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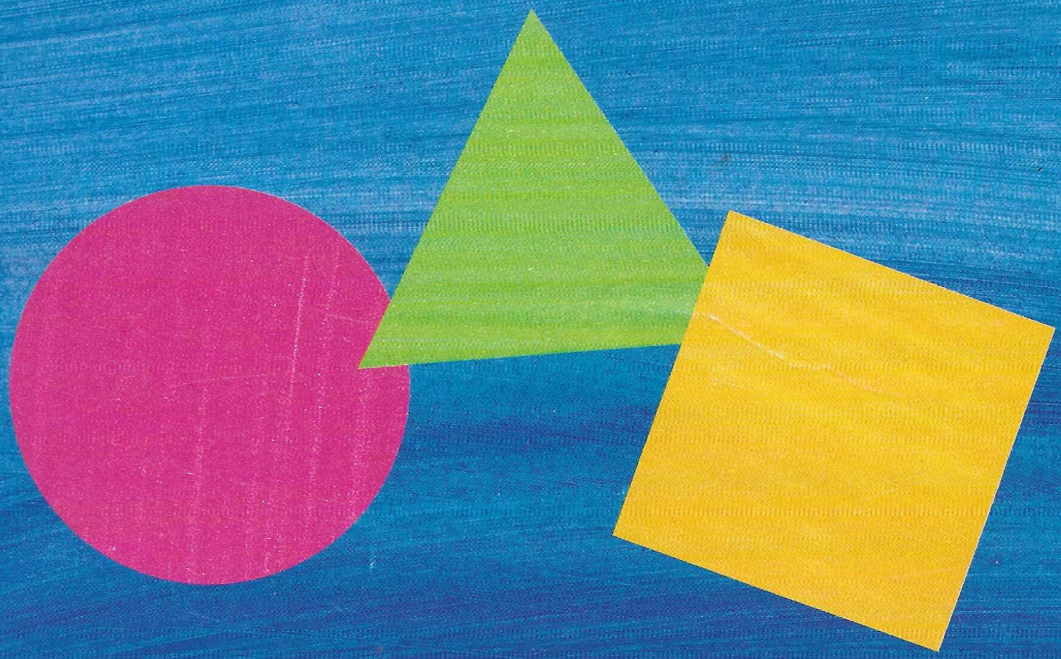

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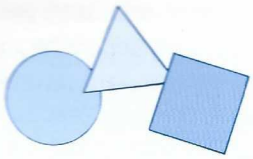

Effect of commercially available pyrethrin containing insecticides on dust mites in carpets and carpet padding

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Introduction

Various products have been used to kill dust mites in carpets. We studied the effect of several commercially available pyrethrin containing insecticides on dust mites in carpet sections in the laboratory. Raid Flea Killer™, a combination of pyrethrum, a pyrethroid, and two synergists, was found to be particularly effective. We compared this product with Acarosan™, measuring the effect not only on mites in the carpet, but also on mites in padding beneath the carpet. Finally, studies were done on carpets in homes, measuring the effect of this product on mite antigen levels during the peak dust mite season.

Pyrethrum is a naturally occurring insecticide extracted from chrysanthemum flowers. It causes rapid-but temporary-paralysis of insects. It has been used in the US since 1858 and has the most EPA approved uses of any insecticide, but there is little information on its effectiveness against mites. Pyrethrum is a mixture of pyrethrins I and II and cinerin I and II.

Pyrethroids are synthetic, pyrethrin-like substances, which are often more potent or more light stable than pyrethrum. They include tetramethrin and phenothrin, among others.

Synergists are substances which are not directly insecticidal or miticidal, but which increase the effectiveness of an insecticide. They work by inhibiting the enzymes in the insect which inactivate the insecticide, generally cytochrome P-450 dependent polysubstrate mono-oxygenases (PSMO). Piperonyl butoxide (PBO) and N-octyl bicycloheptene dicarboxamide (MGK264) are synergists which inhibit different classes of PSMO.

Methods and results (first part)

Laboratory studies were done on D. pteronyssinus cultures maintained on Tetramin™ fish food in incubators at 75°F, 75% RH. Sections of 1.5 cm depth pile carpeting, approx. 7x7cm, were inoculated by pressing them onto the cultures and brushing the culture material with a soft brush. Inoculated sections were incubated for an additional five days. Eight sections of carpet were treated according to the manufacturer's directions with each of the following :

pyrethrum	pyrethroid	synergist	other
A) Untreated Control			
B) Sergeant's Mite Patrol™) (UK)	d-phenothrin .504%		
C) Sergeant's Rug Patrol™	d-phenothrin .48%	PBO 1.63%	
D) Hartz 2 in 1 Flea & Tick Killer™	pyrethrin .11%	PBO .22% + MGK-264 .37%	
E) Raid House & Garden™	pyrethrin .176%	tetramethrin .81% PBO 1.%	
F) Raid Flea Killer™	pyrethrin .14%	tetramethrin .063% PBO 1.% + MGK-264 .98%	
G) Raid Flea Killer Plus™	pyrethrin .14%	tetramethrin .063% PBO 1.% + methoprene MGK-264 1.%	
H) Acarosan		benzylbenzoate	SAN

Powders (products B, C and H) were vacuumed off after three hours. Two days later, the surfaces of the carpet sections were vacuumed to remove dead mites and food; the number of remaining live mites in the carpeting was determined by the heat escape method (Bischoff). Clear plastic adhesive sheets (Contact™) were placed sticky side down on the top of the carpet sections, which were then placed base down on a heated surface (Fisher microscope warmer) and covered with opaque glass and a weight. The temperature of the heated surface was increased by about 1°C per minute, from an amblent temperature of 24°C to 70°C over 45 minutes, and maintained at 70° for an additional 15 minutes.

In an attempt to escape from the heat, the mites moved from their habitat deep in the carpet to the surface of the carpet, where they stuck to the adhesive sheet. The adhesive sheet was then removed and overlaid upon a clear plastic grid. After blinding of the specimens, the number of mites in the central 10 cm^2 of each carpet section was then counted under a stereomicroscope.

Method and results (second part)

In order to more closely replicate the situation in carpets *in situ*, studies were done in the laboratory on carpet sections on top of carpet padding. Two 1500 cm^2 sections of carpeting were inoculated with 10 cc of *D. pteronyssinus* culture. One piece was placed on smooth cardboard, to simulate a carpet placed directly on a hardwood floor. The other piece was placed on Omalon™ foam carpet padding, a commonly used type of carpet padding. Fish food had been sprinkled on the surface of the cardboard and foam prior to placement of the carpet. Carpet sections were incubated for one month at 75°F, 75% RH.

After one month, each piece was cut into thirds. One section from each piece was treated with Raid Flea Killer™, one with Acarosan, and one left as an untreated control. Two days after treatment, each section and its base (foam pad or cardboard) were examined, the carpet and foam pad by heat escape, the cardboard by microscopy.

Mites per 250cm^2

	Carpet over cardboard	Cardboard base	Carpet over foam pad	Foam pad
Raid Flea Killer™	0	0	0	94
Acarosan	191	0	73	127
Control	939	0	272	94

Raid Flea Killer™ killed all mites in the carpet section, but did not kill the mites which had colonized the padding beneath the carpet.

Methods and results (third part)

Further studies were done on carpets in Virginia homes in the summer of 1994. Sixteen bedroom or basement carpets were treated with Raid Flea Killer™. Spray was applied until the carpet was moist, equal to 9-30 ml/m^2, and re-applied 4 weeks later. Dust samples were obtained by vacuuming a 1 m^2 area of carpet for 2 minutes immediately prior to treatment, and then at 2 week intervals. Dust was analysed for Der p 1 and Der f 1 levels using a two site monoclonal antibody immunoassay. Total group I levels and their geometric means were calculated. Because of a non-parametric distribution, data were analysed for statistical significance with the Wilcoxon signed-rank test.

Geometric Mean	Day 0	Day 1	Day 14	Day 28	Day 42	Day 56	Day 70	Day 84
Untreated	10.80	–	23.85 p<.06	24.65 p<.06	28.73 p<.06	24.02 p<.06	54.25 p<.06	(27.22) n=2
Treated RFK™	10.43	8.25 p>.06	12.83 p>.06	8.19 p>.06	11.18 p>.06	12.11 p>.06	11.85 p>.06	15.43 p>.06

Treatment did not reduce mite allergen levels, but did prevent the significant seasonal increase in allergen level which occurred in the untreated carpets.

Untreated carpets Der F 1 µg/gm + Der p 1 µg/gm = total group I µg/ml

	Day 0	Day 1	Day 14	Day 28	Day 42	Day 56	Day 70	Day 84
A)	5.1	ND	15.8	24.3	23.8	59.6	7.16	13.9
B)	8.7	ND	15.2	62.1	180.1	41.4	11.4	ND
C)	25.6	ND	44.7	122.2	ND+5.2	ND+145.	78.4	53.3
D)	2.	ND	2.	2.	2.	2.	ND	ND
E)	25.6	ND	23.6	21.7	7.7	29.6	29.3	ND
F)	4.4	ND	3.6	3.6	3.7	11.	ND	ND
G)	63.7	ND	77.	ND+17.5	190.4	ND	41.2	ND
H)	6.7	ND	18.0	24.6	128.	ND	403.	ND
I)	ND+26.6	ND	ND+276.	ND+100.	ND+150.	ND	ND+275.	ND
J)	7.4	ND	85.5	66.7	82.4	19.8	87.6	ND
	10.8	-	23.85	24.65	28.73	24.02	54.25	(27.22)G.Mean
		p	<.06	<.06	<.06	<.06	<.06	<.06

Treated carpets Der f 1 µg/gm + Der p 1 µg/gm = total group I µg/gm

	Day 0	Day 1	Day 14	Day 28	Day 42	Day 56	Day 70	Day 84
A)	19.4	25.4	26.3	25.9	46.2	11.7	ND	24.2
B)	4.7	2.7	4.7	5.1	4.6	3.8	4.1	2.
C)	29.3	19.4	12.4	10.3	25.3	16.+ND	19.0	17.9
D)	8.5	8.0	14.4	11.9	10.3	4.8	5.6	ND
E)	2.5	2.	2.	2.	1.8	2.	2.	ND
F)	24.2	57.3	12.2	31.1	32.	43.4	30.8	ND
G)	8.7	7.7	32.3	7.1	20.7	86.5	55.2	79.3
H)	16.6	10.8	13.2	20.6	17.	29.5	32.6	12.8
I)	10.6	5.2	41.3	ND+4.4	268.8	155.+ND	192.	99.0
J)	16.7	12.9	25.9	20.1	19.	46.2	39.6	ND
K)	7.4	9.5	18.9	10.1	8.	4.5	4.7	ND
L)	10.2	ND	5.4	6.8	7.4	8.8	11.6	ND
M)	2.	ND+1.	2.	2.	2.	2.6	2.	ND
N)	7.8	7.5	13.9	3.9	3.6	2.	4.6	2.4
O)	4.8	2.5	13.2	4.2	3.3	4.1	6.8	ND
P)	99.5	46.0	58.8	13.9	7.4	46.8	10.2	ND
	10.43	8.25	12.83	8.19	11.18	12.11	11.85	15.43 G. Mean
	p	>.06	>.06	>.06	>.06	>.06	>.06	>.06

Conclusions

1. Raid Flea Killer™, a commercially available insecticide (containing pyrethrum, the pyrethroid tetramethrin, and the two synergists piperonyl butoxide and N-octyl bicycloheptene dicarboxamide) is effective at killing dust mites in carpet sections in the laboratory.

2. When carpet sections are studied on top of carpet padding to more accurately replicate the situation found in homes, inoculation of mites into the carpet is followed by infestation of the padding below.

3. Raid Flea Killer™ and Acarosan™, while killing many or all of the mites in a carpet, do not kill the mites in the carpet padding.

4. Raid Flea Killer™ used during the peak dust mite season on carpets in homes did not reduce mite allergen levels, but did prevent the seasonal increase in allergen which occurred in untreated control carpets.

5. The use of flea killers or similar products by homeowners should be taken into consideration when planning or evaluating the effect of mite avoidance protocols.

6. The inability to kill mites in the padding beneath the carpet may be a fundamental factor limiting the effectiveness of acaricides used in homes. Mites surviving in the padding would allow rapid re-infestation of the carpet.

7. Although not EPA approved for this purpose, Raid Flea Killer™ may have a limited role as a relatively inexpensive acaricide. However, the failure of this and other products to dramatically decrease mite allergen levels in homes supports the recommendation that the carpet be removed from the bedroom of mite-allergic patients.