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EFFICACY OF INSECTICIDAL SPRAY SCHEDULES AGAINST SUCKING INSECT PESTS ON CHILLI

Laxman Singh Saini[1]*, H P Meghwal[1], B K Patidar[1], and M S Meena[1]

[1]Department of Entomology, College of Agriculture, Ummedganj-Kota, Agriculture University, Borkhera, Kota 324001, Rajasthan, India
*Email: sainilaxman22x@gmail.com (corresponding author): ORCID ID 0000-0001-8787-5894

ABSTRACT

A field experiment was conducted at the research farm, Agricultural Research Station, Department of Entomology, College of Agriculture, Ummedganj, Agriculture University, Kota during rabi 2020-21. Bioefficacy of selected insecticides was evaluated against sucking insect pests viz., aphid *(Aphis gossypii* Glover), whitefly (*Bemisia tabaci* Gennadius) and mite (*Polyphagotarsonemus latus* Bank) on chilli (*Capsicum annuum* L.). This study revealed that, among the treatments tested, the combination of insecticides as per spray schedule, treatment T_1 (acetamiprid 20 SP @ 100 g/ ha + ethion 50 EC @ 1500 ml/ ha followed by imidacloprid 17.8 SL @ 125 ml/ ha + propargite 57 EC @ 1500 ml/ ha followed by buprofezin 25 SC @ 300 ml/ ha + fenazaquine 10 EC @ 1250 ml/ ha followed by fipronil 5 SC @ 1000 ml/ ha + spiromesifen 240 SC @ 400 ml/ha followed by chlorantraniliprole 18.5 SC @ 150 ml/ ha) was found significantly most effective against aphid, whitefly and mite population up to 15 days after treatment.

Key words: Chilli, sucking insect pests, whitefly, aphid, mite, insecticides, efficacy, treatment, spray schedule

Chilli *Capsicum annuum* is an important solanaceous vegetable crop. India is the largest producer, consumer, and exporter of chilli. The major chilli-growing states in India are Andhra Pradesh, Maharashtra, Karnataka, Orissa, Gujarat, and Tamil Nadu, (Anonymous, 2021). In Rajasthan, the chilli cultivation area spans to 8.06 thousand hectares, with a productivity of 1.66 mt/ ha (Anonymous, 2018). There are number of factors responsible for reduced yield of chilli but incidence of insect pests is one of the major bottlenecks. The major sap-sucking insect pests that affect chilli are aphids (*Aphis gossypii* Glover), whiteflies (*Bemisia tabaci* Gennadius) and mites (*Polyphagotarsonemus latus* Banks). These pests can cause yield losses ranging from 50 to 90% (Nelson and Natarajan, 1994). The overall reduction in fruit yield of chilli due to thrips and mites damage is up to 34 % (Butani, 1976). Farmers often use pesticides and this has several drawbacks, including residues. To mitigate these IPM strategies that regulate insect populations are to be adopted. The present study was carried out to generate information on the effectiveness of selected insecticides and their cost-effectiveness.

MATERIALS AND METHODS

The field experiment was conducted at the Agricultural Research Station, Ummedganj, Agriculture University- Kota (Rajasthan) during rabi 2020-21. Randomized block design with three replications with plot size of 5.0 x 3.0 m was followed. Seeds of variety "US 611" were sown in a well-prepared nursery tray during the first week of September 2020 in a shade net house located at the Department of Horticulture, College of Agriculture, Ummedganj-Kota. Forty-three days old chili seedlings were transplanted to the main fields at 60 x 45 cm during October. All recommended agronomic practices were followed for transplanting the seedlings, except for plant protection. Upon the appearance of pests, the first spray was applied. Four additional sprays were administered using a manually operated knapsack sprayer equipped with a hollow cone nozzle. Observations on the incidence of *A. gossypii*, *B. tabaci* and *P. latus* were made by selecting five plants randomly from the net plot area of each plot and tagging them. From each tagged plant, the number of nymphs and adults in the case of aphids, and adults in the case of whiteflies and mites, were counted using three tender leaves. The observations were made at various time points, including one day before each spray application, as well as 3, 7, 10, and 15 days after each spray. The combination of insecticides used include: T_1 (acetamiprid 20 SP @ 100 g/ ha + ethion 50 EC @ 1500 ml/ ha in 1st spray, imidacloprid 17.8 SL @ 125 ml/ ha + propargite 57 EC @ 1500 ml/ ha in 2nd spray, buprofezin 25 SC @ 300 ml/ ha + fenazaquine 10 EC @ 1250 ml/ha in 3rd spray, fipronil 5 SC @ 1000 ml/ ha + spiromesifen 240 SC @ 400 ml/ ha in 4th spray and chlorantraniliprole 18.5 SC @ 150 ml/ ha in 5th spray), T_2 (imidacloprid 17.8 SL @ 125 ml/ ha + propargite 57 EC @ 1500 ml/ ha in 1st spray, buprofezin 25 SC @ 300 ml/ ha + fenazaquine 10 EC @ 1250 ml/ha in 2nd spray, fipronil 5 SC @ 1000 ml/ ha + spiromesifen 240 SC @ 400 ml/ ha in 3rd spray, chlorantraniliprole 18.5 SC @ 150 ml/ha in 4th spray and acetamiprid 20 SP @ 100 g/ha + ethion 50 EC @ 1500 ml/ ha in 5th spray), T_3 (buprofezin 25 SC @ 300 ml/ha + fenazaquine 10 EC @ 1250 ml/ ha in 1st spray, fipronil 5 SC @ 1000 ml/ha + spiromesifen 240 SC @ 400 ml/ ha in 2nd spray, chlorantraniliprole 18.5 SC @ 150 ml/ha in 3rd spray, acetamiprid 20 SP @ 100 g/ ha + ethion 50 EC @ 1500 ml/ ha in 4th spray and imidacloprid 17.8 SL @ 125 ml/ ha + propargite 57 EC @ 1500 ml/ha in 5th spray), T_4 (fipronil 5 SC @ 1000 ml/ ha + spiromesifen 240 SC @ 400 ml/ha in 1st spray, chlorantraniliprole 18.5 SC @ 150 ml/ha in 2nd spray, acetamiprid 20 SP @ 100 g/ha + ethion 50 EC @ 1500 ml/ha in 3rd spray, imidacloprid 17.8 SL @ 125 ml/ha + propargite 57 EC @ 1500 ml/ha in 4th spray and buprofezin 25 SC @ 300 ml/ ha + fenazaquine 10 EC @ 1250 ml/ ha in 5th spray), T_5 (chlorantraniliprole 18.5 SC @ 150 ml/ ha in 1st spray, acetamiprid 20 SP @ 100 g/ ha + ethion 50 EC @ 1500 ml/ ha in 2nd spray, imidacloprid 17.8 SL @ 125 ml/ ha + propargite 57 EC @ 1500 ml/ ha in 3rd spray, buprofezin 25 SC @ 300 ml/ ha + fenazaquine 10 EC @ 1250 ml/ ha in 4th spray and fipronil 5 SC @ 1000 ml/ ha + spiromesifen 240 SC @ 400 ml/ ha in 5th spray), T_6 (acetamiprid 20 SP @ 100 g/ ha in 1st spray, ethion 50 EC @ 1500 ml/ ha in 2nd spray, imidacloprid 17.8 SL @ 125 ml/ ha in 3rd spray, buprofezin 25 SC @ 300 ml/ ha in 4th spray and fipronil 5 SC @ 1000 ml/ ha in 5th), T_7 (imidacloprid 17.8 SL @ 125 ml/ ha in 1st spray, propargite 57 EC @ 1500 ml/ ha in 2nd spray, fenazaquine 10 EC @ 1250 ml/ ha in 3rd spray, spiromesifen 240 SC @ 400 ml/ ha in 4th spray and chlorantraniliprole 18.5 SC @ 150 ml/ha in 5th spray). The fruit yield was recorded picking wise from each plot. The data thus obtained for sucking insect pests were analyzed by adopting square root transformation before statistical analysis.

RESULTS AND DISCUSSION

Pooled data of five sprays are presented in Table 1. All the insecticide treatments were found significantly superior up to 15 days of treatment in reducing *B.tabaci* compared to control (4.63 whitefly/ 3 leaves). Among the insecticide treatments, T_1 was found most effective with minimum whitefly incidence (1.77 whitefly/ 3 leaves) in which acetamiprid 20 SP @ 100 g/ ha + ethion 50 EC @ 1500 ml/ ha in 1st spray, imidacloprid 17.8 SL @ 125 ml/ha + propargite 57 EC @ 1500 ml/ha in 2nd spray, buprofezin 25 SC @ 300 ml/ha + fenazaquine 10 EC @ 1250 ml/ ha in 3rd spray, fipronil 5 SC @ 1000 ml/ ha + spiromesifen 240 SC @ 400 ml/ ha in 4th spray and chlorantraniliprole 18.5 SC @ 150 ml/ ha in 5th spray was applied followed by T_2 (1.79 whitefly/3 leaves) followed by T_3 (1.81 whitefly/ 3 leaves) followed by T_4 (2.04 whitefly/3 leaves) followed by T_5 (2.05 whitefly/ 3 leaves followed by T_6 (2.21 whitefly/ 3 leaves) followed by T_7 was found least effective. The treatment T_1 was found most effective against *B. tabaci*. The present results are corroborated with the finding of Sangle et al. (2017) on imidacloprid 17.8 SL @ 0.005%, acetamiprid 20 SP 0.00 4% and triazophos 40 EC @ 0.04%.

In the case of *A. gossypii*, the results indicate that all the insecticide treatments were significantly effective up to 15 days after treatment. Among the different treatments, T_1 was found to be the most effective, resulting in the lowest *A. gossypii* population (1.87 aphids/ 3 leaves). The insecticides used in T_1 were acetamiprid 20 SP @ 100 g/ha + ethion 50 EC @ 1500 ml/ ha in the 1st spray, imidacloprid 17.8 SL @ 125 ml/ ha + propargite 57 EC @ 1500 ml/ha in the 2nd spray, buprofezin 25 SC @ 300 ml/ha + fenazaquine 10 EC @ 1250 ml/ha in the 3rd spray, fipronil 5 SC @ 1000 ml/ ha + spiromesifen 240 SC @ 400 ml/ha in the 4th spray and chlorantraniliprole 18.5 SC @ 150 ml/ha in the 5th spray were applied. The findings of this study are consistent with previous research by Sutnga et al. (2018) on imidacloprid 17.8 SL and thiacloprid 21.7 SC. Varghese and Mathew (2012) also found high toxicity of thiamethoxam 25 WG @ 40 g *a.i.*/ ha, acetamiprid 20 SP @ 20 g *a.i.*/ ha and imidacloprid 17.8 SL @ 17.8 g *a.i.*/ ha.

For *P. latus*, similar results were observed and the most effective treatment was T_1. This treatment T_1 included acetamiprid 20 SP and ethion 50 EC in the first spray, imidacloprid 17.8 SL and propargite 57 EC in the second spray, buprofezin 25 SC and fenazaquine 10 EC in the third spray, fipronil 5 SC and spiromesifen 240 SC in the fourth spray and chlorantraniliprole 18.5 SC in the fifth spray were applied. Present results are supported by Varghese and Mathew (2013) on spiromesifen 45 SC @ 100 g *a.i.*/ha and propargite 57 EC @ 570 g *a.i.*/ ha. Mehta and Raghuraman (2019) also found that the propargite 42% + hexithiazox 2% EC @ 567 + 27 g *a.i.*/ha showed maximum mortility. Sontakke and Mohapatra (2014) found that the buprofezin 25SC was the most effective in checking *P. latus*.

Table 1. Efficacy of insecticide spray schedules against sucking insect pests in chilli (rabi 2020-21)

Treatment	whitefly/ 3 leaves (pooled of five spray)					aphid/ 3 leaves (pooled of five spray)					mite/ 3 leaves (pooled of five spray)				
	PTP	3 DAT	7 DAT	10 DAT	15 DAT	PTP	3 DAT	7 DAT	10 DAT	15 DAT	PTP	3 DAT	7 DAT	10 DAT	15 DAT
T_1	3.27 (1.92)*	1.25 (1.31)	1.45 (1.38)	1.61 (1.44)	1.77 (1.49)	4.50 (2.20)*	1.23 (1.31)	1.44 (1.38)	1.61 (1.45)	1.87 (1.53)	1.53 (1.39)*	0.20 (0.82)	0.25 (0.85)	0.29 (0.87)	0.39 (0.92)
T_2	3.30 (1.92)	1.28 (1.30)	1.48 (1.37)	1.63 (1.42)	1.79 (1.48)	4.43 (2.18)	1.29 (1.31)	1.56 (1.40)	1.71 (1.45)	1.96 (1.54)	1.53 (1.39)	0.23 (0.84)	0.29 (0.87)	0.35 (0.90)	0.43 (0.94)
T_3	3.30 (1.93)	1.35 (1.29)	1.49 (1.35)	1.64 (1.40)	1.81 (1.47)	4.27 (2.15)	1.35 (1.30)	1.60 (1.38)	1.75 (1.44)	2.00 (1.53)	1.47 (1.38)	0.25 (0.86)	0.31 (0.88)	0.36 (0.92)	0.44 (0.95)
T_4	3.43 (1.97)	1.45 (1.37)	1.64 (1.43)	1.83 (1.49)	2.04 (1.56)	4.50 (2.20)	1.52 (1.39)	1.83 (1.49)	2.01 (1.54)	2.29 (1.62)	1.63 (1.43)	0.31 (0.88)	0.36 (0.91)	0.41 (0.94)	0.52 (0.99)
T_5	3.47 (1.97)	1.49 (1.38)	1.67 (1.45)	1.84 (1.50)	2.05 (1.56)	4.53 (2.20)	1.56 (1.40)	1.85 (1.49)	2.03 (1.55)	2.31 (1.63)	1.50 (1.39)	0.31 (0.88)	0.36 (0.91)	0.41 (0.94)	0.53 (0.99)
T_6	3.23 (1.92)	1.63 (1.44)	1.80 (1.50)	1.99 (1.56)	2.21 (1.62)	4.47 (2.19)	1.64 (1.44)	1.95 (1.55)	2.25 (1.63)	2.53 (1.71)	1.53 (1.40)	0.45 (0.96)	0.53 (1.00)	0.60 (1.03)	0.69 (1.07)
T_7	3.40 (1.96)	2.00 (1.56)	2.17 (1.62)	2.39 (1.68)	2.69 (1.76)	4.30 (2.15)	2.23 (1.63)	2.51 (1.71)	2.67 (1.76)	3.03 (1.86)	1.57 (1.40)	0.37 (0.92)	0.44 (0.95)	0.48 (0.97)	0.56 (1.01)
T_8	3.43 (1.97)	4.36 (2.19)	4.51 (2.22)	4.59 (2.24)	4.63 (2.25)	4.53 (2.20)	5.96 (2.50)	6.12 (2.53)	6.16 (2.54)	6.08 (2.54)	1.63 (1.41)	1.71 (1.42)	1.77 (1.44)	1.83 (1.46)	1.88 (1.47)
S. Em±	-	0.026	0.026	0.027	0.027	-	0.025	0.027	0.029	0.026	-	0.017	0.019	0.017	0.019
C.D (p= 0.05)	NS	0.072	0.072	0.076	0.077	NS	0.070	0.077	0.081	0.073	NS	0.049	0.054	0.049	0.052

PTP= Pretreatment; DAT= Day After Treatment; *Figures in parentheses transformed value

S. No.	Treatment	Green chilli fruit yield (q/ ha)	Additional yield over control (q/ ha)	Avoidable yield loss %	Additional gross return (Rs/ ha)	Cost of insecticides (Rs/ ha)	ICBR	Additional net return (Rs/ ha)
1	T_1	96.00	41.33	43.06	103334	16082	5.43	87252
2	T_2	91.11	36.44	40.00	91112	16082	4.67	75030
3	T_3	88.44	33.78	38.19	84445	16082	4.25	68363
4	T_4	84.44	29.78	35.26	74445	16082	3.63	58363
5	T_5	75.56	20.89	27.65	52222	16082	2.25	36140
6	T_6	66.89	12.22	18.27	30556	3928	6.78	26628
7	T_7	61.11	6.44	10.55	16111	12304	0.31	3807
8	Control	54.67	-	-	-	-	-	-
	S. Em±	2.877						
	C. D. (p= 0.05)	8.725						

Sale price of green chilli fruit= Rs. 2500/quintal

Data in Table 1 reveal significantly higher yield of green chilli fruits with insecticide treatments. Maximum yield of green chilli fruit (96.00 q/ ha) was recorded in the treatment of T_1 followed by T_2 (91.11 q/ ha), T_3 (88.44 q/ha), T_4 (84.44 q/ha), T_5 (75.56 q/ha), T_6 (66.89 q/ha). Present results are supported by Randhawa et al. (2020) on chlorantraniliprole 18.5 SC and spinosad 45 SC. Samota et al. (2017) found that the highest fruit yield of 105.11 q/ ha was recorded with imidacloprid followed by thiamethoxam 25 WG, acetamiprid 17.8 SL, dimethoate 30 EC / oxydemeton methyl 25 EC and fipronil 5 SC. Data on economics revealed that the higher additional yield over control (41.33 q/ ha), avoidable yield loss (43.06 %), additional gross return (Rs 103334/ ha) and additional net return (Rs 87252/ ha) was obtained with higher incremental cost benefit ratio (ICBR) over net return was found in the treatment of T_6 (6.78) followed by T_1 (5.43), T_2 (4.67), T_3 (4.25), T_4 (3.63), T_5 (2.25) and T_7 (0.31). The present study's findings are consistent with those of Sangle et al. (2017) found that the highest incremental cost benefit ratio (1:23.17) was registered in imidacloprid. Sahu and Kumar (2018) found the best and most economical treatment was fipronil 5 SC @ 2 ml/l (1:7.30). Vanisree et al. (2017) found that the highest CBR (cost benefit ratio) 1: 2.22 was recorded in spinosad.

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AUTHOR CONTRIBUTION STATEMENT

L S Saini wrote the manuscript in supervision and consultation with H P Meghwal; Review and editing of manuscript (H P Meghwal and B K Patidar and M S Meena). Allocation of treatment (H P Meghwal), Helped me in statistical analysis of my researched data (M S Meena and H P Meghwal).

CONFLICT OF INTEREST

No conflict of interest.

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