Health and Safety Hazards Associated With Farming

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Agriculture is ranked, along with mining and construction, among the three most hazardous industries (U.S. Department of Labor, 1989). Advancements in mechanization of the farm has increased many hazards (Popendorf, 1991). Farm hazards claim as many as 1,300 lives and cause 120,000 injuries annually (National Safety Council, 1989). An estimated 23,000 injuries and 300 fatalities on farms involve children in the United States annually (Rivara, 1985).

Data from the U.S. Bureau of Labor Statistics on injuries and fatalities in agriculture may be underestimated because work sites with fewer than 10 workers are excluded (U.S. Department of Labor, 1989). In addition, workers' compensation data do not reflect the many farm workers who are not covered by workers' compensation.

Farm work includes a wide variety of tasks performed by families on small, family owned farms and by farmworkers employed as full time, seasonal, and/or migrant workers on both family and corporate farms. For many, farming is an inherited lifestyle that involves children, spouses, and parents working together. People choose to farm for many reasons including the lifestyle, creativity, diversity, independence, and the opportunity to work outdoors close to nature (Coughenour, 1986; Kramer, 1987).

Despite these attractions, there are many hazards for farmers, farmworkers, and farm families. Frequently, work and home environments overlap, exposing adults and children to these occupationally related hazards during working and non-working hours. Agricultural workers are not afforded the same protection under Occupational Safety and Health Administration (OSHA) regulations or child labor laws as workers in other industries (U.S. Department of Labor, 1989).

Because of the unique features in agriculture, creative assessment techniques and prevention strategies are needed to reduce farm related injuries and illnesses. Occupational health nurses are in a strategic position to help identify farm related illnesses and provide expertise in prevention of injuries and illnesses for workers in their companies who are also part time farmers. Farmers are independent, creative owner/operators who may choose to initiate or bypass safe work practices and engineering controls, such as machine guards, for perceived expediency.

This article is an overview of some of the many hazards and methods of hazard prevention associated with farming.

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NOISE

An estimated 10% of full time farmers in the United States are exposed to average daily noise levels in excess of the 85 dB(A) "action" level at which hearing conservation programs are man-

Photo: Mary M. Langenfeld.

Farming tractor being used to cut weeds in alfalfa field.

dated for U.S. industrial workers (EPA, 1981). Hazardous sound levels occur during many routine farm activities.

Tractor noise can exceed 100 dB(A), particularly on older models that are in poor repair or lack sound insulated cabs (Plakke, 1990). High sound levels also have been measured from other common farm equipment—including combines, grain grinders, ventilation fans, and shop tools (McMahon, 1988). Even livestock (i.e., hogs) can produce sounds of sufficient intensity to warrant concern (Kristensen, 1988).

A number of studies have documented a high prevalence of hearing loss among agricultural workers. Recent reports indicate that the prevalence of hearing loss among farmers is nearly twice or more than that among age matched, non-noise exposed controls (Marvel, 1991; Thelin, 1983).

Even more alarming is the early age at which such hearing losses can begin. Broste (1989) found evidence of early, noise induced hearing losses among high school vocational agriculture students; and Gregg (1972) reported that 15% to 20% of freshmen entering a predominantly rural university have impaired hearing. Karlovich (1988) estimated that one fourth of the male farming population incurs a significant hearing handicap by age 30, and half by age 50.

The OSHA Noise Standard and Hearing Conservation Amendment (OSHA, 1983) currently excludes agriculture. As a result, intervention programs to educate agricultural workers about the risks of noise exposure have been sparse. Farmers, therefore, lack information on noise hazards, warning signs of hearing impairment, and appropriate preventive measures.

Studies indicate that only 10% to 42% of farmers report using hearing protectors around farm noise; of those who do, the majority use them only 20% or less of the time (Broste, 1989; Karlovich, 1988; Lankford, 1991; Marvel, 1991). Pilot hearing conservation programs in agricultural communities have resulted in significant increases in farmers' use of protective devices, indicating that farmers are willing to implement preventive measures when educated and motivated to do so (Lankford, 1991; Marvel, 1991).

MACHINERY

The four leading causes of unintentional work related deaths for U.S. farmers are agricultural machinery, motor vehicles, falling objects, and electricity (NIOSH, 1992). Agricultural machinery is also a leading cause of non-fatal injury, accounting for approximately 18% of all work related injury in farming (Hoskins, 1988a).

The farm tractor is the most common machine used by farmers and is the greatest hazard. Of the 2,216 work related deaths associated with agricultural machines between 1980 and 1985, 69% were caused by tractors (Etherton, 1991). The single most common event associated with tractors was rollovers, followed by tractor run overs.

Other agricultural machines present additional hazards, including entanglement of victims in rotating shafts, v-belts, or chains (Hoskins, 1988b). Entanglements in drivelines (e.g., power take-off shafts, secondary power drive shafts) account for approximately 18 deaths annually and, even when not fatal, can cause serious,

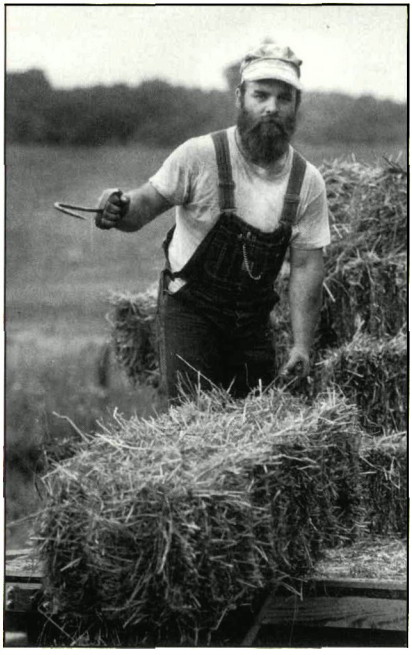

Photo: Mary M. Langenfeld.

Farmer using bale hooks to move hay bales from baler to wagon.

permanent injuries (CDC, 1992).

Motor vehicles present an often overlooked occupational hazard, accounting for an average of 115 agriculture work related deaths annually (NIOSH, 1992). Fatalities related to motor vehicles include not only automobile and truck crashes, but farm tractors and other farm implements involved in crashes on public roadways. One study found that as many as 10% of all tractor related deaths in agriculture occur on public roadways (Jenkins, 1992).

OTHER INJURY HAZARDS

Electrocutions account for approximately 7% of all agricultural work related deaths (Myers, 1989). Electrical hazards are found in many places in the farming environment, including internal wiring of farm structures, buried electrical cables, and overhead powerlines.

Overhead powerlines are especially dangerous because they are present not only near farm buildings, but also in the fields. Contact between machinery or other metal objects, such as irrigation pipes, and overhead powerlines accounts for approximately 15 work related deaths annually (NIOSH, 1986, 1992). Other examples of electrical hazards include faulty wiring, improperly grounded electrical circuits, damaged electrical outlets, and damaged electrical cords on equipment.

Deaths due to being struck by falling objects primarily involve falling trees, bales, farm equipment during maintenance activities, or other heavy objects. Other physical hazards include animals, pressurized hydraulic fluids, stored grains, and hand and power tools (Hoskins, 1988b).

Farming also involves tasks that put the worker at risk for exposure to temperature extremes (Brown, 1991), sprains/strains of the back and other body parts, and degenerative knee disease (Anderson, 1989; Dupuis, 1989). Exposures are related to repetitive squatting, vibration (Marchant, 1989), prolonged sitting, and handling material from awkward positions.

CHEMICAL HAZARDS

Persons engaged in farming are exposed to a variety of chemicals that may endanger health. These substances include pesticides, chemical fertilizers, diesel fumes, metal fumes, solvents, sanitizing solutions, and well water contaminants such as nitrates. Pesticides include insecticides, herbicides, fungicides, and rodenticides. Chemicals used in farming can have a variety of effects on workers and their families, including neurobehavioral changes (Shaver, 1991).

Acute pesticide poisoning is one of the most common chemical related health problems among agricultural workers. However, pesticide poisoning is often unrecognized, as early symptoms may mimic influenza or gastroenteritis. Direct exposure to concentrated forms of pesticides occurs during mixing, loading, or applying the product. Workers also may be exposed to residues or indirect spray during cultivation and harvest. The primary routes of exposure are dermal absorption (direct contact or via contaminated clothing), inhalation, and ingestion (eating food or smoking cigarettes with unwashed hands).

Irritant or allergic contact dermatitis is another acute effect of pesticide exposure. It is often difficult to distinguish pesticide related skin problems from allergies to plants, another common cause of allergic contact dermatitis (Moses, 1989). A careful work history may help to identify the source of the problem.

Some suspected chronic health effects are associated with pesticide exposure. Persons with a history of acute organophosphate poisoning may experience long term deficits in performance on

certain neuropsychological tests of intellectual functioning, academic skills, and simple motor skills (Savage, 1988). Certain hematologic cancers, such as leukemia, multiple myeloma, and non-Hodgkin's lymphoma, have been studied for association with agricultural chemical exposure (Blair, 1991; Pearce, 1990).

Many resources are available to the practitioner for identification of chemical hazards, treatment of suspected pesticide poisonings, and for health education materials. These include material safety data sheets and labels on pesticide containers. Local poison control centers have information on recognition and treatment of suspected pesticide poisonings.

Pesticide poisoning is a serious, preventable illness resulting in loss of work time and possible long term adverse effects. Exposures can be greatly reduced by proper storage and use of the product and disposal of empty containers according to product labels. Protective clothing, barrier creams, and facilities for handwashing are important hygienic measures for reducing exposure. Recommended procedures for washing contaminated clothing to avoid exposing family members, including those who do the laundry, are available through local and state cooperative extension services.

Exposures to agricultural chemicals, such as anhydrous ammonia, pesticides, and sanitizing solutions that contain chlorine, can cause toxic inhalation injuries. In addition, inhalation of anhydrous ammonia can cause severe burns to the upper respiratory tract (Popendorf, 1991). There have been increased reports of asthma with use of carbamate insecticides (Senthilselvan, 1992).

Some chemicals have toxicities that are organ specific. Paraquat is an example of a herbicide that is specifically toxic to the lung. Other farm hazards include solvents, fumes from welding, gases from silage, and chemical elements such as nitrates in wells. The main sources of nitrates are livestock and human excrement and chemical fertilizers. Nitrate ingestion has been associated with methemoglobinemia, and is a particular hazard for infants who drink well water contaminated with nitrates. Stomach and esophageal cancer in adults may be associated with ingestion of nitrate contaminated water (Johnson, 1990). Local health departments or cooperative extension services can be consulted for information about water testing.

RESPIRATORY HAZARDS

Potential respiratory hazards in agriculture include dusts, gases, and, as previously discussed, chemicals. Respiratory hazards related to dusts may include both inorganic and organic dusts. However, organic dusts contain biologically active particles that, when inhaled, can cause a variety of allergic, inflammatory, and/or toxic responses.

Organic dusts are a mixture of plant and animal fibers; insects and insect parts; bacteria and fungi, including their spores and products; feed additives; avian and rodent proteins; and toxic chemicals and residues (Mutel, 1986). Respiratory responses to organic dusts depend on factors such as the intensity and duration of exposure, characteristics of the dust (composition, toxicity, particle size and shape, irritative properties), deposition along the respiratory tract (respirable fraction), and the individual's susceptibility (Merchant, 1987).

Exposure to organic dust can occur during farming activities such as silo uncapping and other processes that aerosolize dust particles. Resulting respiratory conditions can include chronic bronchitis, occupational asthma, allergic rhinitis, organic dust toxic syndrome (ODTS, commonly known as "silo unloader's syndrome"), and hypersensitivity pneumonitis (HP, commonly known as "farmer's lung"). These latter two conditions involve both respiratory and systemic responses, including fever, chills, fatigue, weakness, or cough. The prevalence of HP and ODTS in farmers is unknown (Merchant, 1987).

Other potentially harmful respiratory hazards include exposure to noxious fumes and gases. Sources of exposure to gases and fumes include manure pits, which may contain ammonia, hydrogen sulfide, methane, carbon dioxide, and carbon monoxide; silos which, when newly filled, may form oxides of nitrogen; running farm machinery, which may produce diesel fumes; and machine repair work, which can involve welding fumes.

Some of these exposures may result in pulmonary edema, irritation, respiratory arrest, and death. Gases such as methane, hydrogen sulfide, and carbon monoxide also may displace oxygen, especially in a confined or semi-confined space (Popendorf, 1991). Certain farm structures, such as air tight silos, manure pits, grain bins, and confinement housing may contribute to creating oxygen depleted environments. Asphyxiation may result when persons enter these environments. In addition, suffocation may occur in certain farm structures when farming processes create vacuums, such as during unloading of grain bins.

ZOONOTIC, PARASITIC, AND OTHER COMMUNICABLE DISEASE HAZARDS

Exposure to domestic and wild animals, insects, soil, and contaminated water supplies places workers at risk for about 40 significant zoonotic, parasitic, and other infections (Klingman, 1991; Sienko, 1988). Zoonotic diseases are infections primarily transmitted from animals to

humans (Last, 1980). Antibiotics used to treat infections in animals can lead to the development of allergies and antibiotic resistant infections in workers (Popendorf, 1991).

Zoonotic infections may be confused with non-specific viral infections (Sienko, 1988). A few zoonotic diseases (i.e., rabies) are life threatening. However, most zoonotic infections are self limiting and manifest non-specific symptoms. If health care providers are to identify zoonotic disease, they must be aware of the potential for a problem. Diagnosis is facilitated by collecting information on the type of animal exposures, the health and immunization status of the animals, the occurrence of similar cases in coworkers and family members, and any exposure to insect bites to animals or humans (Klingman, 1991; Rubin, personal communication, 1992). Reports of unusual animal behavior and aborted animal fetuses can suggest possible exposure to sick animals.

Preventive measures include personal hygiene, maintaining a clean environment for animals, and using personal protective equipment and insect repellents. Area veterinarians and cooperative extension agents are excellent resources; they are aware of diseases endemic to the area and may have recommendations for control measures.

PSYCHOSOCIAL FACTORS

Many psychosocial factors affect the health and safety of farmers, farm workers, and farm families. These factors include stress, economic conditions, language barriers, long working hours, care of young children while working, working alone, and lack of access to health care. While little research has been done on specific psychosocial factors, these factors need to be acknowledged and resources sought for addressing them.

In one study almost 50% of farmers reported experiencing serious occupational stress (Merchant, 1988; Thu, 1990). In another study, 60% of farmers reported experiencing stress during the growing season due to machinery breakdown, price uncertainties, machinery costs, interest rates, planting, and weather (Tevis, 1982). Economic failure can result in the loss of a lifestyle as well as property that has been held for generations.

Daymond (1987) reported farm owner/operators to be at increased risk for suicide. In that study, the annual suicide rate for farm owners was 58/100,000 compared to a rate of 31/100,000 for all white males; rates among hired workers and farm women were 3 to 5/100,000 and 1 to 2/100,000, respectively.

Many migrant farmworkers lack the security of regular employment, educational resources for their children, knowledge of the English language, and acceptable living and working conditions. Language limitations can be a barrier to understanding safety instructions (i.e., pesticide labels), acquisition of health care, and job mobility.

Limitations in job mobility have the potential to limit workers' access to safer/more healthful working conditions. The lack of adequate sanitation, including safe drinking water, increases the risk for pesticide exposure and infections (Klingman, 1991; Meister; 1991).

Long working hours demanded by farming, especially during certain seasons, may increase the risk of injury and illness related to fatigue and may increase risk taking behaviors to complete tasks in minimal available time (Leier, 1989). The working hours demanded by farming are often complicated by off-farm jobs (Cordes, 1991; Oliveira, 1990).

Children begin working at a young age on farms and may operate machinery and work around large animals (Aherin, 1991; Meister, 1991; Tevis, 1989). Older children are sometimes responsible for farm work while adults are away at off-farm jobs. It is commonly recognized that parents farm while caring for children of all ages, exposing children to potentially life threatening/permanently disabling hazards.

Family farming is frequently a small business. Farm owners and workers often work alone (Cordes, 1991). Working alone means the worker must handle alone tasks that ordinarily would require assistance, increasing the risk for injury. Furthermore, an injured farmer working alone may have difficulty summoning assistance.

Living in a rural environment may affect one's access to health care. Access to publicly funded clinics for this frequently uninsured population is limited. Lack of health care providers who are knowledgeable about agricultural occupational health may affect accurate diagnoses and treatment of work related illnesses and injury (Meister, 1991). Limited mobile emergency medical services can increase the seriousness of farm injuries not treated promptly (Cordes, 1991).

DISCUSSION

Those who farm need to understand the preferred and effective means of reducing hazards in agriculture. Whenever feasible, engineering controls are preferred to reduce hazards, followed by work practice modifications and proper use of personal protective equipment.

For example, many—perhaps most—tractor related fatalities could be prevented by using roll over protection and prohibiting passengers from riding the tractor (Lehtola, 1992; Thelin, 1990). Practicing basic hygiene and having safe water supplies are also highly important to prevent illness in those who farm.

TABLE

Agricultural Health and Safety Resources

Agency	*Description of Resources*
American Farm Bureau Federation (312) 399-5700	Catalog of educational materials
Cooperative Extension Service (local and state offices listed in phone directory)	Consultation, speakers, and written materials
Farm Safety 4 Just Kids (515) 758-2827	Materials for and about children
National Institute for Occupational Safety and Health (800) 356-4674	Computerized literature searches including NIOSTIC, a listing of all references used in NIOSH papers
NIOSH Publications Center (513) 533-8287	Agricultural bibliography of NIOSH publications
National Pesticide Hotline (800) 858-7378	Technical, chemical, regulatory, and health information
National Safety Council (800) 621-7619	Packet for Farm Safety Week, 12 month calendar of suggested seasonal topics, and other publications
OSHA Consultation Services (contact regional office for agricultural outreach coordinator)	Consultation and resources
Rural Information Center (800) 633-7701	*Agricultural Safety & Health: A Resource Guide* (Zimmerman, 1992)
U.S. Environmental Protection Agency (513) 569-7562	*Recognition and Management of Pesticide Poisonings*, 4th Ed. (Morgan, 1989)

Studies suggest that many agricultural workers who are provided with information about specific occupational health hazards change their behavior to reduce their exposures (Gjerde, 1991; Lankford, 1991; Marvel, 1991).

Occupational health nurses who care for part time farmers need to expand their own knowledge of agricultural health and safety hazards, illnesses, and injuries. While this article highlights some of the problems of greatest concern, it is not a complete compendium on agricultural safety and health problems.

The National Institute for Occupational Safety and Health (NIOSH) is engaged in a 5 year Agricultural Initiative to expand knowledge of agricultural safety and health problems and prevention strategies. Information should expand significantly in the near future. Readers may consult the references and additional resources identified in the Table.

Occupational health nurses can apply their expertise in surveillance to those workers who also farm part time. Occupational health nurses have experience in identification of hazards, development of control strategies, early detection of problems through screening, and worker education that is applicable to agriculture.

When teaching hearing conservation, prevention of skin cancer and other dermal conditions, respiratory protection, and safe use of hazardous chemicals, occupational health nurses can advise workers about ways to apply the information to farming activities. Agricultural occupational health can be promoted through company newsletters, literature racks, and displays. Examples of other activities include providing workers and their families with tetanus inoculations and poison information phone stickers.

Nurses can offer their expertise to local groups such as 4-H, Future Farmers of America, Farm Bureau, Cooperative Extension Service, and agricultural classes. Occupational health nurses can be instrumental in educating health care professionals, including veterinarians, physicians, and school and public health nurses about agricultural occupational health and safety. Furthermore, occupational health nurses can assist these health care professionals in identifying how they can work together to prevent farm related injuries and illnesses.

SUMMARY

Farming is a hazardous occupation with a unique combination of exposures and psychoso-

cial factors that often vary with the type of operation. Some hazards are unique to farming; others are common in industry. Many who farm also work at other jobs. Even for non-agricultural companies, farm related illnesses and injuries can be costly in terms of lost work time, medical insurance, and life insurance.

According to a former U.S Surgeon General, "Because of agriculture's diversity and geographic distribution, we must depend on local action to deal practically with the problem" (Novello,1991). Occupational health nurses in both agricultural and non-agricultural industries can play an important role in local action to protect their workers, neighbors, friends, and families.

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IN SUMMARY

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1. Farming is a dangerous occupation with many potential physical, chemical, and biological hazards. Hazards include noise, machinery, motor vehicles, electricity, temperature extremes, pressurized hydraulic fluids, grain storage facilities, hand and power tools, repetitive motion, vibration, chemicals, dusts, gases, and infectious agents.

2. Psychosocial factors related to agriculture include stress, economic considerations, poor access to health care, and injuries to minors who begin working at a young age.

3. Many who farm also work at other jobs. Farm related illnesses and injuries can be costly to non-farm employers in terms of lost work time, medical insurance, and life insurance.

4. Occupational health nurses can promote agricultural occupational health through companies that employ farmers and through community organizations, thereby contributing to a better understanding of farm related hazards and developing strategies for reducing these hazards.

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