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ENVIRONMENTAL FACTORS DRIVING POPULATION BUILD-UP OF YELLOW MITES IN *CAPSICUM ANNUM* L. ECOSYSTEM

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ABSTRACT

Broad mite [*Polyphagotarsonemus latus* (Banks)] population dynamics in chilli were investigated in relation to abiotic factors during *Kharif* 2023 and 2024 using weekly observations. In 2023, infestation was initially absent up to SMW 28th and then progressively increased, reaching 5.58–6.02 mites/leaf during SMW 37th and 40–44th under warm, dry conditions. In 2024, mites appeared from SMW 30th onwards with populations rising to 3.18–4.69 mites/leaf in SMW 40–44th. Correlation analysis for 2023 revealed a highly significant positive association of mite incidence with maximum temperature (r = 0.667**), whereas minimum temperature, morning and evening relative humidity and wind speed showed significant negative relationships; rainfall exerted a negative but non-significant effect. In 2024, minimum temperature (r = –0.821**), evening relative humidity (r = –0.507*) and wind speed (r = –0.684**) emerged as the principal limiting factors, while maximum temperature, morning humidity and rainfall remained non-significant. Multiple regression models for both years explained about 76% of the variation in mite population, highlighting the predominant role of temperature, humidity and wind in shaping broad mite outbreaks in chilli.

***Key words*: *Polyphagotarsonemus latus* (Banks), abiotic factors, population dynamics, temperature, humidity, rainfall.**

Introduction

Chilli (*Capsicum annuum* L.) is an important member of Solanaceae family and cornerstone of the global spice industry. India stands as both the largest producer and exporter of chillies worldwide and recognized for its immense variety of spices and flavours. In 2023, chillies were cultivated globally on 18.03 lakh hectares and producing 58.22 lakh tonnes at an average yield of 3,229 kg per hectare. India contributed almost half of this area 9.90 lakh hectares and achieved a production of 32.08 lakh tonnes with an average yield of 3,240 kg/ha (Spices Board of India, 2023–24). Other major chilli producers include Bangladesh, Thailand and China but India leads with 27.82 lakh tonnes (Chilli Outlook – April 2025). Domestically, chilli cultivation thrives in several states. Andhra Pradesh is the frontrunner and producing 1,185.27 thousand metric tons, followed by Telangana, Madhya Pradesh, Karnataka and others. Maharashtra, for instance, grows chillies across 105,500 hectares with a production of 48.5 metric tons (Anonymous, 2021). Major growing districts in the state are Nagpur, Jalgaon, Nashik, Nanded, Nandurbar, Palghar, Pune, Jalana, Sambhajinagar and Amaravati (Jayewar, 2022).

Despite its agricultural importance, chilli faces a daunting pest complex, with more than 293 insect and mite species threatening crops from field to storage (Veena *et al*., 2017). Among these, the broad mite, *Polyphagotarsonemus latus* (Banks), also referred to as the yellow mite or chilli mite, is especially destructive. This pest, belonging to the family Tarsonemidae and attacks a diverse array of plants including chilli, potato, beans, bell pepper, cucumber, eggplant, chrysanthemum and cotton (Luypaert *et al*., 2015). Its common name varies globally yellow tea mite in India and Sri Lanka, yellow jute mite in Bangladesh, and broad spider or rust mite in Europe and South America (Bulut *et al*., 2000).

Table 1: Experimental details.

Season & year	*Kharif* - 2023; *Kharif* - 2024
Crop	Chilli
Variety	Navtej
Design	Non-Replicated
Plot Size	3 × 3 m
Spacing	60 × 45 cm
Date of transplanting	1st July 2023 and 3rd July 2024

Broad mite infestations cause severe symptoms: leaf curling, twisted buds, elongated petioles, bud shedding and overall stunted growth, all stemming from the mite's toxic saliva. These symptoms translate into significant yield losses which ranging from 30% to as much as 90% (Monika, 2014) and occasionally up to 96% (Borah, 1987). First discovered in India on chilli by Kulkarni in 1922, the broad mite is now widespread under varied climatic conditions. Even small numbers (as few as ten mites per plant) can result in substantial crop damage, with losses often exceeding 60% (Srinivasan *et al.*, 2003; de Coss-Romero and Peña, 1998; Rodríguez-Cruz, 2014). Damage from mite invasions accounts for around 21% of direct crop impact, and associated leaf curl disease complexes may affect up to 80% of chilli crops in regions like Karnataka (Jeyarani and Chandrasekaran, 2006; Venkatesh *et al.*, 1998).

Table 2: Weekly fluctuations of mite infestation in relation to abiotic variables in *Kharif* 2023.

SMW	Mites leaf^{-1}	Abiotic factors					
		Temperature		Relative humidity		Wind	Total
		Max.	Min.	Morning	Evening	Speed	Rainfall
27	0.00	31.86	24.97	81.57	59.71	3.47	92
28	0.00	30.31	24.06	83.14	60.71	5.14	27.4
29	0.69	29	23.87	86.14	67.14	3.86	13.8
30	0.88	27.37	23.41	89.57	76.57	3.86	26
31	1.65	29.17	23.69	84.29	65.43	4.44	1.6
32	2.65	29.63	23.7	80.71	55.14	4.21	1.6
33	2.74	30.63	23.77	79.29	54.29	4.26	1.4
34	2.38	29.54	23.56	82	59	3.46	8
35	3.75	31.51	23.04	86.43	50	2.4	12.2
36	4.11	31.14	23.94	80.43	62.14	4.54	8.8
37	5.58	31.2	23.54	82.71	52.86	3.04	21
38	3.01	30.17	23.89	84.71	59.86	2.34	82.6
39	2.03	29.43	23	94.14	68.86	1.29	94.6
40	3.61	31.77	22.67	87.71	45.29	1.57	15.4
41	4.66	33.94	22.27	84.57	35.43	1.21	0
42	5.67	33.74	22.31	80.14	37.14	0.74	0
43	5.95	32.6	19.59	75.14	26.57	0.53	0
44	6.02	31.77	17.57	74.29	31.29	0.69	0
Mean	3.08	30.82	22.94	83.17	53.75	2.84	22.58

SMW: Standard Meteorological Week, **Max.:** Maximum, **Min.:** Minimum

These challenges highlight the need for understanding how abiotic factors influence mite population build-up in chilli agro-ecosystems, laying the foundation for targeted and sustainable pest management approaches.

Materials and Methods

The present investigation, titled "Environmental factors driving population build-up of yellow mites in *Capsicum annum* L. ecosystem" was conducted during the *Kharif* seasons of 2023 and 2024 at the Instructional Farm, Department of Entomology, Post Graduate Institute, MPKV, Rahuri, Maharashtra. The MPKV, Rahuri Central Campus, located at an elevation of 500 meters above mean sea level (19°48'–19°57' N; 74°82'–74°91' E), lies within a subtropical region characterized by annual rainfall of 520 mm (primarily from July to September), maximum temperatures reaching 37°C, and minimum temperatures dropping to 17°C, making it an ideal setting for most crop cultivation.

To investigate the seasonal incidence of thrips, healthy seedlings of the prominent chilli variety "Navtej" were selected for transplantation. Seedlings were raised in nursery plastic trays one month prior to transplantation in the main field. Transplantation was carried out at the mid height of prepared ridges using a spacing of 60 × 45 cm, ensuring optimal plant establishment and uniformity for reliable experimental observations Mites counts were made from three leaves one each from the upper, middle and lower position on five randomly selected plants per plot (Samanta *et al.*, 2017). The leaves thus collected from the fields were put in a zip lock polypropylene bag and brought to the laboratory for observation under stereo-zoom binocular microscope. The meteorological data on different abiotic factors *viz.* temperature (maximum & minimum in °C), relative humidity (maximum & minimum in %), total rainfall (mm) and wind speed (Km/hr) during the period of investigation were collected from the Department of Agronomy, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri (MS). The role of abiotic factors on population fluctuation of the yellow mite and correlation between them was analysed by calculating respective "r" (correlation coefficient) with the help of OPSTAT software.

Results

Seasonal population dynamics of yellow mites

The population dynamics of yellow mites,

Table 3: Weekly fluctuations of mite infestation in relation to abiotic variables in *Kharif* 2024.

SMW	Mites leaf^{-1}	Abiotic factors					
		Temperature		Relative humidity		Wind Speed	Total Rainfall
		Max.	Min.	Morning	Evening		
27	0.00	31.6	24.27	83.14	58.43	4.61	6.6
28	0.00	30.4	23.53	83.86	63.43	3.51	39.2
29	0.00	30.34	23.67	87.29	63.43	2.8	79.8
30	0.83	29.17	23.67	84.71	67.14	3.49	31.6
31	1.56	29.97	23.61	82.71	61.57	4.09	3.6
32	2.05	29.66	23.04	84.29	64.29	2.64	3
33	2.71	32.31	22.9	86.71	54.57	2.03	1.4
34	1.58	29.2	22.67	90.29	73.86	1.63	253.4
35	2.06	29.83	22.84	83.14	61.57	2.93	36.8
36	2.90	29.49	22.61	85	61.71	2.4	4
37	4.07	30.23	21.47	78.43	58.57	2.86	3.2
38	5.68	31.71	20.99	81	52.57	2.47	3
39	3.42	30.03	22.66	87.43	65.14	2.16	86
40	3.18	32.49	21.7	82.71	50.29	1.54	0
41	3.41	30.09	21.84	87.71	66.29	1.29	16.2
42	4.05	31.06	22.1	88.14	64.29	1.16	8
43	4.62	30.69	19.64	79.43	55	1.11	6.4
44	4.69	31.53	18.17	80	44.33	1.17	0
Mean	2.60	30.54	22.30	84.22	60.36	2.44	32.34

SMW: Standard Meteorological Week, **Max.:** Maximum, **Min.:** Minimum

Table 4: Relationship between weather variables and mite incidence.

Year	Abiotic factors					
	Temperature		Relative humidity		Wind Speed	Total Rainfall
	Max.	Min.	Morning	Evening		
Kharif-2023	0.667**	-0.689	-0.494*	-0.805**	-0.692**	-0.451^{NS}
Kharif-2024	0.332^{NS}	-0.821**	-0.369NS	-0.507*	-0.684**	-0.304^{NS}

*Significant at 5% level **Significant at 1% level

Table 5: Multiple of regression coefficients linking mites dynamics to abiotic variables in chilli crop.

Year	Regression equation	R^2
Kharif-2023	$Y=5.6+0.308X_1+0.077X_2-0.161X_3+0.067X_4-1.162X_5-0.028X_6$	0.76
Kharif-2024	$Y=7.409+0.477X_1-0.855X_2-0.086X_3+0.136X_4-0.421X_5-0.008X_6$	0.76

during the *Kharif* seasons of 2023 and 2024 are presented in Tables 1 and 2. Weekly observations revealed marked seasonal fluctuations in mites abundance, closely associated with prevailing abiotic factors.

Seasonal population dynamics of yellow mites in Kharif season 2023

The data presented in Table 2 and Fig. 1 recorded during *Kharif* 2023, broad mites were initially absent in the early season (0.00 mites/leaf in SMW 27–28th). Populations appeared at trace levels in SMW 29–30th (0.69–0.88 mites/leaf) and gradually increased to moderate infestations by SMW 31–33th (1.65–2.74 mites/leaf). Mid-season populations reached 3.75–4.11 mites/leaf in SMW 35–36th, peaking at 5.58 mites/leaf in SMW 37th. Heavy rainfall in SMW 38–39th (82.6 and 94.6 mm) temporarily suppressed mite populations to 3.01 and 2.03 mites/leaf, respectively. Subsequently, under warm and dry conditions, populations rebounded and remained high (3.61–6.02 mites/leaf) through SMW 40–44th.

Correlation analysis represented in Table 4, which revealed a strong positive relationship between mite population and maximum temperature (r = 0.667**). In contrast, minimum temperature (r = -0.689), morning humidity (r = -0.494*), evening humidity (r = -0.805**) and wind speed (r = -0.692**) negatively influenced population growth. Rainfall exhibited a weak and non-significant suppressive effect (r = -0.451^{NS}). A multiple regression model (Table 5) incorporating all variables accounted for 76% of population variation: $Y = 5.6 + 0.308X_1 + 0.077X_2 - 0.161X_3 + 0.067X_4 - 1.162X_5 - 0.028X_6$

Seasonal population dynamics of yellow mites in *Kharif* season 2024

The data illustrated in Table 3 and Fig.2 noted during *Kharif* 2024, early-season populations were also absent (0.00 mites/leaf in SMW 27–29th). Low-level populations emerged in SMW 30–33th (0.83–2.71 mites/leaf), followed by mid-season fluctuations of 1.58–3.42 mites/leaf in SMW 34–39th. Late-season populations reached 3.18–4.69 mites/leaf in SMW 40–44th. Environmental conditions during this season included warm days (averaging 30.54°C), moderately cool nights (averaging 22.30°C), consistently humid mornings (averaging 84.22%) and drying evenings (averaging 60.36%, dropping to 44–55% during peak mite weeks). Wind speeds remained low (averaging 2.44 km/h). Heavy rainfall occurred in SMW 34th (253.4 mm) and SMW 39th (86 mm), while later weeks had minimal moisture.

Correlation patterns for 2024 differed slightly: minimum temperature (r = -0.821**), evening humidity (r = -0.507*) and wind speed (r = -0.684**) were the strongest suppressors of mite populations. Maximum temperature (r = 0.332^{NS}), morning humidity (r = -0.369^{NS}) and rainfall (r = -0.304^{NS}) played weaker roles. The regression model for 2024 (Table 5) accounted for

76% of observed variation: $Y=7.409 + 0.477X_1 - 0.855X_2 - 0.086X_3 + 0.136X_4 - 0.421X_5 - 0.008X_6$

Discussion

The results align with several prior studies on mites' population dynamics and their correlation with abiotic factors. Chaudhary and Pandya (2019) reported that broad mites appeared from the 36th Standard Meteorological Week (SMW) at 3.43 mites per 3 leaves and peaked at 18.93 mites per 3 leaves in the 43rd SMW. Their analysis indicated a significant positive correlation with maximum temperature (r = 0.536*), whereas minimum temperature (r = -0.119), morning humidity (r = -0.331), evening humidity (r = -0.385) and wind speed (r = -0.589**) were negatively associated with mite abundance. In the same year, Kumar et al. (2019) recorded a peak population of 17.85 mites per leaf during SMW 42th. They observed a significant positive correlation with maximum temperature, a positive but non-significant correlation with minimum temperature, significant negative correlations with both morning and evening relative humidity and a negative but non-significant correlation with rainfall. Samanta et al. (2017) reported a strong positive correlation with maximum temperature (r = 0.772) and a significant negative correlation with rainfall (r = -0.448), highlighting the influence of environmental factors on seasonal population fluctuations. More recently, Chintkuntlawar *et al*., (2020) found that mite incidence was negatively correlated with rainfall (r = -0.421), morning relative humidity (r = -0.552) and evening relative humidity (r = -0.459), while maximum temperature was positively and significantly correlated (r = 0.521*) and minimum temperature showed a positive but non-significant relationship (r = 0.063). Collectively, these multi-year studies consistently indicate that maximum temperature promotes mite population growth, whereas relative humidity, rainfall and wind speed act as suppressive factors in the population dynamics of chilli mites.

Conclusion

This two-year study demonstrates that *P. latus* populations in chilli respond predictably to weather conditions. Maximum temperature promotes population growth, whereas cooler nights, higher humidity, strong winds and rainfall suppress it. Regression models explained 76% of observed variation, providing a reliable framework for weather-based forecasting. Monitoring evening temperature and humidity, wind speed and rainfall can allow growers to anticipate mite surges and implement timely interventions, reducing pesticide use and enhancing yield sustainability. Future research should validate these models across diverse agro-climatic zones and investigate the physiological mechanisms through which environmental factors influence mite biology and behaviour.

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References

Anonymous (2021).

Borah, D.C. (1987). Bio ecology of *Polyphagotarsonemus latus* (Banks) (Acari; Tarsonemidae) and *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) infesting chilli and their natural enemies. Ph. D Thesis submitted to University of Agricultural Sciences, Dharwad.

Bulut, E., Gocmen H., Albajes R. and Sekeroglu E. (2000). Pests and their natural enemies on greenhouse vegetables in Antalya. Bulletin OILB SROP., **23**, 33-37.

Chaudhary, A.T. and Pandya H.V. (2019). Investigations on population dynamics of sucking pests infesting chilli (*Capsicum annum* L.) *Journal of Entomology and Zoology Studies*, **7(4)**, 812-817.

Chilli Outlook - (April 2025). Agricultural Market Intelligence Centre, PJTAU.

Chintkuntlawar, P.S., Pramanik A. and Chatterjee H. (2020). Population dynamics of chilli thrips *Scirtothrips dorsalis* hood and mite *Polyphagotarsonemus latus* banks on chilli. *International Journal of Entomology Research*, **6(4)**, 86-89.

de Coss-Romero, M. and Peña J.E. (1998). Relationship of broad mite (Acari: Tarsonemidae) to host phenology and injury levels in *Capsicum annuum*. *Florida Entomologist*, **81**, 515-526.

Jayewar, N.E. (2022). Survey on major insect pests of chilli in Marathwada region. *The Pharma Innovation Journal*, **11(6)**, 2403-2405.

Jeyarani, S. and Chandrasekaran M. (2006). Bioefficacy of certain acaricides against chilli mite, *Polyphagotarsonemus latus* (Banks). *Agricultural Science Digest*, **26(2)**, 132-134.

Kumar, D., Raju S.V.S. and Sharma K.R. (2019). Population dynamics of chilli mite and their management with certain newer insecticide combination formulations. *Journal of Pharmacognosy and Phytochemistry*, **8(2)**, 403-407.

Kulkarni, G.S. (1922). The "Murda" disease of chilli (*Capsicum*). *Agricultural Journal of India*, **22(1)**, 51-54.

Luypaert, G., Witters J., Berkvens N., Huylenbroeck J.V., Riek J.D. and Clercq P.D. (2015). Cold hardiness of the broad mite *Polyphagotarsonemus latus* (Acari: Tarsonemidae). *Experimental and Applied Acarology*. DOI 10.1007/ s10493- 015-9894-3.

Monika (2014). Evaluation of chilli hybrids for resistance against mite, *Polyphagotarsonemus latus* (Banks) (*Acari: Tarsonemidae*). M.Sc. Thesis submitted to CCS HAU, Hisar.

Rodrý´guez-Cruz, F.A. (2014). Biological control of broad mites in chili pepper and physic nut. Thesis Federal Univ. of Vicosa, Brazil.

Samanta, A., Sen K. and Basu I. (2017). Incidence study of yellow mite and thrips and their natural enemies in relation to weather parameters on chilli. *Journal of Entomology and Zoology Studies*, **5(4)**, 1213-1216.

Spices Board of India (2023–24).

Srinivasan M.R., Natrajan N. and Planiswamy S. (2003). Evaluation of Buprofezin 25% SC and Fenpyroximate 5% SC against chilli mites (*Polyphagotersonamus latus*). *Indian journal of Plant Protection*, **31(2)**, 116-117

Veena, S.K., Giraddi R.S., Bhemmanna M. and Kandpal K. (2017). Effect of pongamia cake, neem cake and vermicompost on sucking insect pests of chilli. *Journal of Entomology and Zoology Studies*, **5(4)**, 775-778.

Venkatesh, K.M., Munniyappa V., Ravi K.S. and Krishnaprasad P.R. (1998). Management of chilli leaf curl complex. Advances in IPM for Horticulture Crops. Reddy, PP, Kumar NKK and A. Verghese (Eds.), Association for Advancement of Pest Management in Horticultural Ecosystems, Division of Entomology and Nematology, Indian Institute of Horticultural Research, Bangalore, India, 111-117.