

Short communication

Mite fauna of German farms

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Storage mites are important sources of airborne allergens, especially on farms. A mite survey was conducted in the working environments of 121 farms in five regions of Germany. Of 859 samples, 743 (86.4%) contained mites, representing 547 857 astigmatic mites in 723 g of dust and 34 501 prostigmatic mites in 469 g of dust. Dust samples from nine sites of each farm were collected and analyzed. Ninety-three percent of all mites belonged to the order Astigmata (storage- and house-dust-mite species); 35 Astigmata and 14 Prostigmata mite species were identified. According to the abundance and steadiness of the important astigmatic mite species, the following order was found: *Lepidoglyphus destructor* > *Glycyphagus domesticus* > *Acarus siro* > *Tyrophagus longior* > *Blomia tjobodas* > *Chortoglyphus arcuatus* > *Thyreophagus entomophagus* > *Tyrophagus putrescentiae* > *Euroglyphus longior* > *Tyrophagus palmarum* > *Acarus farris* > *Acarus immobilis* > *Gohieria fusca*. *Blomia tjobodas* was described for the first time as an abundant species of farms in Germany.

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In recent years, there has been increased interest in the study of storage mites (SM) as triggers of allergic reactions. Several studies have demonstrated that SM are major sensitizers among farmers (1–13) and that the inhalation of their allergens can provoke asthma and rhinoconjunctivitis. SM have also been identified in urban homes, suggesting that they can also be regarded as causative agents of allergic diseases in people who are not exposed occupationally. People living in damp houses seem to be particularly at risk (7).

Investigations of the mite fauna of farms have been carried out in various European countries, but only one pilot study has been reported in Germany (14). In Scotland, Jeffrey (15) analyzed hay samples from 31 farms and identified *Lepidoglyphus destructor*, *Acarus farris*, *Acarus siro*, *Tyrophagus longior*, and *Tyrophagus palmarum*. In Iceland, Hallas & Gudmundsson (16) examined the mite content of hay samples and reported that the most common astigmatic mite species were *L. destructor* and *A. farris*. In Finland, Terho et al. (17) analyzed the mite species present in hay and identified *T. longior* as the most common, followed by *A. siro* and *A. farris*. In Ireland, Cusack et al. (18) reported

that the main mite species in stored grain were *A. siro* and *Glycyphagus domesticus*, followed by *T. longior* and *Acarus immobilis*; *Tyrophagus putrescentiae* was present only in small numbers. In England and Wales, Griffiths et al. (19) identified *A. farris* and small numbers of *T. putrescentiae* in bulk grain samples. In Denmark, Iversen et al. (7) studied grain, straw, and hay samples, finding that *L. destructor* was predominant in grain and straw, and *A. siro* in hay; *Tyrophagus* spp. were also found in large numbers. In Sweden, Hillerdahl et al. (20) found *L. destructor* and *A. siro* to be the most common astigmatic species in hay. In Scotland, Cuthbert et al. (1) found *A. siro* and *A. farris* in 14/16 hay samples and *Glycyphagus* spp. in 9/16 samples; Pyroglyphid mites occurred in only one sample. In addition to the hay-storage facilities, Leskinen & Klen (21) reported that in Finnish cowsheds *A. siro* was the most abundant mite species, whereas *L. destructor*, *T. longior*, and *G. domesticus* were less common and occurred in about equal numbers. In the hay-storage facilities, *A. siro* was more abundant than *L. destructor* and *G. domesticus*, which occurred in similar numbers.

Most of these studies have shown the presence of mites of clinical importance on European farms. Most of these species have also been identified in house dust throughout the world. The present study aimed to investigate the mite fauna of 121 farms in five regions of Germany.

Material and methods

Sampling sites

In cooperation with the Agricultural Professional Associations of Münster, Hannover, and Augsburg, 121 farms in different regions of Germany (Niedersachsen, Münsterland, Ostwestfalen, Sauerland, and Allgäu) were selected for mite analysis. Dust samples (a total of 859) were collected from nine areas within each farm during February, March, October, and November 1993, and May and June 1994.

Mite counts and identification

All samples were collected by hand (spoon) and immediately transported to the laboratory and stored at 5°C until analysis. Three aliquots were analyzed from each sample. Living mites were isolated with a modified shaker including variable sieves (200–500 µm width), fixed in 70% ethanol or 15% glutaraldehyde, mounted on glass slides, and examined under a microscope (Aristoplan, Fa. Leica). Keys (22–27) were used for the correct identification of the different mite species. Mites belonging to the orders Mesostigmata, Cryptostigmata, and Metastigmata were not identified because they accounted for less than 1% of all the mites. Results are expressed as the number of mites/g (analyzed) dust.

Results

Ninety-three percent of all the mites found belonged to the order Astigmata; 723/859 samples of the working area (84%) contained a total of 547857 Astigmata and 34501 Prostigmata in 469/859 samples (54%); 35 Astigmata mite species (32 SM and three house-dust mites [HDM]) and 14 Prostigmata mite species could be identified (Table 1). Fig. 1 shows a box plot view of the Astigmata mite counts. Altogether, the arithmetic mean of the total Astigmata count in the samples taken from the nine sample areas was 638/g of dust; 108/121 farms were infested by *G. domesticus* (89.2%), followed by *L. destructor* (88.4%), *A. siro* (79.3%), *T. longior* (70.2%), *Chortoglyphus arcuatus* (52%), *Blomia tjbodas* (42.9%), *Thyreophagus entomophagus* (35.5%), *Euroglyphus longior* (31.4%), *T. putres-*

Table 1. Identified mite species: a) Astigmata (in alphabetic order); b) Prostigmata (in alphabetic order)

a) Astigmata	
1. <i>Acarus farris</i>	19. <i>Glycyphagus geniculatus</i>
2. <i>Acarus gracilis</i>	20. <i>Glycyphagus ornatus</i>
3. <i>Acarus immobilis</i>	21. <i>Gohieria fusca</i>
4. <i>Acarus siro</i>	22. <i>Histiostoma feroniarium</i>
5. <i>Acotylenodon paradoxa</i>	23. <i>Histiostoma sapromyzarum</i>
6. <i>Aleuroglyphus ovatus</i>	24. <i>Lepidoglyphus destructor</i>
7. <i>Blomia tjbodas</i>	25. <i>Michaelopus evansi</i>
8. <i>Caloglyphus berlesei</i>	26. <i>Nonacarus</i> sp.
9. <i>Caloglyphus hughesi</i>	27. <i>Thyreophagus entomophagus</i>
10. <i>Chortoglyphus arcuatus</i>	28. <i>Tyrolichus casei</i>
11. <i>Ctenoglyphus palmifer</i>	29. <i>Tyrophagus brevicarinatus</i>
12. <i>Ctenoglyphus plumiger</i>	30. <i>Tyrophagus longior</i>
13. <i>Dermatophagoides pteronyssinus</i>	31. <i>Tyrophagus neiswanderi</i>
14. <i>Diamesoglyphus intermedius</i>	32. <i>Tyrophagus palmarum</i>
15. <i>Euroglyphus longior</i>	33. <i>Tyrophagus pemiciosus</i>
16. <i>Euroglyphus maynei</i>	34. <i>Tyrophagus putrescentiae</i>
17. <i>Glycyphagus bicaudatus</i>	35. <i>Tyrophagus similis</i>
18. <i>Glycyphagus domesticus</i>	
b) Prostigmata	
1. <i>Acaropsis sollers</i>	8. <i>Cheyletus tronessarti</i>
2. <i>Bricella</i> sp.	9. <i>Gunaxa</i> sp.
3. <i>Cheyletiella</i> sp.	10. <i>Eucheyletia</i> sp.
4. <i>Cheletomorpha lepidopterum</i>	11. <i>Pyemotes</i> sp.
5. <i>Cheyletus aversor</i>	12. <i>Spinibdella</i> sp.
6. <i>Cheyletus eruditus</i>	13. <i>Tarsonemus</i> sp.
7. <i>Cheyletus malaccensis</i>	14. <i>Tydeus</i> sp.

centiae (26.4%), *A. farris* (23.9%), *Gohieria fusca* (14%), *T. palmarum* (12.4%), and *A. immobilis* (9%).

Abundance

According to the abundance (number of individuals of one species in all samples of Astigmata counted; Table 2), we found the following ranking of importance: *L. destructor* was the most abundant Astigmata species with a total count of 171845 individuals, followed by *A. siro* (126441 individuals), *B. tjbodas* (82025 individuals), *G. domesticus* (66765 individuals), *C. arcuatus* (26162 individuals), *T. longior* (25498 individuals), *T. entomophagus* (19261 individuals), *E. longior* (4650 individuals), *T. putrescentiae* (4632 individuals), *A. farris* (3877 individuals), *A. immobilis* (3574 individuals), *G. fusca* (3330 individuals), and *T. palmarum* (2753 individuals). The highest infestation densities of the important astigmatic mites found in one sample in each case were as follows: *L. destructor* 30500 individuals/g of dust, followed by *B. tjbodas* (22300), *G. domesticus* (18700), *A. siro* (14600), *T. entomophagus* (5095), *T. longior* (4220), *C. arcuatus* (3860), *T. putrescentiae* (1535), *E. longior* (934), *G. fusca* (750), *A. farris* (727), *A. immobilis* (715), and *T. palmarum* (285). Most of the individuals of *L. destructor* and *G. domesticus* were in the hypopus stage (resting deutonymph).

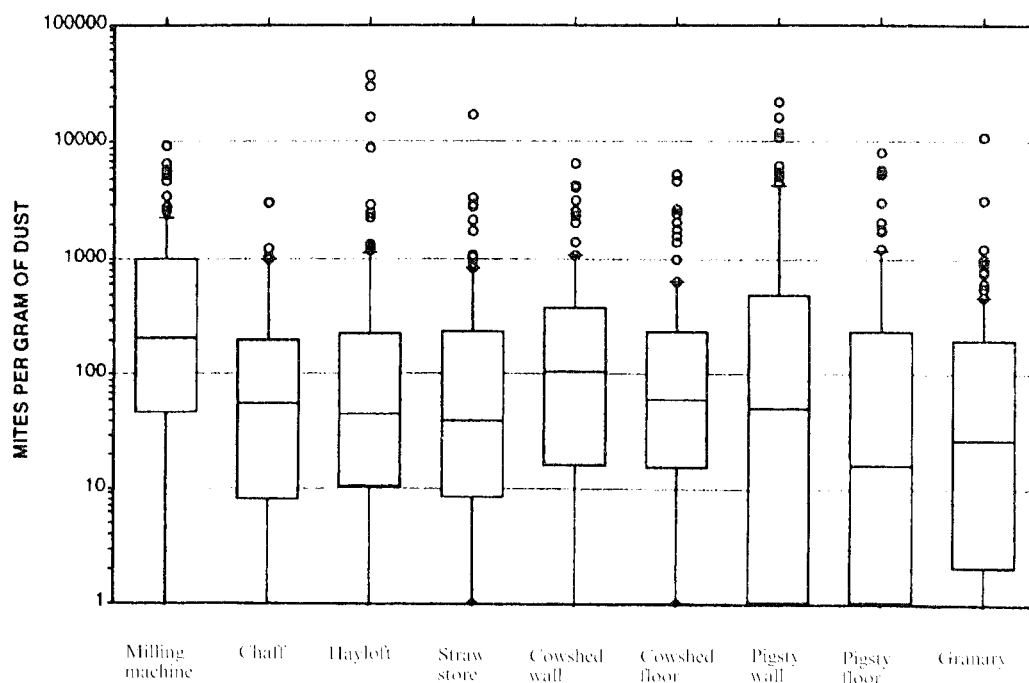


Fig. 1. Box plot view of Astigmata mite counts in sample areas.

Steadiness

According to the steadiness (occurrence of one species in all samples containing Astigmata; Table 2), the following ranking of importance was observed: *L. destructor* was detected in 392/859 analyzed samples, followed by *G. domesticus* (374 samples), *A. siro* (227 samples), *T. longior* (182 samples), *C. arcuatus* (119 samples), *B. tjiibodas* (102 samples), *T. entomophagus* (62 samples), *T. putrescentiae* (53 samples), *E. longior* (47 samples), *T. palmarum* (43 samples), *A. faris* (37 samples), *A. immobilis* (32 samples), and *G. fusca* (26 samples).

Discussion

The morphologic analysis of the dust samples revealed the rich Astigmata fauna of German farms. Representatives of the Tydeidae, Tarsonemidae, and Cheyletidae families (Prostigmata) were also common (Table 1b). Preliminary investigations indicate that mites belonging to the order Prostigmata, especially *Cheyletus eruditus*, may also produce allergens (28). Our results indicate that the mite fauna in farms in Germany comprises clinically important species. Since exposure to 100 mites/g of *Dermatophagoides* spp. has been proposed as the threshold concentration that triggers the genetically prone person to produce mite-specific IgE (29), we consider that German farmers are exposed in the working environment to mite levels that could induce sensitization and/or symptoms.

Higher levels, more than 500 HDM/g of dust, have been proposed as a major risk factor for acute asthma in a sensitized person (29). In the present study, the mean mite level was 638 Astigmata/g of dust, which can be considered high. Mites belonging to the Pyroglyphidae were also found. *Euroglyphus maynei*, *Dermatophagoides pteronyssinus*, and *E. longior* were identified in six, four, and 47 samples of the different working areas, respectively. Additionally, studies of the mite fauna of henhouses (30) showed a high abundance and steadiness of *D. farinae*, *D. pteronyssinus*, and *E. longior*.

Each sample area seems to have a different predominant mite species. These differences in mite infestations and abundance could be caused by differences in humidity and/or food requirements. However, mite infestation of storage products and/or house dust varies according to the climatic conditions and, therefore, from country to country, as shown in different studies and reports of mite allergy and fauna from tropical and sub-tropical countries (31–33).

The Astigmata mite fauna of German farms is similar to the mite fauna of other European countries (1, 7, 14–21). We also identified a great number of Astigmata mite species (35 species), 13 of which may be of allergenic importance. The large number of mite species identified may be due to the number of farms investigated and the large number of sites analyzed within the different farms. The analysis of the mite content of farm dust

Table 2. Abundance (number of individuals of one species in all samples of Astigmata counted) and steadiness (occurrence of one species in all samples containing Astigmata) of important astigmatic mite species in sample areas

Species	Milling machine	Chaff	Straw store	Hayloft	Cowshed wall	Cowshed floor	Pigsty wall	Pigsty floor	Granary
Abundance									
<i>I. destructor</i>	7430	853	90 430	36 512	671	1433	24 033	4586	5897
<i>A. siro</i>	39 565	5616	213	1724	91	20 431	24 438	20 488	13 875
<i>B. tjiobdas</i>	395	21	37	10	22 219	947	51 051	6170	1175
<i>G. domesticus</i>	18 228	2905	22 742	4831	5187	654	4603	2463	5152
<i>C. arcuatus</i>	3090	152	132	529	2218	3116	10 751	5380	794
<i>I. longior</i>	396	143	129	761	15 378	2474	2845	3305	67
<i>T. entomophagus</i>	18 661	81	4	0	172	0	40	288	15
<i>E. longior</i>	472	978	555	120	1455	22	61	4	983
<i>T. putrescentiae</i>	35	0	5	175	522	1260	64	2548	23
<i>A. farris</i>	866	19	10/2	1820	1	22	8	15	54
<i>A. immobilis</i>	779	239	1942	146	206	261	0	1	0
<i>G. fusca</i>	1450	20	0	5	3	59	1175	618	0
<i>T. palmarum</i>	55	13	2	0	877	649	130	1003	24
Total	91 793	11 045	117 304	46 918	49 056	35 460	119 388	48 699	28 194
Steadiness									
<i>I. destructor</i>	37	17	79	69	32	43	31	36	48
<i>G. domesticus</i>	59	20	63	54	42	34	31	26	45
<i>A. siro</i>	44	10	13	18	16	48	10	38	30
<i>I. longior</i>	13	7	4	8	51	49	20	18	12
<i>C. arcuatus</i>	16	5	9	16	11	17	12	17	16
<i>B. tjiobdas</i>	8	4	4	3	28	15	21	12	7
<i>T. entomophagus</i>	34	2	3	0	9	0	5	7	2
<i>T. putrescentiae</i>	4	0	2	1	12	12	4	14	4
<i>E. longior</i>	10	5	4	6	7	3	4	1	7
<i>I. palmarum</i>	2	1	1	0	10	15	4	6	4
<i>A. farris</i>	6	2	11	5	1	6	2	2	2
<i>A. immobilis</i>	5	5	8	5	3	5	0	1	0
<i>G. fusca</i>	5	1	0	2	1	4	4	9	0
Total	90/102	32/37	101/113	95/106	95/107	96/107	68/95	72/95	74/97

samples revealed the presence of many “domestic mites” (DM), and it has been proposed that this term be used for HDM and SM which are found in the domestic environment and elicit an IgE response (34). For the first time, *B. tjiobdas* was detected in the working environments of German farms (14, 35). This mite is biologically related to *Blomia tropicalis*, a very important source of allergens in house dust in tropical and subtropical regions (4, 36–38). Accordingly, it may be speculated that *B. tjiobdas* induces IgE-mediated allergic airway diseases. Initial investigations (39, 40) indicate that there is a high degree of sensitization to *B. tjiobdas* in Germany among farmers and urban dwellers, and a high degree of cross-reactivity between *B. tropicalis* and *B. tjiobdas*. Future publications will elaborate on this subject.

At present, only three SM extracts (*A. siro*, *L. destructor*, and *T. putrescentiae*) are available for skin testing and treatment in Germany. Our results suggest that they do not cover the DM spectrum present in Germany, especially on farms. In addition to mite species with known allergologic impor-

tance, there are other species, such as *A. farris*, *A. immobilis*, *B. tjiobdas*, *C. arcuatus*, *E. longior*, *G. domesticus*, *G. fusca*, *T. entomophagus*, *T. longior*, and *T. palmarum*, which may have clinical importance. Greater efforts should be made to establish the allergenic cross-reactivity among these species.

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