International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 1334-1337

Received: 13-07-2019
Accepted: 15-08-2019

Tarun Kumar Nayak
Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Sonali Deole
Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

SS Shaw
Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Correspondence
Tarun Kumar Nayak
Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Studies on bio-rational insecticides against tobacco caterpillar, *Spodoptera litura* on groundnut crop in Chhattisgarh

Tarun Kumar Nayak, Sonali Deole and SS Shaw

Abstract
The field experiment were conducted at Research Cum Instructional Farm at IGKV, Raipur (C.G.) during kharif 2018, for the purpose to evaluate relative efficacy of bio-rational insecticides against tobacco caterpillar, *Spodoptera litura* infesting groundnut. Based on two spray, it was concluded that the Emmamectin benzoate 5 SG (0.0025%, 0.5 gm/lit.) and Spinosad 45 SC (0.014%, 0.31 ml/lit.) were found superior from rest of the insecticides. The experimental results indicated that the Emmamectin benzoate 5 SG (0.0025%, 0.5 gm/lit.) against the tobacco caterpillar, *S. litura* was found to be most effective chemical treatment because it recorded the highest per cent mortality of the larvae (65.52%). The second best treatment was Spinosad 45 SC (0.014%, 0.31 ml/lit.) with 61.91% mortality followed by Pymetrozine 50 WDG (58.35%), Buprofezin 25 SC (57.45%), Pyriproxyfen 10 EC (55.31%), Azadirachtin 1500 ppm (36.32%), *Metarhizium anisopliae* (34.90%) and *Beaveria bassiana* (28.16%). The *Beaveria bassiana* (2.04 x 10^6, 10 ml/lit.) was seen the least effective treatment as compared to other as, it was observed least per cent mortality of the larvae.

Keywords: Bio-rational, groundnut, mortality, *Spodoptera litura*

Introduction
Groundnut (*Arachis hypogaea* L.), also known as peanut, is a legume that ranks 6th among the oilseed crops and 13th among the food crops of the world. Groundnut is the important crop in India, covering nearly half of the area under oilseeds.

The major growing states are Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan, and Maharashtra. These constituting and contributing around 80% of area and production. (Singh *et al*, 2014) [6]. Groundnut is cultivated on 27.6 million ha with an annual production of 43.9 million metric tons globally (FAO, 2016). In India, groundnut is cultivated an area of 5.8 million ha, production of 6.85 million tones, and an average yield of 1182 kg /ha (FAO, 2016).

A large number of insect pests damage this crop. In India, about 115 insect pests species cause damage, of which only 9 species leafminer, white grub, jassids, thrips, aphid, tobacco caterpillar, gram caterpillar, red hairy caterpillar and termites are found to be economically important. The tobacco caterpillar, *Spodoptera litura* (Fabricius) is one of the economically important and regular polyphagous pests on the field and horticultural crops (Murthy *et al*., 2006) [5]. It is considered as one of the major threats to the present-day intensive agriculture and changing cropping patterns worldwide, next only to *Helicoverpa armigera* (Hubner). *S. litura* causing 26-100 per- cent yield loss under field conditions (Dhir *et al.*, 1992) [1]; more than 180 crops (Isman *et al*., 2007) [4].

When insect pest control was mostly based on broad-spectrum, conventional insecticides such as organochlorines, organophosphates (OPs), and carbamates leads to severe adverse effects of pesticides on the environment, problems of resistance reaching crisis proportions, and farmers health hazards. (Horowitz *et al*, 2010) [3]. For this purpose a newer class of bio-rational insecticides are evaluated to examine the specificity to harmful pests, selectivity to beneficial insects and their suitability to fit well into integrated pest management (IPM) programs.

Materials and Methods
A field experiment was conducted at Research Cum Instructional Farm at IGKV, Raipur, (C.G.) during *kharif* 2018 under field condition to determine the bio-efficacy of bio-rational insecticides against leaf eating caterpillar, *S. litura* on groundnut.

Spraying of various insecticides was done twice. The first applications of the insecticides was given at the time of ample population of insect pests and the second application was given 15 days after first application. The pre-treatment observation on number of larvae per plant were taken 24 hours before spraying, while post-treatment observation made after 1, 3 and 7 days after spraying on five plants randomly selected from each plot and per cent reduction of *S. litura* was worked out. The data on population of *S. litura* was converted into corrected per cent mortality by using the following formula given by Abbott (1925) and modified by Henderson and Tilton (1955) [2].

$$\text{Corrected percent mortality} = 100 \times \left\{ 1 - \frac{Ta \times Cb}{T_b \times C_a} \right\}$$

Where,
T_b = No. of insect pests observed before treatment.
T_a = No. of insect pests observed after treatment.
C_b = No. of insect pests observed before treatment in control plot.
C_a = No. of insect pests observed after treatment in control plot.

Results and Discussion

First Spray

The data on per cent mortality of *S. litura* recorded at one day after first spray presented in Table.1 and depicted in Fig.1 showed that Emmamectin benzoate 5 SG 0.15 per cent showed significantly the highest mortality (48.84%) and it was on at par with the treatment of Buprofezin 25 SC 0.014per cent (46.43%), Pyriproxyfen 10 EC 0.04 per cent (44.33%), Spinosad 45 SC 0.0025 per cent (43.81%) and Pymetrozine 50 WDG 0.01 per cent (42.08%). Whereas, the *Beaveria bassiana* recorded significantly the lowest mortality (23.02%) and it was on at par with *Metarhizium anisopliae* (28.03%). Among the other treatments, Azadirachtin 1500 ppm 0.040 per cent (35.86%) remained next best treatments.

The data on mortality of *S. litura* recorded at three day after first spray presented in Table.1 and depicted in Fig.1 revealed that Emmamectin benzoate 5 SG 0.15 per cent showed significantly the highest mortality (59.21%) and it was on par with the treatment of Spinosad 45 SC 0.0025 per cent (58.06%), Pymetrozine 50 WDG 0.01 per cent (57.07%), Buprofezin 25 SC 0.014 per cent (49.29%) and Pyriproxyfen 10 EC 0.04 per cent (48.88%). On the other side, the *Beaveria bassiana* recorded significantly the lowest mortality (30.71%) and it was on at par with *Metarhizium anisopliae* (33.09%) and Azadirachtin 1500 ppm 0.040 per cent (35.52%).

The data on mortality of *S. litura* recorded at seventh day after first spray presented in Table.1 and depicted in Fig.1 revealed that significantly the highest mortality was found in Emmamectin benzoate 5 SG 0.15 per cent showed significantly the highest mortality (54.66%) and it was on at par with the treatments of Spinosad 45 SC 0.0025 per cent (54.64%), Buprofezin 25 SC 0.014 per cent (52.68%), Pyriproxyfen 10 EC 0.04 per cent (51.27%), Pymetrozine 50 WDG 0.01 per cent (50.77%) and *Metarhizium anisopliae* (46.22%). On the other side, the Azadirachtin 1500 ppm 0.040 per cent recorded significantly the lowest mortality (39.59%) and it was on at par with *Beaveria bassiana* (39.82%).

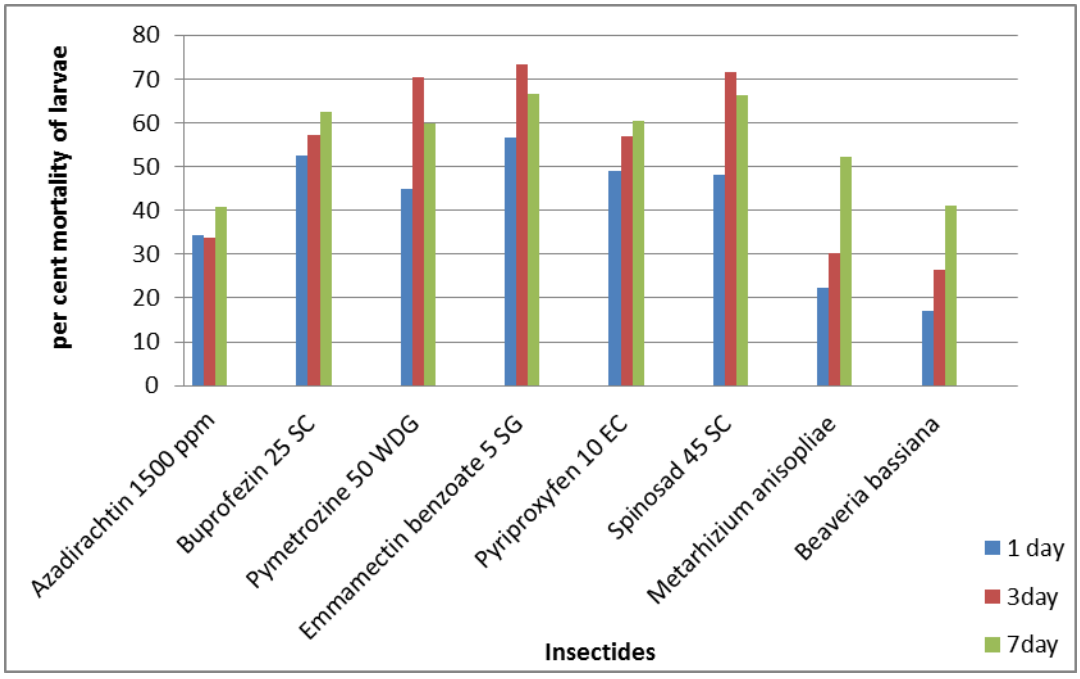

Fig. 1: Corrected per cent mortality of *Spodoptera litura* after first spray

Second Spray

The data on mortality of *S. litura* recorded at one day after second spray presented in Table.1 and depicted in Fig.2 revealed that Emmamectin benzoate 5 SG 0.15 per cent showed significantly the highest mortality (51.37%) and it was on at par with the treatment of Spinosad 45 SC 0.0025 per cent (46.99%), Pyriproxyfen 10 EC 0.04 per cent (46.76%), Pymetrozine 50 WDG 0.01 per cent (43.39%), and Buprofezin 25 SC 0.014 per cent (41.17%). Whereas, Azadirachtin 1500 ppm 0.040 per cent recorded significantly the lowest mortality (31.02%) and it was on at par with *Metarhizium anisopliae* (39.73%) and *Beaveria bassiana* (40.24%).

The data on mortality of *S. litura* recorded at three day after second spray presented in Table.1 and depicted in Fig.2 revealed that Emmamectin benzoate 5 SG 0.15 per cent showed significantly the highest mortality (58.21%) and it was on par with the treatment of Spinosad 45 SC 0.0025 per cent (51.42%), Pyriproxyfen 10 EC 0.04 per cent (50.04%), Pymetrozine 50 WDG 0.01 per cent (48.91%) and Buprofezin 25 SC 0.014per cent (47.89%). On the other side, the Azadirachtin 1500 ppm 0.040 per cent recorded significantly the lowest mortality (26.99%) and it was on at par with *Beaveria bassiana* (32.89%) and *Metarhizium anisopliae* (38.53%).

The data on mortality of *S. litura* recorded at seventh day after second spray presented in Table.1 and depicted in Fig.2 revealed that Emmamectin benzoate 5 SG 0.15 per cent showed significantly the highest mortality (58.87%) and it was on par with the treatment of Pymetrozine 50 WDG 0.01 per cent (53.65%), Spinosad 45 SC 0.0025 per cent (53.35%), Buprofezin 25 SC 0.014per cent (52.25%), Pyriproxyfen 10 EC 0.04 per cent (49.45%) and Azadirachtin 1500 ppm 0.040 per cent (48.58%). On the other side, the *Beaveria bassiana* recorded significantly the lowest mortality (38.60%) and it was on at par with *Metarhizium anisopliae* (44.84%).

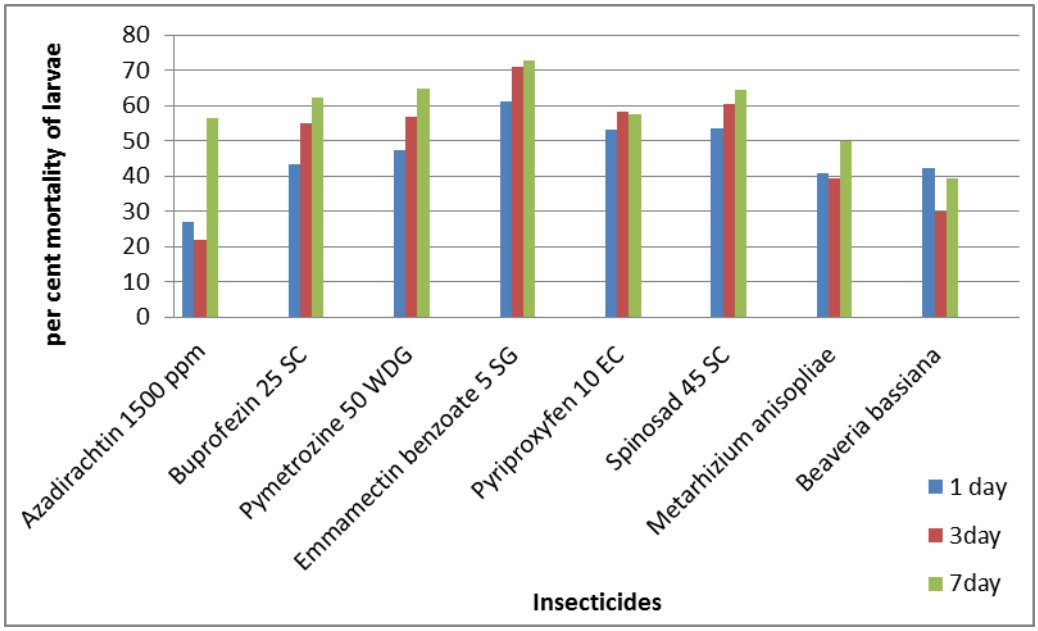

Fig 2: Corrected per cent mortality of *Spodoptera litura* after second spray

Table 1: Evaluation of bio-rational insecticides against *Spodoptera litura* on groundnut crop

Treatments	Concentration (%)	Corrected Per Cent Mortality of *S. litura* after First Spray				Corrected Per Cent Mortality of *S. litura* after Second Spray			
		1 day	3day	7day	Overall mean	1 day	3day	7day	Overall mean
Azadirachtin 1500 ppm	0.040%	34.40 (35.86)	33.86 (35.52)	40.70 (39.59)	36.32	26.81 (31.02)	21.88 (26.99)	56.27 (48.58)	34.98
Buprofezin 25 SC	0.014%	52.53 (46.43)	57.27 (49.29)	62.54 (52.68)	57.45	43.37 (41.17)	54.96 (47.89)	62.22 (52.25)	53.52
Pymetrozine 50 WDG	0.01%	45.01 (42.08)	70.34 (57.07)	59.71 (50.77)	58.35	47.23 (43.39)	56.75 (48.91)	64.79 (53.65)	56.26
Emmamectin benzoate 5 SG	0.15%	56.70 (48.84)	73.36 (59.21)	66.51 (54.66)	65.52	61.01 (51.37)	71.13 (58.21)	72.95 (58.87)	68.36
Pyriproxyfen 10 EC	0.04%	48.85 (44.33)	56.77 (48.88)	60.32 (51.27)	55.31	53.07 (46.76)	58.29 (50.04)	57.39 (49.45)	56.25
Spinosad 45 SC	0.0025%	48.01 (43.81)	71.43 (58.06)	66.28 (54.64)	61.91	53.48 (46.99)	60.45 (51.42)	64.38 (53.35)	59.44
Metarhizium anisopliae	2.8 x 10^6	22.25 (28.03)	30.31 (33.09)	52.14 (46.22)	34.90	40.89 (39.73)	39.23 (38.53)	49.75 (44.84)	43.29
Beaveria bassiana	2.04 x 10^6	16.92 (23.02)	26.46 (30.71)	41.11 (39.82)	28.16	42.05 (40.24)	29.74 (32.89)	39.18 (38.60)	36.99
SE(m)		4.04	4.28	3.346		3.491	6.172	3.627	
C.D.		12.397	13.115	10.246		10.691	18.903	11.108	

( ) Figures in the parentheses are angular transformed

Table 2: Yield and economics of different insecticides applied for the management of *S.litura* on groundnut

Treatments	Pod yield (q./ha)	Increased yield over Control (q./ha)	Price of increased Yield over control (Rs./ha)	Cost of Treatment (Rs./ha)	Net profit (Rs./ha)	Cost Benefit Ratio
Azadirachtin 1500 ppm	10.83	2.22	10,855.80	4400/-	6455.80	1:1.46
Buprofezin 25 SC	12.55	3.94	19,266.60	2440/-	16,826.60	1:6.89
Pymetrozine 50 WDG	11.30	2.69	13,154.10	7720/-	5434.10	1:0.70
Emmamectin benzoate 5 SG	13.80	5.19	25,379.10	4000/-	21,379..10	1:5.34
Pyriproxyfen 10 EC	11.13	2.52	12,322.80	2736/-	9586.80	1:3.50
Spinosad 45 SC	12.52	3.91	19,119.90	6952/-	12167.90	1:1.75

Metarhizium anisopliae	10.72	2.11	10,317.90	2300/-	8017.90	1:3.48
Beaveria bassiana	10.66	2.05	10,024.50	2300/-	7724.50	1:3.35
Control	8.61	-	-	-	-	-

Labour rate per day = Rs. 250 per laborer (2 laborer required for spraying in one hectare per day).
Price of Groundnut = 4890 Rs per quintal.

The B:C ratio of different insecticidal treatments applied for the management of *S. litura* has been worked out. The highest cost benefit ratio was found in treatment Buprofezin 25 SC (1:6.89) followed by Emmamectin benzoate 5 SG (1:5.34) (Table.2).

Conclusion

It can be concluded from the results that Emmamectin benzoate 5SG (0.0025%, 0.5 gm/lit.) against the tobacco caterpillar, *S. litura* was found to be most effective chemical treatment because it recorded the highest per cent mortality of the larvae (65.52%). The second best treatment was Spinosad 45SC (0.014%, 0.31 ml/lit.) (61.91%).

References

1. Dhir BC, Mohapatra HK, Senapati B. Assessment of crop loss in groundnut due to tobacco caterpillar, *Spodoptera litura* (F.). Indian J Plant Protect. 1992; 20:215-217.
2. Henderson CF, Tilton EW. Tests with acaricides against the brow wheat mite, J Econ. Entomol. 1955; 48:157-161.
3. Horowitz AR, Ellsworth PC, Ishaaya I. Biorational Pest Control – An Overview. Springer Science and Business Media, 2010, 1-20.
4. Isman MB, Machial CM, Miresmailli S, Bainard LD. Essential oil based pesticides: new insights from old chemistry. Pesticide chemistry, 2007, 113p.
5. Murthy S, Thippaiah M, Kitturmmath MS. Effect of neem formulations on larvae of tobacco cutworm, *Spodoptera litura* (Fab.). Insect Environment. 2006; 12: 84-85.
6. Singh S, Thirumalaisamy PP, Harish G, Ram D, Sushil SN, Sinha AK *et al*. Integrated Pest Management Package for Groundnut, 2014, 49p.