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Seasonal abundance and diversity of astigmatic mites in storage facilities of Punjab, India

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ABSTRACT

Stored-product mites cause economic loss by feeding on stored grain and imperil the human health by contamination of food by allergens. The present study has been carried out to access the mite fauna associated with warehouses and other grain storage facilities of Punjab. Samples were collected three times a year. The year was divided into three climatic classes i.e. summer CCL I, rainy CCL II and winter CCL III. Mites were found in 146 (83.90%) of 168 analyzed samples. A total of 2400 mites were isolated of which, 1326 (55.25%) mites were found in samples collected during rainy season, 747 (31.12%) during summer and 327 (13.63%) during winter season. A total 2400 mites were isolated of which 1364 (56.83%) mites were from order Astigmata. Among the collected specimens, 11 species of astigmatid mites were identified belonging to 7 genera of 4 families i.e. acaridae, glycyphagidae, pyroglyphidae and saproglyphidae. *Tyrophagus putrescentiae* (18.3%) was found to be the most abundant mite species followed by *Glycyphagus domestics* (17.48%).

Key words: Allergen, Astigmatic, Mite, Seasonal, Warehouse.

INTRODUCTION

Mites are important pests of stored products (Hughes, 1976). Infestation is one of the most important problem associated with storage ecosystem. Mites are tiny creatures, well distributed throughout the world. They may survive in the temperature ranging from -18ºC to + 50º C (optimum temperature 35º C) and relative humidity ranging from 60%-80% (Henzel *et al*., 2010).

The infestation of stored food products with mites is usually associated with three types of damage (Stejskal, 2001). Firstly, storage mites directly imperil human due to allergenic contamination of grain and food products (Olsson and Hage-Hamsten, 2000; Arlian, 2002). Secondly, mites species feeding on fungi acts as a vector of toxicogenic fungi (Hubert *et al*., 2004) thus indirectly contribute to the contamination of food through mycotoxins (Griffiths *et al*., 1959~ Hubert *et al*., 2004). Thirdly, mites significantly reduce grain mass, quality, germinability and nutrient content of stored grain (Ždárková and Reska, 1976; White *et al*., 1979; Armitage *et al*., 2002).

Mites infest wide range of grains and other food products. Mites belonging to different families (acaridae, glycyphagidae and chortoglyphidae) of order astigmata are most important and commonly found in stored food products, granaries, other farming and occupational environments (Solarz *et* al., 2004). The most abundant and most frequently reported astigmatid mites are *Acarus siro* Linnaeus,1758, *Acarus farris* (Oudemans, 1905) and *Tyrophagus putrescentiae* (Schrank, 1781) from Acaridae, *Lepidoglyphus destructor* (Schrank, 1781), and *Gohieria fusca* (Oudemans, 1902) from Glycyphagidae (Leskinen and Klen, 1987; Franz *et al*., 1997; Boström *et al*., 1997 and Mehl, 1998).

Mites are found in geographical areas and climates with sufficient humidity. In most temperate humid regions of the world, house dust mites and storage mites are the major source of allergens. In tropical climates, the storage mite *Blomia tropicalis* (Family Echymyopodidae) along with pyroglyphid mites are most prevalent mites in dwellings (Arlian and Platts-Mills, 2001). It has been observed that the optimal temperature and relative humidity are major governing factors for the abundance of mite population (Palyvos and Emmanouel, 2006).

Astigmatid mites are the source of clinically important allergens and cause diseases like asthma, dermatitis, allergic rhinitis and damage to the food grains. (Armentia *et al*., 1997; Arlian and Platts-Mills, 2001, Solarz *et al.,* 2004). Therefore the present research was carried out to find the seasonal abundance and the diversity of these in the storage facilities of Punjab. Moreover no such study has been done on these mites in this region.

MATERIALS AND METHODS

Study area: Present investigation was carried out in Punjab, located at the altitude 30º4" North and longitude 75º5' East with an area of 50,362 km^2 in northwestern India. Fourteen districts were selected for present study, *viz.* Amritsar,

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Bathinda, Faridkot, Jalandher, Kapurthala, Ludhiana, Barnala, Bathinda, Mansa, Patiala, Hoshiarpur, Ropar, Ferozpur, Mukatsar Sahib (Fig. 1). Faunistic survey of mites was carried out from April 2014- March 2015.

Collection of samples: Collection was done seasonally from warehouses and other storage facilities of Punjab. The year was divided into three seasons: summer season CCL I (March-June), rainy season CCL II (July-Oct), winter season CCL III (Nov-Feb). Grain and grain residue were collected in zip lock bags. Relative humidity and temperature of the collection site was recorded with thermo hygrometer. Samples were brought to laboratory for further studies.

Extraction and identification of mites: Flotation method was used to extract the mites. Each sample was gently weighed and then a 100 g sub-sample was put into 80% alcohol for 4 hrs. After that the supernatant was decanted and replaced directly with saturated NaCl solution (Fain and Hart, 1986). Mites were preserved in mixture of 70% alcohol and glycerine in 10:1 ratio in small vials. To prepare microscopic slides, specimens were cleared in 60% lactic acid and mounted in Hoyer's medium. Ringing of slides was done with the help of nail polish. Photography of specimens was done by using LEICA microscope in Sophisticated Instrumentation Centre of Punjabi University, Patiala. Identification of mites was conducted according to the acarological keys given by Hughes, (1976); Krantz, (1978); Colloff and Spieksma, (1992).

RESULTS AND DISCUSSION

During present study period, 168 grain and residue samples were collected from various storage facilities of Punjab. Of which, 146 (83.90%) samples were observed positive for mite infestation. From total 14 inspected grain stores, all had mite infestation in both grain mass as well as in the residues.

Results shows that samples were infested with 11 species from 7 genera of 4 families: acaridae (43.23%), glycyphagidae (29.35%), pyroglyphidae (18.42%) and saproglyphidae (2%) of order astimata (Table I). In 2004, Solarz and his collaborators reported that the astigmatic mites were most abundant in farming environment and constituted 67.4% of total mites collected. Similarly during present study the astigmatic mites were most abundant constituting 56.83%

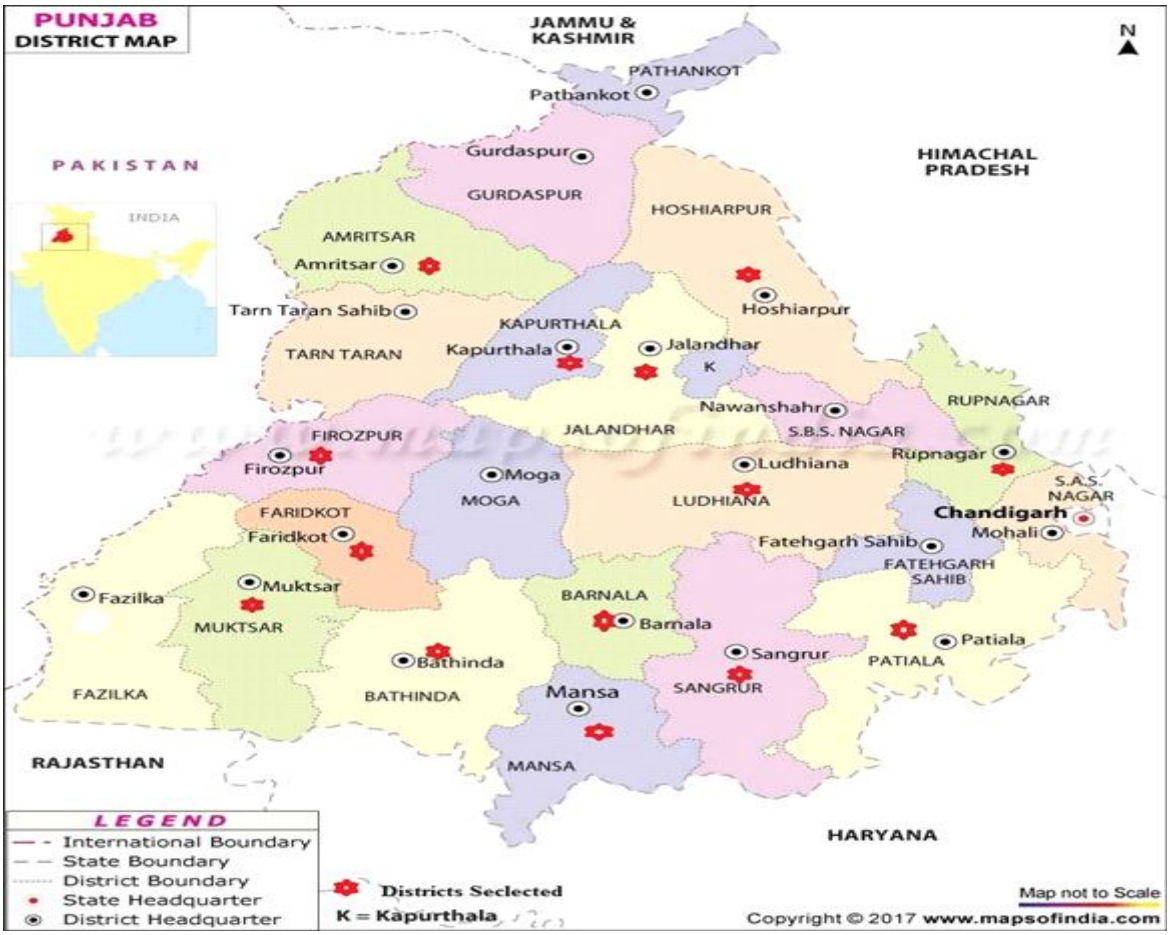


Fig-1: Map of Punjab (Study area)

Table 1: Percentage of astigmatid mites found in stored grains of Punjab.

Family	Genus	Species	Percentage of mites in total fauna
ACARIDAE			43.23%
	Tyrophagus	*Tyrophagus putrescentiae*	18.3%
		Tyrophagus longior	6.4%
	Acarus	*Acarus siro*	8.42%
		Acarus immobilis	2.63%
		Acarus farris	3.0%
	Rhizoglyphus	*Rhizoglyphus* sp.	2.68%
	Cosmoglyphus	*Cosmoglyphus oudemanis*	1.8%
GLYCYPHAGIDAE			29.35%
	Glycyphagus	*Glycyphagus domesticus*	17.48%
	Lepidoglyphus	*Lepidoglyphus destructor*	11.87%
PYROGLYPHIDAE			18.42%
	Dermatophagoides	*Dermatophagoides pteronyssinus*	11.32%
		Dermatophagoides farina	7.1%
SAPROGLYPHIDAE			2.00%
	Suidasianes	*Suidasia nesbitti*	2%

of total mites showing that the mites got transferred from the farming environment to the storage facilities. Similar results were observed by Seiedy *et al.*, 2012. They reported Acaridae as major family with some high populations in stored product samples. A total of 2400 mite specimens were isolated, including 1364 (56.83%) mites belonging to order astigmata. The astigmatid mites were found in 125(93%) of the total examined samples. These results are in accordance to the above findings. *Tyrophagus putrescentiae* (Fig.2) was found to be the dominant species with 18.3 % of the total population of astigmatic mites followed by *Glycyphagus domesticus* with 17.48% (Fig. 3).

Tyrophagus putrescentiae, *Glycyphagus domesticus*, *Lepidoglyphus destructor*, *Dermatophagoides pteronyssinus, Acarus siro* were most commonly found among all the infested samples. Palyvos and his collaborators in 2008 studied mite fauna of stored products in Greece and observed that *Tyrophagus putrescentiae* and *Lepidoglyphus destructor* were dominant and accessory species. In 2006 Palyvos and Emmanouel reported *Tyrophagus putrescentiae* and *Acarus siro* as serious pest of stored grain. Among the astigmatid mites isolated from the samples some may evoke allergenic reaction in human beings and cause severe dermatitis known as "grocer's itch" (*Glycyphagus domesticus),* "copra itch" (*Tyrophagus putrescentiae*) and "baker's itch" (*Acarus siro*). All these three species were found predominantly in infested samples during present study, showing that they can evoke allergic reaction in people working in these facilities.

During present investigation 1326 (55.25%) mites were found in samples collected during rainy season, 747 (31.12%) during summer and 327 (13.63%) during winter season. Similar results were observed by Slizman *et al.* (2006). There is a significant relationship between relative humidity and mite abundance. Mite counts were significantly higher in the samples collected during the months with mean monthly relative humidity above 50% and mean temperature 30º-35ºC (Rainy season CCL II). These findings are also in accordance with Ramanath and Channabasavanna (1989).



Fig-2: *Tyrophagus putrescentiae* (Schrank, 1781)

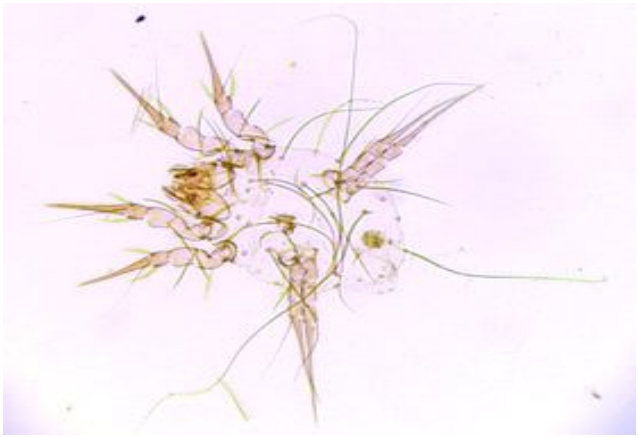


Fig-3: *Glycyphagus domesticus* (De Geer, 1778)

The results provide data regarding astigmatic mite population dynamics seasonally which is essential for planning physical, chemical or biological control measures that keeps mite population below threshold in storage facilities so that grain damage and occupational allergens can be controlled.

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