ANALYSIS OF BEDDING AND RAFTER DUST FROM NORTH CAROLINA CHICKEN COOPS

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Respiratory problems documented among poultry farmers include airway irritation, cough, chest tightness and phlegm. In the present study, bedding and rafter dust from 16 different chicken coops were examined. The bedding ranged in age from 2 weeks to 3 years old. Each bedding and dust was examined for bacteria (total, gram negative and thermophilic), fungi, endotoxin, histamine and ammonia. The presence of chicken sera, sera albumin, IgG and egg albumin were also documented. The rafter dust was aerosolized, the respirable fraction collected and evaluated for endotoxin, histamine, and ammonia. Only ammonia correlated with the age of the bedding (up to 1.5 years old r-0.9488). The 2-week-old bedding contained an unusually high amount of endotoxin (13570 EU/mg). In the other beddings, rafter and respirable dusts endotoxin levels ranged from 15.2 to 814 EU/mg, 50.9 to 865.2 EU/mg, and 0.1 to 512.8 EU/mg, respectively. Histamine was found in all samples tested ranging from 0.33 to 6.6 ng/mg bedding or dust. Chicken coop bedding and dust contains a variety of substances and organisms that may present a potential respiratory risk to farmers.

MUSCULOSKETAL INJURIES IN AGRICULTURE—AN ERGONOMICS PERSPECTIVE

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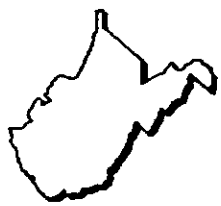
The National Institute for Occupational Safety and Health has begun a major research initiative addressing mortality and morbidity in the agricultural workforce. Review of data from the Supplementary Data System (SDS), maintained by the Bureau of Labor Statistics, indicates that upper extremity sprains and strains, including back injuries, account for more than 30 percent of the agriculture-related workers' compensation claims. SDS data were examined for 1985 from 25 states that provided records. A total of 9, 970 sprain/strain injury claims were filed. Of these, 3,138 (31.5 percent) occurred in landscaping/horticultural services and horticultural specialties. Also, 2,268 (22.7 percent) sprain/strain injuries occurred in the production of fruits, nuts, vegetables and melons. Typical work activities from these two agricultural sectors will be observed and recorded on videotape for study using a motion measurement system to identify biomechanical stresses in this workforce. The ultimate goal of this study is to identify potential intervention strategies (work place modifications or development of specialized mechanical-assist devices) to reduce musculoskeletal injuries in these agricultural industry sectors.

ENDOTOXIN IN COTTON DUST: A RESPIRATORY HAZARD WITH IMPLICATIONS FOR WORKER HEALTH IN BOTH AGRICULTURE AND MANUFACTURING



By Robert M. Castellan, M.D., M.P.H., Stephen A. Olenchock, Ph.D.
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The Public Health Service's *Year 2000 Objectives for the Nation* call for the elimination of exposures that cause byssinosis ("brown lung disease"), an occupational lung disorder which affects cotton workers. Recent research on the etiology of byssinosis has contributed substantially to the body of knowledge necessary to achieve this goal. Although byssinosis is usually considered in the context of the textile manufacturing industry, results of this recent research have implications for both agricultural worker health and agricultural practices which may prevent downstream risk in manufacturing. Recent experimental evidence has clearly demonstrated that the acute airway response of humans exposed to cotton dust is associated with airborne endotoxin concentration. Cotton is contaminated by endotoxin-containing gram-negative bacteria while in the field before harvest. Local cotton growing conditions appear to substantially affect the level of colonization by gram-negative bacteria, resulting in wide variation in the potency of cotton dust with respect to endotoxin. A survey of commercial cotton gins has revealed substantial regional differences in endotoxin contamination of airborne cotton dust. In addition to regional effects, year-to-year variability within the same growing location has been observed in the level of endotoxin contamination of experimentally-generated cardroom dust. Subsequent environmental sampling of cardroom work areas in selected commercial cotton textile mills has shown that area of growth differences are also reflected in yarn manufacturing processes. Airborne endotoxin concentrations in work areas of both agriculture and manufacturing range widely, from relatively low levels to levels which may represent a substantial respiratory hazard. Byssinosis prevention may be enhanced by appropriately applying knowledge of how to limit the natural tendency for gram-negative bacteria to colonize cotton. Therefore, defining the factors which influence the level of gram-negative bacterial contamination of cotton is a prime objective of ongoing research. Furthermore, because of the relationship between endotoxin exposure and byssinosis, a pilot surveillance system to monitor endotoxin in cotton is currently under development.

AN ANIMAL MODEL TO PREDICT THE PULMONARY RESPONSE TO INHALATION OF AGRICULTURAL DUSTS

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Agricultural dusts are associated with many farm operations such as grain unloading, hay handling, chicken or pig confinement, etc. Such dusts are often contaminated with bacteria, fungi and molds as well as endotoxins, mycotoxins and spores associated with these microbes. Several farm operations are known to generate high levels of dust and have been reported to cause adverse physical reactions in farm workers. Symptoms often include fever, headache, malaise and respiratory difficulty. The present report describes an animal model which characterizes the pulmonary responses to inhalation of selected agricultural dusts. Bulk samples collected at the farm site can be placed in a container and dust aerosols of respirable size generated by acoustical energy. Guinea pigs can be exposed to these aerosols and their pulmonary responses, such as airway constriction and inflammation, can be monitored as a function of exposure dose and time. This animal model may have the capability to predict the potential biological reactivity of various agricultural materials. In addition, this system could be used to determine the agent(s) associated with agricultural dust which causes disease and to determine the mechanisms by which disease develops.

ROLLOVER PROTECTION STRUCTURE (ROPS) FOR FARM TRACTORS: THE STAGE IS SET FOR LOCAL ACTION

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W. Maines
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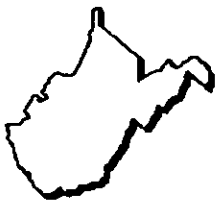
Between 1980 and 1985, nearly 800 people were killed in the United States in farm tractor rollovers. Current data show that farm tractor rollover fatalities have been a factor in 17 percent of all deaths to workers in the Agriculture, Forestry, and Fishing Industry. A 30 percent reduction in the fatality rate for this industry is a *Year 2000* goal for the nation. To address this problem of farm tractor rollovers, a workshop was held to develop strategies for research and safety promotion in preventing fatalities to farm tractor operators. A widely recognized engineering intervention to prevent rollover fatalities is the use of rollover protective structures (ROPS) and seat belts on all tractors. Proposed strategies fell into two categories: (1) retrofitting tractors built between 1970 and 1985, for which ROPS have already been designed; and (2) retrofitting tractors built before 1970, for most of which there are no ROPS designs. Workshop attendees felt that local action groups should begin educational campaigns to encourage owners of tractors built since 1970 to have lifesaving ROPS and seat belts installed.

ASSESSMENT OF INHALED AGRICULTURAL DUST HAZARD AND MECHANISMS OF DISEASE USING AN ANIMAL INHALATION MODEL IN COMBINATION WITH STUDIES OF ISOLATED AIRWAYS



By Jeffrey S. Fedan, Ph.D.
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It is becoming increasingly clear that inhalation of some agricultural dusts in the workplace may cause pulmonary obstruction. We have been conducting biological experiments designed to both assess the potential hazard of agricultural dusts and to determine the mechanism(s) of the pulmonary response. This has been accomplished through the use of a computer-operated dust generation and animal inhalation exposure system (designed by David G. Frazer), which provides dust-exposed animals from which airways are then removed for additional study of the mechanisms of inhaled dust toxicity. Studies on isolated airways involve the isolated perfused guinea pig trachea. The perfused trachea is used because it contains respiratory smooth muscle, which is involved in narrowing of the airways in response to inhaled substances, and other cell types such as epithelium, which lines the airways and is known to be a target of the toxic effects of some agents. The isolated trachea also permits a detailed evaluation of the mechanisms of effect of suspected etiologic agents under carefully controlled laboratory conditions. We are able to ascertain the effect(s) of inhaled substances on respiratory smooth muscle and epithelium. The protocol used to examine dust effect(s) is to apply the bronchoconstricting drug, methacholine, to the fluid surrounding the trachea in order to establish the dose-response relationship for the diameter decrease caused by contraction of the smooth muscle. The methacholine easily reaches the muscle, which is situated on the outer surface of the trachea. These results are compared with the dose-response relationship obtained after the trachea is challenged with methacholine perfused through the lumen. The muscle contracts to luminal methacholine only after the drug has crossed the epithelium. The epithelium is a diffusion barrier and a metabolic site, and also releases modulatory factors which affect the responsiveness of the muscle. We have examined the effects of respirable cotton and barn dusts. A six-hour exposure to cotton dust caused pulmonary obstruction, the degree and duration of which depended on the level of dust in the air. The perfused trachea preparation revealed that a complex set of changes had occurred in the release of modulatory factors from the epithelium, which altered in a dust level- and post-exposure, time-dependent manner responsiveness of the muscle. Inhaled barn dust did not affect pulmonary function or tracheal reactivity. The use of these laboratory methods will continue to assist in the identification of inhaled dust hazards and disease mechanisms.

BUILDING STATE-BASED AGRICULTURE SAFETY AND HEALTH INFRASTRUCTURES: A MODEL AGRICULTURE HEALTH PROMOTIONS SYSTEM PROGRAM

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Based on data from the National Traumatic Occupational Fatalities (NTOF) database maintained by the National Institute for Occupational Safety and Health (NIOSH), Agriculture, Forestry, and Fishing is one of the most hazardous industrial divisions in the U.S. While only 2 percent of the U.S. workers are employed in this sector, it has the fourth highest injury fatality rate (20.4 deaths/100,000 workers) in the U.S. Farming as an occupation has the second highest rate of work-related injury deaths (21.4/100,000 workers). In addition, during 1988 the agriculture industry ranked third among the 10 industrial sectors for occupational injury rates (10.4 injuries/100 workers). Because of the hazardous nature of agricultural employment, the NIOSH, Division of Safety Research (DSR), has instituted an intervention program with the goal of reducing the incidence of fatal and nonfatal traumatic injury, chronic injury, and occupational diseases among the 3.4 million agricultural workers in the U.S. This program, the Agricultural Health Promotion Systems (AHPS), is administered through cooperative agreements to Land-Grant Universities and the Cooperative Extension Service within the States. Through the AHPS, the land-grant universities will disseminate information and conduct programs to prevent illness and injury among agricultural workers and their families. Currently, 15 states are conducting programs in this area for FY 1991, with eight more states to be added by FY 1992. Examples of some of the emphasis areas include, but are not limited to, youth training, bilingual work-site safety packets for farm workers, and programs targeted to older farmers. Also included are programs in forestry, logging and fishing.

WORKER FATALITIES IDENTIFIED BY IRRIGATION KEY-WORD SEARCHES OF THE DATABASE

By David L. Hard, Ph.D., Patricia Cutlip, Nancy Stout, Lynn Jenkins
Suzanne Kisner, Rosemary Cianfrocco
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This analysis describes fatal occupational injuries involving irrigation operations or mechanisms in the United States. Cases were identified by examining data from the National Traumatic Occupational Fatality (NTOF) database, which is maintained by the Division of Safety Research (DSR), National Institute for Occupational Safety and Health (NIOSH). NTOF includes data from death certificates, obtained from all 50 States, New York City and the District of Columbia, that indicated the decedent was 16 years or older, died from an external (injury) cause and was injured at work. A key-word search of injury descriptions and cause of death narratives from NTOF identified cases described as involving "irrigation." This analysis includes cases from 1980 to 1989, although data for 1987-89 are incomplete. From 1980 through 1989, 60 workers died in the U.S. from work-related injuries involving irrigation. Twenty-two percent of these deaths occurred in California and 12 percent were in Texas. Most fatalities were among men (97 percent). More deaths occurred to Whites (65 percent) than to Hispanics (30 percent), Blacks (3 percent), or other races (2 percent), although Hispanics may be over-represented relative to their proportion of the labor force. Workers between the ages of 20 and 34 accounted for 43 percent of the deaths. Farmers (32 percent) and farmworkers (37 percent) were the most frequent occupations of the victims. Seventy percent of the fatalities were in the Agriculture, Forestry and Fishing Industry. From 1980 through 1986, the leading causes of death involving irrigation operations or mechanisms were electrocution (67 percent), drowning/suffocation (11 percent), and machines (9 percent). The ability to identify specific occupational fatalities are possible through computer keyword searches of injury descriptions and cause-of-death narratives from the NTOF data base.

AGRICULTURAL LUNG DISEASE: A NATIONAL PROGRAM

By Gregory Kullman, M.S., Richard D. Kennedy, Michael Lyman, William G. Jones
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Occupational exposures to dust of agricultural origin are known to cause respiratory illness among farm workers. Several pulmonary responses have been described in different agricultural settings. The National Institute for Occupational Safety and Health (NIOSH), Division of Respiratory Disease Studies (DRDS), in Morgantown, West Virginia is involved in a nation-wide agricultural program, emphasizing the study of respiratory illness among farm workers, as a foundation for preventing occupational lung disease through the development and dissemination of appropriate prevention strategies. Surveillance, research, and intervention are key elements of this research program. Our program involves many separate projects that are part of an integrated, multi-disciplined approach to the study of agricultural respiratory disease involving clinical evaluations, environmental exposure assessments, laboratory research evaluating biological disease mechanisms, microbiological characterizations of agricultural materials, animal exposure studies and epidemiological surveillance. NIOSH scientists at DRDS have been actively involved in the study of respiratory illness in a variety of agricultural settings including Dairy Farming (Silo Unloading and Bedding Chopping), Cotton Processing, Recycling, Mushroom Farming, Poultry Growing, Grain Harvesting and Storage, and others. NIOSH scientists are interested in learning about instances of respiratory illness among farm workers and have a Respiratory Disease Health Hazard Evaluation Program available, at no cost as a resource for farm workers. To request assistance or to provide information on the occurrence of respiratory illness among agricultural workers, call (304) 291-4203.

ORGANIC DUST EXPOSURE FROM COMPOST HANDLING OPERATIONS

By Gregory J. Kullman, W.G. Jones, S.A. Olenchock, Ph.D., W.G. Sorenson
R. Marcelo-Baciu, E.L. Petsonk, J.E. Parker, M.D.
NIOSH, Division of Respiratory Disease Studies, Morgantown, West Virginia

Environmental measurements were made during hand loading of compost in a small scale recycling project. The compost consisted of chopped leaves and branches stored outdoors during a spring and summer of record rainfall. Exposures to organic dust from this material resulted in the hospitalization of one individual experiencing severe respiratory illness. Measurements included inspirable and respirable dust, particle size distribution, endotoxins, spore counts and viable microorganisms. Visible clouds of fine particulate were easily generated during handling activities; impactor measurement of this aerosol indicated a mass median aerodynamic diameter of approximately 3 micrometers. Worse case dust concentrations of inspirable and respirable particulate were 150 and 83 milligrams per cubic meter (mg/m^3) respectively; however, routine dust exposures from compost handling were below 1 mg/m^3 for all size fractions. Microscopic examination (both light and SEM) of these dusts indicated a predominance of spores. Airborne spore counts, made directly from cellulose ester filters cleared with acetone, ranged from 106 to 109 spores/m^3. Mesophilic fungi and bacteria, collected using the AGI 30 impinger with distilled water, ranged from 105 to 108 colonies/m^3. Airborne thermophilic bacterial concentrations were lower, 103 to 104 colonies/m^3. Spore counts made from filter samples collected downstream from the impinger showed high spore penetration, with break-through weighted toward smaller diameter spores, $< 3\ \mu/m$. Endotoxin concentrations from inspirable, thoracic and respirable dust samples ranged from 636 to 16,300 endotoxin units/m^3. Levels of contaminants found here are consistent with those associated with respiratory illness in other agricultural settings.

HYPERSENSITIVITY PNEUMONITIS (HP) IN RATS CAUSED BY Aspergillus Umbrosus AND Thermoactinomyces Vulgaris

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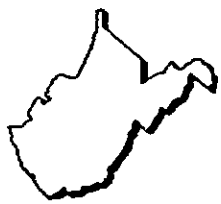
HP is an allergic lung disease in the terminal bronchioles, interstitium and alveoli resulting from repeated exposure to inhaled organic dusts. Thermophilic actinomycetes and fungal spores have been implicated as causes of HP in man. To evaluate the inflammatory potential of the two microorganisms, we exposed rats (Sprague-Dawley, VAF) to extracts of *Aspergillus umbrosus (AU)* and *Thermoactinomyces vulgaris (TV)* six times by intratracheal injection. We made a pathologic evaluation of the changes in the lungs and in the cellular influx in bronchoalveolar lavage fluids (BALF) of exposed and control animals. Initial installations of AU and TV caused an intense inflammatory reaction in and around respiratory bronchioles and blood vessels. The *cellular infiltrate (CI)* predominantly was lymphocytes, but the number of macrophages was also increased. Lymphatoid granulomas were seen as well as thickening of alveolar walls with type II cell hyperplasia. The number of the total cells in BALF increased dramatically, two-and-one-half to fivefold, compared to the controls. Differential estimates of CI showed 71 percent lymphocytes and 27 percent macrophages. Eight and 28 days after the final exposure, the lung appeared normal. These results indicate that these agents can cause an intense pulmonary inflammation, and that the inflammation subsides rapidly when the exposure ends, leaving no apparent permanent pulmonary injury.

HYPERSENSITIVITY PNEUMONITIS ANTIGENS ACTIVATE ALVEOLAR MACROPHAGES IN VITRO



By Janusz Milanowski
NIOSH, Morgantown
and the Clinic of Lung Diseases
University School of Medicine Lublin, Poland

The gaseous phase cultures of alveolar macrophages (AMs) of guinea pigs were exposed to the saline extracts of the dust-borne bacteria *Micropolyspora faeni* (syn. *Faenia rectivirgula*) and *Erwinia herbicola* (syn. *Enterobacter agglomerans*) which have been added at the concentration of 1 μg/ml to culture medium with or without complement. The effects of exposure on superoxide anion (°2-) production by AMs were assessed by the lucigenin-dependent chemiluminescence method. Both extracts caused significant ($p<O.Ol$) increase in °2- generation by AMs, as assessed by the 161-254 percent enhancement of chemiluminescence release comparing to control values. The presence of complement augmented the production °02-, which reached a peak at 3 hours after initial exposure. The possible significance of the generation of oxygen radicals in pathogenesis of the diseases due to exposure to agricultural dusts loaded with bacterial antigens is discussed.

RESPIRATORY DISEASE MORTALITY IN AGRICULTURAL WORKERS

By Karl J. Musgrave, D.V.M., M.P.H., R. Althouse, R.M. Castellan
NIOSH, Morgantown, West Virginia

Agricultural workers have been shown to be at increased risk of developing respiratory diseases (RDs). Most mortality studies of agricultural workers to date have considered only crude mortality using underlying cause of death and may underestimate the public health importance of contributing causes of death. Furthermore, crude mortality data is a poor measure of premature mortality in the working-age population. Decedents noted as having worked in an agricultural industry were selected from national multiple cause of death data tapes for 14 states that had industry and occupation information for each of the years 1985-1987. To estimate the relative public health importance of specific RDs for these decedents, crude "cause of death" ratios (deaths due to a specified RD/total deaths from all RDs), years of working life lost (15-64 years) and years of potential life lost (age 15-life expectancy) were estimated for deaths where specific RDs were mentioned either as an underlying or contributing cause of death. Of the 81,317 decedents, 11,046 (14 percent) had a RD listed as an underlying cause of death while an additional 8,948 (11 percent) had a RD listed as a contributing cause. Of all RDs, respiratory neoplasms contributed most to the total years of working life lost (38 percent or 7,000 years), while pneumonia and influenza contributed the most to the total years of potential life lost (33 percent or 81,340 years). Calculations of premature mortality are useful in determining the relative public health importance of specific RDs on the working-age population in agriculture. Use of multiple causes of death data allows for an analysis of the maximum diagnostic information listed on death certificates.

MICROBIAL CONTAMINATION AND IMMUNOLOGIC REACTIVITY OF STORED OATS

By Stephen A. Olenchock, Ph.D., Ph.D., W.G. Sorenson, John E. Parker, M.D.
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James J. Marx, Jr.
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Bulk samples of oats were obtained from Alabama where a cluster of cases of organic dust toxic syndrome occurred in workers who shoveled approximately 800 bushels of oats from a poorly ventilated storage bin. Airborne dusts were obtained from the samples by acoustical vibration in a laboratory dust generator. Microbial contamination of the airborne dusts, as measured by standard dilution plating techniques, revealed 1.4 x 105 colony forming units per cubic meter of air (CFU/m^3) of total viable bacteria, 1.5 x 103 CFU/m^3 of gram-negative bacteria, 1.8 x 105 CFU/m^3 of thermophilic bacteria, and 8.3 x 104 CFU/m^3 of fungi. The most common fungi isolated from the dust included *Alternaria, Aspergillus, Cladosporium, Penicillium,* and *Scopulariopsis* species. Analysis of the generated airborne dust for gram-negative bacterial endotoxins resulted in the detection of 325.71 Endotoxin Units per milligram of dust (EU/mg). The endotoxin contamination of the bulk oats was 122.66 EU/mg. An extract of the bulk sample consumed human serum complement *in vitro* in a dose-dependent fashion, indicating the inflammatory potential of the material. Sera from the exposed workers were examined for antibodies against the extract, against antigens from the predominant fungi, and against standard antigens associated with hypersensitivity pneumonitis. Evidence of exposure (specific antibodies) was determined, although symptomatic and asymptomatic workers could not be differentiated. Stored oats provided a source of respiratory exposure to microbial antigens and to immunoreactive materials.

DEATHS WITH FARMERS LUNG DISEASE AND DAIRY FARMING PRODUCTION: A CORRELATION USING NATIONAL CENTER FOR HEALTH STATISTICS MULTIPLE CAUSE OF DEATH TAPES

By John E. Parker, M.D., D.M. Mannino, M.C. Townsend
NIOSH, Morgantown, West Virginia

Farmer's Lung Disease (FLD) is a form of hypersensitivity pneumonitis (HP) prevalent in agricultural workers. We hypothesize that extensive prolonged work in closed spaces exposes the dairy farm worker to various sensitizing agents associated with HP and FLD more than other types of farm workers. This report looks at data available from the National Center for Health Statistics (NCHS) multiple cause of death data tapes from 1979 through 1986 concerning deaths with FLD. During this time period, 73 death certificates listed FLD as being present. Data from these death certificates were correlated with farming data from the 1982 agricultural survey and the 1986 *Statistical Abstract of the United States,* by state, using Spearman correlations.

TABLE OF CORRELATIONS

Variables by State	
Whole Milk Sold	0.53*
Dairy Farms	0.54*
Farms with Cows	0.54*
Farmers	0.35*
Deaths	0.11*

$P < 0.05$ - *

In this ecological study, deaths with FLD were more related to dairy farming than farming in general, supporting our hypothesis. The NCHS multiple cause of death data tapes have thus provided a new way to evaluate the demographics of an occupational pulmonary disease, and help generate a hypothesis as to its occupational origin.

HYPERSENSITIVITY PNEUMONITIS (HP) OR ORGANIC DUST TOXIC SYNDROME (ODTS)?: THE CLINICAL DILEMMA IN ORGANIC DUST EXPOSURES

By Edward L. Petsonk, M.D., G. Kullman, W. Jones, S. Olenchock, Ph.D., W. Sorenson J. Parker, M.D.
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S. Weber
West Virginia University, Morgantown, West Virginia

Twelve hours after shovelling composed wood chips and leaves, a healthy 52-year-old male presented to the emergency room with fever (T 38.8°C), myalgia, and marked dyspnea. Inspiratory crackles, hypoxemia (room air arterial PO2 53mm Hg), and bilateral patchy pulmonary infiltrates were seen. Systemic steroids were given, and he improved over 3 days. No antibodies were found to 10 common HP antigens. Using respiratory protection, we repeated the exposure setting and made extensive environmental measurements. General area samples for respirable particulate were < 1 mg/m^3. Peak exposures were > 80 mg/m^3. Mass median aerodynamic diameter of the aerosol was approximately 3 micrometers. Microscopic analysis of the dust indicated a predominance of spores, with counts ranging from 106 to 109 spores/m^3. Airborne endotoxin concentrations ranged from 244 to 16,300 endotoxin units/m^3, levels previously associated with illness in similar settings. Cultures of air samples yielded high levels of mesophilic fungi and lower levels of thermophilic bacteria. Serum from the patient showed precipitation with extracts of bulk samples of the compost material. Inhalation of dust from contaminated organic materials may result in acute respiratory tract illness. Possible mechanisms include toxic and cellular reactions from microbial and other organic products or immunologic responses after prior sensitization to an antigen. Differentiation is based on clinical and epidemiologic clues. Our data suggest that, in a clinical setting even with extensive environmental measurements, separation of ODTS and HP may not be possible.

MICROBIOLOGICAL ANALYSES AND INFLAMMATORY EFFECTS OF SETTLED DUSTS FROM RICE AND HAY

By W.G. Sorenson, Ph.D., Yi-E Shen, D.M. Lewis, S.A. Olenchock, Ph.D.
NIOSH, Division of Respiratory Disease Studies, Morgantown, West Virginia

Fourteen samples of settled dust from two factories processing rice and wheat straw near Shanghai, China, were examined by dilution plating for total bacteria, gram-negative bacteria, thermophilic actinomycetes and fungi. They were also examined for aflatoxin, endotoxin and potential to stimulate production of human interleukin lB (IL-lB) and to consume complement. The concentrations of total microorganisms were consistently greater than 107 CFU/g and ranged from 107 to 109 CFU/g. In general, the level of microbial contamination was greater in the hay dust samples than in the rice dust samples, with bacteria being the most numerous microorganisms observed followed by molds, thermophilic actinomycetes and yeasts. The predominant fungi were species of *Asversillus, Cladosporium, Penicillium, Trichosporon,* and *Cryptococcus.* No significant levels of aflatoxin were observed and the isolate of *A. flavum* examined lack significant aflatoxigenic potential. The levels of microorganisms in these samples, the types of organisms found, and the inflammatory mediators such as endotoxin suggest that workers exposed to these dusts may be at risk for respiratory illness.

IMPROVED METHODOLOGY TO VALIDATE ENDOTOXIN LEVELS IN INHIBITORY AGRICULTURAL SAMPLES

By Michael P. Whitmer, Ebon Research Systems, Stephen A. Olenchock, Ph.D.
Daniel M. Lewis, Judith C. Mull
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Endotoxins are lipopolysaccharide-protein complexes that are integral parts of the outer membrane of gram-negative bacteria. They are ubiquitous in the agricultural environment, both in bulk material and airborne dusts. Because endotoxins can exert profound effects on humans after exposure, it is important to quantify their presence in agricultural workplaces. However, certain agricultural materials cause inhibition or enhancement of endotoxin analyses. In this study, an improved methodology was used to validate the endotoxin levels and overcome inhibition due to agricultural samples. Settled dusts and litters from chicken houses were extracted in water by standard technique. Endotoxin analyses were performed on 31 samples in duplicate using the kinetic *Limulus* amebocyte lysate assay. Product inhibition was found in 27 of the 31 samples (87 percent), which indicates that lower than actual levels of endotoxins may be reported erroneously. Through the use of a new methodology that includes serial dilution followed by spiking with known concentrations of endotoxin standards, comparisons between values in spiked and unspiked dilutions by a computer-enhanced kinetic plate reader are generated. With these data, the proper levels of endotoxin in the samples were determined. This improved capability should have a positive impact on future studies of endotoxins in agricultural materials.

EFFECTS OF AIRBORNE CONTAMINANTS IN SWINE CONTAMINANTS IN SWINE CONFINEMENT BUILDINGS ON ACUTE CHANGES IN LUNG FUNCTION IN SWINE FARMERS

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By NIOSH, Morgantown, West Virginia

Dust, endotoxin, ammonia and carbon dioxide were measured in 25 swine confinement buildings and lung function tests were conducted before work and every 2 hours subsequently on 52 swine farmers working in the buildings. Swine farmers had 8.7 ± 6.8 swine farming years and 4.3 ± 2.3 work-hours per day. Values for forced vital capacity (FVC), forced expiratory volume in one second (FEVl) and maximum mid-expiratory flow rate (MMFR) in these farmers were significantly lower after 2, 4, 6 and 8 hours of work than at baseline ($p < 0.05$). Average shift changes during the day were: -3.98 ± 6.18 percent for FVC, -6.07 ± 6.14 percent for FEVl, -2.06 ± .42 percent for FEV1FVC and -12.14 ± 11.17 percent for MMFR. Male swine farmers had significantly greater shift changes than did female swine farmers (p 1<°-°S). Swine farmers with acute cough, acute chest tightness and chronic cough symptoms had greater shift changes in FEVl than those without these symptoms ($p < 0.05$). Multiple regression analysis showed that endotoxin, total dust, number of swine per farm, swine farming years, grain farming years and mask wearing were associated with the shift changes in FEV1 in non-smoking swine farmers. We conclude that swine farming is associated with acute reductions in lung function which are related to exposures to airborne contaminants in confinement buildings. (Supported by Health and Welfare Canada and the Saskatchewan Lung Association).