OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

WASHINGTON, D.C. 20460

October 20, 2025

Julie Kozlowski
julie@northstarregusa.com
OR-CAL, INC.

Subject: Non-PRIA (Pesticide Registration Improvement Act) Labeling Amendment - Addition of Note to Physician, 4-gallon package size, telephone number, navel orange worm, update chemical resistant gloves. Removed livestock and Red Berry pest and other minor label updates.
Product Name: TETRASUL 4S5
Admin Number: 71096-11
EPA Receipt Date: 08/28/2025
Action Case Number: 00666464

Dear Julie Kozlowski:

The amended labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, is acceptable.

This approval does not affect any terms or conditions that were previously imposed on this registration. You continue to be subject to existing terms or conditions on your registration and any deadlines connected with them.

A stamped copy of your labeling is enclosed for your records. This labeling supersedes all previously accepted labeling. You must submit one (1) copy of the final printed labeling before you release this product for shipment with the new labeling. In accordance with 40 CFR § 152.130(c), you may distribute or sell this product under the previously approved labeling for 18 months from the date of this letter. After 18 months, you may only distribute or sell this product if it bears this new revised labeling or subsequently approved labeling. “To distribute or sell” is defined under FIFRA section 2(gg) and its implementing regulation at 40 CFR § 152.3.

Should you wish to add/retain a reference to your company’s website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product’s label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains statements or claims substantially differing from statements or claims made in connection with obtaining a FIFRA section 3 registration, the website will be referred to the EPA’s Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6.

If you have questions, please contact Senedu Alemu via email at alemu.senedu@epa.gov.

Sincerely,

Kable Bo Davis

Kable Bo Davis, Senior Advisor
FB, RD
Office of Pesticide Programs

Label – 7/25/2025, 10/13/2025

[The following diagram is to be placed in the upper right quadrant of the front panel]

LIME SULFUR	**GROUP**	**M2**	**FUNGICIDE**
LIME SULFUR	**GROUP**	**UN**	**INSECTICIDE**

TETRASUL 4S5

Fungicide-Insecticide-Miticide for Listed Fruits, Nuts, Ornamentals and Roses

Not for residential use or application to residential sites.

KEEP OUT OF REACH OF CHILDREN

DANGER - PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

SEE ADDITIONAL PRECAUTIONARY STATEMENTS BEGINNING ON NEXT PAGE.

ACTIVE INGREDIENT: Calcium Polysulfide …… 27%
OTHER INGREDIENTS …… 73%
TOTAL …… 100%
CONTAINS 2.86 LBS. ACTIVE INGREDIENT PER GALLON

ALL APPLICABLE DIRECTIONS, RESTRICTIONS AND PRECAUTIONS ON THE LABEL ARE TO BE FOLLOWED. SEE DIRECTIONS FOR USE IN BOOKLET.

FIRST AID

If in Eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

If On Skin Or Clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

If Swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to

do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage.

HOT LINE NUMBER: Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact the National Pesticide Information Center at: 1-800-858-7378 for information about this product (including health concerns or pesticide incidents).

NET CONTENTS: 1 GAL., 2.5 GAL., 4 GAL., 5 GAL., 30 GAL., 110 GAL., 220 GAL. & 250 GAL.

Manufactured by:
OR-CAL, INC.
29454 MEADOWVIEW RD
JUNCTION CITY, OR 97448
Phone: (541) 689-4413
EPA REGISTRATION NO. 71096-11
EPA ESTABLISHMENT NO. 52251-OR-005

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER - PELIGRO

Corrosive. Causes irreversible eye damage. Harmful if absorbed through the skin. Harmful if swallowed. Do not get in eyes, on clothing, or on skin. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Mixers, loaders, applicators and other handlers must wear:

- Coveralls worn over long-sleeved shirt and long pants,
- Chemical-resistant gloves (such as: Barrier laminate; Butyl, Nitrile or Neoprene Rubber ≥ 14mils; Polyvinyl chloride (PVC) ≥ 14mils; or Viton ≥ 14mils),
- Protective eyewear (goggles, face shield, or safety glasses),
- Chemical-resistant footwear plus socks,
- Chemical-resistant apron when mixing, loading or cleaning equipment, and
- Chemical-resistant headgear for overhead exposure.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS

Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to fish. Drift may be hazardous to aquatic organisms in water adjacent to treated areas. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

PHYTOTOXICITY AND NON-TARGET ORGANISM ADVISORY STATEMENT: This product may be toxic to plants and may adversely impact the forage and habitat of non-target organisms, including pollinators, in areas adjacent to the treated site. Protect non-target plants, and the forage and habitat of non-target organisms, by following label directions intended to minimize spray drift.

PHYSICAL OR CHEMICAL HAZARDS

Do not mix TETRASUL 4S5 with acids or phosphate fertilizer products. Deadly and potentially extremely flammable hydrogen sulfide gas may be emitted.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and green houses and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), notification to workers, and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard (WPS).

DO NOT enter or allow worker entry into treated areas during the restricted entry interval (REI) or **48 hours**.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls worn over long-sleeved shirt and long pants
- Chemical-resistant gloves (such as: Barrier laminate; Butyl, Nitrile or Neoprene Rubber ≥ 14mils; Polyvinyl chloride (PVC) ≥ 14mils; or Viton ≥ 14mils)
- Chemical-resistant footwear plus socks
- Goggles or face shield
- Chemical-resistant headgear for overhead exposure

ALL APPLICABLE DIRECTIONS, RESTRICTIONS AND PRECAUTIONS ON THE LABEL ARE TO BE FOLLOWED

Faulty spray equipment, highly concentrated materials, or extremes of weather during or following spraying may lead to fruit or foliage injury. The risk of spray injury is greater when drought stress exists. The user is advised not to use Lime Sulfur on any crop unless local use has proved that Lime Sulfur does not damage crops in that locality.

PRODUCT USE RESTRICTIONS

- **Not for residential use or application to residential sites.**
- **DO NOT use Lime Sulfur on apricots.**
- **DO NOT use Oil with Lime Sulfur in summer applications except where specified on the label.**
- **DO NOT apply when temperature exceeds 85° F.**
- **DO NOT apply Oil following Lime Sulfur, nor Lime Sulfur following Oil, in foliage period.**

TO MINIMIZE POSSIBLE ADVERSE EFFECTS:

- **DO NOT** enter or allow worker entry into treated areas during the restricted entry interval (REI) or 48 hours. **DO NOT** enter treated areas without protective clothing until sprays have dried. **DO NOT** apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

- **DO NOT** apply this product through any type of irrigation system.
- **DO NOT** apply TETRASUL 4S5 to Apricots, Evergreens, Euonymus and Rhododendrons or allow spray to drift on these susceptible species.
- **DO NOT** acidify spray solution with strong acidifiers. This product is a highly alkaline material until dry and is incompatible with metal containing sprays including copper and zinc. TETRASUL 4S5 may be mixed with other pesticides that are compatible with or in tank solutions. A compatibility test must be made by each individual user or grower on the basis of possible injury or performance as a pesticide solution when mixed with other pesticides. Each year a test plot needs to be done due to environmental variances from year to year.
- **DO NOT** use Oil with Lime Sulfur in growing season applications except where specified on the label. When applied in dormancy, lime sulfur can be used with oil to increase the penetration of the caustic sulfur into the surface of the infected tissues. Once green tissue appears, combination lime sulfur and oil sprays may cause injury. **DO NOT** apply Oil following Lime Sulfur or Lime Sulfur following Oil within 21 days except where specified on the label, to prevent injury to flowers, leaves and fruit. **DO NOT** use a combination of oil and lime sulfur spray on certain plants including maple, beech, black walnut, Japanese walnut and flowering cherry. Check the product labels for these and other restrictions before use. **See Combination Oil Spray section of the label for more information.**
- **DO NOT** apply during freezing temperatures. **DO NOT** apply when temperature exceeds, or remains at or above 85 F. When high daytime temperatures exist, wait for cool evening or early morning temperatures to apply.

SPRAY DRIFT MANAGEMENT

MANDATORY SPRAY DRIFT MANAGEMENT

Airblast Applications:

- Sprays must be directed into the canopy.
- **DO NOT** apply when wind speeds exceed 15 miles per hour at the application site.
- User must turn off outward pointing nozzles at row ends and when spraying outer row.
- **DO NOT** apply during temperature inversions.

Aerial Applications:

- **DO NOT** release spray at a height greater than 10 ft above the vegetative canopy, unless a greater application height is necessary for pilot safety.
- For all applications, applicators are required to use a medium or coarser spray droplet size (ASABE S572.1).
- The boom length must not exceed 65% of the wingspan for airplanes or 75% of the rotor blade diameter for helicopters.

- Applicators must use ½ swath displacement upwind at the downwind edge of the field.
- Nozzles must be oriented so the spray is directed toward the back of the aircraft.
- **DO NOT** apply when wind speeds exceed 10 miles per hour at the application site.
- **DO NOT** apply during temperature inversions.

Ground Boom Applications:

- User must only apply with the release height recommended by the manufacturer, but no more than 4 feet above the ground or crop canopy.
- Applicators are required to use a Medium or coarser droplet size (ASABE S572.1).
- **DO NOT** apply when wind speeds exceed 15 miles per hour at the application site.
- **DO NOT** apply during temperature inversions.

Boom-less Ground Applications:

- Applicators are required to use a medium or coarser droplet size (ASABE S572.1) for all applications.
- **DO NOT** apply when wind speeds exceed 15 miles per hour at the application site.
- **DO NOT** apply during temperature inversions.

Handheld Technology Applications:

- Take care to minimize spray drift.

SPRAY DRIFT ADVISORIES

THE APPLICATOR IS RESPONSIBLE FOR AVOIDING OFF-SITE SPRAY DRIFT.
BE AWARE OF NEARBY NON-TARGET SITES AND ENVIRONMENTAL CONDITIONS.

IMPORTANCE OF DROPLET SIZE

An effective way to reduce spray drift is to apply large droplets. Use the largest droplets that provide target pest control. While applying larger droplets will reduce spray drift, the potential for drift will be greater if applications are made improperly or under unfavorable environmental conditions.

Controlling Droplet Size - Ground Boom

Volume - Increasing the spray volume so that larger droplets are produced will reduce spray drift. Use the highest practical spray volume for the application. If a greater spray volume is needed, consider using a nozzle with a higher flow rate.

Pressure - Use the lowest spray pressure recommended for the nozzle to produce the target spray volume and droplet size.

Spray Nozzle - Use a spray nozzle that is designed for the intended application. Consider using nozzles designed to reduce drift.

Controlling Droplet Size - Aircraft
Adjust Nozzles - Follow nozzle manufacturers' recommendations for setting up nozzles. Generally, to reduce fine droplets, nozzles should be oriented parallel with the airflow in flight.

BOOM HEIGHT - Ground Boom
Use the lowest boom height that is compatible with the spray nozzles that will provide uniform coverage. For ground equipment, the boom should remain level with the crop and have minimal bounce.

RELEASE HEIGHT - Aircraft
Higher release heights increase the potential for spray drift. When applying aerially to crops, do not release spray at a height greater than 10 ft above the crop canopy, unless a greater application height is necessary for pilot safety.

SHIELDED SPRAYERS
Shielding the boom or individual nozzles can reduce spray drift. Consider using shielded sprayers. Verify that the shields are not interfering with the uniform deposition of the spray on the target area.

TEMPERATURE AND HUMIDITY
When making applications in hot and dry conditions, use larger droplets to reduce effects of evaporation.

TEMPERATURE INVERSIONS
Drift potential is high during a temperature inversion. Temperature inversions are characterized by increasing temperature with altitude and are common on nights with limited cloud cover and light to no wind. The presence of an inversion can be indicated by ground fog or by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing. Avoid applications during temperature inversions.

WIND
Drift potential generally increases with wind speed. AVOID APPLICATIONS DURING GUSTY WIND CONDITIONS. Applicators need to be familiar with local wind patterns and terrain that could affect spray drift. **Boom-less Ground Applications:** Setting nozzles at the lowest effective height will help to reduce the potential for spray drift. **Handheld Technology Applications:** Take precautions to minimize spray drift.

RESISTANCE MANAGEMENT
Adopt an integrated pest management program for fungicide/insecticide/miticide use that includes scouting, uses historical information related to pesticide use, and crop rotation

(where possible), and which considers host plant resistance, impact of environmental conditions on pest development, pest thresholds, as well as cultural, biological and other chemical control practices. Where possible, make use of predictive pest models to effectively time lime sulfur applications. Note that using predictive models alone is not sufficient to manage resistance. Monitor treated pest populations for resistance development. Contact your local extension specialist or certified crop advisor for any additional pesticide resistance-management and/or IPM recommendations for specific crops and pests. Contact OR-CAL, Inc. at orcalinc.com to report suspected pest resistance.

GUIDELINES AND HELPFUL INFORMATION

For best disease control, developmental stages on the label are listed as Dormant through Post Harvest, with some of the important symptoms, life cycles and pest management data given in each stage. This information is found at the end of each crop chart. Lime sulfur is a contact fungicide/insecticide. Anticipated occurrence of infection is helpful for disease control. Lime sulfur is not used in all growth stages, depending upon the crop.
A description of growth stages follows:

Fall—Just before and during leaf drop in the autumn
Post-harvest—After crop is harvested. **Note:** Post-harvest applications do not include applications to harvested crops.
Dormant—After leaves have fallen and first rains begin, but not before the soil is thoroughly wet, until the buds begin to swell. As a rule, this is not before November 15th below 39th parallel.
Delayed Dormant—From the first swelling of the buds until color begins to show.
Bud (Pink)—From the time of new color until the first blossoms begin to open.
Blossom (Bloom)—From opening of the first blossoms until the petals fall.
Calyx—From falling of the petals until the calyxes are closed by the sepal or by the pollen filaments converging.
Growing Season—From when fruit and/or new leaves begin to develop until just before leaf drop.

Symptoms, Life Cycle and Pest Management data is provided by State University Cooperative Extension Services of: Arkansas, California, Colorado, Florida, Georgia, Illinois, Massachusetts, New York, Ohio, Oregon, Pennsylvania, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin.

SPRAY EFFICIENCY GUIDELINES

The most active compounds in the lime sulfur spray are the Calcium Polysulfides (CaS_4 and CaS_5) and are strong reducing agents, taking up oxygen and CO_2 as they dry, changing pH, forming free sulfur and releasing hydrogen sulfide (H_2S)—the rotten egg smell. Particularly, through the release of H_2S, the sulfide solution is drawn into the pests and instantaneously reacts forming crystals of elemental sulfur and changing the surrounding pH. These combined reactions are responsible for destroying the pests. Minimizing these reactions until the spray is in place increases the efficacy. Once the spray is fully reacted and dry, hydrated calcium sulfate remains and can for a short time limit the amount of sunlight

reaching leaf surfaces, mildly reducing metabolic functions until the leaf adapts or the hydrated calcium sulfate is washed off.

Use mixed product within three hours to prevent degradation of spray mix. Even spray distribution is very important. Spray thoroughly, but do not drench foliage. Lime Sulfur does not translocate and is not systemic. Use a full cover spray from the orchard floor or trunk soil line to the top of canopy. See additional label instructions for broader use directions.

The risk of bronzing, tip burn and leaf margin chlorosis is greater when: drought stress exists, temperatures are high and humidity is low, foliage is drenched, and/or excessive rates with low dilutions are used. Faulty equipment can cause damage. If injury occurs, increasing dilution rates by 25% and/or lengthening time from oil applications can reduce symptoms.

Spotting at or near the central part of the leaf is usually caused by fungus or insects which have made possible the entrance of the spray into the inner and more tender tissue. The pre-existing damage to the leaves is made evident after the lime sulfur spray; in these cases, if no apparent damage is sustained, the diseases probably would not be controlled.

Read the label to determine a lower use rate or different application timing or omitting the use of this product on a variety of crop altogether where spray injury cannot be mitigated. In any case, if it occurs, the spray injury will appear within 1 to 4 days. The user is advised not to use Lime Sulfur on any crop unless local use has proved that Lime Sulfur does not damage crops in that locality.

This product may be used with a compatible surfactant or non-metal containing type spray adjuvants to enhance spray coverage.

Sprayer clean up is best achieved by using a mildly acid rinse. If spray contacts concrete or white painted surfaces, discoloration of these surfaces may occur.

DILUTION RATES

Label directions are based on 100 gallons of water plus TETRASUL 4S5 product which is a general application dilution and application rate per acre; however, the grower or applicator will need to make spray volume adjustments to attain sufficient coverage for variations in tree density, row spacing or maturity of any given crop; thus, larger volumes of dilute spray may be used per acre, but maintain percentage dilution when mixing less than 100 gallons; also, medium or low volume spraying employing electrostatic or other low volume sprayers at reduced dilution rates may be used but must follow sprayer manufactures' guidelines and rates must be based on active material per acre; although, spray tests are necessary to ensure that the crop is not damaged at higher concentrations. Where a rate range is given, use the highest rates when disease is severe or where disease was severe in the previous season.

RATE EQUIVALENT: POUNDS (LBS) ACTIVE INGREDIENT (AI) PER GALLON

GALLONS TETRASUL 4S5	LBS ACTIVE INGREDIENT
½	*1.43*
¾	*2.15*
1	*2.86*
1 1/4	*3.58*
1 ½	*4.29*
2	*5.72*
2 ½	*7.15*
3	*8.58*
4	*11.44*
5	*14.30*
6	*17.16*
7	*20.02*
8	*22.88*
10	*28.60*
12	*34.32*

ALMONDS
(Bearing, Non-bearing, Nursery, Ornamental)

USE RESTRICTION: DO NOT apply more than 6 gallons (17.2 lbs. of Calcium Polysulfide) per application per acre or more than 48 gallons of TETRASUL 4S5 product (137.3 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 14 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Pre-harvest Interval = 0 days.

Application timing	**Pests controlled**	**Single use rate per 100 gallons water per acre**	**Maximum number of applications**
Dormant	Mites, Peach Twig Borer, Navel Orange Worm, Powdery Mildew, San Jose Scale, Shot Hole	2 to 3 gallons	2
Apply every 10 to 14 days from November 15 through December for pathogen spores.			
Delayed Dormant	Mites, Scab, Peach Twig Borer	2 to 3 gallons	2
For **Scab,** apply again 2 to 5 weeks after petal fall at the rate of ½ gallon per 100 gallons water per acre.			
Pre-Bloom, Early Bloom, Full Bloom	Brown Rot Blossom Blight, Mites, Peach Twig Borer, Powdery Mildew, Shot Hole	½ to 1½ gallons	4
Apply at Pre-bloom, then again at pink bud (5-10% bloom) and/or full bloom			
Growing Season	Alternaria Leaf Spot, Mites, Peach Twig Borer, Navel	½ to 1 gallon	4

	Orange Worm, Powdery Mildew, Rust, Scab, Shot Hole		
For **Rust and Alternaria leaf spot**, applications need to be made at the first sign of disease, before leaf symptoms appear, in late spring through summer at 10 to 14 day intervals. Non-Bearing Almonds may receive applications at 7 day intervals.			
Fall Clean-up	Overwintering insects and eggs; disease spores and fungal parts	1 to 2 gallons* then 2 to 3 gallons**	2 total
Not for post-harvest application to harvested nuts. Apply *[1 to 2 gallons rate] immediately post-harvest and then **[2 to 3 gallons rate] anytime after leaf drop. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT ALMOND PESTS

Powdery Mildew
Pathogens: *Podosphaera* (=*Sphaerotheca) pannosa, Podosphaera tridactyla, and P. leucotricha*
Symptoms, Life-cycle and Pest Management
Typical symptoms of powdery mildew include russeting on almond hulls. The symptoms are reminiscent of rusty spot on peach fruit caused by *Podosphaera leucotricha* but without the typical powdery white growth. No conidia (asexual spores) or chasmothecia (sexual fruiting structures of powdery mildew fungi) are observed on the fruit. Foliar and twig symptoms are absent.

San Jose Scale
Scientific name: *Diaspidiotus (=Quadraspidiotus) perniciosus*
Symptoms, Life-cycle and Pest Management
Scales suck plant juices from twigs and limbs, and inject a toxin, resulting in loss of tree vigor, growth and productivity, and death of limbs. A red halo is produced around a feeding site on 1-year-old green wood. Untreated infestations can kill fruit spurs and scaffold wood within 1 to 3 years. Dormant season treatments are the key to controlling this pest.

Shot Hole or Coryneum Blight
Pathogen: *Stigmina carpophila, syn. Coryneum carpophilum or Wilsonomyces carpophilus*
Symptoms, Life-cycle and Pest Management
Spots occur on leaves, fruit, twigs, and flowers; however, flower and twig lesions are relatively scarce or difficult to find. Leaf lesions begin as tiny reddish specks that enlarge by several millimeters into spots having tan centers and purplish margins. When the fungus sporulates, the fruiting structure appears as a small dark speck (the sporodochium and spores) in the center of the spot; this is a diagnostic characteristic of shot hole disease. Spots on young leaves usually fall out, leaving a hole (the shot hole); older leaves retain their lesions. Fruit spots are small with purplish margins, slightly corky and raised. Spots

are found on the upper surface of fruit with respect to the way it hangs on trees. Heavy infection of young fruit may cause fruit drop or distortion and gumming of fruit.

The fungus survives on infected twigs and as spores in healthy buds. Spores are moved by water to new sites; prolonged periods of wetness, either due to rain or sprinkler irrigation, are required for the disease to develop. Shot hole can cause losses in yield, defoliation, and weakened trees.

Monitor orchards in fall and spring for shot hole lesions and fruiting structures. Fruiting structures appear in the center of leaf lesions as small black spots and can be seen with a hand lens. If fruiting structures are present in leaf lesions in fall, there is a high risk of shot hole development the following spring. Apply a petal fall treatment. Whether or not a petal fall treatment is applied, monitor leaves in spring for lesions with fruiting structures. As soon as fruiting structures are evident, apply a treatment; continue treatments at the specified label interval as long as conditions are conducive to disease development.

Scab
Pathogen: *Cladosporium carpophilum*
Symptoms, Life-cycle and Pest Management
Grayish black, soft looking spots form on leaves, fruit, and twigs. Young lesions are indistinct small yellow specks, best seen by holding a leaf up to the light. Lesions usually are not visible until late spring or early summer.

Scab may be controlled by shot hole sprays, though a delayed dormant spray for scab improves the efficacy of spring control programs. A scab treatment may be required if rain occurs into mid- to late spring.

Brown Rot Blossom Blight
Pathogen: *Monilinia laxa;* rarely *Monilinia fructicola*
Symptoms, Life-cycle and Pest Management
Young blossom spurs and associated leaves collapse to form shoot blight. Gum may exude at the base of infected flowers. Cankers on blighted twigs have tan centers with dark margins. At high humidity, gray to tan spore masses form on diseased flower parts and twig cankers.

Flowers may become infected from pink bud to petal fall and are most susceptible when fully open. In almonds, stigma, anthers, and petals are all very susceptible to infection. Spores are airborne or rain splashed.
Treat at pink bud (5-10% bloom) and/or full bloom. One application at full bloom is sufficient in most orchards in most years if there is no rain. If brown rot has been severe or in years of extended bloom accompanied by rainfall, a second or even third application near full bloom may be necessary.

Alternaria Leaf Spot
Pathogen: *Alternaria alternata*
Symptoms, Life-cycle and Pest Management

Alternaria leaf spot appears as fairly large brown spots on leaves, about 0.5 to 0.75 inches (12-18 mm) in diameter. The spots turn black as the fungus produces spores. Leaf spot develops most rapidly in June and July, and trees can be almost completely defoliated by early summer when the disease is severe. The disease appears to be most severe where dews form, humidity is high, and air is stagnant.

Monitor for signs of the disease in April through June. If monitoring indicates the presence of Alternaria, begin late spring treatments about mid-April. In orchards with a history of the disease, treat in mid- to late April and 2 to 3 weeks later.

Rust
Pathogen: *Tranzchelia discolor*
Symptoms, Life-cycle and Pest Management
Rust appears as small, yellow spots on the upper surface of leaves. On the lower surface of the leaf these spots take on a rusty red appearance when the rust-colored spores produced in the lesions erupt through the surface. These spores are spread by air movement and infect other leaves to continue the disease cycle. Young twigs may be infected, but twig lesions are seldom seen on almond. Rust occurs sporadically.

The development of rust is favored by humid conditions, and the disease becomes worse when rain occurs in late spring and summer. Trees can be defoliated quickly when rust becomes severe. The rust fungus survives from one season to the next in infected leaves and possibly also in infected twigs. To be effective, treatments must be applied before rust symptoms appear on leaves. Examine one-year-old fruiting wood for small blisters or longitudinal splits. If twig cankers are found and rain is forecasted, make a treatment. Fall and Dormant applications are efficacious in helping manage the disease.

Peach Twig Borer
Scientific Name: *Anarsia lineatella*
Symptoms, Life-cycle and pest management
The peach twig borer is widely distributed and is found on several hosts. The adult moth is about 0.3 to 0.5 inch long, with steel gray mottled forewings. Females lay eggs on twigs, fruit, and leaves. Eggs hatch in 4 to 18 days. Small larvae are almost white with black heads. Mature larvae are about 0.5 inch long and have black heads and brownish bodies with white portions between each body segment, giving the appearance of stripes. Peach twig borer overwinters as larvae in tiny cells, called hibernaculum, that are located in the crotches of 1- to 4-year-old wood and at pruning wounds. Pupae are dark brown, without a cocoon, and are found in tree crevices, between hull and shell, in curled leaves, or in debris on the ground. There may be three to four generations each year.

Dormant or delayed dormant applications will reduce populations of overwintering larvae. When control has not been achieved by delayed dormant treatment, make additional applications during the bloom to petal fall period or shortly thereafter. For summer sprays (May–July) on young trees, monitor for flagging or shoot strikes.

APPLES AND QUINCE

USE RESTRICTION: DO NOT apply more than 15 gallons (42.9 lbs. of Calcium Polysulfide) per application per acre or more than 142 gallons of TETRASUL 4S5 (406.1 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 22 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Pre-harvest Interval = 0 days. Use on the fruit of Golden Delicious and Ginger Gold apples may result in injury.

Application timing	**Pests controlled**	**Use per 100 gallons of water up to 500 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant	Brown Mite, European Red Mite, Pear Leaf Blister Mite, San Jose Scale	2 to 3 gallons	2
Delayed Dormant (when buds begin to show green tips)	Green Apple, Rosy Apple, Wooly Apple Aphid Eggs, Scab, Black Rot and Frogeye Leaf Spot, Brown Mite, Rust Mite, Pear Leaf Blister Mite	2 to 3 gallons	2
For **Green Apple, Rosy Apple and Wooly Apple Aphid Eggs**, apply in February to March, about the time the outer aphis shells split. For **Scab,** Delayed Dormant spray is vital to scab control and leads to cleaner fruit and a minimum of later applications; see Pre-Pink and Pink stages for later application instructions. For **Black Rot and Frogeye Leaf Spot**, see Petal Fall and Growing Season stages for later application instructions. For **Oystershell Scale see Combination Oil spray section.**			
Pre-Pink	Powdery Mildew Scab	1 to 1 ½ gallons ¾ to 1 ½ gallons	*6 total (Pre-Pink to Petal Fall)
For **Powdery Mildew**, apply in pre-pink, pink and calyx stages.			
Pink, Pre-Bloom	Scab Powdery Mildew Sooty Blotch	¾ to 1 ½ gallons ¾ to 1 ½ gallons 1 to 2 gallons	See above*
For **Sooty Blotch**, apply three more applications in pre-bloom and petal fall stages, then 10 days later**.**			
Petal Fall	Apple Blotch, Black Rot and Frogeye Leaf Spot Powdery Mildew, Sooty Blotch	½ to 1 gallon	See above*
For Apple Blotch, Black Rot and Frogeye Leaf Spot, apply two more applications, the first two to four weeks later and ten weeks after petal fall. For **Powdery Mildew,** apply at petal fall and 2 to 3 weeks later, then as needed. Treat immediately if mildew is found on shoots or leaves on inner scaffolds.			
Growing Season	Apple Blotch, Black Rot and	½ to 1 gallon	10

	Frogeye Leaf Spot, Flyspeck, Scab		
For **Apple Blotch, Black Rot and Frogeye Leaf Spot**, apply two to four weeks and ten weeks after petal fall. For **Flyspeck**, apply at 10 to 14 day intervals through the growing season, 4 to 6 applications. For **Scab**, apply every 10 to 14 days until about a month before harvest.			
Fall Clean-Up/ Post-Harvest	Aphid eggs, Apple Blotch, Scab, Rust Mite, Blister Mite, San Jose Scale	1 to 2 gallons* and/or 2 to 3 gallons**	2 total
Not for post-harvest application to harvested fruit. Apply in late fall after temperatures cool and preferably before the first frost. For **Aphid eggs, Apple Blotch, Scab, Rust Mite, Blister Mite, San Jose Scale**, apply *[1 to 2 gallons rate] post-harvest and/or **[2 to 3 gallons rate] anytime after leaf drop begins. Optionally, add 1 to 2 gallons superior oil per 100 gallons of mixed spray. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT APPLE AND QUINCE PESTS

Brown Mite
Scientific name: *Bryobia rubrioculus*
Symptoms, Life-cycle and Pest Management
Brown mites overwinter in the egg stage. Eggs are red and spherical but do not have a stipe rising from the top. Newly hatched brown mites have six legs and are bright red. After they molt for the first time, they turn brown, develop eight legs, and resemble the adult, only smaller. Adult brown mites are dark reddish brown, and the first pair of legs is longer than the other three pairs. Brown mites are usually the first mites to appear in spring. Brown mite is best controlled in the dormant season or early foliage season. In-season sprays are rarely justified.

European Red Mite
Scientific name: *Panonychus ulmi*
Symptoms, Life-cycle and Pest Management
European red mites overwinter as eggs; eggs hatch in spring when trees bloom. With the use of a hand lens, look for overwintering eggs in roughened bark at bases of buds and spurs on smaller branches and twigs, or in wounds, thus the importance of a dormant spray in control. They are globular and red with a slender stalk (stipe) rising from the top center and many grooves extending from top to bottom. During the growing season, eggs are laid on leaves. There are three instars before the adult stage. Immature mites are bright red, except just after molting when they appear bright green. The green color turns to red after the mites resume feeding. Adults are dark red and have six to eight white spots at the base of hairs on the back. Severe mite infestations can cause bronzing of leaves.

Pearleaf Blister Mite
Scientific name: *Eriophyes (=Phytoptus) pyri*
Symptoms, Life-cycle and Pest Management
Adult mites are very small, about the same size as rust mites, and cannot be seen without a 14 to 20X hand lens. The body is white, long and slender, striated, and with a few long

hairs. Immature forms resemble adults but are smaller. Eggs are spherical and pearly white.

Monitor and treat in fall or dormant season. Most of the overwintering blister mites are found beneath the outer bud scales in October and November and are readily controlled with a fall spray. The presence of any mites indicates the need for control. As the season progresses, control becomes more difficult.

San Jose Scale
Scientific name: *Diaspidiotus (= Quadraspidiotus) perniciosus*
Symptoms, Life-cycle and Pest Management
Female San Jose scales give birth to living young that emerge from under the edge of the scale covering. These tiny yellow crawlers wander in a random fashion until they find a suitable place to settle. Immediately upon settling, the crawlers insert their mouthparts into the host plant and begin feeding and secreting a white waxy material (white cap stage); eventually the waxy covering turns black and is known as the black cap stage. Later the covers turn various shades from gray to black. Infested fruit develop a reddish purple ring surrounding each spot where a scale settles. Dormant season treatments are the key to controlling this pest.

Black Rot and Frogeye Leaf Spot
Pathogen: *Botryosphaeria obtuse*
Symptoms, Life-cycle and Pest Management
Black rot and frogeye leaf spot fungus overwinters in cankers, mummified fruits, and the bark of dead wood. In the spring, the black fungal fruiting bodies (pycnidia and perithecia) release conidia and ascospores, respectively. These two types of spores spread the disease to healthy leaves, fruit, and wood. The heaviest discharge of spores occurs around blossom time, but the production of conidia may continue during wet periods throughout the summer. The conidia can remain viable for at least one year.

Leaf infection usually occurs during the petal-fall period. Conidia become attached to the leaf and may germinate in a film of moisture within 5 or 6 hours. After germination, the fungus penetrates the leaf through natural openings in the under surface or through insect, hail, or other wounds. Spore germination and infection are most rapid at 75 to 80 degrees F.

Fruit infection can occur as early as petal fall. The disease usually starts at the calyx end of the fruit. The fungus usually enters the fruit through wounds caused by insects, hail, growth cracks, or an open calyx tube. At first, a light brown spot forms on the fruit. Usually only one spot occurs per fruit. With time, the spots enlarge and commonly develop a series of brown and black concentric bands or rings. The rotted fruit finally turns black. All apple varieties appear to be equally susceptible to fruit rot.

Green Apple Aphid
Scientific name: *Aphis pomi*
Symptoms, Life-cycle and Pest Management

Overwintering eggs are found on twigs of the previous season's growth and on fruit spurs. They are identical in appearance to rosy apple aphid eggs: shiny, black, and football shaped. Newly hatched apple aphids are dark green. Mature aphids on apple foliage in spring and summer have a bright, yellow-green abdomen with darker green lateral spots.

Rosy Apple Aphid
Scientific name: *Dysaphis plantaginea*
Symptoms, Life-cycle and Pest Management
Newly hatched rosy apple aphids are dark green and are found on new growth in early spring. Mature rosy apple aphids, clustering in curled leaves or on young fruits in spring, are purplish and covered with a waxy, powdery bloom. Winged forms develop on apple trees in late spring and migrate to plantain, where they are found in summer. In fall, winged forms develop and migrate back to the apple trees. Overwintering eggs are laid on fruit spurs and shoots of the apple trees; they are shiny, black, and elongated.

Examine the spurs for rosy apple aphid eggs. This can be done in conjunction with the dormant European red mite sample. Although difficult to detect, if any eggs are found, a dormant treatment is required because aphid colonies may quickly spread over the tree. Treat nonbearing trees to prevent stunting of terminal shoots. Because overwintering eggs are located on the bark, delayed dormant application will greatly reduce populations. Young trees need to be treated when terminals are infested.

Woolly Apple Aphid
Scientific name: *Eriosoma lanigerum*
Symptoms, Life-cycle and Pest Management
Woolly apple aphids infest roots, trunks, limbs, shoots, and occasionally fruit of apple trees. The bodies of these bark-feeding aphids are completely covered by masses of white, wool-like, waxy materials. This aphid is found in colonies on the aerial portions of the tree and on roots during winter. The nymphs migrate up or down the trunk of infested trees during summer and fall.

Scab
Pathogen: *Venturia inaequalis*
Symptoms, Life-cycle and Pest Management
Superficial, velvety dark-olive-to-black spots on fruits and leaves are the initial symptoms of apple scab. These fruit spots become scab like with age and tissues may become misshapen.

The fungus survives in dead leaves on the ground. Primary spores are discharged during spring rains and infect young leaves and fruits during prolonged moisture. Secondary spores may spread disease from established infections on trees. As a rule, this disease requires yearly treatments. As plant parts mature and the weather gets warmer, susceptibility to this disease decreases, but pinpoint scab can occur during extended periods of moisture during summer.

The main objective in scab management is the reduction or prevention of primary infections in spring. Extensive primary infections result in poor fruit set and make scab

control during the season more difficult. If primary infections are successfully controlled, secondary infections will not be serious. The key to success in scab control is exact timing and full coverage so the Lime sulfur can eradicate the spores. Scab control is often part of a combination treatment aimed at other diseases and insect control so timing is extremely important.

The key to successfully controlling scab is to apply early and thoroughly to protect new growth. The first susceptible tissues exposed in opening cluster buds are the tips of the leaves and sepals. The most critical period for scab development is from the breaking of the cluster buds until leaves are fully expanded, thus the Delayed Dormant spray is vital to control and leads to cleaner fruit and a minimum of later applications. This is followed by sprays at pre-pink, pink, calyx and first cover. Fungicide protection is especially critical from shuck split to 5 weeks post bloom. Apply sprays every 10 to 14 days until about a month before harvest. During the month before harvest sprays applied for brown rot control will help reduce late-season scab infections on the fruit, twigs, and leaves.

Powdery Mildew
Pathogen: *Podosphaera leucotricha*
Symptoms, Life-cycle and Pest Management
Powdery mildew is distinguished by superficial, white powdery growth on leaves and shoots that results in the stunting and distortion of young growth. Infected fruit are stunted and russeted, and fruit set may be reduced.

The fungus overwinters in terminal buds that are white, flattened, and pointed. Disease development is favored by warm days and cool, moist nights. Thus, the post harvest treatment is important for good management of the fungus.

Preferred spring application is at pre-pink and pink bud. Treat immediately if mildew is found on shoots or leaves on inner scaffolds. If powdery mildew continues to be a problem in the orchard, apply additional treatments as needed.

Sooty Blotch
Scientific name: *Gloeodes pomigena*
Symptoms, Life-cycle and Pest Management
Sooty blotch appears as greenish irregular blotches or patches on the fruit surface. Individual blotches can grow together to form larger infected areas. Sooty blotch fungus is common in the Eastern U.S. but rare in the West. Fruit may be infected by heavy spore dissemination on twigs of various wild trees. On apples, clusters of short dark hyphae make a thallus on the cuticle and this appears as a sooty brown or black blotch ¼ inch in diameter. Numerous spots may completely cover the apple. The disease develops in rainy summer weather when nighttime temperatures and overall humidity remains high. It infects fruit from after petal fall through late summer.

Apple Blotch
Pathogen: *Phyllosticta solitaria*
Symptoms, Life-cycle and Pest Management
Blotch can infect the fruit, leaves, and twigs of apple and crabapple trees. Leaf spots occur on the veins, midribs, and petioles (leaf stems) as long, narrow, slightly sunken, light-colored lesions. These contain several dark dots--the fruiting structures (pycnidia) of the fungus. When petiole infections are numerous, leaves might drop off.

New shoot infections look similar to petiole infections at first, except that they are longer and more visible. They occur at the juncture of the petiole with the shoot (node) or between the nodes. Once the lesion is established, it might continue to enlarge for 3 or 4 years, becoming noticeably larger than the diameter of the normal limb. In this manner, the organism causing apple blotch establishes itself in the tree.

Fruit infections vary in size from small, dark spots to large blotches that can cover much of the fruit surface. Edges of the larger lesions are irregularly lobed with many radiating projections. Large lesions often cause the fruit to crack.

The fungus overwinters in twig and limb cankers. The first infections in spring occur at about petal fall on leaves, young fruit, and new shoot growth and are caused by spores oozing from the cankers. Secondary infections from spores produced in the pycnidia can occur until late summer. Frequent rains and temperatures above 75°F favor the disease.

Since the disease characteristically occurs annually, control measures need to be applied each year. There are two lines of remedial procedure: the removal of the cankered twigs and the protection of the susceptible parts by spraying. Spraying must be done before inoculation takes place; this occurs within a month after the petals fall. First application, three weeks after the blossoms drop. Make a second application two to four weeks after the first. A third application is advised ten weeks after the petals fall. Fall clean up spray and dormant sprays can help reduce overwintering spores.

Fly Speck
Scientific name: *Microthyriella rubi*
Symptoms, Life-cycle and Pest Management
Similar to Sooty blotch, Fly speck fungus is common in the Eastern U.S. but rare in the West. Flyspeck appears as groups of small, shiny, black dots on the fruit surface. Fruit may be infected by heavy spore dissemination on twigs of various wild trees. The disease develops in rainy summer weather when nighttime temperatures and overall humidity remains high. It infects fruit from after petal fall through late summer.

BLUEBERRY

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 71 gallons of TETRASUL 4S5 product (203.1 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year

when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 300 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant	Anthracnose, Fusicoccum (Godronia) Canker, Stem Canker and Stem Blight Mummy berry	2 to 3 gallons 3 gallons	2 total
For **anthracnose**, spray the ground as well. For **mummy berry**, use up to 300 gallons of spray per acre. Additionally, spray on the soil surface very early in the spring to destroy the apothecia (as the first mummy berry cups appear), use 3 gallons of product per 100 gallons of water. Use up to 300 gallons of spray per acre.			
Delayed Dormant	Anthracnose, Phomopsis Canker and Twig Blight, Exobasidium fruit and leaf spot	2 to 2 ½ gallons	2
For **Anthracnose**, apply in early spring before growth starts. Follow-up with Pre-Bloom applications in the next section. In addition to spray application, remove old fruiting canes as soon as the crop is picked.			
Pre-Bloom, Bloom, and Growing Season	Anthracnose Citrus Thrips, Mites, Powdery Mildew	2 gallons* and ½ to 1 ½ gallons** ½ to 1 ½ gallons	10 total
For **Anthracnose,** apply *[2 gallons rate] when shoots are 6 to 8 inches high and then apply **[½ to 1½ gallons rate] just before the blooming period.			
Fall clean up, post harvest	Blueberry Bud Mite Mummy berry and other Overwintering pests	1 to 1 ½ gallons 2 to 3 gallons	2 total
Not for post-harvest application to harvested fruit. For **Blueberry Bud Mite**, apply immediately after harvest before buds are fully formed so the product can reach the mites under the bud scales. A second application before buds are fully formed may be required to achieve control in highly infested sites. For **Mummy Berry and other Overwintering pests**, apply at post-harvest as leaves begin to fall (September or October) or as an early dormant spray. Use up to 300 gallons of spray per acre. Apply to ground as well. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT BLUEBERRY PESTS

Anthracnose
Pathogen: *Colletotrichum gloeosporioides* Penz.
Symptoms, Life-cycle and Pest Management
Blossom end of ripe fruit softens and orange spore masses seep out. Infected green fruit do not show symptoms until they ripen, and so the disease is nick-named "ripe rot". The fungus overwinters on twigs. Spores are spread by rain splash to bloom and green fruit. Anthracnose is favored by prolonged periods of warm wet weather during bloom and just before harvest. Apply pre-bloom to reduce overwintering inoculum and twig blights.

Fusicoccum (Godronia) canker
Pathogen: *Fusicoccum putrefaciens*
Symptoms, Life-cycle and Pest Management
Fusicoccum canker appears as individual stems exhibit 'flagging' or wilting during the summer. Dark red or brown infected areas form at the base of canes, become covered with pycnidia. Older dead canes develop the sexual fruiting bodies (apothecia). This is the Godronia stage of the disease. Both Fusicoccum and Phomopsis canker can appear separately; however in some cases these cankers may occur simultaneously.

The fungi over winter on 1, 2, or 3-year-old wood, and produces sunken cankers encircling the stems. A mass of black tiny fruiting bodies, (pycnidia) are produced on canker surfaces the first year. During the spring to summer months pycnidia continue to produce conidia that infect susceptible tissue, spreading by rain or water contact. When the temperature is warm and fruit is present, leaves on cankered stems wilt. Precise environmental conditions for infection have not been determined, but the greatest activity for Fusicoccum canker is at temperatures between 50 –72°F. Dormant applications of lime sulfur have shown control of cankers.

Mummy Berry
Pathogen: *Monilinia vaccinii-corymbosi.*
Symptoms, Life-cycle and Pest Management
The first symptom that becomes visible is a blight of young developing shoots in spring. Occasionally, flower clusters also become blighted. The next symptom becomes visible as the berries start to ripen, at which time they become light brown to pink and start to shrivel up, turning into fruit "mummies". Most of the berries fall to the ground, but some end up being harvested. The mummy berry fungus overwinters in mummified fruits on the ground, and in early spring produces spores that start the disease cycle anew. Mummy berry is more common in wet fields and poorly drained areas, therefore scouting must target those sites. Dry, sandy sites may not have any mummies at all. However, wild or escaped blueberries in nearby wooded areas can also be a source of infection.

Mummy berries can be found on the ground below blueberry bushes anytime after harvest and look shriveled and are purplish white in color. Mummies will start germinating in early spring and will show small brown, finger-like projections (stipes). Only a portion of the mummies germinate in any one year. The wetter the site, the higher the germination percentage will be. There can be anywhere from one to seven stipes on a mummy. The

stipes have a hole in the tip that develops into a small mushroom cup, 1/16 to 1/3 of an inch in diameter. The mushrooms start shooting spores when the cup is about 1/8 inch in diameter. Over a million spores can be released per day by a fully functioning mushroom. The ascospores are windborne and can travel fairly long distances within fields and even between fields. Ascospore release continues until the cup collapses. Cups may last 1 week at room temperature to up to 4 weeks at lower temperatures.

There are two stages of infection. First the developing shoots are infected by the ascospores from the mummy berry cups. Blueberry cultivars are susceptible from bud break until shoots are about 3 inches long. Flower clusters also become blighted; these are called flower strikes. Secondary spores (conidia) develop in a grayish layer on blighted shoots and flower clusters and are rain splash- or insect-dispersed to the flowers. Bees are attracted to the infected shoots by their UV-light pattern and unwittingly pick up the spores, which then hitch a ride to the flowers. The conidia infect the flower stigma followed by growth of the fungus into developing fruit, which eventually mummifies and drops to the ground.

Lime sulfur is sprayed on the soil surface very early in the spring to destroy the apothecia (as the first mummy berry cups appear) with lime sulfur at 16-24 gal/acre in 200-300 gal water.

Stem Canker and **Stem Blight**
Pathogen: *Botryosphaeria corticis* and *B. dothidea*
Symptoms, Life-cycle and Pest Management
Symptoms of stem canker first appear as small red lesions on succulent stems. Lesions become swollen and broadly conical within six months. Symptoms vary with the susceptibility of the cultivar. Numerous fruiting bodies of the pathogen occur in cankers of susceptible cultivars. Stems of current season growth are infected in late spring during wet weather and spread by wind throughout the planting. After cankers develop the stem can become girdled and will eventually die. In resistant cultivars, the fungus is restricted to outer portions of the stem, and those cankers are small raised lesions.

Stem blight is commonly known as dieback. Early symptoms will show up as yellowing and reddened or drying leaves on one or more branches. The most obvious clue is a dead branch among live branches. Infection near the ends of twigs can be confused with winter injury. Inoculum is present throughout the growing season in the south, with levels highest in June and July. This fungus enters the plant through wound sites. Most infections occur in the early part of the growing season. Infected plants begin showing symptoms about 4-6 weeks after infection takes place. Dormant application of lime sulfur is advised for control.

Phomopsis Canker and Twig Blight
Pathogen: *Phomopsis vaccinii*
Symptoms, Life-cycle and Pest Management
Phomopsis canker overwinters in infected plant parts. The primary symptom of twig infection is a blighting of one-year-old woody stems that have flower buds. As with other canker diseases, the most conspicuous symptom is "flagging"--during the summer, individual stems wilt and die while leaves turn reddish and remain attached. Under severe

disease conditions, several individual canes may be affected on a single bush. The fungus enters the flower buds and eventually moves into the stem. Infected stems will wilt and die, and young twigs will die back from elongated cankers produced by the fungus.

Cankers on one-year-old stems become obvious by early summer and continue to progress downward, eventually encircling the entire shoot. In hot weather, leaves on infected twigs turn brown and remain attached to the stem. As canes mature, they become girdled by the diseased lesions. Fruiting structures of the fungus will form on dead twigs and leaves. These fruiting structures look like small, black dots, which are the spore-containing bodies (pycnidia) of the fungus. These spores are spread primarily by rain splash. Infected fruit are soft and often split and leak juice. To aid control apply lime sulfur at bud-break and in the fall.

Blueberry Bud Mite
Scientific Name: *Acalitus vaccinii*
Symptoms, Life-cycle and Pest Management
All four life stages of the blueberry bud mite live together in large clusters and reproduce rapidly within the scales of the blueberry bud. 15 days are required from oviposition to the adult stage. During fall and early winter, all four life stages are present in low numbers between the preferred large and succulent scales of dormant flower buds. The mites remain almost continuously in the protective confines of the bud. Here, they feed on the epidermal region of the developing leaf, floral parts, and the developing fruit, transferring a substance or toxin, causing the tissue to become roughened and blistered in appearance. Buds appear rosetted and may desiccate due to mite feeding and fail to open. Flowers and berries developing from buds with few mites usually have small blisters and pimples. Summer generations cause retarded leaf growth, reducing the vegetative growth that impacts the following year's crop.

Although some blueberry cultivars are less likely to be infested, there are no fully resistant cultivars identified. Directions for the control of blueberry bud mite are limited to pruning of older and removing of infected branches, and post-harvest application of miticides. Unless the interior spaces of the bud scales are wetted, it is unlikely good control will be achieved. Use of a surfactant to improve the spreading and penetration of the spray increases control of bud mites.

Exobasidium leaf and fruit spot
Pathogen: ***Exobasidium maculosum***
Symptoms, Life-cycle and Pest Management
The first visible symptoms of the disease are light green leaf spots (approximately ¼ inch in diameter) that form on the upper side of infected leaves in the spring. Leaf spots are often pure white on the leaf underside due to a thin, dense layer of fungal growth. Furthermore, the affected leaf area is slightly thicker than surrounding tissue, and becomes necrotic with age during the summer. Spots on fruit are first apparent when fruit turn color, average ¼ inch in diameter and are circular and generally regular in appearance. They do not protrude, but may be sunken and are sometimes tinged with a red color. The diseased fruit tissue is green and unripe, extending roughly 1/8 inch toward the berry center. The spots on berries can occasionally show sparse white fungal growth. Although the fruit

spots do not rot or become necrotic, they do not ripen well and remain firm and green. Exobasidium-affected berries can be eaten, but they are extremely chewy where the spot occurs.

It is assumed that the disease has a one-year cycle (i.e., is not systemic within the plant), and that the pathogen overwinters on or in infected bud scales and/or on or in the bark. Infection occurs in the spring, and late-season leaf flushes do not show additional spots. It is likely that poor air flow, slow drying conditions, and high humidity contribute to an increase in disease severity.

Where plants receive an effective early-season fungicide program, we have not observed the disease at significant levels. In our research trials, a single late-dormant application of lime sulfur provided substantial and statistically equivalent management. Apply lime sulfur at bud swell, about 2 weeks before first green tissue or flowers are exposed.

CANEBERRIES
(Blackberries, Boysenberries, Dewberries, Raspberries, and other caneberries)

USE RESTRICTIONS: DO NOT apply more than 6 gallons (17.2 lbs. of Calcium Polysulfide) per application per acre or more than 50 gallons of TETRASUL 4S5 product (143.0 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant	Cane Blight, Cane and Leaf Rust, San Jose Scale, Spur Blight and Overwintering Fungus Spores	2 to 3 gallons	2
Spray ground as well.			
Delayed Dormant	Blackberry Leaf Mite, Cane Blight, Dryberry Mites, Oystershell Scale, Purple Blotch, Powdery Mildew, Redberry Mite, Rose Scale, San Jose Scale, Septoria Leaf Spot, Spur Blight, Yellow Rust, Anthracnose	2 to 3 gallons	2
For **Blackberry Leaf Mite, Cane Blight, Dryberry Mites, Oystershell Scale, Purple Blotch, Powdery Mildew, Redberry Mite, Rose Scale, San Jose Scale, Septoria Leaf Spot, Spur Blight, Yellow Rust**, apply before shoots reach 3/8 inch. For **Anthracnose**, apply in early spring before growth starts. Follow-up with Pre-Bloom applications in the next section. In addition to spray application, remove old fruiting canes as soon as the crop is picked.			

Pre-Bloom, Bloom, and Growing Season	Anthracnose Cane and Leaf Rust, Powdery Mildew, Redberry Mite	2 gallons* and ½ to 1 ½ gallons** ½ to 1 ½ gallons	10 total
For **Anthracnose,** apply *[2 gallons rate] when shoots are 6 to 8 inches high and then apply **[½ to 1½ gallons rate] just before the blooming period. **DO NOT** use on Raspberries at this time.			
Fall Clean-Up	Redberry Mite, Blackberry Leaf Mite, Rust, Rose Scale, San Jose Scale	2 to 3 gallons	2
Not for post-harvest application to harvested fruit. Apply after old fruiting canes have been removed from the field. Spray ground as well. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves and canes.			

ABOUT CANEBERRY PESTS

Cane Blight
Pathogen: *Leptosphaeria coniothyrium*
Symptoms, Life-cycle and Pest Management
The fungus overwinters on infected dead canes. In the spring spores are blown, splashed by rain, and carried by insects to nearby canes. Under moist conditions the spores germinate and enter the plant through pruning wounds, insect damage, fruit stem breaks and other wounds. The fungus can then rapidly kill bark and other cane tissue. Dark brown to purplish cankers form on the new canes near the end of the season. The cankers enlarge and extend down the cane or encircle it causing lateral shoots to wilt and eventually die. Infected canes commonly become cracked and brittle and break easily. This disease is usually most severe during wet seasons.

Cane and Leaf Rust
Pathogen: *Kuehneola uredinis*
Symptoms, Life-cycle and Pest Management
Cane and leaf rust occurs on some blackberry cultivars, especially trailing varieties. The first symptom of cane and leaf rust is lemon yellow pustules (uredinia) that split the bark of the fruiting canes of susceptible blackberries. Spores from these pustules (urediniospores) infect leaves and produce small yellow pustules (uredinia) on the underside of leaves during early summer. Defoliation can occur if infection is severe. Buff-colored telia develop among the uredinia on leaves in early fall.

It is important not to confuse this common blackberry disease with the less common but far more damaging orange rust, which causes plants to produce many small, weak shoots from the base of the plant.

On susceptible blackberry varieties leaf defoliation can be severe and result in the loss of plant vigor. Normally cane and leaf rust doesn't infect the fruit but masses of spores falling on fruit can render it unmarketable. Raspberries are hosts, but occurrence of this disease

on this crop is rare. Wet spring conditions will favor disease development. The fungus overwinters on canes as mycelium or latent uredinia. Cane and leaf rust can be distinguished from orange rust by the presence of yellow pustules (uredinia) on both the canes and leaves. Orange rust has orange pustules on leaves only.

Removal of fruited canes after harvest and sprays of lime sulfur or some fixed coppers are acceptable management tools.

Spur Blight
Pathogen: *Didymella applanata*
Symptoms, Life-cycle and Pest Management
This disease is more common and serious on red raspberries and to a lesser extent on black and purple raspberries and loganberries. Blackberries and dewberries are highly resistant to this disease. Spur blight can cause yield losses in several ways. It can blight the fruit bearing spurs, cause premature leaf drop, and kill buds on the canes that later develop into fruit bearing side branches. In addition, berries produced on diseased canes may be dry, small, and seedy. Affected canes may be more vulnerable to winter injury than uninfected ones.

Chocolate brown, dark blue or purplish spots with encircling bands form on the new canes and leaf petioles in the late spring or early summer, usually at a bud or leaf attachment. The infected areas, which vary from half an inch to several inches long, gradually enlarge until the cane is girdled.

The fungus survives on infected canes during winter. The following spring and summer, during wet and rainy periods, spores are released and carried by splashing rain and wind to nearby canes and leaves, where they germinate and penetrate plant tissue. Infections commonly occur where the leaf petiole is attached to the stem. Treat with lime sulfur when the buds show no more than 3/8 inch (1 cm) of green at the tips.

Anthracnose
Pathogen: *Elsinoe veneta*
Symptoms, Life-cycle and Pest Management
The fungus overwinters in the bark of within lesion on infected canes. In early spring the spores are rain-splashed, blown or carried by insects to young, succulent, rapidly growing plant parts that are susceptible to infection. The spores germinate in a film of water and penetrate into the plant tissue. Symptoms appear about a week later. Anthracnose can cause symptoms on canes, leaves, fruit and stems of berry clusters. The most striking symptoms appear on the canes.

Infected canes will first show small purplish spots that grow in diameter and become oval in shape. The centers become sunken and are lighter in color. The margins are raised and purple to purplish-brown. If numerous, the lesions may merge and cover large portions of the cane and the diseased tissue will extend down into the bark, partially girdling the cane. As the canes dry in late summer and early fall, diseased tissues often crack. In the following year, fruit produced on severely diseased canes may fail to develop to normal size. On

leaves anthracnose first appears as small yellowish-white spots on the upper surface. The spots enlarge and develop darker margins. The light centers may drop out producing a "shot hole" effect.

Dryberry Mite
Scientific Name: *Phyllocoptes gracilis*
Symptoms, Life-cycle and Pest Management
Adult mites have an oval body. They lack antennae and body segmentation. They are found on ripe fruit, in cracks, and in crevices. Ripening berries with dryberry mite infestations become dry.

Prune out and destroy damaged fruit. Apply lime sulfur at the delayed-dormant stage, just before buds break.

Oystershell Scale
Scientific Name: *Lepidosaphes ulmi*
Symptoms, Life-cycle and Pest Management
The oyster shell scale belongs to a group of insects called the armored scales. There is one or two generations of oystershell scale each season. Oystershell scale feeding weakens the plant. Damage consists of small, dark brown scales cluster on bark or on fruit.

Scales overwinter as fertilized females with 40-150 egg masses under their scale. Eggs hatch in late spring, approximately two to three weeks after bloom, and young crawlers emerge. Crawlers are small white with six legs, moving to an appropriate site where to begin feeding. They insert their mouthparts into the plant, begin to suck sap and soon molt. From this point on, they will remain in the same spot for the rest of their lives. After a few hours of feeding, the scale begins to form. Mating occurs and females die shortly after they lay their last eggs.

Crawlers spread through orchards by wind, birds' feet, workers' clothing and on farm equipment.

Use lime sulfur during late dormancy just before bud break when scales have only a thin wax covering. Delaying application until green tissue is present often results in poor scale control, because scales have produced a larger protective wax coating making complete coverage of the insect more difficult.

Purple Blotch
Pathogen: *Septocyta ruborum*
Symptoms, Life-cycle and Pest Management
All blackberries and hybrid berries are affected by this disease. The causal organism is a fungus similar to Septoria rubi, which causes leaf and cane spot. Dark green irregularly shaped lesions form on canes late in the growing season. In winter and spring, the lesions turn purple with a red margin. Small black fruiting structures (pycnidia) are found in the center of mature lesions on floricanes, which only infect primocanes. Affected areas are ½ to 2 inches long and develop into cankers, which girdle the cane.

The fungus that causes purple blotch survives on infected canes. Spores are released and spread to primocanes from April to mid August. Spores are dispersed by splashing water or rain. Most spores are released when temperatures are near 70º F. Symptoms do not develop unless a chilling requirement is met.

Fungicide applications will not remove the disease once it has developed, but will prevent infection from spreading on young primocanes. For every-year (EY) producers, sprays usually occur after harvest, in October (before every rains begin), and at bud break in early March.

Powdery Mildew
Pathogen: *Sphaerotheca macularis*
Symptoms, Life-cycle and Pest Management
Caneberry leaves infected with powdery mildew develop light green (chlorotic) spots on the upper surface, often with white mycelial growth on the lower leaf surface. Upper surfaces of leaves have a mottled appearance similar to that caused by mosaic virus infection. Infected shoot tips and fruit may also become covered with white, mycelial growth. Severely infected shoots become long and spindly with dwarf leaves that curl upward. Severely diseased plants may be stunted. The disease overwinters as mycelium in buds or on the surface of canes, thus the need for early control by delayed dormant treatment.

Redberry Mite
Scientific Name: *Acalitus essigi*
Symptoms, Life-cycle and Pest Management
The redberry mite is a perennial pest of both cultivated and wild blackberries but is not an economic pest of raspberries. These mites belong to a group of microscopic mites known as eriophyid mites. This eriophyid mite has two pairs of legs; it can be seen with a 10 to 20X hand lens but is best seen with a dissecting microscope. The adult is wormlike and translucent white.

Redberry mites overwinter in bud scales or deep in buds. As shoot growth develops in spring, the mites move onto the developing shoots. As flower buds appear, the mites work their way into the unfolding buds, into the flowers, and down among the developing druplets of the berries, especially near the bases and around the core of the fruit.

Fruit infested with redberry mites do not develop normally colored druplets. Affected druplets usually remain hard and have a green or bright red color. The fruit is unmarketable. Fruit partially affected may have some druplets remain red and hard with the remaining druplets developing proper ripening. If not controlled, redberry mite can spread from isolated infestations to sizable portions of a planting in the next season. Very high populations can result in significant crop loss. The pest is most damaging to late-maturing blackberry cultivars.

The best time to control redberry mite depends upon variety grown and miticide that will be used. Never tank-mix oil and sulfur products because of the risk of phytotoxicity during the growing season.

Timing of lime sulfur applications depends upon variety grown and redberry mite severity. For blackberry varieties that retain a leaf canopy through the winter, begin lime sulfur applications at bud break and continue at 3-week intervals up to 12 days before the start of harvest. For blackberry varieties that naturally defoliate over the winter, apply lime sulfur before buds break dormancy and then not again until canes have a full leaf canopy and first bloom appears.

Rose Scale
Scientific name: *Aulacaspis rosae* (Bouche)
Symptoms, Life-cycle and Pest Management
It is distributed in the United States on raspberry, blackberry, dewberry, rose, pear and some other plants. Female scales are white with more or less yellow at margin; nearly circular, about one-tenth of an inch in diameter. Male scales are white, narrow, and very small.

Plants thickly infested appear as though sprayed with whitewash. It winters in various stages, so all may be present at almost any time.

San Jose Scale
Scientific name: *Diaspidiotus (= Quadraspidiotus) perniciosus*
Symptoms, Life-cycle and Pest Management
Female San Jose scales give birth to living young that emerge from under the edge of the scale covering. These tiny yellow crawlers wander in a random fashion until they find a suitable place to settle. Immediately upon settling, the crawlers insert their mouthparts into the host plant and begin feeding and secreting a white waxy material (white cap stage); eventually the waxy covering turns black and is known as the black cap stage. Later the covers turn various shades from gray to black. Dormant season treatments are the key to controlling this pest.

Septoria Leaf Spot
Pathogen: *Septoria rubi*.
Symptoms, Life-cycle and Pest Management
The fungus overwinters in dead plant debris and on infected canes. In the spring, large numbers of spores are released and carried to young susceptible leaves and canes by splashing or wind-driven rain. The fungus spores germinate in a film of moisture and penetrate the leaf. Infected leaves will develop lesions that have a whitish to gray center, surrounded by a brown to purple border. Leaves of severely infected plants become badly spotted. The disease can cause premature defoliation that will produce weak plants more susceptible to winter injury.

Yellow Rust—Red Raspberry
Pathogen: *Phragmidium rubi-idaei*
Symptoms, Life-cycle and Pest Management
Yellow rust infects only red raspberry and is not a systemic pathogen, meaning the pathogen does not spread internally through the plant. In spring, yellowish orange pustules (aecia) form on the tops of raspberry leaves close to the ground. Early season

observation of aecia on the tops of leaves is a way to distinguish this rust from late leaf rust, which also infects red raspberry.

Severely affected leaves can dry out and die. Later in June and July, orange to yellow pustules (uredinia) appear on the undersides of leaves; these structures later darken as black teliospores develop from the middle of July to fall. The yellow rust fungus overwinters as teliospores on the bark of remaining floricanes (fruiting canes). Such canes are the sources of inoculum that affect emerging leaves and primocanes (vegetative canes) the following spring.

CHERRIES (SWEET and TART)

USE RESTRICTIONS: DO NOT apply more than 9 gallons (-25.7 lbs. of Calcium Polysulfide) per application per acre or more than 75 gallons of TETRASUL 4S5 (-214.5 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 24 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 300 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant	Coryneum Blight (Shot Hole), Scale Insects, Leaf Curl, Leaf Spot, Peach Twig Borer, Mites	2 to 3 gallons	2
Delayed Dormant	Leaf Curl, Powdery Mildew, Scab	2 to 3 gallons	2
Pre-Bloom	Brown Rot Blossom Blight, Scab, Powdery Mildew	3/4 to 2 gallons	4
For **Brown Rot Blossom Blight, Scab**, begin at white bud (popcorn) and repeat every 10 to 14 days through bloom if rains continue. For **Powdery Mildew,** begin at white bud (popcorn) and repeat every 10 to 14 days through petal fall. Treat immediately if mildew is found on leaves or shoots of inner scaffolds.			
Petal Fall and Growing Season	Leaf Spot, Powdery Mildew	½ to 1 gallon	10
Apply at petal fall and 2 to 3 weeks later then as needed. Treat immediately if mildew is found on shoots or leaves on inner scaffolds.			
Pre-Harvest	Brown Rot (Fruit), Leaf Spot, Powdery Mildew	½ gallon	5
Apply 3 to 5 sprays at weekly intervals up to 2 days before harvest.			
Post-Harvest	Brown Mites, Powdery Mildew-, Two Spotted Mites	½ to 1 gallon	2
Not for post-harvest application to harvested fruit.			
Fall Clean-up	Overwintering insects and eggs;	1 to 2 gallons*	2 total

	disease spores and fungal parts, Coryneum Blight (Shot Hole), Leaf Spot	and/or 2 to 3 gallons**	
Not for post-harvest application to harvested fruit. Apply *[1 to 2 gallon rate] post-harvest and/or **[2 to 3 gallon rate] anytime after leaf drop begins. Optionally, add 1 to 2 gallons superior oil per 100 gallons mixed spray. For **Coryneum Blight (Shot Hole),** fall application before winter rains begin is the most important application for control of this disease. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches. To aid in **Leaf Spot** control, spray ground as well to kill spores on dead leaves.			

ABOUT CHERRY PESTS

Cherry Leaf Curl
Pathogen: ***Taphrina deformans or cerast***
Symptoms, Life-cycle and pest management
The fungus also affects peach and nectarine trees. The fungus spreads on water, sticking in the cracks of the tree's bark and on newly developing buds. As the weather warms, the spores reproduce on the flowers and emerging leaves, but only if they are wet. Once a branch is infected, however, it will always produce infected leaves if preventative measures are not taken.

Leaves infected by the fungus will appear thickened and discolored. They may turn brown, yellow or even purplish and curl up or twist. Eventually, they dry up and fall off the tree. Spray the tree with a fungicide in the fall, after the leaves have dropped, and again in the spring just before the leaves begin to open.

Cherry Leaf Spot
Pathogen: *Blumeriella jaapii* (previously called *Coccomyces hiemalis*)
Symptoms, Life-cycle and pest management
The fungus overwinters in dead leaves on the ground. In early spring (about petal fall), fungal fruiting bodies called apothecia develop in these leaves. Spores (ascospores) are produced in the apothecia and are forcibly discharged during rainy periods for about six to eight weeks, starting at petal fall. The optimal temperatures for ascospore discharge are 61 degrees F (16 degrees C) and higher. Very few ascospores are discharged at temperatures below 46 degrees F (8 degrees C). These ascospores are spread by wind or splashing raindrops to the green, healthy leaves and serve as primary inoculum for disease. The ascospores stick to the leaf surface, germinate in a film of water, and within several hours at the proper temperature (Table 1), penetrate the leaf through stomata (natural openings) on the underside of the leaf. The small purple spots soon appear on the upper surface. Incubation time, from fungus penetration to the appearance of the spots, varies with temperature. Under damp conditions and with temperatures between 60 and 68 degrees F (15 and 20 degrees C), the period may be as short as five days. When rain and dews are absent and at lower temperatures, as long as 15 days may be required before symptoms appear.

Once lesions have developed, masses of secondary or summer spores (conidia) are formed from the slightly concave eruptions (acervuli) on the underside of the leaf. This mass of conidia provides the white appearance to the under-leaf lesions. Conidia are spread to other leaves by splashing raindrops and are capable of causing new infections (each producing thousands of additional conidia) under the temperature and wetness conditions. Serious leaf spot damage usually occurs in years with numerous rainy periods throughout late spring and summer, when repeated secondary infection cycles allow the disease to snowball into an epidemic. Preventive fungicides are advised at petal fall, shuck fall and two weeks later.

Coryneum Blight or Shot Hole Disease
Pathogen: *Stigmina carpophila, syn. Coryneum carpophilum or Wilsonomyces carpophilus*
Symptoms, Life-cycle and pest management
Coryneum blight is also called shot hole disease, California blight, peach blight or pustular spot. Severe foliar shot holing may weaken a tree, while the most apparent damage is infection of the fruit.

Fruits are blemished and disfigured by spots and lesions from Coryneum blight. Outbreaks of this disease take place in spring and early summer and in cool, wet periods prior to harvest. Blight is difficult to eradicate because the fungus in infected buds and twigs may produce spores for two to three years, but the fungus does not overwinter in old infected leaves.

The fungus apparently overwinters in dormant infected leaf buds, blossom buds and small twig cankers. Spore production begins in early spring. The first symptoms of infection are observed on young leaves as small red spots that enlarge and become purple with a white center. These spots then drop out of the leaf blade leaving a "shot hole." Numerous holes give a very tattered appearance to infected leaves.

Early season infections are characterized by the presence of a reddish-purple halo surrounding a light tan, scab-like center spot, which is the dead fruit skin killed by the fungus. Severe, early season infections also can have gummy ooze on the fruit surface.

Coryneum blight is serious in years when frequent light showers occur during the summer. Wind currents disperse the spores of this fungus from infected twigs and leaves to uninfected branches. These spores require four hours of contact with free water droplets on the fruit, leaf or twig surface in order to germinate and cause infection. Temperatures of 70 F to 80 F are optimum for Coryneum infections. Lesions can develop at 45 F but at a much slower rate. It takes from two to five days for a spore to initiate infection and cause a visible lesion. Because bud and twig lesions may continue to produce spores for two to three years, a conscientious program of chemical control and removal of dead wood is necessary to eradicate the disease.

Peach Twig Borer
Scientific Name: *Anarsia lineatella*
Symptoms, Life-cycle and pest management
The peach twig borer is widely distributed and is found on several hosts. The adult moth is about 0.3 to 0.5 inch long, with steel gray mottled forewings. Small larvae are almost white with black heads. Mature larvae are about 0.5 inch long and have black heads and brownish bodies with white portions between each body segment, giving the appearance of stripes. Peach twig borer overwinters as larvae in tiny cells, called hibernaculum, that are located in the crotches of 1- to 3-year-old wood and at pruning wounds. There may be three to four generations each year, but later generations occur after cherry harvest.

Dormant or delayed dormant applications will reduce populations of overwintering larvae. When control has not been achieved by delayed dormant treatment, make additional applications during the bloom to petal fall period or shortly thereafter. For summer sprays (May–July) on young trees, monitor for flagging or shoot strikes.

San Jose Scale
Scientific Name: *Quadraspidiotus perniciosus*
Symptoms, Life-cycle and pest management
The San Jose scale has no visible egg stage; scales emerge from under the edge of their mother's covering as nymphs. There are three stages during the first instar: the crawler, which is mobile and locates a feeding site; the white cap, which feeds and becomes covered with a waxy secretion; and the black cap, which is a darker harder wax covering under which they may overwinter. The male scale will molt four times, and is elongate and black. The female molts twice, and is circular and gray. Males emerge as winged adults while the females remain wingless under the scale covering. There are three to four generations per season taking about 7 to 8 weeks per generation.

Powdery Mildew
Pathogen: *Podosphaera clandestine*
Symptoms, Life-cycle and pest management
Powdery mildew is marked by superficial, white, web-like growth on leaves, shoots, or fruit. The fungus overwinters in buds on twigs and as chasmothecia, which are spore-containing structures, on the bark of twigs and branches. Secondary spores produced in spring spread the fungus to new growth. Infections can be severe in commercial orchards during years of low rainfall, high humidity, and warm temperatures (70° to 80°F). The disease is particularly severe on new growth, including shoots of inner scaffolds, and can infect fruit as well, causing direct crop loss.

To protect fruit, spray soon after petal fall and 2 to 3 weeks later if needed. Treat immediately if mildew is found on leaves or shoots of inner scaffolds or water sprouts.

Cherry Scab
Pathogen: *Venturia cerasi (Cladosporium cerasi or Fusicladium cerasi)*
Symptoms, Life-cycle and pest management
Scab can affect fruit, leaves and shoots. It first appears on fruits as small dark spots about six to eight weeks after petal fall. On mature fruits, the fungus forms small, circular, sooty-brown spots or freckles which become scabby. These can merge to form large, irregular dark brown lesions. When infection is severe, the fruit can crack, shrivel and fall prematurely. Scab lesions are pale green and remain flush with the fruit surface.

Leaf infections appear as sooty or olive blotches on the underside of leaves, and as dark lesions running along the mid-rib and petiole. Severe leaf infection can cause defoliation, but in some cases, little or no leaf infection can be found even when the fruit is badly affected. On the shoots, small brown lesions with slightly raised margins may appear. The margins of these lesions become olivaceous where the pathogen is sporulating.

Brown Rot Blossom and Twig Blight
Pathogens: *Monilinia fructicola, Monilinia laxa*
Symptoms, Life-cycle and pest management
Brown rot infection occurs through blossom parts and progresses into the twig, killing blossoms, spurs, and associated leaves. Small cankers on twigs form below infected spurs; gum may be present at the base of flowers and dead flowers remain on the tree. Beige-colored spore masses develop on diseased flowers under high humidity.

Infection is favored by rain or dew during bloom and moderate temperatures (about 58° to 77°F). One and sometimes two applications may be necessary and are most effective when made sufficiently in advance of rain so that the spray has time to dry. Start treatment at the popcorn stage of bloom, and spray every 10 to14 days until bloom is completed.

CITRUS
(Calamondin, Citrus citron, Grapefruit, Kumquat, Lemon, Lime, Mandarin (tangerine), Orange (sweet and sour), Pummelo, Satsuma mandarin, and cultivars, varieties and/or hybrids of these)

USE RESTRICTIONS: DO NOT apply more than 40 gallons (114.4 lbs. of Calcium Polysulfide) per application per acre or more than 142 gallons of TETRASUL 4S5 (406.1 lbs. of Calcium Polysulfide) per acre per year. Only apply in well-watered groves. **DO NOT** apply where heavy copper residues are present. **Not for application to harvested fruit.** Spray injury can be avoided by applying at proper temperatures—below 85 and above freezing—and when weather is predicted to remain in these temperatures. Using a spreader reduces possible spray injury. Lemons are far less susceptible to spray injury than oranges. Apply up to 1500 gallons per acre of dilute spray. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest interval = 0 days.

Pests controlled	Application timing	Use per 100 gallons of water up to 1500 gallons of dilute spray per acre	Maximum number of applications
Red Spider Mites and Scale Insects	Apply when mites and scale appear	1 to 2 ½ gallons	5
Citrus Thrips, Citricola Scale*	After petals have mostly fallen (May)	2 gallons	5
Flat Mite, Rust Mites	January April to May August 15 to September 15	2 gallons ¾ to 1 ½ gallons ¾ to 1 ½ gallons	6 total

COMBINATION OIL AND LIME SULFUR – CITRUS			
Mites and Scale Insects	September to May	¾ to 1½ gallons plus 1 to 2 gallons of Oil	5
Citricola Scale* and Red Spider Mites	October to February	¾ to 1½ gallons plus 1 to 3 gallons of Oil	5
*For **Citricola Scale**, also use a follow-up non-combination spray. See above sections for application rates and timing. Fall oil treatments may increase the risk of damage caused by frost. Narrow range oils with a 50% distillation range of 415, 440 or 455 are specified for citrus. The heavier the oil, the better the insecticidal properties will be, but also the greater potential for phytotoxicity. Check Oil product label for other restrictions before use.			

ABOUT CITRUS PESTS

Citricola Scale
Scientific Name: *Coccus pseudomagnoliarum*
<u>Symptoms, Life-cycle and pest management</u>
Citricola scale is a soft scale. Crawlers of the citricola scale appear from June through August. They settle primarily on the underside of leaves, but in severe infestations they also settle on the upper leaf surface and on twigs, rarely on fruit. Young scales are flat and almost translucent; they grow slowly over the course of the summer and fall, molting only once during that period. By November, immature scales turn a mottled dark brown color and begin migrating to twigs; this migration peaks in February and March. Once on twigs,

they develop faster than they did on leaves and they turn a gray color. By late April, citricola scales molt and mature into the adult female stage. Females lay 1,000 to 1,500 eggs during the time from early May to early August. Eggs hatch after 2 to 3 days and crawlers move to leaves. There is only one generation a year, and there are no males.

Citricola scale may reduce tree vigor, kill twigs, and reduce flowering and fruit set. As they feed, citricola scale excretes honeydew, which accumulates on leaves and fruit. Sooty mold grows on honeydew and interferes with photosynthesis in leaves and causes fruit to be downgraded in quality during packing.

Citrus Thrips
Scientific Name: *Scirtothrips citri*
Symptoms, Life-cycle and pest management
Adult citrus thrips are small, orange-yellow insects with fringed wings. During spring and summer, female's lay about 25 eggs in new leaf tissue, young fruit, or green twigs; in fall, overwintering eggs are laid mostly in the last growth flush of the season. Overwintered eggs hatch in March about the time of the new spring growth. First-instar larvae are very small, whereas second-instar larvae are about the size of adults, spindle-shaped, and wingless. They feed actively on tender leaves and fruit, especially under the sepals of young fruit. Third- and fourth-instar (propupa and pupa) thrips do not feed and complete development on the ground or in the crevices of trees. When adults emerge, they move actively around the tree foliage.

Citrus thrips do not develop below 58°F (14°C). They can produce up to eight generations during the year if the weather is favorable. Shortly after petal fall, immature flower thrips can be seen moving around young fruit, but they soon pupate and adults disperse to other plants, consequently they are only concentrated in citrus orchards for a short period in spring.

On fruit, the citrus thrips punctures epidermal cells, leaving scabby, grayish or silvery scars on the rind. Second-instar larvae do the most damage because they feed mainly under the sepals of young fruit and are larger than first instars. As fruit grow, damaged rind tissue moves outward from beneath the sepals as a conspicuous ring of scarred tissue. Fruit are most susceptible to scarring from shortly after petal fall until they are about 1.5 inch (3.7 cm) in diameter.

Red Spider Mite
Scientific Name: *Panonychus citri*
Symptoms, Life-cycle and pest management
Adult female citrus red mites are oval and globular; the male is smaller and has a tapered abdomen. Each female lays 20 to 50 eggs at a rate of 2 to 3 a day, depositing them on both sides of leaves. The life cycle from egg to egg may be as short as 12 days during warm weather. Populations increase in spring, late summer, and early fall in response to new growth; citrus red mites prefer to feed on fully expanded young leaves but will also infest fruit.

On leaves, citrus red mite feeding results in a pale stippling visible primarily on the upper surface of the leaf. In severe infestations, the stippling enlarges to dry necrotic areas (commonly called mesophyll collapse). Eventually, leaves may drop and twigs dieback. Stippling or silvering also occurs on green fruit but usually disappears when fruit change color. If large populations feed on nearly mature fruit, the silvering may persist. High populations can also cause fruit sunburn if hot weather is occurring. During fall, low levels of citrus red mite can cause a blasting or burning of foliage and leaf drop. Mites increase their reproduction on water-stressed trees. Good irrigation and limiting road dust reduces red mite outbreaks.

Rust Mite (Silver Mite)
Scientific Name: *Phyllocoptruta oleivora*
Symptoms, Life-cycle and pest management
This pest is known as the rust mite on oranges and the silver mite on lemons. Citrus rust mite is about the same size as a bud mite and requires a hand lens to view; it is deeper yellow in color than the bud mite and wedge shaped. A generation may be completed in 1 to 2 weeks in summer, but development slows or stops in winter, depending on temperature.

The rust mite feeds on the outside exposed surface of fruit that is 0.5 inch (1.3 cm) or larger. Feeding destroys rind cells and the surface becomes silvery on lemons, rust brown on mature oranges, or black on green oranges. Rust mite damage is similar to broad mite damage, except that somewhat larger fruit are affected. Most rust mite damage occurs from late spring to late summer.

Citrus rust mite tends to occur together with Broad Mite but usually in greater numbers. Both species thrive in warm, humid conditions. Monitor rust mite from early spring through summer. On orange trees, look for rust mites on young foliage in early spring; by late spring, most of the population will be on fruit. On lemon, rust mites are mostly on fruit throughout the season. If the population increases quickly or if scarring appears, a treatment is required. In some cases, the infestation is localized and a spot treatment may be sufficient for control.

For citrus, spray injury can be avoided by applying at proper temperatures—below 85 and above freezing—and when weather is predicted to remain in these temperatures. Using a spreader reduces possible spray injury. Only apply in well-watered groves. **DO NOT** apply where heavy copper residues are present. Lemons are far less susceptible to spray injury than oranges. Apply up to 1500 gallons per acre of dilute spray.

CURRANTS, GOOSEBERRIES

USE RESTRICTIONS: DO NOT apply more than 6 gallons (17.2 lbs. of Calcium Polysulfide) per application per acre or more than 42 gallons of TETRASUL 4S5 product (120.1 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	Pests controlled	Use per 100 gallons of water at 100 gallons of dilute spray per acre	Maximum number of applications
Dormant	Cane Blight, Leaf Spot, San Jose Scale and Overwintering pests	2 to 3 gallons	2
Use up to 200 gallons of spray mix per acre. Apply to ground as well.			
Delayed Dormant	Anthracnose Powdery Mildew	1 to 2 ½ gallons 2 to 3 gallons	2 total
For **Anthracnose**, apply at bud break stage and repeat 10 to 15 days later. Use ½ to 1 gallon per 100 gallons of water per acre at 10 day intervals after second spray as necessary. For **Powdery Mildew**, apply just when buds are just beginning to open, then apply ¾ to 1½ gallons of product per 100 gallons of water per acre just before bloom and again just after bloom.			
Bloom and Growing Season	Anthracnose, Powdery Mildew	½ to 1 gallon	10
For **Anthracnose**, apply at 10 day intervals after second delayed dormant spray as necessary. For **Powdery Mildew**, apply just before bloom (no more than 10%) and again just after bloom (90% or more of blossoms are set) then use ½ to 1 gallon of product per 100 gallons of water per acre as necessary during growing season.			
Fall Clean-up, Post-Harvest	Anthracnose, Leaf Spot, Powdery Mildew and other Overwintering pests	2 to 3 gallons	2
Not for post-harvest application to harvested fruit. Apply after leaves begin to drop or as early dormant spray. Apply to ground as well to destroy overwintering inoculums. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT CURRANT AND GOOSEBERRY PESTS

Cane Blight
Pathogen: *Leptosphaeria coniothyrium*
Symptoms, Life-cycle and Pest Management
The fungus overwinters on infected dead canes. In the spring spores are blown, splashed by rain, and carried by insects to nearby canes. Under moist conditions the spores germinate and enter the plant through pruning wounds, insect damage, fruit stem breaks and other wounds. The fungus can then rapidly kill bark and other cane tissue. Dark brown to purplish cankers form on the new canes near the end of the season. The cankers enlarge and extend down the cane or encircle it causing lateral shoots to wilt and eventually die. Infected canes commonly become cracked and brittle and break easily. This disease is usually most severe during wet seasons.

Anthracnose / Leaf Spot
Pathogen: *Drepanopeziza ribis (syn. Pseudopeziza ribis) (asexual: Gloeosporidiella ribis)*
Symptoms, Life-cycle and Pest Management
The fungus overwinters on fallen leaves in the form of fruiting bodies which can withstand severe winter conditions. The following spring these structures produce spores of a

different type from those formed on the plant in the summer. These spring spores attack the young leaves to start the infections for that season. Once the disease is present on the bush, it is spread further by the rain-splashed summer spores produced on the leaf spots.

The first symptoms appear on the leaves in early summer as they become spotted with very small, dark brown, round or irregular leaf spots develop, which, when abundant, may cause foliage to yellow and drop by midseason. Small, grayish bodies (acervuli) develop in leaf lesions. The disease reduces the plant's vitality, growth, and productiveness. On currants, fruit as well as leaves may show spotting like fly specks. Severely infected berries crack open and drop also, the leaves fall and the bushes may become defoliated.

Remove and destroy dead leaves from under bushes. Cultivate under and around bushes to bury leaves before bud break in spring. Prune and thin bushes to provide better air circulation and drying conditions. Use a fall clean up and dormant spray to destroy inoculum from dead leaves.

Powdery Mildew
Pathogen: *Podosphaera mors-uvae (formerly Sphaerotheca mors-uvae)*
Symptoms, Life-cycle and Pest Management
The fungus overwinters in pruned or broken twigs. In the spring the spores are released and infect leaves and shoots. Signs of the fungus are white patches on the surface of leaves, shoots and berries. The patches enlarge, merge, and develop white powdery masses of spores which can start new infections. Eventually the fungus turns reddish brown and small black spore containing bodies develop. This causes stunting and dieback of shoots and berries become off-color and rough. In the fall, remove prunings and crop debris then spray with lime sulfur to kill overwintering spores.

San Jose Scale
Scientific name: *Diaspidiotus (= Quadraspidiotus) perniciosus*
Symptoms, Life-cycle and Pest Management
Female San Jose scales give birth to living young that emerge from under the edge of the scale covering. These tiny yellow crawlers wander in a random fashion until they find a suitable place to settle. Immediately upon settling, the crawlers insert their mouthparts into the host plant and begin feeding and secreting a white waxy material (white cap stage); eventually the waxy covering turns black and is known as the black cap stage. Later the covers turn various shades from gray to black.
They feed by sucking valuable plant juices, and in severe cases they affect the fruit as well. Scale insects are easily seen on the dormant wood. Prune out and destroy infested canes before new growth begins in the spring.

FILBERTS / HAZELNUTS

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 75 gallons of TETRASUL 4S5 (214.5 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 4 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days. **[NOT FOR USE IN CALIFORNIA.]**

Application timing	Pests controlled	Use per 100 gallons of water at 100 to 200 gallons of dilute spray per acre	Maximum number of applications
Delayed Dormant	Big Bud Mite	2 to 3 gallons	2
Apply when buds begin to show green in the spring (March-April).			
Fall Clean-up	Moss, Lichen, Bryophytes, and Overwintering pests.	2 to 3 gallons	2
Not for post-harvest application to harvested nuts. Apply after harvest just prior to winter bloom. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT FILBERT / HAZELNUT PESTS

Filbert Bud Mite
Scientific Name: *Phytocoptella avellanae*
Symptoms, Life-cycle and pest management
The filbert bud mite is a very small eriophyid mite that feeds on and within leaf and flower buds and catkins (male flowers) Feeding causes buds to swell to larger than normal size (hence the nickname "big bud mite"), and infested buds do not produce nuts. Cecidophyopsis vermiformis is another eriophyid mite also found in hazelnut orchards. Cecidophyopsis vermiformis feed in the enlarged buds created by the filbert bud mite; while their feeding does not cause big bud symptoms, it does cause further damage to the bud and, subsequently, yield loss. Mite activity can be monitored by placing a sticky substance (Tanglefoot or sticky tape) on twigs above and below buds that have evidence of mite infestation. Best control is achieved by applying treatments in the early spring when adult mites become active and are moving about the tree.

The big bud mite (also known as filbert bud mite and hazelnut gall mite), Phytoptus avellanae, is known to be a problem in most of the major hazelnut production areas around the world. This mite has long been associated with the formation of excessive large buds in hazelnuts.

Specific plant damage is indicated by enlarged buds whereby infested terminal buds become swollen and deformed. Bud deformation also occurs in which the development of leaves, blossoms and fruits are affected.

Big bud mite infestation first becomes obvious during late summer and early autumn. Affected buds become spherical and swell to several times their normal size, reaching about 10 mm in diameter. These buds are prone to desiccation and fall from the tree prematurely). The big bud mite can affect both the vegetative and flower buds of hazelnut trees.

Big bud mites living within buds are protected from adverse conditions during the cold months of winter. However, they are subject to desiccation by warm, dry air when they start to migrate to new leaf buds during spring.

FRUIT & NUTS (NON-BEARING)

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 48 gallons of TETRASUL 4S5 product (137.3 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 200 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant, Delayed Dormant	Blotch, Coryneum Blight (Shot Hole), Peach Twig Borer, Powdery Mildew, Scab	2 to 3 gallons	4
Bloom and Growing Season	Aphids, Mites, Powdery Mildew, Scab	½ to 1 gallon	10
Apply as necessary. For best control, use a full cover spray from the orchard floor or trunk soil line to the top of canopy. Spray thoroughly, but do not drench foliage.			
Fall Clean-up	Overwintering insects and eggs; disease spores and fungal parts, Leaf Spot	2 to 3 gallons	2
Apply anytime after leaf drop begins. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches. To aid in **Leaf Spot** control, spray ground as well to kill spores on dead leaves.			

FRUITS & NUTS (BEARING)
(Listed on this label)

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 48 gallons of TETRASUL 4S5 product (137.3 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 300 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant, Delayed Dormant	Blotch, Coryneum Blight (Shot Hole), Peach Twig Borer, Powdery Mildew, Scab	2 to 3 gallons	4
Bloom and Growing Season	Aphids, Mites, Powdery Mildew, Scab	½ to 1 gallon	10
Apply as necessary. For best control, use a full cover spray from the orchard floor or trunk soil line to the top of canopy. Spray thoroughly, but do not drench foliage.			
Fall Clean-up	Overwintering insects and eggs; disease spores and fungal parts	2 to 3 gallons	2
Not for post-harvest application to harvested fruit. Apply anytime after leaf drop begins. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches. To aid in **Leaf Spot** control, spray ground as well to kill spores on dead leaves.			

GRAPES

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 75 gallons of TETRASUL 4S5 (214.2 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 300 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant	Powdery Mildew, Measles (ESCA) and Overwintering spores Mealybugs	2 to 3 gallons 1 ½ to 3 gallons	2 total
For Powdery Mildew, Measles (ESCA) and Overwintering spores, use up to 300 gallons of spray per acre. Spray on the soil surface and vines very early in the spring to destroy spores on dead rachis, leaves, and twigs. For **Mealybugs**, apply in sufficient water for coverage.			
Delayed Dormant	Anthracnose, overwintering Phomopsis Cane and Leaf Spot, Powdery Mildew, Mealybugs, and Measles (ESCA) spores	2 to 3 gallons	2
Apply prior to bud swell.			
Bud Break through Growing Season	Anthracnose and Mealybugs, Phomopsis Cane and Leaf Spot. Powdery Mildew (both A and B isolate)	½ to 1 gallon	10
For **Anthracnose and Mealybugs**, apply when new shoots are 4 to 6 inches long. For **Powdery Mildew** (both A and B isolate), apply a minimum of 100 gallons of dilute spray per acre. Repeat once or twice at two week intervals or when new shoots are a minimum of 4 to 6 inches long. Dilute sprays of 3 gallons of product per 100 gallons of water per acre may be applied when buds are swelling, when leaves are half grown and just before blossoming. If bronzing occurs on Table Grapes, increase spray dilution to ½ gallon per 125 gallons of water per acre.			
Fall Clean-up	To reduce viability of overwintering Anthracnose, Mealybugs, Measles, Phomopsis and Powdery Mildew spores	2 to 3 gallons	2
Not for post-harvest application to harvested fruit. Apply before late fall rains and just before leaf drop. Apply up to 200 gallons spray per acre. Apply at least 4 hours prior to rainfall or irrigation. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and vines.			

ABOUT GRAPE PESTS

Anthracnose
Pathogen: *Elsinoe ampelina*
Symptoms, Life-cycle and pest management

All succulent parts of the plant, including fruit stems, leaves, petioles, tendrils, young shoots, and berries, can be attacked, but lesions on shoots and berries are most common and distinctive. Symptoms on young, succulent shoots first appear as numerous small, circular, and reddish spots. Spots then enlarge, become sunken, and produce lesions with gray centers and round or angular edges. Dark reddish-brown to violet-black margins eventually surround the lesions. Lesions may coalesce, causing a blighting or killing of the shoot.

A slightly raised area may form around the edge of the lesion. Infected areas may crack, causing shoots to become brittle. Anthracnose lesions on shoots may be confused with hail injury; however, unlike hail damage, the edges of the wounds caused by the anthracnose fungus are raised and black. In addition, hail damage appears on only one side of the shoot, whereas anthracnose is more widely distributed. Anthracnose on petioles appears similar to that on the shoots.

Leaf spots are often numerous and develop in a similar manner to those on shoots. Eventually, they become circular with gray centers and brown to black margins with round or angular edges. The necrotic center of the lesion often drops out, creating a shot-hole appearance. Young leaves are more susceptible to infection than older leaves. When veins are affected, especially on young leaves, the lesions prevent normal development, resulting in malformation or complete drying or burning of the leaf. Lesions may cover the entire leaf blade or appear mainly along the veins.

The fungus overwinters in the vineyards as sclerotia (fungal survival structures) on infected shoots. In the spring, sclerotia on infected shoots germinate to produce abundant spores (conidia) when they are wet for 24 hours or more and the temperature is above 36F. Conidia are spread by splashing rain to new growing tissues and are not carried by wind alone.

Another type of spore, called an ascospore, is produced within sexual fruiting bodies and may also form on infected canes and berries left on the ground or in the trellis from the previous year. The importance of ascospores in disease development is not clearly understood.

Conidia are by far the most important source of primary inoculum in the spring. In early spring, when free moisture from rain or dew is present, conidia germinate and infect succulent tissue. Conidia germinate and infect at temperatures ranging from 36F to 90F. The higher the temperature, the faster disease develops. Disease symptoms start to develop approximately 13 days after infection occurs at 36F and at four days after infection occurs at 90F. Heavy rainfall and warm temperatures are ideal for disease development and spread.

Fungicide directions for anthracnose control consist of a dormant application of lime sulfur in early spring just prior to bud swell, followed by applications of foliar fungicides during the growing season. At 10 gallons per acre, lime sulfur will burn out overwintering inoculum on infected canes, but at this rate it will burn grape tissue. **DO NOT** apply after bud swell. Spraying the ground at this time will also help burn out other inoculum residing on remaining fallen leaves, twigs and mummies.

Measles (ESCA)

Pathogen: ***Nine species of fungi in the genus Phaeoacremonium. The perfect stage has been found for three: Togninia minima, T. californica, and T. fraxinopennsylvanica***

Symptoms, Life-cycle and pest management

Affected leaves display small, chlorotic interveinal areas that enlarge and dry out. Foliage symptoms are frequently called "Esca." In red varieties dark red margins surround the dead interveinal areas. Severely affected leaves may drop and canes may dieback from the tips. Symptoms may occur at any time during the growing season but are most prevalent during July and August. On berries, small, round, dark spots, each bordered by a brown-purple ring, may occur. These spots may appear at any time between fruit set and ripening. In severely affected vines the berries often crack and dry on the vine or are subject to spoilage.

Measles are caused by several species of Togninia, a fungus that produces perithecia on grapevines in old, rotted vascular tissue. Ascospores are released from fall and winter into spring with rainfall; temperatures do not seem to be limiting for spore release. Ascospores reinfect the vine through pruning wounds. Wounds remain susceptible up to 16 weeks after pruning with susceptibility declining over time. The pathogen enters the current season's vascular tissue and it is believed that symptoms are expressed in the same year that new infections occur. Symptoms are caused by a toxin produced in the vascular tissue and include both leaf striping and fruit spotting. Other symptoms that appear in May are shoot tip dieback and tendril dieback.

Another species of fungus, Phaeomoniella chlamydospora, that causes the disease is closely related to the species of Togninia listed above and is also an endophyte in grapevine. This fungus overwinters as pycnidia in 3-5 year-old pruning wounds and releases pycnidiospores with rainfall from fall through spring. The pathogen also infects the vine through current year pruning wounds and produces symptoms. With both pathogens, there can be a 50% reduction in shoot growth.

Measles is more prevalent in areas with consistently high summer temperatures and in areas with heavy spring rainfall. Usually, plantings that are 10 years of age or older are affected, although measles has been seen on fruit and foliage on younger vines. In table grapes, mark areas of poor bud break in spring. Examine these areas at harvest for disease symptoms.

Control can be achieved with lime sulfur. However, it is important that the product get into the cracks and crevices of the vine because that is where the fungal fruiting bodies reside.

Phomopsis Cane and Leaf Spot
Pathogen: *Phomopsis viticola*
Symptoms, Life-cycle and pest management

Phomopsis cane and leaf spot is the name for the cane-and-leaf-spotting phase of what was once known as dead-arm. Eutypa dieback is the name for the canker-and-shoot-dieback phase of what was also once known as dead-arm. The name dead-arm has been dropped. Phomopsis cane and leaf spot and Eutypa dieback are distinctly different diseases and their control directions vary greatly.

The fungus overwinters in lesions or spots on one- to three-year-old wood infected during previous seasons. It requires cool weather and rainfall for spore (conidia) release and infection. Conidia are released from pycnidia (fungal fruiting bodies) in early spring and are spread by rain to developing shoots and leaves.

Phomopsis cane and leaf spot appears as tiny dark spots with yellowish margins on leaf blades and veins. Spots first show 3 to 4 weeks following rain. Leaf death may occur if large numbers of spots build up. Basal leaves with heavy infection become distorted and usually never develop to full size. On shoots, small spots with black centers similar to those found on leaves occur usually on a basal portion of the shoot. After spots lengthen a few millimeters, the epidermal layers of the shoots usually crack at the point of infection. Heavy infection usually results in a scabby appearance of the basal portions of the shoot. On clusters, spots similar to those that occur on shoots occur on the flower cluster stems.

Lesions on leaves, shoots, and clusters become inactive during the summer heat but rain just before harvest can cause light brown spots on clean berries and spots quickly enlarge and become dark brown. Berries may shrivel and become mummified. Infected canes appear bleached during the dormant season. Severely affected canes or spurs exhibit an irregular dark brown to black discoloration intermixed with whitish bleached areas. The black specks visible in the bleached areas are pycnidia that develop during the dormant season.

This disease is most severe where spring rains are common after bud break; moisture is required for infection. Infections occur when shoots begin to grow. Spores are released in large quantities from the overwintering pycnidia on diseased canes and spurs. These are splashed by rain onto early developing shoots and infection occurs when free moisture remains on the unprotected green tissue for many hours.

Spur and cane lesions provide most of the inoculum for new infections. Reducing the source of the disease is important. In table grapes, mark areas in the vineyard exhibiting poor bud break in spring. Later examine these areas for disease symptoms. A treatment of liquid lime sulfur before late fall rains will reduce the viability of pycnidia as well as reduce overwintering powdery mildew spores. Shoot and leaf infection is most likely during the period from bud break until shoots are 6 to 8 inches in length. Lesions appear three to four weeks after infection.

In all areas, spring foliar treatments are advisable if rainfall is predicted after bud break. Apply before the first rain after bud break and before 0.5 inch shoot length and again

when shoots are 5 to 6 inches in length. It must be reapplied after significant rainfall in order to protect shoots up to 18 inches in length.

Powdery Mildew (both A and B isolate)
Pathogen: *Erisiphe necator*
Symptoms, Life-cycle and pest management
The fungus may overwinter as a group of thin threads, called hyphae, inside dormant buds of the grapevine and/or as small black bodies, called chasmothecia, on the exfoliation bark of the vine. Buds on new shoots can be infected 4 to 6 weeks after shoots start growing but not after bud scales become suberized. These new infected buds remain quiescent until the next growing season. The fungus infects developing buds during the growing season.

Under optimal conditions of mild temperatures and high humidity, a single spore can germinate, infect the plant, produce a new colony and a new crop of spores in 3 days. Temperatures over 85°F inhibit germination of conidia (spores). Susceptibility of the fruit drops rapidly after 8% - 15% Brix. Leaves and canes can be infected up to and past harvest.

Appearing in the early stages as whitish or grayish patches on the leaves and ultimately covering both surfaces when severe. Colonies are more easily observed in full sunlight. Later in the season the mildew turns darker and becomes peppered with minute black dots (chasmothecis). On the fruit, the fungus at first may appear grayish and whitish, but later it has a brownish russeted appearance. Infected fruit cracks and drops from the cluster. Even the blossoms can sometimes be infected causing them to dry up or fail to set fruit.

Applications for adequate control or suppression of Powdery Mildew are needed on a continued schedule depending on severity of the infection and migration of the new growth. In southern regions of the United States, or lower elevations, or in warm climates, grape laterals (flag shoots) and terminals grow rapidly often 4 to 6 inches per week and continued coverage is needed for adequate suppression or control of Powdery Mildew. User of the product needs to make careful observations for the timing of application for proper control of Powdery Mildew. Powdery Mildew can attack all aboveground parts of the grape plant. Spray the entire portion of the above ground parts of the plant.

PEACHES AND NECTARINES

USE RESTRICTIONS: DO NOT apply more than 9 gallons (27.5 lbs. of Calcium Polysulfide) per application per acre or more than 75 gallons of TETRASUL 4S5 (214.5 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 20 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days. **DO NOT** apply dormant or delayed dormant strength spray immediately after or during periods of 5 days or more of unseasonably high temperatures if a sufficient number of dormant cold hours have occurred.

Application timing	Pests controlled	Use per 100 gallons of water at 100 to 200 gallons of dilute spray per acre	Maximum number of applications
Dormant	Coryneum Blight (Shot Hole), European Red Mite, Leaf Curl, Rust, San Jose Scale	2 to 3 gallons	2
Apply in early winter and late dormant periods.			
Delayed Dormant	Black Peach Aphid, Leaf Curl Powdery Mildew, Scab	2 to 3 gallons 2 to 3 gallons and then repeat with ¾ to 1 ½ gallons in Pre-bloom and Pink	2 total
For **Black Peach Aphid**, apply in February to March, about the time the outer aphis shells split. For **Powdery Mildew and Scab**, the Delayed Dormant spray is vital to scab control and leads to cleaner fruit and a minimum of later applications.			
Pre-Bloom, Pink, Early Bloom and Full Bloom	Brown Rot Blossom Blight Powdery Mildew, Scab	½ to 2 gallons ¾ to 1 ½ gallons	4 total
For **Brown Rot Blossom Blight**, apply Pre-Bloom through Bloom, if rains continue. For **Powdery Mildew, Scab**, apply Pre-bloom and Pink.			
Growing Season	Brown Rot, Leaf Spot, Coryneum Blight (Shot Hole), Powdery Mildew, Rust	½ to 1 gallon	10 (up to 2 months before harvest)
For **Powdery Mildew**, apply when disease appears. For **Rust**, apply before disease appears on leaves.			
Pre-harvest	Brown Rot (Fruit), Leaf Spot, Powdery Mildew	½ gallon	5 (up to 2 days before harvest)
Fall Clean-up (before winter rains begin)	Coryneum Blight (Shot Hole), Leaf Curl, Rust	1 to 2 gallons* and/or 2 to 3 gallons**	2 total
Not for post-harvest application to harvested fruit. Apply *[1 to 2 gallon rate] post-harvest. Apply **[2 to 3 gallon rate] anytime after leaf drop begins. For **Coryneum Blight (Shot Hole)**, fall application before winter rains begin is the most important application for control of this disease. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT PEACH AND NECTARINE PESTS

Coryneum Blight or Shot Hole Disease
Pathogen: *Stigmina carpophila, syn. Coryneum carpophilum or Wilsonomyces carpophilus*
Symptoms, Life-cycle and pest management
Coryneum blight is also called shot hole disease, California blight, peach blight or pustular spot. Severe foliar shot holing may weaken a tree, while the most apparent damage is infection of the fruit.

The main symptoms of shot hole on nectarines and peaches occur on twigs and buds, but fruit lesions may develop when spring weather is wet. Twig symptoms first appear as small, purplish black spots. These turn brown as they enlarge, often having a light center with a purplish brown margin. Tiny, dark brown bumps develop at the center of each lesion. These bumps are spore-forming structures called sporodochia and are easily seen with a hand lens. When buds are affected, the scales turn dark brown or black and the buds may be covered with a shiny layer of exuded gum. Buds killed by bacterial blast have a similar appearance but tend to be much blacker, and nearby foliage of the affected shoot is wilted. Shot hole can be distinguished on peach by the presence of tan twig lesions with dark margins, usually accompanied by profuse gumming.

The fungus survives on infected twigs and buds. Spores are produced throughout winter and are spread by splashing rain and wind. The disease is favored by prolonged wetness in fall to mid-winter (twig blight). Summer rain or sprinkler irrigation encourages fruit infection. There is more infection low in the tree where fruit stay wet longer. Fall application before winter rains begin is the most important application for control of this disease.

European Red Mite
Scientific Name: *Panonychus ulmi*
Symptoms, Life-cycle and pest management
The female European red mite is about 0.02 inch long and has a brick red, globular body with long curved hairs that arise from white spots or tubercles on the back. Nymphs or unfed females may appear greenish. European red mite eggs are red, slightly flattened, and have a stipe protruding from the top. They overwinter in the egg stage on twigs and spurs. Eggs hatch in early spring just after the trees leaf out, and many generations (8–10) are produced before fall. Ordinarily European red mite populations build up slowly during spring and do not become apparent until large populations are present.

European red mites remove the contents of the leaf cells as they feed, causing leaves to take on a finely mottled appearance. During summer, look for stippling or bronzing on leaves. Rarely do European red mites cause leaf drop in nectarine trees. Treatments for this mite are applied in the dormant/delayed-dormant season.

Peach Leaf Curl
Pathogen: Taphrina deformans
Symptoms, Life-cycle and pest management
Leaves produced in spring are thickened, curled, and colored red or yellow instead of normal green. Severely affected shoots die. Irregular, reddish lesions are sometimes seen on fruit. Badly diseased leaves fall by early summer, and repeated infections debilitate trees and kill branches.

Taphrina deformans survives on tree surfaces and buds and is favored by wet weather during spring. One application in the dormant/delayed dormant period is sufficient except in areas of high rainfall or where leaf curl has become an increasing problem. In such cases,

an added application at the delayed dormant timing in late winter before bud swell is advised.

San Jose Scale
Scientific name: Diaspidiotus (= Quadraspidiotus) perniciosus
Symptoms, Life-cycle and pest management
Female San Jose scale lay eggs that hatch immediately and the young emerge from under the edge of the adult scale covering. These tiny, yellow crawlers wander in a random fashion until they find a suitable place to settle. Immediately upon settling, the crawlers insert their mouthparts into the host plant and begin feeding and secreting a white, waxy material (white cap stage); eventually the waxy covering turns black (black cap stage).

Black Peach Aphid
Scientific Name: *Brachycaudus persicae*
Symptoms, Life-cycle and pest management
In California, this aphid is prevalent in the San Joaquin Valley. Winged and wingless adults of the black peach aphid are shiny black and about 0.1 inch long. The nymphs are reddish brown. Wingless forms overwinter on the roots of nectarine and other closely related trees. In early spring, some migrate from roots to new growth and start colonies on the young leaves. Several generations of female aphids are produced. In early summer, winged adults are produced and migration to other trees occurs. Aboveground colonies usually disappear by midsummer as wingless forms migrate to the roots to feed and overwinter.

Injury consists of leaf curling, yellowing, and premature drop; the leaf curling is first evident at shoot terminals. If aphids are abundant, honeydew excretion may cause black sooty mold to appear on leaves and fruit. Ants may also become a problem, because they tend the aphids while they are on the roots.

Powdery Mildew
Pathogens: *Sphaerotheca pannosa and Podosphaera leucotricha*
Symptoms, Life-cycle and pest management
Symptoms of powdery mildew can be seen on the terminal leaves of shoots, which are covered in powdery, white fungal growth. Leaves become misshapen and puckered, and fruits develop powdery, white spots that can scar over as the fruit mature.

Sphaerotheca pannosa survives as mycelium in bud scales and as cleistothecia. Growth of the pathogen is favored by cool, moist nights and warm days. Fruit is susceptible only up to time of pit hardening, but later infections can occur.

Scab
Pathogens: *Cladosporium carpophilum*
Symptoms, Life-cycle and pest management
Scab affects foliage, young shoots, and fruit, but damage is the result of fruit infections. Fruit infections appear as dark lesions on ripening fruit, most commonly on the upper surface, and may grow together to form large blotches. Lesions may have green or yellowish blotches that turn grayish when spores are produced. On peaches, lesions are flat, circular black spots up to 1/8 inch (3 mm) in diameter. When nectarines are affected,

the skin loses its pigment and becomes pale green to cream in color. The center of each spot is dark with the development of spores.

The fungus that causes scab overwinters in lesions on first-year twigs. Spores are produce in these lesions when humidity exceeds 70% beginning at bloom and lasting several weeks. Spores are spread by air movement and splashing water and will infect developing fruit, although it may take several weeks for lesions to appear.

Delayed dormant spray (when the buds swell and begin to show green) is vital to control with sprays in Pre-bloom and Pink stages. Apply subsequent sprays at 10-14 day intervals until approximately 1 month before harvest. On peaches begin the following subsequent sprays about 1 week after petal-fall, on nectarines begin at about petal-fall. During the month before harvest, sprays applied for brown rot control will help reduce late season scab infections on the fruit, twigs and leaves.

Brown Rot Blossom and Twig Blight
Pathogens: *Monilinia fructicola, occasionally Monilinia laxa*
Symptoms, Life-cycle and pest management
Young blossom spurs and associated leaves collapse to form shoot blight. Gum exudes at base of infected flowers. Cankers on blighted twigs have tan centers with dark margins. Gray brown spore masses form on diseased flower parts and twig cankers under high humidity.

Monilinia fructicola overwinters on mummified fruit that either fall to the ground in late fall or early winter, or remain in the trees. In spring, apothecia form on mummies that are on the ground; these apothecia release ascospores at the same time as the trees bloom. Ascospores serve as primary inoculum for brown rot in many orchards. Mummies in the trees as well as those on the ground may also produce conidia, which may serve as the primary source of inoculum in some years. Twig lesions apparently do not produce spores. A fall or early dormant ground application is useful to clean up spores.

Begin treatment pre-bloom, make a treatment at 20 to 40% bloom and again at 80 to 100% bloom on susceptible varieties or if heavy rainfall and other conditions are occurring that result in high susceptibility to infection.

Cercospora Leaf Spot
Pathogens: *Cercospora circumscissa, Cercospora rubrotincta*
Symptoms, Life-cycle and pest management
The fungus causes gray or brown spots with dark edges on leaves. Spots can be small or large. The centers of the spots can drop out. Leaves turn yellow and fall prematurely. If the infection is severe enough to cause defoliation for two consecutive years, the peach tree can be seriously weakened.

Rust
Pathogen: *Transchelia discolor*
Symptoms, Life-cycle and pest management
Infections of young twigs and leaves are the most common symptoms of rust, fruit infections may be a major component of the disease as well.

Transchelia discolor survives in twig cankers or on other host parts, and airborne spores depend on wetness for infection. This disease typically has been more prevalent on cling varieties of peaches than on other varieties because the areas in which cling peaches are grown tend to have higher rainfall, making conditions more conducive to disease development. Fruit symptoms may resemble damage caused by stink bugs; confirm rust by the presence of rust spores within the fruit lesion or by leaf or twig symptoms.

To be effective, treatments must be applied before rust symptoms appear on leaves. Examine one-year-old fruiting wood for small blisters or longitudinal splits. If twig cankers are found and rain is forecasted, make a treatment. If wet weather persists, additional applications may be necessary in late May or early June. Disease severity in the preceding year is an important factor in determining potential of disease during current year. Fall and Dormant applications are efficacious in helping manage the disease.

PEARS

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 75 gallons of TETRASUL 4S5 (214.5 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 26 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days. Use on d'Anjou, Comice or Seckle varieties only for Dormant, Delayed Dormant, Pre-Pink and Fall Clean up applications.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 300 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant	Brown Mite, European Red Mite, Pear Leaf Blister Mite, Pear Psylla, Rust Mite, San Jose Scale	2 to 3 gallons	2
Delayed Dormant	Aphid eggs, Blister Mite, Pear Psylla, Rust mite, San Jose Scale, Scab	2 to 3 gallons	2
Apply when buds begin to show green tips. For **Aphid Eggs**, apply in February to March about the time the outer shells split. For **Scab**, Delayed Dormant spray is vital to control and leads to cleaner fruit and a minimum of later applications. Use up to 300 gallons of mix per acre. Repeat with ¾ to 1½ gallons of product per 100 gallons of water per acre in Pre-Pink and Pink stages.			
Pre-Pink, Pink and Pre-Bloom	Powdery Mildew Scab	1 to 2 gallons ¾ to 1 ½ gallons	4 total

For **Powdery Mildew;** Apply in Pre-Pink, followed by an application in the Pink and Calyx stages. For **Scab**, apply in the Pre-pink and Pink stages.			
Growing Season	Powdery Mildew	½ to 1 gallon	10
Apply as needed.			
Post-Harvest - Combination Oil	Pear Leaf Blister Mite, Pear Psylla, Rust Mite	2 ½ gallons plus 1 1/2 to 2 gallons light medium summer oil*	2 total
Not for post-harvest application to harvested fruit. Apply *[lime sulfur plus oil rate] immediately after harvest. This is to prevent the Rust mite from overwintering under the developing fruit and leaf buds.			
Fall Clean-up	Aphid eggs, Pear Leaf Blister Mite, Pear Psylla, Rust mite, San Jose Scale, Scab and other overwintering inoculum Optional Scab Treatment	1 to 2 gallons* and/or 2 to 3 gallons** 10 gallons plus 50 pounds 5% solution of biuret urea spray	2 total
Not for post-harvest application to harvested fruit. For **Aphid eggs, Pear Leaf Blister Mite, Pear Psylla, Rust mite, San Jose Scale, Scab and other overwintering inoculum**, apply *[1 to 2 gallon rate] in late fall after temperatures cool and preferably before the first frost. Apply **[2 to 3 gallon rate] anytime after leaf drop begins. **Optional Scab treatment;** Combine 3 gallons of TETRASUL 4S5 with a 5% solution of biuret urea spray at 50 pounds per 100 gallons dilute spray just before leaf fall, this hastens leaf decomposition and reduces spore production the following spring. Take care to wait to the latest moment as early defoliation reduces energy transfer into the tree used for growth in the spring. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT PEAR PESTS

Brown Mite
Scientific name: *Bryobia rubrioculus*
<u>Symptoms, Life-cycle and Pest Management</u>
Brown mites overwinter in the egg stage. Eggs are red and spherical but do not have a stipe rising from the top. Newly hatched brown mites have six legs and are bright red. After they molt for the first time, they turn brown, develop eight legs, and resemble the adult, only smaller. Adult brown mites are dark reddish brown, and the first pair of legs is longer than the other three pairs.

Brown mites are usually the first mites to appear in spring. Brown mite is best controlled in the dormant season or early foliage season. In-season sprays are rarely justified.

European Red Mite
Scientific Name: *Panonychus ulmi*
Symptoms, Life-cycle and pest management
The female European red mite is about 0.02 inch long and has a brick red, globular body with long curved hairs that arise from white spots or tubercles on the back. Nymphs or unfed females may appear greenish. European red mite eggs are red, slightly flattened, and have a stipe protruding from the top. They overwinter in the egg stage on twigs and spurs. Eggs hatch in early spring just after the trees leaf out, and many generations (8–10) are produced before fall. Ordinarily European red mite populations build up slowly during spring and do not become apparent until large populations are present.

European red mites remove the contents of the leaf cells as they feed, causing leaves to take on a finely mottled appearance. During summer, look for stippling or bronzing on leaves. Treatments for this mite are applied in the dormant/delayed-dormant season.

Pearleaf Blister Mite
Scientific Name: *Eriophyes pyri (Pagenstecher)*
Symptoms, Life-cycle and pest management
Pearleaf blister mite (PLBM), also known as pear bud mite, and also by the synonym Phytoptus pyri Pagenstecher, is most often seen in unsprayed trees. This species is part of a complex of related species (E. pyri complex).

No reproduction or feeding occurs during winter in the buds. Mites begin to feed and oviposit as buds swell in the spring. Blisters begin to form at the cluster bud stage, on leaves 1/20 - 1/5 inch (1-5 mm) long. After 1-2 weeks, blisters begin to form small holes. Mites enter these holes and begin egg production. Usually only one female enters each blister. If present in fruit buds, feeding on floral parts will cause fruit blisters. Females produce 7-21 eggs each. In cooler weather, about 18 days are required for development; only 5-8 days are required in warmer weather. There are 2-3 generations per year. Activity ceases during June, July and August, resuming when cool evenings return. Mites return to buds from September to November.

This complex causes blisters on the undersides of pear and apple leaves, especially younger foliage, usually in a row along the mid-vein. The blisters are tiny green swellings at first, later expanding and turning red. These blisters eventually turn necrotic and brown (blisters that are not invaded by mites remain green). Leaf injury can result in small, sparse leaves.

Spray during the dormant or delayed dormant period. Lime sulfur may also be applied in the postharvest period.

Pear Psylla
Scientific Name: *Cacopsylla pyricola (Foerster)*
Symptoms, Life-cycle and pest management
Eggs are pale cream to yellow-orange. They are elliptical in shape, with a tiny peg inserted into plant tissue. Nymphs are pale yellow when young, but have brown sclerotized plates when older. They resemble flat aphids in shape.

Adults overwinter in or near pear orchards. Few adults are mated before overwintering. In early spring adults return to the trees, mate and begin ovipositing in crevices on fruit spurs and on young leaves as they unfold. There are three generations during the spring and summer.

Females lay an average of more than 300 eggs during their life. Most oviposition by summer adults occurs near leaf mid-veins; egg survival is also highest near mid-veins. As nymphs develop, they become engulfed in a droplet of accumulating honeydew. Such droplets may contain the shed skins of the preceding instars.

Pear Rust Mite
Scientific Name: *Epitrimerus pyri (Nalepa)*
Symptoms, Life-cycle and pest management
The pear rust mite (PRM) is found throughout the mid-Atlantic area where it occasionally causes injury to foliage and russeting of the fruit.

PRM is wider at the anterior end, however, giving this species a more "broad-shouldered" appearance. Adults are dull white to pale brown and have wedge-shaped bodies that are larger at the head than the tail end. The two nymphal stages look similar in shape but smaller. The round eggs are flattened, colorless when first laid, and extremely small.

The PRM overwinters solely as adult females beneath bud scales of leaf spurs and under loose bark of 1- to 2-year-old twigs. As the weather begins to warm, usually before buds break, mites move to developing clusters and begin feeding on the succulent parts of buds. Eggs are produced shortly after mites become active. As buds open, adults and immatures move to the expanding leaf tissue and eventually to fruit as the leaves mature and harden. Immature mites develop quickly through two instars, each followed by a resting stage.

San Jose Scale
Scientific Name: *Quadraspidiotus perniciosus (Comstock)*
Symptoms, Life-cycle and pest management
Most of the life cycle of this insect is spent under a secreted waxy covering that protects the soft, sessile insect from predators and to some extent even insecticides. Young scales have smaller, very light colored coverings that darken to a sooty black or ashy appearance as they grow larger and mature.

SJS overwinters as partially grown immatures on the trunks and scaffolds of the tree with the majority being in the first nymphal instar. The nymphal scales remain dormant under their waxy coverings until the sap begins to flow in the spring and then continue to feed until early May when they become mature. There are two to three generations a year with considerable overlap of the broods because of the long reproductive life of the females.

Pear Scab
Pathogen*: Venturia pirina*
Symptoms, Life-cycle and pest management
Scab first appears as velvety, dark olive-to-black spots on fruit, leaves, and stems. When infections occur early, fruit spots become scab like with age and the fruit may become misshapen. On leaves, infections cause leaf puckering and twisting and eventually tear with age. Secondary infections that occur later in the season appear as black, velvety pinpoint spots on fruit and leaves.

The fungus overwinters in dead leaves on the ground. Primary spores are discharged from flask-shaped fruiting bodies in infected dead leaves during spring rains and infect young leaves and fruit during periods of prolonged moisture. These infections produce secondary spores, which may cause further spread of disease during wet periods. Overwintering twig lesions from secondary infections may also be an important source of inoculum in spring.

Data has shown that applying high rates (6 gal/100 gal water with up to 24 gal/acre) of lime sulfur in the delayed dormant period can significantly reduce the viability of overwintering twig lesions, which are usually a significant source of disease inoculum during and in years following severe scab outbreaks. Applying a 5% solution of biuret urea spray at 50 pounds per 100 gallons dilute spray before leaf fall hastens leaf decomposition and may reduce spore production the following spring. Combining 10 to 12 gal/acre of lime sulfur with the urea before leaf fall may offer complementary control. Cultivating leaves into the soil, however, has not significantly reduced infection potential.

Powdery Mildew
Pathogen: *Podosphaera leucotricha*
Symptoms, Life-cycle and Pest Management
The white fungus grows on terminal shoots of pears. Pears are susceptible to fruit infection, which appears as black marks and russeting on young fruit.

The fungus overwinters primarily as mycelium (thread-like, multicellular structures) in infected terminal and fruit buds. It may also overwinter in sexual fruiting bodies on the surface of infected leaves and shoots (occasionally washing off into bark cracks and crevices). As the buds open in the spring, the mycelium grows out into the developing shoot and leaf tissues and soon begins to produce the asexual summer spores (conidia). These spores are wind-borne and germinate readily at mild temperatures and high humidity. The resulting new mycelium colonizes the exterior of the leaf, occasionally penetrating the surface cells to provide access to the food they contain and produce. The disease develops rapidly under cloudy, overcast conditions at temperatures of 70 - 90 F until late-June to early-July, when temperatures reach into the upper 90's F and shoot growth stops.

Preferred spring application is at pre-pink and pink bud. Treat immediately if mildew is found on shoots or leaves on inner scaffolds. If powdery mildew continues to be a problem in the orchard, apply additional treatments as needed.

PECANS

USE RESTRICTIONS: DO NOT apply more than 20 gallons (57.2 lbs. of Calcium Polysulfide) per application per acre or more than 95 gallons of TETRASUL 4S5 product (271.7 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 14 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water up to 500 gallons of dilute spray per acre**	**Maximum number of applications**
Delayed Dormant	Powdery Mildew and Scab	2 to 3 gallons	2
Growing Season	Powdery Mildew, Mites, Scab and Yellow Pecan Aphid	¾ to 1 gallon	10
For mature trees apply as a full coverage spray using up to 500 gallons of spray per acre. Thorough coverage is essential for control. For **Scab** apply first during Delayed Dormant and again 2 to 5 weeks after petal fall. For **Yellow Pecan Aphid**, apply as needed to prevent excessive honeydew buildup. For **Mites**, apply when infestation is first noticed.			
Fall Clean-up	Overwintering insects and eggs; disease spores and fungal parts	1 to 2 gallons* and/or 2 to 3 gallons**	2 total
Not for post-harvest application to harvested nuts. Apply *[1 to 2 gallons] rate in the fall and/or **[2 to 3 gallons rate] anytime after leaf drop begins. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT PECAN PESTS

Yellow Aphids

Scientific names: Yellow pecan: *Monelliopsis pecanis* Black margined: *Monellia caryella*

Symptoms, Life-cycle and Pest Management

Aphids are small, soft-bodied insects that suck sap from pecan leaves. There are two species of "yellow" or "honeydew" aphids, the black-margined aphid, Monellia caryella, and the yellow pecan aphid, Monelliopsis pecanis. The black-margined aphid has a black stripe along the outside margin of its wings, which are held flat over the body. The yellow pecan aphid holds its wings roof-like over its body and lacks the black stripe along the wing margin. Immature aphids are difficult to identify because they lack wings. Infestations may contain both species.

The yellow pecan aphid occurs later in the season. Outbreaks of this species can cause defoliation and reduce yield and quality on most cultivars. Both species primarily feed on the underside of leaves. Black margined aphids feed on the underside of leaves on major leaflet veins while yellow pecan aphids feed on the network of small veins located throughout the leaf. They damage pecan trees by extracting large amounts of

photosynthate and water from leaves, which impairs the growth of both shoots and roots. They also secrete large amounts of honeydew on to leaves, and the sooty mold that grows on the honeydew can reduce photosynthetic efficiency.

Yellow aphid eggs survive the winter hidden in bark crevices on twigs and tree trunks. Immature aphids, called nymphs, hatch from eggs in spring and begin to feed on newly expanded leaves. Nymphs mature in about a week and give birth to live young. All individuals are females that reproduce without males during spring and summer. In late September and October, males and females develop, and females deposit overwintering eggs.

Spider Mites
Scientific Names: *Tetranychidae and Eriophyidae*
Symptoms, Life-cycle and Pest Management
The pecan leaf scorch mite is the most important spider mite attacking pecans. Large numbers of these tiny mites feed on the undersides of pecan leaves. Mites suck plant sap, causing irregular brown spots on infested leaves. Infestations often develop first along the leaf midrib. Damaged leaves appear russeted or scorched. Large infestations can result in leaf loss, especially if trees are under moisture stress.

PISTACHIOS

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 50 gallons of TETRASUL 4S5 product (143.0 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 14 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 200 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant or Delayed Dormant	Alternaria Late Blight, Botryosphaeria Panicle and Shoot Blight, Mealybugs, Scale	2 to 3 gallons	4
Growing Season	Alternaria Late Blight, Aphids, Peach Twig Borer, Powdery Mildew, Mealybugs, Scale	½ to 1 gallon	8
For **Alternaria Late Blight** and **Powdery Mildew** applications need to be made at the first sign of disease, before leaf symptoms appear, in late spring through summer at 7 to 21 day intervals.			
Fall Clean-up	Overwintering insects and eggs; disease spores and fungal parts	1 to 2 gallons* then 2 to 3 gallons**	2 total

Not for post-harvest application to harvested nuts. Apply *[1 to 2 gallons rate] immediately post-harvest and then **[2 to 3 gallons rate] anytime after leaf drop. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.

ABOUT PISTACHIO PESTS

Panicle and Shoot Blight
Pathogen*: Botryosphaeria dothidea; conidial stage: Fusicoccum sp*.
Symptoms, Life-cycle and Pest Management
Vegetative and flowering buds that were killed during the previous fall or winter do not emerge in spring. In mid-spring (end of May to June) buds that were partially infected the previous season produce fruit clusters and shoots that develop blight from the fungus in buds. The rachises of these blighted clusters turn black as do the shoots. When temperatures increase in May through July, the fungus moves into shoots of the previous year, causing blighting of fully developed clusters. These blighted shoots, leaves, and clusters turn brown.

Sources of inoculum for this disease are rachises, shoots, and petioles killed during the previous growing season that remain on the trees. Cankers can also provide inoculum for as long as 6 years. Spores from these sources cause primary infections on the vegetative and flowering buds.

Alternaria Late Blight
Pathogens: *Alternaria alternata, A. tenuissima, A. arborescens,* and *Stemphyllium* spp.
Symptoms, Life-cycle and Pest Management
Alternaria late blight occurs as black angular or circular lesions on leaves of both male and female trees. When the pistachio fruit are maturing, black lesions with a red halo appear on hulls. Black spores develop in the center of the leaf lesions when humid conditions prevail in orchards. Rubbing the leaf lesions with a finger will blacken the finger. In contrast, rubbing a finger on a lesion cause by *Botryosphaeria dothidea* does not blacken fingers because there are no spores produced on the surface of these lesions. However, late in the season both fungi can be present in the same lesion and microscopic identification will be needed. Leaf infections can cause severe premature defoliation and create problems during shaking the trees at harvest.

Black lesions are also present on petioles and main veins of leaf blades. On immature fruit the symptoms appear as small black lesions about 1 mm in diameter. On mature fruit, both small (1–2 mm) and large (5 mm) black lesions are present on the epicarp, usually surrounded by a reddish purple margin. Multiple lesions on leaves and fruit cause leaf blight and deterioration of hulls, respectively. Deterioration of hulls results in shell staining. Orchards with cover crops have more Alternaria blight than disked orchards. Sunburned fruit become more susceptible to Alternaria blight than non-sunburned fruit.

PLUMS AND PRUNES

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 52 gallons of TETRASUL 4S5 product (148.7 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 25 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant	Coryneum Blight (Shot Hole), Leaf Curl, Mites, Peach Twig Borer, Plum Leaf Spot, Plum Pockets, San Jose Scale, Scale insects, Overwintering spores	2 to 3 gallons	2
Delayed Dormant	Aphid eggs, Coryneum Blight (Shot Hole), Black Knot, Brown Rot Blossom Blight, Mites, Scale insects	2 to 3 gallons	2
For **Aphid eggs**, apply in February to March, about the time the outer shells split.			
Pre-Bloom	Brown Rot Blossom Blight, Powdery Mildew, Sooty Blotch and Flyspeck	¾ to 1 ½ gallons	4
For Brown Rot Blossom Blight, begin applications at white bud and repeat every 10 to 14 days through bloom if rains continue. For **Powdery Mildew,** begin at white bud and repeat every 10 to 14 days through petal fall. Treat immediately if mildew is found on leaves or shoots of inner scaffolds. For **Sooty Blotch and Flyspeck,** Apply again at petal fall and 10 days later. Then use ½ to 1 gallon of product per 100 gallons of water per acre 4 to 6 applications**.**			
Petal Fall and Growing Season	Sooty Blotch and Flyspeck, Powdery Mildew, Rust, Plum Leaf Spot, Coryneum Blight (Shot Hole)	½ to 1 gallon	10
For **Sooty Blotch and Flyspeck**, apply at 10 to 14 day intervals through the growing season, 4 to 6 applications. For **Powdery Mildew, Rust**, apply as needed. For **Rust**, applications need to be made before symptoms appear anytime in late spring through summer at 10 to 14 day intervals. For **Plum Leaf Spot**, apply at petal fall, fruit set and two weeks later. Additional sprays at pre-harvest and fall clean up may be needed. For **Coryneum Blight (Shot Hole)**, apply at 10 to 14 day intervals until about 1 month before harvest.			
Pre-Harvest	Brown Rot (Fruit), Leaf	½ gallon	5

	Spot, Powdery Mildew		
Not for post-harvest application to harvested fruit. Apply 3 to 5 sprays at weekly intervals up to 2 days before harvest.			
Post-Harvest and Fall Clean-up	Aphid eggs, Leaf Spot, San Jose Scale and Overwintering spores, Coryneum Blight (Shot Hole)	1 to 2 gallons* and/or 2 to 3 gallons**	2 total
Not for post-harvest application to harvested fruit. For **Aphid eggs, Leaf Spot, San Jose Scale and Overwintering spores and Coryneum Blight (Shot Hole)**, *[1 to 2 gallon rate] apply in late fall after temperatures cool and preferably before the first frost and/or **[2 to 3 gallon rate] apply anytime after leaf drop begins. Spray ground as well. For **Coryneum Blight (Shot Hole)**, fall application before winter rains begin is the most important application for control of this disease. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT PLUM AND PRUNE PESTS

Plum Pockets
Pathogen: *Taphrina pruni*
Symptoms, Life-cycle and pest management
A number of stone fruit diseases are caused by fungi similar to the leaf curl fungus. In the northeastern United States, the most important disease affecting American-type plums is known as plum pockets, or bladder plum.

New shoots and leaves usually are infected, as well as the fruit. Shoots thicken and often are curled or twisted. Diseased leaves are thickened and curled as in leaf curl.

Spores overwinter on twigs, and during cool, wet periods in early bloom can be splashed to the opening buds, where infection takes place. Developing ascospores give the infected fruit a velvety gray appearance, thus completing the disease cycle. A spray program similar to the one for peach leaf curl also can control plum pockets. One application in the dormant/delayed dormant period is sufficient except in areas of high rainfall; in such cases, an added application at the delayed dormant timing in late winter before bud swell is advised.

San Jose Scale
Scientific name: *Diaspidiotus (Quadraspidiotus) perniciosus*
Symptoms, Life-cycle and pest management
San Jose scale can infest branches, shoots, leaves, and fruit. Adults and nymphs suck plant juices and cause considerable damage. They have been known to seriously weaken branches and main scaffold limbs, thus causing permanent injury to mature trees. Crawlers settling on fruit may cause fruit spotting. Partially mature nymphs overwinter on limbs and trunks. Dormant season treatments are the key to controlling this pest.

Black Knot
Pathogen: *Dibotryon morbosum*
Symptoms, Life-cycle and pest management
Black knot is a common and serious disease of plum, prune and chokecherry. The black knot fungus produces spores on one- or two-year old knots. The spores initially are released about the time the leaf buds are in the green tip stage. Spore release is heavy at blossom time and is completed about the time the shoots have finished growth. Spores are carried by the wind, infecting new shoots in wet weather, especially when the temperature is between 55 and 77 degrees Fahrenheit. Best control is achieved by pruning in conjunction with use of lime sulfur spray before bud-break.

Brown Rot Blossom and Twig Blight
Pathogens: *Monilinia laxa and Monilinia fructicola*
Symptoms, Life-cycle and pest management
Blossom and twig blight causes the collapse of young blossom spurs and associated leaves. A gummy exudate is present at the base of flowers. Gray-brown spore masses form on diseased flowers under high humidity.

Monilinia spp. survive on diseased twigs and mummified fruit. Its development is favored by moderate temperatures and moist-to-wet conditions during bloom or on mature fruit. The disease is not common on most plum cultivars because unlike peach and nectarine, many plums are less susceptible to brown rot blossom and twig blight, as well as fruit rot.

Sanitation includes removal and destruction of mummified fruit from trees and orchard floors after harvest and before bloom, as well as heavily thinned fruit from orchard floors that may be colonized by the pathogen and function as a source of inoculum during fruit maturation. On susceptible cultivars, apply a protective fungicide treatment as a delayed bloom application (20-40% full bloom). A second application may be necessary during protracted flowering or during foggy or rainy weather. Protective treatments to prevent fruit brown rot are usually not needed on early or mid-season varieties. If an orchard has a history of the disease or if rainfall is forecasted on mature fruit in the harvest period, protective fungicide treatments may be necessary to prevent brown rot of fruit.

Powdery Mildew
Pathogens: *Sphaerotheca pannosa and Podosphaera tridactyla*
Symptoms, Life-cycle and pest management
Areas of white powdery fungal growth, roughly circular in shape, develop on the fruit in spring. These infected areas later become scabby and dry. In late summer and fall, similar fungal growth appears on leaves. Occasionally, symptoms may develop on fruit and leaves in spring.

Podosphaera tridactyla overwinters as special spore-forming structures called cleistothecia on the surface of shoots, on dead leaves on the orchard floor, and on bark. Spores are produced from these structures during spring rains, and they infect the developing foliage on plum trees. Growth of the pathogen is favored by cool, moist nights and warm days.

Watching for the disease during routine monitoring helps to determine the need for possible action the following year, but by the time it appears on the fruit it is too late to spray during the current season.

Plum Leaf Spot
Pathogen: *Coccomyces prunophorae*
Symptoms, Life-cycle and pest management
Leaf spot of plums and prune-type plums is caused by the fungus The fungus, its life cycle, and the disease it causes are very similar to those of cherry leaf spot. On plum leaves, the spots tend to be smaller, and severely infected leaves often have a tattered appearance. Unlike cherry infection, severe plum leaf infection is often followed by a heavy fruit drop.

Most varieties are susceptible to the disease, so fungicide sprays, along with the sanitation practices suggested for cherry leaf spot, are necessary for control. Lightly disk just before overwintered spores on leaves are ready to be discharged, about the time of shuck fall. Preventive applications at petal fall, fruit set and two weeks later.

Rust
Pathogen: *Tranzschelia discolor*
Symptoms, Life-cycle and pest management
The most common symptoms of rust are bright yellow, angular spots on leaves, with red-brown spore masses on lower sides of leaf, and premature defoliation. The rust pathogen depends on moisture for infection. Twig lesions do not occur on prune trees.

Treating at bloom won't be effective because it is too far in advance of leaf symptoms. The development of rust is favored by humid conditions, and the disease becomes worse when rain occurs in late spring and summer. Trees can be defoliated quickly when rust becomes severe. The rust fungus survives from one season to the next in infected leaves and possibly also in infected twigs.

Treat at the first sign of rust in the orchard. Additional treatments may be necessary, especially if a treatment was required early in the season. After a treatment is applied, continue to monitor weekly. Fall and Dormant applications are efficacious in helping manage the disease.

RED CLOVER, ALFALFA

USE RESTRICTIONS: DO NOT apply more than 2 gallons (5.7 lbs. of Calcium Polysulfide) per application per acre or more than 21 gallons of TETRASUL 4S5 product (60.1 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 15 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days.

Application timing	Pests controlled	Use per 100 gallons of water at 100 gallons of dilute spray per acre	Maximum number of applications
Early Bud Stage through Growing Season	Powdery Mildew	1 to 2 gallons	15
Apply 50 to 100 gallons of spray per acre. Apply at early bud stage or at first sign of disease.			

ABOUT POWDERY MILDEW
Pathogens: *Sphaerotheca pannosa and Podosphaera tridactyla*
Symptoms, Life-cycle and pest management
Powdery Mildew can attack plants at any stage of maturity, but it is most prevalent in late summer and early fall when nights are damp and cool and days are warm and dry. Long periods of relatively dry summer weather favor its development and spread; frequent rains discourage it.

Small patches of fine, white to pale gray, cobwebby growth develop on the upper leaf surface. The patches later enlarge and merge, and the leaf surface looks as if it has been dusted with white flour. The fungus may also grow on the lower surface of the leaves and on the stems. Severe attacks can make entire fields appear white. Infected leaves may turn yellow and wither prematurely.

The powdery mildew fungus survives the winter on diseased plants as fungus fruiting bodies (cleistothecia) that appear as black specks. Ascospores are produced within asci in the cleistothecia and provide primary inoculum. The ascospores are released when the cleistothecia and asci split open and are blown to leaves. Infections can occur at any time during the growing season, but are most common from midsummer to early fall.

ROSES

USE RESTRICTIONS: DO NOT apply more than 6 gallons (17.2 lbs. of Calcium Polysulfide) per application per acre or more than 34 gallons of TETRASUL 4S5 product (97.2 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest interval = 0 days.

Application timing	Pests controlled	Use per 100 gallons of water at 100 gallons of dilute spray per acre	Maximum number of applications
Dormant, Delayed Dormant (Bud Swell)	Rose and San Jose Scale, Case Bearer, Powdery Mildew	1 to 3 gallons	4

Growing Season	Black Spot, Powdery Mildew, Rust, Red Spider Mites	½ to ¾ gallon	10
Apply at 10 to 15 day intervals in growing season. Pick open flowers before spraying to avoid discoloration.			
Fall Clean-up	Rose and San Jose Scale, Powdery Mildew, Overwintering spores	2 to 3 gallons	2
Apply in fall after leaves begin to drop. Spray ground as well. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and stems.			

SHADE TREES, ORNAMENTAL SHRUBBERY, DECIDUOUS HEDGE PLANTS AND BERRIES

USE RESTRICTIONS: DO NOT apply more than 9 gallons (25.7 lbs. of Calcium Polysulfide) per application per acre or more than 75 gallons of TETRASUL 4S5 (214.5 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 16 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. **DO NOT** apply to Evergreens, Euonymus or Rhododendrons or allow spray to drift on these susceptible species. See and use other fruit sections for other appropriate diseases and their control. For specific plants not mentioned above a preliminary trial spray to determine plant sensitivity is needed.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 200 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant and Delayed Dormant	Stem Canker, Anthracnose, Black Spot, Coryneum Blight (Shot Hole), Moss, Lichen, Leaf Blotch, Maple Gall, Nectria Canker, Powdery Mildew, Rust, San Jose Scale, Scale Insects, Juniper Scale on deciduous Fruit Trees, Ornamental Shrubberies, Berries and most Ornamental Trees including but not limited to Lilac, Ash, Poplar, Dogwood, Elm, Birch Willow	2 to 3 gallons	4
For **Stem Canker**, apply in the Fall, repeat at Bud Swell. For **Anthracnose, Black Spot, Coryneum Blight (Shot Hole), Moss, Lichen, Leaf Blotch, Maple Gall, Nectria Canker, Powdery Mildew, Rust, and San Jose Scale**, for best control, use a full cover spray from the orchard floor or trunk soil line to the top of canopy. Spray thoroughly, but do not drench foliage.			

Growing Season	Powdery Mildew, Boxwood Canker	½ to ¾ gallon	10
For **Ornamentals including but not limited to Begonias (Tuberous), Crape Myrtle, Dahlias, Delphiniums, Lilacs, Marigolds, Sweet Peas, Zinnias** for **Powdery Mildew**, apply when foliage appears and repeat at 7 to 10 day intervals as needed. For **Boxwood Canker**, apply in spring at mid-growth, completed growth and fall growth. Follow with a dormant application.			
Fall Clean-up	Aphid eggs, Leaf Spot, San Jose Scale and Overwintering spores, Coryneum Blight (Shot Hole)	1 to 2 gallons* and/or 2 to 3 gallons**	2 total
Not for post-harvest application to harvested fruit. Apply in late fall after temperatures cool and preferably before the first frost. For **Aphid eggs, Leaf Spot, San Jose Scale and Overwintering spores,** apply *[1 to 2 gallons rate] in fall and/or **[2 to 3 gallons rate] anytime after leaf drop begins. Spray ground as well. For **Coryneum Blight (Shot Hole)**, a fall application before winter rains begin is the most important application for control of this disease. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches.			

ABOUT SHADE TREE, ORNAMENTAL SHRUBBERY, DECIDUOUS HEDGE PLANT, AND BERRY PESTS

Maple Gall
Scientific Name: *Eriophyidae*
Symptoms, Life-cycle and pest management
Maple, *Acer* spp., leaves are often infested with a wide variety of brilliantly colored, odd-shaped galls and blotches. Some of these abnormal plant cell growths called galls are caused by very small eriophyid mites in the family *Eriophyidae*. Members of this family of mites are commonly referred to as eriophyid mites. Several species of eriophyid mites cause leaf galls on maple. They are the maple bladdergall mite, *Vasates quadripedes* Shimer, maple spindle gall mite, *V. aceriscrumena* (Riley), and some erineum gall mites, *Eriophyes* spp.

The best time to treat an infested tree is delayed dormant before buds swell. Adults move from their overwintering sites to new growth at this time of the year. This treatment may help reduce the eriophyid mite population on an infested tree.

Nectria Canker
Pathogen: *Nectria cinnabarina*
Symptoms, Life-cycle and pest management
The fungus invades wood damaged by freezing, hail, animals and insects. Most hardwoods with such injuries are susceptible to attack. Slightly sunken areas (cankers) develop around wound or damaged tissue. Both the asexually formed spores (conidia formed all year) and the sexual spores (ascospores) formed in the late summer are capable of causing disease.

WALNUTS

USE RESTRICTIONS: DO NOT apply more than 20 gallons (57.2 lbs. of Calcium Polysulfide) per application per acre or more than 95 gallons of TETRASUL 4S5 product (271.7 lbs. of Calcium Polysulfide) per acre per year. **DO NOT** make more than 18 applications per year when applied at reduced use rates. Minimum Retreatment Interval = 7 days. Preharvest Interval = 0 days. **DO NOT** use oil on walnut trees during the dormant season.

Application timing	**Pests controlled**	**Use per 100 gallons of water up to 500 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant or Delayed Dormant	Aphids, Blight, Botryosphaeria and Phomopsis Canker, Mites, Scale Insects and Walnut Leaf Blotch or Anthracnose	2 to 3 gallons	4
For mature trees apply as a full coverage spray using up to 500 gallons of spray per acre.			
Delayed Dormant	Aphids, Botryosphaeria and Phomopsis Canker, Mites, Scale Insects and Walnut Leaf Blotch or Anthracnose	2 to 3 gallons of product plus 1-1/2 gallons narrow range oil	2
For mature trees apply as a full coverage spray using up to 500 gallons of spray per acre. **DO NOT** use oil on walnut trees during the dormant season; apply oil with caution during delayed dormant period.			
Growing Season	Aphids, Blight, Mites and Scale Insects	¾ to 1 gallon	10
For mature trees apply as a full coverage spray using up to 500 gallons of spray per acre. Thorough coverage is essential for control.			
Fall Clean-up	Overwintering insects and eggs; disease spores and fungal parts	1 to 2 gallons* and/or 2 to 3 gallons**	2 total
Not for post-harvest application to harvested nuts. Apply *[1 to 2 gallons] rate in the fall and/or **[2 to 3 gallons rate] anytime after leaf drop begins. For mature trees apply as a full coverage spray using up to 500 gallons of spray per acre. Clean up sprays are very effective in controlling susceptible insects, their eggs, and newly deposited diseases, spores and fungal parts that overwinter on dead or dying leaves, twigs and branches. Spray any debris on the ground as well.			

COMBINATION OIL SPRAY OPTION
FRUIT TREES, ROSES AND DECIDUOUS HEDGE PLANTS, SHADE TREES AND SHRUBS
(Horticultural Oils combined with Lime Sulfur)

USE RESTRICTIONS: When applied as a **true dormant spray** before growth begins, Lime Sulfur can be used with Oil to increase the penetration of the caustic sulfur into the surface of the infected tissue. **Once green tissue appears,** combination lime sulfur and oil sprays may cause injury. To minimize injury, use caution when applying combination lime sulfur and oil sprays when green tissue is exposed. Lime sulfur rates are reduced when green tissue is exposed. **DO NOT** apply during or when freezing weather is expected.

For post-harvest application to pears, **DO NOT** allow sprays to drift to adjacent apple orchards as defoliation may occur.

The potential for phytotoxicity of oil product and/or oil product mixes has not been fully evaluated for all crop varieties in all growing areas. Small plot tests are prudent to determine safety margins of particular varieties for specific environmental conditions in different growing areas.

DO NOT use oils on certain plants including maple, beech, black walnut, Japanese walnut and flowering cherry. Check the product labels for these and other restrictions before use.

DO NOT apply Oil and TETRASUL 4S5 mix to Apricots, Evergreens, Euonymus and Rhododendrons or allow spray to drift on these susceptible species.

Keep agitated during spraying. Use only on non-sensitive to TETRASUL 4S5 varieties. Drought, cold and high temperatures, and other conditions may weaken trees. **DO NOT** apply TETRASUL 4S5 or oils to trees in weakened condition.

Application timing	**Pests controlled**	**Use per 100 gallons of water at 100 to 300 gallons of dilute spray per acre**	**Maximum number of applications**
Dormant and Delayed Dormant	San Jose Scale, Oyster Shell Scale, Brown Apricot Scale, Black Scale, Moss, Lichen and Overwintering Insect Eggs, Fungus Spores and Plant Diseases	1 to 3 gallons plus 1 to 5 gallons supreme or superior type dormant oil or emulsion	4
ALMONDS			
Dormant and Delayed Dormant	Peach Twig Borer, Powdery Mildew, San Jose Scale, Scab, Shot Hole	1 to 3 gallons plus 1 ½to 3 gallons supreme or superior type oil	4
APPLES			
Dormant	Brown Mite, European Red	1 to 3 gallons plus 1½	2

	Mite, Pear Leaf Blister Mite, Rust Mite, San Jose Scale	to 3 gallons supreme or superior type oil	
Delayed Dormant	Oystershell Scale	1 to 3 gallons plus 1½ to 3 gallons supreme or superior type oil	2
Apply just before bud break.			
Post-Harvest	Rust Mite, Blister Mite, San Jose Scale, Aphid and Mite eggs	1 to 2 gallons plus 1½ to 2 gallons of supreme or superior type oil	2
Not for post-harvest application to harvested fruit. Apply late fall after temperatures cool, preferably before the first frost.			
CHERRIES (SWEET and TART)			
Delayed Dormant	For the control of Coryneum Blight (Shot Hole), Scale Insects, Peach Twig Borer, Leaf Curl, Brown Mites, Red Mites, Silver Mites	1 to 3 gallons with 1 ½ to 3 gallons of superior type oil spray	2
GRAPES			
Post-Harvest	To reduce viability of overwintering Anthracnose, Mealybugs, Measles, Phomopsis and Powdery Mildew spores	1 to 2 gallons plus 2 gallons of supreme or mineral oil	2
Apply before late fall rains and just as leaf drop begins. Apply up to 200 gallons spray per acre. Apply at least 4 hours prior to rainfall or irrigation.			
PEACHES and NECTARINES			
Dormant and Delayed Dormant	Scale Insects, European Red Mite, Leaf Curl, Silver Mites, Peach Twig Borers, Coryneum Blight (Shot Hole), Brown Mites, Red Mites and Aphids	1 to 3 gallons of product per 100 gallons plus 1½ to 3 gallons superior oil	4
PEARS			
Delayed Dormant	Pear Leaf Blister Mite, Rust Mite, European Red Mite, San Jose Scale, Pear Psylla	1 to 3 gallons plus 1½ to 3 gallons supreme or superior type oil	2
Allow a minimum of 10 days between a Delayed Dormant oil application and a later Lime Sulfur application.			
Post-Harvest	Rust Mite Scale Insects, Pear Psylla, Aphid and Mite Eggs, Pear Leaf Blister Mite Bud Mite (Pacific Coast States)	1½ to 2 gallons plus 1½ to 2 gallons light medium summer oil 1 to 3 gallons plus 1½ to 2 gallons of supreme or superior type oil 1 to 2 gallons plus 2	2

		gallons light medium summer oil	
Not for post-harvest application to harvested fruit. For **Rust Mite**, apply immediately after harvest. This is to prevent the Rust mite from overwintering under the developing fruit and leaf buds. ***DO NOT*** *allow sprays to drift to adjacent apple orchards as defoliation may occur.* For **Scale Insects, Pear Psylla, Aphid and Mite Eggs, Pear Leaf Blister Mite**, apply in fall as leaves begin to fall. For **Bud Mite (Pacific Coast States)**, apply in the fall after temperature cools but before the first frost at the time mites first penetrate under the bud scales.			
PLUMS and PRUNES			
Dormant or Delayed Dormant	Scale Insects, Silver Mites, Peach Twig Borers, Coryneum Blight (Shot Hole), Peach Leaf Curl, Brown Mites, Red Mites, Aphids	1 to 3 gallons plus 1½ gallons superior type oil	4
SHADE TREES, SHRUBS, ROSES, OTHER FRUIT TREES			
Dormant or Delayed Dormant	Coryneum Blight (Shot Hole), San Jose Scale, Oyster Shell Scale, Brown Apricot Scale, Black Scale, Moss, Lichen and Overwintering Insect Eggs, Fungus Spores and Plant Diseases	1 to 3 gallons plus 1 to 5 gallons supreme or superior type dormant spray oil	4
Delayed Dormant	As an aid in the control of Powdery Mildew, Anthracnose	1 to 2 gallons plus ¾ to 1½ gallons light medium summer oil	2
Apply once in early spring before buds swell. Full season control of Powdery Mildew and Anthracnose will require additional applications of fungicide that are not oil and lime sulfur in combination.			
Growing Season*	Spotted Wing Drosophila on Fruit Trees, Grapes and Berries	2 ½ gallons of product per 100 gallons of water per acre plus ¾ to 1½ gallons light medium summer oil	
***Apply *to the ground* up to the base of the tree, vine or bush where fruit fall. DO NOT spray foliage. Begin when fruit brix exceeds 6% and apply each week until after fruit have completely decomposed. Use fall clean up spray to reduce remaining adult population.**			

ABOUT OYSTERSHELL SCALE

Oystershell Scale
Scientific Name: *Lepidosaphes ulmi*
<u>Symptoms, Life-cycle and Pest Management</u>
The oyster shell scale belongs to a group of insects called the armored scales. There is one or two generations of oystershell scale each season. Oystershell scale feeding weakens the plant. Damage consists of small, dark brown scales cluster on bark or on fruit.

Scales overwinter as fertilized females with 40-150 egg masses under their scale. Eggs hatch in late spring, approximately two to three weeks after bloom, and young crawlers emerge. Crawlers are small white with six legs, moving to an appropriate site where to begin feeding. They insert their mouthparts into the plant, begin to suck sap and soon molt. From this point on, they will remain in the same spot for the rest of their lives. After a few hours of feeding, the scale begins to form. Mating occurs and females die shortly after they lay their last eggs.

Crawlers spread through orchards by wind, birds' feet, workers' clothing and on farm equipment.

Use lime sulfur during late dormancy just before bud break when scales have only a thin wax covering. Delaying application until green tissue is present often results in poor scale control, because scales have produced a larger protective wax coating making complete coverage of the insect more difficult.

Not for apple blossom thinning

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

Pesticide Storage: Store product in a secure locked place, inaccessible to children, pets, and livestock. Store it in a cool, dry place. Keep container closed when not in use. Do not store near fertilizers.

Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Handling: Non-refillable container. Do not reuse this container to hold materials other than pesticides or dilute pesticides (rinsate). After emptying and cleaning, it may be allowable to temporarily hold rinsate or other pesticide-related materials in the container. Contact your state regulatory agency to determine allowable practices in your state. Triple rinse the container (or equivalent) promptly after emptying. Use rinsate for basal application to labeled trees, vines, canes or crops for additional protection from pathogen spores. Offer for recycling, if available or offer for reconditioning, if appropriate or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

-For 5 gal. or 50 lbs. container or less, triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times.

-For over 5 gallon or 50 lbs. container; triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it

back and forth several times. Turn the container over onto its other end and tip back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times.

-For Refillable, plastic container, greater than 5 gallons: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10 percent full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Use rinsate for basal application to labeled trees, vines, canes or crops for additional protection from pathogen spores.

When empty, return container to point of sale, then offer for recycling if available or reconditioning if appropriate or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures approved by state and local authorities.

-SpaceKraft Composite Intermediate Bulk Containers: The inner liner is a nonrefillable container that is recyclable or disposable. The outer box is recyclable or disposable. The pallet is reusable, recyclable or disposable. Empty the contents into application equipment or a mix tank. To rinse the inner liner: replace the liner's dispense plug, remove the inner liner from the box, remove the fill plug, fill with 1 to 2 gallons of water, replace the fill plug, firmly grasp liner with both hands then agitate for 10 seconds. Pour rinsate into application equipment or use as a drench treatment at base of trees or crops that are being treated. Repeat this procedure two more times.

CONDITIONS OF SALE – LIMITED WARRANTY AND LIMITATIONS OF LIABILITY AND REMEDIES

The directions on this label are believed to be reliable and must be followed carefully. Insufficient control of pests and/or injury to the crop to which the product is applied may result from the occurrence of extraordinary or unusual weather conditions, the failure to follow the label directions all of which are beyond the control of OR-CAL, Inc. or seller. In addition, failure to follow the label directions may cause injury to crops, animals, man or the environment. OR-CAL, Inc. warrants that this product conforms to the chemical description on the label and is reasonably fit for the purpose referred to in the directions for use subject to the factors noted above which are beyond the control of OR-CAL, Inc. OR-CAL, Inc. makes no other warranties or representations of any kind, express or implied concerning the product, including no implied warranty of merchantability or fitness for any particular purpose. To the extent consistent with applicable law, the exclusive remedy against OR-CAL, Inc. for any cause of action relating to the handling or use of this product is a claim of damage and damages or any other recovery of any kind against OR-CAL, Inc. shall not exceed the price of the product, which causes the alleged loss, damage, injury or other claim. To the extent consistent with applicable law, OR-CAL, Inc. shall not be liable for losses or damages resulting from special, indirect, incidental, or consequential damages or expenses, or any nature, including, but not limited to, loss of profits, or income, whether or not based on OR-CAL, Inc. negligence, breach of warranty, strict liability in tort or any other cause of action. OR-CAL, Inc. and the seller offer this product and the buyer and user accept it, subject to the foregoing conditions of sale and limitation of warranty, liability and remedies.

TETRASUL 4S5

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[OPTIONAL FERTILIZER INSTRUCTIONS- example]

GUARANTEED ANALYSIS:
Soluble Potash (K_2O) 3%
Calcium (Ca) 5%
Sulfur (S).....18%
10.0% Combined Sulfur (S)

Derived from calcium polysulfide and potassium hydroxide.

Information regarding the contents and levels of metals in this product is available on the internet at https://www.aapfco.org/metals.html

To encourage the development of plant vigor and strong roots for winter hardiness, mix 2 to 3 gallons of product in 100 gallons of water and spray ground from the base of the treated plant out to the dip zone. Apply up to 300 gallons of spray per acre.

[OPTIONAL MARKETING LOGO:]