

IPM THROUGHOUT THE SEASON

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The development of an integrated pest management (IPM) program should be the goal of all pest managers. IPM is accomplished through the integration of different types of control strategies, such as cultural, biological, and chemical controls, in order to manage pests in a manner that is effective and safe to humans and the environment. IPM programs encourage only the judicious use of pesticides by promoting the use of non-chemical approaches. IPM practitioners accomplish this through an understanding of the biology of pests and beneficial organisms, and by utilizing tools such as monitoring programs, degree-day models, and treatment thresholds. Adoptable IPM programs must also take into account budgetary constraints of crop production.

Previous chapters in this manual have outlined information on how to identify, monitor for, and manage pests of pistachios. Utilizing this information must be done individually on each block or ranch on a case-by-case basis. The following calendar is a month-by-month *example* of practices that can contribute to an IPM program throughout the year.

JANUARY

1. Evaluate mummies for the level of navel orangeworm infestation and parasitism rates. Initial surveys are conducted in October-November in order to advise the manager/grower as to any necessity for orchard sanitation for amelioration of a (NOW) problem. The surveys in January provide further delineation of infestation and parasitism as well as follow-up to any previous sanitation program. Navel orangeworm is a significant contributor to risk of aflatoxin contamination.

2. Weed surveys commence. A species-specific survey is conducted on a block-by-block basis. This survey serves as an informational conduit for a pre-emergent program the following fall. When cover crops are grown, this information is useful from an insect management perspective. Certain weeds, such as burclover, birdsfoot trefoil, lupine, London rocket, tarweed and Russian thistle, are more conducive to being inhabited by injurious insects. Identifying potential insect trouble spots now can save time later in the season when orchard tasks intensify and the time available for monitoring decreases. In addition to superior weed control, cost savings of 15-30% is possible using species-specific surveys.
3. Soft scale populations are evaluated if not completed in the fall. Treatments occur now through mid-February if necessary.

FEBRUARY

1. Tasks performed in January are continued.
2. Where cover crops are grown, assessment of *Hemipteran* populations and predators/parasites begins.
3. Buds and/or small twigs are evaluated for presence of *Botryosphaeria*.

MARCH

1. Monitoring starts for *Phytocoris*, stink bugs, *Lygus*, *Calocoris* and leaf-footed bugs. If a ground cover is present, it is monitored, as are the trees.
2. Initiate the disease control strategy to be pursued during bloom. Monitoring in the fall, harvest observations, and current weather patterns all play a role here. *Botrytis* and *Botryosphaeria* are the diseases of interest.

3. Egg and virgin female traps for NOW are placed in orchards to determine the Biofix from the first generation adults for use in phenological degree-day models.
4. Vertebrate control starts during this month.

APRIL

1. The insect monitoring noted in the first entry for March continues. *Lygus* and *Calocoris* control presents an interesting obstacle here. In those blocks with ground cover, one must separate the tree monitoring from the ground monitoring. If tree levels of *Phytocoris* are below economic threshold levels, the possibility of treating only the ground exists. Some predictive capacity for *Phytocoris* levels is employed here. You do not want to be caught in the position of treating the ground for *Lygus* and immediately coming back and treating the trees for *Phytocoris* when a single treatment for both would have been effective. This adds expense and uses an excessive amount of the annual maximum usage of permethrin. In those orchards with ground cover, one must be cognizant of rapid drying of the cover which may lead to the *Lygus/Calocoris* moving into the trees and causing substantial crop damage. The Pistachio Tree has considerable ability to “compensate” for early nut loss due to insects. This is a key component of deciding to treat early infestations of insects. *Phytocoris* is treated uncommonly, only when large amounts of damage and insects are present, because of the “compensation” factor.
2. Leaffooted bugs, stink bugs and obliquebanded leafroller are occasional pests at this time.

MAY

1. The danger of *Phytocoris* damage is rapidly waning at this time. Marginally economic levels are left untreated, because *Phytocoris* is an excellent predator of NOW eggs. They are left in the field to attack the NOW eggs unless crop loss from *Phytocoris* is becoming severe. Cluster number, density, nut health and orchard health are considerations under evaluation when

making recommendations in this regard. There is no hard and fast numerical formula that can be used in this decision-making process. There are too many factors involved, including "intangibles." The IPM practitioner must take all factors into account to arrive at a recommendation that is practical and cost-effective.

2. The danger of *Lygus/Calocoris* damage reaches a pinnacle during this month. As vegetation in the pistachio orchard or in surrounding areas dries, *Lygus/Calocoris* can move into the trees and create a large amount of damage in a short time. Previous monitoring and current evaluations serve to minimize surprises.
3. The vertebrate control program is now well under way. The choice of control measure depends on the time of year, availability of native food sources, and the type of vertebrate requiring control.
4. Evaluations for *Alternaria* and *Botryosphaeria* (if applicable) begin to occur. Fungicide applications are considered depending upon conditions.
5. If mealybugs were found during the preceding fall, begin monitoring for the emergence of crawlers to help time treatments in June.
6. Control measures for the secondary pests mentioned in April are employed if necessary. The calendar serves as a guideline for the possible timing of certain events. It is not used to define when events will occur, nor is it used to prescribe prophylactic treatments. Definition of what is occurring, including the need for treatment, is based only on field observation; treatments are prescribed on an as-needed basis.
7. Spider mites may become a significant pest at this time through the summer.
8. Young soft scales commence hatching at this time and if found in significant numbers it is noted for control later in the year.

JUNE

1. *Phytocoris* is treated as a beneficial at this time. In a typical year, the danger of *Lygus* is over by this time.

2. Monitoring continues for secondary insect pests.
3. Evaluation and attention to *Alternaria* and *Botryosphaeria* continue. In orchards where sufficient sanitation has occurred, in all but extreme conditions the first fungicides to control these diseases subsequent to the bloom period occurs during this time. Treatment is based on current weather, orchard observation, history, and disease models.
4. The summer weed survey is conducted. This information is used to formulate the spring preemergent program.
5. The citrus flat mite-monitoring program is initiated.
6. Egg and virgin female traps for the second flight of navel orangeworm are placed in orchards for population delineation and phenology.
7. Monitor for emergence of mealybug crawlers, and treat when the majority of the adult females have produced crawlers.

JULY

1. The disease control program continues and monitoring is conducted in earnest during this period. As humidities rise during this period into August, *Alternaria*, if present, becomes more evident, especially on heavily cropped trees.
2. Stink bugs and leaf-footed plant bugs can become more prevalent at this time and are addressed if economic.
3. Early splits are evaluated for presence of NOW and a sound Biofix is formulated from the egg and virgin female traps. The traps are removed in favor of direct observation of nuts for presence of NOW as soon as a Biofix is produced.
4. OBLR can be a significant pest during this period. If present at economic levels, treatments should be applied.

AUGUST

1. The priority at this time is monitoring for NOW. This is accomplished by using degree-day models to anticipate the third NOW flight and by checking for egg deposition and young larvae on early split nuts. In the case where treatments become

required, be sure to communicate with the grower to ensure that any insecticide treatments do not occur within the pre-harvest interval for that crop.

2. Pests such as beet armyworm & *Heliothis* can be significant players in the treatment decisions made during this time. The IPM practitioner must be thoroughly versed on the biology of all pests encountered.
3. If treatments for *Botryosphaeria* and/or *Alternaria* are necessary, the PHI's of available materials plays a significant role in the timing of treatments in order to minimize the number of trips through the field.
4. Verticillium wilt occurrence is surveyed and recommendations for tree removal are made.

SEPTEMBER

1. Monitoring for worm pests, large outbreaks of large bugs and diseases continues through harvest. The IPM practitioner needs to remain in constant communication with the crop manager. Harvest schedules may be altered where practical to accommodate avoidance of economic damage because of insect and/or disease flare-ups. *Botryosphaeria*, if present, is easily detected at this time as pycnidia on the nuts or through shoot blight. *Alternaria* and *Botryosphaeria* levels are accentuated by heavy crops.
2. Harvest reports are analyzed as soon as they are available. It is essential that a correlation be made between the field monitoring and the results at the processing plant. Changes in the field analysis protocol occur if the correlation is not sound. Adaption of field monitoring to current conditions or processing plant quality analysis must occur so the later harvested fields are handled, with respect to pest management, in a way that ensures maximum return to the grower.

OCTOBER

1. All grade sheets are analyzed. Correlation between the resulting grades and the field monitoring are made in order to prepare for next year's program.

2. Fields are monitored for disease levels to aid in formulating recommendations for the following year and the current years pruning program.
3. Each field is evaluated for the quantity of mummies remaining and the level of NOW. Sanitation program recommendations begin.
5. The fall weed survey commences. This is used for defining the spring pre-emergent program and making any recommendations concerning the overall vegetation management program for the following season.
6. Monitor for soft scales on 1-year wood. Parasite levels, if present, are also evaluated.
7. Monitor for white aggregations of mealybugs on the trunk and main scaffolds of the tree. Mark these locations for possible treatment the following June.

NOVEMBER - DECEMBER

1. Continued analysis of results versus field surveys is conducted. Areas of need for improvement are defined. Because of the pest dynamics in pistachios, if one does not constantly make these adjustments, maximizing economic returns is tenuous at best.

The following page has a 12-month calendar showing primary and secondary timing for the various components of integrated pest management for pistachios. Nutrition and cultural programs are an integral part of any economically viable IPM system.

CALENDAR OF OPERATIONS FOR PISTACHIO ORCHARD MANAGEMENT
Southern San Joaquin Valley

	January	February	March	April	May	June	July	August	September	October	November	December
IRRIGATION												
Water Applied		---	-----	-----	-----	-----	-----	-----	-----	-----	-----	--
Pump Testing	-----	-----	-----
Evaluate Pressurized Systems	-----	-----	-----	-----	-----
NUTRITION												
Nitrogen				---	-----	-----	-----	-----				
Foliar Analysis					-----				
Soil Analysis	-----	-----	-----	-----
Foliar Sprays		---	-----	-----		---	---	
Micronutrients		-----	-----	-----	-----	-----	
ORCHARD FLOOR MANAGEMENT												
Surveys	-----	-----				-----	-----		-----	-----	-----	
Pre-emergent Application	-----	-----	-----	-----
Post-emergent Application	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	-----
Mechanical Mowing			-----	-----	-----	-----	-----	-----				
Plant Cover Crop										-----	
Soil Amendments	-----	-----	-----	-----	-----
DISEASES												
Botrytis				-----								
Alternaria					-----	-----	-----				
Botryosphaeria	-----	-----	--	-----	-----	-----	-----	-----			-----
Phytophthora	-----	-----	-----	-----	-----

Main Activity Periods = -----

Secondary Activity Periods =

INSECTS, OTHER PESTS												
Beet armyworm/Heliothis					.....	.....	.....	.....	.....
Phytocoris				-----	.....						
leaffooted Plant Bug				...	.....	-----	-----	-----		
Lygus/Calocoris/Neurocolpus				----	-----	----						
Stink Bugs				...	.....	-----	-----	-----		
Citrus Flat Mite						----	-----	---				
Navel Orangeworm/Carob moth	-----						.....	-----	-----			-----
Gopher	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Ground Squirrel	-----	-----	-----	-----	-----	-----	.....	.....	.....	-----	-----	-----
Soft scale	-----	-----		.....	.....	.....				-----	.....
Spider mites				.....	-----	-----	-----	-----	.....	
Obliquebanded leafroller				.....	.....	-----	-----	.....	
VERTEBRATES		.....	.....	-----	-----	-----	-----	-----	.....	.....	.....
HARVEST									-	-----	-	
TREE CARE												
Flag/pull dead trees									-----	-----	-----	.....
Plant, Stake		...	-----	-----	.....	...						-----
Replant			-----	-----		.....				-----	-----
Sucker/Train (1st, 2nd, 3rd years)					-----	-----	-----	-----				
Prune (4th and later years)	-----	-----	--									-----
Sanitize	-----	-----								-----	-----	-----

Main Activity Periods = -----

Secondary Activity Periods =

IPM CALENDAR

	January	February	March	April	May	June	July	August	September	October	November	December
IRRIGATION		-----	-----	-----	-----	-----	-----	-----	-----	-----
NUTRITION												
Nitrogen				-----	-----	-----	-----					
Tissue tests				-----				
Soil tests							-----	-----		
Micronutrients		-----	-----	-----	-----	-----	
Soil amendments				-----	-----	-----	-----	
WEEDS												
Surveys	-----	-----				-----	-----		-----	-----	-----	
Pre-emergent		-----	-----	-----						-----	-----	
Post-emergent		-----	-----	-----	-----	-----	-----	-----		
DISEASES												
Verticillium				-----	-----	-----	-----			
Alternaria				-----	-----	-----	-----	-----
Botrysphearia		-----	-----	-----	-----	-----	-----	
Botrytis			-----	-----								
Phytophthora	-----	-----	-----	-----	-----
INSECTS												
Beet armyworm/Heliothis					-----	-----	-----		
Phytocoris				-----							
Leaffooted bug				-----	-----	-----	-----			
Lygus/Calocoris		-----	-----	-----						
Stinkbug			-----	-----	-----	-----				
Flat mite					-----	-----	-----			
Navel orangeworm/Carob moth	-----	-----	-----
Soft scale	-----	-----					-----	
Spider mites				-----	-----	-----	-----			
Obliquebanded leafroller				-----	-----				

VERTEBRATES		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
HARVEST									.....	.....
TREE CARE												
Prune	.....	.....	.....								.....	.....
Flag/pull dead trees								.....	.....	.....	.....	.....
Replant		.....	.....		.....					.....	.....
Sucker/train					.....	.....	.....	.....
Sanitize	.....	.....								.....	.....	.....

... Secondary Timing

----- Primary Timing