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Mucocutaneous Candidiasis: Relationship to APS

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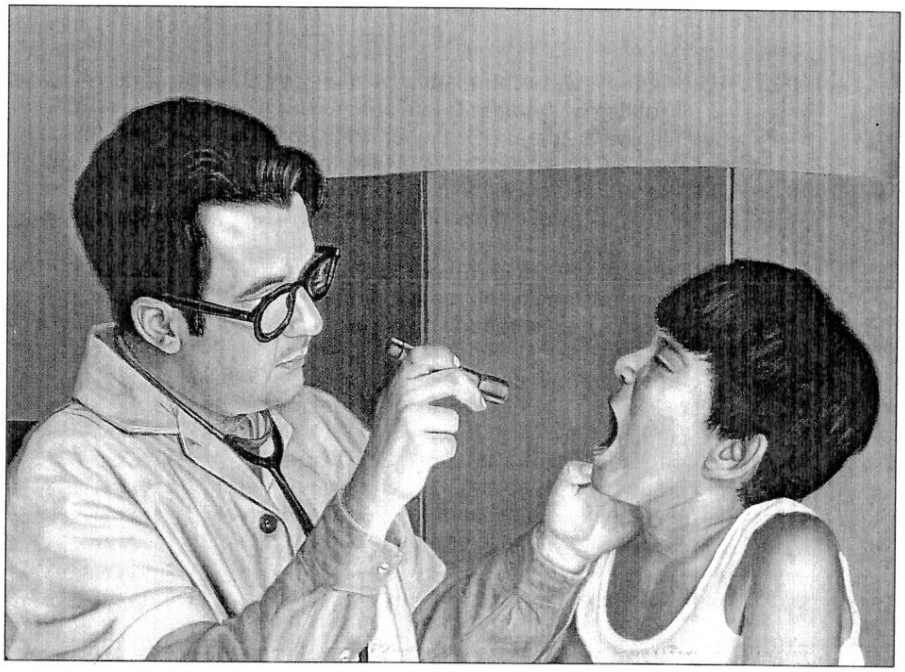

Type I and type II autoimmune polyglandular syndromes (APS) share the common feature of multiple autoimmune endocrinopathies. However, the specific manifestations of the two syndromes are different. Chronic mucocutaneous candidiasis occurs only in the type I syndrome. Since chronic mucocutaneous candidiasis is frequently the presenting manifestation of the type I syndrome, recognition of candidiasis allows for early diagnosis and treatment of the coexisting endocrine diseases that may be serious or even life threatening.

Chronic mucocutaneous candidiasis is a clinical condition of continuing or recurring infection of the mucous membranes, nail beds, and skin with *Candida* species. Chronic mucocutaneous candidiasis occurs in a variety of clinical settings: during antibiotic use, in the setting of *(continued on page 2)*

Fungi as Pesticides Against Ants and Cockroaches

JOHN H. KLOTZ, PhD, KAREN K. KELLEY-TUNIS, and STEPHEN A. KLOTZ, MD

In the interest of pursuing new topics related to fungi that may interest our readers, this article discusses how fungi can be used as pesticides. Public pressures to reduce exposure of humans to pesticides have resulted in research on use of biologic control agents for insect pests. Among these are fungi in the genera* Beauveria *and* Metarrhizium. *The former has been studied as a potential control agent for the red imported fire ant,* Solenopsis invicta. *Although effective in laboratory settings, this agent has been less successful in field trails, partly due to unknown soil factors that reduce efficacy of the fungus. A fungus-containing product is currently being marketed for control of the German cockroach,* Blattella germanica. *However, recent medical studies have indicated that extracts of the pathogen,* Metarrhizium anisopliae, *are cross-reactive to serum from highly mold-sensitive asthmatics, suggesting that use of this material indoors may be precluded or limited.

Fungi were the first recognized pathogens of insects. They infect all orders of insects, but most commonly Diptera (flies), Lepidoptera (butterflies and moths), Homoptera (cicadas, aphids, and scale insects), Hemiptera (true bugs), Coleoptera (beetles), and Hymenoptera (ants, wasps, and bees). The development of fungi as biologic control agents ranks third behind bacteria and viruses in the United States.

Studies of fungi pathogenic for insects go back at least a century. Renewed interest in their potential for pest control began in the 1950s. Eastern European countries pioneered investigations of the fungus *Beauveria bassiana* for control of the Colorado potato beetle. This endeavor laid the groundwork for later studies of these microorganisms, including the use of *Beauveria* and *Metarrhizium* species against the European corn borer and spittlebugs.

Figure 1. Skin reaction to stings of fire ants (USDA photo).

Because of new and stricter government regulations regarding chemical applications, combined with mounting public pressure over environmental deterioration, alternative pest control strategies are gaining attention. This trend is exemplified by current experimental investigations into the use of fungi for the control of two public health pests: the red imported fire ant (*Solenopsis invicta*) with Beauveria and control of the German cockroach (*Blattella germanica*) with Metarrhizium.

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Control of Fire Ants

Because of their economic impact, control of fire ants is a priority in the southern United States. Between 30% and 60% of the population living in urban areas that are infested by fire ants are stung each year. Reactions to stings from fire ants range from local irritation to anaphylactic shock and death in hypersensitive individuals. Besides their medical importance, fire ants are serious agricultural pests.

The rapid spread of fire ants in the United States is a classic example of an organism that was accidentally introduced (near Mobile, Ala, in the 1940s) into an environment that lacked the ants' native competitors, pathogens, parasites, and predators. Consequently, with their tremendous reproductive capacity and their passive dissemination via plant-nursery stock shipments, fire ants spread throughout the southern United States.

Fire ant control is accomplished with insecticidal baits and sprays. Alternative control strategies are now being investigated. One alternative is in the experimental phase of development. *B bassiana*, an imperfect fungus, causes white muscardine disease in insects. This name was applied because the infected insects eventually present with fluffy, white clusters of fungal conidia covering the body. *B bassiana* is a nonspecific insect pathogen that occurs worldwide. Even though it is ubiquitous in the soil, epizootics of naturally occurring fungal infections in fire ants have not been reported. *B bassiana* has been reported to cause keratitis in humans after trauma to the cornea and cavitating pneumonia. However, the rarity of such reports testify to the nonpathogenic properties of this fungus in humans.

A *B bassiana* isolate (named 447) found infecting fire ants from Mato Grosso, Brazil, is now being tested as a bioinsecticide in Gainesville, Fla, against fire ants and other outdoor insects. This fungus has been shown

to kill fire ants under certain circumstances. One major problem encountered so far is the presence of antagonistic factors within the soil that seem to be detrimental to the fungus. The precise cause of this remains unknown, but it seems likely that other microorganisms may harm the fungus. Colony hygiene, ie, grooming and removal of the fungi from infected workers, and the apparent lack of horizontal transfer of the fungus between colonies may limit the utility of this fungus as a biopesticide.

■ **Reactions to stings from fire ants range from** *local irritation to anaphylactic shock and death in hypersensitive individuals. Besides their medical importance, fire ants are serious agricultural pests.*

A biologic control agent should be able to grow, reproduce, and spread among the host targets. Finally, treated colonies frequently move, and what may appear as a successful eradication may merely be the result of the ants abandoning their nests and taking up residence in other locations. Overcoming these difficulties will require improvements in formulation and application.

Control of German Cockroaches

Cockroaches have been present on earth for over 300 million years. Of the 3,500 species of cockroaches found worldwide, 60 species reside within the United States. Of those, the German cockroach is the most widely recognized. Cockroaches are able to adapt to most environments, though most live in environments that are warm and usually dark.

Cockroaches are commonly viewed as nuisance insects, but their impact on human health is a primary concern. In restaurants and health care facilities, cockroaches can act as carriers of many bacteria that can cause disease. The most common forms of bacteria transferred by cockroaches are *Salmonellae*, *Shigella* organisms, streptococci, and *Escherichia coli*. By walking across contaminated surfaces and thus acquiring bacteria, the insects are capable of contaminating any other surfaces they touch. Unlike many other species of cockroaches, the German cockroach is entirely restricted to indoor environments. They produce numerous allergens causing discomfort for some people; allergy to cockroaches is now widely recognized as the second most common allergy among asthmatics. Reactions are due to hypersensitivity to allergens from the cockroach body, cast-off skins, egg shells, and feces. Symptoms usually manifest as allergic rhinitis or bronchial asthma. For asthmatics, acute episodes can be life-threatening.

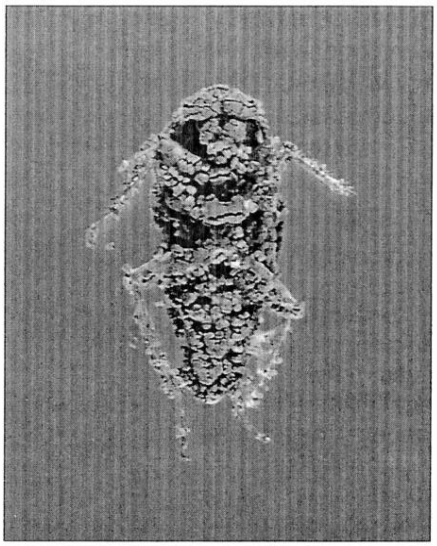

Figure 2. German cockroach infected with Metarrhizium anisopliae *(photo courtesy of James L. Castner, University of Florida, Gainesville).*

Control of these insects is difficult. Resistance to some chemical pesticides has occurred. Increasing consumer movement toward environmentally safe products has prompted a new nonchemical approach. One such method is the use of *Metarrhizium*, a fungus. The container is similar to the well-known cockroach bait station but contains fungi instead of toxic bait. The cockroach enters an inoculation chamber (because of the dark environment provided) and comes in contact with the fungus. Once the cockroach contacts the fungus, conidia attach to the cuticle of the insect. The conidia then begin to grow hyphae, which penetrate the cockroach body cavity and eventually kill the insect. Hyphae will reemerge from the cadaver and begin to produce more conidia, which can then be passed onto other cockroaches coming into contact with the conidia.

Generally, biologic control is regarded as a safe alternative to traditional chemical pesticides. However, because these are living microorganisms, they produce proteins and other substances that may be potentially allergenic to humans. In fact, a recent study examining reactivity of *Metarrhizium anisopliae* extracts to mold-allergic persons showed that serum in 4 of 15 patients exhibited high degrees of cross-reactivity, and the authors concluded that the fungus could pose health risks when placed in the homes of highly mold-sensitive asthmatics. Therefore, although biologic control agents are unequivocally beneficial from a health viewpoint in outdoor settings, such as those of the fire ant, potential allergenicity to humans may preclude or limit use indoors for such pests as the German cockroach. Further health studies are warranted. □

Suggested Reading

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