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Population dynamics of chilli mite, *Polyphagotarsonemus latus* (Banks) in relation to weather parameters

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Abstract
Chilli is an important vegetable crop and ''*Capsaicin*" an alkaloid responsible for their pungency and has medicinal properties. Chilli crop is attacked by chilli mite, *Polyphagotarsonemus latus* and it cause heavy yield loss. Studies on population dynamics of chilli mite was done during 2021-2022 at TNAU, Coimbatore. The chilli mite was recorded maximum during 10th week (3.89 mites/sq.cm leaves) on top, middle and bottom. Occurrence of chilli mite is positively correlated with maximum temperature (r = 0.740) and sunshine hours (r = 0.581). The Simple linear regression on damage of chilli mite with weather parameters was analyzed and it indicated that 89.3% is influenced by various weather parameters.

Keywords: Chilli, chilli mite, *Polyphagotarsonemus latus*, population dynamics, correlation coefficient, weather parameters

1. Introduction
Chilli, *Capsicum annum* L. and *C. frutescens* are the two cultivated species belong to the family Solanaceae and it is a popular spice and vegetable crop in Indian cuisine. It is grown as a cash crop and it is utilized in green and red mature. It is also called as sweet pepper, bell pepper and green pepper. It is an excellent source of vitamins A, B and C (Gill, 1989) [4]. Chilli is one of the most widely produced and highly profitable vegetable crop in the world. India is the largest producer and exporter of spices. India ranks first in the chilli production followed by China and Pakistan. The country commands a share of 25 per cent in global chilli trade and earns 375 million US dollar by exporting about 20 per cent of its production (Pednekar, 2015) [8]. In India, capsicum is cultivated in an area of 30,000 ha with production of 1.71 lakh tonnes (NHB, 2014-2015) [7]. Chilli is known to be infested by 57 insects and 2 non insect pests (Reddy and Puttaswamy, 1985) [12] of which the tarsonemid mite, *Polyphagotarsonemus latus* (Banks) and *Scirtothrips dorsalis* Hood are the most destructive and are considered as the major pests. The yield loss in chilli due to broad mite may go upto 96.39 per cent (Borah, 1987) [2]. Mites have become a menance in the chilli production. During the month of November, it appears in the nursery and spreads to the main field and it causes severe damage to the crop. The symptoms caused by chilli mite includes downward curling of leaves and dropping of fruit may cause under severe infestation (Pena and Bullock, 1994) [9]. Because of changes in weather and pest status, it is important to have a better understanding of the population dynamics of important pests. The study will provide knowledge in their peak period of pest activity, which will aid in the development of pest management strategies. For successful pest management, knowledge of consequences of the numerous factors that cause population fluctuation on a specific crop could help to anticipate its frequency in a particular region (Subha Rani and Singh, 2007) [14]. Thus, understanding the impact of meteorological variables on the occurrence of insect pests on chilli will aid in the development of forecasting system for timely plant protection.

2. Materials and Methods
The field study was carried out in Tamil Nadu Agricultural University, Coimbatore district, Tamil Nadu, India (11 °0131 °N and 76°9323 °E) from Nov' 2021 to Apr'2022. Seeds of TNAU CO1 Hybrids and chilli seedlings were raised in nursery for rabi season cropping. The crop was grown in an a plot size 4.8×4.0 m with spacing of 60 ×45 cm.

Thirty day old seedlings were transplanted in the main field. All agronomic practices were followed throughout the cropping season except for insecticides spray.

2.1 Pest Sampling
Population of mites were observed at weekly intervals starting from transplanting to maturity according to the Standard Meteorological Week during morning hours between 7.00am to 9.00am. Ten plants were randomly tagged in the plot and the observations were taken on top, middle and bottom leaves of each plant. One sq.cm area of each selected leaf was observed for mite population (Rajput *et al*. 2017) [11]

2.2 Weather Parameters
The data on mite population recorded in the experimental plot for population dynamics correlated with different weather parameters *viz.* temperature (Maximum, Minimum), relative humidity (Morning, Evening), rainfall, wind speed, bright sunshine hours which were gathered from Department of Agricultural Meteorology, Tamil Nadu Agricultural University, Coimbatore.

2.3 Statistical Analysis
Mean weekly data of pest population was worked out and correlated with the prevailing weather factors such as temperature (Maximum and Minimum), relative humidity (Morning and Evening), Rainfall, wind speed, Bright sun shine hours were analysed by calculating respective "r'(Correlation coefficient) with the help of SPSS (Statistical Package for Social Sciences) software.

3. Results and Discussion
Results on population dynamics by direct counting revealed that chilli mite (*Polyphagotarsonemus latus*) is also the major pest found to be infesting chillies. Results of monitoring of population dynamics of chilli mite revealed that the highest number of chilli mite, *Polyphagotarsonemus latus* was recorded during 10th Standard week (3.89 mites/sq.cm leaves) on top, middle and bottom (Table 1). Rajesh *et al*. (2020) [10] reported that maximum number of mite population was observed during 10th Standard Meteorological Week. The obtained results are at par with Lingeri *et al.* (1998) [6] , that the peak activity of chilli mite was noticed in the month of February.

3.1 Correlation between weather parameters
Results on the correlation analysis between weather parameters and abundance of chilli mite, *Polyphagotarsonemus latus* revelaed that maximum temperature and bright sunshine hours were positively correlated with population of chilli mite, *Polyphagotarsonemus latus* with the correlation coefficient of 0.740 and 0.581 and was found to be statistically significant at 0.01 per cent. Morning relative humidity, evening relative humidity and rainfall were found to be negatively correlated with the correlation coefficient of -0.748, -0.787 and -0.599. The population of chilli mite exhibits non-significant positive correlation with minimum temperature and wind speed with r value of 0.030 and 0.260 (Table 2). The results are in line with findings of Samanta *et al*. (2017) [1] that mite population is statistically significant and positively correlated with maximum temperature with r value of 0.772 and negatively correlated with rainfall with r value = 0.448. Similar to the findings, Deepak kumar *et al*. (2019) [3] reported that chilli mite was negatively correlated with evening relative humidity with the r value 0.687. Rajput *et al*. (2017) [11] observed that mite population exhibited significant positive correlation with maximum temperature with r value of 0.48 and shows negative correlation with evening relative humidity with r value of r = -0.54 and non significant which is positively correlated with minimum temperature with r value of 0.18. The mite population is statistically significant and negatively correlated with morning relative humidity with r value of about -0.269 (Roopa and Nandihalli 2009) [13]. Kotresh *et al*. (2020) [5] reported that mite population was statistically non-significant and positively correlated with wind speed with the correlation coefficient 0.311.

3.2 Simple linear regression analysis between chilli mite and weather parameters
The Regression equation of chilli mite, *Polyphagotarsonemus* latus fitted with the weather parameters was Y= 4.372+0.360X1-0.143X2-0.159X3+0.041X4-0.016X5+0.194X6-0.060X7. The R^2 value 0.893 indicates that 89.3% influence of weather parameters on the mite population. This equation explains that every unit increase in maximum temperature, evening relative humidity, wind speed would increase the pest occurrence upto 0.360, 0.041, 0.194 per cent respectively In contrast that one unit increase in minimum temperature, morning relative humidity, rainfall, sun shine hours will decrease the pest population by 0.143, 0.159, 0.016 and 0.060 respectively (Table 3). The result showed that linear regression study using multiple parameters influencing chilli mite population as the dependent variable and weather conditions as the independent variable. The weather-based linear regression model could explain 89.3% percent of the variation in mite population fluctuation and variability.

Table 1: Seasonal incidence of chilli mite, *Polyphagotarsonemus latus* on chilli hybrid (TNAU CO1 Hybrid)

SMW	Mite* (y)	Max. Temp. (°c) (x1)	Min. Temp. (°c) (x2)	Rh. Mrng. (%) (x3)	Rh. Evng. (%) (x4)	Rainfall (mm) (x5)	Wind speed (km/hr) (x6)	Sunshine hours (hrs/day) (x7)
46	0.24	29.6	22.6	86.6	66.6	60.0	3.7	3.1
47	0.56	28.9	22.1	86.4	63.6	32.0	3.4	4.0
48	0.71	27.5	22.6	86.1	68.6	25.8	5.5	2.0
49	0.88	29.7	22.5	86.0	66.3	30	3.4	4.9
50	0.76	28.1	21.8	85.1	58.3	19.0	6.2	5.8
51	0.93	28.9	19.6	83.9	52.7	0.0	4.2	6.2
52	1.24	29.2	19.4	83.8	48.4	0.0	5.5	7.8
1	1.16	28.2	21.0	84.4	56.6	16.6	6.3	5.4
2	1.29	30.4	21.3	84.6	50.0	0.0	4.0	6.5
3	1.37	30.8	20.6	85.1	46.1	0.0	5.5	8.1
4	1.52	31.6	19	85.1	42.9	0.0	4.4	8.6
5	1.64	31.1	21.2	84.4	47.1	0.0	5.7	6.9

6	1.71	32.2	20.7	85.0	40.4	0.0	4.6	7.3
7	2.01	31.2	21	82.9	45.1	0.0	5.1	5.0
8	2.14	32.6	22.3	83.3	38.9	0.0	5.6	7.6
9	2.62	32.8	19.4	77.9	28.0	0.0	6.0	8.6
10	3.89	33.4	21.3	76.9	41.4	0.0	5.9	8.7
11	3.25	35.3	21.0	77.6	29.9	0.0	4.7	8.2
12	2.41	35.0	23.4	85.0	44.4	1.0	4.3	6.1
13	2.54	35.1	24.1	87.3	44.7	0.0	4.0	8.2
14	2.48	35.4	24.7	83.3	40.3	8.2	4.9	8.6
15	1.96	32.9	24.0	84.9	57.1	4.3	4.1	3.0
16	1.60	34.8	24.1	84.7	48.0	30.5	4.9	8.7
17	1.25	35.1	25.3	85.4	46.1	1.0	4.5	8.2

Table 2: Correlation matrix of weather parameters with chilli mite, *Polyphagotarsonemus latus*

Parameters	Chilli mite, *Polyphagotarsonemus latus*
Maximum Temperature (°c)	0.740**
Minimum Temperature (°c)	0.030 ^{NS}
Morning Relative Humidity (%)	-0.748**
Evening Relative Humidity (%)	-0.787**
Rainfall (mm)	-0.599**
Wind speed (km/hr)	0.260 ^{NS}
Sunshine hours (hrs/day)	0.581**

**Correlation is significant at the 1 per cent level (2-tailed).
* Correlation is significant at the 5 per cent level (2-tailed).
^{NS} Non-Significant.

Table 3: Simple Linear Regression of chilli mite in relation to weather parameters

Parameters	Coefficient Regression	SE	't' value	R^2
X1- Maximum Temperature (°c)	0.360	0.123	2.924 ^{NS}	89.3%
X2- Minimum Temperature (°c)	-0.143	0.121	-1.177 ^{NS}	
X3- Mrng Relative Humidity (%)	-0.159	0.044	-3.620*	
X4- Evng Relative Humidity (%)	0.041	0.028	1.442 ^{NS}	
X5- Rainfall (mm)	-0.016	0.007	-2.314 ^{NS}	
X6- Wind speed (km/hr)	0.195	0.132	1.471 ^{NS}	
X7- Sunshine hours (hrs/day)	-0.060	0.067	-0.901 ^{NS}	

*Significant at 0.05% level, ^{NS} Non-Significant.

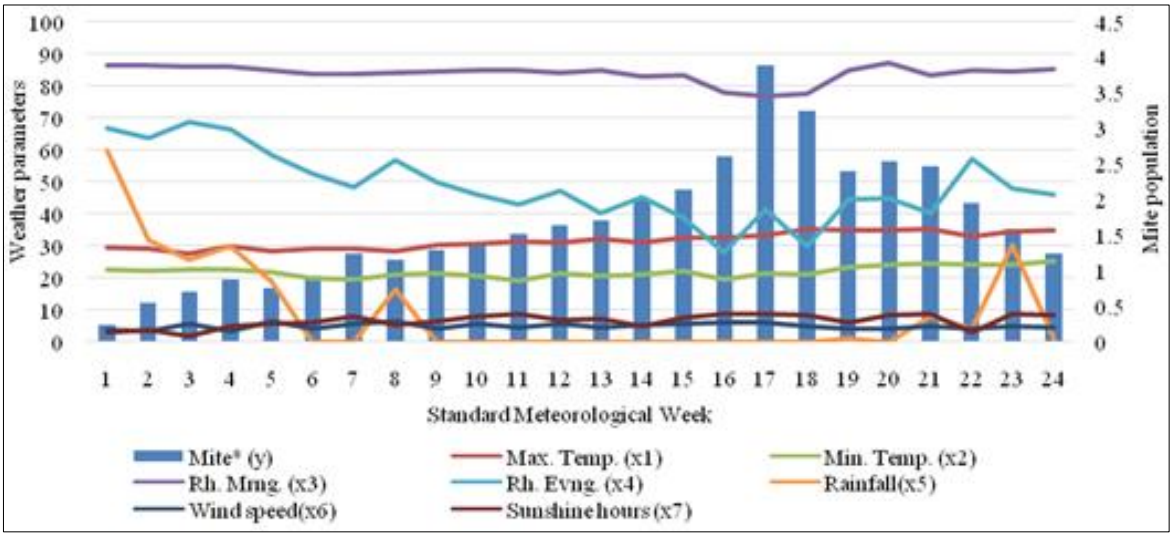

Fig 1: Correlation of Chilli mite, *Polyphagotarsonemus latus* in chilli during 2021-2022

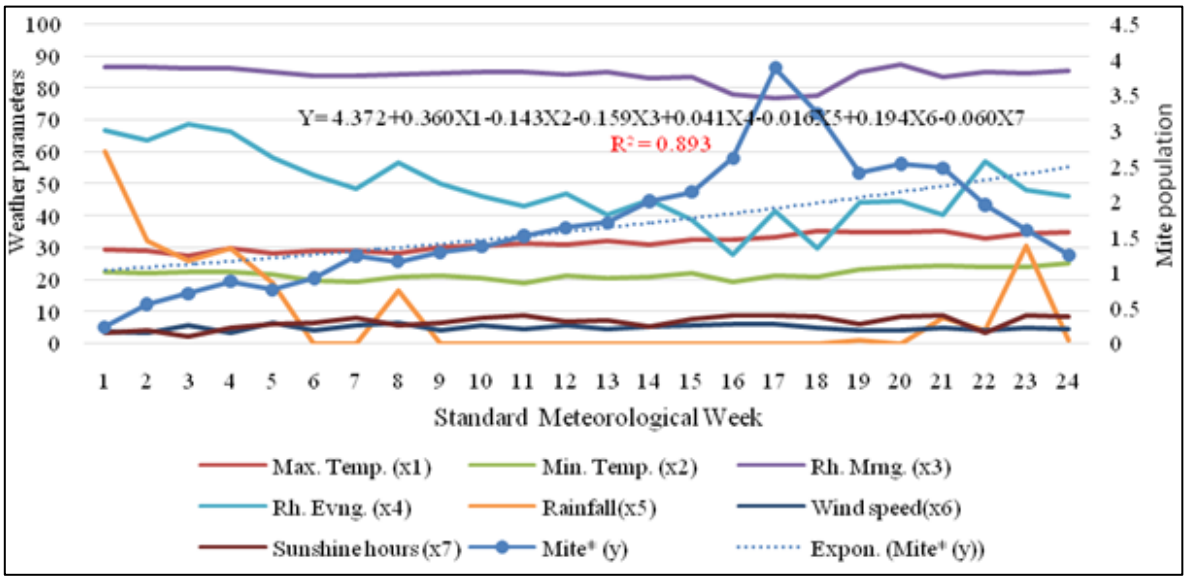

Fig 2: Regression of Chilli mite, *Polyphagotarsonemus latus* in chilli during 2021-2022

4. Conclusion

Chilli mite, *Polyphagotarsonemus latus* was recorded in TNAU, Coimbatore. The peak incidence of chilli mite, *Polyphagotarsonemus latus* was observed during 10th standard meteorological week (3.89 mites/ sq.cm leaves) on top, middle and bottom in 1sq.cm area and according to the level of incidence management practices can be followed. The correlation studies indicated that incidence of chilli mite, *Polyphagotarsonemus latus* had significant positive correlation with maximum temperature and sunshine hours. Hence the population is in dynamics during the entire period and the appropriate IPM practices can be followed during the peak incidence of pest.

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