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Effect of Abiotic Factors to the Population Fluctuation of the Stored Mite in Equine and Poultry Feed of Hisar, Haryana

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ABSTRACT:
Field survey was conducted to study the correlation between mite populations in equine and poultry farms and various environmental factors during August 2021 to July 2022. Mite abundance exhibited a distinct pattern in response to temperature, relative humidity, rainfall, wind speed, sunshine hours, and PAN evaporation. In August 2021, mite numbers were 21.34/5g feed in equine farms and 89.75/5g feed in poultry farms, corresponding to a temperature of 31.10°C. Subsequent fluctuations in mite abundance were observed with changes in temperature, reaching a peak in March 2022. Rainfall positively correlated with mite abundance during the initial months but showed a negative correlation later. Wind speed, sunshine hours, and PAN evaporation also influenced mite populations. These findings provide valuable insights into the seasonal dynamics of mite infestations in equine and poultry farms, emphasizing the importance of understanding environmental variables for effective mite management strategies.

Keywords:
Abiotic Factors, Equine and Poultry Feed

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1. INTRODUCTION

Combinations of temperature, relative humidity and moisture content are important factors for mite growth but these were also found to be influenced by the condition of the feed, predators, fungi, dockage and density dependent factors (Solomon 1962; 1969). *Aleuroglyphus* population growth is affected by a combination of physical and biological factors which interact in a complex manner (Sinha and Wallace, 1973). Aeration appeared to delay mite development by several months in the winter, but the same growth trends were observed (Armitage, 1980; Burrell and Havers, 1976; Hurlock *et al*., 1980). A similar trend has been observed in Greece where the highest mite numbers were recorded during September–November and after the middle of January, coinciding with periods of high temperatures and grain moisture (Athanassiou *et al*., 2001; Palyvos and Emmanouel, 2006).

A rise in temperature, relative humidity and moisture content increased mite productivity, whereas a decrease in temperature, relative humidity and moisture content were found to decrease productivity (Dunn *et al*., 2003). In another study, highest mite numbers were recorded during the periods when the surface moistures were above 16 percent and the temperatures were rising (Coulson *et al*., 1996).

The airborne dust in poultry barns causes respiratory dysfunction in poultry workers (Solarz *et al*., 2004). The composition and abundance of stored mites were strongly affected by the average humidity of the substrate, temperature, relative humidity, number of inhabitants and weight of samples (Palyvos and Emmanouel, 2006). They live in temperatures ranging from -18˚ C to +50˚ C, with optimal temperature of 25˚ C and high relative humidity ranges from 60 to 80 percent (Feng *et al*., 2009). Poultry farms act as reservoir of non- predatory, stored product pest mites due to presence of optimum conditions of temperature and humidity (Rodriguez and Rodriguez, 1987; Feng *et al*., 2009). Storage mites were found in grains such as oats, corn, and hay, as well as facilities that manufacture and store grains for equine feed. Relative humidity limited mite survival and was the key factor that determined mite survival. The critical relative humidity ranged from 55 to 73 percent with resultant death of mites secondary to dehydration if the humidity level dropped below 51 percent for prolonged periods of time (Arlian and Veselica, 1981; Arlian *et al.,* 2001). *Dermatophagoides* mites were considered eurythermic which survived in temperatures ranged between 15°C and 35°C (Hubert *et al*., 2010; Arlian and Veselica, 1981). In locations with temperate seasonal climates, the population of living mites fluctuated with seasonal changes. The number of *Dermatophagoides* mites was highest in the summer months when indoor relative humidity was most favourable for mite survival and breeding (Hughes, 1976; Feng *et al*., 2009; Kosik-Bogacka *et al*., 2012). Mite levels dropped during the fall and were lowest during the winter months when relative humidity was low due to indoor heating (Hughes, 1976; Arlian *et al*., 2001; Arlian and Morgan, 2003).

Aleuroglyphus ovatus and *T. putrescentiae* developed more rapidly when temperature increased (Aspaly *et al*., 2007), which emphasized that developmental conditions are optimal for both species at a temperature of 25 C and 85% humidity. When conditions are not ideal for mite development, mites might enter a hypopus stage, which occurs between the protonymph and trytonymph stages.

Roberts (2014) collected a total of 3332 mites over three seasons. Of these, spring was the only season in which two out of five species and all four genera of mites were identified. The winter mite collection was the greatest at 281, followed by the spring collection with 232 mites and finally, the summer analysis had 78 mites. Throughout all seasons, the SM fauna was dominated by the abundance of *Tyrophagus*. *T. sylvester* was the most plentiful mite species in the winter from the stall that housed a stallion for at least 16 hours a day for the last two years. The greatest number of *T. putrescentiae* were found in the spring in the straw bedding which was the location with the second greatest population of mites collected from one area. The sites sampled revealed that the *Lepidoglyphus* fauna was the only other mite genera present during all three seasons. *Lepidoglyphus* had the greatest number of mites found in the spring. *L. destructor* represented 1.9% (63/3332) of all the mites.

2. MATERIALS AND METHODS

Under this objective, a survey was designed to perceive the prevalence of mites in equine and poultry feed storage sites. A survey was done for one year from August 2021 to July 2022. The samples were collected from sites and survey data was recorded from owners and workers. Feed samples were collected monthly in triplicate from each site to observe the effect of abiotic factors and seasonal variations on the presence and population dynamics of mites.

Sampling sites for the present study, equine and poultry feed samples were collected from five farms of Hisar. The details of farms with GPS co-ordinates are provided in Table 1.

Table 1: Sampling sites of equine farm and poultry farms at Hisar

Town	Farm name	GPS Co-ordinates
Hisar	Horse Stable	29.148898,75.7129432
Khandakheri	BDS Poultry Farm	29.179833N,76.220660E
Bhatol Jatan	Kuldeep Poultry Farm	29.120411N,76.115280E
Bhatol Jatan	Surender Poultry Farm	29.104554N,76.103520E
Bhatol	Ankit Poultry Farm	29.100092N,76.114329E

Collection of samples

The samples of feed (raw/ commercial feed) were collected in triplicate during monthly survey of equine stud and poultry farms to record the presence of mites. These samples were collected in zip lock plastic bags individually labeled with date, place of collection, type of product and storage condition. These collected samples brought in Acarology laboratory for further observations.

Extraction of mites

Mites were extracted from the collected samples by a modified Berlese funnel extraction method (Tullgren, 1918). The samples were placed on 20 mesh metallic sieve which was kept on glass funnel. The funnel's tip was dipped into the distilled water-filled glass vial. A 40W bulb was lighted above the funnel. Since mites have a photonegative behaviour, they run away from the light and gathered in the vial of distilled water. Distilled water containing mites was poured into counting dish with one cm square and placed under the stereo zoom microscope and counting was also done under 10X magnification.

Meteorological data

The meteorological data related with study period (August 2021 to July 2022) was obtained from Department of Agricultural Meteorology, CCSHAU, Hisar and presented in Table 2 to see the effect of abiotic factors on mite abundance in equine and poultry feeds.

Table 2: Monthly values of meteorological data of Hisar

Months	Temperature (°C)		Relative Humidity (%)	Average Wind Speed (Km/h)	Bright Sun Shine Hours(h)	PAN Evaporation (mm)	Rainfall (mm)
	Max	Min					
August 2021	35.50	26.60	74.00	5.80	6.90	5.00	66.70
September 2021	32.30	25.40	83.00	5.30	5.00	3.50	428.20
October 2021	32.00	19.60	68.00	2.90	7.30	3.20	5.50
November2021	27.90	9.90	62.00	1.80	5.50	1.80	0.40
December 2021	21.30	6.30	73.00	2.20	5.00	1.30	1.20
January 2022	16.40	7.20	84.00	3.60	2.80	1.20	64.00
February 2022	23.20	8.10	73.00	4.40	7.10	2.00	5.80
March 2022	31.90	13.80	67.00	3.40	7.80	3.60	0.00
April 2022	40.20	19.00	51.00	4.30	8.50	6.90	1.50
May 2022	40.90	25.00	45.00	6.90	7.80	8.00	31.60
June 2022	40.40	26.30	50.00	7.20	7.90	8.70	10.90
July 2022	34.70	27.10	79.00	6.70	4.60	4.70	225.60

3. RESULT

During study period, mite population at equine and poultry farms was correlated graphically with temperature (Fig. 1), relative humidity (Fig. 2), rainfall (Fig. 3), average wind speed (Fig. 4), bright sunshine hours (Fig. 5) and PAN evaporation (Fig. 6). The number of mites was 21.34/ 5g feed in equine farms and 89.75/ 5g feed in poultry farms in August, 2021 when temperature was 31.1⁰C. There was slightly increase in mite number (26 mites/ 5g feed in equine farm and 112.67 mites/ 5g feed in poultry farms) when temperature was 28.9⁰C in September, 2021. After that there was continuous decrease in number of mites from October, 2021 to January, 2022 *viz*; 19.34, 3.67, 0, 0, 0.67 mites/ 5g feed and 44.58, 29.41, 1.08, 0 and 9.41 mites/ 5g feed in equine and poultry farms, respectively with decline in temperature (Fig. 6). Thereafter, with increase in temperature from 15.7⁰C in February to 22.9⁰C in March, 2022, mite abundance also increased to 0.67, 25.34 mites/ 5 g feed in equine farms and 9.41, 80.67 mites/ 5 g feed. During the months of April, May and June, there was decline in mite abundance in equine (13.34, 0, 0 mites/ 5g feed) and poultry (27.74, 8.25, 0.5 mites/ 5g feed) farms with increase in temperature (29.6, 33, 33.4⁰C).

Similar trend in mite abundance was witnessed with change in relative humidity (Fig. 7). It ranged from 0 to 26 mites/ 5g feed in equine farm and 0 to 112.67 mites/ 5g feed in poultry farms with change in morning relative humidity from 61 to 98 percent, respectively. The number of mites increased (21.34 to 26 and 89.75 to112.67 mites/5g feed) in equine and poultry farms with increase in rainfall (66.7 to 428.2 mm) during first two months of study (Fig. 8), thereafter, it declined (19.34 to 0 and 44.58 to 1.08 mites/5g feed) with corresponding decline in rainfall (5.50 to 64 mm) from October, 2021 to January, 2022. The mite abundance fluctuated between 0 to 25.34 and 8.25 to 80.67 mites/5g feed in equine and poultry farms with rainfall range of 0 to 225.6mm, respectively.

Likewise, with change in wind speed from 1.80 (November, 2021) to 7.20 Km/h (June, 2022) (Fig. 9), sunshine hours from 2.80 (January 2022) to 8.50 h (April 2022) (Fig. 10) and PAN evaporation from 1.20 (January 2022) to 8.70 mm (June, 2022) (Fig. 11), mite abundance also changed from 0 to 25.34 mites/5g feed in equine farms and 8.25 to 80.67 mites/5g feed in poultry farms, respectively.

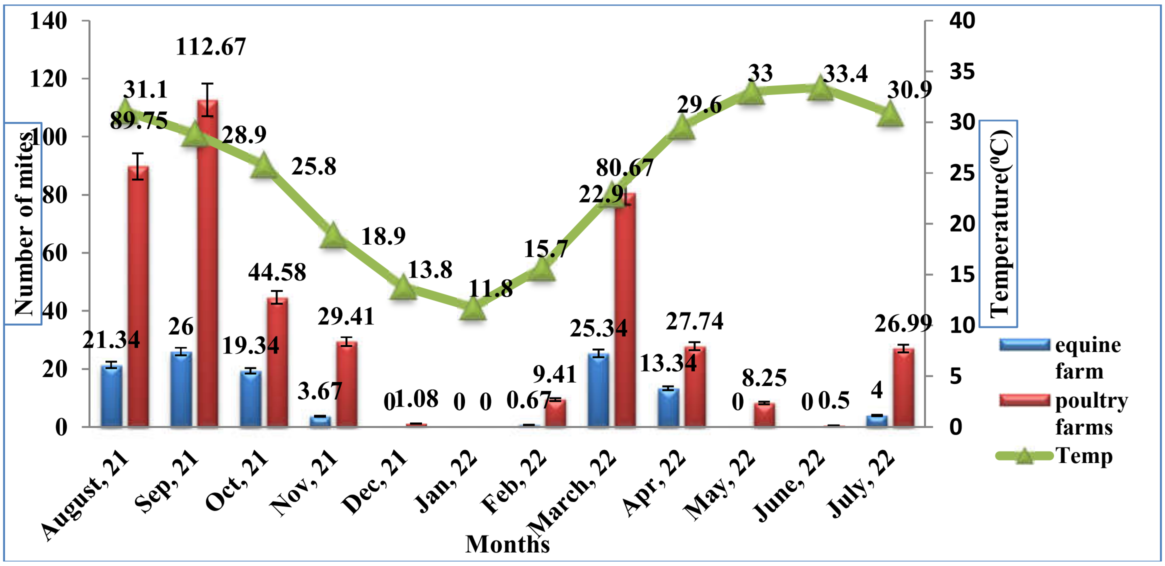

Figure 1: Effect of temperature on mite abundance in equine and poultry farms at Hisar

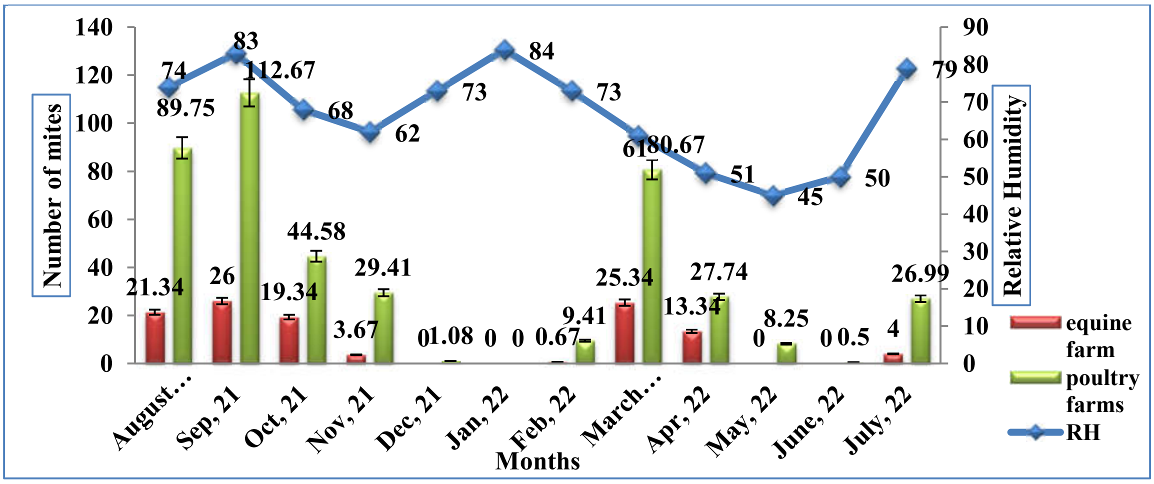

Figure 2: Effect of relative humidity on mite abundance in equine and poultry farms at Hisar

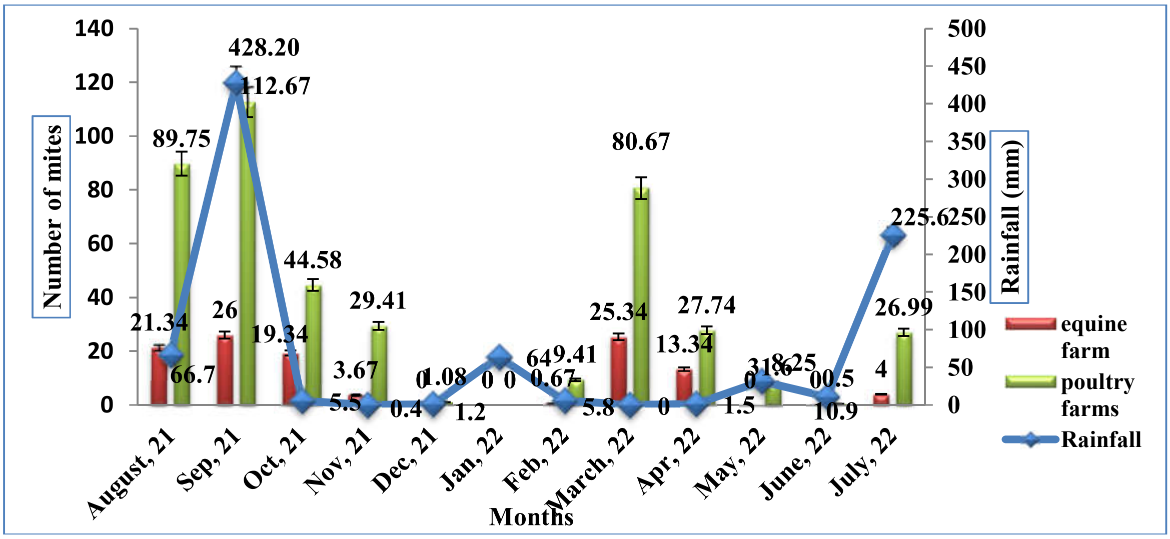

Figure 3: Effect of rainfall on mite abundance in equine and poultry farms at Hisar

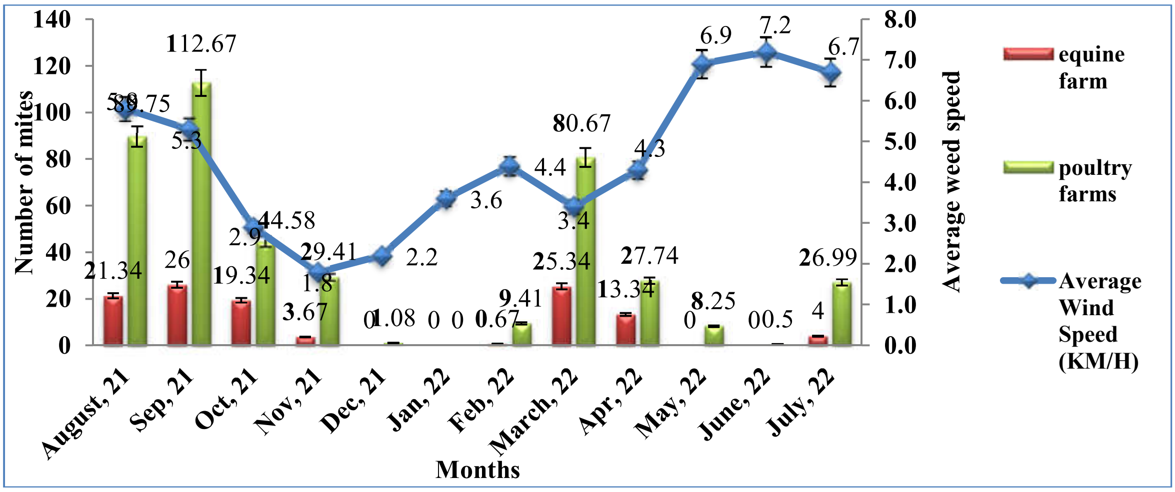

Figure 4: Effect of average wind speed on mite abundance in equine and poultry farms at Hisar

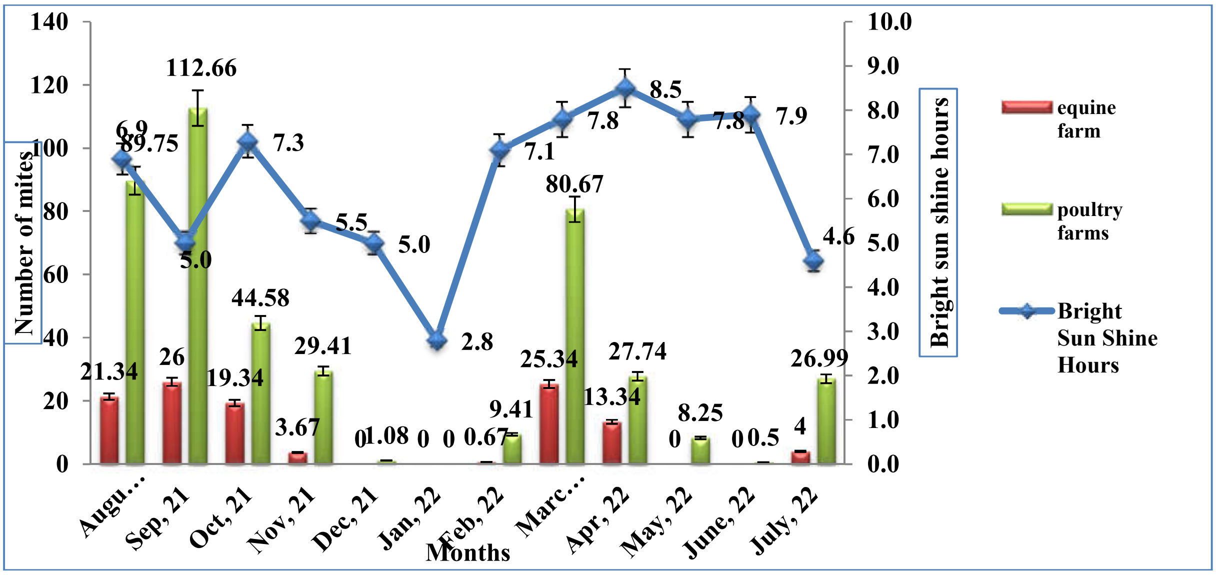

Figure 5: Effect of bright sunshine on mite abundance in equine and poultry farms at Hisar

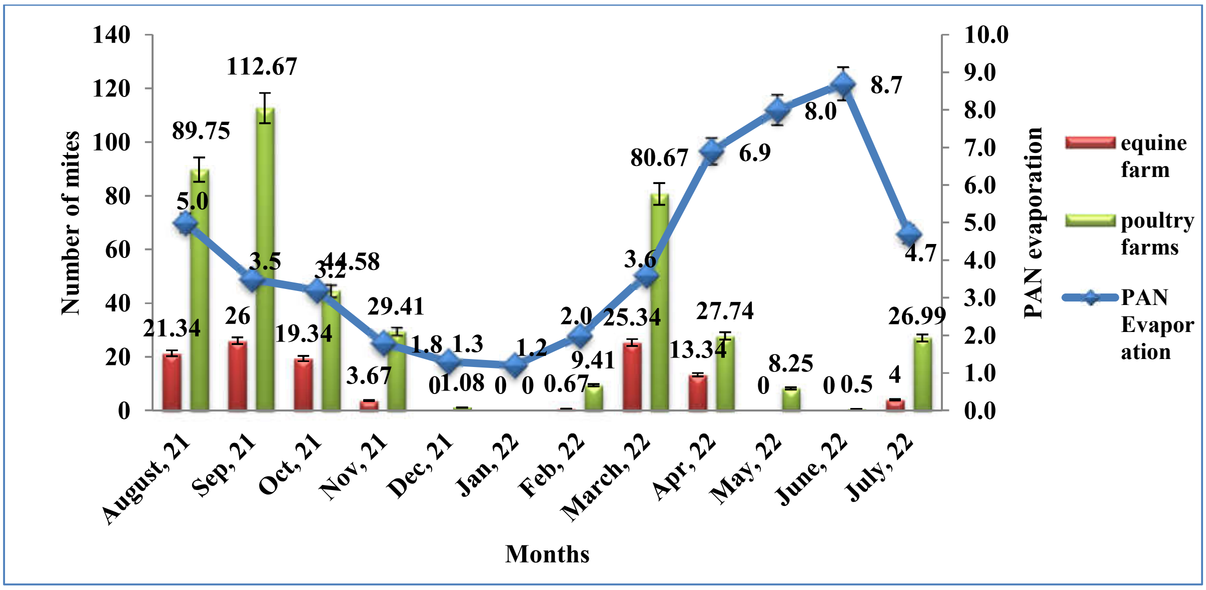

Figure 6: Effect of PAN evaporation on mite abundance in equine and poultry farms at Hisar

4. CONCLUSION

This study investigates the correlation between mite populations in equine and poultry farms and various environmental factors from August 2021 to June 2022. Mite numbers, measured per 5g of feed, were initially 21.34 and 89.75 in equine and poultry farms, respectively, in August 2021 at 31.10°C. As temperatures decreased, mite abundance declined steadily in both farms until January 2022, reaching 0 mites/5g feed. Subsequently, with rising temperatures from February to March 2022, mite numbers increased to 25.34 and 80.67 in equine and poultry farms.

The study highlights a consistent trend where mite abundance inversely correlates with temperature. Similar patterns are observed with relative humidity, rainfall, wind speed, sunshine hours, and PAN evaporation. Notably, mite numbers spike with increased humidity and rainfall, demonstrating the influence of these factors on mite proliferation. Wind speed, sunshine hours, and PAN evaporation also contribute to variations in mite abundance.

Understanding these correlations between environmental variables and mite populations is crucial for developing effective farm management strategies. The findings emphasize the need for temperature and humidity control measures to mitigate mite infestations in equine and poultry farms, contributing to enhanced animal welfare and farm productivity.

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