Apple Programs

Major Insects

Aphids

Natural enemies can be effective on aphids. When 20% of colonies have predators a pesticide application may be delayed or eliminated. Use of pesticides with low toxicity to predators will increase biological control. Product recommendations will be effective on apple aphid, apple grain aphid, and rosy apple aphid, but less so on woolly apple aphid.

Apple rust mite

Apple rust mite feeds on plant foliage, and in very high numbers, can cause shoots to stop growth prematurely. However, in low to moderate numbers, they are generally regarded as an important and positive part of integrated mite management. Predatory mites can eat apple rust mites when spider mites (a more damaging pest) are scarce, and sustain their populations through the season. Choose pesticides that cause minimal harm to apple rust mite unless 1) populations become very high or 2) large early season populations occur on sensitive cultivars where fruit russetting can occur, such as ‘Golden Delicious’. Additional Details about Apple rust mite

Campylomma

Campylomma is a sporadic pest of apple, and primarily a beneficial insect (pear psylla predator) on pear. It overwinters in the egg stage on the tree in the bark, and emerges just before and during apple bloom. Large populations require control as soon as they are detected; earlier sprays will do a better job of preventing fruit damage. Pay attention to label restrictions of bloom applications to protect pollinators. Petal-fall sprays will kill nymphs, but prevent little if any fruit damage. Additional Details about Campylomma

Codling moth

Codling moth is the key pest of pome fruits in the Pacific Northwest. Mating disruption is considered the foundation of an IPM program. Install dispensers prior to bloom (historically first moths are caught between 121 and 220 CM DD, average 175 DD) using the full label rate in the top 2 feet of the canopy. When using aerosol emitters borders should be treated with hand-applied dispensers. Supplementing mating disruption with insecticides may be necessary depending on pressure, and using pheromone traps to monitor populations is important to determine year-over-year pressure. Codling moth has a long history of becoming resistant to insecticides. Avoid using products with the same MOA two generations in a row to minimize resistance danger. WSU recommends a delayed cover program, especially first generation. There are two strategies,1) a delayed cover residual ovicide applied at 225 codling moth degree days (CM DD), or 2) a delayed cover topical ovicide applied at 375 CM DD. Either program delays the first larvicide spray to 525 CM DD by reducing larval numbers. This approach leaves only a small percentage of egg hatch at the end of each generation uncovered. If following a larvicide only program (no ovicide), apply the first larvicide at 425 CM DD. Subsequent first generation applications are based on product residual (e.g. 10-14 days conventional, 6 days organic). For a delayed cover program in the second generation target ovicides at 1225-1375 CM DD (residual ovicide 1225-1325 CM DD and/or a topical ovicide at 1375 CM DD). After the first codling moth generation has completed, degree day (DD) accumulation occurs rapidly, making targeting discreet egg lay and hatch stages more difficult. Target first larvicide of the second generation to 1525 CM DD. In a larvicide only program (no ovicide) a larvicide should be applied at 1425 CM DD. In each program, subsequent second generation applications are based on codling moth capture in traps and product label/residual. If control is required in subsequent generations, add 1000 CM DD to previous timings with subsequent applications based on codling moth capture in traps and product label. (See WSU Decision Aid system at https://decisionaid.systems). Additional Details about Codling moth

Lacanobia fruitworm

First generation control sprays should be applied by 1230-1250 degree-days, when only about 10% of the larvae are in their 4th instar. This timing represents the best opportunity to control *Lacanobia subjuncta* with a single insecticide application. During the second generation, 10% of 4th instar is estimated at 3050 degree-days. The best timing for an insecticide application against larvae of the second generation is at 3050 degree-days, but no later than 3150 degree-days. Additional Details about Lacanobia fruitworm

Leafrollers (Pandemis, Obliquebanded)

Pre-bloom applications of pesticides can be effective and will also conserve natural enemies for leafroller and biological control agents of other pests, such as aphids. If treatments for leafrollers were applied at pink and/or bloom, sampling to determine the density of surviving leafrollers should be completed prior to deciding to apply additional controls at this timing. Most products listed act primarily as stomach poisons versus direct contact to residues, therefore, complete coverage is very

important to achieve maximal control. Repeating an application of any product should be based on the leafroller population surviving previous treatments. Use the leafroller models on the WSU Decision Aid System (https://decisionaid.systems) for the optimum timing. Additional Details about Leafrollers (Pandemis, Obliquebanded)

Oriental fruit moth

Oriental fruit moth (OFM) overwinters as a full grown larva in a silk webbing in tree crevices or ground cover. Overwintering moths appear at peach bloom timing. First generation larvae feed by boring into growing shoots reaching maturity mid May. There are 3 to 4 flights per year in Washington. Damage from first and second generation larva are primarily on shoots while third and fourth generation injure fruit. Monitor for shoot tip damage while first gen larvae are active. Pheremone traps placed starting before peach bloom can be used to monitor adults. Degree days can be used to time sprays. Mating disruption placed before April moth flight and replaced after 2 months is successful for OFM.

Rosy apple aphid

Starting at pre-pink monitor 5-10 trees from each block in sensitive varieties. Treatment is justified when more than one cluster per tree is infested. Sprays become progressively less effective as the season advances and leaves curl.

San Jose scale

San Jose scale can be a minor pest if adequately controlled, or escalate into a major problem if not. It primarily infests the trunk and limbs, but scale crawlers will settle on the fruit. Damage to this season’s crop may become serious, but ultimately the infestation of wood may cause death of limbs or the entire tree. Oil plus an organophosphate in the delayed dormant spray provide control; if the organophosphate is omitted (oil only), monitor the trees carefully and add one of the listed materials if scale become numerous. Additional Details about San Jose scale

Shothole borer

Good sanitation (removing large wood prunings, dead limbs, and woodpiles from the orchard) is the most effective management tactic. Insecticides are only effective against adults. Beetles begin flying in late April and are active through May. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect adult beetle activity. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem. Additional Details about Shothole borer

Western tentiform leafminer

For best results against leafminer, use an adjuvant with abamectin and spinosad. See labels for specific adjuvant recommendations.

White apple leafhopper

Adults fly from late May until frost. Monitor nymphs on the underside of leaves. Egg parasitoid *Anagrus spp.* attacks overwintering and summer eggs. Only control this indirect pest when necessary. Additional Details about White apple leafhopper

Woolly apple aphid

Woolly apple aphid has proven to be one of the most difficult of the aphid pests to control in recent years. The broad-spectrum organophosphates used in previous years are no longer used, and relatively few effective materials remain. This aphid is attacked by many predators (syrphid larvae, lady beetles, lacewings, and earwigs) and a parasitoid, *Aphelinus mali*. These natural enemies may provide control under some circumstances, but biological control may be easily disrupted. Avoid using disruptive pesticides if possible, and if necessary, treat with one of the effective insecticides. See tables. Additional Details about Woolly apple aphid

Major Diseases

Apple mildew

Apple and pear powdery mildew is caused by the same fungal species *Podosphaera leucotricha* which overwinters in dormant apple buds, whereas its survival in pear remains unknown. When infected buds break in spring, the fungus produces spores that are rain and wind-spread to infect freshly emerged leaves which are highly susceptible to powdery mildew. Germination and infections are optimal at temperatures between 60F and 78F. Wetness plays a marginal role. The fungus then continues with multi-cycle infections through spring and early summer until the production of new leaves and shoots cease. The fungus is slowed down by the rising temperature (above 82F) as summer progresses. Infection resumes in fall where the pathogen overwinters as ascospores (sexual form) or infected buds. Under high disease pressure and mild summer conditions, the fungus can cause russeting on fruits and therefore reduce quality. While no cultivar is immune, cultivars like Granny Smith, Honeycrisp, Idared and Crimson Crisp are highly susceptible, whereas Golden Delicious is susceptible and Fuji, Gala and Red Delicious are the least susceptible. Mildew management should start before bud break and at green tip stage (to reduce spread of new inoculum) with sulfur-based products and continue every 10 to 14 days until the production of new shoots cease. Fungicides from FRAC groups 3, 7, 11 and 19 are effective and SHOULD be ROTATED throughout the season. In growing, regions where scab is a problem, spray programs used to control the latter will control powdery mildew as well. In organic orchards, sulfur, potassium bicarbonate, and some biopesticides usually provide a good level of control.

Apple scab

Scab, caused by the fungus *Venturia inaequalis*, is a major disease of pome fruit in many growing regions, especially those with high rainfall. Symptoms are gray-brown to blackish lesions on leaves and fruit. Scab risk is low under arid conditions in Central Washington. However, some microclimates in the north of the state can be conducive to scab, and therefore, management is recommended. Where scab is a problem, the fungus overwinter in fallen leaves making leaf removal/incorporation critical to reduce inoculum for the following season. Scab is effectively controlled by the same fungicides sprayed for apple powdery mildew including fungicides from FRAC groups 3, 7 and 11.

Botrytis-Gray Mold

Gray mold, caused by *Botrytis* , is the second most important apple fruit disease and can be the most important disease affecting pear as shown in recent statewide and regional surveys in the Pacific Northwest. Flowers of both crops are susceptible to *Botrytis* infections which persist throughout the growing season until harvest. *Botrytis* infections remain dormant until storage where the fungus causes Gray Mold with symptoms becoming visible after a few months in storage. Afterward, the fungus can spread to healthy fruit. Temperatures between 64F and 78F are optimal for infections. Because infections occur exclusively in the orchard, it is important to start management as early as possible. Delayed management will fail to control infections that started weeks or months before harvest. The fungus is ubiquitous and overwinters on mummified fruit left on trees and fallen leaves. Good sanitation practices will reduce inoculum loads but because of the explosive nature of this disease, fungicide applications are necessary to achieve good control. At bloom time and during spring, fungicides from FRAC groups 7, 9 and 11, used to control apple powdery mildew or scab, will be effective against Botrytis if resistance is absent. Fungicides from FRAC 3 have a limited efficacy against *Botrytis* infections. As fruit mature, they become more susceptible to *Botrytis*. Late season management is especially important for cultivars picked after mid-September in WA when wet, disease conducive weather is more likely. Preharvest applications and ROTATIONS of fungicides from the FRAC groups 1, 7, 11 and 19 control *Botrytis*. Tank-mixture of single-site fungicide with Ziram or captan will increase efficacy and delay the selection for resistant populations. IMPORTANT: *Botrytis cinerea* is the most risky fungus for fungicide resistance development as the fungus can develop resistance to multiple fungicides simultaneously. Remember this aspect when spraying for other diseases such as powdery mildew, as the same fungicides sprayed early in the season can select for resistant *Botrytis* populations which will persist throughout the season and to the storage rooms resulting in limited efficacy of eventual postharvest treatment.

Bull's eye rot

Bull's eye rot is a major disease of apple and pear. The disease can be caused by four different fungal species from the genus *Neofabraea*. The main species causing Bull's eye rot of apple in eastern Washington is *N. perennans*, whereas *N. malicorticis* has been reported to be predominant in western Washington. It infects fruit and causes cankers on trees where it overwinters until conditions become favorable in the following spring when it causes new infections. Fruit are infected exclusively in orchards but Bull's eye rot symptoms are only seen after several months in cold storage. Therefore, preharvest management is key to reducing decay

rates in the packinghouse. Prune cankered branches to reduce the inoculum load and use fungicide applications prior to harvest to control. Ziram applied within two weeks before harvest is recommended for control of Bull’s eye rot in the Pacific Northwest. Topsin-M is ONLY recommended under wet conditions and for cultivars, such as Golden Delicious, Pinata, Fuji and Granny Smith, more susceptible to Bull's eye rot. Tank-mixtures of Ziram with other single-site fungicides are recommended to increase efficacy and reduced risks of fungicide resistance development. Frequent sprays may increase risk of resistance development to FRAC 1 fungicides used after harvest.

Fire blight

There is a risk of fire blight infection any time there are flowers on the tree, the weather is warm, and wetting occurs. **Early bloom**. Apply biologicals (Blossom Protect) during early bloom (2 applications). Reapply biological if lime sulfur was applied (lime sulfur is antimicrobial and reduces biological populations). **Full bloom to petal fall.** Watch the model. Apply materials 12-24 hours BEFORE moisture events. Sprays every 2 days may be necessary to cover opening flowers during extended high or extreme risk periods. Product used must contact the interior of the flowers in sufficient water and approved wetting agent to completely wet the interior. Applications of less than 100 gal/A can be effective on small trees if flower interiors are well covered, but do not drop the ppm below 200 (oxytetracycline). Application by ground equipment on each row is highly recommended. Application of antibiotics by aircraft are not effective. ***Organic.*** Prebloom: Fixed copper sanitation if fire blight was in the orchard last year. Apples Easy to Thin: Blossom Protect/ Buffer Protect early, lime sulfur (+ oil), second Blossom Protect/ Buffer Protect. Followed depending on the model and cultivar russet risk with soluble copper (Previsto 3 qt, Cueva 4 qt, or Cueva 3 qt + Serenade Opti, or Instill). Petal fall + 1-2 weeks Serenade Opti (most fruit safe) or 2% lime sulfur (red apples), essential oils (Cinnerate, Thyme Guard), peracetic acids (Oxidate 5.0, Jet-Ag). Apples Hard to Thin/Long Bloom Period: Lime sulfur (+ oil), then Blossom Protect + Buffer Protect, then a Lime sulfur (+ oil), then a second Blossom Protect + Buffer Protect. Depending on the model and cultivar russet risk soluble copper (Previsto 3 qt, Cueva 4 qt, Cueva 3 qt + Serenade Opti, or Instill). Petal fall + 1-2 weeks Serenade Opti or 2% lime sulfur (red apples), essential oils (Cinnerate, Thyme Guard), peracetic acids (Oxidate 5.0, Jet-Ag). Apples Hard to thin varieties/ short bloom period: Lime sulfur (+ oil) 2-3 applications. Depending on the model and cultivar russet risk follow with soluble copper (Previsto 3 qt, Cueva 4 qt, Cueva 3 qt + Serenade Opti, or Instill). Petal fall + 1-2 weeks: Serenade Opti (most fruit safe) or 2% lime sulfur (red apples), essential oils (Cinnerate, Thyme Guard), peracetic acids (Oxidate 5.0, Jet Ag). Pears Easy to Mark Varieties: 2 applications of Blossom Protect + Buffer Protect during early bloom to petal fall (70-80% bloom if single treatment). Follow with Serenade Opti at petal fall to reduce russet risk from Blossom Protect yeast. Pears Marking Tolerant Varieties: 2 applications of Blossom Protect + Buffer Protect during early bloom to petal fall (70-80% bloom if single treatment). Follow with soluble copper (Cueva 4 qrt, Previsto 3 qrt, or Cueva 3 qrt + Serenade Opti) if the model indicates risk (warm/wet).

Storage Rots (Sphaeropsis, Lambertella, Alternaria)

Several other fungal fruit infections initiated in the orchard can cause storage rots. Alternaria rot: A dark-brown to black infection caused by *Alternaria alternata* (and other spp.) is ubiquitous in most orchards. Infections, usually sporadic, may become frequent when sanitation is not observed or when wet conditions occur for an extended period. The fungus infects flowers at bloom, but can also infect fruit through the calyx end or wounds. Floral infections can result in moldy-core disease later in storage.

Sphaeropsis rot: A sporadic emerging disease caused by the fungus *Sphaeropsis pyriputrescens* infects fruits in the orchard and develops stem and calyx end rots in storage. The fungus overwinters on cankers and twigs. Prune diseased branches to help reduce inoculum. Pruning symptomatic crab apples is particularly important. Although this disease can be sporadic, it is still quarantined in many export countries and its identification in entry ports will result in fruit lot rejection.

Yellow-Lambertella rot: This disease was recently reported in the Pacific Northwest and, therefore, is considered as quarantine pathogen. Infections are caused by the fungus *L. corni-maris*, which has been isolated from mummies of other fruit crops in the past but its disease cycle in apple is still unknown. The disease develops yellow mycelium that cover the fruit, but symptoms are only observed after several months of storage. Recent studies have shown that fungicides from FRAC group 1 are not effective against *Lambertella* , whereas fungicides from FRAC groups 7 and 11 have only moderate efficacy. Until further research has shown which other preharvest fungicides are effective, it is recommended to apply a fungicide from FRAC group 9 or 12 postharvest, as these were found to be the most effective. The fungus requires a wound on the cuticle to cause an infection, therefore, reducing damages and punctures at harvest will reduce infection risks. The possibility of infections occurring through the calyx- or stem-ends is still unknown.

Major Fruit Protectants

Apple Sunburn

Sunburn damage costs apple growers tens of millions of dollars annually and is often the primary cause of fruit cullage for apples grown in the Pacific Northwest. Growers often lose more than 10% of their apples to sunburn unless they have used some means of protecting their fruit from sunburn damage. There are four types of apple sunburn: (i) Sunburn Necrosis, (ii) Sunburn Browning, (iii) Photo-Oxidative Sunburn, and (iv) Storage Sunburn. Apple fruit are susceptible to sunburn because they have a much higher thermal mass (the ability of a material to absorb and store heat energy) than leaves and are not able to dissipate this heat as effectively as leaves. It is important to remember that fruit temperature can be considerably higher (20 - 30°F) than the ambient air temperature.

Spray Schedule

Dormant

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
San Jose scale	**petroleum oil- dormant** petroleum oil- dormant	1.5 % v/v	12 h	none listed		4	**Organic**

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

Delayed dormant

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple mildew	**benzovindiflupyr** Aprovia	7 fl oz	12 h	30 d	7	3	Do not follow Aprovia with fungicides from FRAC group 7 such as Fontelis, Luna and Pristine to reduce fungicide resistance development.
	Ipflufenoquin Axios 20 SC	2.25-3 fl oz	4 h	7	52	4	Make first application at green tip stage. Do not apply more than once every 7 days. Do not make more than 3 applications per year. Do not make more than 2 sequential applications. Do not apply within 7 days of harvest; (PHI = 7 days).
	trifloxystrobin Flint Extra	2.9 fl oz	12 h	14 d	11	3	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	3	Fontelis is a FRAC 7 fungicide.
	fluopyram + trifloxystrobin Luna Sensation	5-5.8 fl oz	12 h	14 d	7, 11	4	
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	4	
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	4	Place Rally into solution before adding oil. Apply no sooner than half-inch green.
	lime sulfur/calcium polysulfide Rex Lime Sulfur	See label	48 h	0 d	un	NR	This material is toxic to pest and predatory mites; destroying apple rust mites, the alternate prey of predatory mites, may predispose the orchard to later spider mite problems. **Organic**
	triflumizole Trionic 4SC	16 fl oz	12 h	14 d	3	4	Trionic is a FRAC 3 fungicide an should not be rotated or used with other FRAC 3 fungicides.
	Notes: The efficacy level will depend on the absence of resistant populations from the orchard. To limit the potential for development of fungicide resistance, do not make more than four applications of FRAC group 11 fungicides per season. Do not make more than two sequential applications of FRAC group 11 fungicides. This limitation is inclusive of all FRAC group 11 fungicides labeled for use on pome fruits.						
	Notes: To limit the potential for development of fungicide resistance, rotate between FRAC groups. Do not make sequential applications of fungicides in the same FRAC group. Do not make more than 2 applications of fungicides in the same FRAC group per season.						

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple scab	**benzovindiflupyr** Aprovia	7 fl oz	12 h	30 d	7	2	
	mancozeb Dithane M45	6 lb	24 h	77 d	M3	NR	Do not apply after bloom. See label for restrictions.
	captan Drexel Captan 50W	6 lb	24 h	0 d	M4	NR	Do not use captan on pink through blossom stages. When possible, tank-mix captan with other single-site fungicides to help reduce fungicide resistance development.
	trifloxystrobin Flint Extra	2.5-2.9 fl oz	12 h	14 d	11	3	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	NR	
	fluopyram + trifloxystrobin Luna Sensation	4-5.8 fl oz	12 h	14 d	7, 11	NR	Do not use before or after Fontelis to minimize fungicide resistance development in FRAC group 7. Luna Sensation contains an active ingredient similar to the one in Flint or Sovran. Do not follow-up Luna with either product.
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	NR	
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	NR	Place Rally into solution before adding oil. Apply no sooner than half-inch green.
	lime sulfur/calcium polysulfide lime sulfur/calcium polysulfide	See Label	48 h	0 d	un	NR	This material is toxic to pest and predatory mites; destroying apple rust mites, the alternate prey of predatory mites, may predispose the orchard to later spider mite problems. **Organic**
	ziram Ziram 76DF Fungicide	See label	48 h	14 d	M3	NR	
	Notes: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive of all strobilurin fungicides (Mode 11) labeled for use on pome fruits.						
Fire blight	**Copper Hydroxide (Metallic Copper Equivalent 35%)** Copper Hydroxide (Metallic Copper Equivalent 35%)	6 lb	48 h	0 d	M1	NR	Copper based inoculum sanitation can reduce epiphetic populations of E. amylovora when overwintering cankers are present in orchards (Elkins et al 2015). Recommended only in blocks which had high pressure the previous 1-2 years. Apply between silver and green tip. **Organic**

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Aphids	**petroleum oil- dormant** petroleum oil- dormant	1.5 % v/v	12 h	none listed		4	Apply chlorpyrifos at half-inch green. If using with oil, liquid formulations are preferred. Do not make more than one application of chlorpyrifos per year. **Organic**
Cutworms	**indoxacarb** Avaunt Insecticide	See label	12 h	14 d	22A	4	
	methoxyfenozide Intrepid 2F	See label	4 h	14 d	18	NR	
European red mite	**petroleum oil- dormant** petroleum oil- dormant	1.5 % v/v	12 h	none listed		3-4	Oil is indispensable for an integrated mite control program. **Organic**
San Jose scale	**pyriproxyfen** **+ petroleum oil- dormant** Esteem 35WP + petroleum oil- dormant	4-5 oz 1-1.5 % v/v	12 h	45 d	7C	3-4	
	petroleum oil- dormant petroleum oil- dormant	1-1.5 % v/v	12 h	none listed		3-4	**Organic**

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

Prepink

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple mildew	**trifloxystrobin** Flint Extra	2.9 fl oz	12 h	14 d	11	3	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	3	Fontelis is a FRAC 7 fungicide.
	fluopyram + trifloxystrobin Luna Sensation	5-5.8 fl oz	12 h	14 d	7, 11	4	
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	4	
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	4	Place Rally into solution before adding oil. Apply no sooner than half-inch green.
	lime sulfur/calcium polysulfide lime sulfur/calcium polysulfide	See Label	48 h	0 d	un	NR	This material is toxic to pest and predatory mites; destroying apple rust mites, the alternate prey of predatory mites, may predispose the orchard to later spider mite problems. **Organic**
	Bacillus pumilus strain QST 2808 Sonata	2-4 qt	4 h	0 d		NR	**Organic**
	Notes: To limit the potential for development of fungicide resistance, rotate between FRAC groups. Do not make sequential applications of fungicides in the same FRAC group. Do not make more than 2 applications of fungicides in the same FRAC group per season.						
	Notes: Apply one Group 3 Fungicide at the same growth stage.						
	Notes: The efficacy level will depend on the absence of resistant populations from the orchard. To limit the potential for development of fungicide resistance, do not make more than four applications of FRAC group 11 fungicides per season. Do not make more than two sequential applications of FRAC group 11 fungicides. This limitation is inclusive of all FRAC group 11 fungicides labeled for use on pome fruits.						

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple scab	**mancozeb** Dithane M45	6 lb	24 h	77 d	M3	NR	Do not apply after bloom. See label for restrictions.
	captan Drexel Captan 50W	6 lb	24 h	0 d	M4	NR	Do not use captan on pink through blossom stages. When possible, tank-mix captan with other single-site fungicides to help reduce fungicide resistance development.
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	NR	Fontelis and Luna Sensation are from the same chemical group (7). Apply one of them ONLY at the same growth stage.
	fluopyram + trifloxystrobin Luna Sensation	4-5.8 fl oz	12 h	14 d	7, 11	NR	Luna Sensation and Fontelis are from the same chemical group (7). Apply one of them ONLY at the same growth stage.
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	NR	Apply only one Group 3 Fungicide at the same growth stage.
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	NR	Apply only one Group 3 Fungicide at the same growth stage.
	lime sulfur/calcium polysulfide Rex Lime Sulfur	See Label	48 h	0 d	un	NR	This material is toxic to pest and predatory mites; destroying apple rust mites, the alternate prey of predatory mites, may predispose the orchard to later spider mite problems. **Organic**
	ziram Ziram 76DF Fungicide	See label	48 h	14 d	M3	NR	
	Notes: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive of all strobilurin fungicides (Mode 11) labeled for use on pome fruits.						

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Cutworms	**indoxacarb** Avaunt Insecticide	See label	12 h	14 d	22A	4	
	methoxyfenozide Intrepid 2F	See label	4 h	14 d	18	NR	
Grape mealybug	**acetamiprid** Assail 70WP	3.4 oz	12 h	7 d	4A	1	
	buprofezin Centaur WDG	34.5 oz	12 h	14 d	16	NR	

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Leafrollers (Pandemis)	**Bacillus thuringiensis subsp. kurstaki** DiPel DF	1-2 lb	4 h	0 d	11A	3	While too early for Obliquebanded leafrollers, this timing is appropriate for Pandemis. Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern, above 65°F, for 3 or more days. **Organic**
Lygus and stink bugs	**flonicamid** Beleaf 50 SG Insecticide	2.8 oz	12 h	21 d	29	NR	Needs further study. 50% control of adults and 65% control of young nymphs in one WA study in alfalfa [Walsh 2018].
	sulfoxaflor Transform	2.25 oz	24 h	7 d	4C	NR	Needs further testing. 68% control of adults and 71% control of young nymphs in one WA study in alfalfa [Walsh 2018].
Oriental fruit moth	**OFM pheromone dispensers; + E-8-DODECEN-1-YL ACETATE; Z-8-DODECEN-1-OL; Z-8-DODECEN-1-YL ACETATE** CheckMate OFM Dispenser	100-200 dispensers	none listed	none listed		4	**Organic**
	OFM pheromone dispensers Isomate-M Rosso	100-200 dispensers	none listed	none listed		4	**Organic**

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

Pink

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple mildew	**benzovindiflupyr** Aprovia	5.5-7 fl oz	12 h	30 d	7	3	Do not follow Aprovia with fungicides from FRAC group 7 such as Fontelis, Luna and Pristine to reduce fungicide resistance development.
	Ipflufenoquin Axios 20 SC	2.25-3 fl oz	4 h	7	52	4	Make first application at green tip stage. Do not apply more than once every 7 days. Do not make more than 3 applications per year. Do not make more than 2 sequential applications. Do not apply within 7 days of harvest; (PHI = 7 days).
	trifloxystrobin Flint Extra	2.9 fl oz	12 h	14 d	11	3	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	3	Fontelis is a FRAC 7 fungicide.
	pydiflumetofen Miravis	See Label	12 h	30 d	7	3	
	BLAD Problad Verde	18.1 - 45.7 fl oz	4 h	1 d	BM01	2	Apply every 7 days in rotation with other materials. Use caution with tank mixes. Problad has a surfactant package which can make Kaligreen less crop safe. Caution with Ph-D tank mixes, better to rotate. **Organic**
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	4	
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	4	Place Rally into solution before adding oil. Apply no sooner than half-inch green.
	Bacillus pumilus strain QST 2808 Sonata	2-4 qt	4 h	0 d		NR	**Organic**
	lime sulfur/calcium polysulfide Sulforix	See label	48 h	none listed	UN, M02	NR	Toxic to rust mites, the primary alternate prey of predatory mites. Also toxic to spider mites and predatory mites. **Organic**
	sulfur Sulfur Dry Flowable	10-30 lb	24 h		M2	NR	**Organic**
	Notes: To limit the potential for development of fungicide resistance, rotate between FRAC groups. Do not make sequential applications of fungicides in the same FRAC group. Do not make more than 2 applications of fungicides in the same FRAC group per season.						

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	Notes: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive of all strobilurin fungicides (Mode 11) labeled for use on pome fruits.						
Apple scab	**benzovindiflupyr** Aprovia	5.5-7 fl oz	12 h	30 d	7	3	Do not follow Aprovia with fungicides from FRAC group 7 such as Fontelis, Luna and Pristine to reduce fungicide resistance development.
	mancozeb Dithane M45	6 lb	24 h	77 d	M3	NR	Do not apply after bloom. See label for restrictions.
	trifloxystrobin Flint Extra	2.5-2.9 fl oz	12 h	14 d	11	3	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	NR	Fontelis and Aprovia are from the same chemical group (7). Apply one of them ONLY at the same growth stage.
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	NR	Apply only one Group 3 Fungicide at the same growth stage.
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	NR	Apply only one Group 3 Fungicide at the same growth stage. See note for Inspire Super.
	lime sulfur/calcium polysulfide Sulforix	See label	48 h	none listed	UN, M02	NR	Toxic to rust mites, the primary alternate prey of predatory mites. Also toxic to spider mites and predatory mites. Organic
	ziram Ziram 76DF Fungicide	See label	48 h	14 d	M3	NR	Besides having some activity against scab, Ziram may reduce bull's eye rot inoculum persisting on cankers from the previous season.
	Notes: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive of all strobilurin fungicides (Mode 11) labeled for use on pome fruits.						
Fire blight	**Aureobasidium pullulans strains DSM 14940 & 14941** Blossom Protect	1.25 lb	4 h	none listed	NC	4	Apply with Buffer Protect. Yeasts need 1-2 days before an infection to colonize the flower before bacteria invade to be effective. 70-72% relative control range average WA trials (DuPont et al. 2023). Organic
	lime sulfur/calcium polysulfide lime sulfur/calcium polysulfide	2 % v/v	48 h	0 d	un	NR	Early bloom applications plus oil are antimicrobial. 20 and 70% bloom timings. Reapply biologicals after lime sulfur if used.
	Notes: Early bloom. Apply biologicals (Blossom Protect) during early bloom. If fire blight was in the orchard last year apply two applications of the biological. Reapply biological a second time if lime sulfur was applied (Lime sulfur is antimicrobial and kills biologicals).						

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple rust mite	**spirodiclofen** Envidor 2SC	18 fl oz	12 h	7 d	23	NR	
	fenbutatin oxide Vendex 50WP	1-1.5 lb	48 h	14 d	12B	3-4	
Campylomma	**acetamiprid** Assail 70WP	1.7-3.4 oz	12 h	7 d	4A	NR	Use higher rates for high population numbers.
Codling moth	**CM pheromone dispensers** CM pheromone dispensers	See label	none listed	none listed		NR	Install dispensers before bloom/first flight (historically first moths are caught between 121 and 220 CM DD, average 175 DD) using the full label rate in the top 2 feet of the canopy. When using aerosol emitters borders should be treated with hand-applied dispensers. **Organic**
Leafrollers (Pandemis, Obliquebanded)	**chlorantraniliprole** Altacor eVo Insect Control	2.2 oz	4 h	5 d	28	4	
	Bacillus thuringiensis subsp. kurstaki DiPel DF	See label	4 h	0 d	11A	3	Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern, above 65°F, for 3 or more days. **Organic**
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3	
	Notes: Target leafroller larvae in the spring at 300-560 DD (Obliquebanded) and 300-460 DD (Pandemis). Target 1st summer generation larvae at 955-1300 DD (Obliquebanded) and 1760-2255 DD (Pandemis). Degree day lower threshold 41°F and upper threshold 85°F.						
Rosy apple aphid	**acetamiprid** Assail 70WP	1.7 oz	12 h	7 d	4A	3-4	Use higher rates for high population numbers.

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

Bloom

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple mildew	**polyoxin D zinc salt** Ph-D Fungicide	6.2 oz	4 h	0 d	19	NR	Ph-D is similar to OSO5%SC. Use only one of these fungicides in a given season.
	sulfur Sulfur Dry Flowable	10-30 lb	24 h		M2	NR	**Organic**
	Notes: To limit the potential for development of fungicide resistance, rotate between FRAC groups. Do not make sequential applications of fungicides in the same FRAC group. Do not make more than 2 applications of fungicides in the same FRAC group per season.						
Botrytis-Gray Mold	**fluxapyroxad + pyraclostrobin** Merivon	5.5 fl oz	12 h	0 d	7, 11	3	Merivon is a FRAC group 7 fungicide and should not be rotated or used with other FRAC 7 fungicides. Do not make more than three FRAC 7 applications in a season.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Fire blight	**acibenzolar-s-methyl** Actigard 50WG	2 oz	12 h	60 d	P01	NR	For bloom applications: Apply 2 oz/A in a tank mix with a fire blight treatment (generally an antibiotic) that is standard in your area. This is generally 2-3 applications between 20% bloom and petal fall depending on the environmental conditions. Do not apply closer than a 7-day interval. Also used to reduce re-occurrence of blight after cutting out infected strikes. Apply concentrate to a half meter section of the main leader after cutting see http://treefruit.wsu.edu/crop-protection/disease-management/fire-blight/
	Aureobasidium pullulans strains DSM 14940 & 14941 Blossom Protect	1.25 lb	4 h	none listed	NC	4	Apply with Buffer Protect. Yeasts need 1-2 days before an infection to colonize the flower before bacteria invade to be effective. 70-72% relative control range average WA trials (DuPont et al. 2023). Organic
	copper octanoate Cueva	4 qt	4 h	0 d	M1	3	Little russet in semi-arid WA trials. Some russet risk in wetter OR. Tank mix compatible with Bacillus-based biopesticides. Soluble copper efficacy 47% to 73%. From WSU trials 2013 to 2022 (DuPont et al. 2023). Organic
	Bacillus amyloliquefaciens strain D747 Double Nickel LC Biofungicide	See label	4 h	0 d	BM02	2	Can be used with copper fungicides to increase control. Relative disease suppression in Washington trials average 30%. Organic
	streptomycin sulfate FireWall 50 WP	8-16 oz	12 h	50 d	25	4	Use only 1x per season (at most). Due to history of fire blight resistance to streptomycin products in WA populations are likely to be resistant after first application. Best if used 12-24 h BEFORE a rain event. Due to partial systemic activity can provide some control within 12-24 h after a rain (flowers) or hail event (plant tissue).
	oxytetracycline hydrocloride oxytetracycline hydrocloride	200 ppm	12 h	60 d	41	4	Best activity less than 24 h BEFORE wetness event. Check spray tank pH, 4.5-6.0 optimal. Best activity at 200 ppm.
	Copper Sulfate + Pentahydrate (metallic copper 5.4%) Instill	30 fl oz	48 h	0 d	M1	3	Consider drying conditions to minimize marking risk. 70-72% efficacy range WA trials (DuPont et al 2023).
	copper sulfate pentahydrate Instill-O	30 fl oz	48 h		M1	3	Consider drying conditions to minimize marking risk. Soluble copper efficacy 47% to 73%. From WSU trials 2013 to 2022 (DuPont et al. 2023). Organic
	kasugamycin Kasumin 2L	64 fl oz	12 h	90 d	24	4	Best control when applied less than 24 hrs before wetness event. Control up to 12 hr after wetness event.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	Copper sulfate pentahydrate Mastercop	40 fl oz	48 h	0 d	M1	3	Organic
	calcium oxytetracycline Mycoshield	See Label	12 h	60 d	41	4	Best activity within 24 h before wetness event. Check spray tank pH, 5 optimal. 200 ppm: 1.0 lb/100 gal.
	copper hydroxide Previsto	3-4 qt	48 h	none listed	M1	3	Pay attention to drying times and do not combine with acidifying products to reduce fruit finish risks. Previsto in 70-72% relative control efficacy range average. From WSU trials 2013 to 2022 (DuPont et al. 2023). Organic
	Bacillus subtilis strain QST 713 Serenade Opti	20 oz	4 h	0 d	BM02	2	Efficacy may vary based on disease pressure. Median relative disease suppression 50% in WA trials 2017 to 2021, 60% WA and OR 2012-2015. Organic
	Notes: Full bloom to petal fall. Watch the model. Apply materials 12-24 hours BEFORE moisture events. Sprays every 2 days rotating active ingredients may be necessary to cover opening flowers during extended high or extreme risk periods. Product used must contact the interior of the flowers in sufficient water and approved wetting agent to completely wet the interior. Applications of less than 100 gal/A can be effective on small trees if flower interiors are well covered, but do not drop the ppm below 200 (oxytetracycline). Application by ground equipment on each row is highly recommended. Application of antibiotics by aircraft is not effective. Organic: Depending on the cultivar russet risk and the CougarBlight model risk follow biologicals with copper hydroxide/octanoate (Cueva/Previsto/Instill-O) every 2-5 days (this option is less fruit safe for russet but has higher efficacy) or with Bacillus subtilis (Serenade Opti) (most fruit safe, lower efficacy) every 2-5 days during flower/petal fall rotating active ingredients.						
Storage Rots (Sphaeropsis, Lambertella, Alternaria)	**penthiopyrad** Fontelis	20 fl oz	12 h	28 d	7	3	Fontelis has fair efficacy against Alternaria fungus and Sphaeropsis that may infect fruit preharvest. Fontelis is a FRAC 7 fungicide and should not be rotated or used with other FRAC 7 fungicides. To limit the potential for development of fungicide resistance, do not make more than 3 applications of FRAC 7 fungicides per season. Do not make sequential applications of FRAC 7 fungicides labeled for use on pome fruits.
	polyoxin D zinc salt OSO 5%SC	See Label	4 h	0 d	19	3	Organic
Insect	**Chemical**	**Rate per Acre**	**REI**	**PHI**	**MOA**	**Eff.**	**Notes**
Campylomma	**acetamiprid** Assail 70WP	1.7-3.4 oz	12 h	7 d	4A	NR	Use higher rates for high population numbers. May be applied to blooming plant in late evening, do not begin spraying until 6 pm, and stop spraying at midnight.
Codling moth	**CM pheromone dispensers** CM pheromone dispensers	See label	none listed	none listed		NR	Install dispensers before bloom/first flight (historically first moths are caught between 121 and 220 CM DD, average 175 DD) using the full label rate in the top 2 feet of the canopy. When using aerosol emitters borders should be treated with hand-applied dispensers. Organic

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Leafrollers (Pandemis, Obliquebanded)	**Bacillus thuringiensis subsp. kurstaki** DiPel DF	See label	4 h	0 d	11A	3	Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern, above 65°F, for 3 or more days. **Organic**
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3	Some leafroller populations have developed resistance to Intrepid and in these situations, the level of control can be significantly reduced.
	Notes: Target leafroller larvae in the spring at 300-560 DD (Obliquebanded) and 300-460 DD (Pandemis). Target 1st summer generation larvae at 955-1300 DD (Obliquebanded) and 1760-2255 DD (Pandemis). Degree day lower threshold 41°F and upper threshold 85°F.						

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

Petal fall

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple mildew	**Ipflufenoquin** Axios 20 SC	2.25-3 fl oz	4 h	7	52	4	Make first application at green tip stage. Do not apply more than once every 7 days. Do not make more than 3 applications per year. Do not make more than 2 sequential applications. Do not apply within 7 days of harvest; (PHI = 7 days).
	trifloxystrobin Flint Extra	2.9 fl oz	12 h	14 d	11	3	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	3	Fontelis is a FRAC 7 fungicide.
	flutianil Gatten Fungicide	8 fl oz	12 h	14 d	U13	NR	The mechanism of action of Gatten is yet unknown. Rotate with fungicides from different chemical groups to reduce fungicide resistance.
	potassium bicarbonate Kaligreen	3 lb	4 h	1 d	NC	2	Under low disease pressure, Kaligreen will provide adequate control. If disease pressure increases, rotation or combination with other materials is recommended. Organic
	fluopyram Luna Privilege	6.84 fl oz	12 h	7 d	7	4	Luna Privilege is a FRAC group 7 fungicide.
	fluopyram + trifloxystrobin Luna Sensation	5-5.8 fl oz	12 h	14 d	7, 11	4	
	fluxapyroxad + pyraclostrobin Merivon	5.5 fl oz	12 h	0 d	7, 11	3	Merivon is a FRAC group 7 fungicide.
	pydiflumetofen Miravis	See Label	12 h	30 d	7	3	
	polyoxin D zinc salt OSO 5%SC	13 fl oz	4 h	0 d	19	3	Organic
	polyoxin D zinc salt Ph-D Fungicide	6.2 oz	4 h	0 d	19	NR	Ph-D is similar to OSO5%SC. Use only one of these fungicides in a given season.
	pyraclostrobin + boscalid Pristine Fungicide	18.5 oz	12 h	0 d	11,7	3	Pristine should still be effective against apple mildew as there is no evidence or resistance developing in this fungus. Pristine is a FRAC 7 +11 fungicide and should not be rotated or used with other FRAC 7+11 fungicides.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	BLAD Problad Verde	18.1 - 45.7 fl oz	4 h	1 d	BM01	2	Apply every 7 days in rotation with other materials. Use caution with tank mixes. Problad has a surfactant package which can make Kaligreen less crop safe. Caution with Ph-D tank mixes, better to rotate. **Organic**
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	4	Place Rally into solution before adding oil. Apply no sooner than half-inch green.
	Reynoutria sachalinensis Regalia	4 qt	4 h	0 d	P5	2	Do not use prior to petal fall. Under low disease pressure, it may help control some summer diseases like Alternaria and Bull's eye rot. **Organic**
	lime sulfur/calcium polysulfide Rex Lime Sulfur	See label	48 h	0 d	un	NR	Do not apply lime sulfur if temperatures will exceed 75°F within 3 days of application. **Organic**
	Bacillus pumilus strain QST 2808 Sonata	2-4 qt	4 h	0 d		NR	**Organic**
	sulfur Sulfur Dry Flowable	10-30 lb	24 h		M2	NR	**Organic**
	triflumizole Trionic 4SC	16 fl oz	12 h	14 d	3	4	Trionic is a FRAC 3 fungicide an should not be rotated or used with other FRAC 3 fungicides.
	Notes: The efficacy level will depend on the absence of resistant populations from the orchard. To limit the potential for development of fungicide resistance, do not make more than four applications of FRAC group 11 fungicides per season. Do not make more than two sequential applications of FRAC group 11 fungicides. This limitation is inclusive of all FRAC group 11 fungicides labeled for use on pome fruits.						
	Notes: To limit the potential for development of fungicide resistance, rotate between FRAC groups. Do not make sequential applications of fungicides in the same FRAC group. Do not make more than 2 applications of fungicides in the same FRAC group per season.						

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple scab	**captan** Drexel Captan 50W	6 lb	24 h	0 d	M4	NR	When possible, tank-mix captan with other single-site fungicides to help reduce fungicide resistance development.
	trifloxystrobin Flint Extra	2.5-2.9 fl oz	12 h	14 d	11	3	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	NR	
	fluopyram + trifloxystrobin Luna Sensation	4-5.8 fl oz	12 h	14 d	7, 11	NR	Luna Sensation, Fontelis, and Aprovia are all from the same chemical group (7). Use one of them ONLY.
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	NR	
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	NR	Use only one FRAC group 3 fungicide at the same growth stage.
	triflumizole Trionic 4SC	12-16 fl oz	12 h	14 d	3	NR	Use only one FRAC group 3 fungicide at the same growth stage.
	ziram Ziram 76DF Fungicide	See label	48 h	14 d	M3	NR	
	Notes: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive of all strobilurin fungicides (Mode 11) labeled for use on pome fruits.						
Botrytis-Gray Mold	**copper octanoate** Cueva	8 qt	4 h	0 d	M1	2	**Organic**
	captan Drexel Captan 50W	6 lb	24 h	0 d	M4	2	Do not apply more than 64 lbs. of Captan 50 Wettable Powder per acre per crop cycle.
	fluxapyroxad + pyraclostrobin Merivon	5.5 fl oz	12 h	0 d	7, 11	3	Merivon is a FRAC group 7 fungicide and should not be rotated or used with other FRAC 7 fungicides. Do not make more than three FRAC 7 applications in a season.
	thiophanate-methyl Topsin M WSB	1 lb	2 d	1 d	1	3	Efficacy level is ensured when resistance is absent from the orchard. Do not apply more than 2.8 lbs. a.i. per acre in a year. Topsin-M is very prone to fungicide resistance development, rotation with other FRAC group is required. Do not make sequential applications of FRAC group 1 fungicides and do not make more than two FRAC 1 fungicides per season. Topsin-M is similar to Mertect, used postharvest, therefore careful use is highly recommended.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Fire blight	**acibenzolar-s-methyl** Actigard 50WG	2 oz	12 h	60 d	P01	NR	For bloom applications: Apply 2 oz/A in a tank mix with a fire blight treatment (generally an antibiotic) that is standard in your area. This is generally 2-3 applications between 20% bloom and petal fall depending on the environmental conditions. Do not apply closer than a 7-day interval. Also used to reduce re-occurrence of blight after cutting out infected strikes. Apply concentrate to a half meter section of the main leader after cutting see http://treefruit.wsu.edu/crop-protection/disease-management/fire-blight/
	cinnamon oil Cinnerate	32 fl oz	none listed	0 d	un	2	Essential oil products provided median relative disease suppression (45-49%) in 3 WA trials with repeat applications. Use as part of an integrated program. Consider drying times to minimize marking risk. Rate denoted assumes 100 gal per acre. Organic
	copper octanoate Cueva	4 qt	4 h	0 d	M1	3	Little russet in semi-arid WA trials. Some russet risk in wetter OR. Tank mix compatible with Bacillus-based biopesticides. Soluble copper efficacy 47% to 73%. From WSU trials 2013 to 2022 (DuPont et al. 2023). Organic
	Bacillus amyloliquefaciens strain D747 Double Nickel LC Biofungicide	See label	4 h	0 d	BM02	2	Can be used with copper fungicides to increase control. Relative disease suppression in Washington trials average 30%. Organic
	streptomycin sulfate FireWall 50 WP	8-16 oz	12 h	50 d	25	4	Use only 1x per season (at most). Due to history of fire blight resistance to streptomycin products in WA populations are likely to be resistant after first application. Best if used 12-24 h BEFORE a rain event. Due to partial systemic activity can provide some control within 12-24 h after a rain (flowers) or hail event (plant tissue).
	oxytetracycline hydrocloride oxytetracycline hydrocloride	200 ppm	12 h	60 d	41	4	Best activity less than 24 h BEFORE wetness event. Check spray tank pH, 4.5-6.0 optimal. Best activity at 200 ppm.
	hydrogen peroxide + peroxyacetic acid Jet-Ag	128 fl oz	See label	none listed		2	Median relative disease suppression between 48% and 62% in WA trials with repeat applications. Use as part of an integrated program. Consider drying times to minimize marking risk. Assumes 100 gal per acre rate.
	kasugamycin Kasumin 2L	64 fl oz	12 h	90 d	24	4	Best control when applied less than 24 hrs before wetness event. Control up to 12 hr after wetness event.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	prohexadione calcium Kudos 27.5 WDG	6 oz	12 h	45 d		3	In WA trials weekly application of prohexodine calcium from petal fall to +4 weeks reduced shoot blight severity with a 6 oz rate performing better than 2 oz (2022-2024, DuPont et al in prep).
	calcium oxytetracycline Mycoshield	See Label	12 h	60 d	41	4	Best activity within 24 h before wetness event. Check spray tank pH, 5 optimal. 200 ppm: 1.0 lb/100 gal.
	lime sulfur/calcium polysulfide lime sulfur/calcium polysulfide	2-4 % v/v	48 h	0 d	un	NR	At petal fall lime sulfur (2 to 4%) to clean up bacteria, yeast, mildew and rot fungi.
	hydrogen peroxide peroxyacetic acid OxiDate 5.0	128 fl oz	See label	0 d		2	Provided moderate relative disease suppression (median 48%-62%) in WA over 3 trials with repeat applications. Use as part of an integrated program. Consider drying times to minimize marking risk. **Organic**
	copper hydroxide Previsto	3-4 qt	48 h	none listed	M1	3	Pay attention to drying times and do not combine with acidifying products to reduce fruit finish risks. Previsto in 70-72% relative control efficacy range average. From WSU trials 2013 to 2022 (DuPont et al. 2023). **Organic**
	Bacillus subtilis strain QST 713 Serenade Opti	20 oz	4 h	0 d	BM02	2	Efficacy may vary based on disease pressure. Median relative disease suppression 50% in WA trials 2017 to 2021, 60% WA and OR 2012-2015. **Organic**
	thyme oil Thyme Guard	2 qt	4 h			2	Essential oil products provided moderate relative disease suppression (46-49%) in 4 WA trials with repeat applications. Use as part of an integrated program. Consider drying times to minimize marking risk. **Organic**

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Storage Rots (Sphaeropsis, Lambertella, Alternaria)	**Bacillus subtilis strain IAB/BS03** Aviv	10-30 fl oz	4 h	none listed	BM02	3	Organic
	penthiopyrad Fontelis	20 fl oz	12 h	28 d	7	3	Fontelis has fair efficacy against Alternaria fungus and Sphaeropsis that may infect fruit preharvest. Fontelis is a FRAC 7 fungicide and should not be rotated or used with other FRAC 7 fungicides. To limit the potential for development of fungicide resistance, do not make more than 3 applications of FRAC 7 fungicides per season. Do not make sequential applications of FRAC 7 fungicides labeled for use on pome fruits.
	polyoxin D zinc salt OSO 5%SC	See Label	4 h	0 d	19	3	OSO will help control Alternaria infections preharvest. OSO is FRAC 19 fungicide recommended to rotate with other FRAC groups labeled for pome fruit. Organic
	polyoxin D zinc salt Ph-D Fungicide	6.2 oz	4 h	0 d	19	NR	Ph-D is similar to OSO 5%, so use only one of them in a given season.

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Codling moth	**chlorantraniliprole** Altacor eVo Insect Control	1.5-2.2 oz	4 h	5 d	28	4	Altacor is very effective against leafroller larvae and codling moth eggs and larvae. It has a residual activity of up to 17 days when using the high label rate or not more than 14 days when using the low label rate. (Brunner 2010)
	acetamiprid Assail 70WP	1.7-3.4 oz	12 h	7 d	4A	3-4	Assail is a topical ovicide for codling moth and can be used at ovicide timing of 375 DD, at which time it will also control rosy apple aphid. It is also a larvicide that could be used at 525 DD but note that the retreatment interval is 12 days. Activity is enhanced by the use of oil. Do not apply this product when bees are actively visiting the area to be treated.
	spinetoram Delegate WG	7 oz	4 h	7 d	5	4	Delegate is highly effective against leafroller larvae. While Delegate does not directly kill codling moth eggs it has a strong ovi-larvicidal activity, which means it kills codling moth larvae exiting eggs. Therefore, if Delegate is applied at this timing is can be used as part of a management strategy to delay the first larvicide application against codling moth. Delegate is in the same chemical class, and has the same mode of action, as Success (spinosad) so avoid using these products against two consecutive generations.
	pyriproxyfen Esteem 35WP	4-5 oz	12 h	45 d	7C	3	Esteem works as a residual ovicide for codling moth; time applications for about 250 DD. See leafroller section below to determine optimum timing for leafroller.
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3	
	novaluron Rimon 0.83EC	30-50 fl oz	12 h	14 d	15	3-4	
	petroleum oil, summer petroleum oil, summer	See label	4 h	0 d		NR	Organic
	Notes: WSU recommends a delayed cover program. Apply a “delayed cover” residual ovicide applied at 225 codling moth degree days (CM DD), or a “delayed cover” topical ovicide at 375 CM DD. Either program delays the first larvicide spray to 525 CM DD by reducing larval numbers. This approach leaves only a small percentage of egg hatch at the end of each generation uncovered. If following a “larvicide only” program (no ovicide), apply the first larvicide at 425 CM DD. First generation subsequent applications are based product label/residual. See https://decisionaid.systems for more info. To reduce resistance risk, do not use a product with the same MOA two codling moth generations in a row.						

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Grape mealybug	**imidacloprid** imidacloprid	See Label	12 h	7 d	4A	NR	Rate/PHI for foliar application.
	acetamiprid Assail 70WP	3.4 oz	12 h	7 d	4A	1	
	buprofezin Centaur WDG	34.5 oz	12 h	14 d	16	NR	

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Leafrollers (Pandemis, Obliquebanded)	**chlorantraniliprole** Altacor eVo Insect Control	2.2 oz	4 h	5 d	28	4	
	spinetoram Delegate WG	4.5-7 oz	4 h	7 d	5	4	Delegate is highly effective against leafroller larvae. While Delegate does not directly kill codling moth eggs it has a strong ovi-larvicidal activity, which means it kills codling moth larvae exiting eggs. Therefore, if Delegate is applied at this timing is can be used as part of a management strategy to delay the first larvicide application against codling moth. Delegate is in the same chemical class, and has the same mode of action, as Success (spinosad) so avoid using these products against two consecutive generations.
	Bacillus thuringiensis subsp. kurstaki DiPel DF	See label	4 h	0 d	11A	3	Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern, above 65°F, for 3 or more days. Organic
	spinosad Entrust SC	10 fl oz	4 h	7 d	5	3-4	Entrust is a spinosad formulation registered for organic apple production. Organic
	pyriproxyfen Esteem 35WP	4-5 oz	12 h	45 d	7C	4	Should be applied when the last larval stage is present but before pupation has begun. Use the WSU Decision Aid System (https://decisionaid.systems) for the optimum timing of the product on leafrollers.
	cyantraniliprole Exirel Insect Control	10-17 fl oz	12 h	3 d	28	4	
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3	Some leafroller populations have developed resistance to Intrepid and in these situations, the level of control can be significantly reduced.
	emamectin benzoate Proclaim	3.2-4.8 oz	12 h | 48 h for some activities- see label	14 d	6	4	
	novaluron Rimon 0.83EC	30-50 fl oz	12 h	14 d	15	3-4	
	spinosad spinosad	6-10 fl oz	4 h	7 d	5	3-4	Some leafroller populations have developed resistance to Success so use of this product in this situation may result in reduced control.
	Notes: Target leafroller larvae in the spring at 300-560 DD (Obliquebanded) and 300-460 DD (Pandemis). Target 1st summer generation larvae at 955-1300 DD (Obliquebanded) and 1760-2255 DD (Pandemis). Degree day lower threshold 41°F and upper threshold 85°F.						

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Rosy apple aphid	**imidacloprid** imidacloprid	1.4 - 2.8 fl oz	12 h	7 d	4A	NR	
	acetamiprid Assail 70WP	1.7 oz	12 h	7 d	4A	3-4	
	Notes: Use of these materials at this timing will also control other aphid species.						
Spider mites	**bifenazate** bifenazate	0.75-1 lb	12 h	7 d	20D	4	
	spirodiclofen Envidor 2SC	16-18 fl oz	12 h	7 d	23	3-4	
	fenpyroximate FujiMite SC	1-2 pt	12 h	14 d	21A	3-4	
	hexythiazox Savey 50DF	4-6 oz	12 h	28 d	10A	2-4	Most effective on the egg stage. When mite populations are high and leaf bronzing has already occurred, a miticide effective on the adult stage may be used in combination.
	etoxazole Zeal Miticide1 72WSP	2-3 oz	12 h	14 d	10B	3-4	
Western flower thrips	**spinosad** Entrust SC	6-8 fl oz	4 h	7 d	5	3	Organic
	spinosad spinosad	6-8 fl oz	4 h	7 d	5	3	
	Notes: Timing tests for minimizing thrips damage indicate petal fall (5 mm fruit) is better than the traditional bloom timing.						
Western tentiform leafminer	**abamectin** Agri-Mek SC	4.25 fl oz	12 h	28 d	6	4	Do not apply from the onset of flowering until after petal fall is complete.
	spinosad spinosad	6 fl oz	4 h	7 d	5	3-4	
White apple leafhopper	**imidacloprid** imidacloprid	1.4-2.8 fl oz	12 h	7 d	4A	4	Do not use until pollination is complete and bees have been removed from the area. Rate and PHI indicated is for foliar application.
	indoxacarb Avaunt Insecticide	6 oz	12 h	14 d	22A	3-4	
	spinosad spinosad	6-8 fl oz	4 h	7 d	5	3	
	kaolin clay Surround WP	40 lb	4 h	0 d	particle film	NR	Organic
	Notes: Do not use until pollination is complete and bees have been removed from the area.						

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

14-28 days after full bloom

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple mildew	**penthiopyrad** Fontelis	14-20 fl oz	12 h	28 d	7	3	Fontelis is a FRAC 7 fungicide.
	flutianil Gatten Fungicide	8 fl oz	12 h	14 d	U13	NR	The mechanism of action of Gatten is yet unknown. Rotate with fungicides from different chemical groups to reduce fungicide resistance.
	potassium bicarbonate Kaligreen	3 lb	4 h	1 d	NC	2	Under low disease pressure, Kaligreen will provide adequate control. If disease pressure increases, rotation or combination with other materials is recommended. **Organic**
	fluopyram Luna Privilege	6.84 fl oz	12 h	7 d	7	4	Luna Privilege is a FRAC group 7 fungicide.
	fluxapyroxad + pyraclostrobin Merivon	5.5 fl oz	12 h	0 d	7, 11	3	Merivon is a FRAC group 7 fungicide.
	polyoxin D zinc salt OSO 5%SC	13 fl oz	4 h	0 d	19	3	**Organic**
	polyoxin D zinc salt Ph-D Fungicide	6.2 oz	4 h	0 d	19	NR	Ph-D is similar to OSO5%SC. Use only one of these fungicides in a given season.
	pyraclostrobin + boscalid Pristine Fungicide	18.5 oz	12 h	0 d	11,7	3	Pristine should still be effective against apple mildew as there is no evidence or resistance developing in this fungus. Pristine is a FRAC 7 +11 fungicide and should not be rotated or used with other FRAC 7+11 fungicides.
	BLAD Problad Verde	18.1 - 45.7 fl oz	4 h	1 d	BM01	2	Apply every 7 days in rotation with other materials. Use caution with tank mixes. Problad has a surfactant package which can make Kaligreen less crop safe. Caution with Ph-D tank mixes, better to rotate. **Organic**
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	4	
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	4	Place Rally into solution before adding oil. Apply no sooner than half-inch green.
	Reynoutria sachalinensis Regalia	4 qt	4 h	0 d	P5	2	Do not use prior to petal fall. Under low disease pressure, it may help control some summer diseases like Alternaria and Bull's eye rot. **Organic**
	Bacillus pumilus strain QST 2808 Sonata	2-4 qt	4 h	0 d		NR	**Organic**

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	cyflufenamid Torino Fungicide	See Label	4 h	14 d	U6	NR	DO NOT make more than one (1) application at the 6.8 oz. (0.044 lb. ai.) Torino Fungicide rate per calendar year. DO NOT apply within 14 days of harvest; (PHI = 14 days).
	Notes: The efficacy level will depend on the absence of propiconazole-resistant populations from the orchard. To limit the potential for development of fungicide resistance, do not make more than four applications of FRAC group 11 fungicides per season. Do not make more than two sequential applications of FRAC group 11 fungicides. This limitation is inclusive of all FRAC group 11 fungicides labeled for use on pome fruits.						
Apple scab	**captan** Drexel Captan 50W	6 lb	24 h	0 d	M4	NR	
	penthiopyrad Fontelis	14-20 fl oz	12 h	28 d	7	NR	Fontelis and Luna Sensation are all from the same chemical group (7). Apply ONLY one of them at the same growth stage.
	fluopyram + trifloxystrobin Luna Sensation	4-5.8 fl oz	12 h	14 d	7, 11	NR	Luna Sensation and Fontelis are from the same Chemical group (7). Use only one of them.
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	NR	Rates vary with postinfective schedule; see label. Apply only one Group 3 Fungicide at the same growth stage.
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	NR	
	ziram Ziram 76DF Fungicide	See label	48 h	14 d	M3	NR	
	Notes: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive of all strobilurin fungicides (Mode 11) labeled for use on pome fruits.						
Bull's eye rot	**ziram** Ziram Granuflo 76WDG	6 lb	48 h	14 d	M3	3	Apply 12 to 14 days after caylx formation (early fruitset 12-25 mm) and repeat as needed through the summer. Do not apply more than 24.2 lbs per acre in a crop cycle. Tank-mixing with other fungicides has been reported to increase efficacy and reduce fungicide resistance development.
Storage Rots (Sphaeropsis, Lambertella, Alternaria)	**polyoxin D zinc salt** OSO 5%SC	See Label	4 h	0 d	19	3	OSO will help control Alternaria infections preharvest. OSO is FRAC 19 fungicide recommended to rotate with other FRAC groups labeled for pome fruit. **Organic**
	polyoxin D zinc salt Ph-D Fungicide	6.2 oz	4 h	0 d	19	NR	Ph-D is similar to OSO 5%, so use only one of them in a given season.

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Codling moth	**chlorantraniliprole** Altacor eVo Insect Control	1.5-2.2 oz	4 h	5 d	28	4	Altacor is very effective against leafroller larvae and codling moth eggs and larvae. It has a residual activity of up to 17 days when using the high label rate or not more than 14 days when using the low label rate. (Brunner 2010)
	acetamiprid Assail 70WP	3.4 oz	12 h	7 d	4A	3-4	If applied to control codling moth, this product will provide control of rosy apple aphid as well at this timing. Use an appropriate surfactant to enhance coverage and penetration.
	Novaluron + Acetamiprid Cormoran	24 fl oz	12 h	14 d	4A, 15	4	This product is a mixture of acetmiprid and novaluron. If used against the first generation, do not use insecticides containing either of these active ingredients in the second generation.
	CM granulosis virus strain M (CpGV-M) Cyd-X HP Insecticidal Virus	See Label	4 h	0 d	31	3	Virus genotype A. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. **Organic**
	spinetoram Delegate WG	6-7 oz	4 h	7 d	5	4	Delegate is very effective against codling moth larvae. It has a residual activity of 14 days.
	Bacillus thuringiensis subsp. kurstaki DiPel DF	0.5-2 lb	4 h	0 d	11A	NR	Bacillus thuringiensis subspecies kurstaki has efficacy on codling moth larvae (Brunner and Smith 1993) and can be used to supplement codling moth granulosis virus as part of a virus resistance management plan. **Organic**
	spinosad Entrust SC	10 fl oz	4 h	7 d	5	NR	Entrust is a spinosad formulation registered for organic apple production. It is effective against codling moth larvae hatching from the egg. It has a residual activity of 7 to 10 days. When Entrust is incorporated into an organic pest control program using pheromones, summer oil, and codling moth virus, good control of this key pest is possible. Best results occur when applications are timed for egg hatch. Do not use on successive codling moth generations. **Organic**
	cyantraniliprole Exirel Insect Control	10-17 fl oz	12 h	3 d	28	4	
	phosmet Imidan 70W	5.33 lb	7 d	7 d	1B	3	

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3	Intrepid is a stomach poison so complete coverage is important to good control. This product is recommended only as a supplement to mating disruption. Apply the first application of Intrepid at 425 degree days using the new codling moth model (525 DD when using the delayed first cover with oil at 375 DD) and follow with additional applications at 14-day intervals for a total of 3 sprays. Intrepid can also be used in the second generation (if not used in the first generation) timed at egg hatch and using the same re-treatment intervals.
	CM granulosis virus isolate V22 (CpGV-M) Madex HP Insecticidal Virus	0.5-3 fl oz	4h	0 d	31	3	Virus genotype A. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil.
	CM granulovirus isolate GV-0017 Madex XLV	0.5–3.0 fl oz	4h	0 d	31	3	Virus genotypes A, B, and E. For 2027 field season, do not use north of I-90, where resistance to genotypes A and E have not been identified. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. Do not use two generations in a row on a block without known resistance. **Organic**
	petroleum oil, summer petroleum oil, summer	See label	4 h	0 d		NR	**Organic**
	CM granulovirus strain S (CpGV-S) Virosoft CP4	0.5-3.2 fl oz	4h	0 d	31	3	Virus genotype E. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. **Organic**
	Isocycloseram Zivalgo	1.6-2.1 fl oz	12 h	14 d	30	4	Zivalgo is a new Mode of Action for codling moth, IRAC Group 30. It should not be used on two successive generations. Zivalgo is fairly broad-spectrum, and may be hard on some natural enemies.
	Notes: Codling moth resistance to codling moth resistance genotypes A and E has been identified in five Washington apple orchards, all South of I-90. We have not observed resistance to genotype B. However, reduced effects of codling moth virus can also be due to low pesticide coverage, UV breakdown, or washing product off with overhead sprinklers. Evaluate efficacy by cutting apples open and looking for mortality, noting where in the canopy larvae are surviving. To slow resistance spread and improve mortality, pair virus with horticultural oil and do not apply a product with the same virus genotype two generations in a row. Because Madex XLV includes all three genotypes (A,B, and E), do not use it in northern regions where codling moth resistance has not been documented. For southern regions, do not use Madex XLV in successive generations unless there is no resistance to genotypes A and E in the block.						

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	Notes: WSU recommends a delayed cover program. Apply a “delayed cover” residual ovicide applied at 225 codling moth degree days (CM DD), or a “delayed cover” topical ovicide at 375 CM DD. Either program delays the first larvicide spray to 525 CM DD by reducing larval numbers. This approach leaves only a small percentage of egg hatch at the end of each generation uncovered. If following a “larvicide only” program (no ovicide), apply the first larvicide at 425 CM DD. First generation subsequent applications are based product label/residual. See https://decisionaid.systems for more info. To reduce resistance risk, do not use a product with the same MOA two codling moth generations in a row.						
Rosy apple aphid	**imidacloprid** imidacloprid	1.4-2.8 fl oz	12 h	7 d	4A	NR	Rate and PHI indicated is for foliar application.
	acetamiprid Assail 70WP	1.7 oz	12 h	7 d	4A	3-4	If applied to control codling moth, this product will provide control of rosy apple aphid as well at this timing. Use an appropriate surfactant to enhance coverage and penetration.
White apple leafhopper	**indoxacarb** Avaunt Insecticide	6 oz	12 h	14 d	22A	3-4	
	kaolin clay Surround WP	40 lb	4 h	0 d	particle film	NR	**Organic**
Woolly apple aphid	**sulfoxaflor** Transform	See Label	24 h	7 d	4C	3	Use an adjuvant such as Exit at 0.25% vol:vol.
	spirotetramat Ultor	10-14 fl oz	24 h	7 d	23	2-4	Time Ultor applications shortly after petal fall, when the canopy is well developed, but leaves have not hardened off. A second application 14 days after the first may be helpful in high pressure situations. This material is systemic and will suppress root and shoot colonies of woolly apple aphid. Ultor suppresses woolly apple aphids when applied later in the season, but overall control is not as good as with the early season timing (see Late Spring and Summer).

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

Late spring and summer

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple maggot	**thiamethoxam** Actara	5.5 oz	12 h	14 d/35 d	4A	NR	Estimated residual activity: 7-14 days. PHI depends on rate used. See label.
	imidacloprid imidacloprid	2.8 fl oz	12 h	7 d	4A	NR	Estimated residual activity: 10-14 days. Rate/PHI for foliar application.
	chlorantraniliprole Altacor eVo Insect Control	1.5-2.2 oz	4 h	5 d	28	NR	Provides suppression only. Also effective against codling moth and leafrollers. Estimated residual activity: 10-14 days.
	acetamiprid Assail 70WP	3.4 oz	12 h	7 d	4A	NR	Assail is also used to control codling moth. The estimated residual activity is 10-14 days.
	fenpropathrin Danitol 2.4EC	16-21.3 fl oz	24 h	14 d	3A	NR	Also effective against codling moth and leafrollers. Estimated residual activity: 7-10 days.
	spinetoram Delegate WG	6-7 oz	4 h	7 d	5	NR	Provides suppression only. Also effective against codling moth and leafrollers. Estimated residual activity: 10-14 days.
	spinosad Entrust	2-3 oz	4 h	7 d	5	NR	Provides suppression only. Also effective against codling moth and leafrollers. Estimated residual activity: 5-7 days. **Organic**
	spinosad GF-120 NF Naturalyte	See Label	4 h	0 d	5	NR	Begin applications as soon as monitoring traps indicate flies are present in the orchard and continue coverage until flights stop. Repeat applications every 7 days, reapplying sooner if rain washes off the deposit. Do not apply more than 10 applications per season. **Organic**
	phosmet Imidan 70W	5.33 lb	7 d	7 d	1B	NR	Imidan is also used to control codling moth. The estimated residual activity is 14 days.
	lambda-cyhalothrin Warrior II	1.28-2.56 fl oz	24 h	21 d	3A	NR	Also effective against codling moth and leafrollers. Estimated residual activity: 7-10 days.

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Codling moth	**chlorantraniliprole** Altacor eVo Insect Control	1.5-2.2 oz	4 h	5 d	28	4	Altacor is very effective against leafroller larvae and codling moth eggs and larvae. It has a residual activity of up to 17 days when using the high label rate or not more than 14 days when using the low label rate. (Brunner 2010)
	acetamiprid Assail 70WP	3.4 oz	12 h	7 d	4A	3-4	
	Novaluron + Acetamiprid Cormoran	24 fl oz	12 h	14 d	4A, 15	4	This product is a mixture of acetmiprid and novaluron. If this product was used against the first generation, do not use insecticides containing either of these active ingredients in the second generation.
	CM granulosis virus strain M (CpGV-M) Cyd-X HP Insecticidal Virus	See Label	4 h	0 d	31	3	Virus genotype A. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. **Organic**
	spinetoram Delegate WG	6-7 oz	4 h	7 d	5	4	Delegate is very effective against leafroller and codling moth larvae. It has a residual activity of 14 days. Delegate is in the same chemical class as Success (spinosad) so avoid using these products against two consecutive generations.
	Bacillus thuringiensis subsp. kurstaki DiPel DF	0.5-2 lb	4 h	0 d	11A	NR	Bacillus thuringiensis subspecies kurstaki has efficacy on codling moth larvae (Brunner and Smith 1993) and can be used to supplement codling moth granulosis virus as part of a virus resistance management plan. **Organic**
	spinosad Entrust SC	10 fl oz	4 h	7 d	5	NR	Entrust is a spinosad formulation registered for organic apple production. It is effective against codling moth larvae hatching from the egg. It has a residual activity of 7 to 10 days. When Entrust is incorporated into an organic pest control program using pheromones, summer oil, and codling moth virus, good control of this key pest is possible. Best results occur when applications are timed for egg hatch. Do not use on successive codling moth generations. **Organic**
	cyantraniliprole Exirel Insect Control	10-17 fl oz	12 h	3 d	28	4	
	phosmet Imidan 70W	5 lb	7 d	7 d	1B	3	
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3	

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	CM granulosis virus isolate V22 (CpGV-M) Madex HP Insecticidal Virus	0.5-3 fl oz	4h	0 d	31	3	Virus genotype A. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil.
	CM granulovirus isolate GV-0017 Madex XLV	0.5–3.0 fl oz	4h	0 d	31	3	Virus genotypes A, B, and E. For 2027 field season, do not use north of I-90, where resistance to genotypes A and E have not been identified. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. Do not use two generations in a row on a block without known resistance. **Organic**
	novaluron Rimon 0.83EC	30-50 fl oz	12 h	14 d	15	3-4	
	petroleum oil, summer petroleum oil, summer	See label	4 h	0 d		NR	**Organic**
	CM granulovirus strain S (CpGV-S) Virosoft CP4	0.5-3.2 fl oz	4h	0 d	31	3	Virus genotype E. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. **Organic**
	Isocycloseram Zivalgo	1.6-2.1 fl oz	12 h	14 d	30	4	Zivalgo is a new Mode of Action for codling moth, IRAC Group 30. It should not be used on two successive generations. Zivalgo is fairly broad-spectrum, and may be hard on some natural enemies.
	Notes: Codling moth resistance to codling moth resistance genotypes A and E has been identified in five Washington apple orchards, all South of I-90. We have not observed resistance to genotype B. However, reduced effects of codling moth virus can also be due to low pesticide coverage, UV breakdown, or washing product off with overhead sprinklers. Evaluate efficacy by cutting apples open and looking for mortality, noting where in the canopy larvae are surviving. To slow resistance spread and improve mortality, pair virus with horticultural oil and do not apply a product with the same virus genotype two generations in a row. Because Madex XLV includes all three genotypes (A,B, and E), do not use it in northern regions where codling moth resistance has not been documented. For southern regions, do not use Madex XLV in successive generations unless there is no resistance to genotypes A and E in the block.						
	Notes: For a “delayed cover” program second generation target ovicides at 1225-1375 CM DD (residual ovicide 1225-1325 CM DD and/or a topical ovicide at 1375 CM DD). Either program will delay the first larvicide of the second generation to 1525 CM DD. In a “larvicide only” program (no ovicide) target a larvicide at 1425 CM DD. Subsequent applications are based on codling moth capture in traps and product label/residual. If control is required in subsequent generations, add 1000 CM DD to previous timings. See https://decisionaid.systems for more info. To reduce resistance risk, do not use a product with the same MOA two codling moth generations in a row.						
Cutworms	**indoxacarb** Avaunt Insecticide	6 oz	12 h	14 d	22A	4	

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Grape mealybug	**imidacloprid** imidacloprid	See Label	12 h	7 d	4A	NR	Rate/PHI for foliar application.
	acetamiprid Assail 70WP	3.4 oz	12 h	7 d	4A	1	
	buprofezin Centaur WDG	34.5 oz	12 h	14 d	16	NR	
	phosmet Imidan 70W	4-5 lb	7 d	7 d	1B	2	
Green apple aphid	**acetamiprid** Assail 70WP	1.7 oz	12 h	7 d	4A	3-4	
Lacanobia fruitworm	**indoxacarb** Avaunt Insecticide	3-6 oz	12 h	14 d	22A	4	
	spinosad Entrust	3 oz	4 h	7 d	5	3-4	Entrust is a spinosad formulation registered for organic apple production. It is effective against codling moth larvae hatching from the egg. It has a residual activity of 7 to 10 days. When Entrust is incorporated into an organic pest control program using pheromones, summer oil, and codling moth virus, good control of this key pest is possible. **Organic**
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3-4	
	spinosad spinosad	6-10 fl oz	4 h	7 d	5	3-4	Some leafroller populations have developed resistance to Success (spinosad) and its use could result in reduced levels of control. Success is in the same chemical class as Delegate (spinetoram) so avoid using these products against two consecutive generations.
	kaolin clay Surround WP	50 lb	4 h	0 d	particle film	3-4	**Organic**

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Leafrollers (Pandemis, Obliquebanded)	**chlorantraniliprole** Altacor eVo Insect Control	2.2 oz	4 h	5 d	28	4	
	spinetoram Delegate WG	4.5-7 oz	4 h	7 d	5	4	Delegate is very effective against leafroller and codling moth larvae. It has a residual activity of 14 days. Delegate is in the same chemical class as Success (spinosad) so avoid using these products against two consecutive generations.
	Bacillus thuringiensis subsp. kurstaki DiPel DF	See label	4 h	0 d	11A	3	Two or three Bt applications are usually required to achieve acceptable control. Time the first application to coincide with leafroller egg hatch. A repeat application might be required if leafroller populations are high. Organic
	spinosad Entrust	3 oz	4 h	7 d	5	3-4	Entrust is a spinosad formulation registered for organic apple production. It is effective against codling moth larvae hatching from the egg. It has a residual activity of 7 to 10 days. When Entrust is incorporated into an organic pest control program using pheromones, summer oil, and codling moth virus, good control of this key pest is possible. Some leafroller populations have developed resistance to Success (spinosad) and its use could result in reduced levels of control. Success is in the same chemical class as Delegate (spinetoram) so avoid using these products against two consecutive generations. Organic
	cyantraniliprole Exirel Insect Control	10-17 fl oz	12 h	3 d	28	4	
	methoxyfenozide Intrepid 2F	16 fl oz	4 h	14 d	18	3-4	
	emamectin benzoate Proclaim	3.2-4.8 oz	12 h | 48 h for some activities-see label	14 d	6	4	
	novaluron Rimon 0.83EC	30-50 fl oz	12 h	14 d	15	4	
	spinosad spinosad	6-10 fl oz	4 h	7 d	5	3-4	

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Shothole borer	**esfenvalerate** Asana XL	14.5 fl oz	12 h	21 d	3A	4	Sanitation is the most effective management for shothole borer.
	acetamiprid Assail 70WP	3.4 oz	12 h	7 d	4A	NR	
Spider mites	**bifenazate** bifenazate	0.75-1 lb	12 h	7 d	20D	4	
	spirodiclofen Envidor 2SC	16-18 fl oz	12 h	7 d	23	3-4	
	fenpyroximate FujiMite SC	1-2 pt	12 h	14 d	21A	3-4	
	hexythiazox Savey 50DF	4-6 oz	12 h	28 d	10A	2-4	Most effective on the egg stage. When mite populations are high and leaf bronzing has already occurred, a miticide effective on the adult stage may be used in combination.
	etoxazole Zeal Miticide1 72WSP	2-3 oz	12 h	14 d	10B	3-4	
Western tentiform leafminer	**abamectin** Agri-Mek SC	4.25 fl oz	12 h	28 d	6	4	
	spinosad spinosad	6-10 fl oz	4 h	7 d	5	3-4	
White apple leafhopper	**imidacloprid** imidacloprid	1.4-2.8 fl oz	12 h	7 d	4A	4	Do not use until pollination is complete and bees have been removed from the area. Rate and PHI indicated is for foliar application.
	indoxacarb Avaunt Insecticide	4-6 oz	12 h	14 d	22A	3-4	
	carbaryl carbaryl	2 pt	12 h	3 d	1A	NR	Carbaryl may disrupt integrated mite control depending on history of use. Use higher rate if leafhopper population is comprised primarily of adults.
	kaolin clay Surround WP	40 lb	4 h	0 d	particle film	NR	Organic
Woolly apple aphid	**sulfoxaflor** Transform	See Label	24 h	7 d	4C	3	Use an adjuvant such as Exit at 0.25% vol:vol.
	spirotetramat Ultor	10-14 fl oz	24 h	7 d	23	2-4	Ultor may only provide suppression if used in mid- and late-season sprays; preliminary evidence suggests that better efficacy may be obtained when it is applied prophylactically shortly after petal fall.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple mildew	**flutianil** Gatten Fungicide	8 fl oz	12 h	14 d	U13	NR	The mechanism of action of Gatten is yet unknown. Rotate with fungicides from different chemical groups to reduce fungicide resistance.
	potassium bicarbonate Kaligreen	3 lb	4 h	1 d	NC	2	Under low disease pressure, Kaligreen will provide adequate control. If disease pressure increases, rotation or combination with other materials is recommended. **Organic**
	fluopyram Luna Privilege	6.84 fl oz	12 h	7 d	7	4	Luna Privilege is a FRAC group 7 fungicide.
	fluxapyroxad + pyraclostrobin Merivon	5.5 fl oz	12 h	0 d	7, 11	3	Merivon is a FRAC group 7 fungicide.
	polyoxin D zinc salt OSO 5%SC	13 fl oz	4 h	0 d	19	3	**Organic**
	polyoxin D zinc salt Ph-D Fungicide	6.2 oz	4 h	0 d	19	NR	Ph-D is similar to OSO5%SC. Use only one of these fungicides in a given season.
	pyraclostrobin + boscalid Pristine Fungicide	18.5 oz	12 h	0 d	11,7	3	Pristine should still be effective against apple mildew as there is no evidence or resistance developing in this fungus. Pristine is a FRAC 7 +11 fungicide and should not be rotated or used with other FRAC 7+11 fungicides.
	Reynoutria sachalinensis Regalia	4 qt	4 h	0 d	P5	2	Do not use prior to petal fall. Under low disease pressure, it may help control some summer diseases like Alternaria and Bull's eye rot. **Organic**
	triflumizole Trionic 4SC	16 fl oz	12 h	14 d	3	4	Trionic is a FRAC 3 fungicide an should not be rotated or used with other FRAC 3 fungicides.
Apple scab	**captan** Drexel Captan 50W	8 lb	24 h	0 d	M4	NR	
	trifloxystrobin Flint Extra	2.5-2.9 fl oz	12 h	14 d	11	3	
	fluopyram + trifloxystrobin Luna Sensation	4-5.8 fl oz	12 h	14 d	7, 11	NR	Luna Sensation and Fontelis are from the same Chemical group (7). Use only one of them.
	triflumizole Procure 480SC	8-16 fl oz	12 h	14 d	3	NR	Rates vary with postinfective schedule; see label. Apply only one Group 3 Fungicide at the same growth stage.
	myclobutanil Rally 40WSP	5 oz	24 h	14 d	3	NR	Use only one Group 3 fungicide at the same growth stage.
	Notes: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides.						

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Bull's eye rot	**ziram** Ziram Granuflo 76WDG	6 lb	48 h	14 d	M3	3	Apply 12 to 14 days after caylx formation (early fruitset 12-25 mm) and repeat as needed through the summer. Do not apply more than 24.2 lbs per acre in a crop cycle. Tank-mixing with other fungicides has been reported to increase efficacy and reduce fungicide resistance development.
Storage Rots (Sphaeropsis, Lambertella, Alternaria)	**Reynoutria sachalinensis** Regalia	4 qt	4 h	0 d	P5	2	Do not use prior to petal fall. Under low disease pressure, it may help control some summer diseases like Alternaria and Bull's eye rot. **Organic**

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

Preharvest

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple scab	**captan** Drexel Captan 50W	6 lb	24 h	0 d	M4	NR	When possible, tank-mix captan with other single-site fungicides to help reduce fungicide resistance development.
Botrytis-Gray Mold	**copper octanoate** Cueva	8 qt	4 h	0 d	M1	2	**Organic**
	thiophanate-methyl Topsin M WSB	1 lb	2 d	1 d	1	3	Efficacy level is ensured when resistance is absent from the orchard. Do not apply more than 2.8 lbs. a.i. per acre in a year. Topsin-M is very prone to fungicide resistance development, rotation with other FRAC group is required. Do not make sequential applications of FRAC group 1 fungicides and do not make more than two FRAC 1 fungicides per season. Topsin-M is similar to Mertect, used postharvest, therefore careful use is highly recommended.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Bull's eye rot	**captan** Drexel Captan 50W	6 lb	24 h	0 d	M4	NR	Do not apply more than 64 lbs. of Captan 50 Wettable Powder per acre per crop cycle. Make 1 or 2 applications with late cover sprays and 1 final spray prior to harvest. When possible, tank-mix captan with other single-site fungicides to help reduce fungicide resistance development.
	thiophanate-methyl Topsin M WSB	1 lb	2 d	1 d	1	4	Efficacy level is ensured when resistance is absent from the orchard. Do not apply more than 2.8 lbs. a.i. per acre in a year. Topsin-M is very prone to fungicide resistance development, rotation with other FRAC group is required. Do not make sequential applications of FRAC group 1 fungicides and do not make more than two FRAC 1 fungicides per season. Topsin-M is similar to Mertect, used postharvest, therefore careful use is highly recommended.
	ziram Ziram 76DF Fungicide	See label	48 h	14 d	M3	3	Apply in the first cover spray and in preharvest ideally before rain. Do NOT apply within 14 days of harvest. When applicable, tank-mix with other single-site fungicides to increase efficacy and reduce risk of fungicide resistance development. Do not apply more than 18.4 lbs. a.i of Ziram 76DF or equivalent per season.

Disease	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Storage Rots (Sphaeropsis, Lambertella, Alternaria)	**Aureobasidium pullulans strain DSM 14940/14941** Botector	10 oz	4 h	0 d	NC	3	Start applications 5 weeks before harvest up to applications prior to harvest in rotation with other organic materials as needed. **Organic**
	cinnamon oil Cinnerate	See Label	none listed	0 d	un	3	Applications are not recommended temperatures above 85 F. Rate denoted assumes 100 gal per acre. **Organic**
	hydrogen peroxide + peroxyacetic acid Jet-Ag	126 fl oz	See label	none listed		3	Rate per 100 gal.
	fluxapyroxad + pyraclostrobin Merivon	5.5 fl oz	12 h	0 d	7, 11	3	Merivon is a FRAC group 7 fungicide and should not be rotated or used with other FRAC 7 fungicides. Do not make more than three FRAC 7 applications in a season.
	polyoxin D zinc salt OSO 5%SC	See Label	4 h	0 d	19	3	OSO will help control Alternaria infections preharvest. OSO is FRAC 19 fungicide recommended to rotate with other FRAC groups labeled for pome fruit. **Organic**
	polyoxin D zinc salt Ph-D Fungicide	6.2 oz	4 h	0 d	19	NR	Ph-D is similar to OSO 5%, so use only one of them in a given season.
	BLAD Problad Verde	See Label	4 h	1 d	BM01	2-3	Apply as a preharvest spray within 1 to 10 days before harvest. Use caution with tank mixes. Problad has a surfactant package which can make Kaligreen less crop safe. Caution with Ph-D tank mixes, better to rotate. **Organic**
	thiophanate-methyl Topsin M WSB	1 lb	2 d	1 d	1	3	Efficacy level is ensured when resistance is absent from the orchard. Do not apply more than 2.8 lbs. a.i. per acre in a year. Topsin-M is very prone to fungicide resistance development, rotation with other FRAC group is required. Do not make sequential applications of FRAC group 1 fungicides and do not make more than two FRAC 1 fungicides per season. Topsin-M is similar to Mertect, used postharvest, therefore careful use is highly recommended.
	ziram Ziram Granuflo 76WDG	6 lb	48 h	14 d	M3	2	When applicable, tank-mix with other single-site fungicides to reduce risk fo fungicide resistance development.

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Apple maggot	**thiamethoxam** Actara	5.5 oz	12 h	14 d/35 d	4A	NR	Estimated residual activity: 7-14 days. PHI depends on rate used. See label.
	chlorantraniliprole Altacor eVo Insect Control	1.5-2.2 oz	4 h	5 d	28	NR	Provides suppression only. Also effective against codling moth and leafrollers. Estimated residual activity: 10-14 days.
	acetamiprid Assail 70WP	3.4 oz	12 h	7 d	4A	NR	Assail is also used to control codling moth. The estimated residual activity is 10-14 days.
	fenpropathrin Danitol 2.4EC	16-21.3 fl oz	24 h	14 d	3A	NR	Also effective against codling moth and leafrollers. Estimated residual activity: 7-10 days.
	spinetoram Delegate WG	6-7 oz	4 h	7 d	5	NR	Provides suppression only. Also effective against codling moth and leafrollers. Estimated residual activity: 10-14 days.
	spinosad Entrust	2-3 oz	4 h	7 d	5	NR	Provides suppression only. Also effective against codling moth and leafrollers. Estimated residual activity: 5-7 days. Organic
	phosmet Imidan 70W	5.33 lb	7 d	7 d	1B	NR	Imidan is also used to control codling moth. The estimated residual activity is 14 days.
	lambda-cyhalothrin Warrior II	1.28-2.56 fl oz	24 h	21 d	3A	NR	Also effective against codling moth and leafrollers. Estimated residual activity: 7-10 days.

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
Codling moth	**acetamiprid** Assail 70WP	3.4 oz	12 h	7 d	4A	3-4	
	CM granulosis virus strain M (CpGV-M) Cyd-X HP Insecticidal Virus	See Label	4 h	0 d	31	3	Virus genotype A. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. **Organic**
	spinetoram Delegate WG	6-7 oz	4 h	7 d	5	4	Delegate is effective against codling moth larvae. It has a residual activity of 14 days.
	spinosad Entrust SC	10 fl oz	4 h	7 d	5	NR	Entrust is a spinosad formulation registered for organic apple production. It is effective against codling moth larvae hatching from the egg. It has a residual activity of 7 to 10 days. When Entrust is incorporated into an organic pest control program using pheromones, summer oil, and codling moth virus, good control of this key pest is possible. Best results occur when applications are timed for egg hatch. Do not use on successive codling moth generations. **Organic**
	CM granulosis virus isolate V22 (CpGV-M) Madex HP Insecticidal Virus	0.5-3 fl oz	4h	0 d	31	3	Virus genotype A. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil.
	CM granulovirus isolate GV-0017 Madex XLV	0.5–3.0 fl oz	4h	0 d	31	3	Virus genotypes A, B, and E. For 2027 field season, do not use north of I-90, where resistance to genotypes A and E have not been identified. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. Do not use two generations in a row on a block without known resistance. **Organic**
	carbaryl Sevin XLR Plus	1-3 qt	12 h	3 d	1A	2	
	petroleum oil, summer petroleum oil, summer	See label	4 h	0 d		NR	**Organic**
	CM granulovirus strain S (CpGV-S) Virosoft CP4	0.5-3.2 fl oz	4h	0 d	31	3	Virus genotype E. Residual activity, shortened by UV light, lasts at most 7 days. Virus typically kills the caterpillar after it has entered the apple, reducing damage the next generation. Apply with oil. **Organic**

Insect	Chemical	Rate per Acre	REI	PHI	MOA	Eff.	Notes
	Notes: Codling moth resistance to codling moth resistance genotypes A and E has been identified in five Washington apple orchards, all South of I-90. We have not observed resistance to genotype B. However, reduced effects of codling moth virus can also be due to low pesticide coverage, UV breakdown, or washing product off with overhead sprinklers. Evaluate efficacy by cutting apples open and looking for mortality, noting where in the canopy larvae are surviving. To slow resistance spread and improve mortality, pair virus with horticultural oil and do not apply a product with the same virus genotype two generations in a row. Because Madex XLV includes all three genotypes (A,B, and E), do not use it in northern regions where codling moth resistance has not been documented. For southern regions, do not use Madex XLV in successive generations unless there is no resistance to genotypes A and E in the block.						
Leafrollers (Pandemis, Obliquebanded)	**Bacillus thuringiensis subsp. kurstaki** DiPel DF	See label	4 h	0 d	11A	3	Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. **Organic**

Rate and PHI indicated is for foliar application. Efficacy numbers denote the relative efficacy of a pesticide against a given pest on a 1 to 4 scale with 1 being low and 4 high efficacy. This information is based primarily on research conducted with WSU researchers in Washington.

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