETH	PYR	PYR ETH	DES	CLE	CLO	P/D	PYR	P/D ETH	P/D[2] ETH	SET	TRS	EPT	PYR	TRI
ANNUAL WEEDS																		
Barnyardgrasses	C	P	C	P	N	P	N	C	N	N	N	P	C	C	P	C	N	C
Cockleburs	C	C	N	N	P	P	P	N	C	P	P	P	P	N	C	N	N	N
Crabgrass	C	C	C	P	N	P	N	C	N	N	N	P	C	C	N	C	N	C
Cudweeds	C	N	P	P	C	C	C	N	C	C	P	C	C	N	N	C	P	N
Datura, sacred	C	C	N	C	P	P	C	N	P	C	N	C	—	N	N	N	N	N
Docks (seedling)	C	C	P	C	C	C	C	N	C	C	P	C	C	N	C	C	P	C
Fleabane, hairy	C	C	C	P	C	C	C	N	P	C	P	C	P	N	N	C	P	N
Foxtail	C	C	C	C	N	C	N	C	N	N	N	P	C	C	P	C	N	C
Goosefoot	C	C	C	C	C	C	C	N	N	C	N	C	C	N	C	C	N	C
Groundcherries	C	C	P	C	C	C	C	N	P	C	P	C	C	N	C	C	P	N
Knotweed, common	C	C	P	P	P	C	P	N	N	P	P	C	P	N	C	P	P	C
Lambsquarters	C	P	C	C	C	C	C	N	N	C	P	C	C	N	C	C	P	C
Lettuce, prickly	C	C	C	C	C	C	C	N	C	C	P	C	C	N	N	C	P	N
Lovegrasses	C	C	C	C	N	C	N	C	N	N	N	P	C	C	N	C	N	C
Marestail	C	C	C	P	C	C	C	N	P	C	P	C	P	N	N	C	P	N
Nightshades	C	C	C	C	C	C	C	N	P	C	P	C	C	N	C	C	P	C
Orach, halberdleaf	C	C	C	C	C	C	C	N	—	C	P	C	—	N	—	C	P	C
Pigweeds	C	C	C	C	P	C	C	N	N	C	P	C	P	N	C	C	P	C
Puncturevine	C	C	P	C	P	C	P	N	N	P	N	P	P	N	P	P	P	C
Purslane, common	C	C	C	C	C	C	P	N	N	C	N	C	C	N	P	C	N	C
Sandburs	C	P	C	P	N	C	N	C	N	N	N	P	C	C	N	C	N	C
Sowthistles	C	C	C	C	C	C	C	N	P	C	C	C	C	N	C	C	C	N
Spurge, spotted	C	C	C	C	C	C	C	N	N	C	P	C	N	N	—	C	P	N
Thistle, Russian	C	P	P	P	P	P	P	N	N	P	N	P	P	N	P	P	N	P
Velvetleaf	P	P	N	N	N	N	—	N	C	N	N	N	N	N	C	N	N	N
Volunteer cereals	C	C	N	C	N	C	N	C	N	N	N	P	C	P	N	P	N	N
PERENNIAL WEEDS																		
Johnsongrass seed	C	C	C	P	N	C	N	C	N	N	N	P	P	C	N	C	N	C
Johnsongrass rhizome	C	N	N	N	N	P	N	C	N	N	N	N	N	C	N	N	N	P
Nutsedges	P	P	P	P	N	P	N	N	N	N	N	N	P	N	N	C	N	N

C = control N = no control P = partial control — = no information

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CLO = clopyralid (Stinger)
CYC = cycloate (RoNeet)
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SET = sethoxydim (Poast)
TRI = trifluralin (Treflan)
TRS = triflusulfuron methyl (UpBeet)

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HERBICIDE TREATMENT TABLE (1/13)

Common name (trade name)	Amount per acre	R.E.I.‡ (hours)	P.H.I.‡ (days)

The following materials are listed in alphabetical order. When choosing a pesticide, consider information relating to environmental impact. Not all registered pesticides are listed. Always read the label of the product being used.

BEFORE PLANTING

Preplant foliar

A. GLYPHOSATE — 0.5–1.0 lb a.i. — see comments — NA
(Roundup, Touchdown)
WSSA MODE OF ACTION GROUP NUMBER[1]: 9
COMMENTS: Apply to emerged annual weeds at least 3 days before sowing crop or before it emerges. Weeds should be less than 4 inches tall and vigorously growing. Observe label restrictions for application. Restricted entry interval (REI) for Roundup is 4 hours and for Touchdown 12 hours.

B. PARAQUAT* — 0.5–0.1 lb a.i. — 24 — NA
(Gramoxone Inteon)
. . . PLUS . . .
surfactant — 8 oz/100 gal
WSSA MODE OF ACTION GROUP NUMBER[1]: 22
COMMENTS: Apply to emerged annual weeds before sowing crop or before it emerges. Grasses after tillering not well controlled. Avoid drift from treated area. Flush all spray equipment directly after use; paraquat may be corrosive to aluminum.

Preplant incorporated

A. CYCLOATE — 3–3.99 lb a.i. — 12 — NA
(Ro-Neet) 6E
WSSA MODE OF ACTION GROUP NUMBER[1]: 8
COMMENTS: Incorporate into soil immediately after application; use of power driven tiller preferred. Use only in mineral soils; lower rate in sandy soil, higher rate in heavy soils. May slow beet germination and seedling growth. Make only 1 application/growing season.

B. ETHOFUMESATE — 1–2 lb a.i. — 12 — NA
(Nortron) SC
WSSA MODE OF ACTION GROUP NUMBER[1]: 8
COMMENTS: Incorporate 1 to 2 inches deep with power-driven tiller. Temporary stunting with leaf fusion may occur.

C. PYRAZON — 3–3.5 lb a.i. — 12 — 0
(Pyramin) DF
WSSA MODE OF ACTION GROUP NUMBER[1]: not available
COMMENTS: Also known as chloridazon. Incorporate 1-2 in. deep with power driven tiller. If no rain falls within 5-10 days, furrow irrigate to thoroughly wet bed top. Do not use in sands, loamy sands, muck, or peat soils. Use lower rate on low organic matter sandy loam soils. Do not sprinkler irrigate until beets have 2 true leaves. Pyrazon is prone to settling out in the spray tank, so agitate continuously to avoid uneven application.

D. PYRAZON — 2.99 lb a.i. — 12 — 0
(Pyramin) DF
. . . PLUS . . .
ETHOFUMESATE — 1.5–1.9 lb a.i. — 12 — 90
(Nortron)
WSSA MODE OF ACTION GROUP NUMBER[1]: (not available) plus 8
COMMENTS: Incorporate 1-2 in. deep with power-driven tiller. If no rain falls within 5-10 days furrow irrigate to thoroughly wet bed top. Do not use in sands, loamy sands, muck, or peat soils. Use lower rate on low organic matter sandy loam soils. Do not sprinkler irrigate until beets have 2 true leaves. Temporary stunting and leaf fusion may occur. Pyrazon, also known as chloridazon, is prone to settling out in the spray tank; agitate continuously to avoid uneven application. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank mixing products that contain the same a.i.

Common name (trade name)	Amount per acre	R.E.I.‡ (hours)	P.H.I.‡ (days)

AFTER PLANTING

Preemergence (Herbicides applied after planting but before irrigation)

A. ETHOFUMESATE (Nortron SC) — 1.125–3.75 lb a.i. — 12 — NA
WSSA MODE OF ACTION GROUP NUMBER[1]: 8
COMMENTS: Temporary stunting with leaf fusion and twisting may occur.

B. PYRAZON (Pyramin) DF — 3–3.5 lb a.i. — 12 — NA
WSSA MODE OF ACTION GROUP NUMBER[1]: not available
COMMENTS: Also known as chloridazon. If no rain falls within 5-10 days, sprinkler irrigate; do not use more than 0.75 in. of water per set until beets have 2 true leaves. If significant rainfall occurs after treatment, the risk of crop injury is increased. Do not use in sands, loamy sands, muck, or peat soils. Use lower rate on low organic matter sandy loam soils. Pyrazon is prone to settling out in the spray tank; agitate continuously to avoid uneven application.

C. PYRAZON (Pyramin) DF — 2.99 lb a.i. — 12 — 0
. . . PLUS . . .
ETHOFUMESATE (Nortron) SC — 1.5–1.9 lb a.i. — 12 — 90
WSSA MODE OF ACTION GROUP NUMBER[1]: (not available) plus 8
COMMENTS: If no rain falls within 5 -10 days, sprinkler irrigate; do not use more than 0.75 in. of water per set until beets have 2 true leaves. Do not use in sands, loamy sands, muck, or peat soils. Use lower rate on low organic matter sandy loam soils. Temporary stunting, with leaf fusion and twisting, may occur. Pyrazon, also known as chloridazon, is prone to settling out in the spray tank so agitate continuously to avoid unevenapplication. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank mixing products that contain the same a.i.

Postemergence (seedling stages)

A. CLETHODIM (Select Max) — 0.09–0.2425 lb a.i. — 24 — 40
. . . PLUS . . .
N/S SURFACTANT
WSSA MODE OF ACTION GROUP NUMBER[1]: 1
COMMENTS: Keep spray volume at 20-30 gpa for best activity. Adequate soil moisture required for best activity. Do not mix with other herbicides. Controls annual bluegrass when plants have fewer than 8 leaves. Perennial grasses may require repeat applications.

B. CLOPYRALID (Stinger) — 0.1–0.2425 lb a.i. — 12 — 45
WSSA MODE OF ACTION GROUP NUMBER[1]: 4
COMMENTS: Apply when crop and weeds are at cotyledon stage of growth; delayed application can increase risk of crop injury. Effective for controlling velvetleaf and cocklebur. It can be tank-mixed with UpBeet, Betamix, or Progress for broader weed control. Do not exceed 0.25 lb/acre/season. Refer to label for significant plant-back restrictions.

C. DESMEDIPHAM (Betanex) — 1.0–1.21875 lb a.i. — 24 — 75
WSSA MODE OF ACTION GROUP NUMBER[1]: 5
COMMENTS: Temporary sugarbeet stunting may occur, with possible sugarbeet kill at temperatures over 85°F. Adequate soil moisture must be present at application, or furrow irrigate after treatment. If pigweed is the primary species, desmedipham alone provides better control than in a mixture with phenmedipham. Does not have soil activity.

D. PHENMEDIPHAM+DESMEDIPHAM (Betamix) — 0.24–0.75 lb a.i. — 24 — 75
WSSA MODE OF ACTION GROUP NUMBER[1]: 5/5
COMMENTS: Temporary sugarbeet stunting may occur, with possible sugarbeet kill at temperatures over 85°F. Treat cotyledon-stage beets for best results. Control is erratic if weeds are larger than 2-leaf stage. Adequate soil moisture must be present at application, or furrow irrigate after treatment. Application after 3:00 pm increases safety to crop. Split applications about 7 days apart (50% of rate applied at each application) are safer and more effective than single applications. Do not exceed 0.5 lb/acre at the first application when applying to cotyledon-stage beets.

	Common name (trade name)	Amount per acre	R.E.I.‡ (hours)	P.H.I.‡ (days)
E.	PHENMEDIPHAM+DESMEDIPHAM (Betamix)	0.24 lb a.i.	24	75
	. . . PLUS . . .			
	ETHOFUMESATE (Nortron)	0.125 lb a.i.	12	90
	WSSA MODE OF ACTION GROUP NUMBER[1]: 5/5/ plus 8			
	COMMENTS: Temporary sugarbeet stunting may occur, with possible sugarbeet kill at temperatures over 85°F. Treat cotyledon-stage beets for best results. Control is erratic if weeds are larger than 2-leaf stage. Adequate soil moisture must be present at application, or furrow irrigate after treatment. Application after 3:00 pm increases safety to crop. Split applications about 7 days apart (50% of rate applied at each application) are safer and more effective than single applications. Do not exceed 0.5 lb/acre at the first application when applying to cotyledon-stage beets. This mixture can provide improved control of difficult-to-control weeds such as knotweed. For tank mixes, observe all directions for use on all labels, and employ the most restrictive limits and precautions. Never exceed the maximum a.i. on any label when tank mixing products that contain the same a.i.			
F.	PHENMEDIPHAM+DESMEDIPHAM+ ETHOFUMESATE (Progress)	0.25–0.75 lb a.i.	48	75
	WSSA MODE OF ACTION GROUP NUMBER[1]: 5/5/8			
	COMMENTS: A premixed herbicide applied as a split-sequential application 7 to 10 days apart, beginning at the crop and weed cotyledon stage. Can be tank-mixed with UpBeet and Stinger for broader weed control.			
G.	PYRAZON (Pyramin) DF	2.99 lb a.i.	12	0
	WSSA MODE OF ACTION GROUP NUMBER[1]: not available			
	COMMENTS: Also known as chloridazon. Use on small broadleaf weed seedlings in the 2- to 4-leaf stage during the cool season (below 70°F). If no rain falls, irrigate within 4 days to move the herbicide into the weed root zone. Controls certain weeds resistant to mixtures of phenmedipham/desmedipham. Pyrazon requires continuous agitation of the spray tank to prevent uneven application.			
H.	SETHOXYDIM (Poast)	0.25–0.45 lb a.i.	12	60
	. . . PLUS . . .			
	COC adjuvant	1 qt/acre		
	WSSA MODE OF ACTION GROUP NUMBER[1]: 1			
	COMMENTS: Keep spray volume 20-30 gpa low for best activity. Adequate soil moisture required for best activity. Do not mix with other herbicides. High spray volume leads to reduced activity; follow label restrictions in relation to spray volume to use. Will not control annual bluegrass; perennial grasses may require repeat treatments.			
I.	TRIFLUSULFURON METHYL (UpBeet)	0.016–0.031 lb a.i.	4	60
	. . . PLUS . . .			
	N/S SURFACTANT			
	WSSA MODE OF ACTION GROUP NUMBER[1]: 2			
	COMMENTS: Apply as a split-sequential application 5-10 days apart, beginning at the cotyledon stage of the crop and weeds. Two applications required in most cases for effective control. It may be tank-mixed with Betamix, Progress, or Stinger to broaden weed control. Do not mix with grass herbicides (Poast or Prism). Use with caution to prevent weed resistance following other ALS-inhibiting herbicides, such as Raptor, Staple, or Matrix.			

LAYBY (after thinning)

A.	EPTC (Eptam)	2 lb a.i.	12	49
	WSSA MODE OF ACTION GROUP NUMBER[1]: 8			
	COMMENTS: Inject into irrigation water; use only where uniform irrigation can be achieved. Will not control emerged seedlings or established plants. Do not permit treated water to run off field or use it for irrigating other crops. Follow-up repeat application is required for best activity.			
		. . . or . . .		
		3 lb a.i		
	COMMENTS: Must be thoroughly incorporated into soil.			

Common name (trade name)	Amount per acre	R.E.I.‡ (hours)	P.H.I.‡ (days)
B. TRIFLURALIN (Treflan)	0.75 lb a.i.	12	NA

WSSA MODE OF ACTION GROUP NUMBER[1]: 3

COMMENTS: Incorporate into soil immediately after application; use of ground-driven rolling cultivator is preferred. Avoid piling treated soil into the beet crowns. Field must be weed-free at treatment; does not control emerged weeds.

‡ Restricted entry interval (R.E.I.) is the number of hours (unless otherwise noted) from treatment until the treated area can be safely entered without protective clothing. Preharvest interval (P.H.I.) is the number of days from treatment to harvest. In some cases the REI exceeds the PHI. The longer of two intervals is the minimum time that must elapse before harvest.

* Permit required from county agricultural commissioner for purchase or use.

1 Group numbers are assigned by the Weed Science Society of America (WSSA) according to differentmodes of action. Although weeds may exhibit multiple resistance across many groups, mode of action numbers are useful in planning mixtures or rotations of herbicides with different modes of action. For more information, see http://www.hracglobal.com.

NA Not applicable.

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PRECAUTIONS FOR USING PESTICIDES

Pesticides are poisonous and must be used with caution. READ THE LABEL BEFORE OPENING A PESTICIDE CONTAINER. Follow all label precautions and directions, including requirements for protective equipment. Apply pesticides only on the crops or in the situations listed onthe label. Apply pesticides at the rates specified on the label or at lower rates if suggested in this publication. In California, all agricultural uses of pesticides must be reported. Contact your county agricultural commissioner for further details. Laws, regulations, and information concerning pesticides change frequently. This publication reflects legal restrictions current on the date next to each pest's name.

Legal Responsibility
The user is legally responsible for any damage due to misuse of pesticides. Responsibility extends to effects caused by drift, runoff, or residues.

Transportation
Do not ship or carry pesticides together with food or feed in a way that allows contamination of the edible items. Never transport pesticides in a closed passenger vehicle or in a closed cab.

Storage
Keep pesticides in original containers until used. Store them in a locked cabinet, building, or fenced area where they are not accessible to children, unauthorized persons, pets, or livestock. DO NOT store pesticides with foods, feed, fertilizers, or other materials that may become contaminated by the pesticides.

Container Disposal
Dispose of empty containers carefully. Never reuse them. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Consult your county agricultural commissioner for correct procedures for handling and disposal of large quantities of empty containers.

Protection of Nonpest Animals and Plants
Many pesticides are toxic to useful or desirable animals, including honey bees, natural enemies, fish, domestic animals, and birds. Crops and other plants may also be damaged by misapplied pesticides. Take precautions to protect nonpest species from direct exposure to pesticides and from contamination due to drift, runoff, or residues. Certain rodenticides may pose a special hazard to animals that eat poisoned rodents.

Posting Treated Fields
For some materials, *restricted entry intervals* are established to protect field workers. Keep workers out of the field for the required time after application and, when required by regulations, post the treated areas with signs indicating the safe re-entry date. Check with your county agricultural commissioner for latest restricted entry interval.

Preharvest Intervals
Some materials or rates cannot be used in certain crops within a specified time before harvest. Follow pesticide label instructions and allow the required time between application and harvest.

Permit Requirements
Many pesticides require a permit from the county agricultural commissioner before possession or use. When such materials are recommended, they are marked with an asterisk (*) in the treatment tables or chemical sections of this publication.

Processed Crops
Some processors will not accept a crop treated with certain chemicals. If your crop is going to a processor, be sure to check with the processor before applying a pesticide.

Crop Injury
Certain chemicals may cause injury to crops (phytotoxicity) undercertain conditions. Always consult the label for limitations. Before applying any pesticide, take into account the stage of plant development, the soil type and condition, the temperature, moisture, and wind. Injury may also result from the use of incompatible materials.

Personal Safety
Follow label directions carefully. Avoid splashing, spilling, leaks, spray drift, and contamination of clothing. NEVER eat, smoke, drink, or chew while using pesticides. Provide for emergency medical care IN ADVANCE as required by regulation.