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RESEARCH **P**APER

Bio-efficacy of insecticides against aphid (*Aphis craccivora* Koch) infesting cowpea [*Vigna ungiculata* (L.) Walp.]

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Eleven different insecticides were evaluated for their efficacy against *A. craccivora* at Regional Horticulture Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat during *Rabi* season of the year 2013-2014. The treatment imidacloprid 0.005 per cent (0.19 aphid index/plant) was found to be most effective followed by thiamethoxam 0.01 per cent (0.33 aphid index/plant). *Verticillium lecanii* 0.40 per cent (0.58 aphid index/plant), azadirachtin 0.002 per cent (0.62 aphid index/plant) and dimethoate 0.03 per cent (0.77 aphid index/plant) were the next in order. The highest marketable pod yield (30.37 q/ha) and maximum per cent increase in pod yield of cowpea over control (84.28 %) was recorded from the plots treated with thiamethoxam 25 WG @ 0.01 per cent.

Key words : Bio-efficacy, Imidacloprid, Cowpea, Aphids

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INTRODUCTION

Cowpea [*Vigna ungiculata* (L.) Walp.] belonging to family Leguminaceae is one of the principal pulse crops of the tropics. Cowpea grain contains 23.4 per cent protein, 18 per cent fat, 60.3 per cent carbohydrates (Singh, 1983). It is also a major source of energy, minerals, vitamins and roughages. In Gujarat, cowpea (grain legume) is cultivated in about 23,600 ha with an annual production of 19,900 tones and average productivity of 845 kg/ha (Anonymous, 1997) whereas, vegetable purpose cowpea occupies an area of 6937 ha with an annual production of 42432 tones (Anonymous, 2004). Among the constraints responsible for low yield of important pulse crops, the loss due to insect pests is considered to be an important. As many as 21 insect pests of different groups were observed on cowpea during summer and *Kharif* seasons (Sardana and Verma, 1986). The sap sucking insects like aphids (*A. craccivora* Koch) cause significant damage to the crop and is reported as one of the important, major and economic pest of cowpea (El-Ghareeb *et al*., 2002). The aphid causes both qualitative and quantitative losses in the seed yield and crop production by different ways include: nutrient drain which cause direct reduction of plant productivity, transmission of viruses, phytotoxicity as a result of saliva toxins and excretion of honey dew leading to the development of black sooty mold and leaf shedding (Kotadia and Bhalani, 1992) which also attract saprophytic fungi covering the leaf surface and accelerating the ageing of leaves (Schepers, 1988). A virus "Rosette" is known to be transmitted by the aphid, *A. craccivora* in cowpea (Atwal, 1976). Controlling aphid in cowpea is very important to increase the quality and quantity of the products. Therefore, the present study was undertaken to understand the bio-efficacy of some newer insecticides, bio-pesticide and neem product for evolving an effective control schedule on cowpea aphid. This work will help to

optimize crop yield and quality of cowpea and also will be helpful to the farmers for managing the population of aphids efficiently in cowpea.

RESEARCH METHODOLOGY

Field experiments were conducted with cowpea cultivar (Pusa Phalguni) at Regional Horticulture Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat to evaluate the bio-efficacy of some insecticides against aphid (*A. craccivora*). The experiment was conducted in a Randomized Block Design (RBD) with twelve treatments and three replications. The treatments were imposed when the pests crossed the economic threshold level (ETL). Two sprays were given with a pneumatic knapsack sprayer with a spray fluid volume of 500 lit. ha^{-1}. The pre and post treatment observations on 1, 3, 7 and 15 days were recorded on the incidence of aphids. Population of aphid was recorded after following aphid index: leaves, flowers and pods on selected plants and the degree of infestation level was recorded and categorized as 0, 1, 2, 3 and 4 according to visual and inspection counts from five plants per plot selected at random leaving border rows. The pod yield of cowpea per plot was recorded and expressed in q ha^{-1}. The economics of various treatments was also worked out.

RESEARCH FINDINGS AND ANALYSIS

The differences in population of aphid recorded before spraying was found to be non-significant among different treatments which indicated that the infestation of aphid was in homogenous condition.

After first spraying :

The perusal of data (Table 1) recorded on first day after first spraying indicated that the aphid index on plants was significantly reduced by different insecticidal treatments as compared to control (water spray). Among different insecticidal treatments imidacloprid 0.005 per cent (0.08 aphid index/plant) was found most effective treatment and it was at par with thiamethoxam 0.01 per cent (0.15 aphid index/plant). *V. lecanii* 0.40 per cent (0.35 aphid index/plant), azadirachtin 0.003 per cent (0.42 aphid index/plant), dimethoate 0.03 per cent (0.42 aphid index/plant), acephate 0.075 per cent (1.02aphid index/plant) and chlorfenapyr 0.015 per cent (1.15 aphid index/plant) were next effective treatments. Fipronil 0.01 per cent, cartap hydrochloride 0.05 per cent, ethion 0.05 per cent and diafenthiuron 0.05 per cent recorded 1.35, 1.35, 1.48 and 1.75 aphid index/plant, respectively and were found less effective. Higher number of aphid index/plant was observed in control (4.15 aphid index/plant). A similar trend was observed on 3, 7 and 15 DAT.

Table 1: Effect of insecticides against *A. craccivora* on cowpea after 1st spraying

Treat. No.	Treatments	Dose (%)	Aphid index				
			Before spraying	1 DAS	3 DAS	7 DAS	15 DAS
1.	Imidacloprid	0.005	3.5333	0.08	0.20	0.17	0.33
2.	Thiamethoxam	0.01	2.8000	0.15	0.33	0.17	0.80
3.	Acephate	0.075	3.0667	1.02	0.60	0.90	1.33
4.	Chlorfenapyr	0.015	2.8667	1.15	0.60	1.24	1.46
5.	Cartap hydrochloride	0.05	3.3333	1.35	0.66	1.30	1.66
6.	Fipronil	0.01	3.2000	1.35	0.87	1.50	1.66
7.	Azadirachtin	0.002	3.0000	0.42	0.46	0.44	0.93
8.	Ethion	0.05	2.9333	1.48	1.67	1.57	1.93
9.	Dimethoate	0.03	3.2667	0.42	0.47	0.70	1.20
10.	Diafenthiuron	0.05	2.9333	1.75	1.80	2.17	2.20
11.	*Verticillium lecanii*	0.4	2.6000	0.35	0.46	0.36	0.93
12.	Control (Water)	–	3.5333	4.15	3.39	3.04	2.93
	S.E. ±		0.2098	0.06	0.06	0.08	0.09
	C.D. (P=0.05)		NS	0.20	0.17	0.23	0.28
	C. V. %		11.76	10.58	10.60	12.47	11.52

NS=Non-significant

After second spraying :

The data (Table 2) recorded at one day after second spraying indicated that all the insecticidal treatments recorded significantly lower number of aphid index per plant as compared to control treatment (water spray). Among different insecticidal treatments imidacloprid 0.005 per cent (0.13 aphid index/plant) was found most effective treatment and it was at par with thiamethoxam 0.01 per cent (0.26 aphid index/plant), azadirachtin 0.003 per cent (0.30 aphid index/plant), *V. lecanii* 0.40 per cent (0.33 aphid index/plant) and dimethoate 0.03 per cent (0.40 aphid index/plant). Acephate 0.075 per cent (1.06 aphid index/plant), chlorfenapyr 0.015 per cent (1.20 aphid index/plant), cartap hydrochloride 0.05 per cent (1.26 aphid index/plant) and fipronil 0.01 per cent (1.40 aphid index/plant) were next effective treatments. Ethion 0.05 per cent and diafenthiuron 0.05 per cent recorded 1.60 and 1.86 aphid index/plant, respectively and were found less effective. Higher number of aphid index was observed in control (2.6 aphid index/plant). A similar trend was observed on 3, 7 and 15 DAT. After both the applications, all the insecticides tested were statistically superior.

The all previous obtained data revealed that the efficacy of neonicotinoid insecticides were superior compared with the majority of the tested insecticides and proved higher activity. These results agree with (Mahdi

Table 2: Effect of insecticides against *A. craccivora* on cowpea after 2nd spraying

Treat. No.	Treatments	Dose (%)	Aphid index				
			Before spray	1 DAS	3 DAS	7 DAS	15 DAS
1.	Imidacloprid	0.005	0.33	0.13	0.20	0.33	0.13
2.	Thiamethoxam	0.01	0.80	0.26	0.26	0.33	0.40
3.	Acephate	0.075	1.33	1.06	0.73	1.06	1.66
4.	Chlorfenapyr	0.015	1.46	1.20	0.80	1.26	1.66
5.	Cartap hydrochloride	0.05	1.66	1.26	0.80	1.40	1.86
6.	Fipronil	0.01	1.66	1.40	1.46	1.53	2.06
7.	Azadirachtin	0.002	0.93	0.30	0.40	0.80	1.26
8.	Ethion	0.05	1.93	1.60	1.60	1.86	2.13
9.	Dimethoate	0.03	1.20	0.40	0.66	0.93	1.40
10.	Diafenthiuron	0.05	2.20	1.86	1.90	2.06	2.33
11.	*Verticillium lecanii*	0.4	0.93	0.33	0.46	0.60	1.20
12.	Control (Water)	–	2.93	2.60	3.00	3.06	2.80
	S.E. ±		0.09	0.05	0.07	0.06	0.09
	C.D. (P=0.05)		0.28	0.17	0.21	0.19	0.26
	C. V. %		11.52	9.71	12.51	8.83	9.71

Table 3: Effect of different insecticides on the yield of cowpea

Treatments	Dose (%)	Yield (q/ha)	% Increase in yield over control
Imidacloprid 17.8% SL	0.005	25.83	56.73
Thiamethoxam 25%WG	0.01	30.37	84.28
Acephate 75% SP	0.075	24.91	51.15
Chlorfenpyr 10% SC	0.015	24.90	51.09
Cartap hydrochloride 50 SP	0.05	23.45	42.29
Fipronil 5% SC	0.01	25.25	53.21
Azadirachtin 1EC	0.002	25.65	55.74
Ethion 50 EC	0.05	21.04	27.66
Dimethoate 30 EC	0.03	28.50	72.93
Diafenthiuron 50 WP	0.05	23.71	43.87
Verticillium lecanii 2×10^8 cfu/gm	0.4	26.17	58.79
Control (Water)	–	16.48	–
S.E. ±		1.67	
C.D. (P=0.05)		4.88	

et al., 2014; Liu *et al*., 2010; Gonclaves and Bleicher, 2006) their reports mentioned that, imidacloprid and thiamethoxam were the most effective in preference to insecticides such as dimethoate and azadirachtin against *A. craccivora*. Also, thiamethoxam, a second generation neonicotinoid insecticide and imidacloprid were developed for controlling many sucking pests and provided excellent control of cotton, aphid *A. gossypii* with very low application rates which was in conformity with the findings of Preetha *et al*. (2012); Anitha and Nandihalli (2009); Babu and Sharma (2003); Misra (2002); Kharboutli and Allen (2000). High susceptibility of other species of aphids like *A.nerri* (Patel *et al*., 2012), *Myzus persica* (Fazal *et al*., 2005), *Toxoptera aurantii* (Sharma, 2004), and *Lipaphis erysimi* (Sreekanth and Babu, 2001) to imidacloprid and thiamethoxam was well documented.

Yield :

Looking to the (Table 3) per cent increase in pod yield of cowpea over control, the treatment thiamethoxam 25 WG @ 0.01 per cent gave 84.28 per cent higher yield over control followed by dimethoate 30 EC @ 0.03 per cent, *V. lecanii* 2×10^8 cfu/gm @ 0.4 per cent, imidacloprid 17.8 SL @ 0.005 per cent, azadirachtin 1 EC @ 0.003 per cent, fipronil 5 SC @ 0.01 per cent, acephate 75 SP @ 0.075 per cent, chlorfenapyr 10 SC @ 0.015 per cent, diafenthiuron 50 WP @ 0.05 per cent, cartap hydrochloride 50 SP 0.05 per cent and ethion 50 EC @ 0.05 per cent recorded 72.93, 58.79, 56.73, 55.74, 53.21, 51.15, 51.09, 43.87, 42.29 and 27.66 per cent increase in yield over control, respectively.

Economics of various insecticides :

It is evident from the Table 4 that the highest net profits of Rs. 24460/ha was achieved through the treatment thiamethoxam 25 WG @ 0.01 per cent (T_2). It was followed by dimethoate 30 EC @ 0.03 per cent (T_9), imidacloprid 17.8 SL @ 0.005 per cent (T_1), *V. lecanii* 2×10^8 cfu/g @ 0.4 per cent (T_{11}), azadirachtin 1 EC @ 0.003 per cent (T_7) and acephate 75 SP @ 0.075 per cent (T_3) which recorded net profits of Rs. 20672/ha, 17870/ha, 17540/ha, 15300 and 15300/ha, respectively. The incremental cost benefit ratio (ICBR) in various treatments ranged from 1: 1.98 to 1: 21.53. The highest ICBR (1:21.53) was observed in imidocloprid 17.8 SL @0.005 per cent followed by acephate 75 SP @ 0.075 per cent (1: 9.80), *V. lecanii* 2×10^8 cfu/g @ 0.4 per cent (1: 9.53), thiamethoxam 25 WG @ 0.01 per cent (1: 7.36) and ethion 50 EC @ 0.05 per cent (1:4.93). The findings of present investigations are corroborating with the yield and economics worked out by the following researchers. Preetha *et al*. (2012) reported that imidacloprid was quiet promising in reducing the population of both the pests

Table 4 : Economics of different insecticidal treatments used against *Aphis craccivora* on cowpea

Sr. No.	Treatments	Total quantity of insecticides (l/ha or kg/ha)	Cost of treatment (2 sprays) including labour charge (Rs./ha)	Average yield of produce (q/ha)	Gross realization of produce (Rs./ha)	Gross realization over control (Rs./ha)	Net profit (Rs./ha)	Net ICBR
1.	Imidacloprid (0.005 %)	0.28	829.88	25.83	51660	18700	17870	1: 21.53
2.	Thiamethoxam (0.01 %)	0.4	3320	30.37	60740	27780	24460	1: 7.36
3.	Acephate (0.075 %)	1	1560	24.91	49820	16860	15300	1: 9.80
4.	Chlorfenapyr (0.015 %)	1.5	5640	24.90	49800	16840	11200	1: 1.98
5.	Cartap hydrochloride (0.05 %)	1	2500	23.45	46900	13940	11440	1: 4.57
6.	Fipronil (0.01 %)	2	4240	25.25	50500	17540	13300	1: 3.13
7.	Azadirachtin (0.002 %)	2	3040	25.65	51300	18340	15300	1: 5.03
8.	Ethion (0.05 %)	1	1536	21.04	42080	9120	7584	1:4.93
9.	Dimethoate (0.03 %)	1	3368	28.50	57000	24040	20672	1:6.13
10.	Diafenthiuron (0.05 %)	0.5	4240	23.71	47420	14460	10220	1:2.41
11.	*Verticillium lecanii* (0.4 %)	4	1840	26.17	52340	19380	17540	1:9.53
12.	Control (Water)	-		16.48	32960	-		

Market price of cowpea pods: Rs. 2000/quintal — Labour charge (skill) @ Rs. 120/day

Imidacloprid	: Rs. 1050/lit	Fipronil	: Rs. 1000/lit	*Verticillium lecanii*	: Rs. 200/kg
Thiamethoxam	: Rs. 3850/kg	Azadirachtin	: Rs. 700/lit	Acephate	: Rs. 660/kg
Ethion	: Rs. 648/lit	Chlorfenapyr	: Rs. 1800/lit	Dimethoate	: Rs. 1564/lit
Cartap hydrachloride	: Rs. 1130/kg	Diafenthiuron	: Rs. 4000/kg		

without any phytotoxicity symptoms and produced better yield. Mahdi *et al*. (2014) reported that the practical budget analysis of imidacloprid, thiamethoxam, dimethoate and azadirachtin indicated that the tested compounds with their effective doses increased the net profits. Kanan and Sabita (1993) reported that fewer application of azadirachtin spray gave a significant increase in yield (840 kg/ha) compared with (540 kg/ha) yield over control. Saranya and Ushakumari (2011) reported that maximum number and weight of the cowpea pods were obtained in plants treated with *V. lecanii* @ 10^8 spore's ml^{-1}.

From the present study it is concluded that the treatment imidacloprid 0.005 per cent (0.19 aphid index/plant) was found to be significantly effective treatment among all the treatments.

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