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Bio-efficacy of different insecticides against leaf hopper, *Empoasca kerri* Pruthi (Cicadellidae: Hemiptera) in clusterbean

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ABSTRACT

Experiments were conducted during three cosecutive *Kharif* seasons (2015-17) to study the effect of commercially available insecticides formulations *i.e.* Acetamaprid 20 % SP (0.4 g/ litre of water), Imidacloprid 17.8 % SL (0.33 ml/ lit.), Quinalphos % 25 EC (2.0 ml/ lit.), Thiamethoxam 25 % WG (0.5 g/ lit.), *Neem* (*Azadirachta indica*) oil 2% (20 ml/lit.), Karanj (*Pongamia pinnata*) oil 2% (20 ml/lit.) against the Jassids, *Empoasca kerri* Pruthi in *Clusterbean*. The order of most effective insecticide was: Imidacloprid > Thiamethoxam> Acetamaprid. The maximum population reduction over control after 7 days of second spray was 71.76 and 70.14 per cent due to Imidacloprid, and Thiamethoxam during 2015. The same trend was found in 2016 and 2017. Thus, Imidacloprid was found most effective against the Jassids, *Empoasca kerri* Pruthi (Cicadellidae: Hemiptera).

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INTRODUCTION

Clusterbean, *Cyamopsis tetragonoloba* is cultivated in India for ages which is also native of the country. *Cyamopsis tetragonoloba* belongs to Leguminosae (Fabaceae) family and having tolerance against high temperature and drought (Kumar and Rodge, 2012). Clusterbean has been used as a green manure, fodder and vegetable. Clusterbean gum is used in a various types of industries. Clusterbean gum is a type of hydrocolloid naturally present in the endosperm of seed. The gum is produced from seed endosperm after dehusking of clusterbean seed (Sabahelkheir *et al.*, 2012). Export quality cultivars of clusterbean should have higher viscosity (4000-5000 cps) and more than 32% gum content. India clusterbean export worth of Rs. 21000 million in 2012-13 (Bhatt *et al.*, 2017).

Cyamopsis tetragonoloba (L.) mostly grown in semi-arid and arid regions under resource constrained conditions (Kumar, 2005). Clusterbean mainly grown in India, USA, Pakistan, Morocco, Spain, Italy, and Germany (Punia *et al.*, 2009). Clusterbean is grown in the arid regions of Rajasthan, Haryana, Gujarat and

Punjab for gum purpose and in other parts of India for vegetable. Clusterbean is mainly grown in Jaisalmer, Barmer, Churu, Nagaur, Bikaner, Sriganganagar, Sikar, Jhunjhunu, Jalore, Alwar and Jaipur districts of Rajasthan (Jyani *et al*., 2018).

During 2016-17 India recorded the ever highest pulse production as 23 million tonnes with an area of 29.28 m.ha and productivity 765 kg ha^{-1}. India accounts 80% clusterbean production in the world (Tripathy and Das, 2013). Clusterbean growing states of india are Rajasthan, Haryana, Madhya Pradesh, Uttar Pradesh and Punjab. Rajasthan accounts 82.1 per cent area and 70 per cent production of India with an area of 46.30 lakh hectare, production of 27.47 M tonnes, productivity of 593 kg/ha and having first rank in terms of area and production in India (Anonymous, 2015-16).

The insect pests, *viz.*, leaf hopper (jassid), *Empoasca motti* Pruthi; whitefly *Bemisia tabaci* (Genn.) and aphid, *Aphis craccivora* Koch cause great damage in clusterbean (Singh, 1997). The whitefly, leaf hopper is a polyphagous insect pest and causes heavy toll to the crops by sucking large amount of cell sap (Dodia *et al*., 2003). Acharya (1985) has revealed that only 5 to 6 per cent of the growers use plant protection measures and remains a neglected in pulse cultivation. The sap feeding insects which cause significant damage to green gram and other legume foliage, pods are jassids, *Empoasca kerri* Pruthi; white flies, *Bemisia tabaci* Gennadius, bean aphids, *Aphis craccivora* Koch; thrips belonging to genus *Megalurothrips* and *Caliothrips indicus* Bagnall; the pod bug, *Clavigralla* spp. and the plant bugs, *Riptortus* spp., *Nezara viridula* L., *Plautia fimbriata* (Fabricius) (Swaminathan *et al.*, 2007 and Hussain and Saharia, 1994). Integrated pest management practices involve the use of disease free seeds, management of vectors, use of resistant varieties, manipulation of cultural practices, chemical and biological control methods (Raguchander *et al*., 1995 and Vidhyasekaran and Muthamilan, 1995).

The effectiveness of nsecticides revealed that imidacloprid (0.005 %) and Thiamethoxam (0.025 %), dimethoate (0.03%), proved to be the most effective against sucking insect pests, *viz.*, leaf hopper, *Empoasca motti* Pruthi; whitefly, *Bemisia tabaci* (Genn.) and aphid, *Aphis craccivora* Koch of clusterbean. The acephate (0.037 %), lambda cyhalothrin (0.008 %) and profenophos (0.05 %) were less effective while least effective insecticides were diflubenzuron (0.05 %), Metarrhizium anisopliae (2 x107 spores l-1) novaluron (0.02 %), and NSKE (5.0 %) (Yadav *et al*., 2015).

Raghuraman *et al.* (2008) reported that acetamiprid 20 % SP at three doses *i.e.* 20, 40 and 80 g a.i./ha were effective in reducing the population of leafhoppers and whiteflies up to nine days in cotton significantly. Seetha Ramu *et al*. (2011) investigated the efficacy of insecticides and found that acetamiprid @ 0.2 g/lt and Thiamethoxam @ 0.2 g/lt were found highly effective for the control of whitefly to minimize YVMV in Mesta with lowest 13.33 whiteflies/leaf and 12.67 % disease incidence. High vegetative growth attracts higher number of insects pests which are detrimental for the production and causing severe yield losses (Lal and Sachan, 1987). Mechanism of escape from the viral diseases can be achieved through avoidance of the incidence of the sucking pests rather than control to obtain higher seed yield (Mahalakshmi *et al.*, 2015). Hence, in the present study insecticides evaluated for scheduling the foliar sprays against leafhoppers in Clusterbean to avoid yield loss.

MATERIAL AND METHODS

The present study on evaluation of insecticides were conducted at the Experimental Farm of Agricultural Research Station, Navgaon, Alwar (Rajasthan) for three consecutive *Kharif* seasons, *i.e.* during 2015, 2016 and 2017. The variety in HG 2-20 was selected as test variety and sown in plots each measuring 15 sq.m. at 30 x 10 cm spacing. The crop was sown during first fortnight of July and harvested at maturity during September in all the seasons. Six insecticides treatments were evaluated including untreated control and each treatment was replicated thrice. Three popularly used insecticides *i.e.* neoicotiniods, (Imidacloprid 17.8 % SL, Thiamethoxam 25 % WG, Acetamaprid 20 % SP), Quinalphos 25 % EC, Neem oil 2%, Karanj oil 2% were selected with different modes of action were selected against against sucking pests for the present study. The conventional pesticides such as Quinalphos 25 % EC was selected as standard insecticide checks against leaf hoppers along with one untreated check. One spray was given at 30 DAS followed by second spray at 45 DAS against leaf hoppers using water volume of 500 litre per hectare.

The population counts of leaf hoppers were recorded on one day before spraying was considered as pre-treatments counts for first spraying and the post-

treatment counts were recorded from ten randomly selected plants per plot after 1, 3, 5, 7 and 14 days of each spray. Fourteenth day population counts formed the pre-treatment counts for the second spray. The sucking pests such as Jassids were counted from three trifoliate leaves each one from top, middle and bottom canopies (Fleming and Retnakaran, 1985). From these data the mean population per ten plants was estimated and after transformation, it was subjected to statistical analysis. The Per cent reduction in Population were analysed using a formula given By Henderson and Tilton (1955) as under:

$$\text{Per cent reduction in population} = 100 \left[1 - \frac{T_a \times C_b}{T_b \times C_a}\right]$$

where,

T_a = Number of insects after treatment

T_b = Number of insects before treat ment

C_a = Number of insects in untreated check after treatment

C_b = Number of insects in untreated check before treatment

The data thus obtained were analyzed statistically by ANOVA after converting it to suitable transformed values.

RESULTS AND DISCUSSION

Imidacloprid 17.8 SL, lowers the population of *Empoasca kerri* by 51.01, 41.38 and 42.69 per cent over control after one day of first spraying during 2015, 2016 and 2017, respectively. After seven days of first spraying the efficacy of Imidacloprid 17.8 SL went upto 71.36, 62.50 and 70.91 per cent during 2015, 2016 and 2017, respectively. Imidacloprid 17.8 SL effectively reduced the population of *Empoasca kerri* by 71.76, 72.07 and 73.16 per cent over control at 7 days of II spraying during 2015, 2016 and 2017, respectively. Effectiveness of Imidacloprid 17.8 SL was followed by Thiamethoxam 25 WG and Acetamaprid 20 % SP against *Empoasca kerri* in per cent reduction of leaf hopper population over control at 1, 3, 7, 14 days after I and II spraying during all the three years (Table 1, 2 and 3).

Efficacy of Thiamethoxam 25 WG against *Empoasca kerri* in per cent reduction over control after one day of first spraying was 32.95, 38.82 and 39.89 per cent during 2015, 2016 and 2017, respectively. The efficacy of Thiamethoxam 25 WG went upto 67.93, 60.09 and 67.78 per cent during 2015, 2016 and 2017 respectively after seven days of first spraying and after 7 days of II spraying population reduced by 70.14, 71.45 and 68.83 per cent during 2015, 2016 and 2017 respectively. Karanj oil 2 per cent was least effective treatment against *Empoasca kerri* and reduced the jassids population at 1 day after I spraying by 10.57, 22.02 and 21.99 per cent during 2015, 2016 and 2017, respectively (Table 1, 2 and 3).

Imidacloprid 17.8 SL controls *Empoasca kerri* and

Table 1 : Efficacy of different insecticides against Jassids, *Empoasca kerri* in Clusterbean during *Kharif* 2015

Sr. No.	Treatments g.a.i./ha	Formulation Dose (g/ml/ha)	PTP/ Plants	Mean reduction (%) in population days after									
				First spray					Second spray				
				1 DAS	3 DAS	5 DAS	7 DAS	14 DAS	1 DAS	3 DAS	5 DAS	7 DAS	14 DAS
1.	Acetamaprid 20 % SP	0.4gm/ litre of water	24.66	29.13 (32.61)	43.08 (41.01)	54.21 (47.39)	63.44 (52.78)	38.94 (38.58)	56.07 (48.46)	63.04 (52.54)	58.34 (49.78)	65.81 (54.21)	48.76 (44.29)
2.	Imidacloprid 17.8 % SL	0.33ml/ litre of water	21.00	36.38 (37.07)	51.01 (45.57)	62.80 (52.40)	71.36 (64.30)	44.97 (42.09)	62.19 (52.04)	69.97 (56.59)	68.91 (56.12)	71.76 (58.23)	56.35 (48.62)
3.	Quinalphos % 25 EC	2.0 ml/ litre of water	26.66	18.98 (25.74)	33.29 (35.19)	44.59 (41.88)	51.78 (45.99)	32.21 (34.51)	48.51 (44.12)	56.17 (48.53)	47.40 (43.49)	51.94 (46.09)	40.79 (39.65)
4.	Thiamethoxam 25 % WG	0.5 gm/ litre of water	23.00	32.95 (35.00)	47.12 (43.32)	58.47 (49.86)	67.93 (55.50)	39.98 (39.19)	59.18 (50.26)	66.47 (54.60)	63.46 (52.78)	70.14 (56.86)	51.89 (46.07)
5.	*Neem* oil 2%	20.0 ml/ litre of water	27.33	14.63 (22.35)	28.06 (31.94)	39.57 (38.93)	46.95 (43.22)	29.21 (32.64)	45.32 (42.28)	51.22 (45.69)	41.82 (40.28)	47.35 (43.45)	36.40 (37.08)
6.	Karanj oil 2 %	20.0 ml/ litre of water	28.00	10.57 (18.94)	19.70 (26.23)	31.65 (34.20)	42.33 (40.56)	26.35 (30.81)	36.39 (36.92)	45.65 (42.48)	33.13 (35.10)	41.86 (40.28)	29.95 (33.13)
7.	Untreated control		24.33	-	-	-	-	-	-	-	-	-	-
	S.E.±			0.662	0.462	0.341	2.871	0.785	1.497	0.629	0.317	0.857	0.443
	C.D. (P=0.05)			2.031	1.420	1.047	8.812	2.410	4.595	1.930	0.973	2.632	1.361

PTP: Pre treatment population, Transformed values in parenthesis, DAS- Days after spraying

gave highest Mean reduction (%) in population by 71.76, 72.07 and 73.16 per cent at 7 days after II spyray during 2015, 2016 and 2017, respectively in Clusterbean (Table 1, 2 and 3). From the present study it can be concluded that foliar sprays should be given to protect the crop from pest incidence after 30 days. Foliar spray of Imidacloprid 17.8 % SL (0.33ml/litre of water), at 30 DAS and II spray at 45 days of crop stage offers complete protection against incidence of Jassids.

The present findings corroborate with that *the effectiveness of* imidacloprid 0.005 per cent was reported by Afzal *et al*. (2002); Dodia *et al*. (2003); Ganapathy and Karuppiah (2004) and Singh *et al*. (2014).

Chaudhary *et al*. (2018) reported that imidacloprid 17.8 SL @ 0.005 % was the most effective treatment in controlling jassids under field conditions followed by acetamiprid 20 SP @ 0.004 % and dimethoate 30 EC @ 0.03 %. The next group of effective insecticides treatments were Thiamethoxam 25 WG, buprofezin 25 SC and chlorfenapyr 10 SC. Similarly botanical insecticide (*Neem* oil 1500 ppm @ 0.5 %) and biopesticides (Beauveria bassiana 2 x 108 cfu/g and

Table 2 : Efficacy of different insecticides against Jassids, *Empoasca kerri* in Clusterbean during *Kharif* 2016

Sr. No.	Treatments g.a.i./ha	Formulation Dose (g/ml/ha)	PTP/ Plants	Mean reduction (%) in population days after									
				First spray					Second spray				
				1DAS	3 DAS	5 DAS	7 DAS	14 DAS	1 DAS	3 DAS	5 DAS	7 DAS	14 DAS
1.	Acetamaprid 20 % SP	0.4gm/ litre of water	34.67	35.96 (36.82)	42.19 (40.45)	50.26 (45.14)	56.61 (50.81)	36.37 (37.03)	50.71 (45.38)	56.64 (48.78)	59.89 (50.70)	69.26 (56.29)	48.06 (43.87)
2.	Imidacloprid 17.8 % SL	0.33ml/litre of water	31.00	41.38 (40.00)	48.21 (43.95)	56.70 (48.85)	62.50 (54.62)	42.09 (40.43)	55.88 (48.35)	62.27 (52.07)	66.28 (54.53)	72.07 (58.09)	50.35 (45.18)
3.	Quinalphos % 25 EC	2.0 ml/litre of water	36.67	28.45 (32.18)	34.39 (35.82)	42.51 (40.66)	46.99 (45.10)	32.68 (34.71)	44.07 (41.57)	50.70 (45.38)	52.61 (46.46)	61.18 (51.44)	38.13 (38.08)
4.	Thiamethoxam 25 % WG	0.5 gm/ litre of water	33.00	38.82 (38.49)	45.27 (42.24)	53.51 (47.00)	60.09 (52.98)	37.50 (37.69)	53.37 (46.92)	59.49 (50.45)	63.06 (52.58)	71.45 (56.87)	50.32 (45.15)
5.	Neem oil 2%	20.0 ml/ litre of water	37.33	25.21 (30.09)	30.15 (33.18)	42.21 (40.43)	42.88 (42.70)	27.50 (31.54)	41.23 (39.93)	46.28 (42.84)	52.07 (46.20)	58.54 (49.70)	34.83 (36.34)
6.	Karanj oil 2 %	20.0 ml/ litre of water	38.00	22.02 (27.86)	23.39 (28.65)	31.82 (34.23)	38.90 (40.32)	24.87 (29.80)	35.39 (36.38)	41.33 (39.98)	42.67 (40.69)	55.24 (47.97)	30.66 (33.56)
7.	Untreated control		37.33	-	-	-	-	-	-	-	-	-	-
	S.E.±			0.369	0.534	0.994	0.423	0.922	0.861	0.496	0.954	0.526	0.450
	C.D. (P=0.05)			1.131	1.639	3.050	1.299	2.828	2.641	1.521	2.927	1.615	1.382

PTP: Pre treatment population, Transformed values in parenthesis, DAS- Days after spraying

Table 3 : Efficacy of different insecticides against Jassids, *Empoasca kerri* in Clusterbean during *Kharif* 2017

Sr. No.	Treatments g.a.i./ha	Formulation Dose (g/ml/ha)	PTP/ Plants	Mean reduction (%) in population days after									
				First spray					Second spray				
				1 DAS	3 DAS	5 DAS	7 DAS	14 DAS	1DAS	3 DAS	5 DAS	7 DAS	14 DAS
1.	Acetamaprid 20 % SP	0.4gm/ litre of water	31.00	36.81 (37.31)	42.53 (40.52)	52.17 (46.22)	63.71 (53.00)	37.72 (37.83)	51.15 (45.63)	57.41 (49.82)	61.15 (51.43)	62.10 (51.99)	47.47 (43.54)
2.	Imidacloprid 17.8 % SL	0.33ml/litre of water	27.33	42.69 (40.77)	57.31 (49.23)	57.11 (49.10)	70.91 (57.50)	43.86 (41.46)	57.16 (49.08)	64.07 (53.16)	68.80 (56.08)	73.16 (53.99)	50.42 (45.23)
3.	Quinalphos % 25 EC	2.0 ml/litre of water	33.00	28.73 (32.37)	34.19 (35.67)	43.79 (41.19)	52.99 (46.69)	33.77 (35.40)	43.68 (41.34)	50.65 (45.34)	52.84 (46.59)	49.56 (44.71)	35.89 (36.56)
4.	Thiamethoxam 25 % WG	0.5 gm/ litre of water	29.33	39.89 (39.12)	48.06 (43.85)	53.67 (47.10)	67.78 (55.71)	38.92 (38.56)	54.21 (47.39)	60.75 (51.19)	64.91 (53.69)	68.83 (54.23)	50.25 (45.13)
5.	*Neem* oil 2%	20.0 ml/ litre of water	34.33	25.26 (30.12)	31.61 (34.14)	43.61 (41.22)	48.48 (44.08)	28.29 (32.04)	40.54 (39.50)	47.34 (43.99)	52.33 (46.30)	45.46 (42.36)	32.08 (34.45)
6.	Karanj oil 2 %	20.0 ml/ litre of water	32.00	21.91 (27.81)	24.38 (29.41)	32.36 (34.55)	44.13 (41.57)	25.54 (30.24)	34.14 (35.60)	40.20 (39.31)	41.69 (40.08)	40.45 (39.44)	27.31 (31.40)
7.	Untreated control		31.00	-	-	-	-	-	-	-	-	-	-
	S.E.±			0.395	1.592	1.162	0.555	0.996	0.955	0.679	1.089	0.481	0.496
	C.D. (P=0.05)			1.211	4.885	3.566	1.702	3.055	2.931	2.084	3.340	1.477	1.522

PTP: Pre treatment population, Transformed values in parenthesis, DAS- Days after spraying

Lecanicillium lecanii 2 x 108 cfu/g) have also proved effective against untreated control. Sutaria *et al*. (2010) concluded that Thiamethoxam 0.05 per cent, acetamiprid 0.04 per cent and imidacloprid 0.01 per cent were most effective treatments to control the jassid in soybean.

These results are in conformity with the findings of Pachundkar *et al*. (2013) that imidacloprid, Thiamethoxam and acephate effectively control the *Empoasca kerri, Bamicia tabaci, Megaleurothrips distalis*. The higher effectiveness was observed with the application of Thiamethoxam 25 WG (0.0125%) and clothianidin 50 WDG (0.025%) against jassid and whitefly, whereas imidacloprid 70 WG (0.015%) against jassids and spiromesifen 240 SC (0.0192%) against whitefly. Ethion 50 EC (0.05%) and Thiacloprid 48 SC (0.012%) were found less effective against sucking insect pests of clusterbean. Carbosulfan, fipronil and acephate were observed comparatively less effective against jassid and whitefly in clusterbean.

The results obtained from the present study are in confirmitty with Kumawal and Kumar (2007) who reported that acetamiprid @ 80 g a.i/ha provided significantly superior control of leafhoppers in soybean. Suganya *et al*. (2007) revealed that acetamiprid 20 SP at 20 g a.i. ha^{-1} did not show any phytotoxic symptoms on cotton even at higher doses and highly effective against leafhoppers and aphids in cotton. Raghuraman *et al*. (2008) reported that acetamiprid 20 per cent SP at three doses *i.e.* 20, 40 and 80 g a.i./ha were effective in suppressing the population of leafhoppers and whiteflies significantly upto nine days in cotton. The above report is in line with the present findings.

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