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Bio-efficacy of insecticides against aphids infesting chilli

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Abstract
The field experiment was carried out to evaluate of bio-efficacy of insecticides against aphids infesting chilli during *rabi* season of 2016-17 at Central Experimental Station, Wakawali, Dist- Ratnagiri. During this experiment total seven insecticides tested *viz*., acetamiprid 20 SP @ 0.004, dimethoate 30 EC @ 0.6, emamectin benzoate 5 SG @ 0.002, imidacloprid 17.8 SL @ 0.004, lambda cyhalothrin 5 EC @ 0.018, spinosad 45 SC @ 0.014 and thiamethoxam 25 WG @ 0.01 percent, respectively. The results regarding overall mean of three sprays against aphids revealed that treatment thiamethoxam 25 WG @ 0.01 percent recorded (5.03) and was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (5.32). All the above treatments were found superior to untreated control.

Keywords: Bio- efficacy, aphids, chilli, insecticides

Introduction
Chilli (*Capsicum annuum* L.), also called hot pepper, chile pepper, chilli pepper, paprika and aji, is a member of nightshade family, Solanaceae. It is grown in both tropical and subtropical areas all over India. It is one of the important spice and vegetable crop. Chilli pods are used for culinary purposes as fresh green or dried. It is eaten raw in salad, cooked as a vegetable, pickled or used for flavouring different dishes. (Anon., 2013) [1].

Besides several factors responsible for low productivity and quality deterioration of chilli the damage caused by insect pests is the most important. Berke and Shieh, (2000) [2] revealed that during the Asian Vegetable Research and Development Center (AVRDC) surveys in Asia, aphid, *Myzus persicae* Sulzer and *Aphis gossypii* Glover, yellow mite, *Polyphagotarsonemus latus* (Banks) and thrips, *Scirtothrips dorsalis* Hood are the major insect pests attack on chilli. Over 35 species of insect and mite are reported as pests of pepper which includes thrips, aphids, whiteflies, fruit borers, cutworms, plant bug, mites and other minor pests (Sorensen, 2005)[6]. Unlike many of the field problems, insect pest problems are peculiar to poly house/green house/shade net cultivation. Thrips *S. dorsalis*, mite *P. latus*, aphid *Myzus persicae* (Sulz.), whitefly *Bemisia tabaci* (Gennadius), leaf miner *Liriomyza trifolii* (Burgess), gall midge *Asphondylia capsici* Barens and nematodes *Meloidogyne incognita* Chitwood are serious problems on capsicum under protected condition (Kaur *et al*., 2010) [3].

Aphid is a polyphagous pest it occurs on many hosts plants and play vital role in transmitting diseases in cultivated crops. Due to mono culture of chilli over a period of time, the pest buildup of *A. gossypii* has increased enormously and the farmers are resorting to a minimum of 5 - 6 chemical sprays. In addition to this the increased pesticide sprays become a threat to chilli ecosystem causing resurgence of pests and menace to natural enemies. Pesticide residues in chilli are also of great concern for domestic consumption and exports as well. Keeping in view the present investigation has been carried out suitable, effective, feasible and economical plant protection measures against chilli aphid was undertaken.

Materials and methods
A field experiment was conducted during *rabi* season of 2016-17 to study the effectiveness of some insecticides against aphids infesting chilli (cv. Konkan kirti). The details of experiment are given in below

Cultural operations

The land was prepared as per the requirements of cucumber crop and cleared by removing the residues of the previous crop. The experiment was laid out in Randomized Block Design (RBD). The recommended dose of fertilizers for cucumber is 100:50:50 N:P:K kg ha^{-1}. Nitrogen @ 100 kg ha^{-1} was applied in three splits doses *viz*., first dose of 50 percent N at the time of transplanting, second dose of 50 percent N during flowering and fruiting stage. Phosphorus was applied @ 50 kg ha^{-1} and potassium was applied @ 50 kg ha^{-1}, these fertilizers were applied in a single dose at the time of transplanting.

The experimental area was sown with good seed of chilli (cv. Konkan kirti) in each plot. The transplanting of seedlings was done forty days after sowing. The other agronomic operations *viz.*, intercultural operations and weeding were done as per recommendation.

Details of the field experiment

1	**Location**	**:**	**Central Experimental Station, Wakawali, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist- Ratnagiri**
2	Variety	:	Konkan kirti
3	Spacing	:	60 cm × 60 cm
4	Total plot size	:	190.08 m^2
5	Size of treatment plot	:	6.6 m × 1.2 m
6	Date of transplanting	:	26th December, 2016
7	Method of planting	:	On raised bed
8	Design	:	Randomized Block Design (RBD)
9	Number of treatment	:	Eight
10	Number of replication	:	Three
Treatment Details:			
No.	**Insecticides**		**Concentration (%)**
T_1	Acetamiprid 20 SP		0.004
T_2	Dimethoate 30 EC		0.6
T_3	Emamectin benzoate 5 SG		0.002
T_4	Imidacloprid 17.8 SL		0.004
T_5	Lambda cyhalothrin 5 EC		0.018
T_6	Emamectin benzoate 5 SG		0.002
T_7	Thiamethoxam 25 WG		0.01
T_8	Untreated Control		-

Spraying

The quantity of spray suspension required for each treatment was calibrated by spraying water over three plots in the experiment prior to the application of insecticide. Spray suspension of desired strength of each insecticide was prepared against aphids in the field.

The insecticides were sprayed thrice. First spray of each insecticide was applied when incidence was noticed, while remaining two sprays were given at an interval of 15 days with manually operated knapsack sprayer. The observations were recorded in each treatment on randomly selected five plants.

Method of recording observations

An observation on the number of aphids was recorded on five randomly selected plants per plot. Numbers of aphids were recorded from three leaves top, middle and bottom of the plant. The populations of aphids before spraying as precount and on third, seventh, tenth and fourteenth days after each spray were recorded in the early morning hours. The data thus obtained were converted into square root transformation and then statistically analysed.

Results and Discussion

Efficacy of insecticides against aphids (*A. gossypii*) infesting chilli

1. Efficacy of some insecticides against aphids (*A. gossypii*) infesting chilli recorded at different intervals after first spray

The data pertaining to the efficacy of different insecticides against thrips infesting chilli at 3, 7, 10 and 14 days after spray are represented in Table 1.

The data on mean population of aphids prior to insecticide application ranges from 11.12 to 11.37. There is no significant difference among the different treatments since uniform distribution of thrips in different treatments.

The observations recorded at third day after spraying of insecticide treatment thiamethoxam 25 WG @ 0.01percent (9.78) which was at par with treatments acetamiprid 20 SP @ 0.004 percent (9.87), imidacloprid 17.8 SL @ 0.004 percent (9.88) and spinosad 45 SC @ 0.014 percent (10.07). The treatments *viz.*, emamectin benzoate 5 SG @ 0.002 percent (10.49), dimethoate 30 EC @ 0.6 percent (10.68) and lambda cyhalothrin 5 EC @ 0.018 percent (10.79).The maximum (11.18) aphids population was found in untreated control.

At the seventh day after first spray the minimum aphid population recorded in the treatment thiamethoxam 25 WG @ 0.01percent (9.51) was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (9.77).The aphid population in treatment acetamiprid 20 SP @ 0.004 percent (10.05) was at par with treatment spinosad 45 SC @ 0.014 percent (10.12). The remaining treatment emamectin benzoate 5 SG @ 0.002 percent (10.47), dimethoate 30 EC @ 0.6 percent (10.57) and lambda cyhalothrin 5 EC @ 0.018 percent (10.70). The maximum (11.22) aphid population was noticed in untreated control.

The observations recorded at 10th day after first spray revealed that the minimum pest population in the treatment with thiamethoxam 25 WG @ 0.01 percent (9.60) which was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (9.79) and acetamiprid 20 SP @ 0.004 percent (9.97). The aphid population in remaining treatments were spinosad 45 SC @ 0.014 percent, dimethoate 30 EC @ 0.6 percent, emamectin benzoate 5 SG @ 0.002 percent and lambda cyhalothrin 5 EC @ 0.018 percent as follows 10.31, 10.50,

10.53 and 10.70, respectively. The maximum (11.15) pest population was recorded in untreated plot.

At 14th day of observation, the minimum pest population was recorded in thiamethoxam 25 WG @ 0.01percent (9.67) which was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (9.90). The treatment acetamiprid 20 SP @ 0.004 percent (10.06) was at par with treatment spinosad 45 SC @ 0.014 percent (10.12). The remaining treatments were emamectin benzoate 5 SG @ 0.002 percent (10.68), lambda cyhalothrin 5 EC @ 0.018 percent (10.85) and dimethoate30 EC @ 0.6 percent (10.86). Untreated plot maximum aphid population (11.09) was recorded.

2. Efficacy of some insecticides against aphids (*A. gossypii*) recorded at different intervals after second spray

The results on effect of second spray are presented in Table 1. The observations recorded at third day after second spray indicated that minimum aphid population in the treatment thiamethoxam 25 WG @ 0.01percent (8.38) was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (8.69). The pest population in remaining treatments were acetamiprid 20 SP @ 0.004 percent (9.17), spinosad 45 SC @ 0.014 percent (9.62), emamectin benzoate 5 SG @ 0.002 percent recorded (10.08), dimethoate 30 EC @ 0.6 percent recorded (10.17) and lambda cyhalothrin 5 EC @ 0.018 percent (10.37). The maximum (10.75) mean aphid population per three leaves per plant was noticed in untreated control.

At 7th day after second spray, the minimum pest population was recorded in the treatment thiamethoxam 25 WG @ 0.01percent (6.83) followed by treatment acetamiprid 20 SP @ 0.004 percent (7.26) which was at par with each other. The remaining treatments *viz.*, imidacloprid 17.8 SL @ 0.004 percent (7.58), spinosad 45 SC @ 0.014 percent (8.83), emamectin benzoate 5 SG @ 0.002 percent recorded (9.27), dimethoate 30 EC @ 0.6 percent recorded (9.28) and lambda cyhalothrin 5 EC @ 0.018 percent (9.52) aphids per three leaves per plant, while maximum (10.27) aphid population was observed in untreated control.

The observations recorded at 10th day after second spray revealed that minimum population in the treatment thiamethoxam 25 WG @ 0.01 percent (2.73) at par with treatment imidacloprid 17.8 SL @ 0.004 percent (3.03). The treatments were acetamiprid 20 SP @ 0.004 percent (3.82) which was at par with treatment spinosad 45 SC @ 0.014 percent (3.95). The treatment emamectin benzoate 5 SG @ 0.002 percent recorded (4.93) at par with treatment dimethoate 30 EC @ 0.6 percent recorded (5.02) and lambda cyhalothrin 5 EC @ 0.018 recorded percent (5.20). The maximum aphid population (8.37) recorded in untreated control.

At 14th day of observation, the minimum aphid population was recorded in thiamethoxam 25 WG @ 0.01 percent (2.96) was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (3.06). The treatment acetamiprid 20 SP @ 0.004 percent and spinosad 45 SC @ 0.014 percent was at par with each other. The remaining treatments dimethoate 30 EC @ 0.6 percent recorded, emamectin benzoate 5 SG @ 0.002 percent recorded and lambda cyhalothrin 5 EC @ 0.018 percent recorded pest population 3.90, 3.91, 5.00, 5.03 and 5.03, respectively and at par with each other. The maximum population observed 6.29 in untreated control.

3. Efficacy of some insecticides against aphids (*A. gossypii*) infesting chilli recorded at different intervals after third spray

The results on effect of third spray are presented in Table 1. After 3 days of third spray, the treatment thiamethoxam 25 WG @ 0.01 percent was found significantly superior to rest of treatments which recorded (0.53) mean aphid population per three leaves per plant. The treatment imidacloprid 17.8 SL @ 0.004 percent recorded (1.47) and was at par with acetamiprid 20 SP@ 0.004 percent (1.72).The remaining treatments were spinosad 45 SC @ 0.014 percent (2.14), emamectin benzoate 5 SG @ 0.002 percent recorded (3.00), dimethoate 30 EC @ 0.6 percent recorded (3.38) and lambda cyhalothrin 5 EC @ 0.018 recorded percent (3.69), respectively. The highest aphid population was noticed in untreated control (5.87).

The data at 7th day of third spray indicated that thiamethoxam 25WG @ 0.01 percent recorded 0.12 pest population and was significantly superior over rest of the treatments. The treatment imidacloprid 17.8 SL @ 0.004 percent recorded (0.49) and was at par with acetamiprid 20 SP @ 0.004 percent (0.70). The remaining treatments were in descending order spinosad 45 SC @ 0.014 percent (1.45), emamectin benzoate 5 SG @ 0.002 percent recorded (2.02), lambda cyhalothrin 5 EC @ 0.018 recorded percent (2.20) and dimethoate 30 EC @ 0.6 percent recorded (2.44). The maximum aphid population was recorded 5.49 in untreated control.

The observations recorded at 10th day after third spray revealed that no pest population in treatment thiamethoxam 25 WG @ 0.01 percent and was at par with treatments imidacloprid 17.8 SL @ 0.004 percent recorded (0.08) and acetamiprid 20 SP @ 0.004 percent (0.15). The remaining treatments were spinosad45 SC @ 0.014 percent (0.78), emamectin benzoate 5 SG @ 0.002 percent recorded (0.93), dimethoate 30 EC @ 0.6 percent recorded (1.00) and lambda cyhalothrin 5 EC @ 0.018 recorded percent (1.47). Untreated plot recorded highest (4.32) mean aphid population per three leaves per plant.

At 14th day of observation, the no pest population was recorded in treatment thiamethoxam 25 WG @ 0.01 percent and imidacloprid 17.8 SL @ 0.004 percent recorded and followed by acetamiprid 20 SP @ 0.004 percent (0.07). The remaining treatments were spinosad 45 SC @ 0.014 percent (0.23), emamectin benzoate 5 SG @ 0.002 percent recorded (1.00), dimethoate 30 EC @ 0.6 percent recorded (1.08) and lambda cyhalothrin 5 EC @ 0.018 recorded percent (1.38) while untreated control recorded maximum aphid population (3.92).

4. Overall mean of different insecticides against aphids (*A. gossypii*) infesting chilli

The data pertaining to the overall efficacy of different insecticides against aphids (*A. gossypii*) infesting chilli presented in Table 1.

The results regarding overall mean of all sprays revealed that treatment thiamethoxam 25 WG @ 0.01 percent recorded (5.03) and was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (5.32). The next treatments in descending order of effectiveness were acetamiprid 20 SP @ 0.004 percent recorded (5.54), spinosad 45 SC @ 0.014 percent (6.01), emamectin benzoate 5 SG @ 0.002 percent recorded (6.56), dimethoate 30 EC @ 0.6 percent recorded (6.70) and lambda cyhalothrin 5 EC @ 0.018 recorded percent (6.84) mean pest population, respectively. All the above treatments were found to be superior over untreated control which recorded highest aphid population (8.33).

Present finding are in agreement with Kumar *et al.* (2015) [4] tested six insecticides, spirotetramat 120 + imidacloprid 120-240 SC @ 90 g + 90 g a.i. ha^{-1} caused maximum reduction of aphids at 5 and 10 days after each spray. Patel *et al*. (2017) [5] observed eight treatments best and most economical treatment was spinosad 0.2 ml l^{-1} (1:11.55) followed by imidacloprid 0.5 ml l^{-1} (1:10.53), cypermethrin 1.8 ml l^{-1} (1:9.14), dimethoate 1.6 ml l^{-1} (1:8.3), neem oil 2.5 ml l^{-1} (1:7.79), NSKE 5% (1:7.02) and garlic sap+ extract 10 g l^{-1} (1:5.67), as compared to control (1:3.37).

Conclusion

From the present investigation, it can be concluded that the overall mean of all sprays revealed that treatment thiamethoxam 25 WG @ 0.01 percent recorded (5.03) and was at par with treatment imidacloprid 17.8 SL @ 0.004 percent (5.32). The next treatments in descending order of effectiveness were acetamiprid 20 SP @ 0.004 percent recorded (5.54), spinosad 45 SC @ 0.014 percent (6.01), emamectin benzoate 5 SG @ 0.002 percent recorded (6.56), dimethoate 30 EC @ 0.6 percent recorded (6.70) and lambda cyhalothrin 5 EC @ 0.018 recorded percent (6.84) mean pest population, respectively. All the above treatments were found to be superior over untreated control which recorded highest aphid population (8.33).

Table 1: Efficacy of different insecticides against aphid (*A. gossypii)* infesting chilli

Treatment	Pre count	Mean population of aphid per 3 leaves per plant												Overall mean
		Ist spray				IInd spray				IIIrd spray				
		3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	
T_1	11.13 (3.48)*	9.87 (3.30)	10.05 (3.32)	9.97 (3.31)	10.06 (3.33)	9.60 (3.26)	7.26 (2.87)	3.82 (2.19)	3.90 (2.21)	1.72 (1.65)	0.70 (1.30)	0.15 (1.07)	0.07 (1.03)	5.54 (2.56)
T_2	11.21 (3.49)	10.68 (3.42)	10.57 (3.40)	10.50 (3.39)	10.86 (3.44)	10.40 (3.38)	9.52 (3.24)	5.02 (2.45)	5.00 (2.45)	3.38 (2.09)	2.44 (1.85)	1.00 (1.41)	1.08 (1.44)	6.70 (2.77)
T_3	11.12 (3.48)	10.49 (3.39)	10.47 (3.39)	10.53 (3.40)	10.68 (3.42)	10.28 (3.36)	9.33 (3.21)	4.93 (2.43)	5.03 (2.46)	3.00 (2.00)	2.02 (1.74)	0.93 (1.39)	1.00 (1.41)	6.56 (2.75)
T_4	11.25 (3.50)	9.88 (3.30)	9.77 (3.28)	9.79 (3.28)	9.90 (3.30)	8.78 (3.13)	7.58 (2.93)	3.03 (2.01)	3.06 (2.01)	1.47 (1.57)	0.49 (1.22)	0.08 (1.04)	0.00 (1.00)	5.32 (2.51)
T_5	11.32 (3.51)	10.79 (3.43)	10.70 (3.42)	10.81 (3.44)	10.89 (3.45)	10.43 (3.38)	9.52 (3.24)	5.20 (2.49)	5.03 (2.46)	3.69 (2.16)	2.20 (1.79)	1.47 (1.57)	1.38 (1.54)	6.84 (2.80)
T_6	11.22 (3.50)	10.07 (3.28)	10.12 (3.33)	10.31 (3.36)	10.12 (3.34)	9.95 (3.31)	9.07 (3.17)	3.95 (2.22)	3.91 (2.22)	2.14 (1.77)	1.45 (1.56)	0.78 (1.33)	0.23 (1.11)	6.01 (2.65)
T_7	11.37 (3.52)	9.78 (3.49)	9.51 (3.24)	9.60 (3.26)	9.67 (3.27)	8.62 (3.10)	6.83 (2.80)	2.73 (1.93)	2.96 (1.99)	0.53 (1.23)	0.12 (1.06)	0.00 (1.00)	0.00 (1.00)	5.03 (2.46)
T_8	11.20 (3.49)	11.18 (3.49)	11.22 (3.50)	11.15 (3.49)	11.09 (3.48)	10.75 (3.43)	10.27 (3.36)	8.37 (3.06)	6.29 (2.70)	5.87 (2.62)	5.49 (2.55)	4.32 (2.30)	3.92 (2.22)	8.33 (3.05)
SE (m±)	0.05	0.02	0.01	0.02	0.01	0.03	0.03	0.03	0.01	0.04	0.03	0.03	0.02	0.02
CD at 0.05%	NS	0.05	0.04	0.06	0.03	0.09	0.10	0.10	0.04	0.13	0.10	0.09	0.06	0.07

*Figures in parenthesis are $\sqrt{X+1}$ values (DAS- Days After Spraying)

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