University of California Cooperative Extension Fresno County

Vine Lines

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Battling Heat Stress in the 2008 Legal Context

Howard Rosenberg

High temperatures and the rush of summer activity prompt many of us to think about problems that heat may bring. An early wave of hot weather and a few headline-making farm worker deaths already this year have intensified concerns about the most extreme hazards of heat to the human body. But heat can cause plenty of harm short of fatality, and not only in warm-weather seasons. It is a fact of life to deal with in vineyards and many other types of workplace across the nation.

With harvest work approaching full swing, California grape growers and workers are facing familiar heat-related challenges in a changed legal context. A permanent state regulation designed to reduce risks of heat illness in outdoor workplaces took effect in mid-summer 2006, adding to employers' responsibilities for safe operation. While people in agriculture have long coped with heat in various ways, the new rule obligates all covered employers to take a specific set of measures to help workers control heat stress and get timely care when showing signs of heat-related illness. Cal/OSHA has noticeably stepped up enforcement of its requirements this year.

So besides their employees' and own exposure to the old risks of heat build-up causing discomfort, illness, injury, operational disruption, and insurance premium bumps, vineyard employers are now subject to penalties for not meeting terms of the relatively new standard. Regardless of any legal mandates, most managers can and are behooved to help workers minimize the impacts of heat stress. Simply keeping the igloos full and reciting the familiar litany of advice to drink lots of water, beware of stress symptoms, and rest when necessary goes only so far.

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Managing Pacific Spider Mite Resistance in Vineyards

Mel Stavrinides and Nicholas Mills

The Pacific spider mite (PSM – *Tetranychus pacificus*) causes significant damage in California vineyards (Figure 1). These small, web-spinning arthropods usually live on the underside of grape leaves where their needle-like mouthparts are used to penetrate cells and feed on plant juices (Figures 2-3). In high populations, PSM severely damages grape leaves, reduces grape yield, and slows fruit maturity.

Grape growers spend 20 million dollars annually, treating approximately 250,000 acres with miticides for the control of mites. However, miticide applications against PSM are not always effective. For example, growers in Lodi, Sonoma and the south Salinas Valley experienced poor PSM control in treated vineyards between 2005 and 2007, suggesting that PSM populations could be developing miticide resistance.

Resistance occurs when a PSM population becomes insensitive to a miticide. Some individuals in every PSM population are naturally resistant, even before a miticide is used against them. When growers apply the same miticide or products with the same mode of action (Table 1) in their vineyard, the proportion of resistant mites increases because only the susceptible mites are killed.

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Heat Stress

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How Heat Hurts

Humans are capable of performing work under a wide range of conditions as long as their internal organs and biochemical reactions are doing well, which depends on their temperature being within a narrow range around 98.6 -degrees. When bodies get too cool or warm, natural processes that add or release heat kick in to restore the norm. Although "feeling hot" causes discomfort and distraction, the very process of cooling often gives rise to greater dangers.

Heat stress tends to be more of a problem when the weather is hot, but high ambient temperature is not its primary cause. While some of the heat that vineyard workers have to deal with comes from solar radiation and hot air in their midst, most of it is produced within their own bodies. The body's metabolism generates some heat even at rest, and when it speeds up to convert energy faster during physical work, its yield of heat as a by-product also increases. Roughly three to four times as much of this converted energy turns into heat as to motion.

Heat that accumulates in the body raises internal temperature, threatens normal functioning, and triggers dissipation mechanisms. Though internally generated heat can stress people in almost any environment, it is more difficult to release where the air is hot, humid, or still. Both retained heat and the body's attempts to shed it can eventually cause symptoms recognized as a "heat illness" that impairs physical or mental activity, reduces performance, increases risk of accidents, and endangers life. Heat stroke, the most serious such illness, is a medical emergency. Although less critical ailments -- heat exhaustion, heat syncope (fainting), heat cramps, and heat rash -- are not immediately life-threatening, they reduce well-being and performance and can progress to stroke if not treated. The **box below** describes common symptoms of and treatment guidelines for these illnesses.

Heat Illness Symptoms and First Aid

Heat rash
Acute skin inflammation and clogging of sweat ducts. Regarded as the least severe of heat illnesses. Though it usually causes only temporary discomfort, it can lead to a bacterial infection that shuts down the function of sweat glands.

Rx: Cleanse the affected area thoroughly and dry completely. A mild steroid cream, calamine or other soothing lotion may help relieve discomfort and infection.

Heat syncope
Loss of consciousness, generally sudden, due to lack of sufficient blood and oxygen to the brain. Greatest danger is secondary injury from a slip or fall. Most likely to affect people not yet acclimatized to work in hot environments. Heat stress can cause it by diverting blood to extremities or lower body at the expense of the brain.

Rx: Rest, ventilate, and drink plenty of water or electrolyte fluids.

Heat cramps
Painful, involuntary muscle contractions -- most commonly in calves, thighs, arms, and abdomen -- heavy sweating, and thirst. Often extremely uncomfortable and can be completely disabling. Typically occur during or after hard work and are induced by electrolyte deficiencies that result from extended periods of intense sweating.

Rx: Rest and drink plenty of water or electrolyte fluids.

Heat exhaustion
Symptoms include fatigue, headache, dizziness, muscle weakness, nausea, and chills, tingling of hands or feet, confusion, loss of coordination, fainting and collapse. Occurs during work and results from dehydration, lack of acclimatization, reduction of blood in circulation, strain on circulatory system, and reduced flow of blood to the brain.

Rx: Rest in the shade or a cool place. Drink plenty of water (preferred) or electrolyte fluids.

Heat stroke
The most extreme consequence of uncontrolled heat stress, a medical emergency that can develop suddenly from an untreated condition of heat exhaustion. Skin is hot and dry, body is typically hotter than 104 degrees and no longer able to cool itself, and mind is confused, delirious, or convulsive. Brain damage and death may result.

Rx: Immediately move to the coolest place available, loosen clothing, fan and douse or spray the body continuously with a cool liquid, begin to replenish body fluids by drinking, and summon or rush to aid. Get medical attention or/and transport to a medical facility as soon as possible.

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Heat Stress

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Even pre-illness effects of excess body heat and the loss of fluid through sweating may cause damage. Subtle discomfort, weakness, blurred vision, slowed reactions, diverted attention, lapses in concentration or judgment, reduced coordination, and irritability add to chances of workers doing things that not only hurt themselves but also translate into higher production costs. Heat stress is probably under-credited as a factor contributing to such incidents as falling off a ladder, cutting a finger, driving a tractor into a ditch, miscalibrating a chemical solution, and picking a fight.

How do these symptoms develop? When metabolism generates heat faster than needed, adjustments begin in the circulatory system. The heart pumps faster and blood vessels dilate (i.e., expand) to bring more blood to surface layers of skin, from which the heat it carries is conducted, convected, and radiated to the cooler environment. If a body cannot cool fast enough this way alone, or when the air is warmer than the skin, it resorts to sweating, its most efficient means for dissipating heat. Sweat glands draw water from the bloodstream, carrying heat, and send it through pores onto the skin surface, from which the heat transfers more easily to the surrounding air. The evaporation of sweat (turning it from liquid to gaseous state) consumes energy, so it also has a slight cooling effect on the air adjacent to skin surface. The higher the humidity, however, the slower the evaporation and the less it contributes to cooling.

Figure 1. Igloo containers allow for direct access to water and can be easily moved to new locations as the workday progresses.

These mechanisms are not without cost to other bodily functions. Increasing flow of blood to the body surface reduces the volume available to carry oxygen and nutrients to muscles, the brain, and other internal organs, which in turn impairs strength, diminishes alertness, and accelerates fatigue. Moreover, the loss of fluid from blood volume through sweating reduces the body's ability to cool itself and perform work later, and the related depletion of electrolytes carried out in sweat can touch off muscle cramps.

The longer that sweating goes on, the less blood volume there remains to circulate and the greater the risk of experiencing symptoms of heat illness. A 150-lb. man performing moderately active work in warm weather, for example, would lose about 3/4 quart of water, or 1% of his body weight, per hour. At that rate, if not replacing any of the lost fluid he would likely feel notable loss of energy and endurance after three hours, have serious fatigue and nausea after six, and lose consciousness after eight.

Keys to Prevention

Research in sports, exercise, military and industrial settings has yielded lessons about heat stress that are very applicable to agricultural workplaces. Not surprisingly, the single measure that these studies suggest as most important for reducing risks of heat stress is to steadily replenish the fluid that the body loses as sweat. Because thirst signals a water deficit only after it begins to affect performance, starting to drink based on knowledge and anticipation is safer than waiting to feel thirsty.

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Heat Stress

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Chugging to quench an intense thirst is no more timely than pouring water on a wilted plant.

The amount of water needed to replace loss through sweating is a function of workload, weather, and personal physical attributes. A U.S. Army guide recommends drinking one quart per hour when performing hard work and wearing protective gear in 90+ degree temperatures, about ¾ quart when doing moderate work in temperatures of 82-90 degrees. This reference also suggests resting for substantial portions of each hour in those conditions, so as to slow the metabolic generation of additional heat as the body releases its accumulated excess.

Few businesses can provide as much break time as the fully loaded soldier needs, but all can strive to help workers follow the advice to drink. At most vineyards and other agricultural workplaces, water is provided in an "igloo" container available to employees throughout the day. (Figure 1.) My observations from conversations with numerous managers and two field studies, however, are that production workers in strenuous activity tend to visit the igloo infrequently, when quite thirsty, and that they drink large quantities on each visit, all resulting in a low volume and poor rate of fluid replenishment over the course of the day.

When workers do not drink as much or often as they need, it is typically due to some combination of their undervaluing the replacement of lost body fluid and experiencing high "costs" to obtain the water that is provided. Costs or impediments to access the igloo include physical effort, supervisory or co-worker disdain, foregone earnings opportunity when on piece-rate pay, and the chance of ingesting microbes (wariness perhaps based on experience with non-bottled water in another country).

For managers as well as workers, putting too low a priority on fluid replacement may stem from limited knowledge of how the body generates and copes with internal heat. Many people feel thirst after their fluids are somewhat depleted but do not suspect the connection between inadequate hydration and other early, non-specific symptoms of heat illness. Without understanding the reasons behind exhortations to drink water frequently, workers are neither as equipped nor as motivated as they could be to do their part in combating heat stress, and supervisors are less apt to assist them with logistical support, information, and personal example.

Basics of the Heat Illness Prevention Standard

The regulation that now obligates employers to take certain heat illness prevention measures entered the California Code of Regulations on July 27, 2006, as section 3395 of Title 8, Chapter 4, Subchapter 7, Group 2, Article 10. The Heat Illness Prevention (HIP) standard applies to all outdoor workplaces in California, all the time. In brief, it requires employers of people who work outside to provide four things:

1. One quart of drinking water per person-hour for the entire work shift;
2. A shaded rest area and the opportunity to use it for 5 minutes or more;
3. Training on nine specific topics for all employees, and on an additional two for supervisors; and
4. Written documentation of procedures to be followed in complying with the regulation.

Definitions in the regulation text and interpretations in a Q&A document from Cal/OSHA elaborate on these requirements and instruct enforcement personnel. Regarding the water, unless a plumbed or other continuous supply is readily available to workers, the whole amount is to be provided in portable containers either at the beginning of the shift or in stages through a reliable system of replenishment that allows all employees to drink at least one quart per hour. Employers are considered out of compliance if at any time no drinking water is available, or if the replenishment practice is to wait until either the container is empty or employees request more water. Cal/OSHA sees a replenishment system as unreliable if employees feel pressured to reduce their water consumption in order to conserve for later in the day.

Shade, according to the regulation, is blockage of direct sunlight. It can be effected by buildings, canopies, awnings, "pop-up" (Figure 2) or other temporary structures, and even trees.

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Heat Stress

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One indicator of blockage adequacy is that "objects do not cast a shadow in the area of blocked sunlight," but a shaded area that is too hot to allow the body to cool does not pass muster. Access to the shade is to be permitted at all times to any employee "suffering from heat illness or believing a preventative recovery period is needed" (including before the onset of any symptoms).

The regulation spells out topics for the content of training. While it does not similarly specify training methods, Cal/OSHA says that evaluation of compliance will also depend on manner of presentation, and that enforcement personnel will quiz employees in assessing whether an employer has made a good faith effort to convey essential content.

The topics required in training for all employees are:

- Environmental and personal risk factors for heat illness
- Importance of frequent water consumption, especially when weather is hot and sweating is more than usual
- The importance of acclimatization
- Common signs and symptoms of different heat illnesses
- Importance of immediately reporting to employer, directly or through a supervisor, signs of heat illness in self or in co-workers
- Employer's procedures for responding to symptoms
- Employer's procedures for contacting and transporting to emergency medical care
- Employer's procedures for clearly directing emergency responders to the worksite
- Employer's other procedures for complying with this standard

Two more to cover with supervisory employees are:

- Procedures to follow in implementing the heat illness prevention plan
- Procedures to follow in responding to employee symptoms of possible heat illness

Finally, the documentation of compliance and response procedures is to be made available to employees and to enforcement personnel upon request. It may be kept as a stand-alone policy but probably is best integrated into the employer's overall written injury and illness prevention program.

The permanent standard and the temporary regulation that preceded it in 2005 have been enforced both through Cal/OSHA inspections, which are driven mostly by complaints and accident reports, and through area-industry sweeps by the state Economic and Enforcement Employment Coalition (EEEC). The most commonly cited violation is failure to train employees. Second most common is lack of a written compliance plan. Intensified enforcement since 2007 has targeted areas at times when they are forecast to have heat waves.

Meeting Challenges on the Ground

Like most laws, the HIP regulation applies to people in a broad range of circumstances. It is a rather blunt instrument, not tuned to differences between outdoor

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Figure 2. Mobile pop-up shade units allow workers to work or break in an area protected from direct sunlight.

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industries or across agricultural sectors, places, and time. While based on sound principles, the measures prescribed by section 3395 make a lot more sense in some outdoor work situations than others. Neither the vine pruner in December nor the trainer in April, for example -- to say nothing of the San Francisco hotel doorman or Tahoe ski-lift operator in January -- has the same needs to cool, to drink, and to know about heat stress as the grape harvester in August.

Nevertheless, the regulation exposes employers to legal risks that can only be controlled by attending to its terms. Achieving its fundamental purpose is another matter. Complying with rules of the state hardly assures success in contending with physiological processes. Even dutifully following HIP requirements where and when they are appropriate cannot eliminate the chances of workers being harmed by heat. Minimizing that kind of risk depends on managers, first-line supervisors, and workers themselves making good choices within the legal bounds.

Controlling heat stress is a team sport. Managers have various choices that affect workers' inclination to drink and rest as needed, and many now make them with eyes on both the purpose and letter of the law. I have seen and heard about creative adjustments in the provision of water, shade, and education that help workers to make and act on their own risk-reducing decisions. They often amount to improving access.

The distance that vineyard employees have to walk from where they are working to the water container varies with differences in field layout, proximity of equipment used in tasks being performed, and directions given by employers. During harvest the igloo is usually attached to a tractor or gondola only a few strides away, and in vine training and other row operations that involve no machines it may sit in a truck or at end of a row far from the action. A north coastal vineyard operator has modified the metal igloo cradle that normally attaches to a gondola during harvest so that it can be removed easily and placed to stand freely in the row and serve workers when the full gondola departs. So while workers await the next (empty) gondola, the igloo remains continuously available, and they take good advantage of it (Figure 1).

A central valley labor contractor in row-crops has reduced workers' cost of access to drinking water without any such bar bending or welding. He simply instructed each crew leader to frequently drive the igloo-carrying, toilet-toting pickup truck closer to the workers as they eased farther from the day's starting point, and he explained why. His basic idea has broad applicability, as there are often opportunities for supervisors to move the water closer to workers' current center of activity as they progress through a field. If managers explain that they want foremen to place and keep the water as close as possible, and why, workers will end up with less of a physical price to pay for going to it and probably less concern about supervisory scorn as well.

Growers and contractors have purchased assorted pop-up canopies, umbrellas, and camp awnings to provide portable shade. Some have fashioned awnings that attach to trucks or other equipment. The principal of a large labor contracting firm based in the southern desert region has literally raised shade to a new level by designing a one-axle trailer that integrates two large fold-up shade screens, a table, igloo frames, and a stack of plastic chairs. Most of his crews are outfitted with one of these portable structures, and on warm days workers spend all or most break time in the shade it creates. More important, some crew members spend much of their *work* time in the shade of a tarp stretched over the full width of the field packing machine at the center of their melon harvest.

Knowledge of some basic physiological principles is needed up and down the line to inform choices that protect against harm from heat while fitting with other business objectives. Since agricultural workers are just as inclined as anyone else to make reasonable decisions based on what they know, managers can effectively support workers' day-to-day control of risks by helping them understand the causes, consequences, and autonomic responses to heat stress. In **the accompanying box (Page. 10)** is a list of ten key points that I suggest trying to convey by whatever means possible. They can be delivered and discussed in orientations, tailgate meetings, and company handbooks.

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Heat Stress

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A two-sided, bilingual folding heat stress information card, the English side of which **is shown on page 10** (Bottom, English shown)**,** is designed for distribution to employees at meetings or in paycheck envelopes. Many other references and field training tools are available from grower organizations, Cal/OSHA, and UC-DANR.

Growing and Pruning Uncertainties

In wake of the highly publicized fatalities and reports of several more heat-related cases early this summer, Cal/OSHA has launched a wave of informational outreach and enforcement activity that focuses on the requirements listed in the heat illness prevention standard. It remains to be seen whether this campaign will allay more concerns than it raises about agency efforts' consistency with the regulation itself and about employers' exposure to penalties for purely technical violations.

The very notice from the Department of Industrial Relations (July 9) inviting farm labor contractors to a series of training programs specifically designed for them has caused some confusion. Though stating that participation is not a legal requirement and does not substitute for the annual 8-hours of continuing education needed to renew an FLC license, the notice is on the DIR Director's letterhead, it promises attendees a proof of completion, and it says that ag groups will strongly encourage growers to ask for this proof. So inferences by growers and FLCs alike that they are now faced with yet another mandate, though mistaken, should not be astonishing.

Each part of the rule leaves room and need for interpretation. Among questions of practical significance to which employers continue seeking answers are:

* What is the criterion for adequacy of access to the required drinking water? Must the water be within a certain range of distance or time?

* How close should the shaded area be? If provided by a quickly erected portable structure, must it be up before any employee wants to use it? How many people does it have to accommodate at a time? Are chairs or other furnishings required?

* Can the validity of an employee's assertion of belief that s/he needs a preventive recovery period ever be questioned?

* Must a copy of written procedures for complying with the regulation be on hand at every worksite?

* What if the required training falls on deaf or distracted ears?

To my reckoning, the most consequential element of the HIP standard is the training requirement. And it is also the element most open to options on how to comply, despite its specificity about topics to cover. By what methods is training to be provided? By whom? Where? When? To what depth? Using what materials? None of these has a universally right answer, of course, and each could be the subject of an entire article.

No matter how Cal/OSHA administers the new regulation, there is no substitute for exercising informed personal judgments at managerial, supervisory, and production crew levels of a vineyard operation. Managers do well for their businesses as well as their crews when they consider environmental conditions and physical demands of jobs in scheduling work, make access to the igloo as easy as possible, and patiently explain why frequent visits to it are a good idea.

The array of references and instructional aids for workplace education about heat stress physiology has expanded in recent years. Much can be gained by drawing from it to give workers and supervisors with substantial knowledge rather than a mechanical recitation of cautions, commands, and assorted mantras. Everybody in a grape production business is better off when all join in understanding and battling heat stress.

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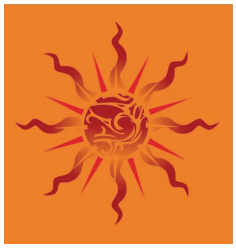

Spider Mite Resistance

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Eventually, resistant mites become widespread in the vineyard and the miticides loose their effectiveness.

To identify whether PSM populations in California vineyards have become resistant, we collected PSM from vineyards that reported miticide failures recently in the south Salinas Valley, Lodi and Sonoma. We tested the collected populations for resistance to Acramite (bifenazate), Nexter (pyridaben) and Omite (propargite) because these are among the most frequently used miticides in vineyards. To estimate the resistance of each PSM population we sprayed mites with different concentrations of each miticide and we estimated the concentration required to kill 50% of the mites (LC_{50}). We then compared the LC_{50} of each population to the LC_{50} of a susceptible laboratory mite population.

We found that PSM from the south Salinas Valley and Lodi showed around 10 times higher resistance to Nexter than the susceptible laboratory population. The Sonoma population showed 4-fold resistance to Nexter. Furthermore, we detected 7-fold resistance to Acramite in the Sonoma population and 3-fold resistance in the Lodi population. Lastly, we found 4-fold resistance to Omite in the Lodi population. These results suggest that resistance was likely one of the factors responsible for the reported miticide failures in these vineyards. For Acramite and Omite, the highest level of resistance had developed in the vineyard that had used the greatest number of applications of the respective miticides in the last five years. However, for Nexter we detected the highest level of resistance in the Lodi vineyard that has not experienced any Nexter applications in the last four years. This suggests that resistant PSM may be moving from neighboring vineyards. The movement of resistant PSM between neighboring fields has been documented before in almond and cotton fields.

Figure 2. Grape leaf infested with Pacific spider mites. In heavy infestations mites cover leaves with webbing and are found on both lower and upper sides of a leaf.

To delay the development of resistance among PSM populations in vineyards there are three simple steps to consider.

1) Reduce the risk of mite outbreaks by adopting the UC IPM guidelines (www.ipm.ucdavis.edu) on cultural and biological control of PSM. For example, minimize dust by driving slowly on dirt roads and only treat for mites in the absence of a high population of predatory mites.

2) Avoid the use of preventive miticide applications and when treatment is necessary, calibrate your spray equipment to make sure that you get 100% coverage of both upper and lower sides of the leaves.

3) Avoid using the same miticide or products with the same mode of action (Table 1) in the same year, or even better for a period of two years in your vineyard.

Figure 1. Vineyard in Madera with heavy Pacific spider mite infestation in 2007.

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Spider Mite Resistance

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Table 1. The major miticides registered for use in grapes in California in 2008 (California Department of Pesticide Regulation database), their mode of action, and the targeted life stage of Pacific spider mite.

Product Name[1]	Active ingredient	IRAC[2] mode of action	Targeted life stage
Agri-mek, Epi-mek, etc	Abamectin	6 (neurotoxin)	Juveniles/adults
Apollo	Clofentezine	10A (growth inhibitors)	Eggs/juveniles
Onager, Savey	Hexythiazox		
Zeal	Etoxazole	10B (growth inhibitor)	Eggs/juveniles
Vendex	Fenbutatin-oxide	12B (disruption of energy production)	Juveniles/adults
Omite	Propargite	12C (disruption of energy production)	Juveniles/adults
Akari, Fujimite	Fenpyroximate	21 (inhibition of mitochondrial respiration)	All stages
Nexter	Pyridaben		
Envidor	Spirodiclofen	23 (inhibition of lipid biosynthesis)	All stages
Acramite	Bifenazate	25 (neuronal inhibitor3)	All stages
Dicofol, Kelthane	Dicofol	Unknown	Juveniles/adults

[1]Read the label and consult with a licensed Pest Control Adviser for restrictions and specific recommendations on the use of these miticides. For example, Savey is only allowed on non-bearing vines.

[2]Insecticide Resistance Action Committee (www.irac-online.org). According to IRAC, alternation of miticides in different sub-groups (e.g. clofentezine and etoxazole) is generally a viable resistance management strategy.

[3]Recent research findings suggest that bifenazate possibly inhibits mitochondrial respiration, but acts in a different way than miticides in group 21.

Figure 3. Pacific spider mite female (lower right) with a juvenile and eggs on the underside of a grape leaf.

Resistance management for PSM in vineyards poses an ever changing problem for grape growers. The registration of new miticides provides growers with more treatment options, but the overuse of newer products will eventually lead to resistance development and loss of effectiveness. Effective management of PSM requires a combination of approaches, starting with cultural and biological control, and making use of miticide applications when required. Adopting the recommendations provided above can not only lead to more effective and sustained mite control, but also to reduced financial costs of mite management.

Mel Stavrinides is a Ph.D. candidate at the University of California, Berkeley. Nicholas Mills is a Professor of Entomology at UC Berkeley. Photos courtesy of M. Stavrinides.

Heat Stress

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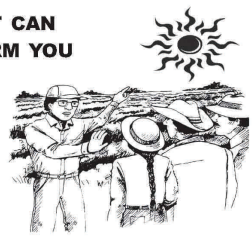
Key Points about Heat Stress

1. Functions of the human body depend on blood circulation and chemical reactions that best occur at about 98.6 degrees F. Your body has natural ways of gaining or losing heat to maintain that "normal" temperature.
2. The main source of heat that may stress you is your own body. In using its stored energy for physical work, about three-fourths of the energy turns into heat, only one-fourth into motion. An active body usually generates more heat than it needs and therefore has to release some.
3. The harder you work, the faster you generate heat, and the more your body has to get rid of. Hot weather, high humidity, and insulating clothes increase your risks of stress mainly by slowing the transfer of excess body heat to your surroundings.
4. When you produce heat that raises internal temperature, your heart rate quickens and vessels expand to bring more blood to the outer layers of skin, from which heat it carries can gradually flow to the environment.
5. If excess heat is not released fast enough this way, your sweat glands become more active. They draw water from the bloodstream to make sweat that carries heat through pores and onto your skin surface, where it evaporates and releases the heat.
6. When more blood flows toward your body surface for cooling, less is available to serve your muscles, brain, and other internal organs. And as prolonged sweating draws water out of the bloodstream, it further reduces capacity to deliver nutrients, clear out wastes, lubricate joints, and cool you later. You can expect to sweat out one quart of water or more during an hour of heavy work in hot weather, 3/4 quart during moderately strenuous work.
7. Continual loss of water makes you increasingly likely to experience symptoms of "heat illness" -- general discomfort, loss of coordination and stamina, weakness, poor concentration, irritability, muscle pain and cramping, fatigue, blurry vision, headache, dizziness, nausea, confusion, and unconsciousness. These and even milder effects of heat stress also increase your chance of accidental injury.
8. The single most important way to reduce heat stress risks while working is to steadily replenish the water you lose as sweat. Drinking small amounts frequently, such as 6-8 ounces every 15 minutes, is more effective than taking large amounts less often.
9. Relying on thirst as the signal to drink is dangerous. Most people do not feel thirsty until their fluid loss reaches 2% of body weight and is already affecting them.
10. If you notice heat illness symptoms, rest to stop generating heat, get fluids, and tell a supervisor as soon as possible. A person whose fluid loss is 8% of body weight is likely to have a core temperature above 104 degrees and serious risk of heat stroke -- a life-threatening emergency in which the brain is deprived of oxygen and the body can no longer cool itself. Please don't let yourself or a co-worker get to this condition. But if you do, call for medical help right away.

Heat can harm you



When working, your body produces heat that can make you uncomfortable and unsafe. You normally release heat, fastest by sweating, but sometimes not enough. Keeping extra heat inside and losing water as sweat are both dangerous.

- The harder you work, the faster you build body heat.
- Releasing heat is slower when the air is hot, humid, or still.
- "Heat stress" often affects people before] they notice it.

Reducing heat build-up

You can lessen heat stress by cutting the amount of heat you create yourself or absorb from the sun and other sources.

- Resting or working slower allows your body to release heat while not making much more.
- Taking breaks and working in the shade, if possible, keeps sun rays from making you even hotter.
- Blocking rays with a hat, clothing, or other cover also reduces the heat you absorb.

Produced by California agricultural associations and the UC Division of Agriculture and Natural Resources, with support from the USDA Western Center for Risk Management Education.

Sweating releases heat

You get rid of heat fast by sweating. Sweat uses water from the bloodstream, which not only helps cooling but also carries vital nutrients and oxygen through your body. Drinking is important to maintain a safe fluid level.

- You may need to drink one quart or more per hour to replace sweat lost when working hard on a hot day.
- Taking small amounts of fluid frequently is better than larger drinks less often.
- Bodies adjust to work in hot weather by sweating faster after a few days, so take it slowly while you "acclimatize."
- Drinks with alcohol and caffeine do not help control heat because they cause water loss without sweating.

Responding to symptoms

Early signs of too much heat or too little blood include loss of strength, stamina, and concentration. They may advance to cramps, nausea, headache, fainting, and even stroke -- a medical emergency.

- Symptoms get worse if their cause remains, and heat stroke puts life at risk.
- If you feel signs of "heat illness" or notice them in someone else, please help in cooling and notify your supervisor or get other assistance.
- Your good judgment and our company plan can keep heat stress from hurting everyone here.

Calendar of Events

Local Meetings and Events

Save the Date!
San Joaquin Valley Grape Symposium
January 7, 2009
C.P.D.E.S. Hall
172 W. Jefferson Avenue
Easton, California

U.C. Davis University Extension Meetings

(800) 752-0881

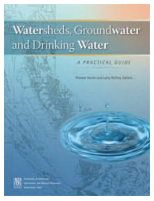
The Endangered Species Act: California's Water Supply
October 2, 2008
8:30 a.m.— 5:00 p.m.
Buehler Alumni and Visitors Center, Old Davis Rd,
UC Davis, CA
Instructor: Chris Beale
Section: 082NAT500

Taxation and Accounting for the Small Vineyard
October 23, 2008
9:00 a.m. — 4:00 p.m.
Da Vinci Building
1632 Da Vinci Ct.
Davis, CA
Instructor: L. Gregory Scott
Section: 082VIT205

Taxation and Accounting for the Small Winery
October 24, 2008
9:00 a.m. — 4:00 p.m.
Da Vinci Building
1632 Da Vinci Ct.
Davis, CA
Instructor: L. Gregory Scott
Section: 082VIT206

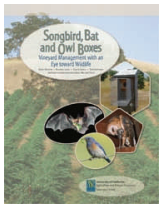
Establishing a Small Vineyard
October 25, 2008
9:00 a.m. — 4:00 p.m.
198 Young Hall, East Quad
Davis, CA
Instructor: Donna Hirschfelt and Rhonda J. Smith,
Section: 082VIT201

Publications from the University of California



Watersheds, Groundwater and Drinking Water: A Practical Guide
ANR Publication 3497
Price - $40.00 + tax and shipping

This handy guide is a "must-have" for environmental scientists, water technicians, educators, and students. Water shed and groundwater hydrology fundamentals are discussed.



Songbird, Bat, and Owl Nest Boxes
ANR Publication 21636
Price - $15.00 + tax and shipping

This guide explains the benefits of the biodiversity and aesthetics of songbirds, bats and owls. Methods on how to integrate nest boxes within a vineyard are discussed.

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Produced by U. C. Cooperative Extension Farm Advisor Stephen J. Vasquez. Contact me for further article information, or to be added to the mailing list.

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