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Pest Complex on Bell Pepper (*Capsicum annuum* L. *var*. *grossum* Sendt.) Under Protected Cultivation

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ABSTRACT

The study was conducted under protected condition at College of Horticulture, Hiriyur, Chithradurga district, Karnataka during 2015-16 to study the pest complex on bell pepper. During the study period three species of insect, one species of mite and three natural enemies were found associated with bell pepper. The insect pests were thrips (Thysanoptera: Thripidae), fruit borer (Lepidoptera: Noctuidae), mealybug (Homoptera: Pseudococcidae) and grasshopper (Orthoptera). The mite was Polyphagotarsonemus latus (Banks) (Acari: Tarsonemidae). The natural enemies were predatory mite (Acari: Cunaxidae) and spiders (Arachinida) and rarely Chrysopids (Nueroptera: Chrysopidae).

Key words: *Pest complex, Bell pepper, Protected cultivation*

INTRODUCTION

Bell pepper (*Capsicum annuum* L. *var*. *grossum* Sendt.) is also known as capsicum and sweet pepper. The genus *Capsicum* belongs to the family Solanaceae. Capsicum, being a commercial vegetable crop, it has a vast potential for protected cultivation in Karnataka[1]. Its yield in open field condition ranges from 20-40 t/ha where as in greenhouse it is 100-120 t/ha [2]. Insect pest problems are peculiar to greenhouse cultivation. Mites, thrips, whitefly, leaf miner, aphids, gall midge and nematodes are serious problems on vegetable crops under protected condition. They multiply in large numbers under controlled temperature and relative humidity as well as pesticide use there by leading to significant crop loss. Hence, present study undertaken to know the incidence of pest complex on bell pepper under protected cultivation.

MATERIAL AND METHODS

The experiment was conducted under protected condition with drip irrigation system at College of Horticulture, Hiriyur, Chithradurga district, Karnataka during 2015-16. Seedlings of capsicum, hybrid Indra were raised in nursery in raised bed. Thirty five days old, vigorous and uniform size seedlings were selected for transplanting in main field of size 5 m × 3 m with spacing of 60 cm × 45 cm. Watering was done immediate after transplanting.

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In experimental plot, all the recommended agronomic practices were followed as per the package of practices except the plant protection measures. Observations were made to record the population of insect and mite pests of capsicum and their natural enemies from 20 randomly selected plants at weekly intervals from September and continued up to last week of February using suitable technique. Mite, *Polyphagotarsonemus latus* Banks population was recorded on top five leaves per plant. Thrips and mealybug were counted on three fully opened young leaves from top, middle and bottom canopy of the plant, fruit borer *Spodoptera litura* Fabricius population was recorded from each plant and expressed in terms of number of larvae per plant. The population of different natural enemies *viz.*, spiders and predatory mite were recorded from 20 randomly selected plants at weekly intervals. The data of insect and mite pests and their natural enemies was correlated with weather parameters. Insect and mite pests and natural enemies were collected during the study period and preserved for their identification.

RESULTS AND DISCUSSION

Incidence of mites

The mite, *Polyphagotarsonemus latus* (Banks) population was observed throughout the cropping period. The mean population of 11.36 ± 5.48 eggs/leaf and 1.77 ± 1.03 active stages (Nymph and adult) per leaf was recorded. The peak population of 18.72 eggs/leaf and 3.80 active stages per leaf was recorded during the third and fourth week of November, respectively. The present investigation are in conformation with[3] who reported three peaks of incidence of mite, two in summer (April-May) and one in rabi (November). Similarly, Mote *et al.*[4] also opined that the mite number was highest during November (360-590 mites/30 leaves) on chilli when the average temperature and humidity was 20°C and 75 per cent, respectively and there were no rains during that period.

The correlation studies on the incidence of mite revealed that the abundance of egg were significantly positive correlated with minimum temperature (r= 0.622) and maximum relative humidity (r=0.508). The active stages of mite were significantly positive correlated with maximum relative humidity (r=0.531) whereas other factors did not significantly influence the mite infestation. During the present investigations, the peak incidence of mites was noticed during the third week of November which might be due to moderate temperature with high relative humidity that prevailed during this period.

Incidence of thrips

The thrips, *Scirtothrips dorsalis* (Hood) population was observed throughout the cropping period and its population ranged from 0.20 to 10.95 per leaf in top canopy, 0.50 to 8.75 per leaf in middle canopy and 0.40 to 8.65 per leaf in bottom canopy. The peak incidence of thrips was noticed during the last week of February in top canopy with mean population of 8.47 ± 2.79 thrips per leaf whereas, it was during the second week of February in middle and bottom canopy with a mean population of 6.16 ± 2.52 and 4.24 ± 2.59 per leaf, respectively. Thrips population was significantly positively correlated with maximum temperature (r= 0.532) and negatively correlated with maximum relative humidity (r= - 0.622) in top canopy. In middle canopy, thrips were significant negatively correlated with maximum relative humidity (r= -0.664). In bottom canopy, thrips were significantly negative correlated with maximum relative humidity (r= -0.680) whereas other factors did not significantly influence on the thrips population.

The present findings are in agreement with the observations of Senapati *et al.*[5] on the activity of thrips during January to March with peak population during the last week of February. Similarly, Patel *et al.*[6] revealed that

the incidence of *S. dorsalis* on chilli crop commenced from first week of September and continued up to harvest of the crops and peak activity was recorded in November (4.99 to 5.54 thrips/leaf) and February - March (5.29 to 7.38 thrips/leaf). The correlation coefficient of thrips with the weather parameters revealed that significant negative correlation was found with morning temperature.

Incidence of mealy bug

The population of mealy bug was noticed from first week of September to last week of November and once again recorded in February. The population was ranged from 0.10 to 1.75 per leaf among different canopy. The peak incidence was noticed during the September with a mean population of 0.24 ± 0.43 per leaf of top, 0.17 ± 0.26 per leaf of middle and 0.16 ± 0.24 per leaf of bottom canopy, respectively. The population mealy bug of top and middle canopy was significantly positively correlated with minimum temperature. The present findings were in conformity with Malumphy *et al.*[7] who reported the mealy bugs infestation in greenhouse condition.

Incidence of *Spodoptera litura* (Fabricius)

Spodoptera litura was recorded from second week of November and continued till last week of February. The population ranged from 0.15 to 1.35 per plant. The peak incidence was noticed during the first week of January with a mean population of 0.44 ± 0.40 per plant. These results were in line with the reports of Nadaf *et al.*[8] also reported about the incidence of *S. litura* on chilli during *kharif*. The present results were in conformity with Nandini *et al.*[9] who also recorded the incidence of *S. litura* on capsicum under protected cultivation during August. The populations of *S. litura* were significantly negatively correlated with minimum temperature (r = -0.706) and minimum relative humidity (r = -0.519). The reason for negative relation of *S. litura* with temperature and relative humidity was not understood.

Incidence of Grasshopper

Grasshopper population was observed throughout the cropping season and its occurrence ranged from 0.05 to 0.20 per plant. The peak incidence of 0.20 grasshoppers per plant was recorded during the second week of September with a mean population of 0.06 ± 0.053 per plant. This incidence might be due to capsicum was grown in naturally ventilated polyhouse. These findings are similar with the results of Girish *et al.*[10] who reported the occurrence of grasshopper population on chilli at Bangalore. Grasshopper were significantly positively correlated with minimum temperature (r = 0.515) and minimum relative humidity (r = 0.549).

Natural enemies

Phytoseiid mite, *Cunaxa* sp. population was observed from second week of October and continued throughout the cropping period. The population ranged from 0.05 to 1.25 per leaf. The peak population of 1.25 predators per leaf was noticed during the third week of December with a mean population of 0.38 predators per leaf. *Cunaxa* sp. were negatively correlated with maximum temperature whereas, positive correlation with minimum temperature, maximum and minimum relative humidity and the relationship was non-significant. Spiders were significantly positively correlated with minimum and maximum temperature, minimum relative humidity and maximum relative humidity and the relationship was non-significant. The present investigations are in agreement with[11] who reported that natural enemies population comprising coccinellids, spiders, anthocorid and predatory mite throughout the cropping period.

Table 1. Incidence of yellow mite, *Polyphagotarsonemus latus* Banks on capsicum

Date of observations	No. of mites per leaf		
	Eggs	***AS**	**Egg + AS**
7/9/15	0.00	0.00	0.00
14/9/15	0.00	0.00	0.00
21/9/15	0.00	0.00	0.00
28/9/15	1.22	0.30	1.52
5/10/15	4.28	0.80	5.08
12/10/15	11.38	1.22	12.60
19/10/15	11.96	1.28	13.24
26/10/15	12.12	1.58	13.70
2/11/15	11.92	1.34	13.26
9/11/15	14.20	2.54	16.74
16/11/15	18.72	2.74	21.46
23/11/15	18.38	3.80	22.18
30/11/15	13.02	1.76	14.78
7/12/15	13.10	2.08	15.18
14/12/15	13.06	1.80	14.86
21/12/15	13.62	2.02	15.64
28/12/15	13.44	2.00	15.44
4/1/16	14.68	2.42	17.10
11/1/16	13.98	2.14	16.12
18/1/16	14.26	2.42	16.68
25/1/16	16.28	2.80	19.08
1/2/16	16.12	2.94	19.06
8/2/16	11.51	3.70	15.21
15/2/16	12.34	1.30	13.64
22/2/16	13.02	1.46	14.48
29/2/16	12.86	1.54	14.40
Mean ± SD	**11.36 ± 5.48**	**1.77 ± 1.03**	**13.13 ± 6.38**

***AS- Active Stages (nymphs and adults)**

Table 2. Correlation between abiotic factors and yellow mite population on capsicum

Mite stages	Temperature (°C)		Relative Humidity (%)	
	Maximum	Minimum	Maximum	Minimum
Egg	-0.259	0.622*	0.508*	0.315
****AS**	-0.244	0.367	0.531*	0.414
Egg + AS	-0.162	0.568*	0.523*	0.388

*Significant at 5 per cent r = 0.495

**AS- Active Stage (nymphs and adult)

Table 3. Incidence of thrips and mealybug on capsicum under protected cultivation

Date of observations	No. of thrips per leaf			No. of mealybug per leaf		
	Top	middle	bottom	Top	middle	bottom
7/9/15	0.20	0.00	0.00	1.75	0.80	0.60
14/9/15	0.80	0.50	0.00	1.05	0.80	0.00
21/9/15	1.20	0.90	0.40	0.70	0.85	0.35
28/9/15	1.90	1.00	0.60	0.60	0.20	0.85
5/10/15	2.60	1.30	0.70	0.85	0.15	0.45
12/10/15	3.20	1.40	1.10	0.25	0.10	0.70
19/10/15	2.65	2.55	1.10	0.00	0.35	0.10
26/10/15	2.95	2.25	1.80	0.25	0.15	0.10
2/11/15	3.25	2.20	2.05	0.15	0.10	0.30
9/11/15	3.15	3.05	2.95	0.45	0.10	0.00
16/11/15	2.85	3.30	2.15	0.00	0.20	0.25
23/11/15	4.25	3.60	2.20	0.00	0.30	0.00
30/11/15	3.85	3.15	2.25	0.00	0.10	0.10
7/12/15	4.20	3.10	2.25	0.00	0.00	0.15
14/12/15	3.50	2.25	1.65	0.00	0.00	0.00
21/12/15	4.35	3.80	3.20	0.00	0.00	0.00
28/12/15	4.00	4.75	3.65	0.00	0.00	0.00
4/1/16	5.10	4.55	3.00	0.00	0.00	0.00
11/1/16	6.15	6.10	6.05	0.00	0.00	0.00
18/1/16	9.70	6.80	6.80	0.00	0.00	0.00
25/1/16	6.90	6.55	6.20	0.00	0.00	0.00
1/2/16	5.45	6.20	5.95	0.00	0.00	0.00
8/2/16	6.15	5.90	6.15	0.00	0.15	0.00
15/2/16	9.25	8.75	8.65	0.00	0.00	0.00
22/2/16	9.15	7.90	7.15	0.10	0.00	0.25
29/2/16	10.95	8.25	7.15	0.10	0.15	0.05
Mean ± SD	**8.47±2.79**	**6.16±2.52**	**4.24±2.59**	**0.24±0.43**	**0.17±0.26**	**0.16±0.24**

Table 4. Correlation between abiotic factors and incidence of thrips and mealybug on capsicum

Insect pests	Capsicum leaf	Temperature (°C)		Relative Humidity (%)	
		Maximum	Minimum	Maximum	Minimum
Thrips	Top	0.532*	-0.032	-0.622*	-0.378
	Middle	0.419	-0.090	-0.664*	-0.430
	Bottom	0.324	-0.013	-0.680*	-0.480
Mealybug	Top	0.422	0.554*	0.098	0.355
	Middle	0.254	0.524*	0.152	0.482
	Bottom	0.388	0.467	0.140	0.293

*Significant at 5 per cent r = 0.495

Table 5. Incidence of grasshopper and *Spodoptera litura* on capsicum

Date of observations	No. of individual per plant	
	Grasshopper (N+A)*	*Spodoptera* larvae
7/9/15	0.15	0.00
14/9/15	0.20	0.00
21/9/15	0.10	0.00
28/9/15	0.10	0.00
5/10/15	0.15	0.00
12/10/15	0.10	0.00
19/10/15	0.10	0.00
26/10/15	0.05	0.00
2/11/15	0.05	0.00
9/11/15	0.05	0.15
16/11/15	0.10	0.20
23/11/15	0.05	0.35
30/11/15	0.00	0.60
7/12/15	0.05	0.85
14/12/15	0.05	0.80
21/12/15	0.00	0.85
28/12/15	0.00	0.45
4/1/16	0.00	1.35
11/1/16	0.05	0.70
18/1/16	0.05	0.75
25/1/16	0.00	0.90
1/2/16	0.00	0.90
8/2/16	0.05	0.50
15/2/16	0.00	0.65
22/2/16	0.05	0.70
29/2/16	0.05	0.65
Mean ± SD	**0.06 ± 0.053**	**0.44 ± 0.40**

(N+A)*- Nymph + Adult

Table 6. Correlation between abiotic factors and incidence of grasshopper and *Spodoptera litura* on capsicum

Insect pests	Temperature (°C)		Relative Humidity (%)	
	Maximum	Minimum	Maximum	Minimum
Grasshopper	0.393	0.515*	0.285	0.545*
Spodoptera litura	-0.345	-0.706*	-0.322	-0.519*

*Significant at 5 per cent r = 0.495

Table 7. Incidence of natural enemies on capsicum under protected cultivation

Date of observations	Natural enemies	
	Spider/pl.	*Cunaxa* sp./leaf
7/9/15	0.20	0.00
14/9/15	0.10	0.00
21/9/15	0.10	0.00
28/9/15	0.15	0.00
5/10/15	0.05	0.00
12/10/15	0.05	0.25
19/10/15	0.05	0.00
26/10/15	0.05	0.20
2/11/15	0.05	0.60
9/11/15	0.05	0.35
16/11/15	0.10	0.00
23/11/15	0.00	0.80
30/11/15	0.05	0.65
7/12/15	0.10	0.45
14/12/15	0.00	0.35
21/12/15	0.05	1.25
28/12/15	0.05	0.85
4/1/16	0.00	0.90
11/1/16	0.00	0.05
18/1/16	0.00	0.20
25/1/16	0.10	0.75
1/2/16	0.05	0.25
8/2/16	0.00	0.60
15/2/16	0.00	0.45
22/2/16	0.05	0.20
29/2/16	0.00	0.60
Mean ± SD	**0.054 ± 0.05**	**0.38 ± 0.35**

*pl. – Plant

Table 8. Correlation between abiotic factors and incidence of natural enemies in capsicum

Natural enemies	Temperature (°C)		Relative Humidity (%)	
	Maximum	Minimum	Maximum	Minimum
Spider	0.209	0.429	0.103	0.358
***Cunaxa* sp.**	-0.188	0.224	0.407	0.299

*Significant at 5 per cent r = 0.495

CONCLUSION

From the study it can be concluded that three species of insect, *viz.*, thrips (Thysanoptera: Thripidae), fruit borer (Lepidoptera: Noctuidae), mealybug (Homoptera: Pseudococcidae) and grasshopper (Orthoptera), one mite species, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae). The natural enemies were predatory mite (Acari: Cunaxidae) and spiders (Arachinida) and rarely Chrysopids (Nueroptera: Chrysopidae).

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