

Biodiversity And Population Dynamics Of Dust Mites

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Abstract: Mites are living organisms having cosmopolitan distribution and have free to parasitic mode of life. They are microscopic and belong to the largest Arthropods. According to their habit and habitat they are of different types like plant mites, gall mites, animal mites, poultry mites etc. They dwell in dust accumulating in carpets, bedding, fabrics, furniture and poultry. They are negatively photo tactic. Mites are allergens too causing allergies, eczema, asthma, rhinitia, bronchitis etc to human and animals. Humidity and temperature are the most important factors that regulate the dust mite population. Common house dust mite population can be influenced by housekeeping practices. They are killed by predators in nature and by direct exposure to sunrays. As house dust mites are widely distributed, a lot of work has been done on the seasonal dynamics and distribution. The maximum literature available in library, journals, books and internet sites have been cited and studied for the diversity of dust mites and tried to summarize here.

Keywords: Dust mites, cosmopolitan, allergens, factors, influence and diversity.

I. Introduction

Mites are the micro and macro living organisms, have cosmopolitan distribution, free to parasitic mode of life. Mites are among the oldest of all terrestrial animals with fossils known from the early Devonian, nearly 400 million years ago¹(Norton *et al.*, 1988)[1]. They are found everywhere and eat flakes of skin in addition to other things.

1. Taxonomy & Habitat: Mites are tiny structured creature, belonging to the largest phylum Arthropoda, and are the most diverse representatives. Mites belong to Class Arachnida, Subclass Acari, Order Acarina. Most of the mites are the members of the family pyroglyphidae (Colloff. 2007; 2009)[2]. Mites are distributed everywhere and have plasticity in habitat. Most of the mites are microscopic size. Many of the mites live freely in the soil or water (fresh or marine), but a large number of mites species live as parasites on plants, animals (invertebrate & vertebrate), some are predators while others are beneficial symbionts (Holliday *et al.*, 2000)[3]. About 48,200 species of mites have been described. A large number of mites are found in the dust of home, offices, hospitals and other human and animal environment. They live in bedding and carpets and feed on skin shed by person, mice and pets (Nayer *et al.* 1974)[4]. They live in our rugs, furniture, mattresses, and other areas where organic detritus and high level humidity is accumulated.
2. Types of mites: according to the habit and habitat mites are of different types. They are plant pest mite including spider mites (Bolland H. R. *et al.*, 1997)[5], thread footed mites and gall mites (Yutaka Saito. 2009)[6]. etc.; animal mites such as demodex mites (family demodicidae) living in or near hair follicle, sarcoptic mange mite (family sarcoptidae) that burrow under the skin; insect mite (family tarsonemidae); dog and cat mite etc; poultry dust mites; house dust mites and storage mites. Some are very harmful to human and cause diseases such as clover mites, itch mites harvest mites etc. Kern (1921)[7] discovered *Dermatophagoides pteronyssinus* in house dust as allergen in U.S.A. 8 Miyamota *et al.* (1969)[8] found *D. farinae* as common floor dust mite. Prevalence of two most common species of *Dermatophagoides*, *d. farinae* and *d. pteronyssinus* (Hughes 1961)[9] established in the house dust samples of India. Dust mites are cosmopolitan in distribution accumulating in carpets, bedding, fabrics and furniture's. In the world 36 species of house dust mites have been reported, out of which 29 have been reported in India. Dust mites are also present in poultry dust. Bird mites feed on bird's blood dwelling near bird's nest and poultry house. Mites are negatively photo tactic, the anterior-lateral regions of the body being sensitive to light (Murton and Madden. 1977)[10].
3. Morphology & Life cycle: Mites are minute sac like animals without body division. They are small sized, microscopic with translucent bodies, measuring 420 micrometers in length and 250-320 microns in width, adult mites are creamy blue and rectangle or oval in shape. Mouth parts produce a head like structure bearing a pairs of chelicerae and a pair of padipalps. Four pair legs are found, Eyes and antenna are absent. The whole body bears long hairs and setae (Thompson *et al.* 1958)[11]. Dust mites are poikilothermic animals so the length of their life cycle varies with the temperature. Female lay eggs at the rate of 1-3 per day depending upon the environmental condition (Hart, 1998)[12]. The stages in the life cycle are the egg, a

six legged larva protonymph, eight legged nymph stage tritonymph and adult male and females (Arlian, 1989)[13].

4. Mites and Allergy: about 10 million people suffer from different allergy type like allergies, eczema, asthma, rhinitia, bronchitis etc. In India Rao *et al.* (1973)[14] at Bhillai, 15 Nayar *et al.* (1974)[15] and Krishnarao *et al.* (1982)[16] at Bangalore, Tripathi and Parikh (1984)[17] at Bombay, Tilak and Jogdand (1989)[18] at Aurangabad have worked on house dust mite allergy. The allergens are some enzymatic proteins present in mite debris or skin faeces in the form of dry pellets which deposit on skin by dust mites which makes allergy or irritation on human skin; inhale of pellets mediate sensitization of bronchial hyper responsiveness causing bronchitis (Carlos *et al.* 2011)[19]; in the bed of asthmatic patients Dematophagoides mites were found in abundantly (Saha 1994)[20], and their serum contained significantly higher IgE concentrations (Sun and Lue 2000)[21]. Perennial allergic rhinitis is a common chronic disorder that results most frequently from sensitivity to house dust mites (Sheikh and Hurwitz. 2003)[22]. Mahesh *et al.* (2005)[23] suggested a possible association of house dust mite sensitivity with chronic urticaria. Poddar *et al.* (2006)[24] carried out a systematic survey on the prevalence of total mites and four common allergic mites in the city of Kolkata. Marina *et al.* (2007)[25] indicated that along with dermatophagoides, blomia tropicalis is also found common and abundant allergen responsible for asthma and rhinitis from house dust mite in some part of the world. Magnus Wickmam (1991)[26] and Levin (2004)[27] studied the house dust mite sensitization in children.
5. Factors regulating dust mite frequency: Environmental factors like temperature, rainfall and relative humidity are found to determine the indoor mite's population. Walters and Proctor, (1999)[28] found a significant association between the presence of mites and the relative humidity, any condition which help to maintain high humidity increases the house dust mite population. Live mites were seen only when the relative humidity had been above 50% during the month of collection (Andrew *et al.* 1979)[29]. Relative humidity also affects the development and growth of the mite population (Zheltikova. 1985)[30]. Tilak and Jogdand (1989)[18] worked on the impact of environment on the occurrence of house dust mites in different localities of Aurangabad and reported highest percent contribution of house dust mite is recorded during rainy season in the month of September under congenial environmental conditions, when the temperature was around 25^o C and range of humidity was between 75% and 85%. The highest concentrations of house dust mites within homes are usually in areas of high use such as beds, furniture and carpeted floors in areas where humans shed skin (Korsgaard. J. 1998)[32]. Feeding rate and allergen production is directly influenced by the relative humidity; mites feed, multiply, and produce more faecal matter at higher relative humidity than at lower ones (Arlian, 1992[33]; Channa Basavanna, 1995)[34]. The house dust mites are extremely sensitive to minimal variations in microclimate (Cadman A. *et al.* 1998)[35], numbers of mites fluctuate according to season. In temperate climates, mite's density follows a seasonal cycle which corresponds to relative humidity with highest mite levels in summer and early fall seasons characterized by high humidity. Pyroglyphids were highest in summer and lowest in winter; glycyphagids were highest in autumn and lowest in spring Murrey And Zuk, 1979[36]; Chew *et al.*, 1999[37]; and Chaudhary *et al.*, 2011)[38].
6. Housekeeping practices & Control: The population of house dust mites can be influenced by housekeeping practices. Regular vacuuming, replacing carpets, covering mattresses and pillows in plastic and lowering humidity can reduce mite population. The RCC type of buildings supports maximum dust mites population, followed by Assam type (semi- RCC) buildings, and the lowest count was observed in the wooden houses (Sharma *et al.* 2011)[39]. The concentration of house dust mites in the patient's dwellings was also associated with the age of the patients and increased with increasing number of persons in the households (Hallas and Korsgaard, 1997)[40]. Mites are killed by predators in nature. Effective management of mites is possible through better cleaning practices, proper waste disposal methods from dwelling and application of disodium octaborate tetrahydrate (DOT) (Codina *et al.*, 2003)[41]. Other than this, herbs specially seeds of kranj, castor and neem is also utilized as extract in controlling these harmful dust mites (Khatri *et al.*, 2011)[42].

II. Dust mites diversity

The seasonal distribution of different acaroids mite species may differ with the major limiting factors like temperature, humidity and eating habits. The determining species composition and diversity of mite community's in house ecosystem also differ. Comparing to the field and the forest, in human living area including house and working place, mites showed less bio-diversity.

Here presenting list of work done on dust mite's diversity in different regions/ countries/states/cities related to the habit and habitat. We tried to cover maximum dominant group and families of acaroids species. (TABLE.)

III. Conclusion

Mites are microscopic living organisms having cosmopolitan distribution, included in arthropods, having free to parasitic life on plants and animals. They are abundantly found in the dust of homes, offices, hospitals, poultry farms, etc. they live in bedding, carpets, our rugs, furniture, mattresses. They are versatile from plants to animals. Some mites are harmful to human and cause allergy diseases such as eczema, skin rashes, wheezing, coughing, fatigue, headache, asthma, rhinitis (common chronic disorder), and bronchitis in adults, women and children. The frequency of dust mites are regulated by the environmental factors like temperature, rainfall and relative humidity. Under these congenial environmental conditions the dust mite population increases. They are extremely sensitive to minimal variations in microclimate fluctuating according to season following a seasonal cycle. Indeed the population of house dust mites can be influenced by the housekeeping practices like regular vacuuming, replacing carpets, covering mattresses and pillows by plastic, proper waste disposal methods from dwellings, and lowering humidity. Dust Mites are killed by the predators in nature and when exposed to direct sunrays. By applying chemicals like disodium octaborate tetrahydrate (DOT), Lindane, malathion, DDT, locally available seeds like kranj, castor and neem. Dust mites are seasonal dynamic and widely distributed in human habitat and work environment and produce very harmful allergens. Though small, dust mites have a huge impact on society. A large percentage of the population has been affected by them; hence multiple industries have developed to produce wide varieties of products for cleaning, dust protection, treatment and reduction of dust mites and to reduce the number of people that suffer from symptoms associated with dust mites. Farther studies and researches on dust mites may be the field of interest for forth coming scholars.

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TABLE: List of some work on Dust mites diversity:

Sl.N .	Region (Country/ state/ City)	Habitat	Dominant group/Families	Dominant genera/ species	Reference
1.	Copenhagen, Denmark	Residences of patients with atopic diseases	Pyroglyphidae, Glycyphagidae Cheyletidae	<i>Dermatophagoides pteronyssinus</i> , <i>D. farinae</i> , <i>Euroglyphus maynei</i> , <i>Acoropsis docta</i> , <i>Berlese</i> , <i>Cheyletus eruditus</i> , <i>Schrank</i> , <i>Cheyletus trouessarti</i> <i>Oudemanns</i> , <i>Acarussiro L.</i> , <i>Glycyphagus privatus Oudemans</i>	Milhim <i>et al.</i> , 1972 [43]
2.	Brazil.	House dust	22 sps. Glycyphagidae, Pyroglyphidae, Cheyletidae, Acaridae, Bdellidae, Tydeidae, Chortoglyphidae, Raphignathidae, Ascidae, Oribatei	<i>Dermatophagoides pteronyssinus</i> , <i>Dermatophagoides farinae</i> , <i>Cheyletus eruditus</i> , <i>Glycyphagu</i> <i>sp.</i>	Rasa and Flechtman, 1979 [44]

3	Karnataka	House dust	23 Sps. 5 families of Astigmata and one of Prostigmata	Pyroglyphids	Krishna Rao <i>et al.</i> , 1981
4	India Lucknow, Darjeeling, Shilong and Cherrapunji, Dibrugarh, Jammu & Kashmir and Delhi.	Human houses (Healthy & Patient)	16 sps. Acaridae (7 species), Chortoglyphidae (1-species), Glycyphagidae (7 species) and Labidophoridae (1 species)	<i>Dermatophagoides pteronyssinus</i> , <i>D. farina</i> ,	Rishi Ram <i>et al.</i> (1983)
5	Bombay	Human houses (Healthy & Patient with bronchial asthma)	Pyroglyphidae,	<i>D. farina</i> <i>D. pteronyssinus</i>	Tripathi and Parikh (1984)[17]
6	Karnataka	Human and animal houses	11 species under 8 genera which belong to 6 families. Pyroglyphidae,	<i>D. pteronyssinus</i> , <i>D. farinae</i> , <i>E. maynei</i> , <i>A. griffutsi</i> , <i>D. gallinae</i> , <i>T. longior</i> , <i>T. rutrescentiae</i> , <i>C. berlesesi</i> , <i>B. tropicalis</i> , <i>S. nesbitti</i> .	Valandikar and Basavanna (1987)[45]
7	Cool hilly region of Tamil Nadu	Brood chamber of <i>Apis Cerana</i> .	varroaidae	<i>Dermatophagoides pteronyssinus</i> and <i>D. farinae</i> ,	Soundararanjan <i>et al.</i> 1987 [45]
8	Three districts of West Bengal (24 Parganas, Bardhaman and Calcutta	Bed & Bed room of patients of asthma diseases	Pyroglyphidae,	<i>Dermatophagoides pteronyssinus</i> and <i>D. farinae</i> , <i>Hirstia domicola</i> .	Modak <i>et al.</i> 1991 [46]
9	Paun, argentina.	Soil sample	Orbatid	<i>Zygoribatula lata</i> , <i>Z. elongate</i> .	Denegri and alzuel, 1992 [47]
10	Northwest	Injurious plant feeding mites.	Metaseiulus, ambtseius, stigmaeidae	<i>Predator mites- Typhlodromus occidentallis</i> , and <i>Neoseiulus fallacies</i> , <i>Zezei mali</i> .	Berry 1998 [48]
11	Kearla	Office, Hotels, Houses	Pyroglyphidae, Glycyphagidae Acaridae	<i>Dermatophagoides pteronyssinus</i> , <i>Blomia tropicalis</i> , <i>Malayaglyphus</i> , <i>Rizoglyphus</i> , <i>Caloglyphus</i> , <i>Austroglyphus</i> , <i>Glycyphagus</i>	Laxmi and Haq, 1999 [49]
12	Haryana Punjab	Stored food products	Pyroglyphidae, Cheyletidae	<i>Chyletus malaccenus</i> , <i>D. pteronyssinus</i> ,	Putatunda <i>et al.</i> , 1999 [50]
13	Western Thong Pha Phum, Kanchana-buri	House mites	Pyroglyphidae Cheyletidae	<i>Dermatophagoides pteronyssinus</i> , <i>Chyletus</i> sp.	Insung (2002)[51]
14	Description	Bacterial disease in domestic fowl.	Poultry red mite	<i>Dermanyssus gallinae</i> ,	Chirici, 2003
15	Iran.	Dust from hotels & Inn	Pyroglyphidae, Cheyletidae	<i>D. pteronyssinus</i> , <i>Chyletus melaccerisis</i>	Soleiman M and Rafinejad J (2008)[53]
16	Egypt.	School	Pyroglyphidae Cheyletidae Dermanyssidae	<i>Dermatophagoides pteronyssinus</i> , <i>D. farina</i> , <i>Chyletus malccensis</i> and <i>Dermanyssus</i> sp.	Mohammad <i>et al.</i> (2009)[54].
17	Hawaii	Human houses	Pyroglyphidae,	<i>Dermatophagoides pteronyssinus</i> ,	Douglas <i>et al.</i> 2010[55]
18	Jeddah governorate	Wheat floor, bakeries, mills and departmental stores.	Pyroglyphidae, Acarophenacidae, Cheyletidae, Acaridae	<i>Dermatophagoides farinae</i> , <i>Acarophenax tribolii</i> , <i>Chyletus malaccenus</i> , <i>Blattisocius tarsalis</i> and <i>Blattisocius keogani</i>	Sulaiman A. and A.L. Nasser (2011)[56]
19	Malawi	Local chicken	Pyroglyphidae,	<i>Dermatophagoides gallinae</i> , <i>cnemidocoptes mutans</i>	Banda, 2011[57]
20	Vilnius Lithuania	houses	Pyroglyphidae,	<i>Dermatophagoides pteronyssinus</i> , <i>D. farina</i>	Dautartiene. A.[58]