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ESTIMATION OF LOSSES IN CAPSICUM (*CAPSICUM ANNUM* L.) DUE TO YELLOW MITE, *POLYPHAGOTARSONEMUS LATUS* (BANKS) UNDER SHADE NET HOUSE

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ABSTRACT
Field experiments were conducted under shade net house at Hi-Tech Horticulture farm, Rajasthan Agriculture Research Institute (Sri Karan Narendra Agriculture University, Jobner) Durgapura, Jaipur, (Rajasthan) to work out the losses in capsicum caused by yellow mite, *Polyphagotarsonemus latus* (Banks) during summer 2014 and 2015. The experiment was conducted following the paired plots design as protected as well unprotected with fourteen replications. Alternate sprays of propergite 57 EC @ 2.0 ml /l and spiromesifen 22.9 SC 1.0 ml /l at the interval of 20 days, starting after mites initiation were given to one set of fourteen plots (protected) against mites and another set of fourteen plots were retained as untreated check (unprotected). Results indicated that mite population and per cent leaf curl were significantly low (0.87 per three leaves and 4.58 per cent leaf curl) and plant height, number of fruits and yield were significantly high (64.49 cm, 7.86 per plant and 57.76 q/ha) in protected condition as compared to unprotected condition (4.15 per three leaves, 20.71 per cent leaf curl, 56.32 cm. 6.25 per plants and 43.09 q/ha). The present finding indicated a significant net avoidable loss of 25.40, 12.66 and 20.45 per cent in fruit yield, plant height and number of fruits, respectively.

INTRODUCTION

Capsicum is one of the most popular and highly remunerative vegetable crops grown in most parts of the world, *viz*., China, Spain, Mexico, Romania, Yugoslavia, Bulgaria, USA, India, Europe, Central and South America are the major countries producing capsicum. In India, capsicum is extensively cultivated in Andhra Pradesh, Karnataka, Maharashtra, Tamilnadu, Himachal Pradesh, and hilly areas of Uttar Pradesh. Capsicum, also known as sweet pepper, bell pepper, green pepper or Shimla Mirch. In the world, the area and production of capsicum (bell pepper) is merged with that of hot peppers. Hence, the statistics related to pepper / chilli as a whole is given. Annual world production in the year 2010-2011 amounted to 29.9 million tons from an area of 1.9 million ha. China is the major producer in the world with an area of 0.707 million ha with a production of 15546 thousand tones. India's contribution was estimated to be 65.9 thousand tones from an area of 7,700 thousand hectares with productivity of 8.6 tones/ha. Andhra Pradesh stands first in area of 171.450 thousand ha with a production of 537.7 thousand tones. While, Karnataka stands second in production of about 94.5 thousand tons with area of about 69.8 thousand ha. Rajasthan is also important producer in India with an area 17720 ha with production of 17530 tones (Anon., 2013).

It is a cool season crop but it can be grown round the year using protected structures. The warm, humid conditions and abundant food under protected conditions provide an excellent, stable environment for pest development. Often, the natural enemies that keep pests under control outside are not present under protected environment. For these reasons, pest situations often develop in the indoor environment more rapidly and with greater severity than outdoors. Sucking pests *viz*, thrips and mite considerably damage this crop. The yellow or broad mite, *Polyphagotarsonemus latus* (Banks) is fast emerging as major pest of capsicum and chilli in Rajasthan. Feeding of these mites caused downward curling of leaves, elongation of petioles on older leaves and clustering of tender leaves at the tip of the branches. The growth of plant is arrested and the entire plants look like a leaf curl plant. The extent of loss caused due to mite infestation and resultant leaf curl varies with the places. The level of damage that can be tolerated is greatly dependent on the type of crop. Producers of vegetable crops generally can accept a higher level of damage than those of ornamental crops that are produced for their aesthetic value. They multiply in large numbers under controlled temperature, relative humidity and due to developing of resistance against pesticides there by leading to significant crop loss. This has been well documented in protected flower crops such as rose, carnation, chrysanthemum etc. Mites cause about 53 per cent damage on rose plants (Dhooria, 1999). Reddy (2005) reported that chilli mite, *P. latus* (Banks) and thrips (*Scirtotrips. dorsalis* Hood) as the major pest of infesting sweet pepper both under protected and open field condition Sunitha (2007) has also revealed the occurrence of aphids, thrips and mites as major pest in capsicum. Among different pests reported on capsicum there is information indicating significant crop losses due to key pests. (Nandini, 2010)

However, in other related crops like chilli yellow mite (*P. latus*) is the major pest causing yield loss up to 96.4 per cent in North Karnataka (Borah, 1987) and 34.14 per cent in West Bengal (Ahmed *et al*., 1987) under open field conditions. Meena *et al*., 2013 revealed that yellow mite is prominent pest infesting chilli in the Rajasthan region and Kumar *et al*., (2014) also reported mite in other than chilli crop. Other than yellow mite, spider mite (*Tetranychus urticae*) pose a great expense on vegetable grower worldwide in terms of damage and control and are therefore globally considered an important agriculture pest (Reddy *et al*., 2014). Reddy and Kumar (2006) in an IPM trial estimated per ha crop loss of 40 to 60 tons of capsicum if the crop is not subjected to insecticidal control. Thrips (*S. dorsalis* Hood) and mite, *P. latus* (Banks) are not serious in temperate countries but can be devastating in the tropical climate of India (Moorthy and Reddy, 2004). No sincere attempt has been made in the past to estimation of yield losses against yellow mite under shade net house conditions in Rajasthan.

Looking to the severity of damage due to yellow mite on capsicum crop, hence in this regard, study was initiated to understand the estimation of losses in capsicum (*capsicum annum* L.) due to yellow mite, *Polyphagotarsonemus latus* (Banks) under shade net house.

MATERIALS AND METHODS

The experiment was conducted for two consecutive years during summer 2014 and summer 2015 under shade net house at Hi-Tech Horticulture farm, Rajasthan Agriculture Research Institute (Sri Karan Narendra Agriculture University, Jobner) Durgapura, Jaipur, (Rajasthan). The experiment was laid out in paired plot Design with 2 treatments (protected and unprotected to mite infestation) with fourteen replications (Desai *et al*., 2007). The seedling of capsicum variety PSO 26 were transplanted in the beds measuring 3.5 X 1.0 m, keeping row to row and plant to plant distance of 0.50 m and 0.40 m on 22nd and 10th March during 2014 and 2015, respectively. Crop was raised as per the package of practices. Alternate sprays of propergite 57 EC @ 2.0 ml /l and spiromesifen 22.9 SC 1.0 ml /l at the interval of 20 days, starting after mites initiation were given to one set of fourteen plots (protected) for check the mite infestation and another set of fourteen plots were retained as untreated check (unprotected). Incidence of mite, leaf curl and actual amount of quantitative losses inflicted by the yellow mite and their effect on various yield attributing character *viz*., plant height(cm), number of fruit per plant and green capsicum yield (q /ha) were recorded separately.

Incidence of mite

The population of mites (Nymphs and Adults) was recorded at fortnightly intervals. The mites were counted on five randomly selected tagged plants per plot during early hours of the day when they remain less active. Observations on pest population mite, (*Polyphagotarsonemus latus)* were taken on three leaves from upper, middle and lower portion of each tagged plant. Number of mites was counted by using binocular in laboratory.

Leaf curl

Leaf curl damage due to mites were recorded at fortnightly intervals based on visual method of symptom of damage and then leaf curl index/plant was worked out as per the method described by Niles (1980) and per cent leaf curl were computed.

Plant height

Five plants from each replication of both the treatments were selected at the harvesting stage. The height was measured with the help of meter scale.

Number of fruits per plants

Five plants from each replication of both the treatments were selected and total number of fruits were counted at each picking (Total five picking).

Fruit yield

Yield data recorded at the time of each picking from each treatment separately and pooled than calculated on the basis of yield q/ ha.

The losses in yield and yield attributing character were workout by using the following equation:

$$\text{Mean loss in yield} = \frac{\text{Mean yield in protected crop - Mean yield in unprotecte d crop}}{\text{Mean yield i n protected crop}} \times 100$$

The population of mite, per cent leaf curl, plant height, number of fruits and yield were subjected to statistical analysis and significance was tested using t test in 2014 and 2015 separately as under :

$$\text{Standard deviation (sd)} = \sqrt{\frac{\text{Sum of square of the deveation from the mean difference}}{\text{Number of paired plots}^{-1}}}$$

$$\text{Standard error of mean (SE)} = \frac{\text{Standard deviation (sd)}}{\sqrt{\text{Number of paired plots (n)}}}$$

$$t \text{ calculated} = X_1\text{-}X_2\text{/ SE}$$

Where

X_1 = Average yield in treated plot (Protected)

X_2 = Average yield in untreated plot (unprotected)

SE = Standard error of mean difference.

Pooled analysis of both the years was also calculated.

Monetary loss due to mite infestation was workout considering prevailing market price in green capsicum in respective year.

RESULTS AND DISCUSSION

In field experiment conducted on crop losses estimation due to yellow mite, *P. latus* (Banks) observation were taken protected as well as unprotected condition with regards to mite incidence, leaf curl plant, plant height, number of fruits and yield and these are presented in Table 1-7.

Incidence of mite

Observations were made on mite population from second fortnight of March to first fortnight of July. The data presented in Table 1 and 2 revealed that there was significant difference between the mite population in protected and unprotected plots during both the years. The overall per cent reduction of mite population 80.05% and 78.99 % over unprotected was noticed during 2014 and 2015 respectively. On the basis of

Table 1: Population of yellow mite on capsicum under protected and unprotected conditions during 2014

Treatments	No. of mite/three leaves in fortnight								
	March II	April I	April II	May I	May II	June I	June II	July I	Overall
Protected	0.44	0.59	1.17	1.67	1.26	1.04	0.3	0.16	0.83
Unprotected	2.29	2.25	6	9.6	6.84	3.71	1.64	0.9	4.15
't' value	10.57*	8.15*	19.83*	49.40*	19.62*	17.91*	16.86*	7.85*	60.72*
% reduction of mite over untreated	80.63	73.92	80.48	82.59	81.63	71.92	81.74	82.54	80.05

*Significant at 5% level

Table 2: Population of yellow mite on capsicum under protected and unprotected conditions during 2015

Treatments	No. of mite/three leaves in fortnight								
	March II	April I	April II	May I	May II	June I	June II	July I	Overall
Protected	0.61	0.71	1.33	1.64	1.49	0.99	0.34	0.19	0.91
Unprotected	2.5	2.76	6.47	9.07	6.9	4.39	1.71	0.94	4.34
't' value	17.08*	11.98*	16.12*	49.45*	19.01*	16.96*	23.34*	8.98*	45.37
% reduction of mite over untreated	75.43	74.09	79.47	81.89	78.47	77.52	80	80.3	78.99

* Significant at 5% level

Table 3: Population of yellow mite on capsicum under protected and unprotected conditions (pooled of 2014 &2015)

Treatments	No. of mite/three leaves in fortnight								
	March II	April I	April II	May I	May II	June I	June II	July I	Overall
Protected	0.53	0.65	1.24	1.66	1.37	1.01	0.32	0.17	0.87
Unprotected	2.39	2.5	6.2	9.34	6.87	4.05	1.68	0.92	4.25
't' value	20.48*	13.74*	22.84*	31.62*	25.53*	22.98*	25.30*	10.65*	69.23
% reduction of mite over untreated	77.91	74.01	80.07	82.25	80.04	74.96	80.85	81.4	79.51

* Significant at 5% level

Table 4: Per cent leaf curl due to yellow mite on capsicum under protected and unprotected conditions

Treatments	Per cent Leaf Curl (Week after transplanting)											
	2014				2015				Pooled			
	7	11	13	Overall	7	11	13	Overall	7	11	13	Overall
Protected	3.21	5.36	4.64	4.4	3.93	5.71	4.64	4.76	3.57	5.54	4.64	4.58
Unprotected	17.14	23.21	20.71	20.36	18.93	23.93	20.36	21.07	18.04	23.57	20.54	20.71
't' value	6.41*	14.25*	7.19	11.18*	4.01*	5.32*	6.56*	13.18*	8.66*	9.34*	10.04*	16.10*
% reduction of leaf curl over untreated	81.27	76.91	77.6	78.39	79.24	76.14	77.21	77.41	80.21	76.5	77.41	77.88

* Significant at 5% level

Table 5: Effect of infestation of yellow mite on plant height of capsicum under protected and unprotected conditions

Treatments	Plant height (cm)		
	2014	2015	Pooled
Protected	62.74	66.23	64.49
Unprotected	54.60	58.04	56.32
't' value	17.16*	32.35*	23.12*
% reduction of height	12.98	12.37	12.66
Reduction in height (cm)	8.14	8.19	8.17

* Significant at 5% level

Table 6: Effect of infestation of yellow mite on number of fruits in capsicum under protected and unprotected conditions

Treatments	No. of fruits		
	2014	2015	Pooled
Protected	8.04	7.67	7.86
Unprotected	6.53	5.97	6.25
't' value	4.51*	7.31*	5.27*
% reduction of number of fruits	18.83	22.16	20.45

* Significant at 5% level

pooled analysis (Table 3 indicated that there was significant difference between the mite population in protected (0.53, 0.65, 1.24, 1.66, 1.37, 1.01, 0.32, 0.17, and 0.87 mites per three leaves) and unprotected (2.39, 2.50, 6.20, 9.34, 6.87, 4.05, 1.68, 0.92 and 4.25 mites per three leaves) plots in second fortnight of March to first fortnight of July with mean values, respectively. A mean of 79.51 per cent reduction in mite population over untreated was noticed, with highest being

Table 7: Yield losses in capsicum due to yellow mite under protected and unprotected condition

Treatments	Fruit yield (qt/ha)		
	2014	2015	Pooled
Protected	54.18	61.33	57.76
Unprotected	41.12	45.05	43.09
't' value	6.97*	18.76*	13.01*
Per cent yield loss over protected	24.11	26.54	25.40
Loss in yield (q / ha) over protected	13.06	16.28	14.67
Monetary loss (Rs/ha	52240	65100	58680

* Significant at 5% level

in first fortnight of May (82. 25%).

Leaf curling due to mite

Observations were made on mite damage in form of leaf curl due to mite at 7, 11 and 13 week after transplanting. The data presented in Table 4 revealed that there was significant difference between leaf curl in protected (3.21, 05.36, 4.64 and 4.40 %) and unprotected (17.14, 23.21, 20.71 and 20.36%) plot at 7 WAT, 11 WAT, 13 WAT and overall, respectively during 2014. In 2015 significant difference was also noticed between the per cent leaf curl damage in protected (3.93, 5.71, 4.64 and 4.76) and unprotected (18.93, 23.93, 20.36 and 21.07) plot at 7 WAT, 11 WAT, 13 WAT and overall, respectively. The overall percent reduction of leaf curl 78.39 and 77.41 over unprotected was observed during 2014 and 2015, respectively. On the basis of pooled analysis indicated that there was significant difference between the per cent leaf curl in protected (3.57, 5.54, 4.64 and 4.58) and unprotected (18.04, 23.57, 20.54 and 20.71) plots at 7 WAT, 11 WAT, 13 WAT and overall, respectively. The percent reduction in leaf curl was (76.50 to 80.21) with highest being at 7 WAT (80.21%).

Plant height

It is evident from the Table 5 that plant growth was adversely affected. In protected plots the height of plants had a mean of 62.74 cm in comparison to the mean height of 54.6 cm. in unprotected plots during the year 2014. In 2015, significant difference was also observed between the plant height in protected (66.23 cm) and unprotected (58.04 cm) plots. On the basis of pooled analysis indicated that there was significant difference between the plant height in protected (64.49 cm) and unprotected (56.32 cm) plots. The yellow mite infestation caused 12.98, 12.37 and 12.66 per cent reduction in plant height during 2014, 2015 and pooled of both the years, respectively.

Number of fruits

It is evident from the Table 6 that, there was significant difference between the number of fruits /plant in protected (8.04) and unprotected (6.53) plots during 2014. In 2015 there was significant difference between the number of fruits/ plant in protected (7.67) and unprotected (5.97) plots. The pooled analysis indicated that there was significant difference between the number of fruits per plants in protected (7.86) and unprotected plots (6.25). The yellow mite infestation caused 18.83, 22.16 and 20.45 per cent reduction in number of fruits per plant during 2014, 2015 and pooled of both the years, respectively.

Fruit yield

It is evident from the Table 7 that, there was significant difference between the yield in protected (54.18 q/ha) and unprotected (41.12 q/ha) plots during 2014. The per cent reduction in fruit yield due to mite infestation was 24.11, which accounted for 13.06 q/ha loss in yield. Thus, were monetary loss of Rs 52,240 per ha was calculated during 2014. In 2015, significant difference also was noticed between the yield in protected (61.33 q/ha) and unprotected (45.05 q/ha) plots. The per cent reduction in fruit yield due to mite infestation was 26.54, which accounted 16.28 q/ha loss in yield. Thus, Rs. 65,100/- was calculated as monetary loss per ha. The pooled analysis indicated that there was significant difference between the yield in protected (57.76 q/ha) and unprotected (43.09 q/ha) plots. The per cent reduction in fruit yield due to mite infestation was 25.40, which accounted 14.67 q/ha loss in yield. Thus Rs. 58,680/- was calculated as monetary loss per ha.

The results indicated that mite population and leaf curl index were significantly low and plant height, no. of fruits and yield were significantly high in protected condition as compared to unprotected condition. The per cent reduction in mite population and leaf curl were observed 79.51 and 77.88, respectively in protected condition. The present findings indicated a net avoidable loss of 25.40, 12.66 and 20.45 percent in fruit yield, plant height and no. of fruits, respectively on the basis of pooled analysis. Studies conducted at different places showed net avoidable loss in fruit yield 34.4 per cent due to thrips and mites in Andhra Pradesh (Ahmed *et al*. 1987) on chilli. The reduction in potential yield of green chilli due to infestation of chilli mite alone was recorded 27.78 per cent under south Gujarat condition (Desai *et al*., 2007) and 29.15 to 36.36 per cent loss at Jobner, Rajasthan (Sharma 2005). Dhooria (1985) reported mite may hamper plant growth in brinjal. In severe infestation up to 96.4 per cent yield loss is reported from Karnataka, India (Borah, 1987). Variation in per cent loss in yield of chilli reported by different worker may be attributed to change in agro- climatic conditions, type of crop, crop raise conditions (open or protected field).

In conclusion the present finding indicated that a net avoidable loss of 25.40, 12.66 and 20.45 per cent in fruit yield, plant height and number of fruits, respectively with monetary loss Rs 58680 per ha

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