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Sunitha ND
Associate Professor of Entomology, College of Agriculture, Vijayapura, Karnataka, India

Narasamma
Post Graduate Student, Dept. of Entomology, College of Agriculture, Vijayapura, Karnataka, India

Correspondence
Sunitha ND
Associate Professor of Entomology, College of Agriculture, Vijayapura, Karnataka, India

Ecofriendly management of thrips in capsicum under protected condition

Sunitha ND and Narasamma

Abstract

Over 35 species of insects and mites are reported as pests of capsicum among which thrips is the major pest infesting both under protected and open field conditions. The warm, humid conditions and abundant food under protected conditions provide an excellent, stable environment for pest development. Escalated public concern over extensive pesticide use and high pesticide residue levels in vegetables demanded the use of integrated pest management approaches in high pest attractive vegetable crops. In the backdrop of severity of thrips in capsicum in the recent past under protected conditions, studies were carried out during 2016 and 2017 on the management of capsicum thrips with promising insecticide molecules and solar light trap. The treatments with Solar light traps + insecticide molecules (Spinosad 45SC @ 0.1ml/l and Emamectin Benzoate 5%SG@0.25g/l) were found significantly superior over the treatments with insecticides alone. The combination of solar light traps and insecticides also resulted in significantly highest yield of capsicum, highest net returns and C:B ratio.

Keywords: Capsicum, Thrips, Ecofriendly pest management, Solar light traps

Introduction

Capsicum (*Capsicum annuu* L: family-Solanaceae), which is also known as sweet pepper, bell pepper or green pepper is one of the most popular and highly remunerative vegetable crops grown throughout the world. China, Spain, Mexico, Romania, Yugoslavia, Bulgaria, USA, India, Europe and Central and South America are the major countries of capsicum production. (Roopa 2013) [1].

In India, it is intensively cultivated in Karnataka, Maharashtra, Tamil Nadu, Himachal Pradesh and hilly areas of Uttar Pradesh. The fruits of capsicum have a variety of names depending on place and type. Common names include chilli pepper, capsicum, red and green pepper, or sweet pepper in Britain, and typically just capsicum in Australia. The colour of the bell peppers can be green, red, yellow, orange, and more rarely white, purple, blue, brown and black, depending on time of harvest and the type of cultivar. It is broadly classified into sweet and hot pepper based on the level of pungency. It is a cool season tropical crop and lacks adaptability to varied environmental conditions. It is produced in India for consumption as vegetable and also for export. It differs from hot chilli in size, fruitshape, capsicin content and usage. Nutritionally, it is rich in vitamins particularly, vitamins A and C. Hundred gram of edible portion of capsicum provides 24 k cal of energy, 1.3 g of protein, 4.3 g of carbohydrate and 0.3 g of fat (Kaur and Singh 2013) [2].

Capsicum cultivation under protected condition is gaining popularity especially coloured hybrids in peri-urban production system because of easy access to urban markets. 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.

Over 35 species of insect and mite pests are reported as pests of pepper (Sorensen, 2005) [3], According to the reports by Ananthakrishnan (1971) [4], Krishna Kumar (1995) [5], Krishna Kumar *et al.* (1996) [6], Vasicek *et al.* (2001) [7], and Eswara Reddy and Krishna Kumar (2006) [8], the thrips *Scirtothrips dorsalis* is a serious pest of chilli and sweet pepperin India. Similarly Eswara Reddy (2005) [9], reported that thrips, *S. dorsalis* is the major pest infesting sweet pepper both under protected and open field conditions. Sunitha (2007) [10], has also revealed the occurrence of aphids, thrips and mites as major pests in capsicum.

According to Sanap and Nawale (1987) [11], adults and nymphs of *S. dorsalis* suck the cell sap of leaves, causing rolling of the leaf upward and leaf size reduction. Thrips feed on new leaves and developing flowers, causing misshapen, twisted and cupped pepper leaves feeding by larvae causes scarring and discoloration in developing fruit. (http://www.seminis-us.com/resources/disease-guides/pepper-eggplant/thrips-2/)[12]

Over use of synthetic organic insecticides results in destruction of natural enemies, pest resurgence and failure of control strategies and simultaneous development of resistance against insecticides. Escalated public concern over extensive pesticide use and high pesticide residue levels in vegetables demanded the use of integrated pest management approaches in high pest attractive vegetable crops. In the backdrop of severity of thrips in capsicum in the recent past under protected conditions studies were carried out during 2016 and 2017 on the management of capsicum thrips with eco friendly pest management strategies

Materials and methods

The studies on the management of thrips in capsicum were conducted during 2016 and 2017 in Vijayapura district under protected conditions (shade net)(Fig 1). The variety under study was Indra.The experiment was conducted in randomized block design with an area of 0.25acre/treatment. First spray of insecticides was given at 45 days after transplanting when the thrips population was sufficient enough to impose the treatments. Second spray was given at 15 days interval after the first spray. Solar light traps were installed at the centre of the experimental area on the day of application of insecticides.(Fig 2) Observations on the number of thrips on two leaves each selected from top, middle and bottom portions of a plant was counted separately. The average population per six leaves was calculated and recorded one day prior to the implementation of treatments and at 3, 7 and 10 days after treatment. Percent reduction in the thrips population was calculated using formula by Henderson and Tilton (1955)[13]

$$\text{Per cent reduction in population} = 1 - \left(\frac{TaxCb}{TbxCa}\right) x\ 100$$

Where,

Ta= Number of insect after treatment in treated plot

Tb= Number of insect before treatment in treated plot

Ca= Number of insect in untreated check after treatment

Cb= Number of insect in untreated check before treatment

The analysis of variance was computed after subjecting the data in to angular transformation. Yield of capsicum fruits was recorded at each picking and finally yield/acre was worked out. C:B ratio was worked out by considering annual management expenditures incurred in management of one acre area of capsicum field under protected condition other than insecticides, cost of insecticides, cost of solar light trap and market selling price of capsicum fruits.

Results and Discussion

Effect of various treatments on thrips in capsicum under net house is presented in table (1). Data represents pooled values of first and second spray given during each trial.

Trial 1(2016)

Significant difference was not found between the various treatments at 1 day before treatment. At 2 days after treatment the treatments consisting of Solar light trap + Spinosad 45 SC @ 0.1 ml / lit and Solar light trap + Emamectin Benzoate 5% SG @0.25gm/ lit were found significantly superior and on par by recording 80.18 and 80.75% reduction in thrips respectively. The treatment Spinosad 45 SC 0.1 ml/lit and Emamectin Benzoate 5% SG @ 0.25gm/lit were found next best treatments and on par by recording 72.30 and 71.00% reduction in thrips population respectively. Solar light trap alone was found significantly superior over UTC and recorded 62.5% reduction in thrips population. Same trend was observed at 5 days after treatment and 10 days after treatment

Trial 2(2017)

At 1 day before treatment no significant difference was found among various treatments in thrips population. At 2 days after treatment thrips population recorded showed significant difference between the various treatments. Solar light trap combined with Spinosad 45 SC @ 0.1 ml/lit and Emamectin Benzoate 5% SG @ 0.25gm/lit were found significantly superior over other treatments and recorded 77.15 and 76.00 percent reduction in thrips population respectively. Spinosad @ 0.1ml/lit alone recorded 64.45% reduction and was found on par with Emamectin Benzoate 5% SG @ 0.25 gm/lit which recorded 67.15% reduction in thrips population.The trend was similar at 5 days after treatment also.The treatment in which Solar light trap were combined with insecticides were found significantly superior over Solar trap alone and insecticides without solar trap. At 10 days after treatment the treatment with solar trap + Spinosad 45 SC @ 0.1ml/ lit and Solar trap + Emamectin Benzoate 5% SG @ 0.25gm /lit recorded 98.10 and 96.85% reduction in pest population respectively and were at par and significantly superior over all other treatments. Spinosad 45 SC @ 0.1ml/lit and Emamectin Benzoate 5% SG @ 0.25gm /lit recorded 82.55 and 79.35 % reduction in thrips population respectively and were found at par with solar trap alone. (72.25%). Untreated check recorded 0.95% reduction in thrips population.

Yield of Capsicum

The pooled data of 2 years trial on yield of grapes as affected by various treatments is presented in table 2.Significant difference was recorded between all the treatments. Significantly highest yield of 29011.25 kg /acre was recorded in treatment solar trap+ Spinosad 45 SC @ 0.1ml /lit Solar light trap + Emamectin Benzoate 5%SG @ 0.25 gm/lit recorded 28358.75kg/acre. The next best treatment only Emamectin Benzoate 5%SG @ 0.25 gm/lit (24525.13kg/ha) which was found significantly superior to Spinosad 45 SC @ 0.1ml /l(22911.68kg/ha).Solar light trap was found significantly superior over UTC and recorded 18689.25kg/acre. UTC recorded significantly lowest yield of 10685.25kg/ha.

Cost benefit ratio

The data on C:B ratio obtained in the present study is presented in Table3. Cost effectiveness of each treatment was analyzed based on net returns. Among the different treatments Solar light trap+ Spinosad 45SC@ 0.1ml/lit registered the maximum net return (Rs 670681.25). This was followed by Solar light trap+ Emamectin Benzoate 45%SG@0.25gm/lit(Rs 654158.75), Emamectin Benzoate

5%SG @0.25gm/lit(562318.25), Spinosad 45SC@0.1ml/lit(522202.00).Solar light trap alone registered net returns of Rs 413231.25 which is twice as that of UTC(Rs 217131.25). C:B ratio was highest in Solar light trap+ Spinosad 45SC@ 0.1ml/lit(12.28).This was followed by Solar light trap+ Emamectin Benzoate @0.25gm/lit(11.93), EmamectinBenzoate5%SG@0.25gm/lit(11.06),Spinosad 45SC@ 0.1ml(10.32). Solar light trap alone registered C:B ratio of Rs 7.65 which is followed by UTC(4.34).

Table1: Efficacy of various treatments on thrips in Capsicum under net house

		Trial 1				Trial 2			
	Treatments	**No of thrips /6 leaves**	**Percent reduction in thrips population (I and II Spray pooled)**			**No of thrips /6 leaves**	**Percent reduction in thrips population (I and II Spray pooled)**		
		1DBT	**2DAT**	**5DAT**	**10DAT**	**1DBT**	**2DAT**	**5DAT**	**10DAT**
1	Solar light trap	46.00	62.5 (52.24)	65.38 (53.91)	66.50 (54.63)	36.00	61.00 (51.35)	66.50 (54.63)	72.25 (58.18)
2	Solar light trap + Spinosad 45SC(0.1ml/lit)	46.00	80.18 (63.51)	83.13 (65.73)	93.50 (75.23)	39.00	77.15 (61.41)	87.60 (69.38)	98.10 (82.08)
3	Solar light trap+Emamectin Benzoate 5%SG(0.25gm/lit	44.00	80.75 (63.94)	81.25 (64.30)	93.43 (75.11)	34.00	76.00 (60.67)	88.75 (70.45)	96.85 (79.86)
4	Spinosad 45SC(0.1ml/lit)	45.00	72.30 (58.24)	73.50 (59.02)	78.70 (62.50)	36.00	64.45 (53.43)	77.75 (61.82)	82.55 (65.27)
5	Emamectin Benzoate 5%SG(0.25gm/lit	45.00	71.00 (57.42)	71.38 (57.00)	79.85 (63.29)	38.00	67.15 (55.06)	77.53 (61.68)	79.35 (62.94)
6	UTC	42.00	0.10 (1.81)	0.10 (1.81)	1.05 (5.74)	39.00	0.10 (1.81)	0.95 (5.44)	0.95 (5.44)
	CD (0.05%)	NS	6.49	6.86	10.38	NS	5.09	8.93	10.02
	Sem±		2.16	2.28	3.46		1.69	2.97	3.34

Figures in the parentheses are arc sine transformed values

Table 2: Yield of Capsicum under various treatments under net house

Sl. No.	Treatments	Yield (kg/Acre) Trial 1	Yield (kg/Acre) Trial 2	Yield (kg/Acre) Pooled
1	Solar light trap	18839.00e	18539.50e	18689.25
2	Solar light trap+Spinosad 45SC(0.1ml/lit)	29100.00a	28922.50a	29011.25
3	Solar light trap+Emamectin Benzoate 45%SG(0.25gm/lit	26781.25b	27936.25	28358.75
4	Spinosad 45SC(0.1ml/lit)	22974.18d	22849.18d	22911.68
5	Emamectin Benzoate 5%SG(0.25gm/lit)	24587.63c	24462.63c	24525.13
6	UTC	10760.25f	10610.25f	10685.25
	CD (0.05%)	890.39	987.79	991.30
	Sem±	296.99	329.48	334.70

Table 3: Returns and C:B ratio under various treatments of capsicum thrips management.

Sl. No.	Treatments	Gross returns(Rs/acre)	Net returns (Rs/acre)	C:B ratio
1	Solar light trap	467231.25	413231.25	7.65
2	Solar light trap+Spinosad 45SC(0.1ml/lit)	725281.25	670681.25	12.28
3	Solar light trap+Emamectin Benzoate 45%SG(0.25gm/lit)	708968.75	654158.75	11.93
4	Spinosad 45SC(0.1ml/lit)	572792.00	522202.00	10.32
5	Emamectin Benzoate 5%SG(0.25gm/lit)	613128.25	562318.25	11.06
6	UTC	267131.25	217131.25	4.34

Fig 1: View of Experimental plot

Fig 2: Solar light trap in the experimental plot

The efficacy of insecticides studied in the present experiment is reported by many authors in green chilli and capsicum and the present results are in agreement with the reports by Roopa (2013) [1] who reported that lowest populations, highest per cent reduction of *S. dorsalis* was recorded with the treatment Spinosad 45 SC @ 0.01% in capsicum and it also resulted in maximum fruit yield (30,050 kg/ha) followed by Fipronil (27750 kg/ha), Imidacloprid (27150 kg/ha) and Emamectin benzoate (27000 kg/ha). Similarly Vanisree *et al.* (2017) [14] reported that Spinosad 0.015% was found most effective in reducing the population of *S.dorsalis* as well as in increasing yields in chilli and it attains highest cost benefit ratio.

The reports on use of solar light traps under protected conditions are scanty and discussion is made in comparison with available reports on solar light traps.

The results of present study on the use of solar light traps are in agreement with reports of Reddy *et al.* (2015) [15] who reported that the pest control with LED lights could effectively reduce the dosage of pesticides as well as their pollution on the agricultural products, soil and water. The solar LED light is easy to use and can be applied to various crops. During the day, energy from the solar panels will be stored in the storage batteries at night, the electrical energy from the battery could drive circuit of LED light to control pests. Similarly Sunitha and Rajasekhar (2015) [16] studied the effect of solar light trap in capsicum under net condition and reported that on an average number of insects trapped ranged between 600-700 /night which included whiteflies, thrips, hoppers, termites, cutworms and fruit borers and number of insecticides are reduced from 3 to 1/week and by 70.00%.Along with reduction in number of sprays, it also resulted in the conservation of many natural enemies. Prabhu (2016) [17] reported that solar powered insect trap captures many sucking pests thereby reducing the dependence on biopesticdes usage to the tune of 50%. It is perhaps the most environment friendly practice as the source of light for trapping insects is sun and device operates automatically turning on the light during dusk (6.00-7.00pm) and turns it off after five hours using a micro controller chip.

Though insecticides are found be the most promising tools of insect pest management, there is a need to integrate other safe methods of pest management to overcome the ill effects of insecticides. Insect light traps are the most widely used visual traps for the agricultural insect pests, and have been particularly important in surveillance and monitoring of the seasonal appearance of many species. Reducing and controlling the pest population using light traps is an age old practice in crop sector. Solar light traps can be used alone or integrated with other tools of IPM especially under protected conditions. The result of present experiments conclusively revealed that Solar light trap+ Spinosad 45SC@ 0.1ml/lit and Solar light trap+ Emamectin Benzoate@0.25gm/lit can be effectively used in the management of thrips in capsicum under protected conditions.

Conclusion

The adoption of IPM is practically low because the method is tedious, time consuming, requires new skills. The failure and complexities of practical IPM systems, particularly monitoring and determination of crop loss and economic thresholds by small and marginal farmers discourages the adoption of the IPM approach and again encourage over reliance on the use of pesticides. In this regard solar traps can be a boon for farming community. Solar trap catches all types of insects like flying adults and young ones belonging to various taxa of insects which cause various types of damages to crop plants. This trap is solar chargeable, with automatic timer device turn on by sunset and turn off after few hours continuous operation. It is portable across the various cropping areas including shade houses and other protected cultivation areas without any changes with no major mounting or installation efforts required and easy to operate. Also no electricity and manpower required to operate once installed in the field. Though initial investment appear to be heavy for some models, in long run it is economical, helps to reduce the number of pesticide sprays and thereby cost of production. Above all it is ecofriendly. Hence they can be incorporated in IPM practices.

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