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Bio-efficacy of diffrent insecticides against Lucerne aphid

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Abstract
Investigations on bioefficacy of different insecticides against lucerne aphid were carried out under field condition during 2018-19 at Instructional Farm, Junagadh Agricultural University, Junagadh. Based on the spray of insecticides aphid can be effectively managed by acetamiprid 20 SP @ 0.008 percent followed by thiamethoxam 25 WG @ 0.01 percent and imidacloprid 17.8 SL @ 0.005 percent. While carbosulfan 25 EC @ 0.01 percent found least effective in controlling lucerne aphid. The highest yield of lucerne 37.20 q /ha was obtained from the treatment of acetamiprid 20 SP @ 0.008 percent followed by thiamethoxam 25 WG @ 0.01 percent (36 q /ha). While the lowest yield of lucerne was recorded in carbosulfan 25 EC @ 0.01 percent with 26.07 q/ha yield of lucerne.
The highest incremental cost benefit ratio (1:56.97) was obtained from the treatment of acetamiprid 20 SP @ 0.008 percent. It was followed by imidacloprid 17.8 @ 0.005 percent (1:49.42), clothianidin 50 WDG @ 0.025 percent (1: 49.29). The other treatments such as carbosulfan 25 EC @ 0.01 percent (1**:**30.89), triazophos 40 EC @ 0.08 percent (1**:**28.89) registered low cost benefit ratio.

Keywords: Lucerne aphid, insecticides, bioefficacy, Lucerne

Introduction
Lucerne (*Medicago sativa* L.) is known as “Green Gold” or Queen of Forage crops, which is also known as alfalfa and in Arabic meaning “the best”. Lucerne is one of the important perennial forage crops, mostly grown for pasturage, silage, Soilage, hay, dehydrated meal and medicinal purpose. It contains 4 to 5 times as much protein as forage sorghum and ample quality of vitamin-A. It also contain 20.2% crude protein, 16.2% digestible crude protein, 30.1% crude fibre, 1240g calcium and 350g phosphorous/100 kg green fodder and metabolic energy 2.17 Mcal/kg. In Gujarat, the average production of lucerne is 60-130 tonnes/ha and average productivity is about 600 kg/ha (Anon, 2018) [2]. Studying the biology of the lucerne aphid was helpful for us to know about the susceptible stage of aphid, which was going to use in integrated pest management. The population of lucerne aphid shows violent fluctuations in natural environment, the population dynamics were help us to know the relationship of aphid population with different weather parameters. In lucerne crop, it is a prime need to find out insecticides, which can be used for the management of aphids in field condition.

Materials and Methods
An experiment was carried out under field condition at Instructional Farm, College of Agriculture, JAU, Junagadh during the season, 2018 to determine the efficacy of different insecticides against Lucerne aphid. The observations were recorded from five apical branches of length 5 cm from each quadrate. The crop was sprayed on the appearance of sufficient aphid population at 15 days interval on first, fifth and seventh days after the application of each spray.
To evaluate the effect of different insecticides on the lucerne aphid. The harvested yield was weighted and converted on a hectare basis. Economics of all treatments was worked out by considering the price of products, cost of insecticides and labour charges. ICBR was worked out to compare the economics of different insecticidal treatments. The per cent increase in yield over control was calculated by using the following formula (Abbott, 1925) [1].

$$\text{Per cent increase over control} = 100 \text{ X } \frac{T - C}{C}$$

T = Yield of diffrent treatment (kg/ha)
C = Yield of control (kg/ha)

Table 1: Details of field experiment

Sr. No.	Insecticides	Concentration	Dose/ 10 lit of water
1.	Thiamethoxam 25 WG	0.01%	3ml
2.	Imidacloprid 17.8 SL	0.005%	3ml
3.	Flonicamid 50 WG	0.015%	3g
4.	Acetamiprid 20 SP	0.008%	10g
5.	Triazophos 40 EC	0.08%	20ml
6.	Carbosulfan 25 EC	0.01%	20ml
7.	Dimethoate 30 EC	0.03%	10ml
8.	Clothianidin 50 WDG	0.025%	5ml
9.	Thiacloprid 48 EC	0.024%	5ml
10.	Untreated control	------	------

Results and Discussion

First day

One day after spray

The data on the Lucerne aphid index found one day after first spray presented in (Table 2) indicated that acetamiprid 20 SP @ 0.008 percent recorded the significantly lowest aphid index of 1.19. However, it was at par with flonicamid 50 WG @ 0.015 percent (1.80), thiamethoxam 25 WG @ 0.01 percent (1.80), and imidacloprid 17.8 SL @ 0.005 percent (1.93). The rest of the treatments *viz.*, dimethoate 30 EC @ 0.03 percent (2.13), clothianidin 50 WDG @ 0.025 percent (2.20), triazophos 40 EC @ 0.08 percent (2.20), thiacloprid 48 EC @ 0.024 percent (2.40), carbosulfan 25 EC @ 0.01 percent (2.40) were the next effective treatments against the lucerne aphid.

Five day after spray

The data on the Lucerne aphid index found five day after first spray presented in (Table 2) indicated that acetamiprid 20 SP @ 0.008 percent recorded the significantly lowest aphid index of 1.56. However, it was at par with flonicamid 50 WG @ 0.015 percent (2.20), thiamethoxam 25 WG @ 0.01 percent (2.33), and imidacloprid 17.8 SL @ 0.005 percent (2.40). The rest of the treatments *viz.*, dimethoate 30 EC @ 0.03 percent (2.60), clothianidin 50 WDG @ 0.025 percent (2.60), triazophos 40 EC @ 0.08 percent (2.67), thiacloprid 48 EC @ 0.024 percent (2.87), carbosulfan 25 EC @ 0.01 percent (2.93) were the next effective treatments against the lucerne aphid.

Seven day after spray

The data on the Lucerne aphid index found seven day after first spray presented in (Table 2) indicated that acetamiprid 20 SP @ 0.008 percent recorded the significantly lowest aphid index of 1.11. However, it was at par with flonicamid 50 WG @ 0.015 percent (1.67), thiamethoxam 25 WG @ 0.01 percent (1.67), and imidacloprid 17.8 SL @ 0.005 percent (1.73). The rest of the treatments *viz.*, dimethoate 30 EC @ 0.03 percent (1.87), clothianidin 50 WDG @ 0.025 percent (1.87), triazophos 40 EC @ 0.08 percent (1.93), thiacloprid 48 EC @ 0.024 percent (2.07), carbosulfan 25 EC @ 0.01 percent (2.07) were the next effective treatments against the lucerne aphid.

Pooled (first spray)

While studying the pooled data on aphid presented in (Table 2) indicated that acetamiprid 20 SP @ 0.008 percent (1.37) recorded the significantly lowest aphid index. This was significantly differing from the other treatment. The order of the effective treatment are acetamiprid 20 SP @ 0.008 percent (1.37) > thiamethoxam 25 WG @ 0.01 percent (1.97) > imidacloprid 17.8 SL @ 0.005 percent (2) > flonicamid 50 WG @ 0.015 percent (2.08) > thiacloprid 48 SC @ 0.024 percent (2.27) > clothianidin 50 WDG @ 0.025 percent (2.32) > dimethoate 30 EC @ 0.03 percent (2.35) > triazophos 40 EC @ 0.08 percent (2.45) > carbosulfan 25 EC @ 0.01 percent (2.5). While, control plot recorded with maximum aphid index of 4.23.

Table 2: Bio-efficacy of different insecticides against lucerne aphid during *Rabi*- 2018 (first spray)

Treatment	Insecticides	Concentration	Aphid index				
			Before Spray	1 DAS	3 DAS	7 DAS	Pooled
T1	Thiamethoxam 25 WG	0.01	2.18 (4.27)	1.51 (1.80)	1.68 (2.33)	1.47 (1.67)	1.57 (1.97)
T2	Imidacloprid 17.8 SL	0.005	2.15 (4.13)	1.55 (1.93)	1.70 (2.40)	1.49 (1.73)	1.58 (2.00)
T3	Flonicamid 50 WG	0.015	2.15 (4.13)	1.51 (1.80)	1.64 (2.20)	1.47(1.67)	1.60 (2.08)
T4	Acetamiprid 20 SP	0.008	2.13 (4.07)	1.30 (1.19)	1.43 (1.56)	1.27 (1.11)	1.37 (1.37)
T5	Triazophos 40 EC	0.08	2.13 (4.07)	1.64 (2.20)	1.77 (2.67)	1.56 (1.93)	1.69 (2.45)
T6	Carbosulfan 25 EC	0.01	2.10 (3.93)	1.70 (2.40)	1.85 (2.93)	1.60 (2.07)	1.73 (2.50)
T7	Dimethoate 30 EC	0.03	2.09 (3.87)	1.62 (2.13)	1.76 (2.60)	1.53 (1.87)	1.69 (2.35)
T8	Clothianidin 50 WDG	0.025	2.07 (3.80)	1.64 (2.20)	1.76 (2.60)	1.53 (1.87)	1.68 (2.32)
T9	Thiacloprid 48 EC	0.024	2.05 (3.73)	1.70 (2.40)	1.83 (2.87)	1.60 (2.07)	1.66 (2.27)
T10	Control	-	2.00 (3.53)	2.20 (4.33)	2.17 (4.20)	2.18 (4.27)	2.17 (4.23)
S.Em. +			0.10	0.10	0.09	0.08	0.05
C.D. @ 5%			NS	0.29	0.28	0.23	0.15
C.V. %			8.09	10.28	9.17	8.70	5.38

Second spray

One day after spray

The data on the lucerne aphid index found one day after second spray presented in (Table 3) indicated that efficacy point of view, more or less similar results was observed as compared to first spray acetamiprid 20 SP @ 0.008 percent (1.00) recorded the minimum aphid index which was at par with thiamethoxam 25 WG @ 0.01 percent (1.6) and imidacloprid 17.8 SL @ 0.005 percent (1.73). The order of the effectiveness are as followed, acetamiprid 20 SP @ 0.008 percent (1.00) > thiamethoxam 25 WG @ 0.01 percent (1.60) > imidacloprid 17.8 SL @ 0.005 percent (1.73) > flonicamid 50 WG @ 0.015 percent (1.80) > thiacloprid 48 SC @ 0.024 percent (2.20) > clothianidin 50 WDG @ 0.025 percent (2.27) > dimethoate 30 EC @ 0.03 percent (2.30) > triazophos 40 EC @ 0.08 percent (2.30) > carbosulfan 25 EC @ 0.01

percent (2.50). The control treatment recorded the highest aphid index (4.47).

Five day after spray

The data on the lucerne aphid index found five day after second spray presented in (Table 3) indicated acetamiprid 20 SP @ 0.008 percent (1.47) recorded the minimum aphid index which was at par with thiamethoxam 25 WG @ 0.01 percent (2.20). The sequences of other treatments are as followed, imidacloprid 17.8 SL @ 0.005 percent (2.30) > flonicamid 50 WG @ 0.015 percent (2.40) > thiacloprid 48 SC @ 0.024 percent (2.40) > clothianidin 50 WDG @ 0.025 percent (2.57) > dimethoate 30 EC @ 0.03 percent (2.80) > triazophos 40 EC @ 0.08 percent (2.87) > carbosulfan 25 EC @ 0.01 percent (3.07). The control treatment recorded the highest aphid index (4.47).

Seven day after spray

The data on the lucerne aphid index found seven day after second spray presented in (Table 3) indicated that acetamiprid 20 SP @ 0.008 percent (1.00) recorded the minimum aphid index which was at par with thiamethoxam 25 WG @ 0.01 percent (1.6) and imidacloprid 30.5 SL @ 0.005 percent (1.73). The order of the effectiveness are as followed, acetamiprid 20 SP @ 0.008 percent (1.07) > thiamethoxam 25 WG @ 0.01 percent (1.57) > imidacloprid 17.8 SL @ 0.005 percent (1.57) > flonicamid 50 WG @ 0.015 percent (1.87) > thiacloprid 48 SC @ 0.024 percent (2.03) > clothianidin 50 WDG @ 0.025 percent (2.07) > dimethoate 30 EC @ 0.03 percent (2.13) > triazophos 40 EC @ 0.08 percent (2.17) > carbosulfan 25 EC @ 0.01 percent (2.17). The control treatment recorded the highest aphid index (4.47).

Pooled (second spray)

The Pooled data on Lucerne aphid index of the second spray presented in (Table 3) indicated that acetamiprid 20 SP @ 0.008 percent (1.27) recorded the minimum aphid index which significantly differed from other. The order of the effectiveness are as followed, acetamiprid 20 SP @ 0.008 percent (1.27) > thiamethoxam 25 WG @ 0.01 percent (1.9) > imidacloprid 17.8 SL @ 0.005 percent (1.97) > flonicamid 50 WG @ 0.015 percent (2.1) > thiacloprid 48 SC @ 0.024 percent (2.32) > Clothianidin 50 WDG @ 0.025 percent (2.42) > dimethoate 30 EC @ 0.03 percent (2.5) > triazophos 40 EC @ 0.08 percent (2.53) > carbosulfan 25 EC @ 0.01 percent (2.68). The control treatment recorded the highest aphid index (4.38). Thus, acetamiprid 20 SP @ 0.008 percent, thiamethoxam 25 WG @ 0.01 percent and imidacloprid 17.8 SL @ 0.005 percent were found effective treatments against the aphid infesting lucerne during *Rabi* 2018. Earlier, the effectiveness of acetamiprid against aphid has been observed by [3]. Chaudhari *et al*. (2015). While, imidacloprid was found effective against the aphid by [4]. Khade *et al*. (2014) and [6]. Swarnalata *et al.* (2015). Also [5]. Patel *et al.* (2007) had found that thiamethoxam 25 WG @ 0.01 percent was found effective in controlling the aphid. Thus, the results obtained in the present investigation are in similar finding with the studies of the earlier workers.

Table 3: Bio- efficacy of different insecticides against Lucerne aphid during *Rabi*- 2018 (second spray)

Treatment	Insecticides	Concentration	Aphid index				
			Before Spray	1 DAS	5 DAS	7 DAS	Pooled
T1	Thiamethoxam 25 WG	0.01	2.08 (3.83)	1.44 (1.60)	1.64 (2.20)	1.43(1.57)	1.57 (1.97)
T2	Imidacloprid 17.8 SL	0.005	2.16 (4.17)	1.49 (1.73)	1.67 (2.30)	1.49 (1.57)	1.58 (2.00)
T3	Flonicamid 50 WG	0.015	2.17 (4.23)	1.51 (1.80)	1.70 (2.40)	1.53(1.87)	1.61 (2.10)
T4	Acetamiprid 20 SP	0.008	2.08 (3.87)	1.23 (1.00)	1.40(1.47)	1.25 (1.07)	1.33 (1.27)
T5	Triazophos 40 EC	0.08	2.25 (4.60)	1.67 (2.30)	1.83 (2.87)	1.62 (2.17)	1.74 (2.53)
T6	Carbosulfan 25 EC	0.01	2.10 (3.93)	1.73 (2.50)	1.88 (3.07)	1.63 (2.17)	1.78 (2.68)
T7	Dimethoate 30 EC	0.03	2.19 (4.30)	1.67 (2.30)	1.81 (2.80)	1.62 (2.13)	1.73 (2.50)
T8	Clothianidin 50 WDG	0.025	2.16 (4.20)	1.66 (2.27)	1.75 (2.57)	1.60 (2.07)	1.71 (2.42)
T9	Thiacloprid 48 EC	0.024	2.09 (3.87)	1.64 (2.20)	1.70 (2.40)	1.59 (2.03)	1.68 (2.32)
T10	Control	-	2.00 (3.53)	2.20 (4.33)	2.17 (4.20)	2.18 (4.27)	2.17 (4.23)
S.Em. +			0.10	0.10	0.09	0.08	0.05
C.D. @ 5%			NS	0.29	0.28	0.23	0.15
C.V. %			8.09	10.28	9.17	8.70	5.38

Yield

The data presented in (Table 4) indicated that all the treatments gave a significantly higher yield of lucerne over untreated control. However, significantly the highest seed yield of 37.20 q/ha (113.8% increase over control) was obtained from the treatment of acetamiprid 20 SP @ 0.008 percent and thiamethoxam 25 WG @ 0.01 percent (36).

Imidacloprid 17.8 SL @ 0.005 percent (34.8 q/ha), flonicamid 50 WG @ 0.015 percent (33.6 q/ha) and thiacloprid 48 SC @ 0.024 percent (32.33 q/ha) in respect of lucerne yield of 36.00, 34.80, 33.6 and 32.33 q/ha lucerne yield with 206.9, 200.0, 193.1 and 185.8 per cent increase over control, respectively. The remaining treatments *viz.*, clothianidin 50 WDG @ 0.025 percent (31 q/ha), dimethoate 30 EC @ 0.03 percent (29.8 q/ha), triazophos 40 EC @ 0.08 percent (27.4 q/ha), carbosulfan 25 EC @ 0.01 percent (26.07 q/ha). The significantly minimum seed yield of 17.40 q/ha was recorded in the control plot. The results obtained are more or less similar to the earlier work done by. Patel *et al*. (2007) [5] and Swarnalata *et al.* (2015) [6]. found that imidacloprid 17.8 SL @ 0.005 percent gave the highest yield.

Table 4: Impact of different insecticides against lucerne seed yield during *Rabi*- 2018

Sr. No.	Treatments	Concentration (%)	Yield (q/ha)	Yield increase over control (q/ha)	Percentage increase in yield over control
1	Thiamethoxam 25 WG	0.01	36.00	18.6	106.9
2	Imidacloprid 17.8 SL	0.005	34.80	17.4	100.0
4	Flonicamid 50 WG	0.015	33.60	16.2	93.1
5	Acetamiprid 20 SP	0.008	37.20	19.8	113.8

6	Triazophos 40 EC	0.08	27.40	10.0	57.5
7	Carbosulfan 25 EC	0.01	26.07	8.7	49.8
8	Dimethoate 30 EC	0.03	29.80	12.4	71.3
9	Clothianidin 50 WDG	0.025	31.00	13.6	78.2
10	Thiacloprid 48 EC	0.024	32.33	14.9	85.8
11	Control	-	17.4	-	-
S. Em.±		1.81			
C.D.@5%		5.31			
C. V.%		10.47			

Economics of different insecticides

The economics of different insecticidal treatments have been also worked out along with Incremental Cost Benefit Ratio (ICBR). The economics of various insecticidal treatments in (Table 5) indicated that the highest (106820 Rs. /ha) net realization was obtained in the treatment acetamiprid 20 SP @ 0.008 percent followed by thiaomethoxam 25 WG @ 0.01 per cent (100280 Rs. /ha), imidacloprid 17.8 SL @ 0.005 percent (93740 Rs. /ha), flonicamid 50 WG @ 0.015 percent (87200 Rs./ha), thiacloprid 48 SC @ 0.024 percent (80279 Rs. /ha), Clothianidin 50 WDG @ 0.025 percent (73030 Rs./ha), dimethoate 30 EC @ 0.03 percent (66490 Rs./ha), triazophos 40 EC @ 0.08 percent (59950 Rs. /ha), carbosulfan 25 EC @ 0.01 percent (46162 Rs. /ha). The highest (1**:**56.97) incremental cost benefit ratio was obtained from the treatment of acetamiprid 20 SP @ 0.008 percent. It was followed by imidacloprid 17.8 SL @ 0.005 percent (1:49.42), clothianidin 50 WDG @ 0.025 percent (1:49.29), flonicamid 50 Wg @ 0.015 percent (1**:**41.52), dimethoate 30 EC @ 0.03 percent (1**:**35.18), thiacloprid 48 SC @ 0.024 percent (1**:**24.86) and thiaomethoxam 25 WG @ 0.01 percent (1**:**21.80). The other treatments carbosulfan 25 EC @ 0.01 percent (1**:**30.89), triazophos 40 EC @ 0.08 percent (1**:**28.89) registered low cost benefit ratios.

The earlier work done by [3]. Chaudhari *et al*. (2015) reported that highest ICBR ratio was obtained from acetamiprid 20 SP @ 250 gm /ha treated plots [4]. Khade *et al*. (2014) found that imidacloprid 17.8 SL @ 0.005 percent proved to be the most economically viable treatment followed by acetamiprid 20 SP @ 0.008 percent, and flonicamid 50 WP @ 0.015 percent. So, the results obtained in the present investigation are said to be in agreement with those of earlier studies.

Table 5: Economics of different insecticidal treatments applied for the control of Lucerne aphid

Sr. No.	Treatments	Total quantity of insecticides for 2 sprays (lit or kg/ha)	Price of insecticides (Rs./lit or kg)	Cost of insect cides (Rs./ha)	Total cost of treat ment (Rs./ha)	Yield (q/ha)	Gross realiz ation (Rs./ha)	Net realiz ation (Rs./ha)	ICBR
1	Thiaomethoxam 25 WG	1.000	3400	3400.0	4600	36.0	196200	100280	1: 21.80
2	Imidacloprid 17.8 SL	0.225	3100	696.6	1897	34.8	189660	93740	1: 49.42
3	Flonicamid 50 WG	0.100	9000	900.0	2100	33.6	183120	87200	1: 41.52
4	Acetamiprid 20 SP	0.375	1800	675.0	1875	37.2	202740	106820	1: 56.97
5	Triazophos 40 EC	0.245	4925	234.3	1564	27.40	123456	59950	1: 28.89
6	Carbosulfan 25 EC	0.003	5650	294.3	1494	26.1	142082	46162	1: 30.89
7	Dimethoate 30 EC	0.675	4560	202.2	3229	29.80	176199	66490	1: 35.18
8	Clothianidin 50 WDG	0.080	3520	281.6	1482	31.0	168950	73030	1: 49.29
10	Thiacloprid 48 EC	0.833	2435	2029.2	3229	32.3	176199	80279	1: 24.86
11	Control	-	-	-	-	17.6	95920	-	-

Notes:

The labour charge has been calculated @ Rs. 600/ha/spray.

The market value of lucerne has been calculated @ Rs. 5450.00 Rs/q.

Conclusion

The data on aphid index were recorded on the basis of pooled over periods. Acetamiprid 20 SP @ percent recorded the significantly lowest aphid index per plant. Next best treatment was thiamethoxam 25 WG @ 0.01 percent, imidacloprid 17.8 SL @ 0.005 percent, flonicamid 50 WG @ 0.015 percent, thiacloprid 48 SC @ 0.024 percent, clothianidin 50 WDG @ 0.025 percent, dimethoate 30 EC @ 0.03 percent, triazophos 40 EC @ 0.08 percent found mediocore in effectiveness against aphid. While, carbosulfan 25 EC @ 0.01 percent found least effective in controlling aphid. As the triazophos insecticide was banned by government of India in 2019 as a result of this complete use of triazophos should be stopped till 31st December 2020. With regards to this my research which was completed in 2019 triazophos is used for chemical control for my research work.

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