CHANGEMENTS DURING 2 YEARS IN POPULATIONS OF DIFFERENT MITE SPECIES IN HOUSE DUST BEFORE AND AFTER A SINGLE ACARICIDAL TREATMENT

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HOUSE-DUST
PYROGLYPHIDAE
MITE SPECIES IN HOUSE-DUST
ACARICIDAL PREPARATIONS
MITE CONTROL
HOME SANITATION
CONTINUANCE
OF MITE CONTROL
RECOLONIZATION
POPULATION DYNAMICS

ABSTRACT : In five rural houses under identical climatic conditions the mite population in the house-dust ecosystem consists of the following species : *Dermatophagoides pteronyssinus, D. farinae, Cheyletus eruditus, C. trouessarti, Acarus siro, Tyrophagus putrescentiae* and *Tarsonemus sp.* With an average for all investigated textiles of 90 living mites per sqm the most abundant species was *D. pteronyssinus*. The analysis was done after vacuuming carpets, mattresses and stuffed furniture.

Possible recolonization was followed after mite control by an acaricide based on solidified benzyl benzoate (ACAROSAN). During the first 6 months after the mite-control no reactivation of the mite populations arrived. The number of dead mites increased in the first months after the acaricidal treatment. Only 12 months later a slow recovery of the *Dermatophagoides* species population could be observed. However, even after 2 years this population reached only about 10 % of the original density. A slow recolonization of the mattresses and the upholstery by *Cheyletus* was observed too, whereas storage mites (*Acarus sp., Glycyphagus sp., Tyrophagus sp., Tarsonemus sp.*) did not reappear after the single acaricidal treatment. Thus it is to be seen that at least during two years the living conditions of the mites in their biotopes are definitively changed after the application of the acaricide.

POUSSIÈRE DE MAISON
PYROGLYPHIDAE
ESPÈCES D'ACARIENS
DANS LA POUSSIÈRE DE MAISON
ACARICIDES
EXTERMINATION D'ACARIENS
ASSAINISSEMENT DE LA MAISON
CONTINUATION
DE L'ACTIVITÉ ACARICIDE
RECOLONISATION
CHANGEMENTS
DES POPULATIONS D'ACARIENS

RÉSUMÉ : Dans cinq maisons rurales, sous conditions climatiques analogues, la population des acariens contenue dans le système écologique de la poussière de maison se compose des espèces suivantes : *Dermatophagoides pteronyssinus, D. farinae, Cheyletus eruditus, C. trouessarti, Acarus siro, Tyrophagus putrescentiae* et *Tarsonemus sp.* Avec une moyenne de 90 acariens vivants par m^2 de textiles examinés la prédominance des *Dermatophagoides pteronyssinus* est significative. L'analyse biologique est effectuée après aspiration des tapis, matelas et capitonnages.

Une éventuelle recolonisation est l'objet d'une étude suivie, après traitement acaricide basé sur l'action du benzoate de benzyl solidifié (ACAROSAN). Les six premiers mois suivant le traitement, aucune nouvelle activité des populations d'acariens n'est constatée. Le nombre des acariens morts augmente pendant les premiers mois consécutifs au début du traitement. Seulement douze mois plus tard, une faible activité des *Dermatophagoides* peut être observée. Même deux ans plus

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tard, cette population n'atteint toujours que 10 % seulement de la densité déterminée à l'origine. D'autre part, une lente recolonisation est effectuée par les *Cheyletus* sur matelas et capitonnages tandis que les acariens des stockages (*Acarus sp., Glycyphagus sp., Tyrophagus* sp., *Tarsonemus* sp.) ne réapparaissent plus après un seul traitement acaricide. Les résultats permettent de conclure que les conditions de vie des acariens dans leurs propres biotopes, ont été définitivement modifiées pendant les deux années consécutives à une unique application d'acaricide.

Introduction

The aim of this study was the follow-up of house dust mite related problems before and after a single acaricidal treatment in houses. We observed as well patients' health as dust quantities and mite numbers. The first part of the results was published in 1988 (Elixmann *et al.*, 1988), concerning changements in the house-dust mite populations during one year and in patients clinical data, drug consumption included (as six case studies). Here we report on studies during two years with special regard to the different mite species.

In the house-dust ecosystem the pyroglyphid mites play a crucial role for the production of house-dust allergens (Voorhorst *et al.*, 1964 ; Spieksma, 1967 ; van Bronswijk, 1981). Beside *Dermatophagoides* Bogdanoff, 1864, other genera e.g. *Glycyphagus*, Hering, 1828, *Cheyletus* Latreille, 1796, *Tyrophagus*, Oudemans, 1923 and *Tarsonemus*, Canestrini and Fanzago, 1876 may live in the house-dust community, and cause sensitizations (Agha and Gnanasakthy, 1981 ; Wraith *et al.*, 1979). Allergen-containing house-dust is always to be found in places, where mites are developing. This is the case not only for mattresses, but also for stuffed furniture and carpets (van Bronswijk, 1981 ; Bischoff, 1986 ; Bischoff, 1988a, b ; Saint-Georges-Gridelet, 1968).

Storage mites need a degree of relative humidity between 75 % and 95 % for their development. As this usually not occurs in homes, storage mites are not so common in house-dust (Lustgraaf *et al.*, 1978 ; Schober, 1988). Normally *Glycyphagus* sp. are living in hay dust of barns and sheds. In the house-dust *Cheyletus* sp. are predators on *Dermatophagoides* spp. and other mites (van Bronswijk *et al.*, 1971).

Mite control in home textiles only by vacuum-cleaning is not a suitable method. It is not possible to remove important parts of mite populations and of mite allergens which are present in the textiles (Wassenaar, 1988 ; Bischoff and van Bronswijk, 1986). Acaricidal products based on solidified benzyl benzoate like Acarosan[1] foam or moist powder kill the house-dust mites in the interior of the home textiles and prepare simultaneously the removing of the allergen-containing dust by vacuum-cleaning (Bischoff 1988a, b ; Bischoff *et al.* 1986a). After the treatments in most of these cases improvements in allergy symptoms in the patients were observed (Elixmann *et al.* 1988). Here we assessed the number and the species of house-dust mites, storage mites and predator mites in these dwellings.

Material and method

The five houses (A, B, C, D, E) (Tab. 1) included in this study belonged to patients sensitized against mite allergens. All are located in Kranenburg (FRG), in the Rhine valley, near the Netherlands (6°5′ e.L., 51°46′n.B.), and have identical climatic conditions (northern maritime climate with moderate winters and relatively high outdoor humidity).

The examinations started in July 1985 and ended in December 1987. Seven times during the two years carpets, stuffed furniture, and mattresses (Tab. 1) were vacuumed during 5 min/sqm with a Philips P77 vacuum cleaner (700 watts, microfilter) using the little nozzle for upholstery. Dust sampling and flotation were applied as the usual method for the assessment of the numbers of living and dead mites

1. Producer : Werner & Mertz Sparte Umweltmedizin D-6500 Mainz.

TABLE 1 : Mites in home textiles in five houses. Legend : l = living mites; d = dead mites; st.f. = stuffed furniture.

	Room	Object	Surface in m²	Dust in g	Mites per m²												
					Dermatophagoides				*Cheyletus*				*Acarus*		*Tarsone-*	*Tyrophag.*	
					pteron.		*farinae*		*eruditus*		*troues.*		*siro*		*mus* sp.	*putresc.*	
					l	d	l	d	l	d	l	d	l	d		l	d
1a	Living room	carpet	12,2	15,8	15	33	0	0	0	0	0	0	0	0	0	1,5	4,5
		st.f.A.	21	6,8	128	82	11	7	4	24,5	7	2	11	0	9	2	0
		st.f.B.	18	7,8	69	168	0	0	0	6	0	0	0	0	0	0	0
	Sleep room	carpet	13,6	40,2	87	260	3	6	9	43	0	0	15	0	6	0	9
		mattr.	18	9,1	512	875	0	0	44	127	0	11	77	0	143	0	6
in house A	Child	mattr.	10,5	16,4	112	76	0	2	36	10	0	0	5	0	17	0	2
	Floor	carpet	6,8	38,4	126	151	25	0	0	0	0	0	12	0	0	12	0
1b	Living room	carpet	3	48,2	145	54	0	0	0	0	0	0	0	0	0	0	0
		st.f.	18	78,7	897	794	0	0	0	23	0	0	0	0	0	0	12
	Room	carpet	13,5	111,9	378	447	69	52	0	0	0	0	0	0	0	34	17
	Floor	carpet	7,2	76,8	79	102	0	0	0	0	0	0	0	0	0	11	0
in house B	Sleep room	mattr.	18	23,5	113	68	0	0	0	0	0	0	0	0	0	0	0
		carpet	16,3	90,1	165	165	18	12	0	0	0	0	6	0	0	0	6
	Child room	carpet A	14,0	31,2	24	48	0	0	0	0	0	0	0	0	0	0	2
		carpet B	19,0	110,6	142	135	24	24	0	6	0	0	0	0	0	0	18
		mattr.	17,9	28,0	9	27	0	0	0	0	0	0	0	0	0	0	0
1c	Living room	carpet	51	54	3	5	0	0	0	1	0	0	6	3	4	0	0
		st.f.A	14	63,4	12	168	12	36	0	0	0	0	120	12	0	0	12
		st.f.B	15,5	16,3	13	455	0	0	0	39	0	0	78	85	0	0	0
	Floor	carpet A	29	101,7	0	7	0	0	0	0	0	0	11	4	0	0	0
		carpet B	11	20,9	2	7	0	0	0	0	0	0	0	4	0	0	0
in house C	Child room A	carpet	15	27,5	4	6	0	0	0	2	0	0	0	0	0	0	2
		mattr.	16	23,5	9	4	0	0	0	0	0	0	0	0	0	0	4
	Child room B	carpet	19	64,1	14	7	0	0	0	4	0	0	4	4	0	0	4
		mattr.	20	11,6	5	32	7	5	0	2	0	0	4	4	0	0	0
	Sleep room	carpet	20	11,6	11	14	0	0	1	13	0	0	4	1	0	1	2
		mattr.	18,5	24,9	196	220	36	20	0	72	4	16	12	0	0	4	16
1d	Floor	carpet	20	5,9	1	6	1	0	0	1	0	0	5	2	0	0	0
	Living room	carpet	50	55,7	1	5	0	0	0	0	0	0	14	13	0	0	2
		st.f.	17	80,1	266	434	14	42	0	0	0	0	98	70	0	0	0
in house D	Bath	carpet	3,5	3,3	280	126	0	0	0	14	0	0	28	28	56	0	0
	Sleep room	carpet	17	9,3	20	22	3	5	1	4	0	2	4	2	2	0	0
		mattr.	18	25,9	116	116	28	28	0	48	0	8	52	16	0	8	4
	Child room	carpet	20	43,4	5	18	2	2	0	0	0	2	12	14	0	0	9
		mattr. A	10	3,1	6	24	8	5	0	1	0	0	29	9	0	2	0

	Room	Object	Surface in m²	Dust in g	Mites per m²												
					Dermatophagoides pteron.		*farinae*		*Cheyletus eruditus*		*troues.*		*Acarus siro*		*Tarsonemus* sp.	*Tyrophag. putresc.*	
					l	d	l	d	l	d	l	d	l	d		l	d
le	Living room	carpet	48	29,1	7	7	0	0	0	1	0	0	1	1	3	0	0
		st.f	6,5	11,3	490	611	0	0	6	55	0	0	0	0	0	0	0
	Floor	carpet	13,7	15,0	46	70	4	4	1	7	0	0	1	0	0	0	0
	Child room	carpet	8,2	6,9	24	13	3	2	2	6	1	6	1	0	10	0	0
		mattr.	16	23,3	86	50	0	0	0	0	0	0	0	0	14	0	0
in house E	Sleep room	carpet	15,2	12,4	41	92	0	0	3	13	0	0	0	0	71	0	0
		mattr.	18	10,6	203	110	0	0	6	73	0	0	6	0	522	26	0

suitable for comparative studies. The mite numbers, found in this way do not represent the total quantity of living mites in a certain textile object (BISCHOFF and FISCHER, 1987 ; WASSENAAR, 1988).

The first vacuuming served for the assessment of the initial mite populations. After this, the acaricide with solidified benzylbenzoate as the acaricidal compound (BISCHOFF *et al.*, 1986b, 1987) was used in three forms of application : as a liquid (in dwelling A, D) or a moist powder (in dwelling B, C, D) for the treating of carpets, and as a foam to treat stuffed furniture and mattresses (Tab. 2). The acaricidal treatment was executed one time only. A total textile surface of 737,1 sqm was investigated, taking dust samples seven times (Tab. 3).

Three and seven weeks after the treatment all textile objects were vacuumed during 5 min/sqm to control the effectiveness of the acaricide on the mite ecosystem. This procedure was repeated in November 1985 (12 weeks after the treatment), in February 1986 (22 weeks) and one and two years after the treatment. Totally a surface of more than 5 000 sqm has been vacuumed and 301 dust samples were examined afterwards for mite counting and determination of mite species.

For each object a new paper bag was used. Mite separation in each sample was executed using the flotation method (VAN BRONSWIJK, 1981). The results show the mite contamination before and after the acaricidal treatment. Living and dead mites were isolated and determined according to HUGHES (1961) and VAN BRONSWIJK (1981). Each examination was done in duplo. We distinguished between dead and living mites using complete mites, bearing all setae, as a definition for mites being alive before vacuuming. Only for *Tarsonemus sp.* we were not able to discuss living and dead mites as a consequence of the little body shape of this species (Fig. 7).

A. Liquid :	
cleaning compound (anionic tensids)	5,5 %
acaricidal compound (benzyl-benzoate with polymeres)	14,5 %
water	80,0 %
	100,0 %
B. Powder :	
Powder-carrier substance cellulose-fibers 40,5 %	42,3 %
cleaning compound (iso-paraffin)	8,1 %
acaricidal compound (benzyl-benzoate with anorganic adsorbers)	10,0 %
water	39,6 %
	100,0 %
A. Foam :	
cleaning and foam compound (anionic tensids)	1,3 %
acaricidal compound (benzyl-benzoate with polymeres)	6,5 %
water	92,2 %
	100,0 %

TABLE 2 : Application forms and composition of Acarosan ®

TABLE 3 : Dwellings, and patients at the beginning of the survey.

Dwelling	Patient		Object		
	sex	age		surface	age
A (farm)	female	6	mattresses	28,5	> 3
			furniture	39,0	20
			carpet	32,6	8
B (new house)	male	7	mattresses	35,9	3
			furniture	18,0	9
			carpet	73,0	1
C (farm *)	male	8	mattresses	54,5	> 6
			furniture	29,5	> 7
			carpet	145,0	> 7
D (farm *)	female	69	mattresses	28,0	> 10
			furniture	17,0	25
			carpet	110,5	1
E (old house)	female	33	mattresses	34,0	> 5
	female	8	furniture	6,5	9
			carpet	85,1	9
				737,1	

* C and D are living on the same farm two years after the treatment this farm wasn't vacuumed.

RESULTS

1. *Dust reduction* :

The amount of dust received by standard vacuuming is shown in Fig. 1. The initial amount of dust extracted from the different habitats is rather high, although the dwellings have been cleaned quite regularly.

Three weeks after the acaricidal treatment only the carpets, which had been treated with moist powder, did not show an immediate reduction of the amount of dust. This may be caused by the powder carrier making 42 parts from 100 of this agent.

The changements caused by the treatments concern only the dust quantities obtained during the first and the second vacuum cleaning (3 and 7 weeks after the treatment). Further on we observed a rather stable equilibrium between dust reduction and reappearing of dust portions.

2. *Mite assessment* :

The initial mite population are to be seen in Tab. 1a-e. In all houses *Dermatophagoides pteronyssinus* is the most abundant species. In no case *Glycyphagus sp.* was isolated before the treatment.

In house A (Tab. 1a) *D. pteronyssinus* is followed by *Cheyletus eruditus* and *Acarus siro*. In the bedroom high amounts of *Tarsonemus* sp. in carpets and mattresses were collected. Only little amounts of *D. farinae* and *Tyrophagus putrescentiae* were isolated from the house-dust in this house.

In house B (Tab. 1b) *D. farinae* were found in three carpets in a quantity of nearly 20 % of the amount of *D. pteronyssinus*. Small amounts of *Tyrophagus putrescentiae* were isolated.

Besides *D. pteronyssinus, A. siro* is the most common mite in the dust of the houses C and D (Tab. 1c, d). *D. farinae* and *Cheyletus sp.* were found as the next important mite populations. Only small amounts of *Tyrophagus putrescentiae* were detected.

In house E (Tab. 1e) high amounts of *Tarsonemus* sp. were isolated (522 animals per sqm).

3. *Mite control related to all textiles investigated* :

A survey of mite control by acaricidal treatments is shown in Fig. 2a. Three weeks after the treatment the average number of living house-dust mites (*D. pteronyssinus* and *D. farinae*) for all textiles investigated decreased from 90 to about 10 per sqm (Fig. 3a). During the following 22 weeks this number decreased more and more. After one year the first new growing of the mite population was observed. Even two years later no more than ten house-dust mites per sqm were found in the home textiles.

The number of living predator and storage mite species *Cheyletus* sp. and *Acarus siro* diminished three weeks after the acaricidal treatment down to zero. Even during the following two years only a few living mites were found (< 10/sqm) (Fig. 4a, 6a).

The analogous survey of dead mites is given in Fig. 2b. The number of dead house-dust mites (*Dermatophagoides* sp.) first increased from 100 to 350 per sqm after the treatment. Seven weeks later it decreased to the starting level (Fig. 2b) and remained there during the following time. This is even the case two years after the acaricidal treatment.

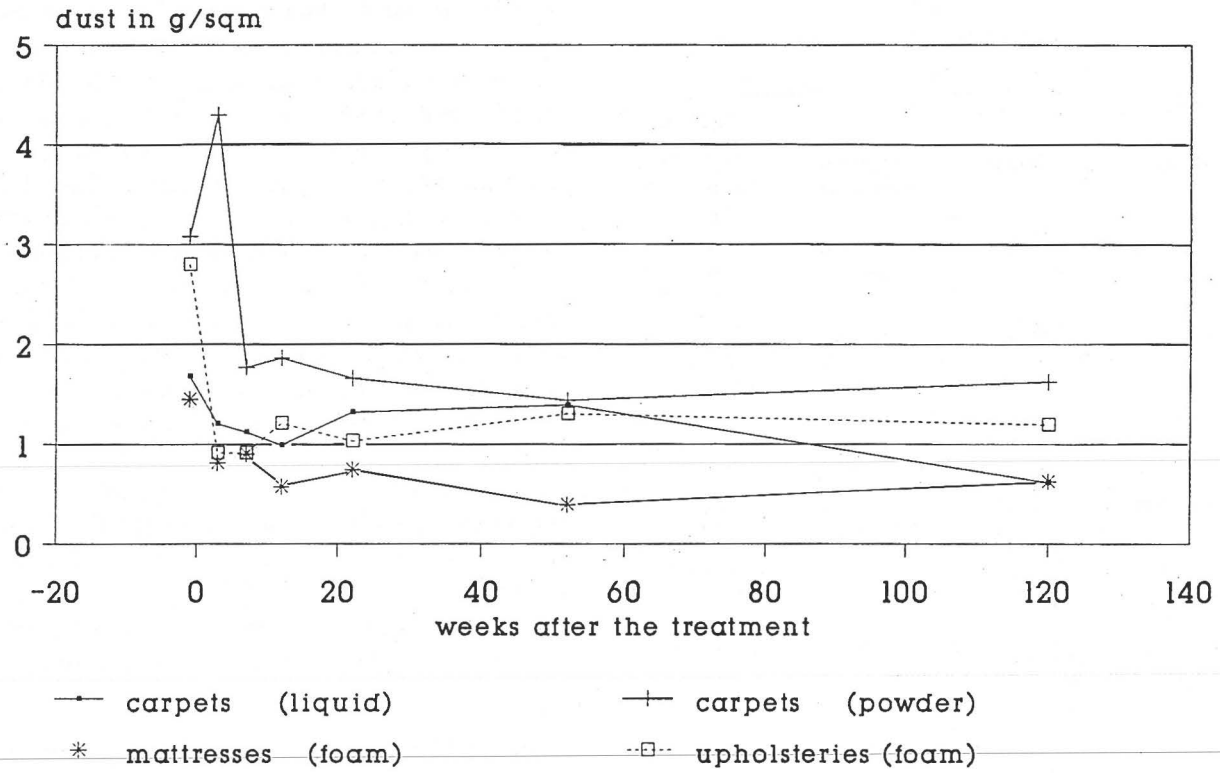

FIG. 1 : Amount of sampled dust from different textile objects before and after the acaricidal treatment. Application form of acaricide in parenthesis.

On the other side dead organisms of *Glycyphagus destructor* which had not been found before the acaricidal treatment, occur now (Fig. 5b). The number of dead *Acarus siro* mites increases strongly (Fig. 4b). For *Tarsonemus* sp. we have not distinguished between living and dead mites (Fig. 7).

An exception in the changement of the number of dead mites has been observed for the predator mite *Cheyletus* sp. Most of these mites were extracted before the treatment. Afterwards their number diminished significantly and later on slowly (Fig. 6b).

4. *Mite control related to the single mite species* :

Fig. 3 to 6 show the follow-up of the numbers of the detected mite species after the acaricidal treatment of the different textile objects.

In Fig. 3a and b the numbers of living and dead *Dermatophagoides pteronyssinus* and *D. farinae* in the different textiles before and after the acaricidal treatment are shown. There were found by far more living house-dust mites in the upholstery than in the mattresses (Fig. 3a). The number of house-dust mites decreased rapidly after the treatment. Twelve weeks later merely few living mites were still present and after 22 weeks almost no mite. Beginning with the 52th week the number of *Dermatophagoides* sp. increased slowly. Little numbers of these mites were found in the carpets before the treatment, and the number was still low two years after.

Regarding the dead house-dust mites (Fig. 3b), their number increased strongly after the treatment especially in the mattresses (7 times) and in the stuffed furniture (2 times). Before the treatment of the carpets the same amount of dead mites was found as in the mattresses. After the treatment, a little and temporary rise of the dead mites in the carpet was observed.

Living *Acarus siro* mites (Fig. 4a), especially found in upholstery, are completely controlled by

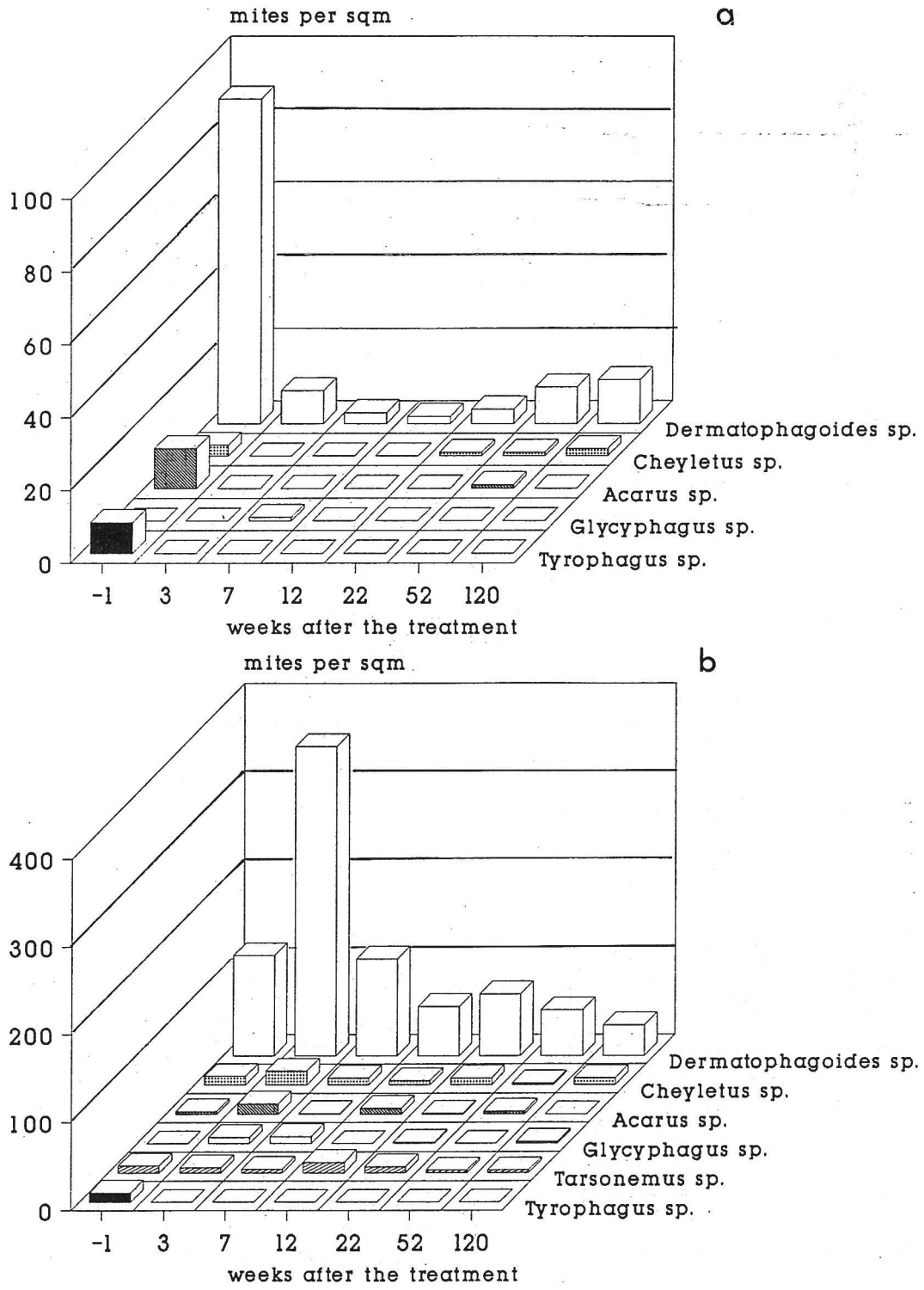

FIG. 2 : Mites in home textiles before and after the acaricidal treatment. Average of all textiles investigated. a. — Living mites. b. — Dead mites.

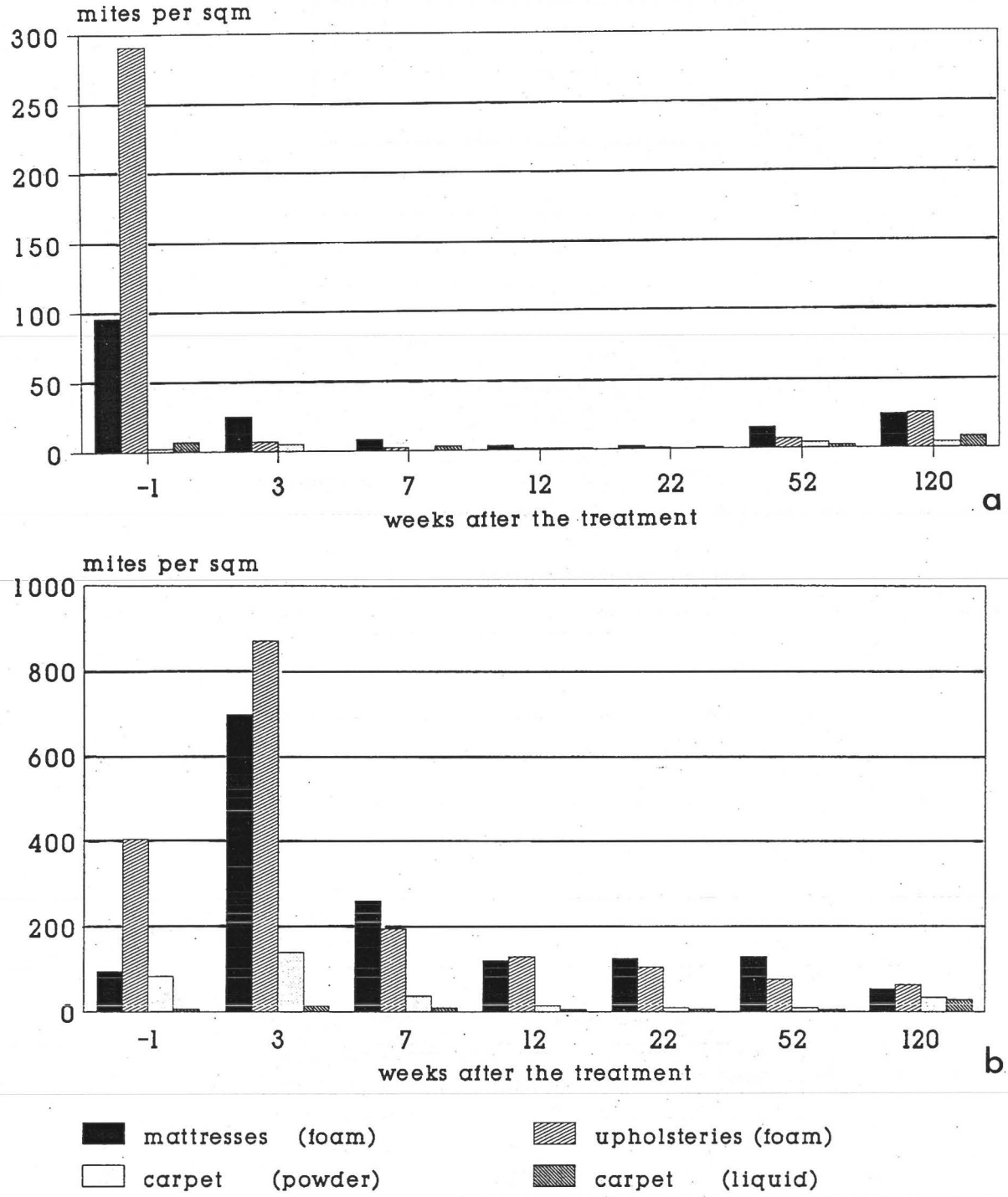

FIG. 3 : *Dermatophagoides* sp. in different home textiles. Application form of acaricide in parenthesis. a. — Living mites. b. — Dead mites.

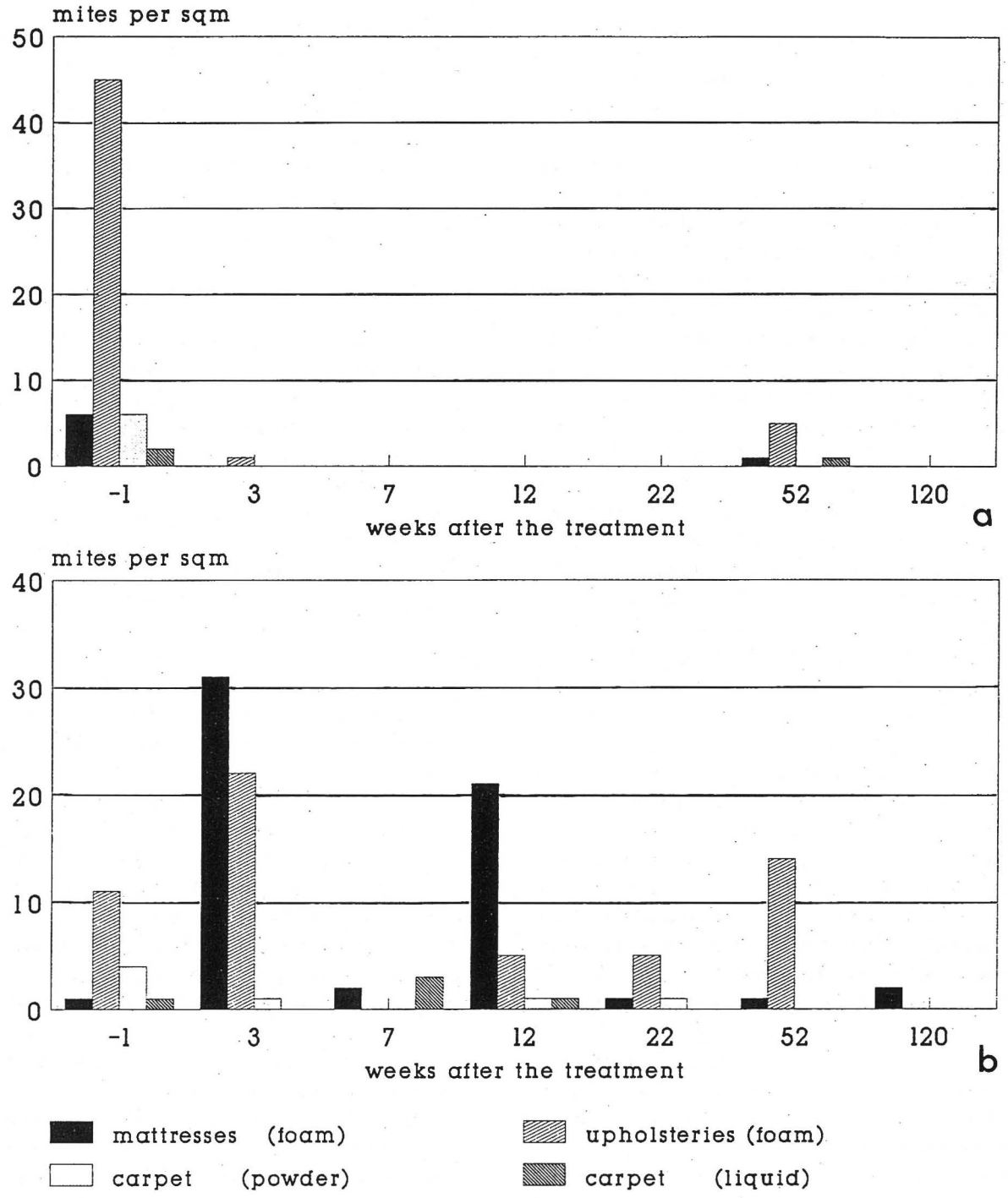

FIG. 4. : *Acarus* sp. in different home textiles. Application form of acaricide in parenthesis. a. — Living mites. b. — Dead mites.

the acaricidal treatment, too. Three or seven weeks after the treatment no living mites appeared, and only a few mites were isolated in the 52th week. After the treatment the number of dead mites (Fig. 4b) extremely raised for mattresses and significantly for upholstery. After this we observed irregular changements.

Living *Glycyphagus destructor* mites were not detected in any textile before the treatment and were rarely seen after the treatment (Fig. 5a). Nevertheless the number of dead *Glycyphagus* sp. increased strongly in upholstery, mattresses and carpets after the treatment (Fig. 5b). Most of these dead mites were found on the stuffed furniture. 12 weeks later less than 5 dead mites per sqm were found.

The numbers of predator mites *Cheyletus* sp. in different textiles are given in Fig 6a and 6b. Before the treatment most of the living mites were found in the mattresses (10 mites per sqm). Surely the numbers of this species normally are very restricted, but this number still decreased to zero between the 3rd and 12th week after the treatment. It increased slowly after this time. In all other textiles less *Cheyletus* sp. mites were found. Their number decreased to zero and remained there for a long time. Only in the 52th week *Cheyletus* sp. reappeared in mattresses, in the 128th week in mattresses, carpets and upholstery.

As for the dead *Cheyletus* sp. again, most of them were detected in the mattresses, too (Fig. 6b). In all textile objects no increase was found after the treatment, in the mattresses the number decreased from nearly 200 to 50 dead mites per sqm three weeks after the treatment. During the whole of the later period no more than 12 dead mites were found.

The number of *Tarsonemus* sp. in different textiles can be seen in Fig. 7. The global number of living and dead *Tarsonemus* sp. in mattresses increased slightly after the acaricidal treatment. 12 and 120 weeks after the treatment their number climbed about two times the level, observed before and directly after the treatment. We suggest that this rise is mainly due to dead mites as it is the case for other mite species too. The cleaning action of the acaricide demands more time as in other cases for loosening these extremely small mites. On the carpets almost the same number of mites as in mattresses was found before the treatment and after the treatment sometimes about the half of this quantity. From stuffed furniture only little amounts of *Tarsonemus* sp. could be isolated.

No living *Tyrophagus putrescentiae* mite was found after the treatment and only 3 dead animals were found 22 weeks after the treatment in mattresses and 10 mites 52 weeks after treatment. In all other objects no *Tyrophagus putrescentiae* was detected.

Discussion

Our results show that the dust of rural houses is a biotop, which is not only inhabited by house-dust mites (*D. pteronyssinus* and *D. farinae*). Other mite species, which normally demand special climatic and special conditions (van Bronswijk *et al.*, 1971, Pin *et al.*, 1986) live together with them. In rural houses storage mites can easily enter coming from sheds and barns and rest for some time in the house-dust ecosystem.

Although in laboratory experiments 0,5 % of *Cheyletus* sp. animals in a *Dermatophagoides* sp. population are able to destroy this population within 8 weeks (van Bronswijk *et al.*), we find that a mixed population of several species in natural biotopes is able to build up a rather stable equilibrium.

Mite sampling by vacuum-cleaning includes only the extraction of a representative fraction of the mite population (about 5-10 %) (Bischoff and van Bronswijk 1986). Supposed that this part of the really existing population of living mites is representative for the whole population, we are able to follow mite control and the remaining efficiency during a long time. On this basis our study concerning a single acaricidal shows for the first time the mite control related to different mite species in different textile objects.

Rests of mite populations in stable niches may be unchanged and cause a recolonization of treated areas after a certain time. We notice that a single acaricidal treatment drastically diminishes the population, so that no significant recolonization for about two years took place. The pyroglyphid mite *Dermatophagoides* sp. reappears slowly after 52

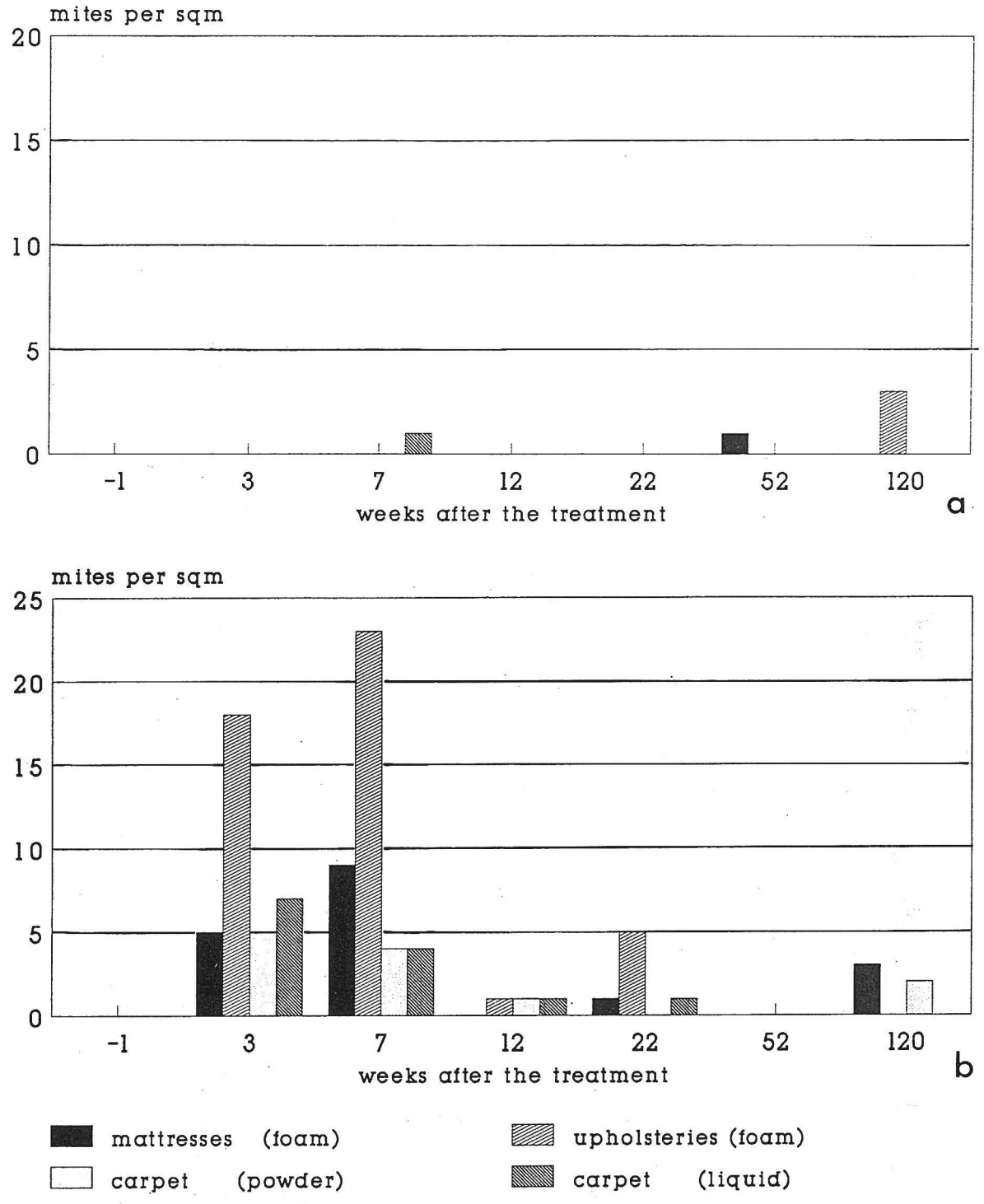

FIG. 5 : *Glycyphagus* sp. in different home textiles. Application form of acaricide in parenthesis. a. — Living mites. b. — Dead mites.

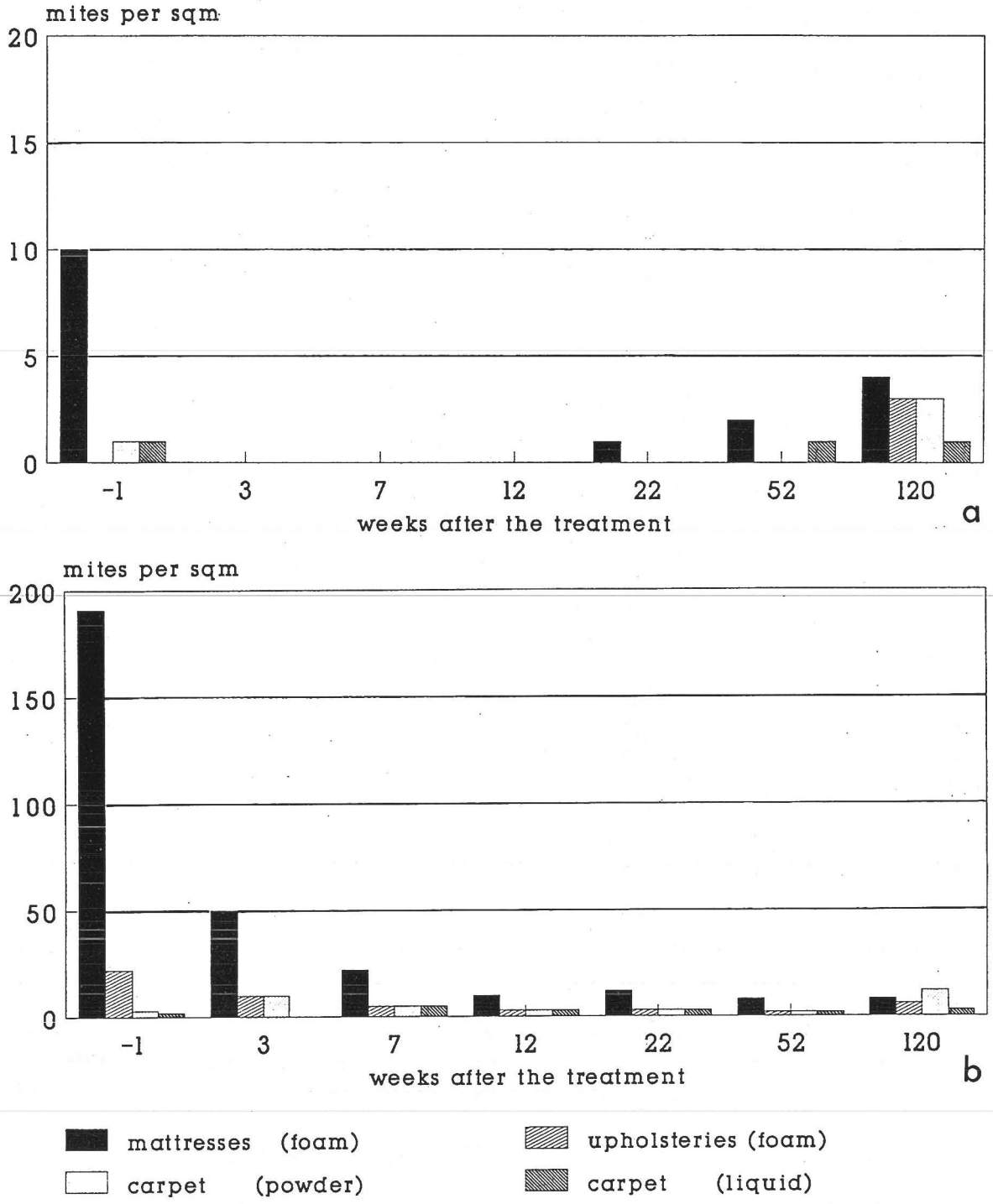

FIG. 6 : *Cheyletus* sp. in different home textiles. Application form of acaricide in parenthesis. a. — Living mites. b. — Dead mites.

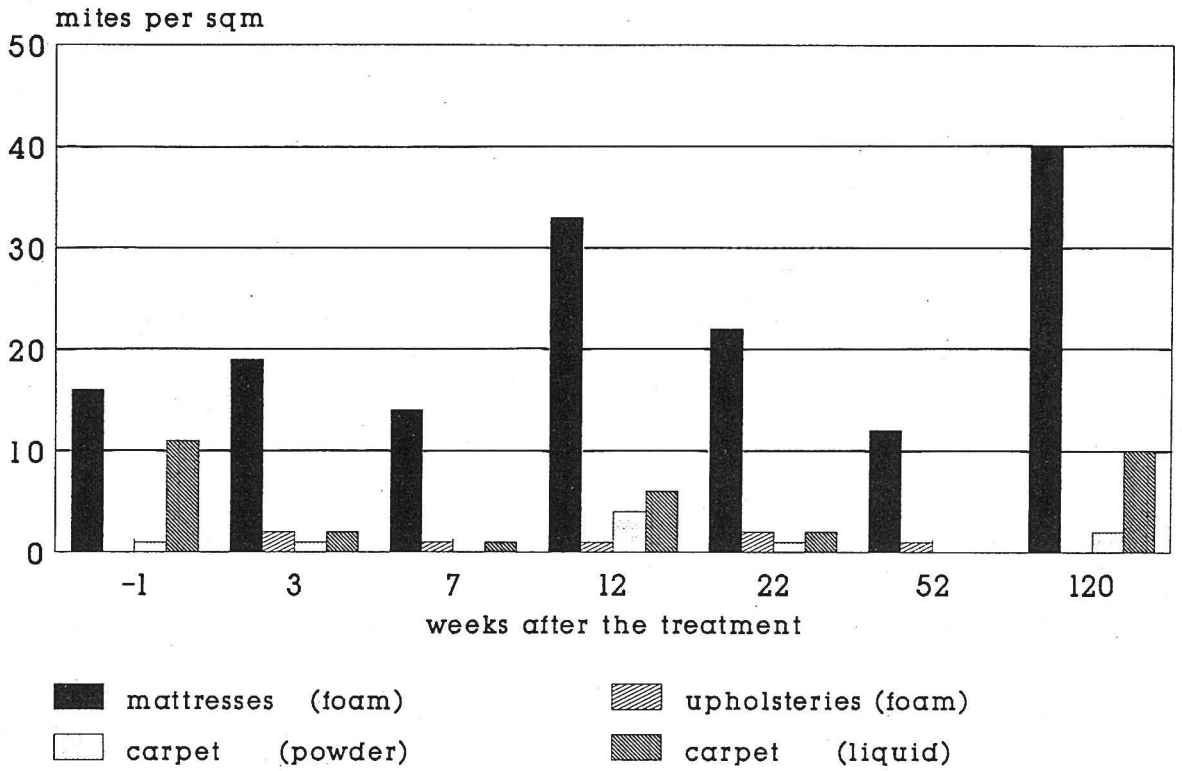

FIG. 7 : *Tarsonemus* sp. in different home textiles. Application form of acaricide in parenthesis.

weeks. From the other mites *Acarus* sp. and *Glycyphagus* sp. reappeared slowly after 52 weeks too, the predator mite *Cheyletus* sp. only after 22 weeks.

Thus mite control was effective during more than one year. No mite species was able to rebuild the former population. This means too that the stability of the acaricidal substances lasts more than a year. We suppose that the recolonization takes place from outside the treated niches. New mites may possibly enter the treated textiles transportated in clothes (LIEBENBERG and BISCHOFF, 1989 ; KNIEST *et al.*, 1989 ; KNIEST, 1988) or by immigration from places that were not treated, included rooms with stored food or hay (like in rural communities).

We observed very high differences between the numbers of living and dead mites of every mite species before and after the mite control. These differences were assessed for all textile objects in the houses. This means too, for all findings before the treatment that we observed undisturbed natural biotopes.

The most important living mite species before the treatment was *Dermatophagoides* sp. with an average of about 90 mites per sqm (Fig. 2a). The population of this mite arised in single textiles of upholstery up to 900 animals/sqm, of mattresses up to 500/^{2} and to carpets up to 400/^{2} (Tab. 1a-e). They were followed by the storage mites (*Acarus siro*) with an average of about 10 mites/sqm (Fig. 2a), but in single textiles up to 120 as in upholstery (Tab. 1c). *Glycyphagus* sp. mites were not present in all of these textiles. The predator mite *Cheyletus* sp. with an average of 2-3 mites/sqm arised up to 44 mites/sqm in single mattresses (Tab. 1a).

Related to the different mite species in the groups of textiles we observed after the acaricidal treatment for *Dermatophagoides* sp. changements from about 100 to 15 living mites/sqm in mattresses, and from about 300 to 15 living mites/sqm in uphols-

tery (Fig. 3a). This means a mite reduction to 15 resp. 5 %, still after two years. The storage mite *Acarus* sp. changed from 5 mites/sqm in mattresses to 0,5 and from 45 in upholstery to 5 animals/sqm after the first year and to zero in both of these textile groups after two years (Fig. 4a).

DEDICATION

To the Memory of late Dr. Fritz LUKOSCHUS, University of Nijmegen, Holland, who taught us mite biology.

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