

Preventing Heat Stress in Nursery/Landscape Workers

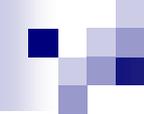
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Outline

- Basics of how heat stress affects the body
- Conditions caused by heat stress
- Controlling heat stress
- Practical issues for nursery/landscape
- How to prevent heat stress in workers



Heat stress (total net heat load on the body)

= heat from external sources (environmental)

plus (+) internally generated heat (metabolic)

minus (-) heat lost from the body to the environment

Physiology of heat stress

- During both rest and activity, the human body tries to maintain an internal temperature of 98.6 F.
- Hot weather, heat sources, and hard work raise the body's core temperature.
- Heated blood is pumped to the skin's surface where excess body heat is lost to the cooler outside environment.
- If more heat needs to be shed, the evaporation of sweat aids in cooling.
- During heavy work, a person can lose 1- 2 liters of water per hour.
- After 2-3 hrs a person may lose endurance, become uncomfortable, feel hot and become thirsty.

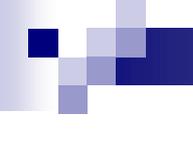
Physiology of heat stress (continued)

- The longer a body sweats, the less blood there is to shed excess heat or carry oxygen and nutrients to muscles.
- After 3 hours, a dehydrated worker may experience:
 - Headaches, muscle fatigue, loss of strength, loss of accuracy and dexterity, heat cramps, reduced alertness, nausea
- Water is key to cooling the body and counteracting heat stress.
- Without fluid replacement during an extended period of work, the body may be in serious danger.
- Untreated heat exhaustion may lead to heat stroke.

Heat stress effects if no fluid is replaced

<i>Dehydration</i>	<i>Cumulative Fluid Loss</i>	<i>% Body Wt.</i>	<i>Time to Reach*</i>	<i>Symptoms and Effects</i>
Minor Dehydration	1.5 lb. (.75 L)	1%	1 hr	Generally unperceived
Incipient Stress	3.0 lb. (1.5 L)	2%	2 hr	Begin thirsty, hot, minor discomfort .
Advanced Stress	4.0 lb. (2.25 L)	3%	3 hr	Loss of energy, muscle endurance.
Heat Cramping	6-9 lb. (3-4 L)	4-6%	4-5 hr	Impaired coordination, endurance. Less energy, strength. Fatigue, cramps.
Heat Exhaustion	9-12 lb. (4-5.5 L)	6-8%	6-7 hr	Headache, dizziness, nausea. Serious fatigue.
Heat Stroke	11+ lb. (5+ L)	7+%	7+ hr	High body temperature, confusion. Loss of consciousness.

* based on a 150 lb. male performing moderately active work in hot weather and not drinking to replace fluids



Summary

The physiological responses of the body to heat are:

- Increase in “core” body temperature
- Increase in heart rate
- Increase in blood flow to the skin
- Loss of water and salt (sweating)
- Heat illness that impairs cooling mechanisms

Environmental factors that affect body heat gain and loss

- Air Temperature
- Air Movement
- Humidity
- Radiant Heat
- Altitude



NWS Heat Index

Relative Humidity (%)

°F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	103	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Air Temperature

Heat Index
(Apparent
Temperature)

With Prolonged Exposure
and/or Physical Activity

Extreme Danger
Heat stroke or sunstroke highly likely
Danger
Sunstroke, muscle cramps, and/or heat exhaustion likely
Extreme Caution
Sunstroke, muscle cramps, and/or heat exhaustion possible
Caution
Fatigue possible

Average high temperatures in AZ + CA

(Average annual high temperatures for each month @ 40% humidity)

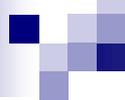
	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>
Phoenix	93	101	104	103	99	89
Tucson	91	99	99	98	95	86
Flagstaff	68	78	82	79	74	71
Yuma	94	102	106	105	102	91
Prescott	74	85	88	86	81	71
Bakersfield	84	92	98	96	90	80
El Centro	94	104	108	106	101	90

Personal factors affecting tolerance

- Activity level (metabolic heat)
- Fluid intake and electrolyte replenishment
- Alcohol and drug use

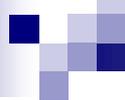


- Acclimatization
- Age
- Physical fitness
- Body fat
- Diet



Issues exacerbating heat stress in the nursery and landscape industries

- Unconditioned environment
- High temperatures and humidity
- Physically demanding work
- Misread as or combined with pesticide exposure
- “Costs” of access to water



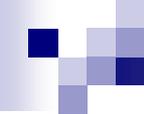
Causes of Serious Injury in AZ Nursery and Agriculture Industries 2001-02

- Caught or struck by equipment (32%)
- Machinery and vehicles operation (26%)
- Overexertion (21%) (including heat stress)
- Falls (11%)
- Other (25%)
 - electrical, chemical, livestock

Other Hazards of Heat Stress

Besides the medical hazards of illness or injury caused by heat stress, there is also a higher frequency of accidents in hot environments.

- Direct causes of accidents:
 - Sweat in the eyes
 - Slippery hands
 - Fogged glasses
 - Dizziness or fainting
- Indirect causes of accidents:
 - Physical discomfort
 - Slower mental and physical job reactions
 - Diverting attention from the job
 - Lapse in judgment
 - Irritability and anger



Heat and Pesticide Exposure

- Symptoms of organophosphate and carbamate pesticide exposure are similar to those of heat stress
- How much misdiagnosis ?

Symptom Comparison

Heat Stress

- Sweating
- Headache
- Fatigue
- Dry membranes
- Faster pulse
- Nausea
- Dilated pupils
- CNS effects
 - Coordination loss
 - Confusion
 - Fainting

Pesticide Exposure

- Sweating
- Headache
- Fatigue
- Most membranes ok
- Slower pulse
- Nausea and diarrhea
- Small or normal pupils
- CNS effects
 - Coordination loss
 - Confusion
 - Coma



Coping with the Hazards

- Planning, training, and supervision are key to preventing heat disorders
- Understand the effects of heat stress
- Know the symptoms and treatments
- Take personal precautions

Preventive Measures to Consider

- Consider current and predicted weather conditions, issue heat-alert if necessary
- Evaluate and modify work assignments
- Adjust rest period frequency and length
- Schedule heavier jobs for cooler hours
- Provide shade for stationary work
- Help workers become acclimatized
- Medical exam to identify need for accommodation
- Train / educate -- recognition, treatment, physiology
- Use cooling garments
- Find lighter weight protective gear
- Provide cool places for breaks
- **Improve fluid replenishment**

Providing shade for stationary tasks such as filling pots with media can help mitigate exposure to heat.



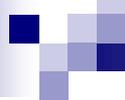
Fluid Replacement Guidelines

U.S. Military & NIOSH Research:

- 25 oz./hr. during moderate work at 82-90 F
- 33 oz./hr. during heavy work at >90 F
- Drink small amounts frequently (drip, not flood)
- Don't wait for thirst
- Rest every hour: "Rest means minimal physical activity such as sitting or standing. The following examples will vary depending on individual and circumstances)
 - Moderate work in moderate heat (85-89 F) work/rest 40/20 min
 - Moderate work in High heat (>90 F) work/rest 20/40 min
 - Hard work in moderate heat (85-89 F) work/rest 30/30 min
 - Hard work in high heat (>90 F) work/rest 10/50 min

Do current means of providing water effectively address risk of heat stress?





Drip vs. Flood Irrigation in Sport

- Personal hydration systems enable cyclists to hydrate on the move.
- Cyclists can keep going, save time, and maintain high speed.
- Exercise research shows increases in fluid consumption and performance using a hydration system vs. traditional container.

Employer testimonies:

- O'Reilly Auto Parts . . . Warehouse piece rate work environment. Field test initiated by the Risk Manager . . .

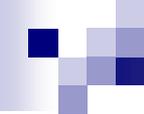
“The use of a CamelBak hydration system has increased our productivity by 20%.”

- Berry producer in Oxnard . . . Agricultural workers in the field. Field test initiated by the Safety manager.

“Every single person that used a CamelBak hydration system in our study -- 100% of them -- had an increase in productivity.”

Casual Observations: Water Availability versus Intake

- Igloo is state of the art for many field operations.
- Workers walk to reach water, distance varies.
- Costs to access water are not only physical.
- Infrequent visits to igloo are thirst-driven.
- Large quantities are then drunk at each visit.
- Less access taken while on piece-rate basis.
- Faster pace of work in the morning.
- Workers have little understanding of how heat affects the human body.
- Are workers chronically underhydrated and show subacute symptoms of heat stress?



OSHA General Duty

“...every employer covered under the Act furnish to his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees.”



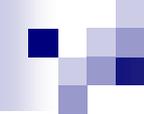
“Ideal Heat Stress Standard”

- Simple
- Inexpensive to implement
- No interference with production
- Easy to enforce

Recommended Training Objectives:

Enable Workers to

- understand how a body responds to heat, function of the body's cooling system, factors that affect body heat gain or loss, and effects of heat stress.
- know and effectively use prevention measures.
- describe causes and symptoms, and be able to give initial aid to others with minor heat stress disorders.
- describe the causes and symptoms, and be able to give or obtain first aid for others with major heat stress disorders.



Additional Resources

- *Heat Stress in Agriculture*, U.S. EPA
- <http://are.berkeley.edu/heat/>
- Cal/OSHA Advisory Committee
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