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Studies on the field efficacy of certain insecticides against web worm *Antigastra catalaunalis* (Duponchel) infesting sesame

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Abstract
Field evaluations were conducted during *Kharif* and *Rabi* seasons of 2019-2020 at two locations in Thondamuttur and Pooluvapatti village of Coimbatore district, Tamil Nadu, India to assess the efficacy of certain insecticides against web worm, *Antigastra catalaunalis* (Dup.) infesting sesame. The mean percent reduction in leaf and capsule damage low in all the insecticidal treatments its proved that significantly superior over the in reducing the pest population. The overall mean percent reduction in leaf damage was recorded in the treatment with Chlorantraniliprole 18.5 SC @ 27.75 g a.i./ha (83.26% and 79.96% for location 1 and 2 respectively) in both the locations during both the seasons and next best treatment Spinosad 45 SC@ 33.75 g a.i./ha (76.35% and 74.73% for location 1 and 2 respectively) compared to untreated check. The mean percent reduction in capsule damage over control was registered in the treatment with Chlorantraniliprole 18.5 SC @ 27.75 g a.i. /ha (95.63% and 91.51% for location 1 and 2 respectively) next best treatment Spinosad 45 SC@ 33.75 g a.i./ha (81.15% and 78.64% for location 1 and 2 respectively) compared untreated check. Maximum yiled in the treatment of Chlorantraniliprole 18.5 SC @ 27.75 g a.i./ha (600.33 and 571.99 kg/ha for location 1 and 2 respectively) in untreated check (318.93 and 327.97 kg/ha for location 1 and 2 respectively).

Keywords: Sesame, *Antigastra catalaunalis*, bio-efficacy, insecticides

Introduction
Sesame (*Sesamum indicum* L.) commonly called as Til, is one of popular oilseed crops. It belongs to family Pedaliaceae and is described as 'Queen of Oilseed crops' because of its high oil content (46-52%) and high protein content (18-20%). The web worm, *Antigastra catalaunalis* (Dup) is one of the major pests of sesame in India that causes severe losses in crop yield. This pest is active from germination to till the harvest of the crop and hence designated as a key pest of sesame (Thakur and Ghorpade, 2006). In order to address the various insect pests that need to be controlled with a variety of pesticides, pest management is essential and new discoveries must be developed to close the current research gaps. Farmers mostly rely on chemical control, despite a variety of other pest management strategies (Dhaliwal and Koul, 2010) [2]. New pesticide compounds require scientific review in order to generate commercially viable, socially adaptive, and ecologically acceptable sound pest management practises. In light of the aforementioned, this study was carried out to assess specific more recent pesticides against A. catalaunalis that infests sesame.

Material and Methods
Studies on the efficacy of insecticides against *A. catalaunalis* on sesame was conducted during *kharif* and *Rabi* seasons during the 2019-2020 at Thondamuttur and Pooluvapatti village of Coimbatore district, Tamil Nadu, India. The experiment was lay out in a Randomized Block Design (RBD) with three replications with eleven treatments each plot having 5 x 4 square meter plot with a spacing of 30 x 30 cm and the variety used was TMV 4.The recommended doses of fertilizers *viz*.,18:23:23 kg/ha of NPK respectively and 25t/ha of FYM as basal dose, 10 and 7 kg/ha of N at 25 and 45 days after sowing respectively were applied. Observations on leaf damage and capsule damage were recorded on 10 randomly selected plants in each plot from 30 days after sowing (DAS) and continued up to 90 DAS. The leaf damage by *A. catalaunalis* was assessed based on the total number of leaves and affected leaves on 10 randomly selected plants in a plot and the per cent leaf damage was worked out.

$$\text{Per cent leaf damage} = \frac{\text{No. of affected leaves}}{\text{Total no. of leaves}} \times 100$$

The pod damage by *A. catalaunalis* was assessed based on the total number of pods and affected pods on 10 randomly selected plants in a plot and the per cent pod damage was worked out (Philiip Sridhar, 1990).

$$\text{Per cent pod damage} = \frac{\text{No. of affected pods}}{\text{Total no. of pods}} \times 100$$

The foliar treatments were given using high volume sprayer (Hand operated knapsack sprayer). Three foliar applications were given at 30th, 45th and 60th DAS. The observations were recorded at 1, 3, 5, 7 and 14 days after treatment (DAT) and over all mean data were computed for *Kharif* and *Rabi* seasons of 2019-2020.The grain yield was recorded at harvest. The per cent data recorded for leaf, pod damage was converted into corresponding angular transformation (Arcsine) if the values ranged from 0 to 100 for statistical analysis (Snedecor and Cochran, 1967). The data obtained from the field were analysed in a simple Randomized Block Design by "F" test for significance as described by Panse and Sukhatme (1958) [5]. Critical difference values were calculated at 5 per cent probability level and the treatment mean values of the experiments were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) [3].

Table 1: Details of the insecticidal treatments against *A. catalaunalis*

Treatment No.	Treatments	Dose	Qty per ha (ml/gr)	Source
1	Profenofos 50 EC	500g a.i/ha	1000	Curacron™- Syngenta India limited-Mumbai
2	Chlorantraniliprole 18.5 SC	27.75 g a.i /ha	150	Coragen™-FMC India limited-Mumbai
3	Lambda cyhalothrin 5 EC	25 g a.i/ha	500	Karate™ -Syngenta India limited -Mumbai
4	Spinosad 45 SC	33.75 g a.i/ha	75	Tracer™- Dow agro science-Mumbai
5	Bifenthrin 10 EC	62.5 g a.i/ha	625	Talstar™-FMC India limited -Mumbai
6	Imidacloprid 17.8 SL	22.2 g a.i/ha	125	Tatamida™-Rallis India limited-Mumbai
7	Emamectin benzoate 5% SG	10 g a.i/ha	200	Proclaim™- Syngenta India limited-Mumbai
8	Azadirachtin	0.03%	2000	Azadirachtin ™-Peptech bio science limited-New Delhi
9	*Lecanicillium lecanii*	1.5 gr/lit	750	Verticilium lecani™-Peptech bio science limited- New Delhi
10	*Beauveria bassiana*	1.5 gr/lit	750	Beauveria bassiana ™-Peptech bio science limited- New Delhi
11	Untreated check	---		

Antigastra catalaunalis Images

Fig 1: *Antigastra catalaunalis* larva

Fig 2: *Antigastra catalaunalis* leaf damage

Fig 3: *Antigastra catalaunalis* capsule damage

Table 2: Field efficacy of certain insecticides against *A. catalaunalis* on sesame based on leaf damage.

Sl. No	Treatment	Dose	Location -1 Thondamuttur						Location -2 Pooluvapatti					
			Pre count	Kharif	Pre count	Rabi	Overall Mean	% reduction over control	Pre count	Kharif	Pre count	Rabi	Overall Mean	% reduction over control
1	Profenofos 50 EC	500g a.i/ha	13.60 (21.64)	9.22 (17.62)^{d}	14.85 (22.67)	7.97 (16.29)^{de}	8.60 (17.04)^{d}	60.31	12.65 (20.83)	10.23 (18.60)^{d}	14.59 (22.46)	8.33 (16.70)^{d}	9.28 (17.71)^{e}	57.59
2	Chlorantraniliprole 18.5 SC	27.75 g a.i/ ha	13.51 (21.56)	4.51 (12.22)^{a}	15.25 (22.99)	2.74 (9.51)^{a}	3.63 (10.90)^{a}	83.26	12.55 (20.75)	5.33 (13.34)^{a}	14.79 (22.62)	3.43 (10.64)^{a}	4.38 (12.01)^{a}	79.96
3	Lambda cyhalothrin 5 EC	25 g a.i/ha	13.74 (21.75)	6.63 (14.87)^{c}	14.95 (22.75)	5.45 (13.36)^{bc}	6.04 (14.21)^{bc}	72.12	12.10 (20.36)	7.46 (15.82)^{bc}	14.62 (22.48)	5.56 (13.58)^{bc}	6.51 (14.75)^{c}	70.23
4	Spinosad 45 SC	33.75 g a.i/ha	13.90 (21.89	5.72 13.78)^{b}	15.10 (22.87)	4.53 (12.06)^{b}	5.12 (13.06)^{b}	76.35	12.4 (20.62)	6.47 (14.69)^{b}	14.55 (22.42)	4.59 (12.30)^{b}	5.53 (13.55)^{b}	74.73
5	Bifenthrin 10 EC	62.5 g a.i/ha	13.20 (21.30)	7.53 (15.88)^{c}	15.40 (23.10)	6.54 (14.65)^{cd}	7.03 (15.37)^{c}	67.52	12.6 (20.79)	8.37 (16.78)^{c}	14.56 (22.43)	6.46 (14.67)^{c}	7.41 (15.77)^{d}	66.11
6	Imidacloprid 17.8 SL	22.2 g a.i/ha	13.04 (21.17)	19.12 (25.88)^{f}	15.20 (22.95)	18.35 (25.26)^{g}	18.74 (25.65)^{f}	13.47	12.8 (20.96)	20.07 (26.56)^{f}	14.87 (22.68)	18.25 (25.23)^{f}	19.16 (25.95)^{h}	12.40
7	Emamectin benzoate 5% SG	10 g a.i/ha	13.98 (21.96)	7.24 (15.57)^{c}	15.35 (23.07)	6.33 (14.39)^{cd}	6.78 (15.09)^{c}	68.68	12.9 (21.05)	8.04 (16.44)^{c}	14.23 (22.16)	5.91 (14.01)^{c}	6.97 (15.27)^{cd}	68.13
8	Azadirachtin	0.03%	13.90 (21.89)	10.36 (18.73)^{e}	14.85 (22.66)	9.58 (17.88)^{ef}	9.97 (18.40)^{e}	53.96	12.87 (21.02)	11.11 (19.44)^{de}	14.98 (22.77)	9.20 (17.61)^{de}	10.16 (18.56)^{f}	53.56
9	*Lecanicillium lecanii*	1.5 gr/lit	13.67 (21.70)	18.33 (25.29)^{f}	15.45 (23.15)	18.96 (25.60)^{gh}	18.65 (25.58)^{f}	13.89	12.98 (21.12)	20.25 (26.65)^{f}	14.89 (22.70)	18.37 (25.26)^{f}	19.31 (26.06)^{h}	11.73
10	*Beauveria bassiana*	1.5 gr/lit	13.70 (21.72)	11.20 (19.52)^{e}	14.90 (22.71)	10.37 (18.68)^{f}	10.78 (19.17)^{e}	50.20	12.65 (20.83)	11.97 (20.22)^{e}	14.76 (22.59)	10.04 (18.44)^{e}	11.01 (19.36)^{g}	49.69
11	Untreated check	-----	13.76 (21.77)	21.93 (27.87)^{g}	15.01 (22.79)	21.38 (27.43)^{h}	21.66 (27.73)^{g}		12.78 (20.95)	22.98 (28.59)^{g}	14.78 (22.61)	20.76 (27.04)^{g}	21.87 (27.88)^{i}	
	S.Ed		NS	0.51	NS	0.95	0.46		NS	0.64	NS	0.63	0.26	
	CD (P=0.05)			1.065		1.982	1.261			1.333		1.304	0.696	

In a column, means followed by a common letter are not significantly different by DMRT (p=0.05)
NS -Nonsignificant
Values in parentheses are arc sine transformed

Table 3: Field efficacy of certain insecticides against A. *catalaunalis* on sesame based on capsule damage

Sl. No	Treatment	Dose	Location -1 Thondamuttur						Location -2 Pooluvapatti					
			Pre count	Kharif	Pre count	Rabi	Overall Mean	% reduction over control	Pre count	Kharif	Pre count	Rabi	Overall Mean	% reduction over control
1	Profenofos 50 EC	500g a.i/ha	7.00 (15.34)^{e}	6.85 (15.18)f	6.00 (14.17)^{f}	8.09 (16.52)^{f}	7.47 (15.85)^{ef}	62.57	7.20 (15.56)^{f}	8.36 (16.80)^{e}	5.51 (13.57)^{f}	7.15 (15.51)^{e}	7.76 (16.16)^{e}	61.40
2	Chlorantraniliprole 18.5 SC	27.75 g a.i/ ha	3.65 (11.01)^{a}	0.82 (5.18)^{a}	3.00 (9.98)^{a}	0.93 (5.40)^{a}	0.87 (5.37)^{a}	95.63	4.25 (11.88)^{a}	2.31 (8.71)^{a}	2.56 (9.18)^{a}	1.10 (5.92)^{a}	1.71 (7.38)^{a}	91.51
3	Lambda cyhalothrin 5 EC	25 g a.i/ha	5.25 (13.24)^{c}	5.08 (13.03)c	4.45 (12.18)^{c}	5.92 (14.07)^{c}	5.50 (13.55)^{c}	72.45	5.67 (13.77)^{c}	6.59 (14.87)^{c}	4.07 (11.62)^{bc}	5.38 (13.41)^{c}	5.99 (14.15)^{c}	70.20
4	Spinosad 45 SC	33.75 g a.i/ha	4.12 (11.71)^{b}	3.39 (10.60)^{b}	4.15 (11.75)^{b}	4.14 (11.73)^{b}	3.76 (11.18)^{b}	81.15	5.37 (13.40)^{b}	4.90 (12.77)^{b}	3.75 (11.16)^{b}	3.69 (11.06)^{b}	4.29 (11.93)^{b}	78.64
5	Bifenthrin 10 EC	62.5 g a.i/ha	5.65 (13.75)^{d}	6.46 (14.72)e	5.25 (13.25)^{e}	7.45 (15.83)^{e}	6.95 (15.28)^{de}	65.16	6.45 (14.70)^{e}	7.97 (16.40)^{e}	4.83 (12.68)^{d}	6.76 (15.06)^{e}	7.36 (15.73)^{e}	63.36

6	Imidacloprid 17.8 SL	22.2 g a.i/ha	14.25 (22.18)^{i}	11.72 (20.02)^{j}	13.24 (21.34)^{j}	12.88 (21.02)^{i}	12.30 (20.53)^{i}	38.39	14.40 (22.30)^{j}	13.23 (21.33)^{i}	12.89 (21.04)^{i}	12.02 (20.28)^{i}	12.62 (20.81)^{i}	37.18
7	Emamectin benzoate 5% SG	10 g a.i/ha	5.35 (13.37)^{c}	5.74 (13.86)^{d}	4.85 (12.72)^{d}	6.76 (15.07)^{d}	6.25 (14.47)^{cd}	68.68	6.05 (14.23)^{d}	7.25 (15.62)^{d}	4.29 (11.95)^{c}	6.04 (14.22)^{d}	6.65 (14.93)^{d}	66.93
8	Azadirachtin	0.03%	8.18 (16.62)^{f}	7.61 (16.01)^{g}	7.98 (16.41)^{g}	8.70 (17.15)^{f}	8.16 (16.58)^{f}	59.13	9.18 (17.64)^{g}	9.12 (17.58)^{f}	7.41 (15.79)^{f}	7.92 (16.33)^{f}	8.52 (16.96)^{f}	57.61
9	*Lecanicillium lecanii*	1.5 gr/lit	13.26 (21.36)^{h}	10.32 (18.74)^{i}	11.26 (19.61)^{i}	11.72 (20.02)^{h}	11.02 (19.38)^{h}	44.79	12.45 (20.66)^{i}	11.83 (20.11)^{h}	10.90 (19.27)^{h}	10.62 (19.01)^{h}	11.22 (19.57)^{h}	44.16
10	*Beauveria bassiana*	1.5 gr/lit	9.00 (17.46)^{g}	8.99 (17.45)^{h}	9.34 (17.80)^{h}	10.01 (18.45)^{g}	9.50 (17.95)^{g}	52.40	10.40 (18.81)^{h}	10.50 (18.90)^{g}	8.89 (17.35)^{g}	9.29 (17.75)^{g}	9.90 (18.33)^{g}	50.76
11	Untreated check	-----	17.25 (24.54)^{j}	20.52 (26.94)^{k}	16.25 (23.77)^{k}	19.40 (26.13)^{j}	19.96 (26.53)^{j}		18.25 (25.29)^{k}	21.13 (27.36)^{j}	15.56 (23.23)^{j}	19.06 (25.88)^{j}	20.10 (26.63)	
	S.Ed		0.13	0.46	0.18	0.31	0.36		0.14	0.29	0.24	0.29	0.27	
	CD (P=0.05)		0.279	0.318	0.366	0.641	0.979		0.302	0.594	0.504	0.595	0.728	

In a column, means followed by a common letter are not significantly different by DMRT (p=0.05)
NS -Nonsignificant
Values in parentheses are arc sine transformed

Table 4: Influence of certain insecticides against *A. cataluanalis* on seed yield in sesame

No	Treatment	Dose	Location -1 Thondamuttur				Location -2 Pooluvapatti			
			Kharif	Rabi	Mean	Percent reductionover control	Kharif	Rabi	Mean	Percent reduction over control
1	Profenofos 50 EC	500g a.i/ha	423.43 (20.58)^{efg}	406.34 (20.16)^{f}	414.88 (20.37)^{ef}	30.09	412.34 (20.32)^{e}	400.32 (20.01)^{c}	406.33 (20.16)^{d}	23.89
2	Chorantraniliprole 18.5 SC	27.75 g a.i/ ha	607.92 (24.66)^{a}	592.73 (24.34)^{a}	600.33 (24.50)^{a}	88.23	598.43 (24.47)^{a}	545.54 (23.36)^{a}	571.99 (23.92)^{a}	74.4
3	Lambda cyhalothrin 5 EC	25 g a.i/ha	482.96 (21.98)^{c}	474.52 (21.78)^{c}	478.74 (21.88)^{c}	50.11	467.30 (21.63)^{b}	456.40 (21.36)^{b}	461.85 (21.49)^{b}	40.82
4	Spinosad 45 SC	33.75 g a.i/ha	562.96 (23.73)^{b}	538.40 (23.20)^{b}	550.68 (23.47)^{b}	72.67	578.10 (24.05)^{a}	546.20 (23.37)^{a}	562.15 (23.71)^{a}	71.41
5	Bifenthrin 10 EC	62.5 g a.i/ha	440.05 (20.98)^{de}	410.12 (20.25)^{f}	425.09 (20.62)^{e}	33.29	454.30 (21.32)^{b}	398.23 (19.96)^{c}	426.27 (20.65)^{c}	29.97
6	Imidacloprid 17.8 SL	22.2 g a.i/ha	417.32 (20.43)^{fg}	428.66 (20.70)^{de}	422.99 (20.57)^{ef}	32.63	380.23 (19.51)^{d}	410.32 (20.26)^{c}	395.28 (19.88)^{d}	20.52
7	Emamectin benzote 5% SG	10 g a.i/ha	456.43 (21.36)^{d}	445.34 (21.10)^{d}	450.89 (21.23)^{d}	41.38	454.50 (21.33)^{b}	459.40 (21.43)^{b}	456.95 (21.37)^{b}	39.33
8	Azadirachtin	0.03%	432.67 (20.80)^{ef}	403.96 (20.10)^{f}	418.32 (20.45)^{ef}	31.16	380.20 (19.51)^{d}	401.00 (20.02)^{c}	390.60 (19.76)^{d}	19.1
9	*Lecanicillium lecanii*	1.5 gr/lit	407.59 (20.19)^{g}	412.32 (20.30)^{ef}	409.96 (20.25)^{fg}	28.54	389.50 (19.75)^{d}	400.32 (20.01)^{c}	394.91 (19.87)^{d}	20.41
10	*Beauveria bassiana*	1.5 gr/lit	403.43 (20.09)^{g}	399.43 (19.99)^{f}	401.43 (20.04)^{g}	25.87	412.32 (20.32)^{c}	376.43 (19.40)^{d}	394.38 (19.86)^{d}	20.25
11	Untreated check	-----	317.76 (17.83)^{h}	320.09 (17.89)^{g}	318.93 (17.86)^{h}		320.5(17.92)^{e}	335.43 (18.31)^{e}	327.97 (18.11)^{e}	
	SED		0.25	0.21	0.16		0.20	0.18	0.20	
	CD (p=0.05)		0.525	0.438	0.328		0.428	0.384	0.410	

In a column, means followed by a common letter are not significantly different by DMRT (p=0.05)
Values in parentheses are square root transformed

Results and Discussion

The lowest percent leaf damage was observed in the plants treated with Chlorantraniliprole 18.5 SC @ 27.75 g a.i /ha (3.63 and 4.38% for location 1 and 2 respectively) and next best treatment Spinosad 45 SC@ 33.75 g a.i/ha (5.12 and 5.53 % for location 1 and 2 respectively) which was superior over the untreated check in both the locations (Table 2).Similarly, it was observed that the most effective treatment against A. catalaunalis was Spinosad 45 SC@ 33.75 g a.i/ha, which was followed by Indoxacarb 14.5% SC and Emamectin benzoate 5% SG (Rakesh Yalawar *et al*., 2020) [7]. Moreover, they found that while lambda-cyhalothrin 2.5% EC, quinalphos 25% EC, and profenophos 50% EC were less effective against web worms, flubendiamide 2% WG, Novaluron 10% EC, and Thiodicarb 75% WP were all somewhat effective.

The mean percent capsule damage was low in the plants treated with Chlorantraniliprole 18.5 SC @ 27.75 g a.i /ha (0.87% and 1.71% for location 1 and 2 respectively) and next best treatment Spinosad 45 SC@ 33.75 g a.i/ha (3.76 and 4.29% for location 1 and 2 respectively) and Lambda cyhalothrin 5 EC@ 25 g a.i/ha (5.50 and 5.99% for location 1 and 2 respectively). Significantly, maximum capsule damage was recorded in the untreated check (Table 3). These findings are consistent with those of Sasikumar and Kumar (2014) [8], who found that the treatment with lambda cyhalothrin 5 EC at 25 g a.i./ha resulted in the highest larval mortality, followed by spinosad 45 SC at 33.75 g a.i./ha and B. thuringiensis var. kurstaki at 50 g a.i./ha. Similarly, Varma *et al*. (2013) found that emamectin benzoate 0.001% caused the least capsule damage. According to Afzal *et al*. (2002) [1], the treatment with Lambda cyhalothrin 5 EC reduced pest population the most (96%) followed by Sevin 10 SP (85%). According to Naveen *et al*. (2019) [4], the best insecticide was chlorantraniliprole 18.5% SC @ 0.006%, which had the lowest larval population, the highest percentage of reduction over control, and the least capsule damage and highest grain yield.

Among different insecticides tested,significantly the highest grain yield was recorded in the plots treated with Chlorantraniliprole 18.5 SC @ 27.75 g a.i /ha followed by Spinosad 45 SC@ 33.75 g a.i/ha and Lambda cyhalothrin 5 EC@ 25 g a.i/ha in contrast to the lowest yield in untreated check as earlier reported by Naveen *et al*. (2019) [4] (Table 4).

Conclusion

The application of Chlorantraniliprole 18.5 SC @ 27.75 g a.i /ha and Spinosad 45 SC @33.75 g a.i./ha was found effective against *A.catalaunalis*, whereas imidacloprid 17.8 SL@22.2 g a.i./ha was the least effective.

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