

WORK-RELATED ALLERGIES AND ASTHMA FROM EXPOSURE TO INSECTS

Cockroaches and dust mites are common environmental allergens for children and young adults. Approximately 8% of the U.S. population have a positive skin prick test to cockroaches and 10% to house dust mites.¹ Exposure to cockroaches, mites and multiple other species of insects can cause work-related allergies and asthma. Workplace exposures to insects causing allergic disease has occurred where the insects are part of the production process (fish bait manufacturing, labs or facilities raising insects for pest control) or where insect infestations have occurred in workplaces (flour and grain handling facilities including bakeries or farms, hydroelectric dams or mushroom growing facilities). Given that the protein antigens in the insects are large molecular weight compounds, patients with work-related allergies and/or asthma have generally had both positive skin prick testing and specific IgE results to extracts of the insects, their larvae or their eggs.

INSECTS USED FOR FISH BAIT

Bee or greater wax moth (*Galleria melonella*)

The bee moth is an insect in the order *Lepidoptera*, family *Pyralidae*, which parasitizes honeybee hives. It is used as live fishing bait. It is also used in research laboratories as a substitute for mice/rats. It is found worldwide. Work-related asthma has been reported in both Italy and Michigan among workers raising the bee wax moth to produce live bait.²

Common greenbottle (*Lucilia caesar*)

Lucilia caesar is a member of the fly family *Calliphoridae*, commonly known as blow flies. It is in the order *Diptera*. It is found in Europe, North Africa and Asia. Its larvae are used for fish bait. The larva feed on carrion. There are approximately 1,100 species. *Lucilia cuprina* (Australian Sheep Blowfly) also causes work-related asthma in sheep farmers in Australia. The reports of work-related asthma from *Lucilia caesar* have been among fishermen in Italy.³

Mealworm beetle (*Tenebrio molitor*)

Mealworms are the larvae of the mealworm beetle, which having spread through commercial trade, are found throughout the world. It is in the order *Coleoptera*, family *Tenebrionidae*. There are approximately 20,000 species of beetles in the *Tenebrionidae* family. Darkling beetles are the common name for beetles in this family. Their larvae feed on grain. Because of their large size, they are eaten, used in research, and as fish bait. Five workers handling fish bait in Ohio developed asthma, rhinitis and urticaria from exposure to particulates of the beetle's exoskeleton.⁴ Grain workers in Wisconsin, with allergic sensitization to the mealworm beetle, have also been reported.

INSECTS IN LABORATORIES AND PRODUCTION FACILITIES

Australian Sheep Blowfly (*Lucilia cuprina*)

The Australian Sheep blowfly is in the order *Diptera*, family *Calliphoridae*. The fly lays eggs in carcasses and open wounds of sheep. The larvae of the blowfly can cause a large enough amount of tissue destruction to kill the sheep. Besides Australia, blowflies are found in Africa and North America. There are approximately 1,000 species of blowflies. Workers from Australian entomology laboratories were reported with work-related asthma.⁵

Colorado potato beetle (*Leptinotarsa decemlineata*)

The Colorado potato beetle is native to North America. It has a strong association with plants in the *Solanaceae* family, including potatoes. The beetle is an important agricultural pest on commercial potatoes. There are more than 40 species of beetles in the *Leptinotarsa* genus. There was a report of work-related asthma among workers at an Italian laboratory developing biological controls for the potato beetle.⁶

Cricket (*Acheta domesticus*)

There are 900 known species of cricket in the family *Gyrillida*. They are found throughout the world. The house cricket, *Acheta domesticus*, is a native of Southwestern Asia and was the standard food for pets and research labs. The cricket was also kept as a pet. A virus in 2010 in the United States destroyed the house cricket. The Jamaican field cricket (*Gryllus assimilis*) which is resistant to the virus, has replaced the house cricket in the commercial market. The Jamaican field cricket is found in the Caribbean, South and Central America and the southern United States. Occupational asthma has been reported among workers raising crickets in Michigan, Saudi Arabia, and Spain.⁷

European corn borer (*Ostrinia nubilalis*)

The European corn borer is also known as the European corn worm or European high-flyer. It is a grass moth in the family *Crambidae*. It was first found in the United States and Canada in the early 1900's. Its primary target plant is corn but will feed on other plants. Genetically modified corn kills the larvae of European corn borer. There is a report of work-related asthma from an Italian laboratory that produced biological controls for the European corn borer.⁶



(European corn borer)

Fruit Fly (*Drosophila melanogaster*)

The fruit fly is a species in the family *Drosophilidae*. Another name is the vinegar fly. Since 1910, *Drosophila melanogaster* has been a model organism bred in captivity and used in laboratories for genetic studies. It can also be found in rotten fruit. The Mediterranean fruit fly (*Ceratitiscapitate*) is a commercial pest in a separate family *Tephritidae*. Laboratory workers from Holland working with *Drosophila melanogaster* have been reported with work-related asthma.⁸

Green Lacewing (*Chrysoperla carnea*)

Green lacewing (*Chrysoperla carnea*) is an insect in the *Chrysopidae* family, whose larvae feed on aphids and other insects, and is used in biological control. It is found throughout the world. There is a report of work-related asthma from an Italian facility producing beneficial arthropods.⁶

Honeybee (*Apis mellifera*) and Bumblebee (*Bombus terrestris*)

There are seven species of honeybee. The Western or European honeybee has been domesticated for honey production for thousands of years. It is in the family *Apidae*. The Africanized honeybee is a hybrid of the African honeybee *Apis mellifera scutellata* and either *Apis mellifera ligustica* or *Apis mellifera iberiensis*. The Africanized honeybee was introduced in Brazil in the 1950's and has spread north. An allergic reaction to the venom in a bee sting is the most common reaction to individuals who work with honeybees; however, inhalation allergies to proteins in the bee and larvae have been recognized.⁹ Seven workers at a bumblebee (*Bombus terrestris*) farm in Belgium had anaphylactic reactions to bumblebee protein and were successfully desensitized with allergy shots containing honeybee venom.

Lesser mealworm beetle (*Alphitobius diaperinus*)

Lesser mealworms are the larvae of the litter beetle, which is found throughout the world. *Alphitobius diaperinus* is a species of beetle in the order *Coleoptera*, family *Tenebrionidae*, and genus *Alphitobius*. Darkling beetles are the common name for beetles in the family *Tenebrionidae*. Their larvae feed on grain. Along with *Dermestes* beetles, they are used in museums to clean tissues off specimen carcasses. They are also used for pet reptile food. Two workers from an entomology laboratory in Wisconsin developed work-related asthma from exposure to the Lesser mealworm beetle.¹⁰

Locust (*Locusta migratoria* and *Schistocerca gregoria*) and Grasshoppers (*Melanoplus sanguinipes*)

Locust are species of grasshoppers in the family *Acrididae* with "short horns". Although usually solitary, under certain conditions they can swarm and cause infestations. The two species reported in the medical literature causing work-related asthma in laboratory workers were *Locusta migratoria*, found in Africa, Asia, Australia and New Zealand, and *Schistocerca gregoria*, found in Africa, the Middle East and Asia.¹¹ The locust is used in laboratories as a research model. Locust are eaten in many cultures. Asthma and allergic symptoms were also described in workers from a Canadian research laboratory investigating grasshopper (*Melanoplus sanguinipes*) immunity.¹²

Mediterranean fruit fly (med fly)(*Ceratitiscapitata*)

The Mediterranean fruit fly (med fly) is a species in the order *Diptera* and family *Tephritidae*. *Diptera* are "true flies". *Diptera* means two wings with only one pair of functional wings. There are approximately 100,000 species of *Diptera*. Med flies are native to the Mediterranean area but have been found in the Southern U.S., Central and South America, Africa, Australia and Southern Asia. Med flies lay eggs in fruit and the larvae develop inside the fruit. The appearance of the med fly in the U.S. has led to repeated campaigns to eradicate the species. Laboratories raise sterile males to be released in the wild to mate to control the insect population. Laboratory workers in Spain have been reported with work-related asthma.¹³

New Mexico range caterpillar (*Hemileuca oliviae*)

Hemileuca is a genus of moths in the order *Lepitodera* and family *Saturniidae*. There are approximately 2,300 species of moths in this family. *Hemileuca oliviae* is found in Central and North America. During periodic population increases there is damage to livestock forage, and the hairs of the caterpillar cause skin irritation of livestock. There is a report of an entomologist whose asthma was successfully treated with allergy shots to extracts of the caterpillar.¹⁴

Screw-Worm Fly (*Cochlomyia hominivorax*)

The larvae of the screw-worm eat living tissue of warm-bodied animals (myiasis). The new world species, *Calliphoridae*, and the old world species, *Chrysoma benziiana*, are in the same family. It was eradicated in the United States in 1982 but outbreaks still occur. It has not been eradicated in Central America or the Caribbean. Allergic reactions of coughing, wheezing and shortness of breath were reported among screwworm eradication workers during aerial release of sterilized screw-worms.¹⁵

Silkworm (*Bombyx mori*)

The silkworm is the larvae of *Bombyx mori* in the family *Bombycidae*. After thousands of years of selective breeding, commercial silkworms differ from wild types; i.e. domestic silk moths cannot fly and are a different color. Silk is derived from the cocoon. In addition to its use to produce silk, it is used in research labs and is eaten. Allergenic antigens have been identified in the silkworm cocoon, excrement, scales and urine.¹⁶

INSECT CONTAMINATION OF FLOUR AND/OR GRAINS

Mediterranean flour moth (*Ephestia kuehniella*)

The mediterranean flour moth is a moth in the family *Pyralidae*. It is a pest found in cereal grains/flour in temperate regions. Caterpillars of the moth feed on grains/flour. There are reports of occupational asthma among a baker in Finland, farmers in Spain and laboratory workers in Italy and Spain developing controls for Mediterranean flour moths.¹⁷

Mexican Bean Weevil (*Zabrotes subfasciatus*)

There are over 4,000 species of bean or seed weevils in the family *Chrysomelidae*. They are found worldwide. There are 18 species of weevil in the *Zabrotes* genus. *Zabrotes subfasciatus* is a leaf beetle found in Africa, North and South America and Southern Asia. Asthma and rhinitis was reported in two workers in Minnesota after handling beans and peas infested with the weevil.¹⁸

INSECT INFESTATION IN THE WORKPLACE

Mites/Ticks (*Acari*)

The subclass *Acari*, which consists of mites and ticks, is part of the *Arachnida* class. There are 50,000 known species of mites. Most mites are approximately a millimeter or less and cannot fly. They have multiple ecologic niches. Mites associated with allergies /asthma in the workplace live in hay, grains, flour, bedding of commercial fowl, and on citrus and vegetable plants.

Barn/Grain/Storage Mites (*Acarus siro*, *Lepidoglyphus destructor*, *Pyemotes ventricosus*, *Tyrophagus longior*, *Blomia tjobodas*, *Blomia tropicalis*, *Blomia kulagini*, *Euroglyphus maynei*, *Glycyphagus domesticus*)

Above are the most common mites described in studies assessing sensitization to mites in farmers and grain workers. These studies have been performed in multiple European countries. Allergic symptoms and asthma have been reported in sensitized workers.¹⁹

Bird Mites (*Ornithonyssus sylvarian*)

Bird mites are in the family *Dermanyssidae* (i.e. the chicken mite, *Dermanyssus sadinae*) and *Macronyssidae* family (i.e. the Northern fowl mite, *Ornithonyssus sylvarian*). Bird mites can only reproduce on their bird host, although they will bite humans. They can live weeks to months without a blood meal. Tens of thousands may be found in bird nests. They do not survive in home/work environments with humidity < 35%. Multiple cases of work-related asthma have been reported among poultry workers in Israel.²⁰

Red or Two spotted spider mite (*Tetranychus urticae*)

Tetranychus urticae is a plant feeding mite whose common names includes both red spider mite and the two-spotted mite. It is in the family *Tetranychidae*. It infests many kinds of commercial crops and trees. It is found worldwide. Predatory mites are used to control the spider mite. Six orchard workers in Germany developed asthma from exposure to the red spider mite.²¹

Caddis flies

Caddis flies are in the order *Trichoptera* with 45 families, 600 genera and 12,000 species. They have aquatic larvae, are found in all types of bodies of water and have a wide range of pollution tolerance. Caddis flies have underwater cocoons and have massed emergences, which salmon feed on and anglers attempt to mimic with artificial flies. Canadian workers at hydroelectric dams developed work-related asthma from exposure to caddis flies found at the dams.²²

Champignon flies

Flies found in mushroom cultivation caves in Spain were reported to be from the *Phoridae* family (suborder *Brachycera*), 98% and from the *Sciaridae* family (suborder *Nematocera*), 2%. Both are in the *Diptera* order. There are 4,000 known species in the *Phoridae* family and 1,700 known species in the *Sciaridae* family. A Spanish mushroom cultivator was reported with work-related asthma.²³

Cockroach (American cockroach (*Periplaneta americana*) and German cockroach (*Blattella germanica*))

There are 4,600 species of cockroach of which about 30 species live in human habitats. They are in the order *Blattodea*. The cockroaches associated with allergic sensitization in the United States are the American cockroach (*Periplaneta americana*) and the German cockroach (*Blattella germanica*). Laboratory workers from Ohio and a bakery worker in Italy have been reported with work-related asthma.²⁴

House Fly (*Musca domestica*)

The housefly is found worldwide in association with humans. House fly eggs are laid on decaying organic material such as food waste or manure. Houseflies are found in many workplaces and are also reared in laboratories. Conjunctivitis and rhinitis in workers in Europe exposed to house flies have been reported.²⁵

The only work-related reports of insect-related allergic reactions in Michigan have been on emergency responders or construction workers with known bee allergy who were stung while working. We are interested in hearing from you if you have patients who have work-related asthma from insect exposure. See the last page for various ways to report such cases or give Kenneth Rosenman MD a call at 1-800 446-7805, if you want to discuss diagnostic or management issues.

References

1. Arbes SJ, Gergen PJ, Vaughn B, Zeldin DC. Asthma cases attributable to atopy: Results from the Third National Health and Nutrition Examination Survey. *J Allergy Clin Immunol* 2007; 120: 1139-1145.
2. Stevenson DD, Mathews KP. Occupational asthma following inhalation of moth particles. *J Allergy* 1967, 39:274-283.
3. Siracusa A, Bettini P, Bacoccoli R, Severini C, Verga A, Abbritti G. Asthma caused by live fish bait. *J Allergy Clin Immunol* 1994; 93: 424-430.
4. Bernstein DI, Gallagher JS, Bernstein IL. Mealworm asthma: clinical and immunologic studies. *J Allergy Clin Immunol* 1983; 72: 475-480.
5. Kaufman GL, Gandevia BH, Tovey ER, Baldo BA. Occupational allergy in an entomological research centre. I Clinical aspects of reactions to the sheep blowfly *Lucilia cuprina*. *Brit J Ind Med* 1989; 46:473-478.
6. Cipolla C1, Lugo G, Sassi C, Bonfiglioli R, Maini S, Tommasini MG, Raffi GB. A new risk of occupational disease: allergic asthma and rhinoconjunctivitis in persons working with beneficial arthropods. *Int Arch Occup Environ Health*. 1996; 68: 133-135.
7. Linares T, Hernandez D, Bartolome B. Occupational rhinitis and asthma due to crickets. *Ann Allergy Asthma Immunol* 2008; 100: 566-569; and Bagenstose III AH, Mathews KP, Homburger HA, and Saaveard-Delgado AP. Inhalent allergy due to crickets. *J Allergy Clin Immunol* 1980; 65:71-74.
8. Spieksma FT, Vooren PH, Kramps JA, Dijkman JH. Respiratory allergy to laboratory fruit flies (*Drosophila melanogaster*). *J Allergy Clin Immunol* 1986; 77:108-113.
9. Rudeschko O, Machnik A, Dörfelt H, Kaatz HH, Schlott B, Kinne RW. A novel inhalation allergen present in the working environment of beekeepers. *Allergy* 2004; 59: 332-337; and Ostrom NK, Swanson MC, Agarwal MK, and Younginger JW. Occupational allergy to honeybee-body dust in a honey-processing plant. *J Allergy Clin Immunol* 1986; 77:736-740.
10. Schroeckenstein DC, Meier-Davis S, Graziano FM, Falomo A, Bush RK. Occupational sensitivity to *Alphitobius diaperinus* (Panzer) (lesser mealworm). *J Allergy Clin Immunol* 1988; 82:1081-1088.
11. Lopata AL, Fenemore B, Jeebhay MF, Gáe G, Potter PC. Occupational allergy in laboratory workers caused by the African migratory grasshopper *Locusta migratoria*. *Allergy* 2005; 60:200-205.
12. Soparkar GR, Patel PC, Cockcroft DW. Inhalant atopic sensitivity to grasshoppers in research laboratories. *J Allergy Clin Immunol* 1993; 92: 61-65.
13. de las Marinas MD, Felix R, Martorell C, Cerda JC, Bartolomé B, Martorell A. Occupational Asthma caused by Exposure to *Ceratitis capitata* (Mediterranean fruit fly). *J Investig Allergol Clin Immunology* 2014; 24:192-211.
14. Randolph, H. Allergic response to dust of insect origin. *JAMA* 1934; 103: 560-561.
15. Gibbons HL, Dille JR, Cowley RG. Inhalant allergy to the screwworm fly. *Arch Environ Health* 1965; 10:424-430.
16. Harindranath N, Prakash O, Subba Rao PV. Prevalence of occupational asthma in silk filatures. *Ann Allergy* 1985; 55: 511-515.
17. Mäkinen-Kiljunen S, Mussalo-Rauhamaa H, Petman L, Rinne J, Haahtela T. A baker's occupational allergy to flour moth (*Ephestia kuehniella*). *Allergy*. 2001; 56: 696-700.
18. Wittich FW. Allergic rhinitis and asthma due to sensitization to the Mexican Bean Weevil (*Zabrotes subfasciatus* Boh.). *J Allergy* 1940; 12: 42-45.
19. Cuthbert OD, Brostoff J, Wraith DG, Brighton WD. "Barn allergy": asthma and rhinitis due to storage mites. *Clin Allergy* 1979; 9: 229-236.
20. Lutsky I, Bar-sela S. Northern Fowl mite (*Ornithonyssus sylvarian*) in occupational asthma of poultry workers. *Lancet* 1982; 2: 874-875.
21. Kroidl R, Maasch HJ, Wahl R. Respiratory allergies (bronchial asthma and rhinitis) due to sensitization of type I allergy to red spider mite (*Panonychus ulmi* KOCH). *Clinical and Experimental Allergy* 1992; 22:958-962.
22. Kraut A, Sloan J, Silviu-Dan F, Peng Z, Gagnon D, Warrington R. Occupational allergy after exposure to caddis flies at a hydroelectric power plant. *Occup Environ Med* 1994; 51:408-413.
23. Cimarra M, Martinez-Cóccera C, Chamorro M, Cabrera M, Robledo T, Lombardero M, Alonso A, Castellano A, Bartoleme JM. Occupational asthma caused by champignon flies. *Allergy* 1999; 54:521-525.
24. Steinberg DR, Bernstein DI, Gallagher JS, Arlian L, Bernstein IL. Cockroach sensitization in laboratory workers. *J Allergy Clin Immunol* 1987; 80:586-590.
25. Tee RD, Gordon DJ, Lacey J, Nunn AJ, Brown M, Newman Taylor AJ. Occupational allergy to the common house fly (*Musca domestica*): Use of immunological response to identify atmospheric allergen. *J Allergy Clin Immunol* 1985; 76: 826-831.

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News

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In this issue: V30n1: Work-Related Allergies and Asthma from Exposure to Insects

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S Remember to report all cases of occupational disease!

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