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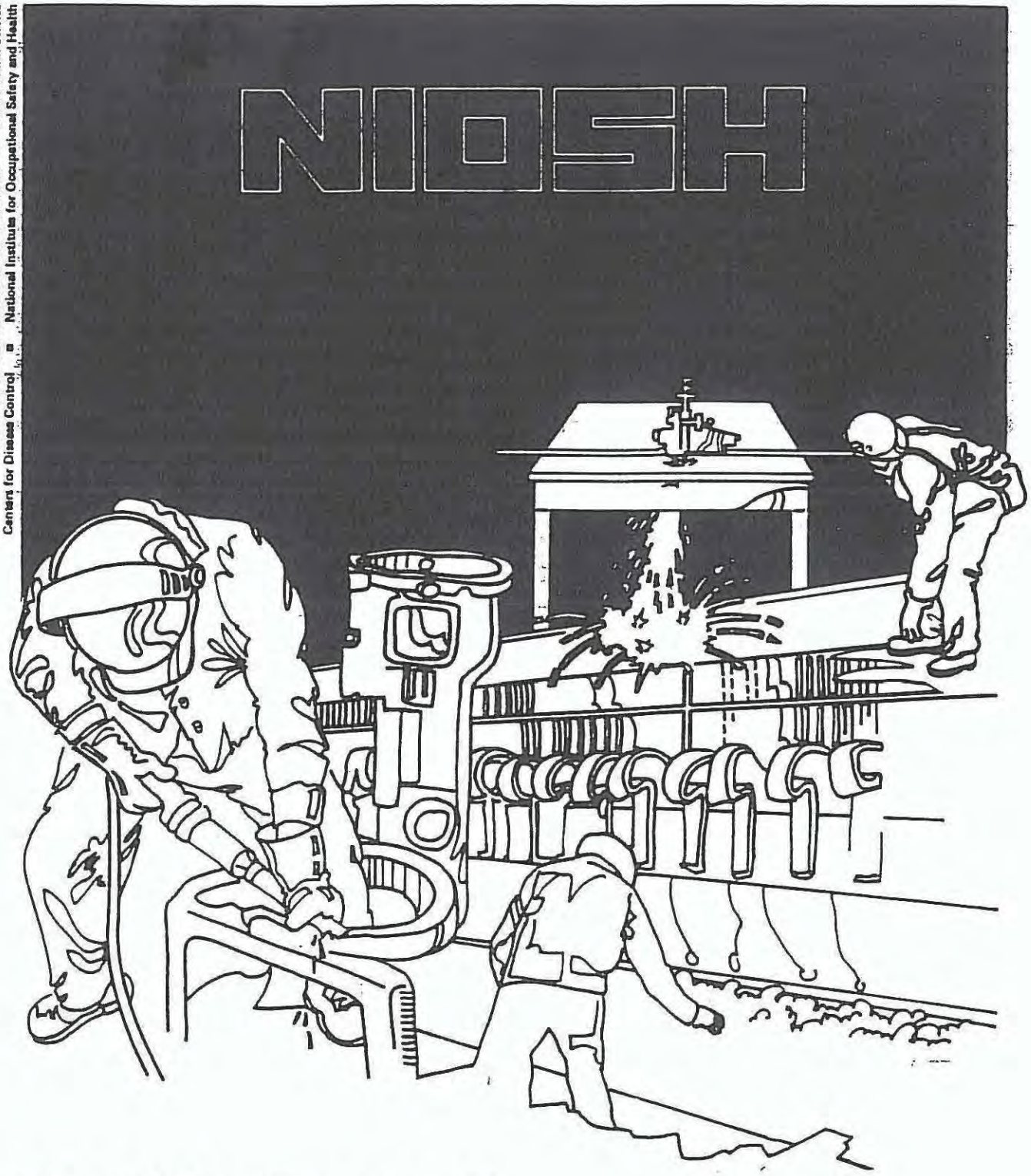

Health Hazard Evaluation Report

HETA 81-121-1421
INSECT REARING FACILITIES
AGRICULTURAL RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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I. SUMMARY

In December 1980, the Agricultural Research Service (ARS) requested technical assistance in evaluation of the prevalence and causes of occupational allergies at its ninety-eight facilities devoted to raising colonies of insects for entomological research, located throughout the United States, and employing over one thousand men and women.

Visits by NIOSH investigators were made to six insect rearing facilities in order to develop a better understanding of the nature of this type of work. A nationwide survey of employees was conducted using mailed self-administered questionnaires. There was an overall response rate of 71% (753/1061). One hundred and ninety (25%) of 753 employees reported by questionnaire that they experienced some type of allergy related to insect exposure at work. Sixty-one percent (52/85) of facilities for which responses were available had at least one employee reporting current or past work-related allergy, and six percent (5/85) had ten or more employees reporting this problem. The most prevalent symptoms included sneezing or running nose (73%), eye irritation (68%), skin irritation or skin rash (41%), and cough (38%).

On the basis of this evaluation, NIOSH has determined that the majority of insect rearing facilities have at least one employee who has experienced symptoms consistent with occupational allergy related to exposures inherent to working with insects, and five facilities have ten or more such employees. Recommendations for reducing exposures to allergenic particulates in arthropod research facilities and for medical surveillance of the workers are contained in the report.

Key Words: (SIC 8922 Non-commercial Educational, Scientific, and Research Organizations) laboratories, allergies, insect rearing facilities

II. INTRODUCTION AND BACKGROUND

In December 1980, NIOSH received a request from the United States Department of Agriculture (USDA), Agricultural Research Service (ARS), to evaluate allergenic airborne particulates associated with rearing colonies of insects in confined spaces. In response, NIOSH visited insect rearing facilities, conducted a mailed, self-administered questionnaire survey, and reviewed medical records.

The United States Department of Agriculture (USDA) performs and funds much of the agricultural research in the United States. There are over one hundred USDA entomological research facilities that purposefully rear insects in confined environments. In addition, many academic and commercial institutions are involved with research requiring insects for experimentation. Work activities may result in employee exposure to various airborne particulates such as insect parts or excrement, culture medium components, and airborne bacterial and/or fungal contaminants. Repeated exposures may result in immunologic sensitization and subsequent allergic symptoms in some workers.

Allergic symptoms associated with rearing insects in confined spaces have been known for many years. For example, watery eyes, sneezing, and asthma were reported in 1918 by a USDA entomologist rearing the New Mexico range caterpillar.(1-2) However, reports of allergic phenomena seem to have increased in frequency over the last twenty years with the increase in size and number of insect rearing facilities. In 1965 inhalant allergy symptoms were described in workers at a USDA screwworm facility.(3-4) In 1972 "terrible fits of asthma and itching eruptions of hands" were reported by USDA entomologists working with the cockroach.(5) Allergic sensitivity in USDA gypsy moth workers was studied around 1976.(6-7) Immediately prior to the request for NIOSH technical assistance, an in-house health survey conducted at a USDA insect rearing facility indicated that 40% of 100 employees were experiencing, or had experienced sometime in the past, symptoms which they felt were allergic in nature.(8) In addition, a case of hypersensitivity pneumonitis attributed to Penicillium mold had been reported in an entomologist at another USDA insect rearing facility.(9) The USDA had established an Allergen Research Division in 1936, but this operation was discontinued in 1973.(10)

III. METHODS AND MATERIALS

Questionnaire Survey

A register of current employees was developed from the USDA, ARS "Directory of Researchers Working in the Entomological Sciences." In August 1981, a health questionnaire prepared by NIOSH investigators was mailed to these workers for self-administration. (see Appendix A)

Information obtained from this "Insect Allergy Questionnaire" included basic demographic data, a brief occupational history, and smoking history. The prevalence of allergy to insects at work (affirmative response to Question 13) was ascertained. Further information was obtained from those reporting insect allergy, including types of allergic symptoms, their temporal relationship to insect exposure at the worksite, the method of contact with allergens, whether or not a physician had been seen and/or medication had been prescribed, and whether it had been necessary to stop work or be transferred to another work area or job because of health problems related to insect exposure. Also, information relating to the types of protective equipment used at the worksite was obtained from all respondents.

Insect Rearing Facility Visits

A NIOSH medical officer and/or industrial hygienist visited six ARS insect rearing facilities in order to become better acquainted with the nature of this type of work. Evaluation methods consisted of interviews with employees and supervisors, and observation of work practices.

Medical Records

At the Metabolism and Radiation Research Laboratory, Fargo, North Dakota, employees who had seen private physicians for occupationally related allergic illness were requested to authorize release of their private medical records to NIOSH. Copies of released medical records were reviewed for objective documentation of illnesses and their relationship to exposures at work.

IV. EVALUATION CRITERIA:

No specific standards exist to guide medical and environmental evaluation of occupational exposure to particulate insect matter or airborne microorganisms.

V. RESULTS

Questionnaire Survey

Employees at eighty-five of ninety-eight (87%) of ARS insect rearing facilities participated in the questionnaire survey, representing a geographical area of 37 states. There was an overall individual response rate of 71% (753/1061). For respondents, the average duration of employment at an insect rearing facility (current job assignment plus any prior job experience) was 11.7 years.

One hundred and ninety (25%) of the 753 respondent employees reported by questionnaire that they were currently experiencing, or had experienced in the past, some type of allergy related to insect exposure at work. Sixty-one percent (52/85) of respondent facilities had at least one employee reporting current or past work-related allergy. Six percent (5/85) of respondent facilities had ten or more employees reporting current or past work-related allergy. These five facilities are identified in Table 1.

Eighty-eight percent (168/190) of workers reporting work-related allergy were entomologists and laboratory technicians who work directly with insects in experimentation or rearing. (Table 2) For the 190 workers reporting allergy, the most prevalent symptoms included sneezing or running nose (73%), eye irritation (68%), skin irritation or skin rash (41%), and cough (38%). Wheezing and shortness of breath were reported by approximately 25%. (Table 3)

Forty-eight percent (92/190) stated that symptoms began within 1/2 hour after the start of exposure at work, and an additional thirty percent (57/190) between 1/2 hour to four hours. Sixty-six percent (125/190) felt that symptoms improved when going home after work, seventy-four percent (141/190) felt that symptoms improved or went away on weekends, and eighty-two percent (155/190) stated that symptoms improved or went away on vacations. Forty-four percent (83/190) saw a physician for their symptoms, and eighty-three percent of these (69/83) had treatment prescribed. Twenty-two percent (41/190) found it necessary to stop work with the insect causing their problem or be transferred to another work area or job.

Eighty-three percent (157/190) thought that airborne insect material caused their problems. The most frequently implicated insects were those in the Lepidoptera order (moths and butterflies). (Table 4) For entomologists and laboratory technicians who worked directly with insects, seventy-seven percent (130/168) of those with insect allergy problems used protective equipment to minimize exposure, compared to fifty-nine percent (188/321) of unaffected workers in the same job categories. Disposable respirators ("face masks"), ventilation hoods, and gloves were most frequently used.

Insect Rearing Facility Visits

Six insect rearing facilities were visited. A brief description of each of these follows.

1. Biological Control of Insects Research Laboratory

The Biological Control of Insects Research Laboratory, Columbia, Missouri, rears the following insects: Heliothis virescens; Heliothis zea; Anticarsia gemmatalis; Trichoplusia ni; Spodoptera frugiperda; and Plutella xylostella.

To control mold growth, insect diet is briefly heated to 100 degrees Centigrade during preparation, kept refrigerated until use, and discarded if not used within 14 days. Also, chemical inhibitors are used. To control pathogens, eggs are bathed in a 10% formaldehyde solution.

Several methods were noted that might have a direct or indirect impact on any allergic contaminants:
(a) To avoid contamination of the insect rearing laboratory with virus or bacteria, the doors to various insect rearing areas are kept locked. Only authorized personnel are allowed to enter.
(b) Light traps with suction are used to attract moths that have escaped. The captured insect drops into ethylene glycol which kills the insect and wets the remains to prevent scales from becoming airborne. Hallways are kept darkened with the only light source being these light traps.
(c) An effort is made to schedule tasks that stir up dust late in the day. This minimizes the time personnel might be exposed to dust.
(d) The ventilation system is equipped with HEPA (high efficiency particulate air) filters (effective to 0.3 microns).
(e) Laminar flow hoods are used when insects are placed on diet or harvested.
(f) Wastes are enclosed in plastic bags, sealed, and discarded into waste barrels lined with large plastic bags, which are sealed and replaced at the end of each day.
(g) The autoclave is used extensively to sterilize objects.
(h) Frequent washing of hands and forearms is encouraged as lab personnel proceed from one task to another.
(i) The building is constructed of a waterproof concrete block material to allow a thorough cleaning with a wash-down method three times per week. A solution of 180 degrees Fahrenheit water and detergent with a broad-spectrum disinfectant is sprayed with sufficient pressure to dislodge insects and particles from the walls. A wet-vacuum method is used to remove the washings. No mops, waxes, brooms, or brushes are permitted.

On the questionnaire survey, the response rate from this facility was 63% (15/24). Two respondents had indicated problems with insect allergy, but these problems had either been present before coming to work at this facility, or had developed in some area of the laboratory where the clean-up/flush-down regimen was not used. Both of these workers indicated that symptoms had improved when they worked in areas of the laboratory using this technique.

2. Boll Weevil Research Laboratory

The Boll Weevil Research Laboratory at Starkville, Mississippi, rears the following insects: Anthonomus grandis; Heliothis virescens; Heliothis zea; Spodoptera frugiperda; and Diatraea grandiosella.

A "universal cage" is used in one of the moth rearing rooms. This consists of a screen box with wax paper strips that hang vertically, providing surface area for moths to lay eggs. The lower part of the cage is slanted at a forty-five degree angle, and this faciliates collection of dead insects and scale. It also reduces any need to come in direct contact with adult moths. Several other methods to control dust were pointed out: (a) the ventilation system was turned on at 3:00 am, so minimal insect dust is present when workers arrive at 7:00 am; (b) an electrostatic dust precipitator was used; (c) the workers threw away rearing containers with Aspergillus contaminated diet without opening the container; (d) a quaternary ammonia compound was used on surfaces to reduce Aspergillus flavus and niger; (e) when raising moths in a bottle, wing scale dispersion was minimized by placing paper at the bottom of the bottle and keeping the paper moist; (f) hands were washed to avoid prolonged scale contact (or gloves were worn); and (g) respirators were used.

For the entire laboratory, the response rate to the NIOSH questionnaire was fifty-seven percent (17/30). Only three respondents had indicated a problem with work-related insect allergy. However, on tour of this facility, workers in several different work areas mentioned that they knew graduate entomology students, employed on a temporary basis, who had changed career plans because of allergy problems. In addition, at least six additional workers were identified who had health complaints related to insect exposure. Four of these six additional workers had experienced "weevil eye", consisting of redness and itching from rubbing the eye after handling a boll weevil. These workers were not included in the results of the questionnaire analysis.

3. Southern Field Crop Insect Management Laboratory

The Southern Field Crop Insect Management Laboratory, Stoneville, Mississippi, rears the following insects: Heliothis virescens; Heliothis zea; Heliothis hybrid; Anticarsia gemmatalis; Pseudoplusia includens; Spodoptera exigua; and Galleria mellonella.

During peak season, approximately twenty workers are employed at this facility. At the time of the NIOSH visit there were only five workers. Two of these had experienced work-related runny nose, sneezing, or rash at sometime during their employment. One of the symptomatic workers indicated that symptoms were present when the facility was rearing large quantities of Heliothis virescens, but disappeared when production of this insect decreased. Disposable respirators also helped to alleviate symptoms. For this laboratory, the response to the NIOSH questionnaire had been 46% (13/28), and 46% (6/13) of respondents had work-related insect allergy.

4. Otis Methods Development Center

The Otis Methods Development Center, Otis Air Force Base, Hyannis, Massachussetts, raises gypsy moths. This insect has been reported to cause outbreaks of allergic reactions in the general population.(6,7) It was the experience of the workers at the Otis facility that the gypsy moth egg, larva, pupa, and adult were all capable of producing allergic reactions. The larva was a particular problem. On escape from a container, it climbs to the highest point, and hangs from a fine silk strand. There had been an allergic worker at the lab who had walked into a hanging larva, and suffered an intense eye reaction.

Non-perishable diet components are stored in a cool room. A transparent plastic curtain separates this room from the area where the ingredients of the diet are weighed under an exhaust hood. Sorbic acid is used in the diet as a broad spectrum bacterial inhibitor, and methyl para-hydroxybenzoate is used as a mold inhibitor.

Egg masses are submerged in a 10% formalin solution for surface disinfecting. Eggs collected are given nine weeks to develop and prepare for winter. They are then chilled and stored under refrigeration for 180 days to simulate the winter diapause.

Pupae are harvested and sexed in a trailer separate from the main rearing building. The supply air for the trailer is prefiltered through HEPA filters. At each work station, a circular hole has been cut into the workbench. A screen has been placed over the hole. Workers can perform their tasks on the screen, while local exhaust ventilation draws particles down into the hole and away from the workers' breathing zone.

In the main rearing building, newly hatched larvae are placed into a diet cup by means of a brush. The air is HEPA filtered in this work area. However, workers have complained of itchy eyes, cough, and skin rash, and at the time of the NIOSH visit, one worker at this step of the production cycle was observed to have a forearm wheal.

In another room in the main building, the larva sheds its skin five times, and becomes a large caterpillar. The caterpillar spins silk and hangs from the lid of the cup. When the cup is opened, this silk, as well as hairs from the caterpillar, can become airborne. Also, the dry skins can release particles into the air when the cup is opened. The air in this room is filtered and recycled.

Adults are handled in the main building in a room with a work bench enclosed in an exhaust hood. This room has an independent air handling system, is maintained under negative pressure, and is equipped with a cyclone exhaust system. Workers can isolate themselves from the insects by using tweezers or disposable gloves. Disposable respirators are available. Escaped moths are captured with a household vacuum cleaner. Insect rearing cups are disposed of in plastic bags positioned at the side of each worker.

At the time of the NIOSH visit around 40 workers were employed. There is seasonal variation, and in June the work force can increase up to 75. Only ten workers had responded to the NIOSH questionnaire. Seven of these workers indicated that they had experienced work-related insect allergy problem.

The Otis facility also raises Epilachna varivestis. Employees complained that the adult and larval stages of this insect secreted a fluid that caused dry skin and skin rash. To counteract this, one worker would tape paper towels over the forearm area and wear long shirt sleeves and gloves. The air in the room where this insect is raised is filtered, but not by a HEPA filter, and re-circulated. The temperature is maintained at 77 degrees Fahrenheit and the relative humidity at 50% or greater. Mold growth was observed on diet dishes.

5. Forest Insect and Disease Research Laboratory

The Forest Insect and Disease Research Laboratory, Hamden, Connecticut, also raises gypsy moths, but is smaller than the Otis laboratory. It employs around 30 permanent employees, but only 4 work full time in the insect rearing area.

Gypsy moth diet is prepared in a kitchen by one worker. Two agar plates per batch of diet are placed in the rearing environment and checked for contamination. Also, when diet is prepared, subsamples are frozen. Thus, if contamination appears, the source can be located. In order to reach the kitchen, visitors must enter a "dirty room", put on shoe covers, and walk through a hallway.

There is a room for egg production, and another room for rearing. Rooms are equipped with a central in-house vacuum line, which helps to avoid the recirculation of dust that occurs when regular vacuum cleaners are used. A HEPA filtering system functions independently of the heating and cooling system. Recently, vertical laminar flow hoods have been installed. For sanitizing, rooms are sprayed with a fog consisting of 2% chlorine dioxide, washed down, and mopped. A new mop head is used each day. Lab coats, disposable gloves, and quarter-face respirators are available for use during clean up.

Airborne contamination is checked by settling plates left out for two hours. The results are expressed in colony forming units per square foot per minute. With current methods, less than 1% of diet is contaminated, but types of organisms that have been found include: Bacillus cereus; Bacillus subtilis; Group D streptococci; yellow and white micrococcus; Roto torra yeast; Penicillium; and Aspergillus niger and flavus.

There were nine respondents to the NIOSH questionnaire survey. Four (44%) of these workers indicated they had experienced work-related allergy problems. A survey by Paul Etkind in 1976, as part of a Masters of Public Health Thesis at Yale University, had found: ten of seventeen (59%) researchers at this laboratory had rash and itching when working with the gypsy moth, four of seventeen (24%) had watery eyes, and two of seventeen (12%) had rhinitis and dyspnea.(6-7)

6. Metabolism and Radiation Research Laboratory

Examples of insects reared at the Metabolism and Radiation Research Laboratory (MRRL), Fargo, North Dakota, include: Heliothis virescens; Manduca sexta; Cochliomyia hominivorax; Musca domestica; and Anthonomus grandis.

This facility consists of a complex of buildings and employs around 100 workers. There is a recent structure specifically designed for the rearing of insects. It has engineering controls such as the "room in a room concept" (where several walk-in incubation chambers are isolated in a room), local exhaust ventilation, and high efficiency filtering units.

Impinger samples and Marple cascade impactor samples collected for microscopic examination in one of the inner rooms with a moth colony revealed intact and fragmented moth scales against a background of unrecognizable particulate matter.(8) Intact scales were 150-250 microns in length, and the length was more than three times the width. Limited Andersen viable and non-viable sampling for particle size distribution of airborne dust suggested that 50% or more was capable of depositing in the major airways of the lung.

Eighty workers returned the NIOSH questionnaire (84% response rate). Fifteen of these 80 (19%) indicated that they had experienced some type of allergy related to insect exposure at work. Private medical records were obtained and reviewed for nine of the ten employees at MRRL who indicated that they had seen physicians. These are summarized below:

Employee A had onset of conjunctival inflammation, as well as nasal and sinus congestion, after working for approximately two years with various moth species. These symptoms would typically begin about one hour after exposure to moths, and would last up to one day after exposure ceased. Symptoms would not occur if and when the employee used a battery-powered, air-purifying respirator. Serologic testing for antibodies to Aspergillus as well as other standard fungal extracts was negative. Allergy skin testing gave negative results to house dust, house dust mite, a series of molds, moth scales, and adult and larval stages of the screwworm fly. A positive (2+) skin reaction occurred to an extract of the larval stage of the Heliothis moth. After the employee stopped working with Heliothis species, there was no recurrence of symptoms.

Employee B worked with both Musca domestica (housefly) and Cochliomyia homonivorax (screwworm) species and developed nasal irritation and congestion, cough, and episodes of shortness of breath with chest tightness. Serum IgE level was markedly elevated. A complete blood count revealed a normal differential with an eosinophil count of 4%. Prior eosinophil counts during employment at a different insect rearing facility (1974) were noted to be in the range of 10-15%. A recent chest x-ray (June 1981) was normal. Allergy skin testing was positive for housefly and moth extracts, as well as for extracts made from the adult stage and larval stage of the screwworm fly. A transfer from all insect-related work duties effected a resolution of symptoms.

Employee C had health problems related to Musca domestica (housefly) exposure. If, during dissection of the housefly, this employee was inadvertently pricked with a needle or scalpel, a local hive developed almost immediately. Intermittent urticaria occurred about twice a month and was associated with handling all stages of this insect. RAST testing was negative for ragweed, Penicillium, Cladosporium, Alternaria and Plantain. Skin tests to the adult and larval stages of the screwworm fly, to housefly, and to moths were all negative. The employee had no further recurrence after instituting the use of protective gloves while doing insect work.

Employee D has been working with various moth species since 1967. Since the early 1970's this employee has had problems with eyelids swelling, conjunctival injection, nasal congestion, sneezing, and occasional cough and wheezing associated with moth exposure. Precipitating antibodies against the adult and pupal stages, as well as the scales and frass of Heliothis species, were all negative. Allergy skin tests were reactive to commercially available moth extract with a 3+ wheal and flare reaction. Treatment consisted of antihistamines and avoidance.

Employee E was evaluated for the occurrence of generalized urticaria associated with exposure to scales and debris from the cockroach. The worker experienced hives with swelling on the face, arms and legs occurring within minutes after exposure. Skin tests to extracts of house dust, various molds, housefly insect, and a cockroach extract were all negative. A transfer to a new worksite with no cockroach exposure resulted in complete resolution of the problem.

Of the four other employees for whom records were reviewed, one had nasal congestion and conjunctivitis associated with screwworm fly exposure, one had skin irritation and conjunctivitis associated with cockroach exposure, and one worker had allergic rhinitis and severe bronchitis associated with moth exposure. The other worker reported work-related sore throats and swallowing difficulties. The worker's physician concluded that symptoms were caused by something other than allergy.

VI. DISCUSSION

Medical

Research concerning allergy associated with insect derived materials is important to the general public as well as to the those who work in insect rearing facilities. For example, in the home, allergic symptoms may result from exposure to the house dust mite(70,83-84) or to the cockroach(5). Allergic reactions in the general population resulting from airborne material of insect origin have been reported with May-flies(85-86), caddis flies(87), gypsy moths(6-7), and chironomids(41).

Great Britain has designated occupational asthma associated with insects in laboratories as compensable under workmen's compensation. (11) A recent bibliography documents over 300 reports of allergic reactions where exposure to allergens occurs or probably occurs through the inhalation of insect derived materials. (12) Most of these are case reports of individual allergic responses to various individual insect species.

Prior reports of allergic sensitization of workers in facilities which rear insects include: moths (1-2, 6-7, 13); grain weevils (14-16); crickets (17); cockroaches (5); screwworms (3-4); and locusts (18-19). Other occupations in which insect allergy has been implicated as a problem include: silk workers (20-21); cosmetic dye workers (22); millers (15,23); bakers (24); bean sorters (25); sewage workers (26); museum curators (27); pet fish food producers (28); beekeepers (31-32); farmers (33-35); rubber plantation workers (36); mushroom growers (37); loggers (38-39); dredge operators (85); dockmen (27); railway workers (40); and flight crew members (3-4,41).

An awareness of a significant prevalence of respiratory allergies among insect workers has led to the recent formation of a national "Insect Allergy Committee" by the Entomological Society of America. A pilot mail survey was recently conducted by Dr. Robert A. Wirtz at 136 educational, government and private institutions rearing insects in the United States. (42) The total number of workers surveyed was not reported, but 50 (60%) of the eighty-four respondent institutions had at least one individual with an allergy related to occupational exposure to an arthropod, host animal, or diet. Allergic conditions were reported by 115 individuals. Lepidoptera were the prominent source of allergic responses, with 67% of the 115 attributing their symptoms to moths and/or butterflies. Twelve percent of respondents reported allergic reactions to cockroach and locust species. Types of allergic symptoms reported included sneezing and running nose (67%), skin irritation (62%), eye irritation (61%) and "breathing difficulty" (33%).

The symptoms reported on the NIOSH questionnaire (Appendix A) are consistent with the findings of Dr. Wirtz, and also with other reports in the medical literature indicating that eye irritation, respiratory symptoms (sneezing, cough, chest tightness), and skin irritation or skin rash are the major symptoms in those with complaints of insect allergy. (19) The frequency of Lepidoptera-related allergic symptoms in ARS facilities is also consistent with the survey results of Dr. Wirtz.

With the NIOSH questionnaire, the occurrence of allergic manifestations appeared to be clearly related to job exposures. Thirty-three percent (168/507) of entomologists and laboratory technicians working with insects reported insect allergy, accounting for 88% (168/190) of the total. A problem with the questionnaire is the potential for biased conclusions resulting from the highly subjective assessment of symptoms and their cause by the respondents. However, the questionnaire proved useful as a screening tool, and medical records at least at one facility appeared to validate the questionnaire responses for many of those who sought medical care for their problems.

Inhalation of airborne material was reported by symptomatic workers as the mechanism most frequently responsible for allergic symptoms at insect rearing facilities. This material may include proteinaceous material from fragments of insects (e.g., scales) and/or their exuviae or feces. Other potential airborne agents include fungal or bacterial

contaminants, plant pollen, animal dander, Dermatophagoides species (house dust mite), insect diet components, and volatile chemicals (e.g., formaldehyde). (43) Combinations of these, cross-reactions between antigens from different insect species, and interactions with humidity, temperature, and non-work related antigens also may be involved in allergy symptoms at insect rearing facilities. (44-47)

Allergy to cockroaches (29) and chironomids(41) has been associated with a Type I (immediate, IgE-mediated) immunologic response.(48) However, it is possible that other types of immunologic response may be involved.(19,88) Several individuals at MRRL had positive immediate skin tests to crude insect-derived extracts, but other symptomatic individuals at MRRL were noted to have negative skin tests. Possible explanations in addition to variation in immunologic response would include unstandardized antigens and/or variation in testing techniques and scoring systems.(94)

Some workers at insect rearing facilities appear to be experiencing symptoms of asthma (chest tightness and wheezing) which are typically associated with acute impairment of respiratory function. Whether chronic impairment of lung function may result from work with insects is not known. At an insect rearing facility in Great Britain, mean FEV_1 was slightly (but not significantly) lower in 13 workers with occupational asthma compared to 10 workers with rhinitis and 91 unaffected workers. (19) In this facility, specific IgG and IgE levels to locust antigens were elevated in workers with work-related asthma. Those with work-related rhinitis had elevated specific IgG antibodies, but not IgE antibodies.

The high temperatures and humidities required for productive insect rearing also may encourage growth of various fungi, many of which are known antigens for hypersensitivity reactions. A case of documented hypersensitivity pneumonitis from Penicillium species has been documented in an entomologist working at an ARS insect rearing laboratory. (9,58)

Medical therapy depends upon the severity of symptoms and the frequency of exposure.(90) Desensitization therapy is reserved for those where more simple medical therapy and avoidance are unsuccessful, and where specific antigens can be identified. Desensitization therapy is effective for IgE-mediated life threatening reactions from specific hymenoptera venoms (30,51), and also for IgE-mediated seasonal allergic rhinitis from grass-pollen sensitivity.(90) There is controversy about the value of desensitization for extrinsic asthma.(92-93) The efficacy of desensitization therapy for allergens in USDA insect rearing facilities is unknown. The NIOSH questionnaire survey suggests that job

transfer or career change was required in twenty-two percent of insect rearing facility employees with work-related allergic symptoms. Medications may be developed in the future that would allow more effective case management. Sodium cromoglycate would be a current example of a medicine under evaluation. (91)

There is tremendous individual variation in susceptibility to sensitizing substances, and there is some evidence suggesting that atopy (hereditary allergic status) may be associated with increased risk of sensitization to biological detergents (59-60), platinum salts (61), laboratory animals (62-64,89), locusts (19), and gypsy moths (6-7). However, some sensitizing agents seem to be able to induce asthma in non-atopic individuals. (60,96-97) Knowledge about the importance of atopy in relation to specific exposures is very limited at this time, and a reactive skin test may not necessarily imply a greater likelihood of respiratory symptoms developing.(49-57,60,94) Standardized extracts for testing allergy to the types of insects reared in USDA facilities have yet to be perfected, and the available data on workers in insect rearing facilities probably is not sufficiently strong to support an employment policy of excluding all atopics. If there were such a policy, it should be pointed out that a considerable proportion of job applicants (30% or greater) might have to be excluded.(49,65)

Further investigations of occupational insect allergy might provide the greatest benefit to ARS insect rearing facility workers if efforts are focused on facilities with: moth scales; a large number of exposed workers; and a high prevalence of symptoms in those workers. An example of such a facility might be the Insect Attractants, Behavior, and Basic Biologic Research Laboratory, located in Gainesville, Florida. This facility raises several types of moths: Plodia interpunctella; Galleria mellonella; Ephestia cautella; Trichoplusia ni; and various Heliothis species. On the NIOSH questionnaire survey, there were 45 respondents (78% response rate). Twenty (44%) reported a work-related allergy problem, and moths were implicated in 95% (19/20).

A medical surveillance system has been established for workers in the Agricultural Research Service.(98) The system provides an annual questionnaire and consultation with a physician. The questionnaire for this program was designed so that it could be used for multiple occupations within the USDA. As a result, there is some compromise on the nature of the questions in comparison, for example, to a specific questionnaire designed for a specific insect rearing facility. Nevertheless, the questionnaire is acceptable, because: (a) the employee's supervisor is consulted for confirmation of environmental exposure agents; (b) there is opportunity for the physician to review the answers to the questionnaire directly with the worker; and (c) the questionnaire asks about: chronic cough; shortness of breath; asthma; bronchitis; nasal irritation; hives; eczema; rash; nasal allergy; conjunctivitis; medicine use (antihistamines and steriods); allergies to

insect scales, pollens, plants, beesting, housedust, and animal dander; and a set of questions that might be used to discriminate the nature of the allergic reaction ("Do you react with rash? hives? hayfever?").

At this time, with regards to screening for health effects of insect dust, the usefulness of information from a chest x-ray, routine urinalysis, or blood chemistry screen would appear to be minimal or unproven.(99) Pulmonary function testing might be useful if the tests conform with American Thoracic Association recommendations(100-101) and are administered to measure acute as well as chronic impairment.

The science of allergy is continually advancing. There are a variety of medical tests that clinicians use to assess individual cases with symptoms of allergy. However, tests that have a place in the diagnosis of an individual case may be less appropriate for routine screening of asymptomatic workers. A well-designed research study would be needed to evaluate the practical utility, in the context of the USDA Health Maintenance Program, of routine assessment of various immunologic factors (for example, the percent eosinophils in a complete blood count, total IgE, and/or IgE directed at specific insect antigens).(102-104) If suitable tests develop in the future, it may become standard practice to obtain, freeze, and store a pre-employment serum specimen, so that seroconversion can be better documented in those workers who eventually develop allergic symptoms.

Environmental

Limited sampling for particle size distribution suggested that 50% was in a size range capable of depositing in the major airways of the lung, and this could cause asthma in hypersensitive individuals. Particles in this size range may become airborne with minimal agitation and then stay airborne for considerable periods of time. Furthermore, because these particles are not visible to the unaided eye, an insectary employee may not recognize exposure until after sensitization has occurred.

Particles in this size range should be readily captured by local exhaust ventilation when work is performed within six inches of the exhaust. HEPA (high efficiency particulate air) filters remove more than 99% of the particles down to 0.3 microns in size, and therefore should effectively control concentrations of smaller airborne particulates. The Racal Airstream Powered Air Purifying Respirators used in some insectaries are more than 99% effective against particles as small as 0.5 microns in diameter. Thus, these respirators should provide effective protection against the particles encountered, and are preferable to disposable, single use respirators, in terms of comfort as well as protection of eyes and face from contact with airborne particles.

Larger size particles such as moth scales and hairs require a much higher ventilation capture velocity. Local exhaust ventilation may be ineffective, unless it is the type of system utilized at the Otis Methods Development Center, where insects are handled on top of a screen covering an exhaust hole cut into the work bench. Also, the larger particulates tend to settle out of the air by gravity onto work surfaces and/or the worker, causing irritation on contact, for example, with the skin, eye, or nose. While high efficiency air-filter devices should be fairly effective against the smaller airborne particulates, the larger particulates may never reach the high efficiency air-filter devices. Thus, a very thorough wet-method cleaning of work surfaces after every use is appropriate to prevent skin contact with the settled larger particulates, in addition to the use of personal protective clothing such as long-sleeve lab coats and disposable gloves.

During insect rearing facility visits, respirators were occasionally found lying about the insectary. This practice allows particles to settle onto the inside of the respirator, with subsequent inhalation of particles from the inside of the respirator when it is used. Also, respirators that are not NIOSH-certified were observed to be in use. In addition, at least one instance was noted where a worker had turned off a HEPA filtering unit because the sound was annoying.

In some insectaries, horizontal laminar flow hood units protect the item(s) being worked on (rather than the employee performing the work) by directing HEPA-filtered air horizontally across the work area toward the worker. Vertical flow laminar hoods would reduce the chances of a worker inhaling insect-related material or having this material come in contact with the eyes, skin, or hair.

Several employees were observed working at the horizontal hoods without full personal protective equipment. Those who have become sensitized appear to use protective equipment more judiciously than those who have not yet become sensitized. The latter group may not fully understand that this equipment is probably more efficacious for preventing sensitization than for preventing symptoms in those already sensitized. Allergic symptoms may occur with exposure to very small quantities of antigen. Once a worker becomes immunologically sensitized, reactions are possible at allergen concentrations much less than those required for sensitization.(71)

A basic goal of industrial hygiene is reduction of the concentration of airborne hazardous materials. This principle also holds for airborne allergens. (64, 71-73) Since the exact nature of the antigen(s) at insect rearing facilities has not been identified, control efforts must be focused on a reduction in total airborne particulate matter.

In addition to devices such as HEPA filters and laminar flow hoods, there are several other devices and procedures that potentially might help reduce exposure. For example, with regards to rearing of Heliothis species, a universal cage has been developed that allows moth scale to collect at the bottom of the cage and be removed in an efficient manner. (74-75) A suction apparatus has been designed that does not appear to disturb the moth but allows moth scale to be vacuumed directly from the cage. (76) A central vacuum system (no exhaust into room being cleaned) has been developed specifically for insectaries. (77) When raising moths in a bottle, wing scale dispersion may be minimized by placing paper at the bottom of the bottle and keeping the paper moist. Entomologists learned many years ago that wet-down methods helped to control allergic symptoms associated with insect rearing, and regular cleaning with simple soap and water should not be neglected. (1,,78)

Workers did not have work-related allergic complaints in areas of an insectary where there was thorough cleaning with a pressurized wet-spray wash-down method three times per week. Wet methods are advantageous because they generally prevent particles from becoming resuspended in air and also provide a convenient means of applying an antiseptic/detergent. The major disadvantages of a wet process are: electrical problems; water damage to certain building materials, furnishings, and equipment; water or humidity damage to HEPA filters; and possibly problems associated with mold growth where there is incomplete removal of moisture.

Fully employing a wet clean-up procedure, even if it requires remodeling and removal of incompatible fabric-covered materials and carpets, would be recommended by: (a) Dr. David Hoffman, Research Entomologist, Biological Control of Insects Research Laboratory, Columbia, Missouri; (b) Dr. Thomas O'Dell, Research Entomologist, USDA North Eastern Forest Experiment Station, Hamden, Connecticut; and (c) Dr. Peter Sikorowski, Professor, Department of Entomology, Mississippi State University, Mississippi.(79-80) Also, this approach would be consistent with: (a) Centers for Disease Control (CDC) Guidelines for Hospital Environmental Control suggesting that carpets not be used in areas where spillage or heavy soilage is likely, such as a laboratory, kitchen, or utility room (81-82); and (b) traditional recommendations by many allergists for control of house dust, that bedroom carpets be removed and that the floor be left bare. (44, 83-84)

However, there is no definitive scientific data concerning the various devices and procedures employed to help reduce allergenic exposure. Insectaries that do not use the specific devices and methods enumerated in this report may have developed alternatives that are equally or more effective. While Dr. Hoffman's pressurized wet-spray method seems to work, it may be overly conservative. Some flexibility would seem appropriate as to whether the method of cleaning involves a

pressurized-spray wash-down, a conscientious sponging with an antiseptic detergent solution, or a central dry vacuum (no exhaust into room being cleaned). For example, if there is potential for electrical problems or water damage to HEPA filters with the pressurized-spray, a combination of conscientious sponging and the central vacuum might be more suitable. However, if there is proper building design, the pressurized-spray has appeal as a simple technique that should be relatively easy to execute and monitor, especially in insect rearing chambers. For an individual facility, the specific techniques used and the frequency are best determined using a common sense approach, by a committee consisting of management, employees, and an individual with background in health and safety (e.g., an occupational nurse or physician, an industrial hygienist, or a safety specialist).

There also is no definitive scientific data on building design with regards to reducing worker contact with potentially allergenic insect material. There would appear to be at least two approaches, each of which, from an industrial hygiene point of view, has some merit. The approach preferred by NIOSH would be to designate an entire building structure for insect rearing and nothing else. The building would be "strictly business" on the inside (e.g., waterproof concrete block surfaces that can be hosed down, high efficiency filtering units and single-pass air from an independent system, and proper use of personal protective equipment such as respirators, gloves, lab coats, and shoe covers). Also, access would be restricted (e.g., locked doors and darkened entry hallways with the only light source being insect light traps). This approach segregates the insect rearing facility as an area of high allergenic hazard, reduces the number of people exposed, facilitates use of the wet method of cleaning, and is particularly reasonable in a facility large enough to dedicate an entire building to the sole purpose of rearing insects.

An alternative approach would emphasize good industrial hygiene in the laboratory, use layered containment and stringent handling procedures, and perhaps is more realistic for some existing ARS facilities where limited numbers of insects are reared, or where there is intermittent use of insects in small numbers, or where the cost of remodeling would be excessive. As outlined by David Easton, industrial hygienist for the USDA, the goal would be to maintain the general laboratory as an area with no potential contact with potentially allergenic insect material.(95) "Dirty" (contaminated) areas and "clean" (uncontaminated areas)" would be designated. Primary containment efforts would be focused at the source of generation. For example, insect rearing would be confined to a "room in a room", and the insect rearing chambers would be ventilated with single-pass air from an independent system. The pressurized-spray wash-down method or a conscientious sponging would be stringently applied where rearing actually occurred. No person would be allowed to enter a rearing chamber without gloves, lab coat, and

respirator. No food would be allowed in the lab. Work stations would be equipped with particulate capturing and air-cleaning devices. Proper use and storage of respirators, gloves, and lab coats would be mandated at the work stations by written handling procedures and enforced through conscientious supervision. Work stations would be cleaned after each use by the wash-down method or by a thorough sponging with an antiseptic detergent solution. For purposes of transport, a mobile isolation unit would be used (e.g., a cart with a plexiglass enclosure equipped with a filtered port for air circulation).

Once an individual becomes sensitized only a very minute exposure is needed to trigger an allergic reaction. The key to an effective anti-allergy program is to prevent sensitization from developing in the first place. If a comprehensive program to limit exposure can be implemented before sensitization develops, it stands a reasonable chance of being effective. However, the very same program applied after sensitization has occurred may not control symptoms, and the worker may have to be removed from the job. It is the nature of allergy that only some individuals are susceptible to sensitization, but full cooperation is required of everyone within a given work area to execute an effective program.

The recommendations that follow are offered as general recommendations to enhance the current efforts by USDA. They are based on the limited information available at this time.

VII. RECOMMENDATIONS

Medical

(1) Medical surveillance should be made available to all workers (including temporary and part-time employees) exposed to insects in the workplace. This should include preplacement and at least annual medical questionnaires with emphasis on allergic symptoms. These questionnaires should be reviewed by a physician who is aware of the existing medical literature concerning insect related allergies. Any employee felt to have medical conditions or symptoms that may be caused or aggravated by exposure to insect material should have more thorough medical evaluation to document whether or not work-related illness exists and to recommend medical treatment and/or total allergen avoidance as appropriate for the frequency and severity of the illness.

(2) Aggregate results of the data generated by this health maintenance program should be reviewed for each USDA insect rearing facility on an annual basis, and a determination made as to whether any modification or corrective action is appropriate.

(3) Physicians involved in the surveillance activity should make a personal inspection of any worksite for which they have responsibility, to better learn the nature of the job exposures and the health problems.

(4) Future research should focus on development of antigen extracts that are standardized with regards to identity, purity, potency, sterility, and safety. Also, investigations are needed which, in standard fashion, assess various immunologic factors (for example, the percent eosinophils in a complete blood count, total IgE, and/or IgE directed at specific insect antigens) and their relation to other signs and symptoms of disease.

Environmental

(1) An insect allergy health and safety committee consisting of management, employees, and an individual with background in health and safety should meet together regularly at each USDA insect rearing facility to work out the specific details of what is most appropriate for that particular facility and to evaluate compliance. Examples of issues for consideration by this committee might include the delineation of areas of possible contamination, the cleaning regimen for corridors and general laboratory space, scheduling of work so that dusty chores are done later in the day, and scheduling cleaning so that it will not interfere with work.

(2) For many laboratories, a simple program of conscientious cleaning and good industrial hygiene practice would be a great improvement, and may be all that is needed. Employees should be educated about the problem of insect allergy and the need to control exposure so that sensitivity does not develop. Formal handling procedures should be developed to limit contact with insects and exposure to airborne contaminants associated with insect rearing. Compliance with these procedures should be strictly enforced by supervisors. Consistent use should be made of the personal protective equipment currently available, including lab coats, gloves, and respirators. When not in use respirators and other personal protective equipment should be stored so that particulates cannot accumulate inside them. Only NIOSH-certified respirators should be available. A battery powered, air-purifying, full face-piece respirator is preferable to disposable, single-use respirators.

(3) Insect colonies scattered in several different locations should be segregated in one building, or in one part of one building, to as great an extent as feasible. Insect rearing facilities should be used for insect rearing and nothing else. Access should be restricted.

(4) Lab coats and disposable gloves should be worn at all hoods and insect-handling work stations. Horizontal laminar flow hoods should be replaced by vertical laminar flow hoods or similar devices so that the worker does not inhale air that has passed across insects. Until this can be accomplished, if work at a horizontal laminar flow hood is absolutely unavoidable, then a powered air-purifying full-face respirator should be worn.

(5) Facilities should be designed in the future to accommodate wet cleaning procedures. The use of carpeting and other dust-retaining items (such as drapes, bookshelves, and fabric-covered furniture) should be discontinued in areas where insects are routinely present. In future design of facilities where insect rearing will constitute a full-time activity, the air handling system for insect rearing chambers and/or rooms should be independent from that for the general laboratory area and office space, and have single pass air. This ventilation system should be functioning before an employee enters the rearing chamber. In addition, the air handling system for the general laboratory space where insects are handled should be independent from the general office space as well as from insect rearing chambers and/or rooms. The air handling systems for the general laboratory should be equipped with high efficiency filters. A schedule for periodic inspection and maintenance of the air handling systems should be formalized and documented by a log or notebook.

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Table 1
Insect Rearing Facility Questionnaire Response Rate
Where Number of Respondents Reporting Insect Allergy Was Ten or More

Laboratory	Questionnaires Sent	Received	Response Rate	Repondents Reporting Insect Allergy
Insect Attractants, Behavior, and Basic Biological Research Lab, Florida	58	45	78%	20 (44%)
Metabolism and Radiation Research Lab, North Dakota	94	80	85%	15 (19%)
Stored-Product Insects Research and Development Lab, Georgia	57	31	54%	12 (39%)
Yakima Agricultural Research Lab, Washington	27	28	100%	10 (36%)
Insects Affecting Man and Animals Research Lab, Florida	70	52	74%	10 (19%)
Facilities with less than ten respondents reporting allergy(n=80)	755	517	68%	123 (24%)
Overall Total	1061	753	71%	190 (25%)

TABLE 2

RESPONSES TO INSECT ALLERGY QUESTIONNAIRE
IN RELATION TO JOB CODES

Job Description	Job Code	Total Respondents #	Respondents Reporting Insect Allergy
Clerical workers: including secretarial staff/administrators	01	41	3 (7%)
Research entomologists: whose work entails some contact with insects in experimentation and/or rearing	02	258	77 (30%)
Research entomologists: who perform insect-related research but who have no direct contact with insects and/or rearing	03	65	9 (14%)
Laboratory technicians: who work directly with insect experimentation and/or rearing	04	249	91 (37%)
Laboratory technicians: assisting in insect related research projects, but having no direct contact with insects and/or rearing	05	28	0 (0%)
Researcher: plant research projects	06	24	2 (8%)
Researcher: animal research projects	07	13	0 (0%)
Laboratory technicians: working or assisting in projects with no direct contact with insects in non-entomological areas (plant or animal physiology)	08	7	0 (0%)
Maintenance/custodial staff: including machinists, engineers	09	31	6 (19%)
Researchers: all others (chemists, microbiologists)	10	37	2 (5%)
Totals		753	190 (25%)

TABLE 3

REPORTED ALLERGIC SYMPTOMS
(Multiple Responses from 190 Respondents)

	Number of Responses	
Sneezing or running nose	138	(73%)
Eye irritation	130	(68%)
Skin irritation or skin rash	77	(41%)
Cough	72	(38%)
Chest tightness	56	(29%)
Wheezing	49	(26%)
Shortness of breath	46	(24%)

Table 4
Insects Associated with Work-Related Symptoms
(Current and Past)

(Multiple Responses from 190 Respondents)

Arthropods

Order	Species	Number of Responses
Lepidoptera	Heliothis species (a)	75
	Lymantria dispar	14
	Spodoptera species (b)	17
	Trichoplusia ni	13
	Manduca sexta	9
	Laspeyresia pomonella	9
	Pectinophora gossypiella	7
	Ostrinia nubilalis	5
	Ephestia cautella	5
	Pseudoplusia includens	4
	Anticarsia gemmatalis	4
	Galleria mellonella	4
	Plodia interpunctella	3
	Sitotroga cerealella	3
	Bombyx mori	2
	Loxagrotis albicosta	2
	Other (c)	7
	Moths (unspecified)	3
Hymenoptera	Apis mellifera	10
	Solenopsis invicta	3
	Trybliographa species	2
	Trichogramma species	2
	"Bees", nonspecific	1
	Others (d)	3
Coleoptera	Tribolium species	4
	Anthonomus grandis	3
	Hypera postica	3
	Diabrotica virgifera	3
	Diabrotica longicornis	2
	Rhyzopertha dominica	2
	Other (e)	8

Table 4
Insects Associated with Work-Related Symptoms
(cont'd)

Diptera	Musca domestica	7
	Aedes species	6
	Cochliomyia hominivorax	4
	Haematobia irritans	2
	Stomoxys calcitrans	2
	Anastrepha suspensa	2
	Anopheles species	2
	Toxorhanchites rutilus	2
	Other (f)	1
Orthoptera	Leucophaea maderae	5
	Melanoplus species	2
	Blattella germanica	4
	Periplaneta americana	2
	Nonspecified	1
Heteroptera	Geocoris species	2
	Other (g)	2
Homoptera	Other (h)	2
Acari	Ornithodoros species	1
	Tetranychus urticae	1

(a) Heliothis virescens -38; Heliothis zea -32; Heliothis subflexa -5.
(b) Spodoptera frugiperda -13; Spodoptera exigua -4.
(c) Single response to: Autographa californica , Anarsia lineatella , Diatraea grandiosella , Harrisinia brillians , Anagasta kuehniella , Diatraea saccharalis .
(d) Single response to: Megachile rotundata , Bruchophagus roddi, Vespula pensylvanica .
(e) Single response to: Leptinotarsa decemlineata, Diabrotica undecimpunctata , Tenebrio species , Attagenus megatoma , Sitophilus oryzae , Lasioderma serricorne , Scolytus multistriatus , Epilachna varivestis .
(f) Single response to: Culex species.
(g) Single response to: Oncopeltus fasciatus , Podisus maculiventris .
(h) Single response to: Macrosteles fascifrons , Exitianus exitiosus.

Appendix A
Insect Allergy Questionnaire

(Please Print)

SUBJECT IDENTIFICATION

LAST NAME _

FIRST NAME _ _ _ _ _ _ _ _ _ _ _ _ _ MIDDLE INITIAL _

ADDRESS _

CITY _ STATE _ _

ZIP CODE _ _ _ _ _ TELEPHONE _ _ _ (Area Code) _ _ _ _ _ _ _ _

PERSONAL DATA

SEX: Male ___ Female ___ DATE OF BIRTH _ _ (Mo) _ _ (Day) _ _ (Yr)

What was your age on your last birthday? _ _ yrs.

Under federal law, people participating in our surveys DO NOT have to tell us their social security number. However, it is very useful and helps us in follow-up studies. May we have your social security number?

SOCIAL SECURITY NUMBER _ _ _ _ _ _ _ _ _

Current U.S.D.A. Work Location: _____

How long have you been working at an insect rearing facility? _____ Years

What is your job title? _____

Briefly describe your work duties: (with special emphasis on those duties that bring you into contact with insects)

_____

_____

_____

_____

Please answer the following questions yes or no whenever possible:

COUGH		COMMENTS
1. Do you usually cough first thing in the morning in the winter?	_____ Yes _____ No	Count a cough with first smoke or on first going out of doors.

		COMMENTS
2. Do you usually cough during the rest of the day in the winter?	____ Yes ____ No	"Usually" means 5 or more days per week.

If Yes to either of the above:

3. Do you cough like this on most days for as much as three months during the year?	___ Yes ___ No	Exclude clearing throat or a single cough.
4. How many years have you coughed like this?	___ Yrs.	Ignore an occasional cough.

PHLEGM

5. Do you usually bring up phlegm from your chest first thing in the morning in the winter?	___ Yes ___ No	Count phlegm with first smoke, or on first going out of doors.
6. Do you usually bring up phlegm during the rest of the day in the winter?	___ Yes ___ No	Count phlegm produced twice or more per day.

If Yes to either of the above:

7. Do you bring up phlegm like this for as much as 3 months during the year?	___ Yes ___ No	Count swallowed phlegm. Exclude phlegm from nose.
8. How many years have you brought up phlegm like this?	___ Yrs	"Usually" means 5 or more days per week.

WHEEZING

9. Does your chest ever sound wheezing or whistling?	___ Yes ___ No

If Yes:

10. Do you get this on most days?	___ Yes	___ No
11. Do you get this on most nights?	___ Yes	___ No

ALLERGY HISTORY

12. OUTSIDE OF THE WORKPLACE, have you ever had: (check appropriate items)

___ Hayfever
___ Asthma
___ Hives
___ Eczema
___ Food Allergies
___ Allergies to Medicines
___ Allergy to Animals
_____ Other (Specify)

ALLERGY HISTORY: AT THE WORKSITE

13. Do you feel that you have allergies related to insect exposure at work?

___ Yes ___ No

If Yes, please answer the following questions: If No, please go directly to Question 23.

14. How many species of insects are you exposed to at work? _____

15. What do you think causes your occupational allergy?

Arthropod: Names: Genus _____ Species _____

Genus _____ Species _____

Genus _____ Species _____

Host Animal: Names _____

Diet: Names _____

Other: _____

16. What kind of symptoms do you experience? (Check appropriate items)

___ Sneezing or running nose
___ Skin irritation or skin rash
___ Headache
___ Eye Irritation
___ Cough
___ Chest tightness
___ Shortness of breath
___ Wheezing
___ Nausea
___ Anaphylactic Shock
Other _____

17. How long after start of your exposure at work do symptoms begin?

___ Within 1/2 hour
___ Between 1/2 - 4 hours
___ Between 4 - 8 hours
___ Other (specify) : _____

18. Do your symptoms improve when you go home after work? ___ Yes ___ No

19. Do your symptoms improve or go away or weekends? ___ Yes ___ No

20. Do your symptoms improve or go away or vacations? ___ Yes ___ No

21. What method of contact seems to cause your allergy? (Check all that apply)

___ Airborne material
___ Direct contact with an insect or insect part. Specify: _____
___ Bite
___ Sting
Other _____

22. Have you had to see a physician concerning work related allergies or other work related health problems? ___ Yes ___ No

If Yes, did this require medication or medical treatment? ___ Yes ___ No

Briefly describe: _____

_____

23. Do you use protective equipment when working? ___ Yes ___ No

If Yes, which of the following is used: (Check all that apply)

___ Face mask
___ Hood (laminar flow/exhaust)
___ Gloves
___ Head net
Other _____

24. Has it been necessary for you to stop work or to be transferred to another work area or job or take another action (explain) because of health problems related to insect exposure?

___ No ___ Yes (explain) _____

25. Are you a cigarette smoker? ___ Yes ___ No ___ Exsmoker

26. Any further comments regarding health aspects of working at an insect rearing facility would be greatly appreciated:

_____

_____

_____

THANK YOU FOR FILLING OUT THIS QUESTIONNAIRE. Please return it by mail in the enclosed addressed envelope. If you have any questions about the project or related matters, please contact the Project Officer, Dr. Michael A. Bauer, by phone (FTS 923-7755) or commercial no. 304-599-7755) or by mail (NIOSH-CIB, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505).

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