Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(2): 1303-1306

Received: 19-01-2017
Accepted: 20-02-2017

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Effect of different organics on mortality and deformed stages of *Spodoptera litura* and *Aproaerema modicella* under laboratory condition

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Abstract
A laboratory study was conducted on efficacy of different organics pesticides like commercial neem oil, Dipel Bt, Agniasthra, brahmasatra, Punchapatta, plant extracts against mortality and deformed stages of defoliators of groundnut. A day after spraying Profenophos significantly highest larval mortality (96.67%) was recorded and was statistically superior over all other treatments followed by commercial neem, Agniasthra and commercial Bt formulation which were found at par other by recording uniform per cent of larval mortality (6.67%). The treatments namely Brahamasthra and *V. negundo* recorded only 3.33 per cent mortality and founds to be at part with each other, while in rest of the treatments including untreated control there was no mortality. The per cent malformed pupa ranged from 0 to 23.33 and the highest being in *M. anisopilae* followed by sweet flag (20%), Panchapatta (13.33%), GCKE (10%) Agniasthra, *V. negundo* (6.67% each), commercial Bt and Brahmasthra (3.33% each) and in other treatments no malformed pupa were recorded.

Keywords: Biorationals, mortality, *Spodoptera litura*, organics

1. Introduction
Groundnut leaf miner (GLM) *A. modicella* is an oligophagous pest and feeds only on leguminous host plants and a serious pest of groundnut in both rainy and post rainy seasons in India and of groundnut and soybean in South and South East Asia. The caterpillar mines the leaflet near the midrib and proceeds towards the epidermal layer. Initially short blisters like mines are seen on groundnut leaflets, but as the feeding advances the damaged leaflets turn brownish, roll, shrivel and dry up. Severely infected crops give a burnt appearance [1]. Due to infestation, there is reduction in dry pod yields. The leaf miner reduces groundnut and soybean yields by feeding on leaves, thereby reducing the photo synthetically active leaf area and the extent of losses varied from 24 to 92 per cent based on the levels of infestation and the genotype. [2].Another important defoliator the Tobacco caterpillar; *S. litura* is an important defoliator on groundnut in the Asian tropics. It is a polyphagous pest and reported on more than 120 host plants and known to cause severe damage to many crops. *S. litura* damage to groundnut is extensively by skelatanization of leaves in early stage and severe defoliation in later stage and thus reducing the photosynthetic capacity of plants. The present study was conducted to evaluate the effect of different organics on mortality and deformed stages of *Spodoptera litura* and *Aproaerema modicella* under laboratory condition.

2. Materials and Methods
2.1. Insecticidal properties of organics against *Spodoptera litura*: The groundnut plants were raised in pots and later these raised plants were sprayed with different organics (commercial neem oil, Dipel, Bt, Agniasthra, brahmasatra, Punchapatta, plant extracts) by using baby hand sprayer and were used for further laboratory study. Insecticidal properties of different bio-rational in comparison with profenophos 50 EC were studied by using 3rd instar larvae of *S. litura* as the test insect. The treated groundnut leaves were collected from the pot culture and then kept in plastic containers and third instar larvae were collected from the stock culture, and released on the treated leaves at the rate of 10 per treatment in three replications. The container was covered with muslin cloth secured by rubber band. In untreated control the leaves were sprayed by water only. The treated leaves were changed daily till the pupation. The observation on larval mortality was recorded at 1, 3, 7, 10 and 15 days after the spraying. Deformity if any, of pupal and adult stages were also recorded from each treatment [3].

2.2. Insecticidal properties of organics against groundnut leaf miner, *A. modicella*: Infested groundnut leaflets along with live larvae were collected from field and ten larvae along with leaflets were selected and kept in the conical flask containing sugar solution by putting cotton swab at base of the petiole for maintaining turgidity. Different organics (commercial neem oil, Dipel Bt, Agniasthra, brahmasatra, Punchapatta, plant extracts) were sprayed on infested leaves by using baby hand sprayer and each treatment was replicated thrice along with a set of water sprayed infested leaves. And this experimental set was kept in the growth chamber by maintaining 25˚C temperature and 68 per cent relative humidity till the completion of the experiment under laboratory condition. The observation on per cent larval mortality and per cent deformed stages if any were recorded at 7, 10 and 15 days after the spraying.

2.3 Statistical analysis

The observation on larval mortality and deformed stages was recorded at 1, 3, 7, 10 and 15 days after the spraying and the collected data was subjected to the Statistically Analysis by using software Statistic 8.1. ANOVA (Statistic, version 8.1 Tallahassee, USA).Significantly different means (P Tallahassee, USA). Significantly different means ($P<0.05$) were separated using Duncan Multiple Range Test (DMRT) at5% probability.

3. Result and Discussion

3.1 Cumulative larval mortality in *Spodoptera litura*

A day after spraying profenophos significantly highest larval mortality (96.67%) was recorded and was statistically superior over all other treatments followed by commercial neem, Agniasthra and commercial Bt formulation which were found at par with each other by recording uniform per cent of larval mortality (6.67%).The treatments namely Brahamasthra and *V. negundo* recorded only 3.33 per cent mortality and were founds to be at par with each other. In rest of the treatments including untreated control there was no mortality and this finding is as par with findings of [4].Three days after spraying cent percent mortality was noticed in profenophos and was statistically superior over all other treatments indicating its effectiveness followed by commercial neem formulation and commercial Bt which recorded significantly highest mortality of 23.33 and 20.00 per cent respectively and differed significantly from other treatments. The next best treatments were Agniasthra (16.67% mortality) and panchapatta (13.33% mortality) whereas Brahmasthra, *V. negundo* and DOR Bt recorded only 6.67% mortality proved to be less effective. Similarly, sweet flag, NSKE and GCKE were also less effective and recorded 3.33 per cent mortality while no mortality was observed in two entomopathogenic fungal treatments and untreated control. On seven days after spraying cent per cent larval mortality was observed in profenophos and proved to be most superior over all other treatments followed by commercial neem were recorded (50%) and commercial Bt (40%) and were significantly superior over rest of the organics. The next best organics were Agniasthra, Panchapatta and *N. rileyi* which recorded 36.67% mortality each. DOR Bt recorded a mortality of 23.33% and was at par with Brahmasthra and *M. anisopilae* which recorded 20.00 per cent mortality each. While other organics included for study recorded 10 to 16.67 per cent mortality and found to be superior to the untreated control. On 10th day of the spray the cent per cent mortality was occurred in commercial neem and NSKE treatments as that of the profenophos treatment and proved to be most effective and found to be statistically superior over rest of the organics. The next superior organics in the order of merit were *N. rileyi* (66.67%) Panchapatta (50%), commercial Bt (46.67%) and Agniasthra (40%), while GCKE (20.00%), *M. anisopilae* and sweet flag (23.33% each) were the least effective organics. The cumulative mortality of larvae after 15 days of spray was cent per cent in profenophos, commercial neem and NSKE treatments. *N. rileyi* was the next best treatment by recording 73.33 per cent mortality followed by commercial Bt (66.67% mortality) and were at par with each other. Agniasthra (60%) DOR Bt, Brahmasthra, panchapatta (53.33% each) and *V. negundo* (46.67% mortality) were the other effective organics in causing the mortality of larvae. Sweet flag, GCKE and *M. anisopilae* were the least effective organics

3.2 Per cent malformed pupae

The per cent malformed pupa ranged from 0 to 23.33 and the highest being in *M. anisopilae* followed by sweet flag (20%), Panchapatta (13.33%), GCKE (10%) Agniasthra, *V. negundo* (6.67% each) and commercial Bt and Brahmasthra (3.33% each) and in other treatments no malformed pupa were recorded.

3.3 Per cent malformed adult

The per cent malformed adult ranged from 0 to 10 and the highest being in *M. anisopilae* followed by GCKE (6.67%) in DOR Bt, Brahmasthra, Agniasthra and *V. negundo* (3.33% each) while in the rest of the treatments no adults were malformed.

3.4 Per cent successful adult emergence

There was no successful adult emergence in treatments *viz.*, profenophos, NSKE and commercial neem indicating their most effectiveness followed by *M. anisopilae* and *N. rileyi*, commercial Bt and Agniasthra which recorded 26.67, 26.67, 30.00 and 30.00 per cent adult emergence respectively, while 93.33 per cent was recorded in the untreated control (Table 1).

3.5 Cumulative larval mortality in *Aproaerema modicella*

The standard chemical check Profenophos 50 EC caused cent per cent mortality of larvae on all the days of observation (7th, 10th and 15thday of spraying) and was found superior over all the treatments. Among biorationals evaluated for their efficacy, the commercial neem and

M. anisopliae were proved to be the best by causing 33.33% and 26.67% mortality on 7th day after exposure of treatments. Other biorationals *viz., V. negundo*, NSKE, DOR Bt and sweet flag were found to be moderately effective and each caused 16.67% larval mortality whereas mortality was observed in GCKE and *N. rileyi* treatments on 7th day of treatment imposition. The similar trend in efficacy was observed with increased per cent mortality of larvae on 10th day after spraying. Observation made on fifteenth day of treatment revealed increased efficacy of DOR Bt (70% larval mortality) and was equally effective as commercial neem which also caused 70% larval mortality. The other promising biorationals which resulted in higher larval mortality are Agniasthra (63.33%) and *M. anisopliae* (60.00%). The other biorationals namely, commercial Bt, NSKE and *V. negundo* caused around 50 per cent mortality, while GCKE and *N. rileyi* were least effective in causing larval mortality.

The effectiveness of commercial neem and NSKE may be due to the presence of active principle Azadirachtin in neem seeds which has several properties including insecticidal while

effectiveness of *M. anisopliae* on leaf miner may be due to concealed living of a leaf miner with required congenial micro climate favouring the multiplication of the pathogen. Effectiveness of both Bt products may be due to their endotoxin effect which has been proved effective against lepidopteron pests.

The bio efficacy of Agniasthra which is a fermented product of botanical ingredients, cow urine and cow dung which might have higher micro flora and enzymatic activity releasing the photochemical toxic to the larvae. The effectiveness of neem products of the present study is in confirmation with [5] who observed 72 per cent of larval mortality after 96 hours of exposure. Similarly [6] have reported that Neem guard, RD-9 Repellen, Alletin and Navneem recording 100, 99.2, 99.2 and 98.3 per cent mortality of larvae respectively.

3.6 Per cent malformed pupa and successful adult emergence in *Aproaerema modicella*

No malformed pupa and adult emergence was observed with profenophos 50 EC treatment as it resulted in cent per cent larval mortality and hence was proved to be most effective against groundnut leaf miner. Among the biorationals the highest per cent malformation of pupae and lowest per cent adult emergence was recorded in NSKE and *M. anisopliae* (16.67,30.0 and 13.33, 26.67%, respectively.) indicating their biological activity in hindering the physiology of development or transformation, while, other biorationals were moderate in causing malformation of pupae and resulting in good adult emergence, whereas GCKE, panchapatta, Brahmasthra and *N. rileyi* have recorded considerably higher adult emergence with less malformed pupae and were proved to be least effective against groundnut leaf miner (Table.2)

4. Conclusion

The preliminary laboratory study revealed that the commercial neem oil and NSKE (5%) were found most effective among different biorationals by causing cent per cent larval mortality of *S. litura* on 10th day after treatment exposure and were found statistically superior over rest of the biorationals. However, these organics cannot compete with synthetic insecticide profenophos 50 EC wherein cent per cent larval mortality was observed on 3rd day itself after imposing treatment. The next best biorational against *S. litura* was *N. rileyi* which recorded 73.33 per cent larval mortality after 15th day of treatment exposure and was followed by commercial Bt, Agniasthra, DOR Bt, Brahmasthra, panchapatta and *V. negundo*; whereas sweet flag, GCKE and *M. anisopliae* caused meager mortality and hence were proved to be least effective.

Among different biorationals, the highest malformed pupa and adult were with *M. anisopliae* followed by GCKE and sweet flag revealing their detrimental effect on developmental biology of insects. Commercial neem oil was the most effective in causing mortality of *A. modicella* followed by M. *anisopliae*, NSKE and *V. negundo*, while sweet flag, *N. rileyi* and GCKE were less effective. Among different biorationals, the highest per cent malformation was observed in NSKE (16.67%) followed by *M. anisopliae* (13.33%) and resulted in lower adult emergence.

5. Acknowledgement

I am very much grateful to Dr. Abdhul H Khadar, Phd, scholar Department of Entomology, Main Agricultural Research Station, Raichur, for their kind help, valuable suggestions, profound source of inspiration and constant ambitious encouragement.

Table 1: Effect of different organics on per cent mortality and deformed stages of *S. litura* under laboratory condition

Treatments		Cumulative larval mortality (%)					Deformity (%)		
		1 DAS	3 DAS	7 DAS	10 DAS	15 DAS	Malformed pupa	Malformed adult	Adult emergence
T_1	Commercial Bt (Lipel) @ 1 g	6.67 (12.29)^{b}	20.00 (26.07)^{c}	40.00 (39.15)^{c}	46.67 (43.08)^{cd}	66.67 (54.78)^{bc}	3.33 (6.14)^{f}	0.00 (0.00)^{c}	30.00 (33.21)^{bc}
T_2	DOR Bt @ 1g	0.00 (0.00)^{d}	6.67 (12.29)^{f}	23.33 (28.78)^{e}	36.67 (37.22)^{de}	53.33 (46.92)^{cd}	0.00 (0.00)^{g}	3.33 (6.14)^{c}	43.33 (41.15)^{de}
T_3	Agniasthra @ 3%	6.67 (12.29)^{b}	16.67 (23.86)^{d}	36.67 (37.22)^{d}	40.00 (39.23)de	60.00 (50.77)^{c}	6.67 (12.29)^{e}	3.33 (6.14)^{c}	30.00 (33.21)^{bc}
T_4	Brahmasthra @ 5%	3.33 (6.14)^{c}	6.67 (12.29)^{f}	20.00 (26.07)^{e}	36.67 (37.22)de	53.33 (46.92)^{cd}	3.33 (6.14)^{f}	3.33 (6.14)^{d}	40.00 (39.23)^{d}
T_5	NSKE @ 5%	0.00 (0.00)^{d}	3.33 (6.14)^{g}	10.00 (14.67)^{h}	100.00 (90.00)a	100.00 (90.00)^{a}	0.00 (0.00)^{g}	0.00 (0.00)^{d}	0.00 (0.00)^{a}
T_6	GCKE @ 5%	0.00 (0.00)^{d}	3.33 (6.14)^{g}	13.33 (21.14)^{g}	20.00 (26.57)ef	36.67 (37.22)^{de}	10.00 (18.43)^{d}	6.67 (12.29)^{c}	46.67 (43.08)^{e}
T_7	*V.negundo* @ 5%	3.33 (6.14)^{c}	6.67 (12.29)^{f}	16.67 (23.86)^{fg}	33.33 (35.22)de	46.67 (43.08)^{cd}	6.67 (12.29)^{e}	3.33 (6.14)^{c}	43.33 (41.15)^{de}
T_8	Panchapatta @ 5%	0.00 (0.00)^{d}	13.33 (21.14)^{e}	36.67 (37.23)^{d}	50.00 (45.00)c	53.33 (46.92)^{cd}	13.33 (21.14)^{c}	0.00 (0.00)^{d}	33.33 (35.22)^{c}
T_9	Sweet flag @ 2%	0.00 (0.00)^{d}	3.33 (6.14)^{g}	13.33 (21.14)^{g}	23.33 (28.78)e	26.67 (31.00)^{e}	20.00 (26.57)^{b}	0.00 (0.00)^{d}	53.33 (46.92)^{f}
T_{10}	Commercial neem oil @ 3 ml	6.67 (12.29)^{b}	23.33 (28.78)^{b}	50.00 (45.00)^{b}	100.00 (90.00)a	100.00 (90.00)^{a}	0.00 (0.00)^{g}	0.00 (0.00)^{d}	0.00 (0.00)^{a}
T_{11}	*M.anisipoliae* @ 1 X 10^{8} cfu	0.00 (0.00)^{d}	0.00 (0.00)^{h}	20.00 (26.07)^{ef}	23.33 (28.78)e	40.00 (39.15)^{d}	23.33 (28.78)^{a}	10.00 (18.43)^{a}	26.67 (26.15)^{b}
T_{12}	*N. rileyi* @ 1 X 10^{8} cfu	0.00 (0.00)^{d}	0.00 (0.00)\$^{h}$	36.67 (37.14)^{d}	66.67 (55.06)b	73.33 (59.00)^{b}	0.00 (0.00)^{g}	0.00 (0.00)^{d}	26.67 (31.00)^{b}
T_{13}	Profenophos 50 EC	96.67 (84.19)^{a}	100.00 (90.00)^{a}	100.00 (90.00)^{a}	100.00 (90.00)a	100.00 (90.00)^{a}	0.00 (0.00)^{g}	0.00 (0.00)^{d}	0.00 (0.00)^{a}
T_{14}	Untreated control	0.00 (0.00)^{d}	0.00 (0.00)^{h}	0.00 (0.00)^{i}	0.00 (0.00)f	6.67 (12.29)^{f}	0.00 (0.00)^{g}	0.00 (0.00)^{d}	93.33 (77.71)^{g}
	S.EM±	0.24	0.36	0.714	1.14	1.35	0.306	0.19	0.92
	C.D (5%)	0.96	1.42	2.79	4.47	5.28	1.19	0.75	3.6

DAS – Days after spraying.

* Figures in the parentheses are arc sine transformed values # similar letters in the columns do not differ significantly by the DMRT (0.01)

Table 2: Effect of different organics on mortality and deformed stages of *A. modicella* under laboratory condition

Treatments		Cumulative larval mortality (%)			Deformity (%)	
		7 DAS	10 DAS	15 DAS	Malformed pupa	Good adult emergence
T_1	Commercial Bt (Lipel) @ 1 g	10.00 (18.43)^{f}	30.00 (33.21)^{gh}	53.33 (46.92)^{d}	3.33 (10.52)e	43.33 (41.17)d
T_2	DOR Bt @ 1 g	16.67 (24.09)^{de}	40.00 (39.15)^{e}	70.00 (57.00)^{b}	0.00 (0.00)f	30.00 (33.21)c
T_3	Agniasthra @ 3%	13.33 (21.14)^{e}	36.67 (37.22)^{ef}	63.33 (52.78)^{c}	3.33 (10.52)e	33.33 (35.26)c
T_4	Brahmasthra @ 5%	13.33 (21.14)^{e}	33.33 (35.22)^{fgh}	43.33 (41.07)^{fg}	3.33 (10.52)e	53.33 (46.91)e
T_5	NSKE @ 5%	16.67 (24.09)^{de}	36.67 (37.14)^{ef}	53.33 (46.92)^{d}	16.67 (24.09)a	30.00 (33.21)c
T_6	GCKE @ 5%	0.00 (0.00)^{h}	16.67 (23.86)^{j}	36.67 (37.14)^{g}	3.33 (10.52)e	60.00 (50.77)ef
T_7	*V.negundo* @ 5%	20.00 (26.57)^{d}	46.67 (43.41)^{d}	50.00 (45.00)^{de}	6.67 (14.96)d	43.33 (41.17)d
T_8	Panchapatta @ 5%	6.67 (12.29)^{g}	23.33 (28.78)^{i}	43.33 (41.15)^{fg}	3.33 (10.52)e	53.33 (46.92)e
T_9	Sweet flag @ 2%	16.67 (24.09)^{cde}	33.33 (35.22)^{fgh}	46.67 (43.08)^{def}	10.00 (18.43)c	43.33 (41.17)d
T_{10}	Commercial neem oil @ 3 ml	33.33 (35.22)^{b}	63.33 (52.78)^{b}	70.00 (57.00)^{b}	10.00 (18.43)c	20.00 (26.57)b
T_{11}	*M.anisipoliae* @ 1 X 10^8 cfu	26.67 (31.00)^{c}	53.33 (46.92)^{c}	60.00 (50.85)^{c}	13.33 (21.42)b	26.67 (31.02)b
T_{12}	*N. rileyi* @ 1 X 10^8 cfu	10.00 (18.43)^{f}	16.67 (23.36)^{j}	36.67 (37.14)^{g}	0.00 (0.00)f	63.33 (52.73)ef
T_{13}	Profenophos 50 EC	100.00 (90.00)^{a}	100.00 (90.00)^{a}	100.00 (90.00)^{a}	0.00 (0.00)f	0.00 (0.00)a
T_{14}	Untreated control	0.00 (0.00)^{h}	0.00 (0.00)^{k}	3.33 (6.14)^{h}	0.00 (0.00)f	83.33 (65.91)f
	S.EM±	0.51	0.79	0.80	0.27	1.13
	C.D (P=0.01)	2.03	3.11	3.15	1.06	4.45

DAS – Days after spraying.* Figures in the parentheses are arc sine transformed values. # Similar letters in the columns do not differ significantly by the DMRT (0.01).

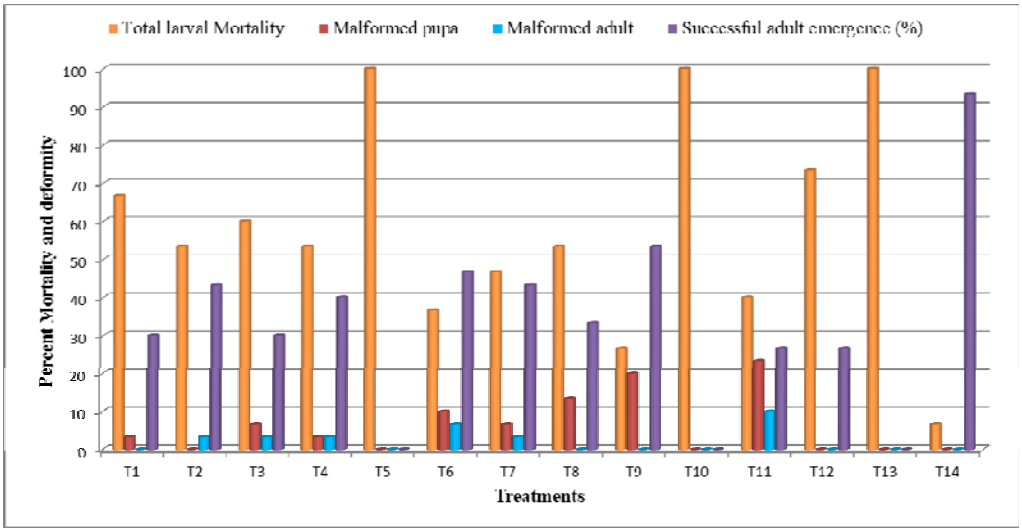

Fig 1: Effect of different organics on larval mortality and deformed stages of *S. litura* under laboratory condition

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