**Healthy Homes Grantees in Region VII, Great Plains**

**Name of Grantee:** Saint Louis University School of Public Health  
**Name of Project:** The Growth and Removal of Microorganisms and Allergens on Carpet  
**Amount Awarded:** $700,000  
**Year of Grant:** 2003  
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**Project Partners:** Canesis Network, NZ

**Summary of Project Activities:**
Carpets have long been known to be a reservoir for the growth and accumulation of microorganisms and allergens, however, the effects of carpet fiber composition, construction, and carpet wear on dust mites and fungal growth have not been fully explored. Recent investigations identified high surface area and the absence of a fluorocarbon coating as significant factors in the retention of dust mite and cat allergen on carpet. Although several investigators studied the effects of acaricides and fungi on contaminated carpets a systematic approach to finding the best combination of cleaning and chemical use had not been established.

The purposes of this research were several: to evaluate the interaction of dust mite and fungal growth on carpet, screen for effective acaricides that can kill dust mites, evaluate biocides that can kill both dust mites and fungi, conduct experiments that can determine the growth of these organisms on various carpets, and determine the most efficacious cleaning and biocidal regimens for abating dust mites and fungi in carpet. Most of the experiments were conducted in the laboratory; however, a small field component was conducted to evaluate two methods; dry vacuuming and steam cleaning, for dust mite mortality, mold, and allergen removal. One major hypothesis tested was that the surface area of a carpet and carpet wear will affect the growth and cleaning of microorganisms and allergens from carpet.

**Project Outcomes/Outputs:**
Evidence for dust mite digestion of mold spores was confirmed by light microscopy. Mite survival appears to be influenced by a fungal species’ unique ability to generate mycelium and trap mites. Other experiments on mite survival indicate that fungi may sometimes increase or decrease mite growth on carpet.

There were no significant differences among mites recovered from high versus low pile or worn versus unworn carpet. When two statistical outliers are removed from the data set, however, unworn carpet supports more mite growth than worn carpet. This could be due to worn or crushed carpets providing less three-dimensional space for mite habitation than unworn carpets. There is some evidence that new-low pile height carpet is more resistant to mite habitation than new-high pile carpet, however, more study needs to be done to determine the characteristics of a mite resistant carpet.

Thirteen agents were screened as acaricides (against mites), eights agents were screened against Cladosporium spherosperrnum (an indicator for fungi), and five agents were screened
against Der f1 (dust mite allergen). Benzyl benzoate-powder and steam demonstrated 95 and 99% reductions in dust mites after three weeks of mite incubation, with steam significantly superior to benzyl benzoate. No visible Cladosporium spherosepermum growth was found on carpet after application of several fungicides, however, only neems oil, Lysol spray, and steam did so without carpet discoloration. Three proprietary agents reduced dust mite allergen concentrations greater than 94%.

Three agents were chosen as most promising for their combined abilities to reduce dust mite, fungi, and allergen concentrations in the laboratory carpet cleaning experiments. After a six-week incubation, steam reduced dust mite and fungal populations by more than 95% and reduced dust mite allergen by 82%. Steam, in laboratory studies, was statistically superior to other methods for dust mite and fungal removal (p<0.01 and p<0.001). Steam removed 56% of mold spores compared to 46% removal using dry vacuuming, over a 90 day interval, in a small field study (n = 5 homes).

This study confirmed that fungi and dust mites interact with certain types of fungal mycelium and spores with antagonistic effects to mites but no information resulted in a strategy at this point for reduction of mites or fungi based on this work. The carpet characterization study does not definitively support selection of a carpet for mite avoidance purposes but there was some evidence to support the use of low carpet pile height for mite resistance and other studies still support the notion that lower surface area carpets will retain less dirt and accumulated allergens. Steam may be a valuable component for use in controlling mite, fungi, and allergen loading in carpets. Field studies need to be done to confirm these results.