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A STUDY ON THE OCCURRENCE AND ABUNDANCE OF MITE *Acarus siro* L. (Acari: Acaridae) REPORTED FROM THE SAMPLES OF SOME STORED FOODS IN KASHMIR (INDIA)

[1]Navpreet Kaur Gill, [2]Mohd Yousuf Paray

[1,2] Department of Zoology and Environmental Science, Punjabi University, Patiala-147002

Abstract: ***Mites are ubiquitous in distribution and are reported to be present almost in all the habitats*****. A great number of stored grains, dried fruits, various farinaceous products and stored foods are often attacked by various types of mites. A faunistic survey of mites was conducted in many stored food stores during research work from December 2014 to November 2017 in Kashmir (India). A total of 2400 samples of ten stored foods i.e. almonds (*Prunus dulcis*), dry coconut (*Cocos nucifera*), groundnuts (*Arachis hypogaea*), maize (*Zea mays*), mustard (*Brassica juncea*), rice (*Oryza sativa*), walnuts (*Juglans regia*), wheat (*Triticum aestivum*), wheat flour (*Triticum aestivum*) and white gram (*Cicer arietinum*) were collected and examined for the mite fauna exploration. Twenty samples (each of 25 grams) of each stored food were collected per season, i.e. Winter (December to February), Spring (March to April), Summer (May to August) and Autumn (September to November). A total of 439 samples (18.29%) were mite positive. A total of nineteen mite species belonging to three orders, eleven families and fourteen genera were reported. A total of 5746 mite specimens were obtained. The mite species Acarus siro (Linnaeus, 1758) was reported in samples of 5 (50%) stored food types. A total of 58 samples (13.1%) out of the 439 mite positive samples were positive for Acarus siro specimens. A total of 974 (16.95%) specimens of Acarus siro were obtained out of the total 5746 mite specimens. Acarus siro was the second most frequent and abundant species found in stored foods after the Tyrophagus putrescentiae Schrank.**

Keywords: **Stored foods, Mites, Acarus siro, Occurrence, Abundance.**

1. INTRODUCTION

Mites are most damaging pests of agricultural and stored food products especially of grains, grain flour and other cereal products. The mites can seriously reduce the quality and also the quantity of stored products. In wheat, these mites damage the seeds and make them unsuitable for germination (Solomon, 1946)[1]. Mites often infest grain and stored food during transporting, processing for consumption and storage. The stored products fed by storage mites become deficient in carbohydrate and protein contents. Some mite genera from the family Acaridae and Glycyphagidae are the important source of allergens to the workers of farm and stores (Arlian, 1991; Cuthbert *et al*., 1979; Hallas and Iverson, 1996; Hughes, 1976)[2,3,4,5].

Acarus sp. and *Tyrophagus sp*. from the family Acaridae; and *Lepidglyphus destructor*, *Glycyphagus demesticus and Gohieria fusca* from the family Glycyphagidae are the most common mite species reported from stored food products from all over the world (Arlian, 1991; Arlian *et al*., 1993; Fian *et al*., 1990; Hallas & Iversen, 1996; Hughes, 1976)[2,6,7,4,5]. Tyroglyphid mites, commonly known as "Cheese mites" infest most stored products particularly grain, flour and other cereal (Solomon, 1945)[8].

The storage mites are the source of many allergies and cause occupational allergy among farmers and other agricultural workers. The relationship between storage-mite sensitivity and allergic symptoms such as asthma, rhinitis, and conjunctivitis was first studied among a group of farmers in Scotland (Cuthbert *et al*., 1979)[3]. Allergens produced by stored mites cause respiratory disease and atopic dermatitis of farmers (Van Hage-Hamsten & Johansson, 1992; Colloff, 1998)[9,10]. Mites are also harmful to bakers, shopkeepers and some of the occupational categories (Arlian *et al*., 1993; Dutkiewicz *et al*., 1988; Hallas & Gudmundsson, 1985; Tee, 1994)[6,11,12,13]. Considering the fact that stored foods like Almonds, dry coconut, groundnuts, maize, mustard, rice, walnuts, wheat, wheat flour and white gram are the most commonly used foods in Kashmir (India), therefore the research was undertaken to explore mite fauna associated with such stored foods.

2. MATERIALS AND METHODS

During this research work carried out seasonally from December 2014 to November 2017, samples from 10 types of stored foods from 4 districts (Anantnag, Kulgam, Pulwama and Shopian) in Kashmir (India) were collected and examined for the presence or absence of mite specimens by using modified Tullgren-Berlese funnel method or/and Flotation method. For each food type a total of 20 samples (each of 25 grams weight) in each season (Winter, Spring, Summer and Autumn) were collected in Ziplock polythene bags and examined in the Laboratory. Sampling was done from different grain stores and grocery shops. A complete record of the date, time, temperature, moisture and locality was also maintained. The extracted mites in 70% alcohol were subjected to clearing in 60% lactic acid for 2 days at 50°C temperature prior to examination under dissection microscope and cleared specimens were sorted into what appeared to be similar taxonomic entities and then representatives were mounted singly to get better understanding of which mite species was present or dozens of mites of similar taxonomic entity were mounted on a single slide to save time and materials. The mounted specimens were observed under a microscope and identified by using keys and literature. This way, the individual population of each mite species in each infested food sample of each stored food was counted and recorded in every season over a period of research work. For making permanent slides, mite specimens cleared in 60% lactic acid were mounted on slides in Hoyer's medium for further identification (Fain *et al*., 1990). Photography of the specimens was done with the help of Leica microscope at a magnification of 100X and 200X.

3. RESULTS AND DISCUSSION

In this research work specimens of 19 mite species belonging to the 14 genera, 11 families and 3 orders were obtained from the ten different stored foods in Kashmir (India) from four districts – Anantnag, Kulgam, Pulwama and Shopian. Out of the 2400 samples collected and examined, 439 (18.29%) samples contained 5746 mite specimens out of which 58 (13.21% in the total 439 infestation and 2.41% in the total 2400 examined samples) samples of 5 (50%) food types contained the specimens of *Acarus siro* and other mite species were present in remaining 381 (86.79%) samples (Figure 1 & 2). There were 4 mite species (viz. *Acarus farris*, *Acarus siro*, *Tyrophagus putrescentiae* and *Caloglyphus rhizoglyphoides*) reported from the family Acaridae which were found in 178 samples (40.55% in the total infestation). The frequency of abundance of the family Acaridae was 2934 specimens (51.57% within the total specimens obtained) and that of the *Acarus siro* was 974 specimens (16.95% within the total specimens obtained) (Figure 3 & 4). The *Acarus siro* was reported in 58 samples (13.21 % in total infestation & 32.58% in the Acaridae infested samples). The frequency (%) of abundance of the *Acarus siro* was 16.95% within the total population obtained (5746 specimens) and 33.20% within the family Acaridae (2334 specimens). Within the genus *Acarus*, the frequency of occurrence and abundance of *Acarus siro* was 80.56% (in 72 *Acarus* infested samples) and 83.97% (in 1162 *Acarus* specimens)

The frequency (number and %) of occurrence and abundance of pest mites and predaceous mites was 313 (70.30%) samples and 4635 (28.70%) specimens for the former and 126 (28.70%) samples and 1111 (19.33%) specimens for the latter (Figure 5). *Acarus siro* is a pest mite and within the total samples infested with pest mites its frequency of occurrence and abundance was 18.53% (58 samples) out of 313 (70.30%) pest mite positive samples and 21.01% (974 specimens) out of 4635 (80.66%) pest specimens, respectively (Figure 6). The seasonal and yearly distribution of the frequency of occurrence of pest mite *Acarus siro* and other pest mites obtained is presented in figures 7 & 8. Seasonal and yearly distribution of proportions of abundance of pest mite *Acarus siro* and other pest mites are shown in the figures 9 & 10.

The frequency of seasonal and yearly distribution of occurrence and abundance of *Acarus siro* and other mite species was well recorded during the research work. The species was most frequent and abundant during the summer season followed by autumn, then spring and least during the winter season. Similarly, the species was most frequent and abundant during the period December 2015 to November 2016 than it was during the period December 2014- November 2015 or December 2016- November 2017.

The mite *Acarus siro* was present in the 58 samples belonged to 5 (%) different food types investigated during the research work. These food types were – Maize, Wheat, Walnuts, Dry coconut and White gram. The mite was most frequent and abundant in the samples of Maize and least in the white gram. Out of a total 240 samples examined for each stored food i.e., maize, wheat, walnuts dry coconut and white gram, only 59 of maize, 74 of wheat, 40 of walnuts, 45 of dry coconut and 34 of white gram were mite positive. The frequency of occurrence of *Acarus siro* in mite infested samples of maize, wheat, walnuts, dry coconut and white gram was 17 (28.81%), 12 (16.22%), 11 (27.5%), 10 (22.22%) and 8 (23.53%), respectively. The frequency of abundance of *Acarus siro* in mite specimens found in infested samples of maize, wheat, walnuts, dry coconut and white gram was 333 (28.81%) out of 918 specimens, 173 (17.32%) out of 999, 182 (30.74%) out of 592, 180 (32.61%) out of 552 and 106 (26.90%) out of 394, respectively. The frequency (%) of occurrence and abundance of the mite Acarus siro was 13.21% and 16.95%, respectively, which in both is above the 10% (Table 1). So, according to the proposal by Rajski (1961), if the relative occurrence and abundance of a species out of the total count is above the 10% then the species is Eudominant species and Constant species, respectively. Hence, *Acarus siro* served to be both the Eudominant and the Constant mite species among other mite species in stored foods in Kashmir.

The present work revealed the differential frequencies of occurrence and abundance of a mite *Acarus siro* in response to the seasonal or yearly average/mean values of some environmental factor variations. Among the independent environmental factors, the seasonal as well as yearly levels of frequency of occurrence and abundance of *Acarus siro* was strongly and straightforwardly in positive correlation to the seasonal and yearly monthly mean temperature differences. However, the seasonal monthly mean values served more significant representatives than yearly monthly mean values. At higher temperature the mite population was more than it was at the lower temperature. The mite populations did not appear to be in direct positive or negative correlation with the monthly seasonal or yearly averaged values of Relative humidity (%) or the Moisture Content (%) of the food (Figure 11 & 12). The lowest average monthly temperature but the highest M.C. (%) of food samples (M.C. %, taken from the reference samples of all 5 foods in which *Acarus siro* was present) and highest R.H.(%) were recorded during the winter season during which lowest number of samples and specimens of the mite *Acarus siro* were obtained. During the summer highest average temperature and lowest R.H. (%) were recorded but the mite population was the highest. However, the estimated amount of water present in per kilogram of air at the given temperature and relative humidity indicated that the absolute humidity was highest during the summer (11.19 g/kg air) followed by autumn (6.86 g/kg air), spring (6.11 g/kg air) and winter (3.97 g/kg air) which was absolutely in positive correlation with the frequency of mite occurrence and abundance. Likely, in maize samples, *A. siro* appeared to be in positive relation with the moisture content provided infestation and the favourable temperature are available (Figure 13). In December 2015-November 2016, the average monthly temperature was higher and the mite occurrence as well as abundance was higher too. It was also observed that the mite *Acarus siro* was the second most frequent and abundant species found after the mite species *Tyrophagus putrescentiae*. The survey emphasizes on the exploration of mite fauna in stored foods; their relative occurrences and abundances; their seasonal and yearly distribution of occurrence and abundance; and to know the environmental factors responsible for their population build up. Further, studies like how to prevent and control their presence and population build up in daily used stored foods is highly desirable.

Diagnostic characters of *Acarus siro*:

Though morphologically similar to other mites, *Acarus siro* does have some distinct characteristics. On the back of the body is an incision between the 2nd and 3rd pair of legs. The males possess tarsal and anal suckers as well as a clearly expressed hook-like extension at the thighs of the first leg pair. The females possess a claw at the end of each foot. Both sexes possess 4 long, dragging hairs on the back end.

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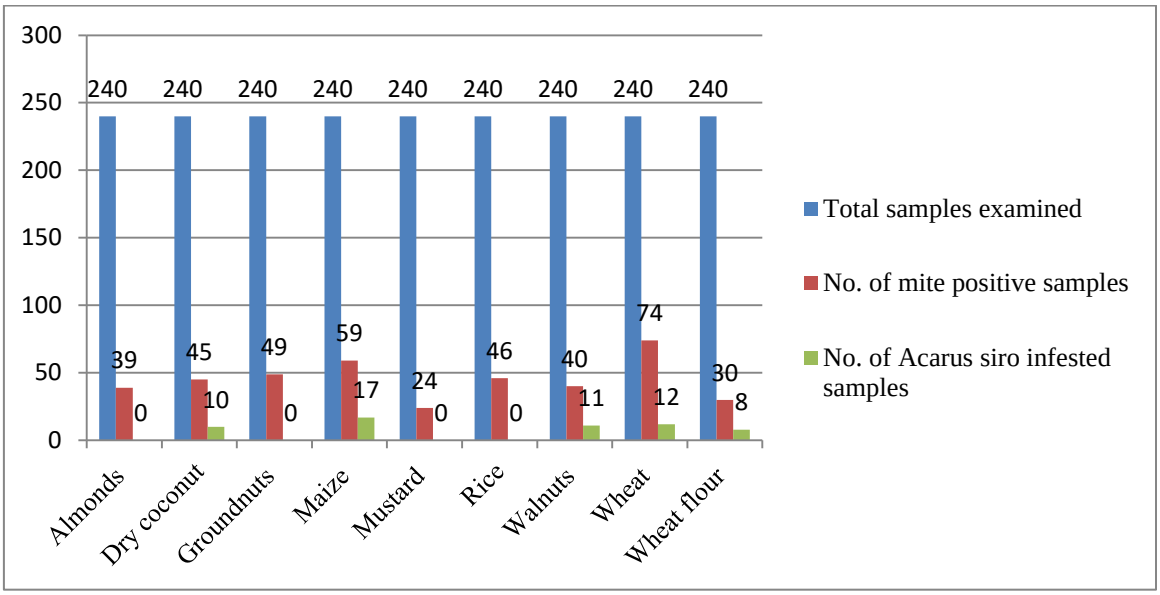

Figure 1: Showing the total food type samples examined, the number of mite positive samples in each food and the number of *Acarus siro* infested samples

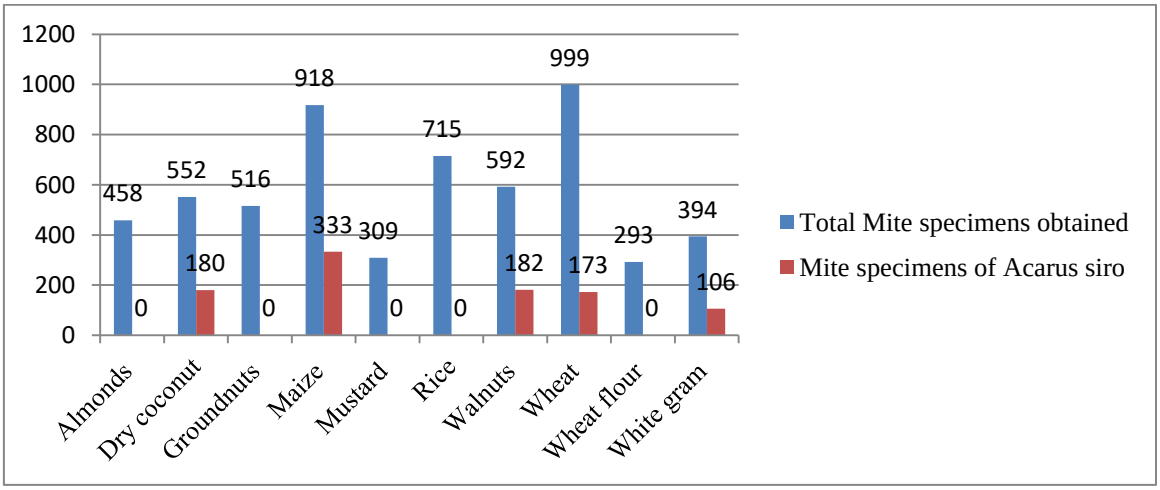

Figure 2: Showing the total mite specimens obtained per food type and the number of *Acarus siro* specimens found

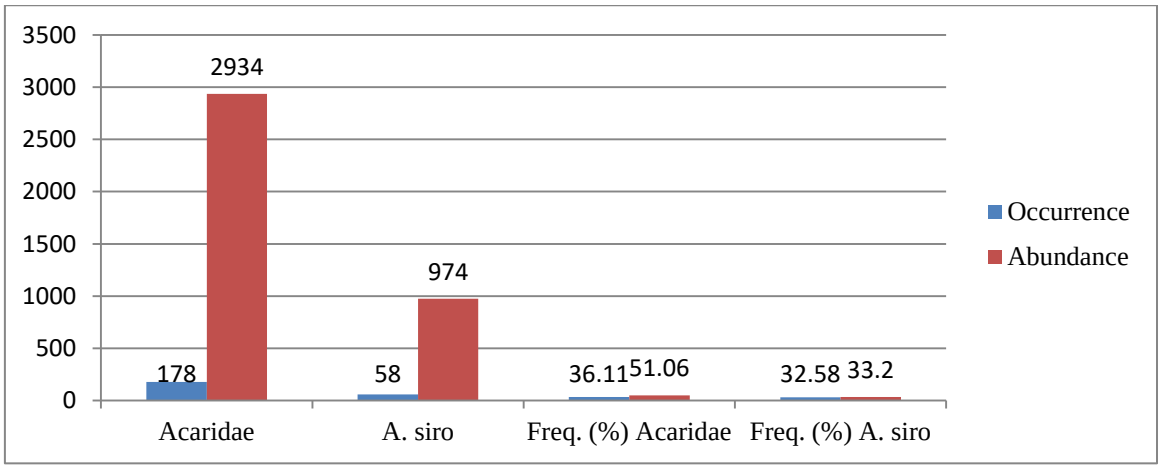

Figure 3: Showing the frequency (in numbers and %) of occurrence and abundance of family Acaridae (within other 10 families reported) and of *Acarus siro* (within Acaridae)

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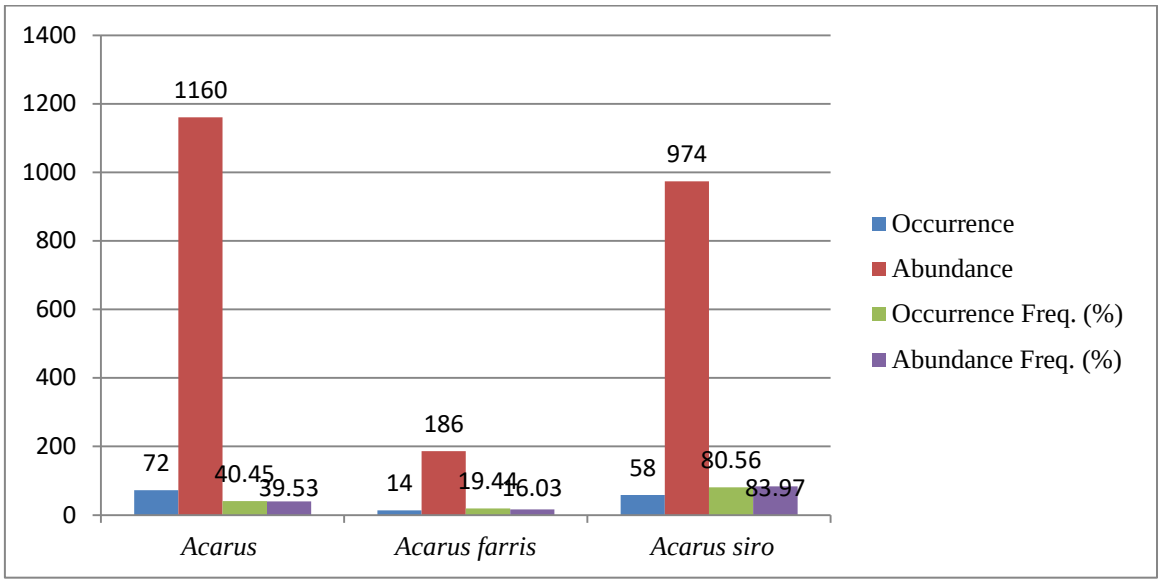

Figure 4: Showing the frequency (in numbers and %) of occurrence and abundance of genus Acarus (within Acaridae), and of *Acarus farris* and *Acarus siro* (within *Acarus*)

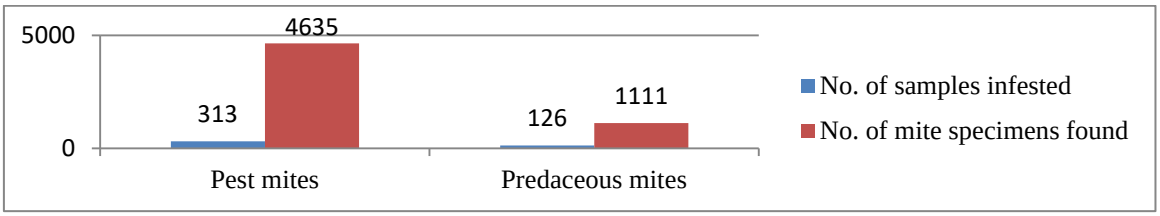

Figure 5: Showing the frequency (in numbers) of occurrence and Abundance of the pest and predaceous mites

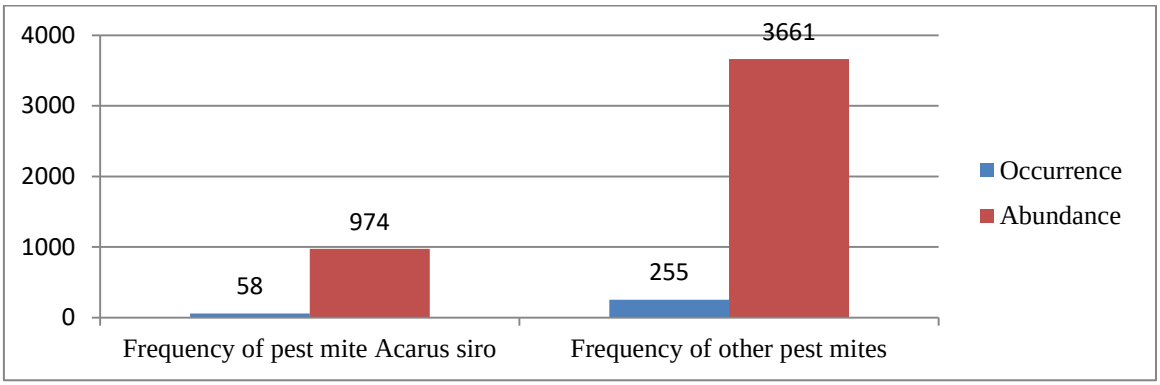

Figure 6: Showing the frequency (numbers) of occurrence and abundance of pest mite *Acarus siro* and others pest mites

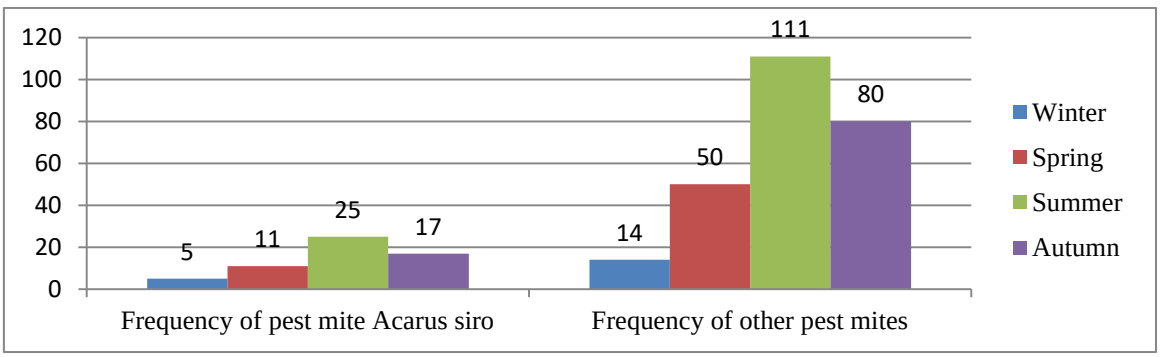

Figure 7: Showing the seasonal distribution of frequency (numbers) of occurrence of pest mite *Acarus siro* and others pest mites

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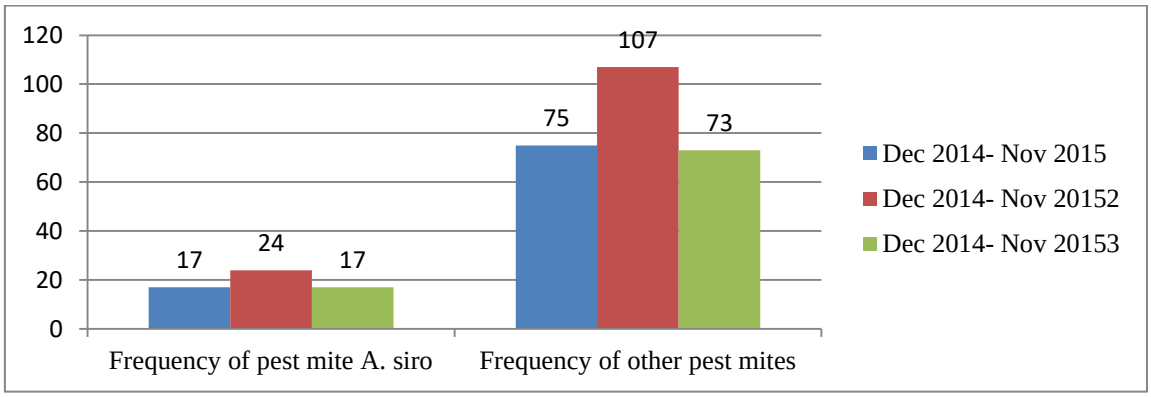

Figure 8: Showing the yearly distribution of frequency (numbers) of occurrence of pest mite *Acarus siro* and others pest mites

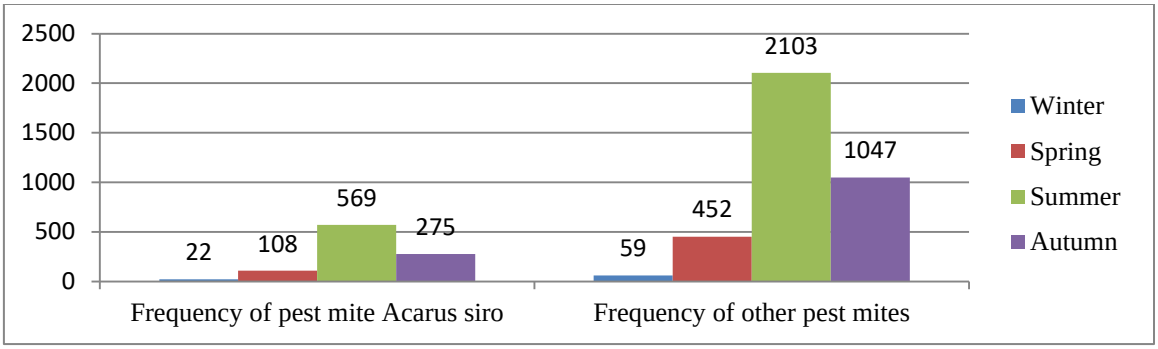

Figure 9: Showing the Seasonal distribution of frequency (in numbers) of abundance of pest mite *Acarus siro* and others pest mites

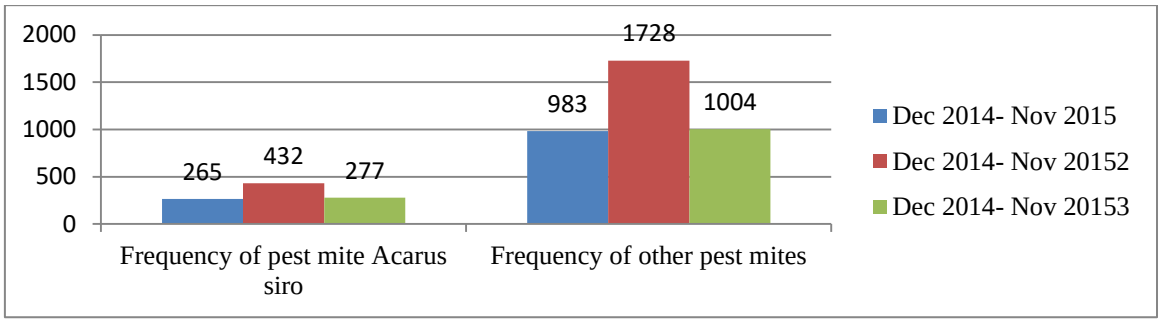

Figure 10: Showing the Yearly distribution of frequency (in numbers) of abundance of pest mite *Acarus siro* and others pest mites

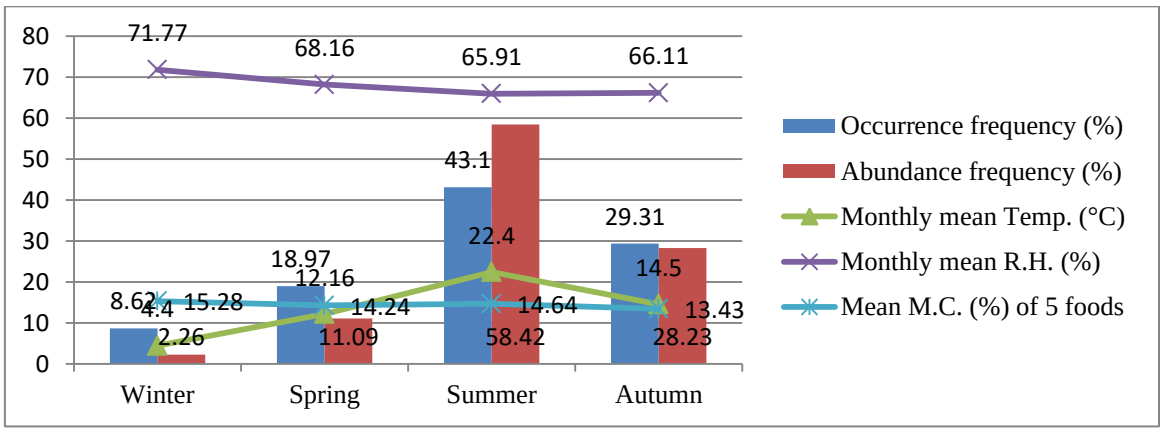

Figure 11: Showing the seasonal frequencies of occurrence and abundance of *Acarus siro* and levels of mean M.C. (%), Temperature (°C), R.H. (%)

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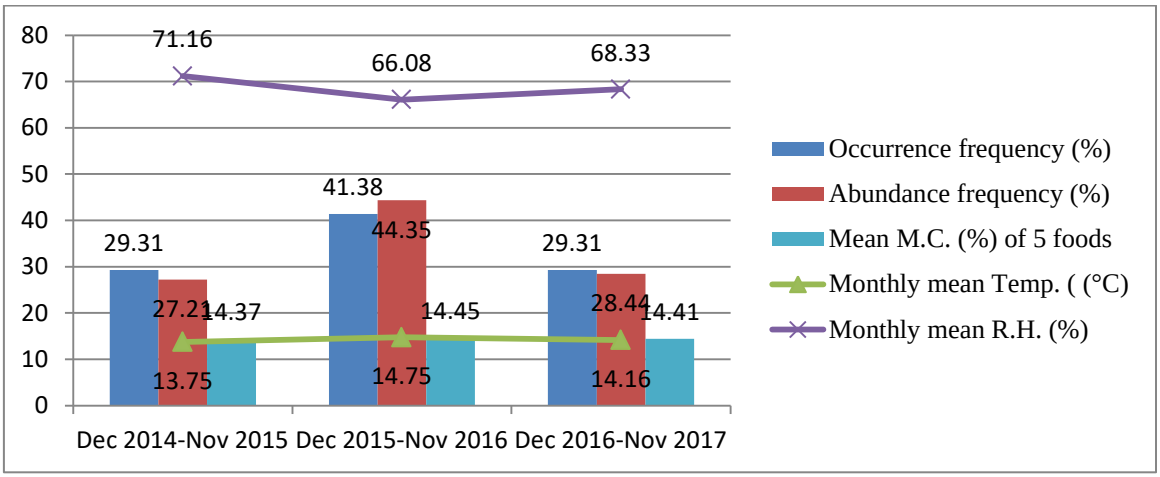

Figure 12: Showing the yearly frequencies of occurrence and abundance of *Acarus siro* and levels of mean M.C. (%), Temperature (°C), R.H. (%)

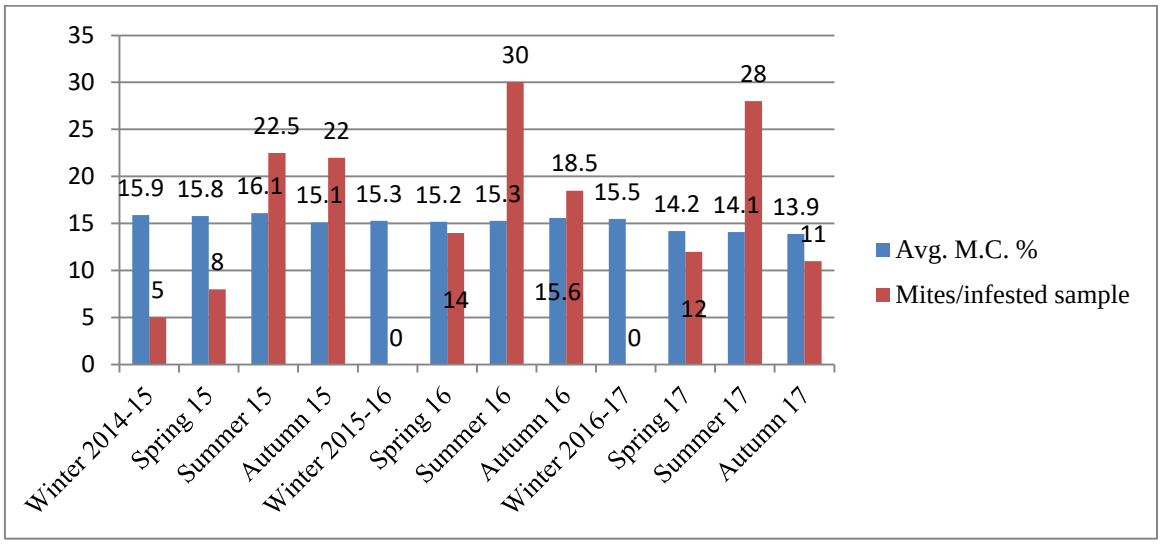

Figure 13: Showing seasonal average M.C (%) in Maize from reference samples and average number of specimens of *Acarus siro* infested samples per season

Table 1: Showing the frequency (%) of occurrence and abundance of *Acarus siro* used for its grouping level proposed by Rajski (1961)

Mite	No. of samples infested	Frequency (%) within total infestation (439)	Remarks	No. of specimens obtained	%age within total specimens (5746)	Remarks
Acarus siro	58	13.21	Frequecy (%) >10% Eudominant species	974	16.95	Frequecy (%) >10% Constant species

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