

Pistachio Year-round IPM Program

ANNUAL CHECKLIST *(Reviewed 10/14)*

These practices are recommended for a monitoring-based IPM program that enhances the use of IPM practices to reduce the risks of pesticides on the environment and human health.

When a pesticide application is considered, review the Pesticide Application Checklist at the bottom of this page for information on how to minimize the risks of pesticide use to water and air quality. Water quality can be impaired when pesticides drift into waterways or when they move off-site. Air quality can be impaired when pesticide applications release volatile organic compounds (VOCs) into the atmosphere.

This year-round IPM program covers the major pests of pistachios in California. Track your progress through the year with the annual checklist form. Details on carrying out each practice, example monitoring forms, and information on additional pests can be found in the Pistachio Pest Management Guidelines.

✓ Done	<h3>Dormancy to delayed-dormancy</h3> <p>Special issues of concern related to environmental quality: runoff and drift. Mitigate pesticide effects to minimize air and water contamination.</p>
What should you be doing during this time?	
	<p>Carry out dormant season sanitation activities:</p> <ul style="list-style-type: none"> • Prune trees. While pruning look for, and keep records of, <i>Botryosphaeria</i> cankers for management decisions later in the season: • Remove and destroy, or disc under, mummy nuts to reduce navel orangeworm overwintering sites and inoculum sources of <i>Botryosphaeria</i> panicle and shoot blight. At a minimum, shake trees and remove mummy nuts from the berms. • Destroy, or remove from the orchard floor, pruned wood and brush piles, to reduce overwintering sites for leaffooted plant bug and the incidence of <i>Botrytis</i> blossom and shoot blight and <i>Botryosphaeria</i> panicle and shoot blight.
	<p>Manage orchard floor weeds:</p> <ul style="list-style-type: none"> • Keep records (PDF) of weeds identified in the orchard, noting locations of problematic weeds. • If using herbicides, before application: • Create a custom herbicide chart for winter weeds in your field. (Learn how online.) • Mechanically remove leaves and debris from the treatment area. • Use drift-reducing spray nozzles where possible, and apply herbicides only when environmental conditions are favorable. • Scout the field following treatment and control escaped weeds.
	<p>In early- to mid-January, examine one-year-old fruiting wood for live and parasitized soft scales, paying special attention to previously infested areas. Treat if needed in mid-February according to the Pistachio Pest Management Guidelines.</p>
	<p>Consider performing a BUDMON test (detects bud colonization and infection) in February to mid-March to predict the risk of <i>Botryosphaeria</i> panicle and shoot blight at harvest.</p>
	<p>Look for vertebrates and their damage and manage if needed:</p> <ul style="list-style-type: none"> • Ground squirrels • Jackrabbits • Meadow voles • Pocket gophers

✓ Done	<h2 style="margin: 0;">Budbreak through bloom</h2> <p>Special issues of concern related to environmental quality: runoff and drift. Mitigate pesticide effects to minimize air and water contamination.</p>		
What should you be doing during this time?			
	Continue weed management. Mow ground cover before bloom for frost protection and to reduce small plant bug and false chinch bug populations. Do not mow during bloom.		
	If not done after the last harvest, at budbreak identify trees infested with mealybugs by looking for them on green bud tips. Note infested trees for more intense monitoring from mid-May to early June.		
	If the orchard has a history of <i>Botryosphaeria</i> panicle and shoot blight, treat when panicles (flower clusters) appear in the spring. If wet and cool weather occurs during bloom, consider treating for <i>Botrytis</i> blossom and shoot blight.		
	Hang navel orangeworm egg or pheromone traps on April 1. Check traps once or twice per week to monitor the first flight (typically in April to mid June with a peak in May) in pheromone traps and to observe the egg-laying peak (typically in May) using egg traps.		
	In late March through April, adult leaffooted plant bugs and stink bugs may migrate into the orchard edges from overwintering sites. Monitor weekly for: <ul style="list-style-type: none"> • Leaffooted plant bugs, small plant bugs, and stink bugs using a beating tray. • Plant bugs and stink bugs using a sweep net in surrounding cover crops and vegetation. Leaffooted plant bugs and stink bugs may require a pesticide application. Small plant bugs, with the exception of California buckeye bug, are less damaging. Areas heavily infested with green stink bug and leaffooted plant bug will require close monitoring after fruit set.		
	Look for obliquebanded leafroller strikes and leaf tying (rolled or folded leaves). Record observations for future pheromone trapping and treatment decisions.		
	Look for vertebrates and their damage and manage if needed: <ul style="list-style-type: none"> • Ground squirrels • Jackrabbits • Meadow voles • Pocket gophers 		
	Sporadic or minor pests and disorders you may see: <table style="width: 100%; border: none;"> <tr> <td style="vertical-align: top;"> Invertebrates <ul style="list-style-type: none"> • Darkling beetles • Thrips (onion, western flower) • Western tussock moth </td> <td style="vertical-align: top;"> Disease and abiotic disorders <ul style="list-style-type: none"> • Armillaria root rot (oak root fungus) mushrooms • Delayed leafing • Frost damage • Wood decay fungi mushrooms (e.g. <i>Schizophyllum</i> spp., <i>Ganoderma</i> spp.) </td> </tr> </table>	Invertebrates <ul style="list-style-type: none"> • Darkling beetles • Thrips (onion, western flower) • Western tussock moth 	Disease and abiotic disorders <ul style="list-style-type: none"> • Armillaria root rot (oak root fungus) mushrooms • Delayed leafing • Frost damage • Wood decay fungi mushrooms (e.g. <i>Schizophyllum</i> spp., <i>Ganoderma</i> spp.)
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✓ Done	<h2 style="margin: 0;">Fruit development</h2> <p>Special issues of concern related to environmental quality: drift and volatile organic compounds (VOCs). Mitigate pesticide effects to minimize air and water contamination.</p>
What should you be doing during this time?	
	Avoid severe water stress in mid-May during stage one of kernel development (bloom through shell expansion) to reduce the incidence of early shell split and navel orangeworm infestations, which can introduce fruit molds that cause aflatoxin contamination.

✓ Done	<h2 style="margin: 0;">Fruit development</h2> <p>Special issues of concern related to environmental quality: drift and volatile organic compounds (VOCs). Mitigate pesticide effects to minimize air and water contamination.</p>		
	<p>Check pheromone and egg traps once or twice per week:</p> <ul style="list-style-type: none"> • Obliquebanded leafroller. Hang pheromone traps by mid- to late April in Fresno and northward. Note biofix (the first date when male moths are consistently caught in traps). Continue monitoring traps to determine treatment timing if needed. • Navel orangeworm. Identify the first (May) and second (late June to early July) generations using egg or pheromone traps. In late July use degree-days, pheromone trap catches, and inspections for eggs on early split nuts to identify the beginning of the third generation for treatment. 		
	<p>Monitor weekly for bugs, small plant bugs, and stink bugs and treat if needed according to the Pistachio Pest Management Guidelines. Look for:</p> <ul style="list-style-type: none"> • Plant bugs, stink bugs, and leaffooted plant bug nymphs, using a beating tray on clusters. • Black (darkened) nuts and epicarp lesions. Cut open nuts to confirm if there is bug feeding (stink bug, leaffooted plant bug, small plant bugs). • Stink bugs and leaffooted plant bug eggs on leaves or fruit. • <i>Calocoris norvegicus</i> and lygus bugs by sampling with a sweep net in weeds and groundcover. Once nut shells harden in late May, small plant bugs no longer cause damage. 		
	<p>In mid-May to early July, check trees where mealybug infestations were noted after harvest or at budbreak. Look for adult females on the rachises and manage as needed at peak crawler emergence (typically the first week of June) according to the Pistachio Pest Management Guidelines. If no treatment was made in June, continue monitoring.</p>		
	<p>In July, sample 100 nuts weekly for early splits. Apply an insecticide for navel orangeworm if more than 2 early splits per 100 nuts are found.</p>		
	<p>Monitor for fruit scabbing and rachis darkening caused by citrus flat mite. If detected, consider a pesticide application.</p>		
	<p>Manage orchard floor weeds:</p> <ul style="list-style-type: none"> • Survey weeds in late spring and identify those not controlled with a fall or winter treatment. • Keep records (PDF) noting the location of problematic weeds. • Create a custom herbicide chart for summer weeds in your field. (Learn how online.) <p>Apply herbicides for weeds that escaped initial management using drift-reducing spray nozzles where possible. Apply herbicides only when environmental conditions are favorable.</p>		
	<p>Monitor and manage diseases:</p> <ul style="list-style-type: none"> • Alternaria blight (lesions) on foliage starting in mid-July. Manage if needed according to the Pistachio Pest Management Guidelines. • Botryosphaeria panicle and shoot blight. Consider a fungicide application in early June or if rain occurs. Consider performing an ONFIT assay in June to predict blighted fruit at harvest. You may need to adjust your fungicide spray program accordingly. • Verticillium wilt. Note trees for future removal. 		
	<p>Look for vertebrates and their damage and manage if needed:</p> <ul style="list-style-type: none"> • Ground squirrels • Jackrabbits • Meadow voles • Pocket gophers 		
	<p>Sporadic or minor pests and disorders you may see:</p> <table style="width: 100%; border: none;"> <tr> <td style="vertical-align: top; width: 50%;"> <p>Invertebrates</p> <ul style="list-style-type: none"> • Darkling beetles • False chinch bugs • Webspinning spider mites (particularly where soils are alkaline) </td> <td style="vertical-align: top; width: 50%;"> <p>Disease and abiotic disorders</p> <ul style="list-style-type: none"> • Botrytis blossom and shoot blight • Epicarp staining (due to rain) • Nut collapse • Pistachio pop </td> </tr> </table>	<p>Invertebrates</p> <ul style="list-style-type: none"> • Darkling beetles • False chinch bugs • Webspinning spider mites (particularly where soils are alkaline) 	<p>Disease and abiotic disorders</p> <ul style="list-style-type: none"> • Botrytis blossom and shoot blight • Epicarp staining (due to rain) • Nut collapse • Pistachio pop
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✓ Done	<h2 style="margin: 0;">Preharvest</h2> <p>Special issues of concern related to environmental quality: runoff, drift, volatile organic compounds (VOCs). Mitigate pesticide effects to minimize air and water contamination.</p>			
What should you be doing during this time?				
	Treat for navel orangeworm at hull split (hull slip) according to the Pistachio Pest Management Guidelines, especially if early splits are abundant and infestation levels of early splits exceed 2%.			
	Monitor newly budded trees for insect pests such as aphids, darkling beetles, and earwigs.			
	<p>Look for:</p> <table style="width: 100%; border: none;"> <tr> <td style="vertical-align: top; width: 33%;"> Invertebrates <ul style="list-style-type: none"> • Citrus flat mite • Mealybugs </td> <td style="vertical-align: top; width: 33%;"> Diseases <ul style="list-style-type: none"> • Alternaria late blight • Botryosphaeria panicle and shoot blight • Verticillium wilt (late strikes) • Other canker diseases </td> <td style="vertical-align: top; width: 33%;"> Vertebrates <ul style="list-style-type: none"> • Birds • Ground squirrels • Jackrabbits • Meadow voles • Pocket gophers </td> </tr> </table> <p>Manage as needed according to the Pistachio Pest Management Guidelines.</p>	Invertebrates <ul style="list-style-type: none"> • Citrus flat mite • Mealybugs 	Diseases <ul style="list-style-type: none"> • Alternaria late blight • Botryosphaeria panicle and shoot blight • Verticillium wilt (late strikes) • Other canker diseases 	Vertebrates <ul style="list-style-type: none"> • Birds • Ground squirrels • Jackrabbits • Meadow voles • Pocket gophers
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	Prepare the orchard floor before harvest by managing weeds according to the Pistachio Pest Management Guidelines.			

✓ Done	<h2 style="margin: 0;">Harvest</h2> <p>Special issues of concern related to environmental quality: None. Mitigate pesticide effects to minimize air and water contamination.</p>
What should you be doing during this time?	
	Expedite the harvest of problematic orchards infested with Alternaria late blight and navel orangeworm. If harvest is delayed or a second shake is planned, consider a treatment for navel orangeworm to reduce damage as well as the incidence of aflatoxin according to the Pistachio Pest Management Guidelines.
	Clean and wash harvest equipment before moving it to uninfested orchards to avoid spreading mealybugs.
	Evaluate current year's pest management program using the processing plant grade sheet to prepare for next year's program.
	<p>Monitor the orchard for:</p> <ul style="list-style-type: none"> • Alternaria late blight lesions (on foliage) and Botryosphaeria panicle and shoot blight. Note the severity of infected trees for next year's management. • Cotton aphid (on first-year newly-budded trees). Manage if needed according to the Pistachio Pest Management Guidelines.
	Hull and dry nuts within 24 hours of harvest to reduce incidence of postharvest disease.

✓ Done	<h2 style="margin: 0;">Postharvest</h2> <p>Special issues of concern related to environmental quality: runoff, drift, volatile organic compounds (VOCs). Mitigate pesticide effects to minimize air and water contamination.</p>
What should you be doing during this time?	
	<p>Carry out postharvest sanitation activities:</p> <ul style="list-style-type: none"> • Prune trees and destroy infected, dead, and dying branches to reduce inoculum sources for Botrytis blossom and shoot blight and Botryosphaeria panicle and shoot blight. • Remove and destroy, or disc under, unharvested nuts and mummies from trees and the ground to reduce overwintering sites for navel orangeworm and sources of inoculum for Botryosphaeria panicle and shoot blight. At minimum, shake trees to remove mummies as soon as possible before rain.

✓ Done	<h2 style="margin: 0;">Postharvest</h2> <p>Special issues of concern related to environmental quality: runoff, drift, volatile organic compounds (VOCs). Mitigate pesticide effects to minimize air and water contamination.</p>
	<p>Monitor for mealybugs.</p> <ul style="list-style-type: none"> • Look for sooty mold on leaves and mealybugs within the clusters. • Once leaves fall, check tree trunks. • Note infested trees for monitoring next season.
	<p>Survey weeds and keep records (PDF). Manage weeds according to the Pistachio Pest Management Guidelines.</p>
	<p>Look for vertebrates and their damage and manage if needed:</p> <ul style="list-style-type: none"> • Ground squirrels • Jackrabbits • Meadow voles • Pocket gophers
	<p>During the fourth week in October for 1- to 6-year-old trees, consider applying zinc sulfate to induce defoliation (prevents winter frost damage) and enhance zinc nutrient levels for spring growth.</p>

✓ Done	<h2 style="margin: 0;">Pesticide application checklist</h2> <p>When planning for possible pesticide applications in an IPM program, consult the Pest Management Guidelines, and review and complete this checklist to consider practices that minimize environmental and efficacy problems.</p>
	<p>✓ Choose a pesticide from the Pest Management Guidelines for the target pest, considering:</p>
	<ul style="list-style-type: none"> • Impact on natural enemies and pollinators. For more information see <i>Protecting Natural Enemies and Pollinators</i> at http://www.ipm.ucanr.edu/mitigation/protect_beneficials.html.
	<ul style="list-style-type: none"> • Potential for water quality problems using the UC IPM WaterTox database. See www.ipm.ucanr.edu/TOX/simplewatertox.html.
	<ul style="list-style-type: none"> • Impact on aquatic invertebrates. For more information, see <i>Pesticide Choice</i>, UC ANR Publication 8161 (PDF), http://anrcatalog.ucdavis.edu/pdf/8161.pdf.
	<ul style="list-style-type: none"> • Chemical mode of action, if pesticide resistance is an issue. For more information, see <i>Herbicide Resistance: Definition and Management Strategies</i>, UC ANR Publication 8012 (PDF), http://anrcatalog.ucdavis.edu/pdf/8012.pdf.
	<ul style="list-style-type: none"> • Endangered species that may be near your site. Find out using the Department of Pesticide Regulation's PRESCRIBE program. (http://www.cdpr.ca.gov/docs/endspec/prescint.htm)
	<p>✓ Before an application</p>
	<p>Ensure that spray equipment is properly calibrated to deliver the desired pesticide amount for optimal coverage. See www.ipm.ucanr.edu/training/incorporating-calibration.html.</p>
	<p>Use appropriate spray nozzles and pressure to minimize off-site movement of pesticides.</p>
	<p>Avoid spraying during these conditions to avoid off-site movement of pesticides.</p> <ul style="list-style-type: none"> • Wind speed over 5 mph • Temperature inversions • Just prior to rain or irrigation (unless it is an appropriate amount, such as when incorporating a soil-applied pesticide) • At tractor speeds over 2 mph
	<p>Identify and take special care to protect sensitive areas (for example, waterways or riparian areas) surrounding your application site.</p>
	<p>Review and follow labeling for pesticide handling, personal protection equipment (PPE) requirements, storage, and disposal guidelines.</p>
	<p>Check and follow restricted entry intervals (REI) and preharvest intervals (PHI).</p>

✓ Done	Pesticide application checklist
	✓ After an application
	Record application date, product used, rate, and location of application.
	Follow up to confirm that treatment was effective.
	✓ Consider water management practices that reduce pesticide movement off-site.
	Consult relevant publications: <ul style="list-style-type: none"> • <i>Reducing Runoff from Irrigated Lands: Orchard Floor Management Practices to Reduce Erosion and Protect Water Quality</i>, UC ANR Publication 8202 (PDF), http://anrcatalog.ucdavis.edu/pdf/8202.pdf. • <i>Reducing Runoff from Irrigated Lands: Causes and Management of Runoff from Surface Irrigation in Orchards</i>, UC ANR Publication 8214 (PDF), http://anrcatalog.ucdavis.edu/pdf/8214.pdf. • <i>Protecting Surface Water from Sediment-Associated Pesticides in Furrow-Irrigated Crops</i>, UC ANR Publication 8403 (PDF), http://anrcatalog.ucdavis.edu/pdf/8403.pdf.
	Consult the Department of Pesticide Regulation Groundwater Protection Program (GWPA) Web site for pesticide information and mitigation measures. (http://www.cdpr.ca.gov)
	Install an irrigation recirculation or storage and reuse system. Redesign inlets into tailwater ditches to reduce erosion. (For more information, see <i>Reducing Runoff from Irrigated Lands: Tailwater Return Systems</i> , http://anrcatalog.ucdavis.edu/pdf/8225.pdf .)
	Use drip rather than sprinkler or flood irrigation.
	Limit irrigation to amount required using soil moisture monitoring and evapotranspiration (ET). For more information, see <i>Reducing Runoff from Irrigated Lands: Understanding Your Orchard's Water Requirements</i> , UC ANR Publication 8212 (PDF), http://anrcatalog.ucdavis.edu/pdf/8212.pdf .
	Consider using cover crops.
	Consider vegetative filter strips or ditches. (For more information, see <i>Vegetative Filter Strips</i> , UC ANR Publication 8195 (PDF), http://anrcatalog.ucdavis.edu/pdf/8195.pdf .)
	Apply polyacrylamides in furrow and sprinkler irrigation systems to prevent off-site movement of sediments.
	✓ Consider practices that reduce air quality problems.
	When possible, reduce volatile organic compound (VOC) emissions by decreasing the amount of pesticide applied, choosing low-emission management methods, and avoiding fumigants and emulsifiable concentrate (EC) formulations.
	Use the Department of Pesticide Regulation calculators to determine VOC emission rates from fumigant and nonfumigant pesticides. (http://www.cdpr.ca.gov)

More information about topics mentioned on this checklist is available at the UC IPM Web site: <http://www.ipm.ucanr.edu/PMG/selectnewpest.pistachios.html>.

For more about mitigating the effects of pesticides, see the Mitigation pages: www.ipm.ucanr.edu/mitigation/.