AgriLIFE EXTENSION
Texas A&M System

COPING WITH HOT WORK ENVIRONMENTS

David W. Smith – Extension Safety Program

Many Texas residents work under hot, humid conditions. Summer heat is a particular hazard to agricultural producers who must work long hours under the sun. Individuals working in a hot yard, garden, kitchen, or industry job or who are just trying to cope with summer weather are also exposed to these conditions.

Discomfort is not the only disadvantage of working in high temperatures and high humidity. Individuals who work long hours in the heat or who are suddenly exposed to working in a hot environment face additional, sometimes serious, and largely avoidable hazards to their safety and health. Responsibility for protecting those who work in hot environments from heat stress belongs to both individuals and employers.

How Your Body Handles Heat

Humans are warm-blooded, which means we maintain a fairly constant internal body temperature regardless of external conditions.

A human body, like a furnace, burns fuel (food) which manufactures heat. To safely limit internal temperatures, the body must shed excess heat. This is accomplished primarily through varying the rate and depth of blood circulation through the release of fluid through the skin and through sweat glands. Under moderate conditions, the brain automatically balances body heat by monitoring the warmth of the blood. When blood temperature exceeds 98.6 degrees F. the brain automatically takes measures to lower it. The heart pumps more blood; blood vessels expand to accommodate the increased flow; and blood begins to flow through bundles of microscopic blood vessels (capillaries) which thread through the upper layers of the skin. Blood circulates closer to the surface of the skin, and the excess heat is transferred to the cooler atmosphere.

Heat loss from increased skin blood circulation is usually enough to stabilize deep body temperature. However, if this is not adequate, the brain senses continued overheating and signals the sweat glands to shed large quantities of fluid in the form of perspiration. Sweat cools the body as it evaporates from the skin. By sweating and increasing skin blood flow, the skin disperses most of the body's heat.

However, as environmental temperatures approach normal skin temperature, cooling the body becomes increasingly difficult. If air temperatures are as warm as or warmer than the skin, blood brought to the body surface cannot shed its heat. Under these conditions, the heart continues to pump blood to the surface, but perspiring becomes the only effective means of maintaining a constant body temperature.

Giving off excess body heat also becomes more difficult when humidity is high. Sweating does not cool the body unless the moisture evaporates. High humidity slows evaporation. Because humid air contains a high percentage of moisture, it cannot easily absorb more. Wiping sweat from the skin with a cloth also prevents cooling from evaporation.

In high heat, hard work becomes harder: the heart pumps a torrent of blood through enlarged circulatory vessels; sweat glands pour liquids and essential dissolved chemical compounds such as salt onto the skin; and below the skin's surface, the production of metabolic heat continues. Since so much blood goes to the skin, less goes to the active muscles. As a result, strength declines, and fatigue comes sooner.

Working in a hot environment may also have psychological effects. Workers who must perform delicate or detailed work, or operate complex machinery may find their accuracy or performance suffering; and those who must think and process

information may find their comprehension and retention lowered.

Safety Problems

Certain safety problems are common in hot environments. These include slippery, sweaty hands, dizziness, and foggy glasses. Hot objects and surfaces also present the possibility of burns from accidental contact. Accidents are more frequent in the heat, because physical performance and mental alertness are lowered. Increased body temperature and physical discomfort promote irritability, anger, and other emotional states which could cause workers to act rash or careless, or distract them from hazardous tasks. A worker's psychological state will usually have a substantial effect on safe performance.

Health Problems

Excessive working exposure to a hot environment can bring about several physical disorders.

Heat stroke is the most serious of these. It occurs when the human heat-regulating system simply breaks down under stress, and sweating stops. There may be little warning to the victim. Just why this happens is unknown, but it robs the body of its most effective means of shedding excess heat.

A heat stroke victim's skin is hot, dry, and usually red or spotted. Body temperature is 105 degrees F. or higher and rising. The person is confused, irritable, and may complain of chills. If the person is not taken out of the hot environment at this early stage of heat stroke and cooled rapidly, more severe symptoms, such as unconsciousness, delirium, and convulsions, will occur and lead to death.

An ambulance should be summoned immediately, but first aid is also vital. Move the worker to a cool area and thoroughly soak his or her clothes with water. Fan the body vigorously to increase evaporation and cooling. Treatment at a medical facility will continue cooling and monitor for complications. Early recognition and treatment of heat stroke are the only means of preventing permanent brain damage or death. Physical fitness and heat acclimation will increase heat tolerance but will not give immunity against heat stroke. Persons suffering from chronic disease, obesity, or alcoholism are more susceptible. A person who has a history of heat illness is more prone to get it again.

Heat exhaustion includes several clinical disorders with similar symptoms. The condition is caused by either loss of fluid in sweating, loss of salt, or by both. A worker with heat exhaustion still sweats but experiences extreme weakness or fatigue, giddiness, nausea, or headache. In more serious cases, the victim may vomit or lose consciousness. The skin is clammy and moist; the complexion is pale or flushed; and the body temperature is normal or slightly higher. The unacclimated, the physically unfit, and the obese are more prone to heat exhaustion.

In most cases, treatment is simple. Have the victim rest in a cool place and give plenty of lightly salted liquids. Persons with mild cases of heat exhaustion may recover spontaneously with this treatment. Severe cases may require care for several days. There are no known permanent effects. **Caution — Persons with heart problems or on low sodium diets must consult a physician on what to do under these conditions.**

Heat cramps are painful spasms of the working muscles of persons who sweat profusely in heat and drink large quantities of water but fail to replace salt. Drinking water dilutes extra-cellular fluids while the body continues to lose salt. Soon, the low salt in the muscles causes painful cramps. Heat cramps can affect muscles in the arms, legs, or abdomen, but tired muscles used in working are usually most susceptible. Cramps can occur during or after work hours and may be relieved by drinking one glass of water containing ½ teaspoon salt. **Caution — Persons with heart problems or on low sodium diets must consult a physician on what to do under these circumstances.**

Fainting. A worker who is not used to hot environments and who stands erect and immobile in the heat may simply black out. Blood may pool in the enlarged blood vessels near the skin and in the lower part of the body rather than returning to the heart to be pumped to the brain, causing a blackout. Once lying down, the worker should soon recover. Avoid further fainting by having the victim move around to prevent blood from pooling.

Heat rash, also known as prickly heat, is likely to occur in hot, humid environments where sweat does not easily evaporate. When sweat is not removed, it may plug sweat ducts. Then, sweat glands may become inflamed, causing a rash. Extensive or infected prickly heat can be so uncomfortable as to reduce a worker's performance. Avoid this condition

by resting in a cool place at regular intervals and by showering periodically.

Momentary or transient heat fatigue refers to discomfort and metal strain from prolonged heat exposure. Workers unused to the heat are particularly susceptible and can suffer a decline in task performance, coordination, alertness, or vigilance, and can become irritable and depressed. Transient heat fatigue can be lessened by gradual adjustment to the hot environment.

Becoming Accustomed to Heat

Humans are, to a large extent, capable of adjusting to heat. Under normal circumstances this adjustment will take about a week, as the body undergoes a series of changes which make heat more endurable.

On the first day of work in a hot environment, body temperature, pulse rate, and general discomfort will increase. With each succeeding daily exposure, these gradually decrease. After the body adjusts, the worker should be able to work with less strain and reduced distress. **Heat disorders are more likely to occur among workers who have not been given time to adjust to working in the heat, or among workers who have been away from hot conditions and have gotten used to lower temperatures.** Summer hot spells or the first day back on the job after a leisurely vacation, extended illness, or injury are likely to catch the worker un-acclimated.

Do not ignore conditions which produce heat stress or try to tolerate its symptoms.

Preventing Heat Stress

Many individuals and employers take measures to decrease heat stress. Heat stress depends, in part, on the amount of heat a person's body produces while working. More heat is produced during hard, steady work than while doing light work. Heat stress on the job may be lowered with the following recommendations:

- Temporarily make the work easier.
- Decrease the speed at which the work is performed.
- Increase the frequency or duration of rest periods.

Reducing the length of exposure. Rather than expose themselves to long periods of work in the heat, individuals should plan work or be permitted to distribute the workload evenly over the course of the day and break long periods of work into shorter work-rest cycles. Short rest periods throughout the day allow the body to get rid of excess heat and slow the production of internal body heat.

Outdoor workers are especially subject to changes in heat and humidity. A hot spell or an unusual rise in humidity can create overly stressful conditions for a few hours or days. Several work practices are commonly recommended during such periods:

- Postpone nonessential work.
- Obtain workers from other jobs or extra helpers to assist those working in the heat. Use caution if workers not normally exposed to heat are suddenly working in it.
- Occasionally, younger or more physically fit workers might take over.

The rest area. Resting periodically in cool surroundings reduces the stress of working in a hot environment. **The rest area should be close to the workplace.** The farther away the rest area is, the more likely it is that it will be used infrequently or that work periods will be lengthened between proper rest breaks. Rest is most beneficial when breaks are short but frequent. As environmental heat increases, increase the frequency and length of rest periods.

Drinking water. In the course of a day's work in the heat, a worker may sweat away as much as 3 gallons of fluid in which vital substances are dissolved. **Because so many heat disorders are caused by dehydration and loss of salt, water intake during the workday must equal the amount of sweat**. Most workers drink less than they should, because thirst is satisfied before the body's water requirements are met. A worker should not depend on thirst to signal when and how much to drink. Instead, he or she should drink more than enough fluids to satisfy thirst every 15 to 20 minutes. Water should be cool (50 to 60 degrees F.), palatable, and conveniently close to the work area.

Unacclimated workers lose much more salt in their sweat than workers who are acclimated to the heat, but everyone loses some. The best way to replace this is to have a 0.1 percent salt solution available as drinking water. A level tablespoon of table salt dissolved in 15 quarts of water (1/4 tablespoon per

gallon) will make this solution. If salt tablets are used, they must be taken with ample water to prevent gastric irritation. Be extra careful during the first days of exposure to heat. Workers should liberally salt their food and do whatever they can to replace lost salt. **Caution — Persons with heart problems or those on a low sodium diet must not be given salt. Consult a physician on how to care for people with these conditions**.

An unacclimated person can sweat as much as 1 quart per hour. However, after a few hours sweating diminishes because of sweat gland fatigue. This occurs particularly in humid environments. The capacity for sweating varies greatly from one individual to another.

Protective clothing. Clothing inhibits the transfer of heat between a person and the surrounding environment. In hot jobs, where the air temperature is less than skin temperature, wearing clothing reduces the body's ability to lose heat.

But when air temperature is higher than skin temperature, clothing helps prevent the transfer of heat from the air to the body. On the hottest of summer days, for instance, conditions may be intolerable for a worker wearing only shorts and tolerable for a worker in shirt and trousers. The advantage of wearing clothing is lost if the clothes interfere with evaporation of sweat. Avoid tight, closely fitted garments made of loosely woven fabrics, because they permit air movement close to the skin. Loose garments made of thin cotton fabric are recommended. In dry climates, adequate evaporation of sweat is seldom a problem.

Changing workplace conditions. Automating work procedures can reduce a worker's body heat production only moderately, but it can often make it possible to isolate workers from a source of heat through distance, shielding of barriers, or perhaps by providing an air-conditioned booth for some jobs. Rather than increasing costs, these and other means of reducing heat in the workplace will most often boost overall production by increasing work efficiency while decreasing fatigue and time needed for rest periods.

A variety of engineering equipment or environmental changes may be tailored to a specific work area. General methods of reducing heat and humidity include:

- Shielding or insulating equipment heat sources from individuals.
- Placing exhaust fans near heat-producing equipment to carry hot or humid air away from workers.
- Opening windows and using fans or air blowers to provide maximum air flow around individuals.
- Providing opportunities when outdoors for individuals to work in well ventilated, shaded areas.
- Providing air-conditioned rooms, enclosures or vehicles as work areas.

Special Considerations during Prolonged Heat

During extremely hot weather lasting longer than three days, the occurrence of heat illnesses usually increases. This is caused by several factors, such as progressive loss of body fluid and salt, loss of appetite, build-up of heat in work and living areas, and breakdown of air conditioning equipment. **The most susceptible to heat illness are the obese, the chronically ill, and the elderly. Adhere to preventative measures rigorously during extended hot spells and avoid any unnecessary or unusual stressful activity.** Sufficient sleep and good nutrition are important for maintaining heat tolerance.

Perform the most stressful tasks during the cooler parts of the day (early morning or at night). **Extend rest periods to correspond with the heat increase.** When production must be maintained, hire additional temporary help rather than schedule lengthy work period or overtime shifts.

Consumption of alcoholic beverages can cause additional dehydration. Persons taking special medication should consult their physician to determine if it could cause and side effects during excessive heat exposure. For example, certain medications for blood pressure control and diuretics, or water pills, may also cause dehydration. Weigh yourself before beginning work and at the end of the workday to determine weight loss from progressive dehydration. Daily fluid intake must be enough to prevent significant weight loss during the workday and over the work week.