A PREVALENCE SURVEY OF POULTRY HOUSE MITES IN ISRAEL

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ACARIDAE
PYROGLYPHIDAE
POULTRY
HOUSE
DUST
ISRAEL

SUMMARY : A survey in Israel of poultry houses at 35 different farms in four zones differing in climate was made to determine the prevalence, number and species of mites. Over an 18-months period, 240 samples were taken : 124 dust samples from dust-laden poultry house surfaces, and 116 soil samples from earth and litter adjacent to or containing poultry droppings. Mites were present in all of the poultry houses surveyed ; in 92 % of dust samples and in 90 % of soil samples. More than 30 species were identified ; as many as 796 mites per 100 mg of dust and 840 mites per 100 mg of soil were counted. In dust samples, the most prevalent species were *Dermatophagoides evansi* (74.4 %) and *Acarus immobilis* (5.6 %) ; and in soil samples : *A. immobilis* (40.9 %), *D. evansi* (11.4 %) and *Hughesiella africana* (9.2 %). The mite population in dust and soil samples was significantly ($p < 0.05$) higher in September. Significantly higher ($p < 0.01$) mite counts were noted in dust samples from the hottest and most arid region of the country. Great variation was noted in the number of mites in samples from the same climatic zone. Seventy-two percent of the poultry farms reported the occurrence of workplace-related respiratory disease.

ACARIDAE
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POULAILLER
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RÉSUMÉ : Les poulaillers de 35 fermes dans 4 zones différant par leur climat ont été examinés en Israel pour déterminer la prévalence, le nombre et les espèces des acariens. Pendant une période de 18 mois, 240 échantillons ont été prélevés : 124 échantillons de poussières des surfaces des poulaillers et 116 échantillons de sols avec de la terre et des détritus à proximité ou contenant des excréments de volaille. Les acariens ont été trouvés dans tous les poulaillers étudiés ; dans 72 % des échantillons des poussières et 90 % des sols. Plus de 30 espèces ont été identifiées. Les espèces les plus fréquentes étaient *Dermatophagoides evansi* (74,4 %) et *Acarus immobilis* (5,6 %) dans les poussières ; dans les échantillons de sol *A. immobilis* (40,9 %), *D. evansi* (11,4 %) et *Hughesiella africana* (9,2 %). La population d'acariens dans les échantillons de poussière et de sol était statistiquement plus importante ($p < 0.05$) en Septembre. Un nombre d'acariens plus élevé de façon significative ($p < 0.01$) a été trouvé dans la poussière en provenance de la région la plus chaude et la plus aride du pays. Il a été noté une grande variabilité dans le nombre d'acariens trouvés dans les échantillons d'une même zone climatique. Dans 72 % des poulaillers, l'incidence des maladies respiratoires dues au lieu de travail a été signalée.

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Introduction

Mites have long been confirmed as a primary cause of house dust allergy in humans (Voorhorst *et al.*, 1969), with the genera *Dermatophagoides* and *Euroglyphus* providing the major source of allergens. Storage mites such as *Tyrophagus, Acarus* and *Glycyphagus* are ubiquitous in their distribution and are commonly found in grain storage areas, feed mills and farms. The inhalation of these mites in workplace dust has been reported as producing allergic respiratory disease (Wraith *et al.*, 1979).

In addition to saprophytic and parasitic mites, the poultry house normally includes a broad range of other workplace allergens such as chicken feathers, egg proteins, poultry litter, fungi, insects and microorganisms (Lutsky *et al.*, 1984).

Poultry workers have described symptoms of asthma and rhinitis upon entering their place of work which may well represent an occupational hypersensitivity (Bar-Sela *et al.*, 1984). On the basis of positive clinical history, skin prick testing, radioimmunoassay and provocative bronchial challenge, the relevance of an ectoparasitic poultry mite, *Ornithonyssus sylviarum*, as a possible cause of poultry-house related hypersensitivity lung disease was reported (Lutsky & Bar-Sela, 1982).

The aim of the study reported here was to determine the prevalence, species and number of mites found in poultry houses in Israel as related to environmental climatic conditions.

Materials and methods

Sample areas : Four geographic sample areas with different climatic conditions were chosen : I. *Coastal plain* : high relative humidity (65-70 % annual average), summers being the most humid. Annual mean temperature : 19°C (August average 26°C). II. *Northern Negev* : Semi-arid ; continental climate with diurnal temperature span ; hot summers with 33.7°C as August average. Annual average humidity : 58 %. III. *Judean Hills* : lower average temperature (16-17°C) and heavier rainfall. Average humidity : 60 %. IV. *Jordan Valley Rift and Arava* : A pronouncedly high continental temperature regime ; very hot and dry ; low relative humidity.

Farms : Study samples were collected at poultry houses from 22 farms within the four climatic regions as noted above. Samples were collected monthly from one poultry house in each region, and from the remaining poultry houses on a quarterly schedule (September, December, March and June). Samples were also collected from 13 additional poultry houses, primarily in the Judean Hills, at irregular intervals.

The flocks studied ranged in size from 1,200 to 25,000 (mean 7,850). Hens were kept in poultry houses [240-1,650 m^2 (mean : 842 m^2)], 75 % of which had been built since 1970. On twenty farms which produced table eggs, chickens were housed 2 to 3 birds per cage. Eighty-five percent of the farms acknowledged entry of wild birds into the poultry houses. Carbamates were most frequently utilized against parasitic mites (e.g. *D. sylviarum*) and Cyromazine against flies. In most cases, temperatures inside the poultry houses reflected the prevailing ambient temperatures. None of the farms employed air conditioning, however on farms located in areas of extreme heat, forced air ventilation, evaporative coolers and water sprinklers helped reduce internal temperature. Litter was removed once a year from most farms (14 of 19), twice per year from 3 farms, and 4 times per year from 2 farms.

Samples : A total of 240 samples were examined. One hundred and twenty-four samples of poultry house dust were collected from dust-laden surfaces adjacent to the poultry cages and feed distribution system. One hundred and sixteen samples were taken from the soil and litter below the cages. Dust samples contained poultry-feed powder, avian epithelia, feather fragments and dust. Soil samples were a mixture of poultry excreta, earth, poultry-feed, egg remains and dust. Samples (10-50 grams) were stored in polyethylene bags at 5°C prior to examination.

Isolation of mites : The samples were examined for mites using a method described previously

(MUMCUOGLU, 1976). 10 ml of concentrated lactic acid containing 0.2 % Naphtholblueblack (Sigma, St. Louis, Mo) was added to 100-250 mg of sample dust which had passed through a 0.6 mm sieve. This mixture was heated to boiling, and immediately diluted with 90 ml distilled water and filtered through black filter paper. Naphtholblueblack stained a large part of the sample particles but not the mites. Filtering the unstained mites on black filter paper facilitated isolation. Using a stereo-microscope (25 ×), mites were removed from the filter paper with a mounted needle. The specimens were mounted in Hoyer's medium and identified by light-microscopy.

RESULTS

Mites were present in samples from all the poultry houses in the study. Mites were found in 92 % of dust samples and in 90 % of soil samples (Table 1). More than 30 species of mites, mainly astigmatid and mesostigmatid mites were identified. *Dermatophagoides evansi* was the most prevalent species in dust samples, comprising 74.4 % of the mite fauna. The next most prevalent species in dust samples was *Acarus immobilis* (6.9 %). *D. evansi* was found in 74.2 % and *A. immobilis* in 30.6 % of the dust samples. *A. immobilis* was the most common species in soil samples (43.8 %) followed by *D. evansi* (12 %), *Leiodinychus krameri* (9.4 %) and *Hughesiella africana* (6.5 %). *A. immobilis* was found in 54.3 % and *D. evansi* in 33.6 % of the soil samples.

Large numbers of mites were found throughout the entire collection period, with the highest average number of mites per gram of sample observed in September (Figure 1). Assuming that the distribution of mites in the samples was random, and therefore described by the Poisson distribution (STEEL & TORRIE, 1960), we found that soil and dust mite counts for September were significantly different ($p < 0.05$) from those for other months. Using the Friedman two-way analysis of variance technique (SIEGEL, 1956) mite counts from four different climatic regions, regardless of season, indicated higher mite counts ($p < 0.01$) for dust samples from the hottest and most arid region, the Arava/Jordan Valley. By the same analysis, poultry house soil samples from these four regions showed no significant difference in the mite count level by region, regardless of the time of year.

Seventy-two per cent of the poultry establishments reported the occurrence of workplace related respiratory disease.

TABLE 1 : Relative frequency and rate of occurence of mites isolated from 240 poultry house in Israel.

	Relative frequency in %		Rate of occurrence in %	
	Dust	Soil	Dust	Soil
ACARI	100	100	92.0	90.5
ACARIFORMES	95.3	85.8		
ASTIGMATA	93.8	83.6		
Pyroglyphidae	76.3	18.5		
Dermatophagoides evansi	74.4	12.0	74.2	33.6
D. farinae	0.1		0.1	
Hughesiella africana	1.9	6.5	16.9	18.1
Glycyphagidae	0.9	0.2		
Glycyphagus spec.	0.8	—	2.4	—
Gohieria fusca	0.1	0.2	1.6	0.9
Acaridae	13.8	60.9		
Acarus immobilis	6.9	43.8	30.6	54.3
A. siro	2.0	4.3	3.2	5.2
Tyrophagus putrescentiae	1.4	6.2	11.3	18.0
Aleuroglyphus ovatus	1.9	2.6	3.2	4.3
Rhizoglyphus echinopus	0.1	2.7	0.8	6.9
Thyreophagus entomophagus	0.3	0.1	1.6	1.7
Caloglyphus berlesei	1.2	1.3	4.0	5.2
Analgidae	2.6	1.0		
Megninia spec.	2.6	1.0	25.7	12.7
Chortoglyphidae	0.2	2.9		
Chortoglyphus arcuatus	0.2	2.9	6.3	16.4
PROSTIGMATA	1.4	2.1		
Cheyletidae	1.1	1.8	15.5	31.0
Tarsonemidae	0.3	0.2	4.1	4.2
Scutacaridae	—	0.1	—	0.1
CRYPTOSTIGMATA	0.1	0.2	0.1	0.1
PARASITIFORMES	4.4	13.2		
MESOSTIGMATA	1.8	3.2	21.5	36.0
Laelaptidae				
Hypoaspis spec.	—	—	0.1	—
Uropodidae				
Leiodinychus krameri	1.4	9.4	5.7	34.5
Dermanyssidae				
Dermanyssus gallinae	—	0.1	—	0.1
Macronyssidae				
Ornithonyssus sylviarum	1.2	0.6	5.6	5.2
UNIDENTIFIED	0.3	1.0	4.6	11.2

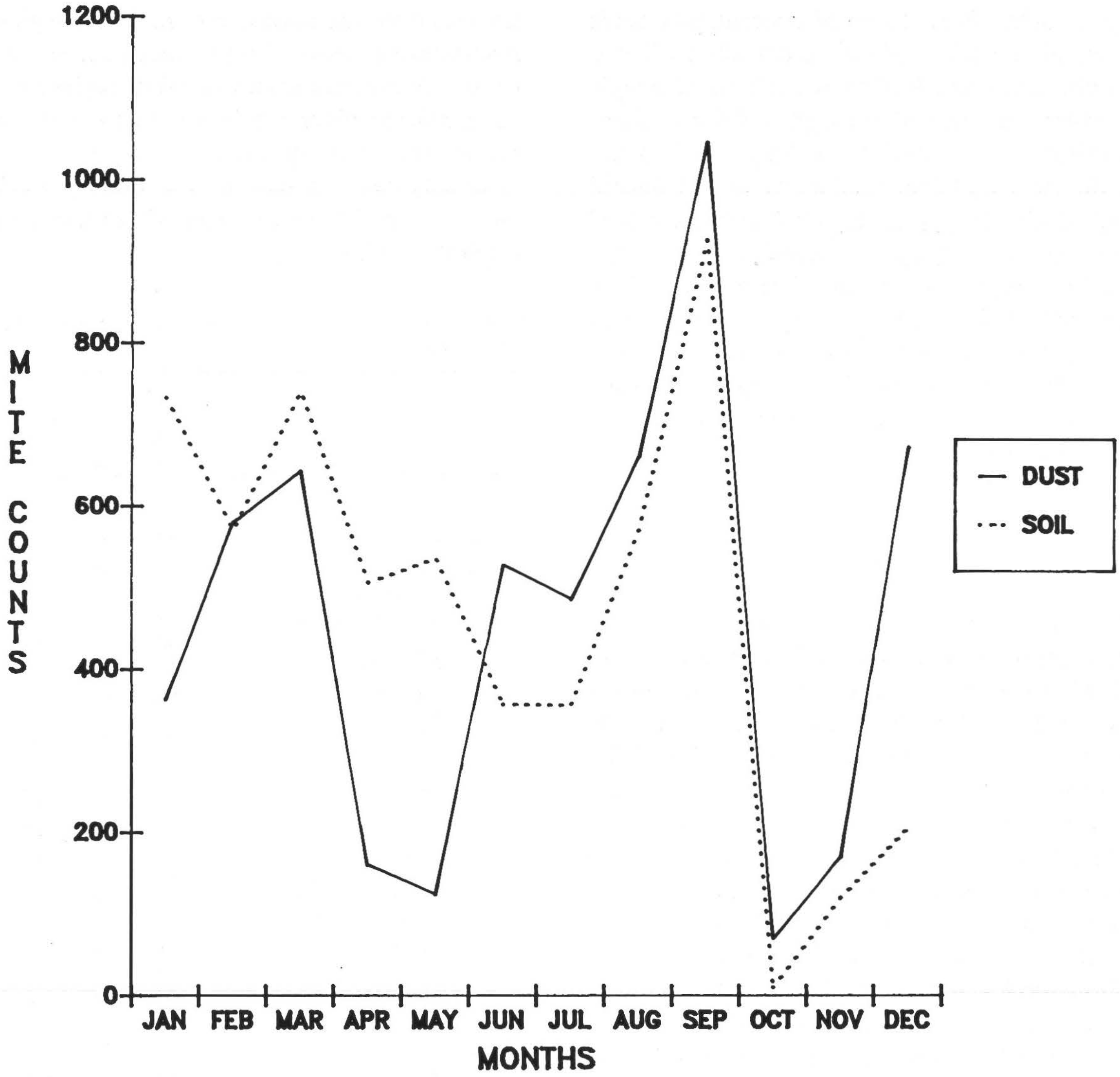

FIG. 1 : Average monthly mite counts (1986-1987) from 22 poultry houses in Israel. August counts were estimated.

DISCUSSION

To our knowledge this investigation constitutes the first study of the presence and prevalence of free-living mites in the poultry house environment in Israel. Heretofore, several Israeli authors have examined the parasitic mite fauna of chickens (KOHANE & HADANI, 1961 ; CWILLICH & HADANI, 1965 ; CWILLICH & DISON, 1967), turkeys (HADANI *et al.*, 1975) and wild birds trapped in poultry houses (ROSEN *et al.*, 1985).

Previous workers examined soil samples only, when studying the mite fauna of poultry houses. By examining dust laden surfaces of poultry houses, we found a mite population which consisted mainly of *D. evansi* (74.4 %). In other studies, this species was found only in 1 % of samples studied (QUINTERO & ACEVEDO, 1984), or was not reported at all (BRADY, 1970). These mites prefer to feed on proteinaceous and fatty materials (BRONSWIJK, 1972). They were prevalent in our dust samples, where skin scales, feather fragments and chicken food had accumulated on surfaces such as poultry cages and the feed distribution system.

Our findings on soil confirm those of other research workers in Europe and America who found that acarid and mesostigmatid mites were the most prevalent mites in poultry houses (BRADY, 1970; TOMANOVIC *et al.*, 1977; GREEN, 1980; QUINTERO & ACEVEDO, 1984). Acarid mites which prefer more humid areas and feed on fungi, were more common in soil samples.

The fact that in our study 18.5 % of the mites isolated from soil samples were pyroglyphid mites may be because the separation technique employed by us was different from the Berlese funnel technique utilized by other workers to separate living mites. In preliminary studies using the Berlese technique we were able to separate only single living pyroglyphid mites. Subsequently, we employed only the filtration method, which permitted separation of all mites, living and dead.

D. evansi was first isolated from a feather pillow in England (FAIN, 1967). It has occasionally been found in house dust samples (ARAUJO-FONTAINE *et al.*, 1973; AMOLI & CUNNINGTON, 1977) and poultry houses (BRADY, 1970; TOMANOVIC *et al.*, 1977; GREEN, 1980; QUINTERO & ACEVEDO, 1984). *H. africana* was previously identified when it was isolated from Angolian fish meal stored in warehouses in England (HUGHES, 1976). In our samples *H. africana* constituted 2 % of the mites in dust samples and 6.5 % of the mites in soil samples; this species was found in 17 % and 18 % of these samples, respectively.

Our results for Israeli poultry houses indicate a much larger number of *D. evansi* and *H. africana* than has been heretofore reported. We believe that these mites are probably present in great numbers in poultry houses of other countries, however the various sampling and isolation techniques utilized by others previously have not detected this high prevalence.

The total number of isolated mites per gram soil sample was higher in Israel than in England (BRADY, 1970) and Yugoslavia (TOMANOVIC *et al.*, 1977). The differences may be associated with hotter climatic conditions in Israel, and to the different separation methods utilized; with our technique, dead mites were also isolated.

Variations noted in the number of mites from samples obtained in the same climatic zone might have been related to the date and frequency of litter removal and acaricidal treatment. Variations within a single climatic Zone were also noted in England (BRADY, 1970).

In Israël the largest number of poultry mites were found during September, following the hottest month of the year i.e. August (ORNI & EFRAT), 1971. The high number of mites found in poultry houses in Israel during summer, corresponds with data from poultry houses in England (BRADY, 1970) and granaries in Japan (SINHA, 1968), where maximum numbers of mites were also found during the summer months.

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