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Effect of Abiotic Factors on the Population Fluctuation of Yellow Mite, *Polyphagotarsonemus latus* (Banks) on Chilli and their Correlation

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ABSTRACT: Chilli mites pose a significant threat to chili crops globally, causing substantial yield losses through leaf damage, reduced photosynthesis, and fruit distortion. Effectively managing chilli mite infestations is challenging due to their rapid reproduction, ability to develop resistance to pesticides, and the complexity of interacting factors such as temperature, humidity, and crop physiology that influence their population dynamics. So, we conducted a field experiment to study the population fluctuation of yellow mite, *Polyphagotarsonemus latus*(Banks) in chilli crop and its relation with different weather variables during *rabi* seasons, 2020-21 under unprotected conditions. The results revealed that the mite incidence (0.73 mite/3 leaves) was initially started after 5th week of transplanting of chilli seedling (47th SMW). Population of mite was gradually increased and reached it's peak (3.47 mite/3 leaves) after 17th week of transplanting (7th SMW) and their after mite population decrease and remained active up to 22nd weeks after transplanting (12th SMW) with mean population 0.87mite/3 leaves. Correlation of mite population with weather parameters revealed that maximum temperature, minimum temperature, evening relative humidity and rainfall showed negatively correlated (r= - 0.4218, - 0.6286, -0.2020 and -0.1264, respectively) while, morning relative humidity was positively correlated (r= 0.1812).

Keywords: Chilli, Yellow mite, Correlation, Abiotic factors, Population fluctuation.

INTRODUCTION

Chilli (*Capsicum annum* L.) holds a significant position as one of the most vital vegetable crops within the Solanaceae family. It is extensively cultivated in sub-tropical and tropical regions, where both ripe and unripe fruits are valued as vegetables and spices. Chilli is a highly significant and economically valuable spice crop cultivated worldwide. In India, Karnataka takes the lead in terms of both the area under cultivation, covering 45.4 thousand hectares, and the production volume, yielding 607.94 thousand tonnes (NHB, 2017). Other states in India, such as Madhya Pradesh, Andhra Pradesh, Bihar, Maharashtra, and Chhattisgarh, are also producers of chilli. Notably, India stands as the largest global producer of dry chillies (FAO, 2012). Chilli, being a highly lucrative and beneficial crop, faces the challenge of being attacked by over 20 insect and non-insect pests specifically in India (Butani, 1976). On a global scale, this crop has been reported to be infested by more than 293 different insects and non-insect pests. Arthropod pests have led to a significant reduction in chilli yield, causing a decrease of up to 76.66% (Ahmed *et al*., 2000). Among the most critical factors limiting chilli production is the chilli mite, also known as broad mite, tropical mite, or yellow mite, *Polyphagotarsonemus latus* (Banks). This mite is responsible for approximately 60% crop loss (Anon., 2005a) and can even result in a complete loss of the crop under greenhouse conditions (Liu *et al*., 1991). The chilli mite exhibits peak activity during the months of November to February (Srinivasulu *et al*., 2002), thriving in higher temperatures, lower humidity, and reduced rainfall intensity (Lingeri *et al*., 1998). This mite poses a significant threat to chilli cultivation, inflicting substantial economic losses annually, particularly in the southern districts of West Bengal. The average infestation rate caused by the mite ranges from 25% to 65%. An investigation into the economic threshold level of the yellow mite on chilli revealed that the ETL (economic threshold level) may be as low as a single mite per leaf (Ukay *et al*., 1999). The mites initially appear on the tender shoots of chilli plants, both on the terminal and auxiliary parts. Nymphs and adults exclusively feed on the lower surface of the leaves. This feeding activity causes the leaves to become brittle and roll downward, forming an inverted cup-like shape. The undersurface of the leaves acquires a shiny, glossy, bronzed appearance, while the overall leaf color turns dark green. A severe infestation leads to defoliation, bud shedding, and drying of the growing points. The toxic saliva of the mites can result in stunted or killed new growth, prompting the emergence of additional shoots (Baker, 1997). Fruit damage includes discoloration, blistering, and shriveling due to the mite's feeding. In severe cases, premature fruit drop may occur. These symptoms can easily be mistaken for viral diseases, micronutrient deficiencies, or herbicide injuries. Although severely damaged fruit is unsuitable for the fresh market, it may still find use in processing (Pena and Campbell 2005). The infestation levels and economic losses caused by these pests vary from region to region due to differences in agro-climatic conditions. The degree of infestation, however, relies on various abiotic factors such as temperature, relative humidity, sunshine hours, and wind velocity, as well as biotic factors like natural enemies. Consequently, it becomes essential to consistently monitor the insect pest population in the field. This surveillance provides valuable insights into the peak periods of their activity, enabling the prevention of sudden pest outbreaks and the formulation of economically effective insect pest management strategies.

MATERIAL AND METHODS

The field experiment on population fluctuation of yellow mite, *Polyphagotarsonemus latus* (Banks) in chilli crop and their correlation with abiotic factors was carried out at experimental farm, Agriculture Research Station, Ummedganj-Kota (Rajasthan) during *Rabi* season in the year 2020-21. Seedlings of chilli variety "US611" were raised in nursery trays and 43 days old chilli seedlings were transplanted in second week of October, 2020. The experiment was laid out in Randomized Block Design (RBD) with spacing of 60 × 45 cm and plot size of 3.0 × 5.0 m^2 respectively. The surveillance of chilli crop to study the fluctuation in population of yellow mites was done throughout the crop growing season. The data on seasonal incidence was recorded during the morning hours from 7 to 8.30 amsince the winged insects were sluggish hence, could be counted easily. The observations were taken at the weekly intervals. To study the mite population, five plants were selected randomly from each plot and were tagged. Population of mite both nymphs and adults were recorded on three leaves *viz.* each from upper, middle, and lower portion of plant till the final picking of chilli fruits. The data collected during the course of study was correlated with weather parameters. The weather data was obtained from the meteorological observatory located at ARS, Kota. The data was further subjected to statistical analysis and correlation coefficient was worked.

RESULT AND DISCUSSION

The data present in Table 1 and Fig. 1 revealed that the initiation of mite incidence (0.73 mite/3 leaves) was initially started after 5^{th} week of transplanting of chilli seedling (47^{th} SMW) when, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall (30.81°C, 14.00°C, 89.71 per cent, 70.00 per cent and 0.00 mm, respectively). Population of mite was gradually increased and reached it's peak (3.47 mite/3 leaves) after 17^{th} week of transplanting (7^{th} SMW) and their after mite population decrease and remained active up to 22^{nd} weeks after transplanting (12^{th} SMW) with mean population 0.87mite/3 leaves. The mite population (3.47 mite/3 leaves) was at peak when, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall (26.80°C, 10.30°C, 85.00 per cent, 63.00 per cent and 0.00 mm, respectively). Correlation of mite population with weather parameters revealed that maximum temperature, minimum temperature, evening relative humidity and rainfall showed negatively correlated (r= -0.4218, - 0.6286, -0.2020 and -0.1264, respectively) while, morning relative humidity was positively correlated (r= 0.1812). The present results of correlation study are corroborated with the findings of Bala (2017) they reported that the population of yellow mite showed positive correlation with maximum relative humidity, whereas minimum temperature, minimum relative humidity and rainfall were showed negative correlation. Rajput *et al.* (2017) also found that the significant negative correlation between yellow mite and evening relative humidity. Meena *et al.* (2013) reported that the maximum temperature had negative correlation with mite population. The results of present investigation are in acquiescence with the findings of Kumar *et al.* (2019 a) who reported that the mite population showed negative correlation with rainfall.

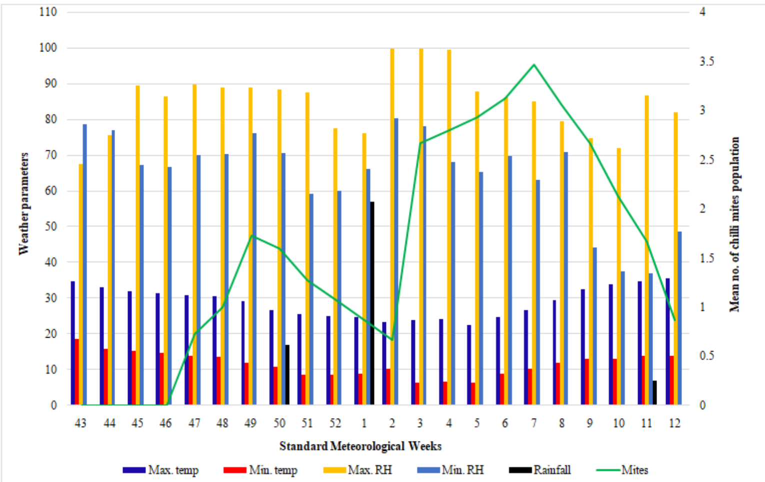

Fig. 1. Effect of abiotic factors on the incidence of yellow mite infesting chilli (*C. annum*) during *rabi* 2020-21.

Table 1: Effect of abiotic factors on the incidence of yellow mite infesting chilli (*C. annum*) during *rabi* 2020-21.

SMW (Duration)	Week after transplanting (Date of observation)	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Mean no. of mite /plant
		Max.	Min.	Morning	Evening		
43rd (22 Oct – 28 Oct)	1st (23-Oct 2020)	34.74	18.64	67.57	78.71	0.00	0.00
44th (29 Oct – 04 Nov)	2nd (30-Oct 2020)	32.93	15.75	75.50	76.83	0.00	0.00
45th (05 Nov – 11 Nov)	3rd (6-Nov 2020)	31.96	15.30	89.57	67.29	0.00	0.00
46th (12 Nov – 18 Nov)	4th (13-Nov 2020)	31.39	14.86	86.43	66.71	0.00	0.00
47th (19 Nov – 25 Nov)	5th (20-Nov 2020)	30.81	14.00	89.71	70.00	0.00	0.73
48th (26 Nov – 02 Dec)	6th (27-Nov 2020)	30.46	13.71	89.00	70.29	0.00	1.00
49th (03 Dec – 09 Dec)	7th (4-Dec 2020)	29.24	12.00	89.00	76.14	0.00	1.73
50th (10 Dec – 16 Dec)	8th (11-Dec 2020)	26.67	10.86	88.29	70.43	17.00	1.60
51th (17 Dec – 23 Dec)	9th (18-Dec 2020)	25.60	8.71	87.43	59.14	0.00	1.27
52th (24 Dec – 31 Dec)	10th (25-Dec 2020)	25.10	8.63	77.38	60.00	0.00	1.07
1st (01 Jan – 07 Jan)	11th (1-Jan 2021)	24.60	9.00	76.00	66.00	57.00	0.87
2nd (08 Jan – 14 Jan)	12th (8-Jan 2021)	23.39	10.14	99.86	80.14	0.00	0.67
3rd (15 Jan – 21 Jan)	13th (15-Jan 2021)	23.89	6.36	99.71	78.00	0.00	2.67
4th (22 Jan – 28 Jan)	14th (22-Jan 2021)	24.24	6.64	99.57	68.14	0.00	2.80
5th (29 Jan – 04 Feb)	15th (29-Jan 2021)	22.60	6.50	87.70	65.30	0.00	2.93
6th (05 Feb – 11 Feb)	16th (5-Feb 2021)	24.70	9.00	86.00	69.60	0.00	3.13
7th (12 Feb – 18 Feb)	17th (12-Feb 2021)	26.80	10.30	85.00	63.00	0.00	3.47
8th (19 Feb – 25 Feb)	18th (19-Feb 2021)	29.40	12.00	79.40	70.70	0.00	3.06
9th (26 Feb – 04 Mar)	19th (26-Feb 2021)	32.40	13.00	74.70	44.30	0.00	2.67
10th (05 Mar – 11 Mar)	20th (5-Mar 2021)	34.00	13.10	72.00	37.40	0.00	2.13
11th (12 Mar – 18 Mar)	21st (12-Mar 2021)	34.70	14.00	86.60	37.00	7.00	1.67
12th (19 Mar – 25 Mar)	22th (19-Mar 2021)	35.50	14.00	82.00	48.60	0.00	0.87
Correlation							
Max. Temp. (°C)							-0.4218
Min. Temp. (°C)							-0.6286
Morning R.H. (%)							0.1812
Evening R.H. (%)							-0.2020
Rainfall (mm)							-0.126

CONCLUSIONS

The mite incidence (0.73 mite/3 leaves) was initially started 3rdweek of November of (47th SMW) and reached it's peak (3.47 mite/3 leaves) second week of February (7th SMW). Mite population showed negative correlation with maximum temperature, minimum temperature, evening relative humidity and rainfall while, positively correlation with morning relative humidity.

FUTURE SCOPE

The current investigation's findings on the seasonal incidence of yellow mites can play a crucial role in implementing appropriate pest control measures. By identifying the vulnerable stages of these pests, it becomes possible to reduce the frequent use of toxic pesticides. This, in turn, creates favorable conditions for the proliferation of natural enemies in a less hazardous environment. The promotion of natural enemies through reduced pesticide application is beneficial for the conservation of the biological control program, enhancing its effectiveness in managing yellow mite populations.

Author contributions. Review & editing of manuscript (H.PM and BKP and MSM); Allocation of treatment (HPM); Conceived and designed the analysis (HPM & BKP); Collected the data (LSS & MSM); Contributed data or analysis tools (HPM, BKP & LSS); Performed the analysis (LSS & HPM); Wrote the paper (LSS).

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Conflict of Interest. None.

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