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COMPARATIVE EVALUATION OF NOVEL INSECTICIDES AGAINST APHID (*APHIS GOSSYPII* GLOVER) ON CAPSICUM UNDER SHADE NET HOUSE

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ABSTRACT

Field experiments were conducted under shade net house at Hi-Tech Horticulture farm, Rajasthan Agricultural Research Institute (Sri Karan Narendra Agriculture University, Jobner) Durgapura, Jaipur, (Rajasthan) to study the bio-efficacy of new insecticide molecules against the aphid (*Aphis gossypii* Glover) on capsicum during summer 2014 and 2015. Among the insecticides evaluated, imidacloprid 17.8 SL (0.0058%) was the most effective treatment recording highest (79.91%) reduction of aphid population, followed by fipronil 5 SG (0.005%) with 76.32 per cent reduction, acephate 0.075 per cent (69.56%) and emamectin benzoate 0.002 per cent (66.55%); whereas, NSKE (5%) and novaluron (0.01%) recorded the lowest reduction of aphids, being 40.7 and 43.0 per cent, respectively.

Key Words: Capsicum, novel insecticide, aphid

INTRODUCTION

Capsicum is one of the most popular and highly remunerative vegetable crops grown in most parts of the world. China, Spain, Mexico, Romania, Yugoslavia, Bulgaria, USA, India, Europe, Central and South America are the major countries producing capsicum. In India, capsicum, also known as sweet pepper, bell pepper, green pepper or *Shimla mirch*, is extensively cultivated in Andhra Pradesh, Karnataka, Maharashtra, Tamilnadu, Himachal Pradesh, and hilly areas of Uttar Pradesh. It is a cool season crop but can be grown round the year using protected structures**.** In the world, the area and production of capsicum (bell pepper) is merged with that of hot peppers. Annual world production in the year 2010-2011 amounted to 29.9 million tons from an area of 1.9 million ha. India's contribution was estimated to be 65.9 thousand ton from an area of 7,700 thousand hectares with productivity of 8.6 tones/ha. (Anon., 2013).

Protected cultivation of crops provides protection from adverse environmental conditions (Sood *et al*., 2015); however, the protected environment also provides stable and congenial micro-climate favorable for the multiplication of insect pests, which in turn becomes a limiting factor for successful crop production (Kaur *et al.,* 2010). 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. Mites, thrips, whitefly, leaf miner, aphids, gall midge and nematodes are serious problems on vegetable crops under protected conditions. The productivity of capsicum is very low due to several limiting factors. Among them, insect pests cause severe losses. Capsicum is attacked by several insect and mite pests from seedling to fruiting stage. About 35 species of insect and mite pests have been reported (Vos and Frinking 1998, Sorenson 2005, Berke *et al*., 2003). Sunitha (2007) revealed the occurrence of aphids, thrips and mites as major pests in capsicum. Gupta *et al.,* (2016) reported chilli aphid as important pest infesting capsicum under shade net house in Rajasthan. Meena *et al.,* (2013) reported the aphid as important pest infesting chilli in Rajasthan. 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. However, in other related crops like chilli, the reported significant yield losses range from 50-90 per cent due to insect pests. No sincere attempt has been made in the past to evaluate novel insecticides against aphid (*Aphis gossypii* Glover) on capsicum under shade net house in Rajasthan. Considering the economic

importance of pest, the study was conducted to test the efficacy of bio-rationales and newer insecticide molecules against aphid under shade net house conditions.

MATERIALS AND METHODS

The field trials were conducted under shade net house at Hi-Tech Horticulture farm, Rajasthan Agriculture Research Institute (Sri Karan Narendra Agriculture University, Jobner) Durgapura, Jaipur, (Rajasthan) during summer 2014 and 2015. The experiment was laid out in a Randomized Block Design with 12 treatments and three replications including untreated check. Thirty day old seedlings of capsicum variety PSO 26 were transplanted in each treatment with the plot size 3.5 X 1.0 m, keeping row to row and plant to plant distance of 0.50 m and 0.40 m. Eleven bio-rationales and newer pesticides *viz.*, spiromesifen 22.9 SC @ 1 ml/l, emamectin benzoate 5 SG @ 0.4gm/l, acephate 75 SP @ 1 gm/l, indoxacarb 14.5 SC @ 0.8ml/l, propargite 57 EC @ 2 ml/l, fipronil 5 SC @ 1 ml/l, novaluron 10 EC 1 ml/l , imidacloprid 17.8 SL @ 0.33 ml/l, azadirachtin 0.15 EC @ 2 ml/l NSKE 5% and spinosad 45 SC 0.3 ml/l were evaluated for the management of the aphid. Two sprays were given, the first when sufficient pest built-up was recorded and the second 20 days later. Treatments were imposed by using pre-calibrated Knapsack sprayer @ 500-550 liters of spray solution per hectare depending on stage of the crop. Care was taken to check the drift of insecticides by putting polythene sheet screen around each plot at the time of spraying. The population of aphids (nymphs and adults) was recorded one day before spraying and 1, 3, 7, and 15 days after each spray. The aphids were counted on five randomly selected tagged plants per plot, using magnifier lens on three leaves representing upper, middle and bottom portion of each tagged plant and the number was recorded as aphids per three leaves. The per cent reduction in the population of aphids were worked out and then transformed to arcsine values and the data were pooled and subjected to ANOVA for 2014 and 2015 separately. The percentage reduction in population was calculated using formula given by Henderson and Tilton (1955) which is modification of Abbott's (1925) formula.

Per cent reduction in population = $\{1-(T_a \times C_b / T_b \times C_a) 100\}$

Where,

T_a= Number of insect after treatment in treated plot

T_b= Number of insect before treatment in treated plot

C_a= Number of insect in untreated check after treatment

C_b= Number of insect in untreated check before treatment

RESULTS AND DISCUSSION

Eleven bio-rationales and newer pesticides (spiromesifen, propargite, fipronil, emamectin benzoate, acephate, indoxacarb, novaluron, imidacloprid, spinosad, azadirachtin and NSKE) were evaluated against the aphids (*Aphis gossypii* Glover) on capsicum under shade net house conditions. The treatments had a significant effect on the population reduction of aphids over that in untreated control during both the years. The data on percentage mortality obtained after each spray are summarized in Tables 1, 2 and the pooled data for two years in Table 3. The trend of relative efficacy of various treatments has been described below on the basis of pooled data.

The observations on population reduction of *Aphis gossypii* recorded one day after first spray revealed that imidacloprid at 0.0058 per cent showed significantly the highest reduction (77.43 %). The treatment of fipronil at 0.005 per cent showed effective reduction of aphid population (70.80%); whereas, propergite 57 EC at 0.114 per cent and NSKE 5 per cent recorded significantly the lowest population reduction of 27.31 and 27.63 per cent, respectively. In second application imidacloprid at 0.0058 per cent was again most effective (70.79% population reduction) followed by fipronil at 0.005 per cent (70.00%); whereas, NSKE 5 per cent recorded significantly the lowest reduction of 29.50 per cent. Earlier, Varghese and Mathew (2012) also reported that imidacloprid proved highly toxic to chilli aphid one day after application.

After three days of first application, imidacloprid at 0.0058 per cent resulted in highest population reduction (90.01%) of the aphids. The treatment of fipronil at 0.005 per cent and acephate at 0.075 per cent recorded effective reduction of aphids 85.73 and 85.44 per cent, respectively; whereas, NSKE 5 per cent recorded significantly the lowest (45.60%) population reduction. In second application, the most effective reduction was recorded in plots treated with imidacloprid at 0.0058 per cent followed by fipronil at 0.005 per cent; however, acephate at 0.075 per cent was at par with fipronil at 0.005 per cent. The present findings are in agreement with that of Varghese and Mathew (2012), who reported that imidacloprid to be highly toxic to chilli aphid, three days after insecticidal application.

After seven days of first application, imidacloprid at 0.0058 per cent caused the maximum reduction in aphid population (86.34%), followed by fipronil at 0.005 per cent. The treatment of acephate at 0.075 per cent also showed effective reduction of aphids (81.90%). In second application imidacloprid at 0.0058 per cent was most effective (83.72 % population reduction). The treatments fipronil at 0.005 per cent, acephate at 0.075

Table 1. Comparative efficacy of bio-rationales and newer pesticides against aphid, *Aphis gosspii* on capsicum during 2014

S.No.	Treatments	Conc.(%)	Mean reduction (%) in aphid population days after							
			First spray				Second spray			
			1DAS	3DAS	7DAS	15 DAS	1DAS	3DAS	7DAS	15 DAS
1	Spiromesifen 22.9 SC	0.0229	28.78 (32.43)*	62.44 (52.20)	60.51 (51.07)	47.06 (43.31)	39.08 (38.69)	56.67 (48.84)	61.98 (51.94)	47.53 (43.58)
2	Emamectin benzoate 5SG	0.002	58.68 (50.00)	73.35 (58.94)	74.89 (59.97)	63.00 (52.69)	51.26 (45.73)	74.69 (59.90)	76.12 (61.41)	68.22 (55.79)
3	Acephate 75 SP	0.075	63.54 (52.86)	86.06 (68.08)	81.24 (64.33)	64.76 (53.96)	52.58 (46.48)	80.49 (63.94)	75.65 (60.44)	58.76 (50.05)
4	Indoxacarb 14.5 SC	0.0116	46.66 (43.08)	73.13 (58.80)	72.96 (58.67)	55.49 (48.31)	36.69 (37.26)	58.12 (49.70)	62.53 (52.28)	52.69 (46.55)
5	Propargite 57 EC	0.114	29.31 (32.77)	61.85 (51.86)	56.23 (48.58)	43.47 (41.19)	32.17 (34.55)	49.53 (44.73)	54.16 (47.39)	43.97 (41.53)
6	Fipronil 5 SC	0.005	72.78 (58.62)	88.02 (69.80)	85.98 (68.02)	67.24 (55.72)	71.56 (57.77)	86.16 (68.34)	78.57 (62.90)	70.10 (57.03)
7	Novaluron 10 EC	0.01	29.57 (32.93)	47.40 (43.43)	48.28 (43.92)	49.76 (44.87)	32.82 (34.95)	47.92 (43.79)	48.40 (44.08)	34.16 (35.76)
8	Imidacloprid 17.8 SL	0.0058	77.93 (61.99)	91.69 (73.32)	87.37 (69.18)	71.83 (58.53)	71.43 (57.69)	88.42 (70.69)	83.39 (66.05)	71.47 (57.89)
9	Azadirachtin 0.15%	0.0003	30.76 (33.68)	47.73 (43.70)	55.35 (48.07)	43.80 (41.39)	37.54 (37.78)	46.90 (43.22)	54.70 (47.70)	40.15 (39.29)
10	NSKE(self-prepared)	5	27.64 (31.70)	45.00 (42.13)	50.30 (45.17)	40.84 (39.70)	32.48 (34.74)	46.36 (42.91)	48.85 (44.34)	39.98 (39.22)
11	Spinosad 45 SC	0.0135	32.44 (34.70)	62.43 (52.20)	69.28 (56.36)	55.67 (48.35)	36.33 (36.78)	63.75 (52.98)	61.81 (51.83)	53.79 (47.19)
12	Untreated check		0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SEm±		0.97	1.51	1.65	1.88	1.65	2.00	2.18	2.15
	CD(P=0.05		2.85	4.43	4.85	5.52	4.85	5.87	6.41	6.31
	CV %		4.34	5.11	5.61	7.41	7.43	6.05	7.69	8.71

* Figures in parentheses are arc sin transformed values. DAS: Days after spray

Table 2. Comparative efficacy of bio-rationales and newer pesticides against aphid, *Aphis gosspii* on capsicum during 2015

S.No.	Treatments	Conc.(%)	Mean reduction (%) in aphid population days after							
			First spray				Second spray			
			1DAS	3DAS	7DAS	15 DAS	1DAS	3DAS	7DAS	15 DAS
1	Spiromesifen 22.9 SC	0.0229	28.70 (32.37)*	60.10 (50.84)	54.13 (47.37)	44.3 (41.7)	36.15 (36.91)	54.10 (47.36)	63.49 (52.84)	46.14 (42.76)
2	Emamectin benzoate 5SG	0.002	56.49 (48.74)	69.48 (56.57)	73.55 (59.12)	60.7 (51.3)	47.16 (43.34)	73.24 (58.88)	73.45 (59.53)	70.51 (57.2)
3	Acephate 75 SP	0.075	57.88 (49.53)	84.82 (67.1)	82.55 (65.39)	61.7 (51.8)	47.21 (43.4)	83.00 (65.65)	76.62 (61.09)	56.02 (48.46)
4	Indoxacarb 14.5 SC	0.0116	40.57 (39.54)	66.59 (54.76)	69.17 (56.32)	51.7 (46)	32.22 (34.59)	56.75 (48.88)	64.03 (53.17)	49.58 (44.75)
5	Propargite57 EC	0.114	25.30 (30.19)	55.56 (48.21)	52.59 (46.49)	42.3 (40.5)	27.99 (31.88)	51.99 (46.14)	55.99 (48.44)	42.44 (40.63)
6	Fipronil 5 SC	0.005	68.81 (56.06)	83.44 (66.25)	81.13 (64.59)	65.8 (54.3)	68.44 (55.84)	84.55 (66.99)	76.15 (60.81)	72.41 (58.44)
7	Novaluron 10 EC	0.01	29.36 (32.80)	54.88 (47.80)	56.85 (48.96)	49.9 (45)	28.88 (32.49)	45.65 (42.5)	50.46 (45.27)	33.86 (35.57)
8	Imidacloprid 17.8 SL	0.0058	76.92 (61.54)	88.32 (70.07)	85.31 (67.52)	68.1 (55.7)	70.14 (57)	88.51 (70.23)	84.04 (66.55)	73.69 (59.27)
9	Azadirachtin 0.15%	0.0003	28.42 (32.17)	48.43 (44.10)	54.89 (47.81)	38.5 (38.4)	33.53 (35.36)	44.61 (41.9)	56.51 (48.74)	38.76 (38.49)
10	NSKE (self-prepared)	5	27.61 (31.66)	46.20 (42.82)	49.97 (44.99)	37.8 (37.9)	26.51 (30.99)	42.30 (40.57)	50.89 (45.51)	38.39 (38.27)
11	Spinosad 45 SC	0.0135	32.34 (34.62)	59.91 (50.72)	66.06 (54.38)	50.0 (45)	33.05 (35.08)	63.14 (52.64)	63.33 (52.73)	45.92 (42.64)
12	Untreated check		0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SEm±		1.62	1.33	1.64	1.4	1.41	1.26	1.54	2.13
	CD(P=0.05		4.75	3.9	4.81	4.11	4.14	3.71	4.52	6.25
	CV%		7.50	4.61	5.65	5.73	6.72	4.51	5.38	8.75

* Figures in parentheses are arc sin transformed values. DAS: Days after spray

Table 3. Comparative efficacy of bio-rationales and newer pesticides against aphid, *Aphis gossipii* on capsicum (pooled of 2014 &2015)

S.No.	Treatments	Conc.(%)	Mean reduction (%) in aphid population days after							
			First spray				Second spray			
			1DAS	3DAS	7DAS	15 DAS	1DAS	3DAS	7DAS	15 DAS
1	Spiromesifen 22.9 SC	0.0229	28.74 (32.40)*	61.27 (51.52)	57.32 (49.22)	45.68 (42.51)	37.62 (37.8)	55.39 (48.1)	62.74 (52.39)	46.84 (43.17)
2	Emamectin benzoate 5SG	0.002	57.59 (49.37)	71.42 (57.76)	74.22 (59.55)	61.85 (52)	49.21 (44.54)	73.97 (59.39)	74.79 (60.47)	69.37 (56.5)
3	Acephate 75 SP	0.075	60.71 (51.2)	85.44 (67.59)	81.90 (64.86)	63.23 (52.88)	49.90 (44.94)	81.75 (64.8)	76.14 (60.77)	57.39 (49.26)
4	Indoxacarb 14.5 SC	0.0116	43.62 (41.31)	69.86 (56.78)	71.07 (57.5)	53.60 (47.16)	34.46 (35.93)	57.44 (49.29)	63.28 (52.73)	51.14 (45.65)
5	Propargite 57 EC	0.114	27.31 (31.48)	58.71 (50.04)	54.41 (47.54)	42.89 (40.85)	30.08 (33.22)	50.76 (45.44)	55.08 (47.92)	43.21 (41.08)
6	Fipronil 5 SC	0.005	70.80 (57.34)	85.73 (68.03)	83.56 (66.31)	66.52 (55.01)	70.00 (56.81)	85.36 (67.67)	77.36 (61.86)	71.26 (57.74)
7	Novaluron 10 EC	0.01	29.47 (32.87)	51.14 (45.62)	52.57 (46.44)	49.83 (44.94)	30.85 (33.72)	46.79 (43.15)	49.43 (44.68)	34.01 (35.67)
8	Imidacloprid 17.8 SL	0.0058	77.43 (61.77)	90.01 (71.7)	86.34 (68.35)	69.97 (57.12)	70.79 (57.35)	88.47 (70.46)	83.72 (66.3)	72.58 (58.58)
9	Azadirachtin 0.15%	0.0003	29.59 (32.93)	48.08 (43.9)	55.12 (47.94)	41.15 (39.9)	35.54 (36.57)	45.76 (42.56)	55.61 (48.22)	39.46 (38.89)
10	NSKE(self-prepared)	5	27.63 (31.68)	45.60 (42.48)	50.14 (45.08)	39.32 (38.8)	29.50 (32.87)	44.33 (41.74)	49.87 (44.93)	39.19 (38.75)
11	Spinosad 45 SC	0.0135	32.39 (34.66)	61.17 (51.46)	67.67 (55.37)	52.84 (46.68)	34.69 (35.93)	63.45 (52.81)	62.57 (52.28)	49.86 (44.92)
12	Untreated check		0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SEm±		0.94	1.01	1.16	1.17	1.09	1.18	1.34	1.51
	CD(P=0.05		2.69	2.87	3.32	3.34	3.1	3.37	3.81	4.32
	CV%		5.86	4.82	5.54	6.47	6.85	5.86	6.51	8.48

* Figures in parentheses are arc sin transformed values. DAS: Days after spray

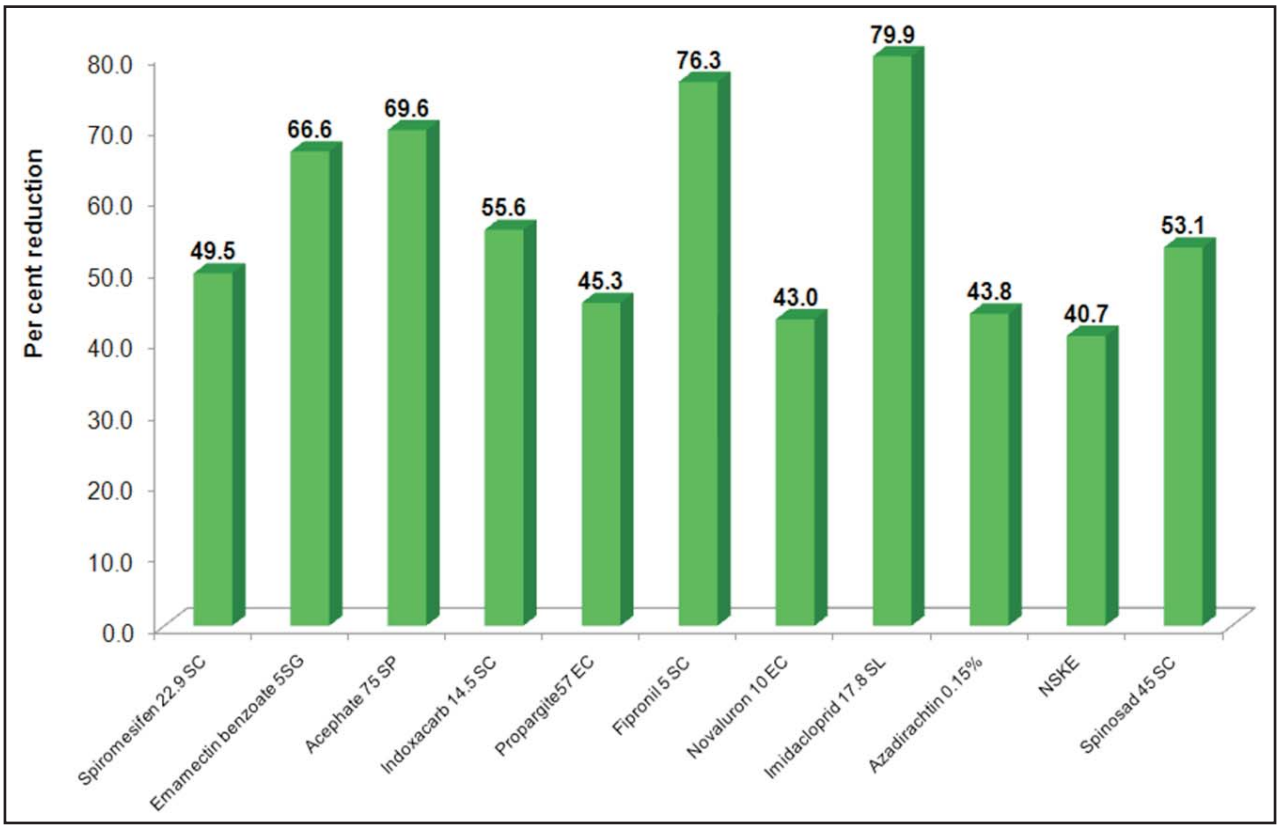

Fig. 1: Over all efficacy of bio-rationales and newer pesticides against aphid

per cent and emamectin benzoate at 0.002 per cent were also effective; whereas, NSKE 5 per cent recorded significantly the lowest population reduction of 49.87 per cent.

The observations on *Aphis gossypii* recorded 15days after first spray revealed that imidacloprid at 0.0058 per cent showed significantly the highest reduction (72.58 %) followed by fipronil at 0.005 per cent. In second application, the maximum reduction was also recorded in the plot treated with imidacloprid (0.0058%), followed by fipronil (0.005%) and emamectin benzoate at 0.002 per cent.

On the basis of pooled and overall efficacy (Fig.1) the maximum reduction in aphid population was recorded in the plots treated with imidacloprid at 0.0058% (79.91%), followed by fipronil at 0.005% (76.32%), acephate at 0.075% (69.56%) and emamectin benzoate at 0.002% (66.55%). Among the other treatments, indoxacarb 14.5 SC and spinosad 0.135 per cent remained next best treatment with 55.6 and 53.1 per cent reduction, respectively; whereas, NSKE 5 per cent and novaluron 0.01 per cent recorded the lowest reduction of aphids 40.7 and 43.0 per cent, respectively. The present findings are in agreement to that of Elbert *et al*. (1991) and Veire *et al.* (1999), who reported maximum reduction of aphids by imidacloprid. The work of Awasthi *et al*. (2013) also supports the present finding wherein imidacloprid and acephate were observed effective and toxic to aphids. The work of Patil *et al*. (2009c) is in conformity with present findings that fipronil is most effective against aphid.

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