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Abstract

BACKGROUND:

Organic dust toxic syndrome (ODTS) is an influenza-like illness typically affecting agricultural workers exposed to organic dusts. In July 2007, Tri-County Health Department investigated a cluster of acute respiratory illnesses among urban landscape workers with known mulch exposure.

METHODS:

An epidemiologic study of landscape workers was conducted. Employees were interviewed regarding illness and occupational exposures. Medical records were reviewed. Mulch samples were tested for fungi and endotoxins.

RESULTS:

Five (12\%) of 43 employees experienced respiratory illness compatible with ODTS. Illness was associated with prolonged mulch exposure (>or=6 vs. <6 hr/day; relative risk = 24.7; 95\% confidence interval = 3.3-184.9). Mulch samples contained high levels of Aspergillus spores and endotoxin.

CONCLUSIONS:

Contaminated mulch was implicated as the source of presumed ODTS among landscape workers, highlighting that ODTS is not limited to rural agricultural settings. Education of employers, safety officers, and clinicians is necessary to improve recognition and prevention of ODTS within urban occupational groups.

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Agricultural seed dust as a potential cause of organic dust toxic syndrome.

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Abstract

AIMS:

Episodes of serious work related health problems resembling organic dust toxic syndrome (ODTS) in workers of a grass seed quality inspection laboratory prompted the authors to study personal endotoxin exposure levels in this facility and in the agricultural seed processing industry. In addition, microbial and inflammatory characteristics of agricultural seeds were studied.
METHODS:

The authors assessed inhalable dust and endotoxin levels in 101 samples from 57 workers in grass, cereal, and vegetable seed plants who were handling mainly grass seeds as bulk product, and horticulture seeds in smaller quantities. Additionally, real-time dust exposure was measured using a DataRAM monitor in 12 grass seed workers to obtain more information on exposure patterns during specific tasks. Endotoxin concentrations in seed extracts were determined by LAL assay and seed samples were analysed by scanning electron microscopy. Release of inflammatory cytokines was measured in supernatants of whole blood samples stimulated with lipopolysaccharide (LPS) or agricultural seed extracts in a human whole blood assay (WBA).

RESULTS:

Endotoxin concentrations in personal samples were high (geometric mean 1800 EU/m3), particularly in the grass seed quality inspection lab where endotoxin levels up to 274 000 EU/m3 were measured. The recommended health based endotoxin exposure limit of 50 EU/m3 was amply exceeded in almost all personal samples. Job tasks dumping and mixing were associated with highest dust and endotoxin exposures, which was confirmed by real-time measurements. Microbial infestation was found in almost all seed samples. WBA results showed that most seed extracts were capable of inducing a pronounced dose dependent cytokine release.

CONCLUSIONS:

Workers handling grass, cereal, or vegetable seeds are at risk of exposure to high levels of endotoxin containing seed dust. Occupational exposure to inhalable agricultural seed dust can induce inflammatory responses, and is a potential cause of ODTS.

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Factors affecting vegetable growers' exposure to fungal bioaerosols and airborne dust.

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Abstract

We have quantified vegetable growers' exposure to fungal bioaerosol components including (1→3)-β-d-glucan (β-glucan), total fungal spores, and culturable fungal units. Furthermore, we have evaluated factors that might affect vegetable growers' exposure to fungal bioaerosols and airborne dust. Investigated environments included greenhouses producing cucumbers and tomatoes, open fields producing cabbage, broccoli, and celery, and packing facilities. Measurements were performed at different times during the growth season and during execution of different work tasks. Bioaerosols were collected with personal and stationary filter samplers. Selected fungal species (Beauveria spp., Trichoderma spp., Penicillium olsonii, and Penicillium brevicompactum) were identified using different polymerase chain reaction-based methods and sequencing. We found that the factors (i) work task, (ii) crop, including growth stage of handled plant material, and (iii) open field versus greenhouse significantly affected the workers' exposure to bioaerosols. Packing of vegetables and working in open fields caused significantly lower exposure to bioaerosols, e.g. mesophilic fungi and dust, than harvesting in greenhouses and clearing of senescent greenhouse plants. Also removing strings in cucumber greenhouses caused a lower exposure to bioaerosols than harvest of cucumbers while removal of old plants caused the highest exposure. In general, the exposure was higher in greenhouses than in open fields. The exposures to β-glucan during harvest and clearing of senescent greenhouse plants were very high (median values ranging between 50 and 1500 ng m(-3)) compared to exposures reported from
other occupational environments. In conclusion, vegetable growers' exposure to bioaerosols was related to the environment, in which they worked, the investigated work tasks, and the vegetable crop.


Exposure to bioaerosols during the growth season of tomatoes in an organic greenhouse using Supresivit (Trichoderma harzianum) and Mycostop (Streptomyces griseoviridis).

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Abstract

In working environments, especially in confined spaces like greenhouses, elevated concentrations of airborne microorganisms may become a problem for workers' health. Additionally, the use of microbial pest control agents (MPCAs) may increase exposure to microorganisms. The aim of this study was to investigate tomato growers' exposure to naturally occurring bioaerosol components [dust, bacteria, fungi, actinomycetes, (1-->3)-beta-D-glucans, and endotoxin] and MPCAs applied by drip irrigation. Airborne dust was collected with filter samplers and analyzed for microorganisms by plate counts and total counts using a microscope. Analysis of (1-->3)-beta-D-glucan and endotoxin content was performed by kinetic, chromatic Limulus amoebocyte lysate tests. The fungal strain (Trichoderma harzianum) from the biocontrol product Supresivit was identified by PCR analysis. Measurements were performed on the day of drip irrigation and 1 week, 1 month, and 3 months after the irrigation. T. harzianum from Supresivit could be detected only on the day of treatment. Streptomyces griseoviridis, an applied MPCA, was not detected in the air during this investigation. We found that bioaerosol exposure increases during the growth season and that exposure to fungi, bacteria, and endotoxin can reach levels during the harvest period that may cause respiratory symptoms in growers. The collected data indicate that MPCAs applied by drip irrigation do not become airborne later in the season.

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Exposure to inhalable dust, endotoxins, beta(1-->3)-glucans, and airborne microorganisms in horse stables.

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Abstract

OBJECTIVES:

Workers in horse stables are likely exposed to high levels of organic dust. Organic dusts play a role in increased risk of inflammatory reactions and are associated with respiratory diseases. The aim of this study was to investigate dust, endotoxin, beta(1-->3)-glucan, and culturable microorganisms exposure levels in horse stables.

METHODS:
Ambient (n = 38) and personal (n = 42) inhalable dust samples were collected using PAS-6 sampling heads. As a special measurement, we included sampling near the horses' heads. Samples were analyzed for endotoxin and beta(1-->3)-glucan by Limulus amebocyte lysate assay and an inhibition enzyme immunoassay, respectively. Culturable bacteria and fungi were collected with an Anderson impactor.

RESULTS:

Geometric means (GMs) of personal exposure to dust, endotoxin, and beta(1-->3)-glucan were 1.4 mg m(-3) (range 0.2-9.5), 608 EU m(-3) (20-9846), and 9.5 microg m(-3) (0.4-631 microg m(-3)), respectively. Exposure levels in the morning shift were higher compared to other shifts. The GMs (ranges) of culturable bacteria and fungi were 3.1 x 10(3) colony-forming unit (CFU) m(-3) (6.7 x 10 to 1.9 x 10(4)) and 1.9 x 10(3) CFU m(-3) (7.4 x 10 to 2.4 x 10(4)), respectively. Variance components for endotoxin and beta(1-->3)-glucan were considerably higher than for dust. Based on dummy variable in a mixed regression analysis, the predominant task explaining exposure levels of dust, endotoxin, and beta(1-->3)-glucan was sweeping the floor. For beta(1-->3)-glucan, feeding the horse was also an important determinant.

CONCLUSION:

Dust, endotoxin, and beta(1-->3)-glucan exposure are considerable in horse stables. Bacterial and fungal exposure levels were moderate. Endotoxin exposures were above the Dutch proposed standard limits, suggesting workers in horse stables to be at risk of adverse health effects.


Overview of personal occupational exposure levels to inhalable dust, endotoxin, beta(1-->3)-glucan and fungal extracellular polysaccharides in the waste management chain.

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INTRODUCTION:

In the past decade, we studied occupational bioaerosol exposures in various sites of the waste management chain. In this paper we present an overview of exposure levels of inhalable dust, endotoxin, beta(1-->3)-glucan (known or probable inducers of airways inflammation), and extracellular polysaccharide antigens of Aspergillus and Penicillium species (EPS-Pen/Asp; a common and probably more specific marker of fungal exposure).

METHODS:

Over 450 personal bioaerosol samples were taken. Mixed regression analyses were performed to estimate exposure determinants, between- and within-worker variance of exposure, and determinants of these variances. Furthermore, we explored whether the type of waste affected the bioaerosol composition of the dust.

RESULTS:
Endotoxin and glucan exposure levels were relatively low and comparable for waste collection and transferral, green waste composting and use of biomass in power plants. Exposure levels were 5-20 times higher in domestic waste transferral with sorting, and composting of both domestic and domestic and green waste (approximately 300-1000 EU m(-3) for endotoxin, and 5-10 mug m(-3) for glucan). Observed exposure exceeded Dutch occupational exposure limits at all sites. EPS-Pen/Asp exposure was detected in 20% of waste collectors and 49% of compost workers. Exposure variability within tasks was large (geometric standard deviation > 2), with smaller between-worker than within-worker variance. Type of company and waste largely explained between-worker variance (40-90%), although within companies no major task-related determinants could be established. Markers of exposure correlated moderately to strongly. Relative endotoxin and glucan content in the dust was only weakly associated with handled waste.

CONCLUSIONS:

Occupational bioaerosol exposure in the waste management chain is lowest for outdoor handling of waste and highest when waste is handled indoors. However, exposure variability is large, with greater within-worker than between-worker variance. Occupational exposure limits for organic dust and endotoxins are frequently exceeded, suggesting workers are at risk of developing adverse health effects.


Variability in endotoxin exposure levels and consequences for exposure assessment.

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OBJECTIVES:

Workers in many industries are exposed to endotoxins, which may cause adverse health effects. In exposure assessment, information about exposure variability is essential. However, variability in exposure has rarely been investigated for biological agents and more specifically for endotoxin. Therefore, variance components and determinants of exposure were studied in a large database with >2000 endotoxin measurements.

METHODS:

Data from 10 individual studies were combined to create a database with 2010 personal inhalable dust and endotoxin measurements, of which 1650 were repeated measurements. Exposure groups were defined based on job codes. Between- and within-worker variance components were estimated for different grouping strategies, and determinants of exposure were studied using mixed effects models.

RESULTS:

Inhalable dust and endotoxin exposure levels are summarized for 46 industries and 4 broadly defined sectors. The between-worker variability exceeded the within-worker variability overall and within sectors and subsectors, and variance components were larger for endotoxin than for dust. Between-worker variability also exceeded within-worker variability in nearly half of the exposure groups based upon industries or job code within industries for endotoxin exposure and in 10% of the groups for dust exposure. Among other things, dustiness of the process,
contact with animals, bulk production, presence of plant material or a cyclic process appeared as determinants of exposure, which largely explained the between-worker variability.

CONCLUSIONS:

Exposure groups were much less homogeneous for endotoxin exposure than for dust exposure. This is distinctly different than for chemical exposure. Large variability in measured exposure levels is inherent to endotoxin exposure, which is caused in part by determinants that influence growth of microorganisms. These findings have major consequences for the design of future occupational intervention and epidemiological studies. The measurement effort needs to be greater than exposure assessment for chemical agents which demonstrate lower exposure variability, especially when evaluating endotoxin exposure for compliance testing. The established determinants of exposure give direction for potential exposure control, although more information about determinants of day-to-day variability in exposure is still needed to be able to effectively control endotoxin exposure.

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automatic (robotic) milking was used and during re-penning of animals, handling of feed and seeds, handling of silos and when distributing bedding. Dust exposure increased also as a result of use of rail feed dispensers in a model without fully automatic milking.

CONCLUSIONS:

The current exposure to dust and in particular endotoxin among Danish dairy farmers demand effective strategies to reduce their exposure. The present findings suggest that future interventions should focus on feeding and manure handling systems. Use of respirators during handling of feed and distribution of bedding should be advised until adequate risk management measures have been established. The expected increased use of fully automatic milking in the future might increase dust exposure of dairy farmers.

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KEYWORDS:

dairy farmers; determinants; dust; endotoxin; variability

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