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Research Article

Incidence of chilli mite, *Polyphagotarsonemus latus* (Banks) on chilli fruit parameters under field conditions

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Abstract

Fourteen chilli hybrids were raised to study the effect of phytophagous chilli mite, *Polyphagotarsonemus latus* (Banks) on fruit parameters of chilli at Research Farm Area, Department of Vegetable Sciences, CCS Haryana Agricultural University, Hisar (Haryana). Chilli mites are one of the major pests of vegetable, ornamental and fruit crops, causing considerable loss in yield. Correlation coefficient (r = -0.98) calculated between mite incidence and fruit length suggested an increase in mite population led to corresponding significant decrease in fruit length in fourteen chilli hybrids. Maximum average fruit length (6.50 cm) was recorded in hybrid 9/CHIhyb-10 with corresponding lowest mite count (2.53mites/leaf). In contrast, decreased fruit length was recorded in hybrids 10/CHIhyb-7 (2.50 cm) and 10/CHIhyb-6 (2.83 cm) with highest mite count of 6.28 and 5.70 mites/ leaf, respectively. Likewise, negative and highly significant correlation was recorded between mite incidence and fruit number (r = -0.98) and fruit yield/plant (r = -0.96).

Keywords chilli hybrids, fruit parameters, *Polyphagotarsonemus latus*

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Introduction

Chilli (*Capsicum annuum* L.) is one of the important vegetables, a commercial spice crop of India and is being widely cultivated throughout the warm temperate, tropical and subtropical countries. Chilli is famous for its pleasant aromatic flavor, pungency and high coloring substance. It is used mostly in culinary, pharmaceutical and beverage industries throughout the world. It is an important condiment used for imparting pungency and color to the food, being rich in vitamin C, A, B, oleoresin and red pigment [1]. India produces about 10.70 lakh tonnes of chilli from an area of 9.08 lakh hectares, which is the second largest exporter of chilli in the world. Out of the total production, about 90-95 per cent is consumed within the country and about 5-10 per cent is exported in the form of dry chilli, chilli powder and oleoresins to south Asian countries, USA and Canada [2]. A number of limiting factors have been attributed for the low productivity, among which, the damage caused by insect pests and mites are the most important aspects. More than 293 insects and mite species attack the crop in the field as well as storage. Amongst these, yellow mite/ broad mite/ chilli mite, *Polyphagotarsonemus latus* are the most significant forms. Their infestation result in qualitative and quantitative crop loss. This minute mite, *P. latus* (0.1–0.3mm in length), is found in the apical portion of plants [3] and tender leaves for their feeding, shelter and ovi-position. This study is aimed to reveal the relationship of *P. latus* with chilli fruit parameters under field conditions. Such information would be needed for maximizing control practices.

Methodology

Plant Material

Seeds of chilli (*Capsicum annum* L.) hybrids; 10/CHIhyb-2, 10/CHIhyb-6, 10/CHIhyb-11, 10/CHIhyb-5, 10/CHIhyb-7, 10/CHIhyb-9, 10/CHIhyb-3, 10/CHIhyb-12, 10/CHIhyb-10, 10/CHIhyb-16, Kashi Anmol , 9/CHIhyb-4, 9/CHIhyb-8 and 9/CHIhyb-10 were grown under natural conditions at Research Farm Area, Department of Vegetable Sciences, CCS Haryana Agricultural University, Hisar (Haryana). The field was divided into plots of 3m × 2.7 m with spacing 60 cm ×45 cm. Plots were made as per the requirement of experiment design. Standard agronomical practices were followed to raise the crop.

Counting

The effect of *P. latus* infestation on the yield of chilli fruits from different plots was recorded. Examination of mite infested leaves was done with the help of Stereo Zoom Binocular Microscope. From both surfaces (dorsal and ventral), mite number was counted for each replicate. While counting the mite population, the surface of the leaf was studied to know the exact pattern of the mite distribution on leaf and symptoms of their damage. Observations on the eggs and mobile population of mites per leaf were recorded. The observations were continued until the crop was terminated.

Physical analysis

In chilli hybrids, the number of fruits, fruit length, plant height and weight were recorded per hybrid. At every harvest, fruit length was assessed by using a scale before the fruits were weighed on a weighing balance. Similarly, plant height was also measured at the end of the season. The experiment was continued until the harvesting of the plants. At the end of the study period, yields of different plots were compared to see the effectiveness of treatments against *P. latus* infestation. The difference in the fruit yields of chilli was calculated and the percent yield loss was worked out by following formula:

$$Loss\ in\ crop\ yield = \frac{\text{Mean yield of least susceptible hybrid} - \text{Mean yield of chilli hybrid}}{Mean\ yield\ of\ least\ susceptible\ hybrid} \times 100$$

Statistical Analysis

Field experiments were laid in randomized block design with three replicates. From each replicate, observations were recorded from ten plants. To know the mite infestation, Critical Differences (CD) was calculated at 5 percent level of significance between fourteen hybrids and observation period by using two factorial CRD.

Correlation analysis was also done between mite infestations and plant/ fruit parameters. Correlation variables vary together and are defined by:

$$r = \frac{\sum\left(X - \overline{X}\right)\left(Y - \overline{Y}\right)}{\sqrt{\sum\left(X - \overline{X}\right)^2}\sqrt{\sum\left(Y - \overline{Y}\right)^2}}$$

The significance of observed correlation coefficient was tested using 't' test where t cal was calculated at n-2 degrees of freedom. If t_{cal} is greater than t_{tab} the observed correlation coefficient is significant otherwise not.

Results and Discussion

The results of the present investigation were associated with *P. latus* infestation on host plant and plant/fruit parameters were correlated with the mite incidence.

Population of Polyphagotarsonemus latus on leaves of Chilli Hybrids

Statistical analysis depicted a significant effect of hybrid on population buildup of *P. latus* on chilli (CD= 0.74; p=0.05). Results revealed that maximum population developed on hybrid 10/CHIhyb-7 (6.28 mites/leaf) followed by 5.70 mites/leaf on 10/CHIhyb-6; both were statistically comparable with each other but significantly higher than population recorded on other hybrids. In other hybrids, *P. latus* population was 5.56, 5.44, 5.34, 5.30, 4.82, 4.75, 4.25, 4.11, 4.03, 3.44, 2.97 and 2.53 mites/leaf on, 10/CHIhyb-10, 10/CHIhyb-11, 10/CHIhyb-12, 10/CHIhyb-2, 10/CHIhyb-9, 10/CHIhyb-16, 10/CHIhyb-3, 10/CHIhyb-5, Kashi Anmol , 9/CHIhyb-4, 9/CHIhyb-8 and 9/CHIhyb-10 hybrids, respectively. The latter two hybrids recorded lowest mite incidence in the present study and were statistically at par with each other.

When the results on population buildup of *P. latus* over fortnightly observations were compared, a significant effect of observation period was recorded (CD= 0.48; p=0.05) (Table 1). Irrespective of the hybrid, the mite number was found to be significantly increase d with each observation period till the attainment of peak in the population in second fortnight of October (9.54 mites/leaf), which afterwards showed a gradual decline to the lowest count of 0.92 mites/leaf on second fortnight of November. During September, the mites count was statistically insignificant in the first (4.35 mites/leaf) and second (4.54 mites/leaf) fortnight.

Mite incidence during second fortnight of September and first fortnight of November was also found to be at par with each other. With increase in observation period, corresponding increase in *P. latus* population was witnessed in various chilli hybrids which showed significant difference with mite numbers at all observation periods (CD= 1.81; p= 0.05).

According to Roopa and Kumar [4], the peak incidence of 2.62 and 2.82 mites/3leaves/plant was observed during 1st and 2nd week of November. The mite population reached to its peak in the second

Table 1. Relative incidence of *Polyphagotarsonemus latus* on chilli leaves of different hybrids under field conditions

	Average number of P. latus/leaf						
Hybrids	**1st Fortnight September**	**2nd Fortnight September**	**1st Fortnight October**	**2nd Fortnight October**	**1st Fortnight November**	**2nd Fortnight November**	**Mean**
9/CHIhyb-10	3.00	2.33	2.67	3.34	3.00	0.84	**2.53^{a}**
9/CHIhyb-8	3.17	2.17	2.00	5.50	4.17	0.84	**2.97^{a,b}**
9/CHIhyb- 4	3.67	2.33	3.00	7.17	4.17	0.33	**3.44^{b,c}**
Kashi Anmol	2.84	4.67	2.00	9.17	4.50	1.00	**4.03^{c}**
10/CHIhyb-5	3.67	4.00	2.50	9.67	4.34	0.50	**4.11^{c,d}**
10/CHIhyb-3	4.50	5.17	3.67	6.00	4.67	1.50	**4.25^{d}**
10/CHIhyb-16	4.34	5.00	4.17	9.50	4.33	1.17	**4.75^{d}**
10/CHIhyb- 9	5.00	5.50	4.17	8.67	4.75	0.84	**4.82^{d}**
10/CHIhyb-2	5.17	4.67	3.50	13.17	4.34	1.00	**5.30^{e}**
10/CHIhyb-12	5.50	4.34	3.50	10.17	7.00	1.50	**5.34^{e}**
10/CHIhyb-11	4.17	6.33	4.00	10.67	6.67	0.84	**5.44^{e}**
10/CHIhyb-10	5.67	4.67	3.67	13.01	5.17	1.17	**5.56^{e}**
10/CHIhyb- 6	4.34	6.17	4.83	12.17	5.84	0.83	**5.70^{f}**
10/CHIhyb- 7	5.84	6.17	4.00	15.34	5.83	0.50	**6.28^{f}**
Mean	**4.35a**	**4.54a**	**3.41**	**9.54**	**4.92**	**0.92**	

CD (p=0.05) for Hybrids (H) =0.74, SE(m) = 0.27; CD (p=0.05) for Observation Period (OP) = 0.48, SE(m) = 0.17
CD (p=0.05) for Interaction OP×H=1.81, SE(m)=0.65; Values with the same superscript do not differ significantly

week of September [5]. Vichitbandha and Chandrapatya [6] reported that mite started building up its population from the end of September and reached their peak after mid-October.

Effect of Polyphagotarsonemus latus infestation on plant height of chilli

As it is evident from Table 2, the plant height at the end of season ranged between 10.00 cm (10/CHIhyb-2) and 46.25 cm (10/CHIhyb-12) and corresponding values of mite population were 5.30 and 5.34 mites/leaf, respectively. Hybrid, 10/CHIhyb-7 showed stunted growth. Negative correlation was observed between the mite incidence and the height of plant, but it was non-significant (r = -0.15) which indicated that the plant height was not influenced by mite incidence in the present study, except in few highly infested plants.

Pest attack influences the height of plants in various crops. Reduction in plant height depends on the severity of pest infestation. Borah [7] reported the negative association of plant height with susceptibility of varieties to *Scirtorthrips dorsalis*; however, the intensity of mite attack did not exhibit any kind of correlation with plant height. Similar trend was witnessed by Hosamani [8] and in present study where non-significant correlation was recorded between *P. latus* incidence and chilli plant height. Manjunatha [9] reported that the height of plant decreased according to the severity of damage caused by mites during the seedling stage.

Effect of Polyphagotarsonemus latus infestation on chilli fruit length

Correlation coefficient was calculated between the two parameters i.e. mite incidence and fruit length to see the effect of former over the latter. Result of the same is presented in Tables 2. Data on *P. latus* incidence in chilli hybrids suggested an increase in mite population led to the corresponding significant decrease in fruit length (r = -0.98). In this study, maximum average fruit length (6.50 cm) was recorded in hybrid 9/CHIhyb-10 with corresponding lowest mite count (2.53 mites/leaf) (Table 2). In contrast, decreased fruit length was recorded in hybrids 10/CHIhyb-7 (2.50 cm) and 10/CHIhyb-6 (2.83 cm) with highest mite count of 6.28 and 5.70 mites/ leaf, respectively. In other hybrids, fruit length ranged between 3.00 to 6.00 cm with a corresponding *P. latus* population ranged from 5.56 to 2.97 mites/leaf.

Effect of Polyphagotarsonemus latus infestation on chilli fruit number

The observations on fruit number revealed the similar trend as observed in fruit length (Table 2). The coefficient of correlation value (r) between the two parameters i.e. mite number and fruit number was negative and highly significant (r =- 0.98). The fluctuations in *P. latus* population were 2.53 to 6.28 mites/leaf; corresponding fruit numbers were 30 to 3 fruits/plant during present investigation. It is evident from the Table that increases in *P. latus* population led to decrease in fruit number in these hybrids. Higher number of mite (6.28 mites/ leaf) in hybrid 10/CHI hyb-7 caused the maximum decrease in fruit number per plant (3.00) in comparison to the lower levels of infestation (30 at mite infestation density of 2.53 mites/leaf in hybrid 9/CHI hyb-10. Severity of mite incidence affects the number of fruits formed. The fruits become smaller because the capacity of plant to meet the nutritional requirement of developing fruit is reduced. The reduced photosynthetic activity in leaves due to severe mite infestation also causes flower and fruit shedding which in turn reduces the number of fruits formed and yield [10]. The findings further confirmed that yellow mites attack the young leaves and shoots, causing significant losses, especially the stoppage of growth or atrophy of the branches and the flower drop markedly as reported earlier by many workers resulting in a fewer number of fruits formed in the plants [11].

Effect of Polyphagotarsonemus latus infestation on chilli fruit yield

Similar trend was witnessed for the individual fruit yield of hybrids. Hybrids with higher mite incidence showed lower yields and vice-versa. Average fruit yield declined from 54.88 g/plant in hybrid 9/CHI hyb-10 with 2.53 mites/ leaf infestation to 4.00 g/ plant in hybrid, 10/CHI hyb-7 with 6.28 mite infestation/ leaf (Table 2). Significant negative correlation (r = -0.96) was calculated between mite number and fruit yield/plant which revealed that with increase in mite infestation, fruit yield showed a corresponding decrease. In other hybrids, the yield ranged between 10.00 to 40.00 g/plant depending upon the variations

Table 2. Effect of *Polyphagotarsonemus latus* on plant/ fruit parameters of chilli

Hybrid	Mite Population/leaf	Plant Height(cm)	Fruit Length(cm)	Fruit Number/ plant	Yield/plant (gm)
9/CHIhyb-10	2.53	25.00	6.50	30.00	54.88
9/CHIhyb- 8	2.97	24.50	6.00	26.50	40.00 (27.11)
9/CHIhyb-4	3.44	24.25	5.79	20.00	37.00 (32.58)
Kashi Anmol	4.03	36.00	5.50	19.00	33.42 (39.10)
10/CHIhyb-5	4.11	39.50	5.00	17.00	26.50 (51.71)
10/CHIhyb-3	4.25	28.00	4.92	13.33	23.67 (56.87)
10/CHIhyb-16	4.75	22.33	4.13	11.00	22.75 (58.55)
10/CHIhyb-9	4.82	14.00	3.75	10.00	22.50 (59.00)
10/CHIhyb-2	5.30	10.00	3.75	8.50	22.00 (59.91)
10/CHIhyb-12	5.34	46.25	3.50	7.00	21.44 (60.93)
10/CHIhyb-11	5.44	31.50	3.38	5.25	15.50 (71.76)
10/CHIhyb-10	5.56	19.83	3.00	4.25	13.50 (75.40)
10/CHIhyb-6	5.70	25.00	2.83	3.00	10.00 (81.78)
10/CHIhyb-7	6.28	18.00	2.50	3.00	4.00 (92.71)
Mean	**4.61**	**26.01**	**4.33**	**12.70**	**24.80**
Correlation		**-0.15**	**-0.98**	**-0.98**	**-0.96**

in mite population. On an average, per plant fruit yield reduction was highest (92.71 %) in hybrid 10/CHI hyb-7 with higher initial infestation (6.28 mites/leaf), followed by 81.78, 75.40, 71.76, 60.93, 59.91, 59.00, 58.55, 56.87, 51.71, 39.10, 32.58 and 27.11percent reduction in 10/CHI hyb-6, 10/CHI hyb-10, 10/CHI hyb-11, 10/CHI hyb-12, 10/CHI hyb-2, 10/CHI hyb-9, 10/CHI hyb-16, 10/CHI hyb-3, 10/CHI hyb-5, Kashi Anmol, 9/CHI hyb-4 and 9/CHI hyb-8, respectively as compared to hybrid, 9/CHI hyb-10 (54.88 g/ plant with 2.53 mites/leaf). Reddy and Puttaswamy [12] suggested that the crop loss due to *P. latus* varied from 23.87 to 73.29 percent. Vichitbandha and Chandrapatya [6] observed that plants infested by broad mites during the early season frequently had a plant damage level higher than 10% in late season. The more plant damage caused the lower chilli yield production. Plant damage level of more than 50% resulted in a significant chilli yield production. Kamruzzaman et al., [13] observed the highest fibre yield losses due to mite infestation was found in the variety OM-1 (74.71%) followed by O-795 (72.98%), O-72 (68.14%) and the lowest was in O-9897 (50.11%) and the highest seed yield losses in O-795(64.34%) followed by O-72(48.21%),OM- 1(44.55%), the lowest was in O-9897(42.69%) under net house condition. Thus, it can be concluded that the broad mite is the most common pest infesting chili plants; caused leaf curling damage and resulted in the reduction of fruit and total yield production.

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