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**Research Article**

# Bio-efficacy of certain botanicals and bio-pesticides against tobacco caterpillar, *Spodoptera litura* Fab. in *rabi* groundnut

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**ABSTRACT:** Field trial was conducted in dry land Farm of S.V. Agricultural College, Tirupati during two consecutive *rabi* seasons of 2012-13 and 2013-14, to evaluate the efficacy of botanical and microbial insecticides against tobacco caterpillar, *Spodoptera litura* infesting groundnut on cultivar Kadiri-6. Among the treatments tested NPV (*S. litura*) @ 250 LE $ha^{-1}$ and *Bacillus thuringiensis* (*Bt*) sprays were significantly effective in reducing larval population, leaf damage and resulted in significant increase in haulm yields and cost benefit ratio. This was followed by *Nomuraea rileyi* $1.5x10^{13}$ spores $mL^{-1}$ and NSKE @ 5.0 per cent compared to other treatments neem oil @ 2.0 $mlL^{-1}$ and *Beauveria bassiana* $1.5x10^{13}$ spores $mL^{-1}$ respectively.

**KEY WORDS:** Botanicals, bio-pesticides, *Spodoptera litura*

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## INTRODUCTION

Groundnut *(Arachis hypogaea* L.) is an important oilseed crop in India belonging to Leguminaceae family. It is grown in an area of 6.41 million ha with a production of 9.18 million tonnes and productivity of 1432 kg $ha^{-1}$ during 2011-12 (CMIE, 2013). It contributes about 30 per cent of the total domestic supply of oil. It is mainly grown as rainfed crop during *kharif* and under irrigation during *Rabi* by resource poor farmers of Andhra Pradesh. Though India ranks first in area under groundnut cultivation, the productivity is quite low compared to that of other developing countries like China (2600 Kg $ha^{-1}$), Argentina (2100 Kg $ha^{-1}$) and Indonesia (1550 Kg $ha^{-1}$) (NRCG. 2012). The reasons for low productivity of groundnut crop in India were attributed to the extensive damage by a number of insect pests and among them the tobacco caterpillar, *Spodoptera litura* Fab. is the most serious pest particularly in *rabi* crop. As a result of excessive dependence on insecticidal control, the pest was found to be developing resistance to insecticides besides, suppression of natural enemy population by commonly used chemical insecticides. Effective botanicals and bio-pesticides usage is essential in modern agriculture to avoid public health hazards that can accrue through insecticide residues in the highly consumed groundnut kernel and groundnut oil. With this objective present study of management of *S. litura* with certain botanicals and bio-pesticides was undertaken.

## MATERIAL AND METHODS

Field trials were conducted in dry land Farm, S.V. Agricultural College, Tirupati during Rabi 2012-13 and 2013-14, to evaluate the efficacy of botanicals and microbial insecticides against tobacco caterpillar, Spodoptera litura infesting groundnut on cultivar Kadiri-6. The treatments were replicated thrice with an individual plot size of 20.5 m (4.1 × 5m) under normal agronomical practices. The spacing adopted was 30 × 10 cm between plants. Spacing of 75cm was adopted between the treatment plots. The trial was laid out in a Randomized Block Design with seven treatments with NPV of *S. litura* (SlNPV) @ 250 LE $ha^{-1}$, *Bacillus thuringiensis* (Bt) @1.0 g $L^{-1}$, *Nomuraea rileyi* @ $1.5 \times 10^{13}$ conidia $ha^{-1}$, *Beauveria bassiana* @ $1.5 \times 10^{13}$ conidia $ha^{-1}$, NSKE @ 5.0 per cent, neem oil @ 2.0 ml $L^{-1}$ and control. The insecticides were sprayed when the level of incidence reached economic threshold level (one egg mass/10 larva per meter). Spray preparations were applied using a foot sprayer. The spray mixture of each treatment was prepared by mixing the required quantity of the insecticide formulations in water to make it equivalent to 625 L $ha^{-1}$. Spray mixtures were freshly prepared for each treat-

ment. The observations were recorded on the leaflets damage by *S. litura* at 5,10,15 and days and for larval counts at 5 and 10 days after spray on randomly selected and tagged ten plants per treatment with three replications. In control plot, plain water was sprayed. Precautions were taken during spraying to cover spray fluid uniformly and insecticide drift was prevented to the extent possible. The population reduction at different time intervals after treatment was calculated over the control. Pod yields from net plot of each treatment was recorded individually and weighed to relate the impact of treatments on tobacco caterpillar, *S. litura*. The economics of bio-pesticide application was worked out by considering the cost of the insecticides and the additional yield obtained over control. The cost benefit ratio was worked out by using the following formula

$$\text{Cost benefit ratio} = \frac{\text{Net Income}}{\text{Total cost}}$$

Efficacy of test treatments was expressed as population reduction in individual treatments with reference to the control and was computed by the formula.

$$\text{Percent leaf damage} : \frac{\text{Number of damaged leaflets}}{\text{Total number of leaflets per plant}} \text{X100}$$

**Table 1. Cumulative efficacy of various bio pesticides and botanicals against leaf damage of tobacco caterpillar, *Spodoptera litura* in groundnut during rabi season**

| Treatment | Pre-treatment | Post treatment (Percent leaf damage) | | | Mean | CBR |
|---|---|---|---|---|---|---|
| | | 5 days after spray | 10 days after spray | 15 days after spray | | |
| $T_1$ :*Spodoptera litura* NPV @ 250 LE $ha^{-1}$ | 46.03(42.71)e | 28.55(32.28)a | 16.30(23.77)a | 6.17(14.38)a | 24.26(28.29)a | 1: 1.85[a] |
| $T_2$: *Bacillus thuringiensis* (*Bt*) @ 1.0 g $L^{-1}$ | 41.59(40.14)d | 31.36(34.05)b | 18.05(25.08)a | 7.97(16.35)a | 24.74(28.91)a | 1: 0.94[b] |
| T3: *Nomuraea rileyi* 1.5x$10^{13}$ spores $ml^{-1}$ | 43.78(41.42)d | 31.58(34.19)b | 20.51(26.90)a | 10.52(18.92)a | 26.60(30.36)a | 1: 0.28c |
| T4: *Beauveria bassiana* 1.5x$10^{13}$ spores $ml^{-1}$ | 42.46(40.66)d | 33.56(35.40)b | 23.53(28.97)a | 13.21(21.31)a | 28.19(31.59)a | 1: 0.039e |
| $T_5$: NSKE @ 5.0 per cent | 43.46(41.24)c | 40.61(39.39)b | 30.96(33.80)a | 14.60 (22.41)a | 34.45(35.24)b | 1: 0.13[d] |
| $T_6$: Neem oil @ 2.0 ml $L^{-1}$ | 50.75(45.43)b | 49.87(44.93)c | 48.15(43.94)d | 33.08(35.08)b | 44.29(41.67)c | 1: 0.11[f] |
| $T_7$: Control | 58.76(50.05)b | 55.63(48.23)d | 48.50(44.14)d | 36.54(37.18)c | 49.86(44.90)d | -- |
| Mean | 39.21(38.05) | 36.80(38.10) | 33.33(36.47) | 28.24(32.87) | 34.39(36.37) | -- |
| CD at *P*=0.05 | 02.79 | 03.63 | 08.85 | 13.02 | 07.07 | -- |

Figures in parentheses are arc sine transformed values.

The values followed by same letters do not differ significantly at p=0.05

**Table 2. Cumulative efficacy of bio pesticides and botanicals against larvae of tobacco caterpillar, *Spodoptera litura* in groundnut during rabi season**

| Treatment | Pre-Treatment (No.of larvae) | Post-Treatment (Per cent reduction of larvae over control) | | | Dry pod yield (Kg ha-1) 1: 1.85a | Dry haulm yield (Kg ha-1) | CBR |
|---|---|---|---|---|---|---|---|
| | | 5 days after spray | 10 days after spray | Mean | | | |
| $T_1$ :*Spodoptera litura* NPV @ 250 L.E $ha^{-1}$ | 13.67 | 95.46 (77.99)a | 98.83 (83.83)a | 97.26(80.46)a | 1: 0.94b | 4172.83a | 1: 1.85a |
| $T_2$: *Bacillus thuringiensis* (*Bt*) @1.0 g $L^{-1}$ | 11.34 | 94.83 (76.86)a | 98.42 (81.23)a | 94.38(82.09)a | 3133.00b | 3976.17b | 1: 0.94b |
| $T_3$: *Nomuraea rileyi* 1.5x$10^{13}$ spores $ml^{-1}$ | 12.00 | 90.17 (71.90)a | 92.23 (74.10)a | 91.90(73.96)a | 2812.33c | 3543.00c | 1: 0.28c |
| $T_4$:*Beauveria bassiana* 1.5x$10^{13}$ spores $ml^{-1}$ | 10.50 | 64.33 (53.51)c | 69.83 (56.72)b | 68.64(56.20)c | 2638.00d | 3369.83d | 1: 0.039e |
| $T_5$: NSKE @ 5.0 per cent | 09.50 | 80.99 (63.47)b | 92.17 (73.79)a | 86.58(68.63)b | 2673.65d | 3332.29d | 1: 0.13d |
| $T_6$: Neem oil @ 2.0 ml $L^{-1}$ | 10.50 | 53.83 (47.20)d | 64.67 (53.57)b | 59.25(50.40)c | 2323.33e | 2950.67e | 1: 0.76f |
| $T_7$: Control | 07.00 | 00.00 | 00.00 | 00.00 | 2239.33f | 2744.00f | -- |
| Mean | | 79.80 | 86.21 | 83.00 | 2745.62 | 3398.43 | |
| CD at *P*=0.05 | | 22.10 | 23.81 | 22.96 | 0398.41 | 0440.68 | |

Figures in parentheses are arc sine transformed values.

The values followed by same letters do not differ significantly at p=0.05

## RESULTS AND DISCUSSION

During the present investigation overall efficacy among the different bio pesticides, *SlNPV* @ 250 LE $ha^{-1}$ **(**24.26%) and *Bt* @ 1.0 g*L*$^{-1}$ **(**24.74%**)** was significantly effective in reducing leaf damage over control **(**49.86%**)** in groundnut crop during Rabi season**.** This was followed by *Nomuraea rileyi* 1.5 x $10^{13}$ spores $mL^{-1}$**(**26.60%**)** and *Beauveria bassiana* 1.5 x $10^{13}$ spores $mL^{-1}$ (28.19%) which were on par with each other (Table 1). The efficacy of above bio pesticides is supported by several workers **(**Ramakrishnan and Tiwari,1969; Bell, 1991; Mehendale *et al.,*1992 and Ramanujam *et al*., 2003). A larval mortality of 76.66 % (Rajan and Muthukrishnan, 2009) was recorded against *S. litura* in different crops. The rest of the treatments, NSKE @ 5.0 per cent (34.45%) and neem oil @ 2.0 ml*L*$^{-1}$ (44.29%) were found to be less effective in reducing leaf damage. No symptoms of phytotoxicity were observed in any of the treatments. Overall efficacy of biopesticide treatments were, *SlNPV* @ 250 LE $ha^{-1}$ (97.26%), *Bt* @ 1.0 g*L*$^{-1}$(94.38%), *Nomuraea rileyi* 1.5x$10^{13}$ spores $mL^{-1}$ (91.90%) and NSKE @ 5.0 per cent (86.58%) thus proving their efficacy in reducing larval population (Table 2). Similar findings were observed by Anuradha (1991) in the case of *S.litura* who reported that NPV infection caused higher mortality with reduced pupation and higher pupal mortality. Khodyrev (1981) reported after effects of *Bt* on *Plutella brassicae* causing deformed pupae. The rest of the treatments, *Beauveria bassiana* 1.5 x $10^{13}$ spores $mL^{-1}$ (68.64%) and neem oil @ 2.0 ml*L*$^{-1}$ (59.25%) showed least efficacy against reduction of larval populations.

The dry pod and haulm yields in different biopesticide treatments ranged between 2239.33 to 3599.67 and 2739.21 and 4174.96 kg $ha^{-1}$. The results revealed that the treatments, *SlNPV* @ 250 LE $ha^{-1}$ and Bt @ 1.0 g $L^{-1}$ recorded highest dry pod and haulm yields over untreated check and was found to be significantly superior to all other treatments. This was followed by *N. rileyi* 1.5x$10^{13}$ spores $mL^{-1}$, *B. bassiana* 1.5x$10^{13}$ spores $mL^{-1}$ and NSKE @ 5.0 per cent which were on par with each other. Neem oil @ 2.0 ml $L^{-1}$ registered lowest dry pod and haulm yield reflecting its least effectiveness on *S. litura* (Table 2). No symptoms of phytotoxicity were observed in any of the bio-pesticide treatments.

Results pertaining to the economics of bio pesticides against *S. litura*, indicated that SlNPV@ 250 LE $ha^{-1}$ had more cost benefit ratio (1:1.85) and less leaf damage, highest larval reduction and maximum pod, haulm yield over the control. The second best treatment *Bt* @ 1.0 $gL^{-1}$ recorded 1:0.94 cost benefit ratio. Rest of the treatments neem oil @ 2.0 $mlL^{-1}$, *N. rileyi* 1.5 x $10^{13}$spores $mL^{-1}$, NSKE @ 5.0 per cent and *B. bassiana* 1.5x$10^{13}$spores $mL^{-1}$ recorded lowest cost benefit ratios (Table 2). These variations are due to the existence of different costs for the treatments. Based on the present results we report that SlNPV @ 250 LE $ha^{-1}$,*Bt* @ 1.0 g $L^{-1}$, *N. rileyi* 1.5x$10^{13}$ spores $mL^{-1}$ and NSKE @ 5.0 percent showed superiority significantly over the treatments in controlling the *S. litura* in groundnut.

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