PEST MANAGEMENT

CALIFORNIA ALMOND **SUSTAINABILITY PROGRAM**

california almonds
Almond Board of California

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INTRODUCTION — SUSTAINABILITY AND PEST MANAGEMENT

Exposure to the principles of Integrated Pest Management (IPM) is probably the first experience involving sustainability concepts for most California Almond growers. In part, this is because the origin of IPM can be traced to efforts by University of California scientists that began in the 1950s. This is also because IPM is an ecosystem-based approach that emphasizes the balanced use of multiple tactics (nonchemical and chemical) to cost-effectively and safely manage pests.

The California Almond community is known nationwide for dramatic success in adopting IPM and for reducing unnecessary uses of pesticides. Records of pesticide use data reveal a dramatic reduction in the use of pesticides in California Almonds since 1980. This includes fewer dormant sprays of organophosphates, which is significant for ensuring the quality of surface waters.

The Almond Board of California (ABC) has funded University of California research supporting IPM understandings and adoption since 1973 (the first year that ABC funded production research). The initial work involved the management of navel orangeworm. By 1979, the single practice of removing mummy nuts in the winter was shown to reduce damage by navel orangeworm by up to 60%. These and other IPM practices resulting from ABC-funded research are being implemented by almond growers and handlers across the state.

Accordingly, ABC has been named a Champion for Pesticide Environment Stewardship by the U.S. Environmental Protection Agency, and twice has been named an IPM Innovator by the California Department of Pesticide Regulation. With the detection of pesticides in waterways and groundwater, and recent attention attributing pesticide use to poor air quality, a proven record of judicious pesticide use provides California Almond growers with a well-deserved good reputation.

Even with refined IPM systems, pest-related challenges in almonds continue. These include the introduction of new pests; the rapid growth in almond acreage; transitions to new varieties, tree spacing and irrigation systems; annual variations in weather; understanding and integrating the use of new pest control products; and adapting to new regulations and international maximum-residue limits. Fortunately, the familiar IPM cornerstone of careful, regular pest monitoring (scouting) to inform decision making remains crucial for dealing with these and related challenges.

The practices in this module are grouped and presented in an order that is consistent with the IPM approach. That is, preventive practices are characterized first, because prevention is the logical first step for minimizing pest problems. Next are recommended practices for

monitoring pests and their symptoms as the basis for deciding if and when to control them. Last, practices are described for the effective and safe use of tactics to control economically damaging pest populations.

ORCHARD ESTABLISHMENT — PREVENTING FUTURE PEST PROBLEMS

1	Was this orchard planted by the current farm owners or managers? ☐ Yes. ☐ No. (Skip to question 26 on page 8.)

	During establishment of this orchard, the following methods were used to *prevent* pest problems:	Not familiar with this	I didn't try it	Used this practice	Not applicable
	SITE PREPARATION				
2	If the previous crop was a perennial, weeds were aggressively controlled for 1–2 years to reduce nematode pests before removing it.	☐	☐	☐	☐
3	Old trees (or other previous crop) were removed and destroyed, and residual roots were removed as deeply as possible from the soil.	☐	☐	☐	☐
4	The site was fallowed or planted with a non-host cover crop for nematodes (e.g., Piper Sudan or safflower) for at least one year.	☐	☐	☐	☐
5	If the site had a significant number of burrowing rodents, the soil was ripped before planting to reduce the population.	☐	☐	☐	☐
6	Before planting, populations of weeds (especially perennials) were reduced by repeated cycles of irrigation, tillage and drying; by postemergent herbicide application followed by cultivation; etc.	☐	☐	☐	☐
7	The site was graded or modified before planting to ensure even drainage and prevent low spots and puddle formation, which can stress trees and/or increase problems with weeds and diseases. If the site is subject to standing water, trees were planted on berms or mounds. (See the Irrigation Management module for detailed information.)	☐	☐	☐	☐
	SAMPLING AND STRATEGY				
8	Prior to planting, the site's micro-climate and crop and pest history were researched to determine potential problems, especially if almonds or related crops (e.g., peaches, plums or cherries) were grown.	☐	☐	☐	☐
9	The soil and, if possible, roots from the previous crop were sampled for nematodes before planting.	☐	☐	☐	☐
10	Integrated pre- and post-plant strategies for managing pests were developed from the crop history and sampling results.	☐	☐	☐	☐

	During establishment of this orchard, the following methods were used to *prevent* pest problems:	Not familiar with this	I didn't try it	Used this practice	Not applicable
	FUMIGATION CONSIDERATIONS				
11	Based on site history (not a replant following almonds or almond relatives; no oak root fungus concerns; etc.) and results from sampling for nematodes, fumigation was not done. ☐ Yes. (Skip to question 17.) ☐ No, the site was fumigated.				
12	The type, rate and method of fumigation were selected according to nematode species and counts, soil diseases present, soil conditions and legal considerations.	☐	☐	☐	
13	What fumigation method was used? ☐ Solid (full coverage) ☐ Strip (tree row) ☐ Spot (planting hole) ☐ GPS-guided spot treatment				
14	Fumigation took place when the soil temperature and moisture were appropriate to maximize efficacy.	☐	☐	☐	☐
15	A thorough review of typically used fumigation methods (e.g., row strip or tree site) was completed, and appropriate safety, quality control and emergency responses are included in written management plans.	☐	☐	☐	
16	When practical, necessary fumigants were applied before or after the peak ozone interval, from May 1 to Oct. 31.	☐	☐	☐	☐
	PLANTING CONSIDERATIONS				
17	When planning for tree spacing, the effects of humidity, canopy architecture, sun exposure, soil conditions and irrigation on pest management were considered.	☐	☐	☐	
18	If this site had problems with root diseases (e.g., oak root fungus) or nematodes, a university-recommended resistant/tolerant rootstock(s) was utilized.	☐	☐	☐	☐
19	Variety selection was based, in part, on disease resistance.	☐	☐	☐	☐
20	Only virus-indexed and certified nematode-free planting materials were used.	☐	☐	☐	☐
21	Orchard rows were planted north to south to optimize sun exposure and reduce the potential for foliar diseases.	☐	☐	☐	☐
22	Effort was taken to ensure tree-graft unions were at least 2 inches above the soil surface to prevent the infection of scions by soil pathogens.	☐	☐	☐	☐
23	Tree guards (e.g., milk cartons) were used to prevent feeding by vertebrate pests on the trunks.	☐	☐	☐	☐
24	For the first few years after planting, extra effort was made to control weeds before they produced seed.	☐	☐	☐	☐
25	Other: _____			☐	

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GENERAL IPM AND PESTICIDE RISK MANAGEMENT — PREVENTION

	For this orchard, the following cultural methods were used to *prevent* pest problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	IRRIGATION AND NUTRIENT MANAGEMENT					
26	Irrigation did not result in standing water (e.g., by using shorter but more frequent run times for heavier soils), which can stress trees and promote weeds and diseases. (See the Irrigation Management module for detailed information.)	☐	☐	☐	☐	
27	Irrigation scheduling was adjusted for orchard canopy and/or root development conditions. (E.g., reducing amounts of water applied to trees stunted by nematodes increases water use efficiency and prevents other pest problems.)	☐	☐	☐	☐	
28	To prevent diseases, the irrigation system was designed and installed to avoid wetting trunks and lower leaves.	☐	☐	☐	☐	☐
29	Necessary amounts of nitrogen were properly determined and applied, therefore avoiding excesses and deficiencies in nitrogen that can increase pest problems. (See the Nutrient Management module for detailed information.)	☐	☐	☐	☐	☐
30	Other: _____				☐	

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GENERAL IPM AND PESTICIDE RISK MANAGEMENT — MONITORING AND STRATEGY

	For this orchard, the following methods were used to *decide if and when to control* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
31	Choose the option that best describes the frequency of and who did the scouting for insects, mites and diseases: ☐ A. The orchard was scouted occasionally or not at all. (If no scouting was done, skip to question 38 on page 11.) ☐ B. The orchard was scouted on a regular schedule by someone other than a Pest Control Adviser (PCA). ☐ C. The orchard was scouted on a regular schedule by a PCA.					
32	Written or electronic scouting reports were kept by or provided to the farm owner or staff to inform decision making.	☐	☐	☐	☐	
33	If reports were available, a year-end review of pest levels and trends was completed.	☐	☐	☐	☐	☐
34	Scouting data, university guidelines and practical experience were used to design and implement management strategies for insects, mites and diseases.	☐	☐	☐	☐	
35	Scouting continued after the use of each pest control tactic to verify efficacy and/or resistance issues.	☐	☐	☐	☐	☐
36	Choose the option that best reflects the scouting method used: ☐ A. "Driving by" the orchard (only checking the perimeter). ☐ B. Walking or driving through the orchard. ☐ C. Representative sampling of the orchard (e.g., by adopting university recommendations).					
37	Other: _____				☐	

Records

Many PCAs do not provide written or electronic records to the orchard manager or owner, but it is recommended that you ask them to do so. If you do the scouting, keep records. The use of records aids decision making by revealing trends within and across seasons.

Several companies provide scouting software that can be used on smartphones or other handheld devices to generate records while scouting. Once in electronic form, scouting data can be used to analyze the cost efficacy of your practices — both before and after they take place.

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GENERAL IPM AND PESTICIDE RISK MANAGEMENT — EFFICACY AND SAFETY OF CONTROL

	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	PESTICIDE APPLICATION EQUIPMENT					
38	For this orchard, choose the option that best reflects who was *primarily* responsible for applying pesticides: ☐ A. A custom applicator or farm management company. (You may have to answer *Not Applicable* for some of the following questions related to equipment and applications.) ☐ B. The farm owner or staff.					
39	Pesticide application equipment has been calibrated prior to use each year, after every equipment repair or modification, and when changes are made in operating pressure, spray pattern, fan speed, tractor type, tractor wheels, etc.	☐	☐	☐	☐	☐
40	A log of calibration and repairs to pesticide application equipment was maintained to ensure timely maintenance and efficient operation.	☐	☐	☐	☐	☐
41	Sprayer operating manuals have been reviewed, and all applicators have been trained in proper operation.	☐	☐	☐	☐	☐
42	Other: _____				☐	
	AERIAL SPRAYING OF PESTICIDES					
43	Aerial spraying has been used for this orchard. ☐ A. Yes, even if the following did not apply. ☐ B. Yes, but only when impossible to get ground sprayers into the orchard, or to complete ground spraying in the time available (such as when a storm is approaching). ☐ C. No. (Skip to question 46 on page 12.)					
44	Aerial spraying was done using GPS guidance to maximize precision.	☐	☐	☐	☐	☐
45	Other: _____				☐	

Spray drift

Pesticides found in streams and rivers are the cause for several regulations affecting California Almond growers. Until better technology is found, air blast sprayers will be necessary for effective tree protection, especially in mature orchards. Frequent calibration and use of properly functioning low-drift nozzles, as well as proper ground speed, fan speed and pressure, optimize spray efficiency and minimize drift. The use of a target-sensing sprayer that can automatically open and close nozzles to match tree height and presence (i.e., turning off nozzles between trees or when a tree is missing) should be considered. Target-sensing sprayers can reduce spray by 25%. Government cost-share funds have been available for this technology. If interested, check with your county Natural Resources Conservation Service office about available funding.

	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	AIR BLAST PESTICIDE SPRAYERS					
46	Prior to each air blast application, the weather was checked for current and forecasted wind speed and direction, inversion conditions, temperature and rain.	☐	☐	☐	☐	☐
	Air blast applications only occurred:					
47	when winds were under 10 mph.	☐	☐	☐	☐	☐
48	when winds were between 2 and 8 mph (minimizes drift from inversions and wind).	☐	☐	☐	☐	☐
49	when winds were blowing away from drift-sensitive sites.	☐	☐	☐	☐	☐
50	at ground speeds of 2 mph or less (optimizes coverage).	☐	☐	☐	☐	☐
51	at night or during the coolest part of the day (to avoid vapor drift and for worker safety).	☐	☐	☐	☐	☐
52	when rain was not forecasted for 48 hours *unless* applications just before rainfall were recommended (e.g., for managing diseases) and zero runoff into waterways was expected.	☐	☐	☐	☐	☐
53	Low-drift nozzles were used to optimize spray placement and minimize off-target movement.	☐	☐	☐	☐	☐
54	Sprayer nozzles have been replaced at least once per season, or more frequently if powders or other corrosive materials were used.	☐	☐	☐	☐	☐
55	The spray pattern was adjusted according to the orchard's average tree size and shape (e.g., reducing size of lower nozzles for a mature orchard with a thin lower canopy, or shutting off top nozzles for a young orchard with short trees).	☐	☐	☐	☐	☐
56	When shifting between foliar sprays and dormant or bloom sprays, the fan speed, pressure and/or nozzle type were adjusted for the canopy density.	☐	☐	☐	☐	☐
57	Spray coverage was periodically checked using water-sensitive paper placed in the target zone.	☐	☐	☐	☐	☐
58	Proven drift-control spray additives or drift-reducing sprayers have been used, when possible.	☐	☐	☐	☐	☐
59	To reduce drift, the sprayer was operated at the lowest pressure providing uniform coverage.	☐	☐	☐	☐	☐
	OTHER PESTICIDE SPRAYERS					
60	Sprayer shields or drift guards were used to keep sprays on target (e.g., for weed sprayers).	☐	☐	☐	☐	☐
61	Ultra-low-volume spray equipment or target-sensing sprayers (e.g., SmartSpray® or WeedSeeker® technology) were used to reduce spray volumes or amounts of pesticides.	☐	☐	☐	☐	☐
62	Other: _____				☐	

	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	ACCOUNTING FOR SENSITIVE SITES					
63	The air blast sprayer was turned off when making row turns and did not resume until the nozzles were adjacent to the first trees.	☐	☐	☐	☐	☐
64	A map of sensitive sites and associated buffer zones within or near the orchard has been created and reviewed with everyone involved in pesticide applications.	☐	☐	☐	☐	☐
65	Spraying near waterways (e.g., creeks or irrigation canals) or other sensitive sites was discontinued when winds blew in the direction of these sites.	☐	☐	☐	☐	☐
66	Outward-facing nozzles on air blast sprayers were turned off when spraying outermost rows adjacent to open spaces (e.g., roads or open fields) or sensitive sites.	☐	☐	☐	☐	☐
67	When operating air blast sprayers next to open or sensitive sites (aquatic areas, residences, schools, etc.), the two rows directly adjacent to these sites were sprayed on the outer side only (i.e., to direct spray into the orchard).	☐	☐	☐	☐	☐
68	If drainage ditches or other aquatic areas exist within or near the orchard, pesticides were not applied within 100 feet upslope of these sites.	☐	☐	☐	☐	☐
69	Other: _____				☐	

Sensitive sites

The term "sensitive sites" refers to areas of human or environmental sensitivity on or near the farm. These include streams, ponds, canals, wellheads, dry wells, drainage or runoff areas, wetlands, homes, schools and workplaces. Making a farm map that identifies sensitive sites and recommended or required buffer zones helps with farm planning, employee training and necessary emergency responses. Free or low-cost online mapping tools can help with farm planning.

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	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	ACCOUNTING FOR ENDANGERED SPECIES					
70	The person(s) responsible for pest management could identify endangered or threatened species that may be found in the area, and periodically checked for signs of them.	☐	☐	☐	☐	☐
71	The person(s) responsible for pesticide selection and application regularly checked county, state or federal sources for endangered species updates that may impact pest management options and, if necessary, modified the selection of products or applications accordingly.	☐	☐	☐	☐	☐
72	Other: _____				☐	

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INSECT AND MITE PESTS — PREVENTION

	For this orchard, the following methods were used to *prevent* insect and mite problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	NAVEL ORANGEWORM (NOW)					
73	To reduce outbreaks of NOW and brown rot, mummy nuts were counted and removed, as needed, during the winter, so that less than two mummies per tree remained by February 1 (less than one mummy per tree for the southern San Joaquin Valley or within 3 miles of pistachio orchards).	☐	☐	☐	☐	☐
74	By March 15, mummy nuts on the ground were destroyed (e.g., by mowing or by verifying there was sufficient moisture to rot them).	☐	☐	☐	☐	☐
75	Timely harvest (harvesting as soon as nuts were dry enough) was completed to reduce nut damage by NOW.	☐	☐	☐	☐	☐
76	Controlled deficit irrigation was used to provide a uniform hullsplit, increase drying on the tree, and facilitate a rapid, timely harvest.	☐	☐	☐	☐	☐
77	Other: _____				☐	
	WEB-SPINNING MITES					
78	To reduce outbreaks of mites, dust was reduced on orchard roadways (via dust suppressants, oiling, watering, mulching, vegetative cover, driving slowly, etc.).	☐	☐	☐	☐	☐
79	Efficient irrigation management (see the Irrigation Management module) was practiced to prevent trees from becoming water stressed and to reduce web-spinning mites and their damage.	☐	☐	☐	☐	☐
80	Other: _____				☐	
	DAMAGE FROM OTHER INSECTS					
81	Rapid pickup of nuts off the ground was completed to reduce nut damage by ants and other pests.	☐	☐	☐	☐	☐
82	Other: _____				☐	

NAVEL ORANGEWORM MANAGEMENT AND MONITORING

Joe Connell, University of California Farm Advisor, Butte County

Management

The original four-point program for naval orangeworm (NOW) management developed by the University of California and the Almond Board of California included winter sanitation, a dormant spray (for peach twig borer control), an in-season spray and a timely harvest. Each can be important to help ensure the delivery of quality almonds.

Winter sanitation is the most critical component of the management strategy for NOW control. Removal of overwintering mummies down to an average of less than two mummy nuts per tree is essential. Often, birds don't do as well as we would like to believe. Make a mummy count in the orchard this winter, and clean the trees if there are too many mummies left. Destroy mummies on the ground by March 15.

Controlling peach twig borer (PTB) is important since NOW often follows PTB into the nuts. If PTB is present, the strategy of using sprays at bloom to control PTB could be substituted for a dormant spray in the NOW program.

An in-season spray at hullsplit can help keep NOW damage low, but it is not as effective as the cultural methods of sanitation and a timely harvest. If winter sanitation is completed effectively, and early harvest is practiced, the in-season spray may not be needed if external sources of infestation are more than one-quarter mile away.

Commence rapid, early harvest once 100% of the Nonpareil nuts at eye level have just begun to split. Nut removal at that time should be at least 99% when the trees are shaken. Anything that delays harvest will increase worm damage. Unexpected rain that slows down Nonpareil harvest or delays the pollinizer harvest will increase damage to soft-shelled pollinizers. Consider on-farm stockpile fumigation along with early harvest to preserve optimum quality.

Monitoring

Black egg traps baited with almond press cake and 10% almond oil are good monitoring tools. Place egg traps in orchards by the first week in April. Use at least four traps per orchard. In large orchards, use an average of one trap per 10 acres. Hang egg traps at head height on the north side of Nonpareil trees 1 to 3 feet inside the drip line.

In sprinkle-irrigated orchards, hang the traps over the sprinkler head to keep the press cake bait dry. These traps are good, and they maintain their attractiveness even after hullsplit.

Check traps twice a week in April and May until the first eggs are found, providing a biofix date. Once a biofix for the first generation is obtained in the spring, the degree-day phenology model can be used to predict the onset of the second to fourth generations. Each time traps are checked, remove the eggs, record the number of eggs, and chart or graph the number of eggs per trap per day.

Insect Life Cycle

There are several approaches to predicting the NOW life cycle. A simple degree-day model using a lower development threshold of 55°F and a horizontal upper development cutoff of 94°F is similar to models used for other insects and works quite well. The horizontal upper cutoff assumes that development continues at a constant rate at temperatures in excess of the upper threshold. This method tends to overestimate NOW development at temperatures over the upper development threshold (i.e., during especially hot summers).

Mean development time for NOW on mummy nuts is 1,056 degree-days, and on new crop nuts is only 723 degree-days, due to improved diet. Mean egg hatch is at 100 degree-days. We know there are three generations each year that have the potential to affect the crop. The first generation takes 1,056 degree-days on mummy nuts, but part of the second, and all of the third generation only take 723 degree-days on new crop nuts after hullsplit begins.

Practical Application

Monitoring with egg traps is useful for two reasons. First, they let you know how much NOW pressure is in the orchard and where it's the worst. Second, once you note when spring egg laying begins, degree-day projections will tell you when worm pressure is likely to increase during harvest and if the crop will be subject to attack by a fourth generation. This can help you determine which blocks to harvest first, or it may provide clues as to whether or not in-season sprays on the Nonpareil or soft-shelled pollinizers are likely to be beneficial.

Usually, the third generation comes in mid- to late August through September, and the fourth generation starts in late September to October and overwinters. When the biofix for the first generation is in May, populations follow this pattern of NOW activity. Although the third generation can do significant crop damage, its impact under these conditions can be minimized with the cultural controls discussed earlier.

When the biofix for the first-generation egg laying is a month earlier (mid-late April) there is more time for the third generation to damage the nuts. In addition, the fourth generation may begin in mid-September instead of in October. Under these conditions, the full impact of the third generation and part of the fourth generation may be felt on the soft-shelled varieties. This is why we have more severe worm problems on late-harvesting soft-shelled pollinizer varieties in years when harvest is delayed.

Using egg traps to monitor NOW activity will help you develop a better appreciation for the severity of worm pressure from year to year. In addition, it can help you anticipate the potential effects of a delayed harvest.

Insect Life Cycle Models (Phenology Models Using Degree-Days):

Although the Internet puts incredible resources at our fingertips, most of us are too busy to spend much time browsing. We usually need specific information quickly.

Web-based degree-day (D°) models are now easy to use and can predict insect life cycles once you provide a start date (the biofix), based on counts from insect traps on your farm. Degree-day projections from your spring biofix can be made using the UC IPM website and weather data from a station close to your location.

Here are simple steps for navigating:

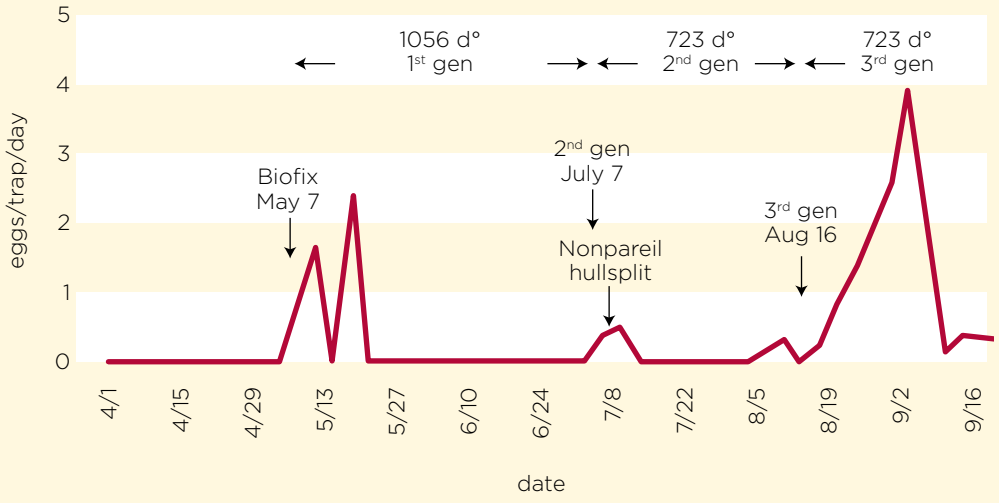
1) Go to the UC IPM website using your browser. http://www.ipm.ucdavis.edu.
2) Once at the website, find "Quick Links" and click on "Weather, models & degree-days."
3) Under "Pest and plant models," click on "Navel orangeworm."
4) Make sure the "crop choice," almonds, is correct and click on the "Continue" button.
5) Specify the source of temperature data: "Weather station from UC IPM database"; then,
6) Under "Select from stations in which California county?" highlight your county's name.
7) Fill in the time period:
    a. "Biofix (start date)": *month date year* < Enter your biofix.
    b. "End date": *month date year* < Enter the latest date you care about or the end of the growing season. The program will use long-term average temperatures to project degree-days for the remainder of the season.

8) Click on “Continue”; then, select the weather station (from the list of county stations) that you wish to use. For example, click on “Durham.A (CIMIS #12, Durham)”
9) Select the Output file format you prefer. (E.g., select “Formatted report [for viewing or printing].”)
10) Click on the “Calculate” button.
11) You’re done!
    - You get a NOW degree-day report on your screen. (You can print it by clicking on “File,” then “Print” from your browser’s menu bar.)
    - The report also shows which temperatures are current (normally up through the date when you ran the model) and which are long-term averages (indicated by an “A” following the temperature).
    - The accumulated-degree-days column is used to identify the dates when each generation should end and the next egg-laying cycle will begin. (For example, after 1,056 degree-days, the first generation should end, and the second-generation egg laying should begin. Then, 723 degree-days after that, the third-generation egg laying should begin.)

If you know the daily maximum and minimum temperatures, you can also read and accumulate NOW degree-days from published charts.

The following graph is an example of how the NOW degree-day model can be useful for anticipating worm pressure at harvest. Monitoring and identifying the spring biofix dates for the major worm pests is an important component of a good pest management program in your orchard.

NAVEL ORANGEWORM D° MODEL



INSECT AND MITE PESTS — MONITORING AND STRATEGY

	For this orchard, the following methods were used to *decide if and when to control* insect and mite pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	SAMPLING NUT DAMAGE AT HARVEST					
83	At harvest, an analysis of types of nut rejects (more than a simple grade sheet) was obtained from the handler(s) to determine the pest(s) causing the damage, the efficacy of the year's pest management program, and the plan for the next year.	☐	☐	☐	☐	☐
84	At harvest, farm staff took their own samples of nuts and analyzed them to determine the pest(s) causing the damage, the efficacy of the year's pest management program, and the plan for the next year.	☐	☐	☐	☐	☐
	NAVEL ORANGEWORM (NOW)					
85	Was NOW sprayed in the past year? ☐ No. (Skip to question 89.) ☐ Yes. (Check all combinations of spray timing and monitoring used to ensure efficacy.)					
86	Spring spray was based on egg traps and degree-day calculations and/or timed to coincide with peach twig borer treatment.	☐	☐	☐	☐	
87	Hullsplit spray was based on the percentage of split hulls.	☐	☐	☐	☐	
88	Hullsplit spray was based on egg traps and degree-day calculations.	☐	☐	☐	☐	
	SAN JOSE SCALE (SJS)					
89	Was SJS sprayed in the past year? ☐ No. (Skip to question 94 on page 22.) ☐ Yes. (Check all types of monitoring used to decide if and when to spray.)					
90	Dormant spur monitoring (also detects brown and European red mites).	☐	☐	☐	☐	
91	Monitoring using pheromone traps and degree-day calculations.	☐	☐	☐	☐	
92	Monitoring crawler emergence (e.g., with sticky tape).	☐	☐	☐	☐	
93	SJS parasite activity was also monitored (e.g., on trap cards) to estimate the potential for biological control.	☐	☐	☐	☐	

	For this orchard, the following methods were used to *decide if and when to control* insect and mite pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	PEACH TWIG BORER (PTB)					
94	Was PTB sprayed in the past year (dormant, bloom or spring sprays)? ☐ No. (Skip to question 98.) ☐ Yes. (Check all types of monitoring used to decide if and when to spray.)					
95	At the previous harvest, nuts were monitored for PTB damage.	☐	☐	☐	☐	
96	Shoot strike monitoring began in April to determine if the number of strikes reached a treatment threshold (generally four or more strikes per tree for mature orchards).	☐	☐	☐	☐	
97	Monitoring using pheromone traps and degree-day calculations.	☐	☐	☐	☐	
	WEB-SPINNING MITES					
98	Hot spots for web-spinning spider mites (e.g., orchard areas along dusty roads) were monitored (generally May to August) to guide control decisions.	☐	☐	☐	☐	☐
99	Mite predators (e.g., predatory mites and six-spotted thrips) were also monitored to estimate the amount of biological control.	☐	☐	☐	☐	☐
	ANTS					
100	The person(s) responsible for pest management was able to identify common ants and distinguish pest from non-pest species.	☐	☐	☐	☐	
101	In mid- or late spring, the number of fire ant and pavement ant colonies per 5,000 square feet was estimated.	☐	☐	☐	☐	☐
	LEAFFOOTED BUGS AND STINKBUGS					
102	Spring and summer monitoring included scouting for nut drop, nut gummosis and signs of other damage from leaffooted bugs and/or stinkbugs.	☐	☐	☐	☐	☐
103	During fall or winter, woodpiles, redwoods, junipers, cypress, eucalyptus, etc. were scouted for aggregations of leaffooted bugs to determine if these overwintering sites should be removed or otherwise managed.	☐	☐	☐	☐	☐
104	Other: _____				☐	

INSECT AND MITE PESTS — EFFICACY AND SAFETY OF CONTROL

	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* insects or mites:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
105	How many times have dormant sprays been applied to this orchard in the past five years? ☐ 0 ☐ 1 ☐ 2 ☐ 3 to 4 ☐ 5 (every year)					
106	If a dormant spray was applied in the past year, what material(s) was used? ☐ Oil alone ☐ Oil and copper ☐ Oil and organophosphate ☐ Oil and pyrethroid ☐ Other _____					☐
107	When insecticide applications were necessary, the lowest label rates shown to be effective (e.g., by UC IPM guidelines) were used.	☐	☐	☐	☐	☐
108	When insecticides or acaricides were chosen, potential negative effects on beneficial and nontarget organisms were accounted for (e.g., by avoiding broad-spectrum pesticides such as pyrethroids, organophosphates and carbamates).	☐	☐	☐	☐	☐
109	In addition to following required practices on product labels, mode-of-action group numbers for insecticides and acaricides (on labels or in UC Pest Management Guidelines) were recorded and used to guide pesticide rotation/resistance decisions.	☐	☐	☐	☐	☐
110	A mating-disruption program for NOW has been used or attempted for this orchard.	☐	☐	☐	☐	☐
111	Control tactics for web-spinning spider mites included releases of predatory mites or insects to augment natural biological control.	☐	☐	☐	☐	☐
112	Other: _____				☐	
	POLLINATOR PROTECTION					
113	Prior to applying new insecticides, impacts to bees and natural enemies were checked (using information from labels and other sources such as the UC IPM website), and the product with the fewest precautions and/or shortest residual was considered for use.	☐	☐	☐	☐	☐
114	Outside of almond bloom, row middles were mowed or otherwise managed to prevent weeds from flowering and, therefore, discourage bees from entering the orchard when insecticide residues may have been present.	☐	☐	☐	☐	☐
115	Other: _____				☐	

Resistance Action Committees (RACs)

Pesticide labels often include numbers that designate groups of active ingredients with common "modes of action." Each group similarly affects pest targets (insects, weeds, etc.). Since multiple products can contain the same active ingredient, and multiple active ingredients can have similar modes of action, the group number is useful for planning pesticide rotations. Each branch of the pesticide industry has a Resistance Action Committee (IRAC for insecticides, FRAC for fungicides and HRAC for herbicides) that categorizes active ingredients by these group numbers. Single products (especially fungicides) can contain active ingredients from separate groups. If the pesticide label does not list the number(s), they can be found on the corresponding RAC website (see "References and more information" sections of this module) or by accessing the online UC IPM Pest Management Guidelines for almonds.

EXAMPLES OF BROAD-SPECTRUM INSECTICIDES

INSECTICIDE CLASS	BRAND NAMES
Carbamates	Lannate, Sevin
Organophosphates	Diazinon, Guthion, Lorsban, malathion, Supracide, Imidan
Pyrethroids	Ambush, Asana, Brigade, Danitol, Pounce

EXAMPLES OF NARROW-SPECTRUM INSECTICIDES OR THOSE LESS TOXIC TO NONTARGETS

INSECTICIDE CLASS	BRAND NAMES
Insect growth regulators	Clinch, Confirm, Dimilin, Distance, Esteem, Intrepid, Seize
Microbials *(Bacillus thuringiensis)*	Condor, DiPel, Javelin
Miticides	Acramite, AgriMek, Apollo
Narrow-range oils	Gavicide Oil, Omni Oil, etc.
Naturalytes *(spinosad, spinetoram)*	Entrust, Delegate, Success

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DISEASES — PREVENTION

	For this orchard, the following methods were used to *prevent* diseases:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	PRUNING AND WOUND PREVENTION					
116	Were trees pruned? ☐ Yes. ☐ No. (Skip to question 119.)					
117	Pruning resulted in minimal stub cuts or damaged branch collars, which could be sites for disease entry.	☐	☐	☐	☐	
118	Pruning was completed during dry weather (e.g., immediately after harvest) to minimize open wounds being exposed to rain.	☐	☐	☐	☐	
119	During harvest, good shaker management was practiced to avoid tree wounding and subsequent infection by pathogens.	☐	☐	☐	☐	
120	Field equipment was operated to avoid wounding tree crowns (where the trunk and roots meet).	☐	☐	☐	☐	☐
121	Other: _____				☐	

DISEASES — MONITORING AND STRATEGY

	For this orchard, the following methods were used to *decide if and when to control* diseases:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
122	The orchard was monitored for shot hole or rust lesions and fruiting structures in the fall to determine if treatment would be necessary at petal fall. After petal fall, monitoring for fruiting structures continued until weather was not conducive for disease development. (NOTE: Zinc sprays applied as foliar fertilizers in the fall may cause incidental leaf loss, thereby reducing potential infection sites.)	☐	☐	☐	☐	☐
123	During bloom and spring periods, the weather was carefully monitored for temperatures and rainfall favorable for disease development.	☐	☐	☐	☐	
124	Disease symptoms were monitored weekly prior to and during bloom, and throughout spring, until weather was no longer conducive for disease development.	☐	☐	☐	☐	
125	The orchard was scouted during postharvest for nuts or leaves stuck on trees or shoot die-back, which may indicate hull rot or damage from San Jose Scale.	☐	☐	☐	☐	☐
126	Other: _____				☐	

DISEASES — EFFICACY AND SAFETY OF CONTROL

	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* diseases:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
127	To reduce the likelihood of diseases becoming resistant, fungicides were sprayed to ensure full coverage (ground speeds of 2 mph or less, no skipped rows, etc.).	☐	☐	☐	☐	☐
128	In addition to required practices on product labels, the most recent fungicide efficacy and resistance management information was reviewed (e.g., *UC Fungicide Efficacy and Treatment Timing* tables) to guide rotation/resistance decisions.	☐	☐	☐	☐	☐
	POLLINATOR PROTECTION AT BLOOM					
129	As much as possible during bloom, sprays were applied when bees were not working flowers (e.g., when temperatures were below 55°F; or mid-afternoon or later when most pollen was foraged). (NOTE: Spraying blossoms during the morning may reduce pollination.)	☐	☐	☐	☐	☐
130	Prior to positioning hives in the orchard, arrangements were made with the beekeeper(s) about what, if any, advance notice was required about pesticide use while hives were present.	☐	☐	☐	☐	☐
131	Other: _____				☐	

BLOOM AND BEES

The California Almond community has attracted media attention in recent years for the large number of beehives that travel to orchards for use in almond blossom, coupled with attention on multiple bee health issues nationwide. To maintain a healthy relationship with your beekeeper(s), cooperation between the grower and beekeeper is essential. The Coalition for Urban/Rural Environmental Stewardship recommends that growers and beekeepers work together to:

- Review the pest management practices in the area before the beehives are delivered.
- Develop a written agreement outlining the crop timing, period for using the hives, and important considerations.
- Clearly define responsibilities for providing supplemental water and food sources and for protecting the hives.
- Place hives away from areas that may be exposed to pesticides toxic to bees during the pollination period.
- Protect water sources from contamination by pesticides.
- Inform neighboring growers and custom applicators operating in the area where hives are located so precautions can be taken when treating nearby fields.
- Remove hives if pesticides toxic to bees will be applied in the immediate vicinity.
- If applications of pesticides toxic to bees near beehives are unavoidable, shield beehives with wet burlap to confine and protect the bees, but ensure that bees are kept cool at all times.
- Post the beekeeper's name and contact information near the hives.

Excerpted from "Pollinators and Pesticide Stewardship," available at www.curesworks.org.

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NEMATODES — PREVENTION

	For this orchard, the following methods were used to *prevent* nematode problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
132	Equipment used in orchards infested with nematodes was cleaned of soil and roots before being moved to noninfested areas.	☐	☐	☐	☐	☐
133	Tail water from blocks or orchards infested with nematode pests was not used to irrigate noninfested areas.	☐	☐	☐	☐	☐
134	If cover cropping was done, the plant species used for cover were rotated annually to restrict the growth of nematode populations.	☐	☐	☐	☐	☐
135	Other: _____				☐	

NEMATODES — MONITORING AND STRATEGY

	For this orchard, the following methods were used to *decide when and how to manage* nematode problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
136	If weak areas of tree growth were evident, root and soil samples were taken from these areas and tested for nematode pests.	☐	☐	☐	☐	☐
137	Other: _____				☐	

NEMATODES — EFFICACY AND SAFETY OF CONTROL

	For this orchard, the following cultural methods were used to *minimize damage* from nematodes:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
138	Recommended irrigation, nutrient and soil management practices were followed to promote tree health and vigor, which provided some tolerance to nematodes.	☐	☐	☐	☐	☐
139	Organic matter was added to the soil (e.g., as compost or a cover crop) to enhance root growth and health.	☐	☐	☐	☐	☐
140	Other: _____				☐	

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WEEDS — PREVENTION

	For this orchard, the following methods were used to *prevent* weed problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
141	Ground cover (resident or planted) was intentionally grown between orchard rows. ☐ Yes. ☐ No. (Skip to question 145.)					
142	Between-row, resident vegetation was managed to minimize weed colonization of tree rows.	☐	☐	☐	☐	
143	A between-row cover crop was selected, seeded and managed to outcompete weeds and prevent weed colonization of tree rows.	☐	☐	☐	☐	
144	Between-row ground cover was managed (e.g., mowed) before bloom to provide frost protection, remove flowers that could compete with almonds for pollination, and ensure cover was short and even at harvest.	☐	☐	☐	☐	
145	To prevent transferring weeds among orchards, equipment was cleaned after working in weedy areas, especially if herbicide-resistant species were suspected or present.	☐	☐	☐	☐	☐
146	The orchard was irrigated using drip or micro-sprinklers (decreases weed growth in row middles).	☐	☐	☐	☐	☐
147	Other: _____				☐	

WEEDS — MONITORING AND STRATEGY

	For this orchard, the following methods were used to *decide if and when to control* weeds:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
148	Weeds were monitored at least twice a year, preferably during the fall after harvest and first rains (for winter annuals and perennials) and during late spring (summer annuals and perennials).	☐	☐	☐	☐	
149	Species and infestation levels were recorded to guide the weed management strategy and type and timing of control(s).	☐	☐	☐	☐	
150	Monitoring included an evaluation after each treatment to identify and manage problems with efficacy, including resistance.	☐	☐	☐	☐	☐
151	Monitoring records included growth stages (seedling or mature) and potential herbicide resistance issues.	☐	☐	☐	☐	☐
152	Groundwater protection areas, nearby surface waters and regulations pertinent to the orchard were known and factored into the weed management strategy.	☐	☐	☐	☐	☐
153	The orchard's soil texture was known and factored into management decisions. (E.g., sandy loams to loamy sands require lower rates of pre-emergent herbicides, and permit more flexible timings for cultivation.)	☐	☐	☐	☐	☐
154	Some annual weeds were tolerated within the tree rows if competition from them was negligible and their presence did not increase rodents or interfere with irrigation or harvest.	☐	☐	☐	☐	☐
155	An integrated weed management strategy was developed (involved multiple control tactics, rotation of herbicides with different modes of action, etc.) that considered monitoring results, past treatments, herbicide resistance and physical characteristics of the orchard and surrounding sensitive areas.	☐	☐	☐	☐	☐
156	Other: _____				☐	

WEEDS — EFFICACY AND SAFETY OF CONTROL

	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* weeds:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
157	Weed control involving cultivation, mowing or flaming did not damage almond roots or trunks or irrigation systems.	☐	☐	☐	☐	☐
158	Potentially adverse environmental effects of nonchemical controls (e.g., soil erosion and/or problematic air emissions associated with cultivation, flaming or mowing) were considered before and during use.	☐	☐	☐	☐	☐
159	Herbicides generally were applied only within the tree rows (not orchard middles).	☐	☐	☐	☐	☐
160	Rates of pre-emergent herbicides were adjusted for soil texture to prevent tree damage and leaching.	☐	☐	☐	☐	☐
161	Herbicides were selected and used to cost-effectively and safely (avoiding off-site movement by drift, runoff, leaching and volatilization) control the majority of weeds and growth stages that were present.	☐	☐	☐	☐	☐
162	Rates of applied postemergent herbicides were decreased by spot-spraying or use of smart sprayers (e.g., SmartSpray® or WeedSeeker® technology).	☐	☐	☐	☐	☐
163	Suspected or identified herbicide-resistant weeds were managed with alternative tactics including cultural practices (such as hoeing small patches when first noticed) and alternating herbicides with different modes of action.	☐	☐	☐	☐	☐
164	Other: _____				☐	

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VERTEBRATE PESTS — PREVENTION

	For this orchard, the following methods were used to *prevent* vertebrate problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
165	Potential vertebrate shelters (e.g., piles of rocks, unused sprinkler pipe, farm equipment, brush piles or brushy vegetation) have been removed from the orchard and its margins.	☐	☐	☐	☐	☐
166	If the orchard is adjacent to grasslands or other wild areas, a cleared margin was maintained to discourage rodents from entering the orchard.	☐	☐	☐	☐	☐
167	Orchard floors were managed to prevent weeds from getting tall and providing shelter for rodents (especially directly adjacent to almond trees).	☐	☐	☐	☐	☐
168	Other: _____				☐	

VERTEBRATE PESTS — MONITORING AND STRATEGY

	For this orchard, the following methods were used to *decide if and when to control* vertebrate pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
169	The orchard and its margins were monitored for signs of vertebrate pests (e.g., ground squirrels and gophers) throughout the season.	☐	☐	☐	☐	☐
170	To detect and control problems early, orchards were intensely monitored during the onset of vertebrate activity (e.g., spring).	☐	☐	☐	☐	☐
171	To prevent harm to nontarget species from control tactics, vertebrate pests were accurately identified (e.g., distinguishing ground squirrel burrows from endangered kit fox dens).	☐	☐	☐	☐	☐
172	Other: _____				☐	

VERTEBRATE PESTS — EFFICACY AND SAFETY OF CONTROL

	For this orchard, the following methods were used to *maximize efficacy and minimize risk when controlling* vertebrates:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	GOPHERS, GROUND SQUIRRELS AND OTHER SMALL BURROWING VERTEBRATES					
173	Burrowing vertebrate pests were managed without toxic baits or fumigants. ☐ Yes. (Skip to question 178.) ☐ No.					
174	Small populations were managed (where permitted) by trapping alone or in combination with chemicals.	☐	☐	☐	☐	☐
175	Spot treatments were used, when possible.	☐	☐	☐	☐	☐
176	Exclusion devices (e.g., bait stations with small openings) or other methods were used to reduce risks to nontarget species from toxins or traps.	☐	☐	☐	☐	☐
177	For severe or chronic infestations, a treatment plan was developed that accounted for pest species and bait acceptance, toxicity and residual activity, and other considerations about efficacy, worker safety and nontarget effects. (E.g., fumigants can pose high risks to applicators but low risks to nontarget vertebrates; some baits are more effective as broadcast than spot treatments.)	☐	☐	☐	☐	☐
178	Biological control of burrowing vertebrate pests was encouraged by installing nest boxes or perches for predatory birds (e.g., owls or hawks) at orchard margins. ☑	☐	☐	☐	☐	☐
179	If nest boxes or perches were provided, they were periodically maintained and cleaned, which included cleaning the orchard floor under them before harvest.	☐	☐	☐	☐	☐
180	Other: _____				☐	

☑ This practice may also have food safety implications. Consult ABC GAP recommendations for more information.

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POSTHARVEST PEST MANAGEMENT

☑ This practice may also have food safety implications. Consult ABC GAP recommendations for more information.

	For this orchard or facility, the following methods were used to *prevent* pests in stockpiles:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	STOCKPILE MANAGEMENT					
181	This orchard or facility stockpiled nuts (in the orchard or elsewhere): ☐ Yes. ☐ No. (Skip to question 194 on page 42.)					
182	Stockpiles were located on clean (e.g., not treated with manure or other contaminants in the past year), dry soil or concrete where water does not collect. ☑	☐	☐	☐	☐	
183	Stockpiles were oriented north to south to minimize condensation and mold.	☐	☐	☐	☐	
184	For nuts that were stockpiled, their moisture content was determined while on the orchard floor, before or after sweeping.	☐	☐	☐	☐	
185	Nuts were not stockpiled if hull moisture exceeded 13% or kernel moisture exceeded 6%.	☐	☐	☐	☐	☐
186	If stacked with nuts having higher-than-recommended moisture, stockpiles were uncovered during the day, when humidity was lower, and recovered at night.	☐	☐	☐	☐	☐
187	Stockpiles were built with smooth tops to reduce "valleys," where condensation concentrates.	☐	☐	☐	☐	☐
188	Stockpiles were covered with white-on-black tarps to minimize condensation and temperature changes.	☐	☐	☐	☐	☐
189	Other: _____				☐	

	For this orchard or facility, the following methods were used to *maximize efficacy and minimize risk when controlling* pests in stockpiles:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
190	Employees handling stockpiles were trained to properly manage them, including use of safe fumigation practices.	☐	☐	☐	☐	☐
191	Traceability procedures were followed when creating stockpiles.	☐	☐	☐	☐	☐
192	A thorough review of typically used types of fumigation (stockpile fumigation, hull pile fumigation, etc.) has been done, and appropriate safety, quality control and emergency responses are in written management plans.	☐	☐	☐	☐	☐
193	Other: _____				☐	

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POSTHARVEST PEST MANAGEMENT (HULLER/SHELLERS OR PROCESSORS)

The practices in this section apply to facilities for huller/sheller operations or processing plants. In addition to the main work area, facilities include connecting or immediately adjacent rooms, storage areas or surrounding environments that could harbor pests which may infest areas where almonds are processed.

Because pests can transmit human pathogens or other contaminants, practices in this section have food safety implications. Practices here should not be considered a definitive guide for Good Manufacturing Practices (GMPs) for food safety. GMPs for food safety are detailed on the Almond Board of California website (www.almondboard.com).

194	Does this facility operate seasonally or year-round? ☐ Seasonally. (If so, the following questions apply from preseason preparation to postseason wrap-up.) ☐ Year-round.					

POSTHARVEST PEST MANAGEMENT (HULLER/SHELLERS OR PROCESSORS) — PREVENTION

	For this facility, the following methods were used to *prevent* pest problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	PROGRAM, POLICIES AND TRAINING					
195	A staff person has been authorized to implement the facility's pest management program, and to serve as the primary point of contact for pest control contractors (if used).	☐	☐	☐	☐	☐
196	The facility has a written and regularly updated employee sanitation, prevention and pest management program that was used to train employees at hiring and by schedule thereafter.	☐	☐	☐	☐	☐
197	Records were kept for employee pest management training.	☐	☐	☐	☐	☐
198	Other: _____				☐	

	For this facility, the following methods were used to *prevent* pest problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	PEST FOOD AND WATER SOURCES					
199	Floors, walls and ceilings were constructed to facilitate cleaning and maintenance.	☐	☐	☐	☐	☐
200	Landscape plants and trees known to serve as food or nesting sites for birds and other pests were not planted or have been removed.	☐	☐	☐	☐	☐
201	Clutter and debris were quickly removed (i.e., daily) from equipment or areas prone to debris (e.g., load levelers, dock areas and conveyor belts), and from less visible or accessible areas (e.g., ledges, cracks and within equipment).	☐	☐	☐	☐	☐
202	Trash bins, dumpsters and other external waste receptacles were on rigid, cleanable surfaces (e.g., concrete pads), which were kept clean.	☐	☐	☐	☐	☐
203	Waste bins and other interior trash receptacles, especially those used for disposing of food or other materials that attract pests, were emptied often (preferably daily) and kept clean (e.g., by removing waste that had collected under trash liners).	☐	☐	☐	☐	☐
204	The facility (interior and exterior) had no standing water, and all sources of water were managed to not attract or harbor pests.	☐	☐	☐	☐	☐
205	No food, beverages, candy, chewing gum, lozenges or similar comestibles were allowed in almond processing areas.	☐	☐	☐	☐	
206	No pets or other animals were allowed inside the facility.	☐	☐	☐	☐	
207	Lunch or snacking areas were separate from almond processing areas.	☐	☐	☐	☐	☐
208	Vending machines were not in buildings where almonds were processed.	☐	☐	☐	☐	☐
209	Food and clothing were removed from employee lockers (if provided) at least weekly.	☐	☐	☐	☐	☐
210	Policies or devices prevented doors and windows from remaining open unnecessarily (especially for bathrooms and other areas of water use).	☐	☐	☐	☐	☐
211	Bins, wagons and other almond storage or transportation equipment were thoroughly cleaned at season's end or when not in regular use.	☐	☐	☐	☐	☐
212	Nuts stored outdoors were covered.	☐	☐	☐	☐	☐
213	Other: _____				☐	

	For this facility, the following methods were used to *prevent* pest problems:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	PEST EXCLUSION TACTICS					
214	At least twice annually, unnecessary openings, gaps or cracks were identified and sealed to exclude insects, rodents, birds, etc. Necessary openings were screened, curtained or had other exclusion devices, if possible.	☐	☐	☐	☐	☐
215	Floor cracks and/or expansion joints were sealed, as needed, and floors and equipment were frequently swept to prevent the accumulation of almond particles.	☐	☐	☐	☐	☐
216	Areas above and around stored almonds were designed and/or maintained to exclude birds and other pests.	☐	☐	☐	☐	☐
217	Exclusion materials (e.g., nets, needle strips, ledge barriers or gels), traps and/or scaring (hazing) devices (e.g., noisemakers, decoys or lasers) were used to prevent birds from roosting, nesting, fouling or causing other problems in or around the facility.	☐	☐	☐	☐	☐
218	To provide a clear zone for pest inspection around the facility's external perimeter, tall grass and other plants adjacent to the facility were removed.	☐	☐	☐	☐	☐
219	During the off-season (if applicable), the facility was not used to store items, or as a workshop involving items that could harbor pests (e.g., farm equipment).	☐	☐	☐	☐	☐
220	Equipment stored on the facility's grounds was maintained as pest-free, and unused or inoperative equipment was removed.	☐	☐	☐	☐	☐
221	Temperature manipulation or a modified atmosphere was used to control pest development in stored nuts.	☐	☐	☐	☐	☐
222	Hull and/or shell piles were on impervious surfaces to prevent insect reproduction in soil under piles.	☐	☐	☐	☐	☐
223	Other: _____				☐	

POSTHARVEST PEST MANAGEMENT (HULLERS/SHELLERS OR PROCESSORS) — MONITORING AND STRATEGY

	For this facility, the following methods were used to *decide if and when to control* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	MONITORING METHODS					
224	A schematic map was made of the locations of all traps and bait stations for insect and rodent pests.	☐	☐	☐	☐	☐
225	A log was kept of pest management activities, including inspections of each trap and bait station.	☐	☐	☐	☐	☐
226	The log included documentation of maintenance issues found when installing insect pheromone lures.	☐	☐	☐	☐	☐
227	The log was kept electronically (e.g., facilitated by use of a bar code scanner).	☐	☐	☐	☐	☐
228	A method of service verification (e.g., stickers, cards or bar codes) was used for traps and bait stations that required them being opened to record or scan information.	☐	☐	☐	☐	☐
229	Pheromone traps used to capture pests for timing necessary treatments were strategically placed (especially near stockpiles, hull piles, and almond storage and processing areas).	☐	☐	☐	☐	☐
230	Other: _____				☐	
	MONITORING FREQUENCY					
231	Traps and bait stations in external locations were checked at least monthly, and those in internal locations at least weekly (more often during periods of expected high pest pressure).	☐	☐	☐	☐	☐
232	At least monthly, the entire facility was inspected for signs of pests, maintenance needs for pest prevention or exclusion, general clutter and debris.	☐	☐	☐	☐	☐
233	At least quarterly, the pest management program was thoroughly audited to determine necessary revisions.	☐	☐	☐	☐	☐
234	Other: _____				☐	

POSTHARVEST PEST MANAGEMENT (HULLER/SHELLERS OR PROCESSORS) — EFFICACY AND SAFETY OF CONTROL

	For this facility, the following methods were used to *maximize efficacy and minimize risk when controlling* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	HULL/SHELL PILES					
235	As each hull or shell pile was developed, perforated pipe was laid on the surface to facilitate later fumigation, if needed.	☐	☐	☐	☐	☐
236	If hull or shell piles intended for animal use were treated, the products used were labeled for animal feedstock.	☐	☐	☐	☐	☐
237	If hull or shell piles were treated for insects, lower-risk insecticides (e.g., insect growth regulators) were used.	☐	☐	☐	☐	☐
238	Other: _____				☐	
	TRAPS AND BAIT STATIONS					
239	Light traps were installed at each door (preferably on two sides of large doors and the hinge side of personnel doors), and were emptied on a regular schedule.	☐	☐	☐	☐	☐
240	The placement of rodent traps included above-ground locations (e.g., beams and ledges) since some rodents rarely descend to ground level.	☐	☐	☐	☐	☐
241	Multiple-catch traps or glue boards were spaced 20–25 feet apart around the inside of exterior walls. (Note: Bait cannot be used inside facilities where it can contaminate almond products.)	☐	☐	☐	☐	☐
242	Rodent control devices, such as bait stations or multiple-catch traps, were spaced no more than 40 feet apart around the exterior of buildings.	☐	☐	☐	☐	☐
243	Rodent control devices, such as multiple-catch traps, were spaced no more than 100 feet apart around the property perimeter. (Note: As of June 2011, rodenticides are no longer permitted more than 50 feet from a building.)	☐	☐	☐	☐	☐
244	If impossible to install traps or bait stations in protected locations, they were secured inside locked and anchored stations.	☐	☐	☐	☐	☐
245	Potential allergens such as peanut butter were not used in baits and traps.	☐	☐	☐	☐	☐
246	Traps were cleaned and maintained to not attract secondary pests.	☐	☐	☐	☐	☐
247	Other: _____				☐	

	For this facility, the following methods were used to *maximize efficacy and minimize risk when controlling* pests:	Not familiar with this	I haven't tried it	I have tried it	My current practice	Not applicable
	PESTICIDE SAFETY AND EFFICACY					
248	If insecticides were applied, food-processing surfaces were covered or thoroughly cleaned to avoid residues.	☐	☐	☐	☐	☐
249	If insecticides were applied, lower-risk materials (e.g., insect growth regulators or pheromone disrupters) were used when possible.	☐	☐	☐	☐	☐
250	Fogging of any part of the facility was completed only if justified by pest monitoring, and nuts could not be exposed to fogging materials.	☐	☐	☐	☐	☐
251	Relevant international MRL (maximum residue level) information was available and consulted prior to selecting pesticides and application methods.	☐	☐	☐	☐	☐
252	Pesticides and pesticide application equipment were stored separately from oils or products used in food processing and away from food processing areas.	☐	☐	☐	☐	☐
253	Other: _____				☐	

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