International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; SP-8(4): 144-150

Received: 01-05-2020
Accepted: 03-06-2020

B Prajna Devaiah
Department of Agricultural Entomology, College of Agriculture, V.C. farm, Mandya, UASB, Karnataka, India

L Vijay Kumar
Professor of Agricultural Entomology, College of Agriculture, V.C. farm, Mandya, UASB, Karnataka, India

K Sunil
Department of Agricultural Entomology, University of Agricultural Sciences, Bengaluru, Karnataka, India

GC Manjunath
Department of Sericulture, University of Agricultural Sciences, Bengaluru, Karnataka, India

Corresponding Author:
B Prajna Devaiah
Department of Agricultural Entomology, College of Agriculture, V.C. farm, Mandya, UASB, Karnataka, India

Bio-efficacy of selected new insecticides against mired bug *Poppiocapsidea biseratense* (Distant) and cost economics of mirid bug management in sesame

B Prajna Devaiah, L Vijay Kumar, K Sunil and GC Manjunath

DOI: https://doi.org/10.22271/chemi.2020.v8.i4c.9881

Abstract
During *Kharif 2018,* a field experiment was conducted at College of Agriculture, V. C. Farm, Mandya to study the bio-efficacy of certain insecticides against mirid bug, *P. biseratense* and the economical feasibility was also studied. The studies showed that among nine insecticide molecules tested for their bio-efficacy against mirid bug, the seed treatment along with foliar sprays of imidacloprid 60 FS and thiamethoxam 25 WG @ 0.3 g/l found to be effective and this was followed by flonicamid 50 WG @ 0.4 g/l, imidacloprid 60 FS + acetamiprid 20 SP @ 0.3 g/l and clothianidin 50 WDG @ 0.1 g/l.

Keywords: *Poppiocapsidea biseratense,* sesame, insecticides and cost economics

Introduction
Sesame is one of the oldest domesticated oilseeds known by the human beings (Weiss, 1971) [13] and they are mainly cultivated in tropical and warm temperate regions for its seeds that contain about 50 per cent fat, 23 per cent carbohydrates and also protein about 18 per cent (Sasikumar and Kumar, 2015) [10]. Despite of its greater importance, the productivity and yield level in major growing regions are low. The decrease in yields has been attributed to several factors among which insect pests have a heavy toll in the yield loss. Among different insect pest recorded on sesame in India, leaf webber, *Antigastra catalaunalis* Duponchel (Pyraustidae: Lepidoptera), sphinx caterpillar, *Acherontia styx* West. (Sphingidae: Lepidoptera); gall fly, *Asphondylia sesami* Felt (Cecidomyiidae: Diptera); cotton aphid, *Aphis gossypii* Glover (Aphididae: Homoptera); leaf hopper, *Orosius albicinctus* Distant (Cicadellidae: Homoptera) (Ahuja and Bakhetia, 1995) [1] and mirid bugs were considered as major importance. Among mirid bugs, three species *viz*., *Poppiocapsidea biserratense* (Distant), *Nesidiocoris tenuis (*Reuter) and *Calocoris* sp. were observed throughout the cropping season. Among the three species of mirid bugs, *P. biserratense* (Distant) was the dominant species causing heavy flower dropping during flower and pod initiation stage. Earlier the mirid bugs were considered as of minor importance, but due intensive cultivation of sesame especially in early and late *Kharif* as major pre-monsoon crop, the bugs assumed major status (Jyothi, 2017) [5].
Mirid bugs (Miridae: Hemiptera) are known as leaf bugs or capsid bugs feeds on wide range of dicots. Both adults and nymph are very active in sunny hours and sucks the sap from leaves, flowers, branches, and pods there by heavy shedding of flowers and young leaves along with brown scars and necrotic lesions on the infested plant parts. The feeding activity of the nymph and adults also results in morphological and biochemical changes in the tissue which leads to reduction in the yield.

Materials and Methods
To study the bio-efficacy of selected new and conventional insecticides against mirid bug, *P. biserratense,* a field experiment was laid out in Randomized Completely Block Design (RCBD) with 10 treatments, including an untreated control replicate thrice. A popular and susceptible variety GT - 1 was sown in *Kharif* 2018 with a spacing of 30 X 15 cm and all package of practices was followed except plant protection measures.

The observations on the incidence of mirid bugs were recorded on 10 designated plants in each replication on leaves, flowers and capsules. An hour before sowing, imidacloprid 60 FS was treated in respective treatments. The foliar spray was given 35 days after sowing except for the seed treatments with imidacloprid 60 FS. To find out the efficacy of seed treatment chemicals in combination with foliar sprays, the pre-treatment observations were made one day before spray in all the treatments. Further to know the efficacy of seed treated and foliar spray chemicals alone and in combination, the post count observations were recorded on 1, 5, 7, 14, 21 and 28 day after spray and per cent reduction of *P. biserratense* was worked out for the last observations. The data on mean mirid bug population in each replications of treatment was processed by using angular transformation ($\sqrt{x+0.5}$) and were subjected for ANOVA (Gomez and Gomez, 1984; Hosmand, 1988) [3, 4] and means were separated by Tukey's HSD (Tukey, 1953) [11]. The harvesting was made at physiological maturity and cost economics for each treatment was worked out. The per cent reduction over untreated control was worked out using modified Abbot's formula (Fleming and Ratnakaran, 1985) [2].

Bio-efficacy of new insecticides against *P. biseratense*, Summer 2018

In the present investigations, nine insecticides were evaluated under field conditions under high pest pressure against *P. biseratense* along with an untreated control. The results obtained from the investigations during *Summer* are presented here under (Table 1; Fig 1).

A day before foliar spray all the seed treated chemicals proved their efficacy at 35 DAS. The number of mirid bugs recorded in imidacloprid 60 FS 5 ml / kg, registered 3.90, 4.20, 3.80 bugs / plant, respectively in all three initial treatments and were on par with each other but before the foliar spray the mirid bug population was in between 5.90 to 6.80 bugs / plant.

One day after spray each treatment differed significantly. The number of mirid bugs population in imidacloprid 60FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g , flonicamid 50 WG @ 0.4 g and clothianidin 50 WDG @ 0.1 g recorded 1.10 bugs / plant followed by imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g and Imidacloprid 17.8 SL @ 0.3 ml with 1.30 bugs / plant which were on par with each other. The treatments *viz.*, thiocloprid 21.7 SC @ 1 ml, dimethoate 30 EC @ 2 ml, imidacloprid 60 FS @ 5 ml and thiamethoxam 25 WG @ 0.3 g recorded 1.50, 1.70, 2.10 and 2.10 bugs / plant, respectively. However, untreated control showed highest bug population of 5.10 per plant.

Five days after spray, imidacloprid 17.8 SL @ 0.3 ml recorded 0.60 bugs / plant followed by imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g, imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g, flonicamid 50 WG @ 0.4 g, thiocloprid 21.7 SC @ 1 ml, dimethoate 30 EC @ 2 ml, clothianidin 50 WDG @ 0.1 g, thiamethoxam 25 WG @ 0.3 g which recorded 0.70, 0.70, 0.70. 0.80, 0.80, 0.90 and 0.90 bugs / plant which were on par with each other. However, imidacloprid 60 FS @ 5 ml recorded 2.10 bugs / plant. Likewise, higher bug population was noticed in the untreated control (5.90 bugs / plant)

Seven days after spray, the treatments imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g, imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g and thiamethoxam 25 WG @ 0.3 g recorded 0.60 bugs / plant which were on par with each other followed by imidacloprid 17.8 SL @ 0.3 ml, clothianidin 50 WDG @ 0.1 g, flonicamid 50 WG @ 0.4 g, thiocloprid 21.7 SC @ 1 ml and dimethoate 30 EC @ 2 ml with 0.70, 0.70, 0.70, 0.80 and 0.90 bugs / plant, respectively and were on par with each other. The higher population was recorded in untreated control (6.40 bugs / plant) followed by imidacloprid 60 FS @ 5 ml (2.70 bugs / plant).

Fourteen days after spray, the number of mirid bug population in dimethoate 30 EC @ 2 ml, imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g, imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g, thiamethoxam 25 WG @ 0.3 g, flonicamid 50 WG @ 0.4 g and imidacloprid 17.8 SL @ 0.3 ml was 1.90, 2.00, 2.10, 2.20, 2.30 and 2.30 bugs / plant. The next best treatments were thiocloprid 21.7 SC @ 1 ml, imidacloprid 60 FS @ 5 ml and clothianidin 50 WDG @ 0.1 g which recorded 2.50, 2.60 and 2.70 bugs / plant and were on par with each other. In untreated control bug count reached the peak of 4.90 bugs / plant.

Twenty one days after spray, the lowest bug population was recorded in imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3g (0.40 bugs/plant) and this was followed by thiocloprid 21.7 SC @ 1 ml, clothianidin 50 WDG @ 0.1 g, thiamethoxam 25 WG @ 0.3 g, flonicamid 50 WG @ 0.4 g, imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g and imidacloprid 17.8 SL @ 0.3 ml which recorded 0.60, 0.60, 0.70, 0.70 and 0.80 bugs / plant, respectively and were on par with each other. The next best treatment was dimethoate 30 EC @ 2 ml with 0.90 bugs / plant. The highest population was recorded in untreated control (3.80 bugs / plant) followed by imidacloprid 60 FS @ 5 ml noticed 2.50 bugs / plant.

Twenty-eight days after spray, imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g, clothianidin 50 WDG @ 0.1 g, imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g, flonicamid 50 WG @ 0.4 g, imidacloprid 17.8 SL @ 0.3 ml, thiocloprid 21.7 SC @ 1 ml, thiamethoxam 25 WG @ 0.3 g and dimethoate 30 EC @ 2ml registered 0.40, 0.40, 0.50, 0.50, 0.50, 0.70 and 0.70 bugs / plant. The highest population was recorded in imidacloprid 60 FS @ 5 ml recorded 2.30 bugs / plant. However, untreated control showed highest population of 3.90 bugs / plant.

The percent reduction over control (28 DAS) was highest in imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g and clothianidin 50 WDG @ 0.1 g with 89.74 per cent reduction in bug population. Followed by imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g, flonicamid 50 WG @ 0.4 g and thiocloprid 21.7 SC @ 1 ml with 87.17 reduction over control. Whereas, imidacloprid 17.8 SL @ 0.3 ml thiamethoxam 25 WG @ 0.3 g and dimethoate 30 EC @ 2 ml recorded 82.05, 82.05 and 79.48 per cent reduction over control, respectively. The least reduction in pest population was registered in imidacloprid 60 FS @ 5 ml (41.02 %).

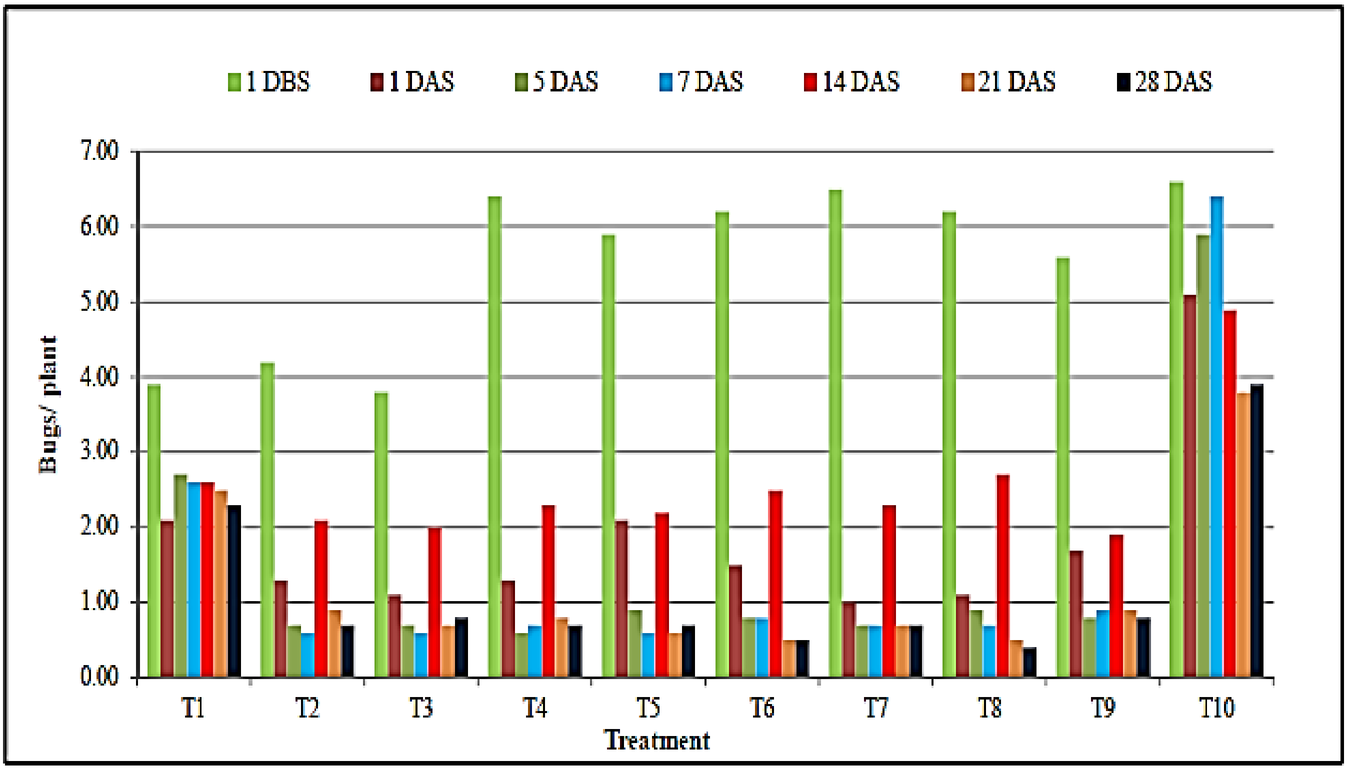

Fig 1: Bioefficacy of new insecticides against mirid bug, *P. biseratense* on sesame, *Summer* 2018

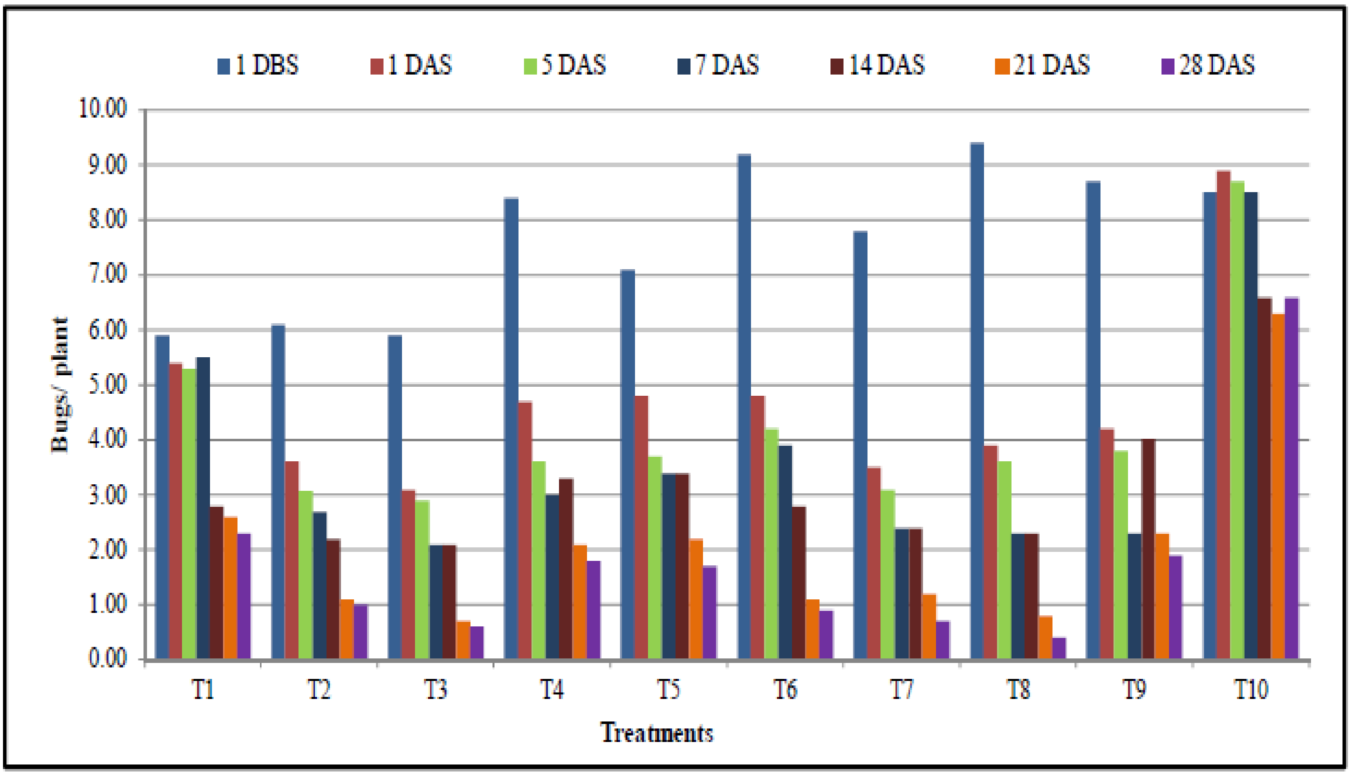

Fig 2: Bioefficacy of new insecticides against mirid bug, *P. biseratense* on sesame, *Kharif* 2018.

T1 : Imidacloprid 60 FS @ 5ml/kg
T2 : Imidacloprid60 FS @ 5ml/kg + Acetamiprid 20 SP @ 0.3g/l
T3 : Imidacloprid60 FS@ 5ml/kg + Thiamethoxam 25 WG @0.3g/l
T4 : Imidacloprid 17.8 SL @0.3ml/l
T5 : Thiamethoxam 25 WG @ 0.3g/l
T6 : Thiocloprid 21.7 SC @ 1ml/l
T7 : Flonicamid 50 WG @ 0.4g/l
T6 : Clothianidin 50 WDG @ 0.1g/l
T9 : Dimethoate 30 EC @ 2ml/l

Table 1: Bio-efficacy of new insecticides against *P. biseratense, Summer* 2018

Sl. No.	Treatment	Dose (ml or g / lit)	Mirid bug / plant							Per cent reduction over control
			DBS	1 DAS	5 DAS	7 DAS	14 DAS	21 DAS	28 DAS	
1	Imidacloprid 60 FS	5 ml	3.90 (2.09)	2.10 (1.61)	2.70 (1.78)	2.60 (1.76)	2.60 (1.76)	2.50 (1.73)	2.30 (1.67)	41.02
2	Imidacloprid 60 FS + Acetamiprid 20 SP	5 ml + 0.3g	4.20 (2.16)	1.30 (1.34)	0.70 (1.09)	0.60 (1.04)	2.10 (1.61)	0.70 (1.09)	0.40 (0.94)	89.74
3	Imidacloprid 60 FS + Thiamethoxam 25 WG	5 ml + 0.3g	3.80 (2.07)	1.10 (1.26)	0.70 (1.09)	0.60 (1.04)	2.00 (1.58)	0.40 (0.94)	0.50 (1.00)	87.17
4	Imidacloprid 17.8 SL	0.3 ml	6.40 (2.62)	1.30 (1.34)	0.60 (1.04)	0.70 (1.09)	2.30 (1.67)	0.80 (1.14)	0.70 (1.09)	82.05
5	Thiamethoxam 25 WG	0.3 g	5.90 (2.52)	2.10 (1.61)	0.90 (1.18)	0.60 (1.04)	2.20 (1.64)	0.60 (1.04)	0.70 (1.09)	82.05
6	Thiocloprid 21.7 SC	1.0 ml	6.20 (2.58)	1.50 (1.41)	0.80 (1.14)	0.80 (1.14)	2.50 (1.73)	0.50 (1.00)	0.50 (1.00)	87.17
7	Flonicamid 50 WG	0.4 g	6.50 (2.64)	1.10 (1.26)	0.70 (1.09)	0.70 (1.09)	2.30 (1.67)	0.60 (1.04)	0.50 (1.00)	87.17
8	Clothianidin 50 WDG	0.1 g	6.20 (2.58)	1.10 (1.26)	0.90 (1.18)	0.70 (1.09)	2.70 (1.78)	0.50 (1.00)	0.40 (0.90)	89.74
9	Dimethoate 30 EC	2.0 ml	5.60 (2.46)	1.70 (1.48)	0.80 (1.14)	0.90 (1.18)	1.90 (1.54)	0.90 (1.18)	0.80 (1.14)	79.48
10	Untreated control	-	6.60 (2.66)	5.10 (2.36)	5.90 (2.52)	6.40 (2.62)	4.90 (2.32)	3.80 (2.07)	3.90 (2.09)^{f}	-
SE m±			0.15	0.12	0.11	0.21	0.28	0.36	0.31	-
CD @ p = 0.05			0.48	0.36	0.34	0.68	0.80	1.08	1.02	-

* DBS: Day before spraying; DAS: Day after spraying; Values in the column followed by common letters are non-significant at p = 0.05 as per Tuckey's HSD (Tukey, 1965). Figures in the parenthesis indicate √x+0.5 transformed values

Bio efficacy of new insecticides against, *P. biseratense, Kharif* 2018.

In the present investigations, nine insecticides were evaluated under field conditions with high pest pressure against mirid bugs along with an untreated control. The results obtained from the investigations during *Kharif* are presented here under (Table 2; Fig 2).

A day before foliar spray all the seed treated chemicals proved their efficacy at 35 DAS. The number of mirid bugs recorded in imidacloprid 60 FS 5 ml / kg registered 5.90, 6.10, 5.90 bugs / plant, respectively in all three initial treatments and were on par with each other but before the foliar spray the mirid bug population is in between 8.70 to 9.30 bug / plant and were on par with each other. However, untreated control showed highest bug population of 5.10 per plant.

One day after spray each treatment differed significantly. The number of mirid bugs population in imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g , flonicamid 50 WG @ 0.4 g and imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g recorded 3.10, 3.50 and 3.60 bugs / plant, respectively followed by clothianidin 50 WDG @ 1 g/l (3.90 bugs / plant). The least control on the first day after spray was noticed in thiamethoxam 25 WG @ 0.3 g and thiocloprid 21.7 SC @ 1 ml/l with 4.80 bug / plant in each chemical along with imidacloprid 60 FS @ 5 ml/kg (5.40). Whereas, in untreated control the bug population had reached the peak (8.90 bugs / plant).

Five days after spray, the treatments imidacloprid 60 FS @ 5 ml + thiamethoxam 25WG @ 0.3 g, imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g, Flonicamid 50 WG @ 0.4 g/l and clothionidin 50 WDG @ 0.1 g/l recorded 2.90, 3.08, 3.10 and 3.60 bugs / plant which were on par with each other followed by imidacloprid 17.8 SL @ 0.3 ml, thiamethoxam 25 WG @ 0.3 g, dimethoate 30 EC @ 2ml and thiocloprid 21.7 SC @ 1 ml with 3.60, 3.70, 3.80 and 4.20 bugs / plant, respectively and they were on par with each other. The higher population was recorded in imidacloprid 60 FS @ 5 ml registered 5.30 bugs / plant. Likewise, higher bug population was noticed in the untreated control (8.70 bugs / plant).

Seven days after spray the treatments imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g recorded 2.10 bugs / plant followed by clothianidin 50 WDG @ 0.1 g, flonicamid 50 WG @ 0.4 g and imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g,which recorded 2.30, 2.40 and 2.70 bugs / plant , respectively and they were on par with each other. The higher population was recorded in imidacloprid 60 FS @ 5 ml registered 5.50 bugs / plant next to the untreated control (8.50 bugs / plant).

Fourteen days after spray, the number of mirid bug population in imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g, clothianidin 50 WDG @ 0.1 g, flonicamid 50 WG @ 0.4 g and imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g imidacloprid 17.8 SL @ 0.3ml registered 2.10, 2.30, 2.40 and 2.20, bugs / plant. Further, thiocloprid 21.7SC @ 1 ml and imidacloprid 60 FS @ 5 ml recorded the the bug population of 2.80 per plant. The next best treatments were imidacloprid 17.8 SL @ 0.3 ml, thiamethoxam 25 WG @ 0.3 g and dimethoate 30 EC @ 2 ml/l which recorded 3.30, 3.40 and 4.20 bugs / plant and were on par with each other. In untreated control bug count reached the peak of 6.60 bugs / plant.

Twenty one days after spray, the lowest bug population was recorded in imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g (0.70 bugs / plant) followed by clothianidin 50 WDG @ 0.1 g, flonicamid 50 WG @ 0.4 g and thiocloprid 21.7 SC @ 1 ml/l which recorded 0.90, 1.00 and 1.10 bugs / plant, respectively and were on par with each other. The highest population was recorded in untreated control (6.30 bugs / plant) followed by imidacloprid 60 FS @ 5 ml registered 2.60 bugs / plant.

Twenty eight days after spray, the lowest bug population was recorded in flonicamid 50 WG @ 0.4 g (0.40 bugs / plant) followed by imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g, clothianidin 50 WDG @ 0.1 g and thiocloprid 21.7 SC @ 1 ml/l which recorded 0.60, 0.70 and 0.90 bugs / plant, respectively and were on par with each other. The highest population was recorded in imidacloprid 60 FS @ 5 ml recorded 2.30 bugs / plant. However, untreated control showed highest population of 6.60 bugs / plant.

The percent reduction over control (28 DAS) was highest in flonicamid 50 WG @ 0.4 g with the reduction of 93.94 per cent followed by imidacloprid 60 FS @ 5 ml + thiamethoxam 25 WG @ 0.3 g (90.91 %), thiocloprid 21.7 SC @ 1 ml (86.36 %), imidacloprid 60 FS @ 5 ml + acetamiprid 20 SP @ 0.3 g with 84.85 per cent in bug population, repectively. Further followed by clothianidin 50 WDG @ 0.1 g and thiamethoxam 25 WG @ 0.3 g with 74.24 per cent reduction in bug population. The least reduction in pest population was registered in imidacloprid 60 FS @ 5 ml (65.15 %)

Table 2: Bio efficacy of new insecticides against, *P. biseratense, Kharif 2018*

Sl. No.	Treatment	Dose (ml or g / lit)	Mirid bug / plant							*Per cent reduction over control
			DBS	1 DAS	5 DAS	7 DAS	14 DAS	21 DAS	28 DAS	
1	Imidacloprid 60 FS	5 ml/kg	5.90 (2.52)	5.40 (2.42)	5.30 (2.40)	5.50 (2.44)	2.80 (1.81)	2.60 (1.76)	2.30 (1.67)	65.15
2	Imidacloprid 60 FS + Acetamiprid 20 SP	5 ml + 0.3 g	6.10 (2.56)	3.60 (2.02)	3.08 (1.89)	2.70 (1.78)	2.20 (1.64)	1.50 (1.41)	1.00 (1.22)	84.85
3	Imidacloprid 60 FS + Thiamethoxam 25 WG	5 ml + 0.3 g	5.90 (2.52)	3.10 (1.89)	2.90 (1.84)	2.10 (1.61)	2.10 (1.61)	0.70 (1.10)	0.60 (1.04)	90.91
4	Imidacloprid 17.8 SL	0.3 ml	9.00 (3.08)	4.70 (2.28)	3.60 (2.02)	3.00 (1.87)	3.30 (1.64)	2.10 (1.61)	1.80 (1.51)	72.72
5	Thiamethoxam 25 WG	0.3 g	9.30 (3.13)	4.80 (2.30)	3.70 (2.04)	3.40 (1.97)	3.40 (1.97)	2.20 (1.64)	1.70 (1.48)	74.24
6	Thiocloprid 21.7 SC	1.0 ml	9.20 (3.11)	4.80 (2.30)	4.20 (2.16)	3.90 (2.09)	2.80 (1.81)	1.10 (1.26)	0.90 (1.18)	86.36
7	Flonicamid 50 WG	0.4 g	9.30 (2.96)	3.50 (2.00)	3.10 (1.89)	2.40 (1.70)	2.40 (1.70)	1.00 (1.22)	0.40 (0.94)	93.94
8	Clothianidin 50 WDG	0.1 g	9.40 (3.14)	3.90 (2.09)	3.60 (2.02)	2.30 (1.67)	2.30 (1.67)	0.90 (1.18)	0.70 (1.09)	74.24
9	Dimethoate 30 EC	2.0 ml	8.70 (3.03)	4.20 (2.16)	3.80 (2.07)	3.40 (1.97)	4.02 (1.97)	2.30 (1.67)	1.90 (1.54)	71.21
10	Untreated control	-	9.00 (3.08)	8.90 (3.06)	8.70 (3.03)	8.50 (3.00)	6.60 (2.66)	6.30 (2.60)	6.60 (2.67)	-
SE m±			0.15	0.30	0.41	0.36	0.28	0.43	0.52	-
CD @ p = 0.05			0.48	1.10	1.16	1.28	1.03	1.48	1.56	-

DBS: Day before spraying; DAS: Day after spraying; Values in the column followed by common letters are non-significant at p = 0.05 as per Tuckey's HSD (Tukey, 1965). Figures in the parenthesis indicate √x+0.5 transformed values.; *per cent reduction over control @ 28 days after spray.

The present investigation on selection of new molecules against mirid bugs are in line with the findings made by Muhammad *et al.* (2005) reported that acetamiprid, imidacloprid and thiamethoxam were proved to be effective in reducing the leafhopper population up to seven days after the application. Similarly, Patil *et al.* (2007) [8] revealed the bio-efficacy of chlothiandin 50 % WDG at different dosage rendered a good protection to crops against the sucking pest and also added to the increased yield of the crop while compared to other chemicals.
Likewise, Udikeri *et al.* (2009) [12] reported that acephate 70SP @ 1g/l was superior in reducing the mirid bug infestation followed by acetamiprid 20 SP @ 0.2 g/l and imidacloprid 17.8 SL @ 0.2 ml/l. In the same way, the findings reported by Prasad *et al.* (2011) [9] showed that imidacloprid 17.8 SL @ 40 g a.i./ha, acetamiprid 20 SP @ 20 g a.i./ha and thiamethoxam 25 WD @ 25 g a.i./ha gave an effective control on sucking pest on cotton both during *Summer* and in *Kharif.*

Cost economics of mirid bug management in sesame

Among the treatments, the higher yield (6.21 q/ha) was recorded in seed treatment with imidacloprid 60FS @ 5ml/l and foliar spray with thiamethoxam 25 WG @ 0.3 g/l, followed by, seed treatment with imidacloprid 60 FS @ 5 ml/l and foliar spray with acetamiprid 20 SP @ 0.3 g/l, flonicamid 50 WG @ 0.4 g/l and thiocloprid 21.7 SC @ 1 ml/l, which recorded 5.81, 5.64 and 5.48 q/ha, respectively. Similarly, the lower yield was recorded in dimethoate 30 EC @ 2 ml/l (4.61 q/ha) followed by seed treatement with imidacloprid 60 FS 5 ml/l (4.72 q/ha) and imidacloprid 17.8 SL @ 0.3 ml/l (5.12 q/ha). However, the lowest yield (2.20 q/ha) was recorded in untreated control (Table 3; Fig 3).
Among the treatments, the highest net profit (60,680/ha) was recorded in seed treatment with imidacloprid 60 FS @ 5 ml/l and foliar spray with thiamethoxam 25 WG @ 0.3 g/l this was followed by seed treatment with imidacloprid 60 FS @ 5 ml/l and foliar spray with acetamiprid 20 SP @ 0.3 g/l (Rs.55,810/ha). Likewise, the treatments *viz*., flonicamid 50 WG @ 0.4 g/l, thiamethoxam 25 WG @ 0.3 g/l, thiocloprid 21.7 SC @ 1 ml/l, clothianidin 50 WDG @ 0.1 g/l, imidacloprid 17.8 SL @ 0.3 ml/l, seed treatment with imidacloprid 60 FS 5 ml/l and dimethoate 30 EC @ 2 ml/l recorded a net profit of Rs. 52551, 51345, 51054, 49011, 47620, 42935 and 41290 per hectare respectively. However the lowest net profit (Rs. 12720/ha) was recorded in untreated control (Table 3; Fig 3)

Table 3: Cost economics of insect management in sesame, *Kharif* 2018

Treatment	Dose (a.i. ha^{-1})	Dose (ml or g/l)	Yield (q ha^{-1})	Gross returns (Rs.)	Cost involved (Rs. ha^{-1}) Other expenditure	Cost of Insecticide	Total cost (Rs.)	Net profit (Rs.)	C:B ratio
Imidacloprid 60 FS	24 ml	5 ml/kg	4.72	56,640	13,680	25.00	13,705	42,935	1: 3.13
Imidacloprid 60 FS + Acetamiprid 20 SP	24 ml + 54 g	5 ml/kg + 0.3 g	5.81	69,720	13,680	230.00	13,910	55,810	1: 4.01
Imidacloprid 60 FS + Thiamethoxam 25 WG	24 ml + 67.5 g	5 ml/kg + 0.3 g	6.21	74,520	13,680	160.00	13,840	60,680	1: 4.38
Imidacloprid 17.8 SL	48.06 ml	0.3 ml	5.12	61,440	13,680	110.00	13,790	47,650	1: 3.46
Thiamethoxam 25 WG	67.5 g	0.3 g	5.43	65,160	13,680	135.00	13,815	51,345	1: 3.72
Thiocloprid 21.7 SC	195.3 ml	1 ml	5.48	65,760	13,680	1026.00	14,706	51,054	1: 3.47
Flonicamid 50 WG	180.0 g	0.4 g	5.64	67,680	13,680	1449.00	15,129	52,551	1: 3.47
Clothianidin 50 WDG	45.0 g	0.1 g	5.27	63,240	13,680	549.00	14,229	49,011	1: 3.44
Dimethoate 30 EC	540.0 ml	2 ml	4.61	55,320	13,680	349.20	14,029	41,290	1: 2.94
Untreated control	-	-	2.20	26,400	13,680	0.00	13,680	12,720	1: 0.93

*Average price of sesame: Rs. 12000 per quintal as per APMC, Mandya

The highest cost benefit ratio (1: 4.38) was recorded seed treatment with imidacloprid 60 FS @ 5 ml/l and foliar spray with thiamethoxam 25 WG @ 0.3 g/l followed by imidacloprid 60 FS @ 5 ml/l + acetamiprid 20 SP @ 0.3 g/l, thiamethoxam 25 WG @ 0.3 g/l, flonicamid 50 WG @ 0.4 g/l, thiocloprid 21.7 SC @ 1 ml/l, and which recorded 1: 4.01, 1: 3.72, 1: 3.47 and 1: 3.47 respectively. Similarly, the cost benefit ratio recorded in imidacloprid 17.8 SL 0.3 ml/l, clothianidin 50 WDG @ 0.1 g/l, imidacloprid 60 FS 5 ml/l and dimethoate 30 EC @ 2 ml/l was 1: 3.46, 1: 3.44, 1: 3.13 and 1: 1.68, respectively. However, the lowest cost benefit ratio (1: 0.93) was recorded in untreated control (Table 3; Fig 3).

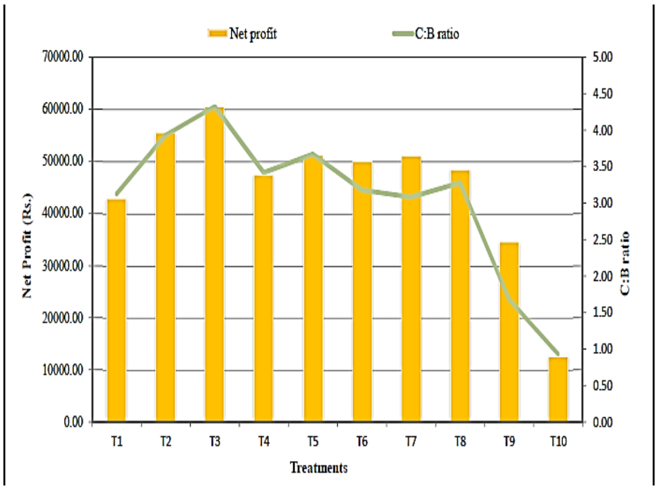

Fig 3: Cost economics of different insecticides for management of mirid bug, *P. biseratense* in sesame, *Kharif* 2018.

Conclusion

Among nine insecticide molecules tested for their bio-efficacy against mirid bugs, the seed treatment along with foliar sprays of imidacloprid 60 FS and thiamethoxam 25 WG @ 0.3 g/l found to be effective and this was followed by flonicamid 50 WG @ 0.4 g/l, imidacloprid 60 FS + acetamiprid 20 SP @ 0.3 g/l and clothianidin 50 WDG @ 0.1 g/l. The cost economics of mirid bug management revealed that, among the treatments the highest yield (6.21 q/ha) was registered in the seed treatment along with foliar sprays of imidacloprid 60 FS @ 5 ml/g and thiamethoxam 25 WG @ 0.3 g/l. This was followed by imidacloprid 60 FS + acetamiprid 20 SP @ 0.3 g/l and flonicamid 50 WG @ 0.4 g/l, which recorded 5.81, 5.64 q/ha respectively. Among the treatments the highest net profit (Rs. 60,680/ha) was recorded in the seed treatment along with foliar sprays of imidacloprid 60 FS and this was followed by seed treatment with imidacloprid 60 FS @ 5 ml/l and foliar spray with acetamiprid 20 SP @ 0.3 g/l (Rs.55,810/ha). The highest cost benefit ratio (1: 4.38) was recorded in imidacloprid 60 FS @ 5 ml/l and foliar spray with thiamethoxam 25 WG @ 0.3 g/l followed by imidacloprid 60 FS @ 5 ml/l + acetamiprid 20 SP @ 0.3 g/l (1: 3.46).

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