Bioefficacy of different biopesticides against major foliage feeders on soybean [Glycine max (L.) Merrill]

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ABSTRACT: Field experiments were conducted to evaluate the efficacy of different biopesticides, viz., Nomuraea rileyi @ 1x10⁸ conidia/lit, Beauveria bassiana @ 1x10⁸ CFU/ml minimum @ 5 ml/lit, Metarhizium anisopliae @ 1x10⁹ CFU/ml minimum @ 5 ml/lit, dipel @ 1 kg/ha, spinosad 45 SC @ 0.5 ml/lit, neem seed kernel extract (NSKE) @ 5% and neem oil @ 2% against foliage feeders of soybean namely, semi looper (Chrysodeixis acuta) and tobacco caterpillar (Spodoptera litura) during Kharif, 2016. The result revealed that all treatments were significantly superior over control. The mean larval population of C. acuta and S. litura ranged from 1.29 to 9.37 and 0.92 to 6.98 larvae per meter row length (mrl) at 3, 7 and 10 days respectively after the application of treatments. The treatments comprising Spinosad 45 SC @ 0.5 ml/lit proved highly effective in reducing the population of C. acuta and S. litura with lowest overall mean larval population of 4.71 and 3.02 larvae per mrl, respectively. Against C. acuta NSKE @ 5% was least effective and against S. litura neem oil was observed as least effective with maximum over all mean larval populations of 7.75 and 4.97, respectively.

KEY WORDS: Biopesticides, Chrysodeixis acuta, foliage feeders, soybean, Spodoptera litura

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and recommended agronomical practices were followed. Observations on larval population were recorded at 24 hours before treatment and 3rd, 7th and 10th days after treatment applications on one meter row length (mrl) at 5 random places in each plot by placing half meter scale between two rows. Data recorded on insect pest population were subjected to analyses of variance.

**Green semilooper (**Chrysodeixis acuta**)**

The data obtained from three sprays against larval population of *C. acuta*/mrl at 24 hrs before and 3rd, 7th and 10th days after treatments are presented in Table 1. The mean larval population *C. acuta*/mrl before treatment varied from 8.48 to 9.37. Three days after spray, *Beauveria bassiana* @ 1x10⁹ CFU/ml minimum @ 5 ml/lit recorded the least larval population (7.80 larvae/mrl) which was significantly superior over control (9.60 larvae/mrl). The application of treatments *Nomuraea rileyi* @ 1x10⁸ conidia/lit and *spinosad 45 SC* @ 0.5 ml/lit were found to be the next effective treatments which recorded 7.88 and 8.03 larvae/mrl, respectively. However, all the treatments were significantly superior over untreated check. At seventh day after the treatment mean larval population among different treatments were significantly reduced over control plots. Among the treatments, spinosad 45 SC @ 0.5 ml/lit was found to be the most effective as it recorded the minimum larval population (4.98 larvae/mrl) followed by *Nomuraea rileyi* (4.82 larvae/mrl), dipel (5.60 larvae/mrl), *Metarhizium anisopliae* (6.44 larvae/mrl) and neem oil (7.06 larvae/mrl). On tenth day after treatment all the treatments exhibited significantly lower population over control plots. Spinosad 45 SC was found to be the most effective (1.29 larvae/mrl), followed *N. rileyi* (1.94 larvae/mrl), dipel (2.43 larvae/mrl), *M. anisopliae* (3.36 larvae/mrl), *B. bassiana* (3.49 larvae/mrl), neem seed kernel extract (6.73 larvae/mrl), and neem oil (6.82 larvae/mrl). On the basis of overall mean the differences in larval population among different treatments were significant as compared to control. Among treatments, spinosad 45 SC @ 0.5 ml/lit was found to be the most effective as it recorded the lowest larval population (4.71), followed by *N. rileyi* (4.93), dipel (5.53), *B. bassiana* (5.78), *M. anisopliae* (6.13), neem oil (7.47), and neem seed kernel extract (7.75).

**Tobacco caterpillar (**Spodoptera litura**)**

A day before imposing the treatments, initial larval population of *S. litura* ranged from 5.55 to 6.98 larvae per mrl which were at par with each other (Table 2). At three days after spray *N. rileyi* @ 1x10⁸ conidia/lit recorded the least larval population (4.97 per mrl), which was significantly superior over the control and spinosad 45 SC @ 0.5 ml/lit was found to be the next effective treatment which recorded 5.42 larvae per mrl. However, all the treatments were significantly superior over untreated control, but *B. bassiana* @ 1x10⁹ CFU/ml recorded highest larval population of 6.42

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### Table 1. Efficacy of microbial insecticides on green semilooper, *Chrysodeixis acuta* infesting soybean crop

| Treatments                          | Pre-Trements | Mean of *C. acuta* larvae/mrl |
|-------------------------------------|--------------|-------------------------------|
|                                     |              | 3 DAS** | 7DAS** | 10 DAS** | Overall mean |
| T1- *Nomuraea rileyi*** @ 1x10⁸ Conidia/lit | 8.76 | (3.04)* | 7.88 | (2.89)* | 4.93 | (2.33)* |
| T2- *Beauveria bassiana*** 1x10⁹ CFU/ml minimum @ 5 ml/lit | 8.48 | (3.00)* | 7.80 | (2.88)* | 5.78 | (2.51)* |
| T3- *Metarhizium anisopliae*** 1x10⁸ CFU/ml minimum @ 5 ml/lit | 9.13 | (3.10)* | 8.60 | (3.02)* | 6.13 | (2.58)* |
| T4- Dipel @ 1 Kg / ha | 9.29 | (3.13)* | 8.55 | (3.01)* | 5.53 | (2.45)* |
| T5- Spinosad 45 SC @ 0.5 ml /lit | 9.18 | (3.11)* | 8.03 | (2.92)* | 4.71 | (2.28)* |
| T6- Neem Seed Karnal Extracts @ 5% | 9.37 | (3.14)* | 9.01 | (3.08)* | 7.75 | (2.86)* |
| T7- Neem Oil @ 2% | 8.88 | (3.06)* | 8.52 | (3.00)* | 7.47 | (2.82)* |
| T8- Control (Untreated) | 8.98 | (3.08)* | 9.60 | (3.18)* | 10.15 | (3.26)* |
| SEM ± | 0.034 | 0.098 | 0.086 | 0.068 | 0.085 |
| CD (*P* = 0.05) | 0.102 |

*Figures in parentheses are square root values; DAS= Days after spraying; **Mean of three sprays; NS= Non- significant; *** adding 0.2% Edible oil + 0.01% Sticker
The bioefficacy of different biopesticides against major foliage feeders on soybean was evaluated. Spinosad 45 SC @ 0.5 ml/lit recorded the lowest larval population (2.72 and 0.92 larvae/mrl, respectively) over untreated control, which was significantly superior over all the treatments. Untreated control recorded significantly higher population (8.88 and 9.95 larvae/mrl, respectively). On the basis of overall mean of 3rd, 7th, and 10th day after spraying all the treatments exhibited significantly low mean larval population of *Spodoptera litura* as compared to control. Among these treatments, spinosad 45 SC @ 0.5 ml/lit was found to be most effective as it recorded the lowest larval population (3.01 larvae/mrl, respectively) as compared to untreated control. This was followed by *N. rileyi* (3.14), dipel (3.87), *M. anisopliae* (4.23), *B. bassiana* (4.33), and neem seed kernel extract (4.94) with significant differences between the treatments. Neem oil proved to be the least effective treatment against *S. litura*.

After introduction of the soybean crop to India during 1970s, there were no major pests infesting this crop and it was harvested with minimum use of chemical insecticides. During the last two decades the crop has been suffering from many pests. Among the insect pests, leaf eating caterpillars play a key role in reducing yield. Suppression of soybean pest by regular means of using pesticides has led to many health and environmental hazards and further use resulted into insecticide resistance problem which deteriorated the situation leading to outbreak of pests. Alternate crop protection methods are gaining interest in order to have sustainable management tactics against many insect pests in field crops and horticultural crops. The soybean pests, *viz.*, *C. acuta* and *S. litura*, are major constraints for soybean production.

Among all the treatments, the significantly lower overall mean population of *C. acuta* was recorded in the plots treated with spinosad 45 SC and the next effective treatment was *N. rileyi*. However, all the microbial insecticide treatments were significantly superior over untreated check, whereas maximum larval population was recorded in plots treated with NSKE5% after untreated check. Similar findings have been reported against American boll worm in cotton, castor semi-looper, tobacco caterpillar, diamond back moth and paddy stem borer (Ranga Rao et al., 2007; Selvaraj and Kaushik, 2013), whereas, the efficacy of *B. bassiana* have been reported against *C. acuta* in soybean (Sharma and Ansari, 2007). Hall et al. (2000) reported highest mortality of soybean looper (*Photedes includens*) when applied with spinosad at 0.012 and 0.025 lb ai/acre. Knight et al. (2000) reported that spinosad had good potential to control soybean looper.

Table 2. Efficacy of microbial insecticides on Tobacco caterpillar, *Spodoptera litura* infesting soybean crop

| Treatments | Pre-Treatments | Mean of *C. acuta* larvae/mrl |
|------------|----------------|-------------------------------|
|            |                | 3 DAS** | 7DAS** | 10 DAS** | Overall mean |
| T1- Nomuraea rileyi*** @ 1×10⁸ Conidia/lit | 5.55 (2.46) * | 4.97 (2.34) * | 2.76 (1.81) * | 1.68 (1.48) * | 3.14 (1.91) * |
| T2- Beauveria bassiana*** 1×10⁵ CFU/ml minimum@5ml/lit | 6.98 (2.73) * | 6.42 (2.63) * | 4.40 (2.21) * | 2.18 (1.64) * | 4.33 (2.20) * |
| T3- Metarhizium anisopliae *** 1×10⁵ CFU/ml minimum@5ml/lit | 5.82 (2.51) * | 5.60 (2.47) * | 3.90 (2.10) * | 3.19 (1.92) * | 4.23 (2.17) * |
| T4- Dipel @ 1 Kg/ha | 6.69 (2.68) * | 6.09 (2.57) * | 3.57 (2.02) * | 1.95 (1.57) * | 3.87 (2.09) * |
| T5- Spinosad 45 SC @ 0.5 ml/lit | 6.12 (2.57) * | 5.42 (2.43) * | 2.72 (1.79) * | 0.92 (1.19) * | 3.02 (1.88) * |
| T6- Neem Seed Karnal Extracts @5% | 5.88 (2.53) * | 5.64 (2.48) * | 4.65 (2.27) * | 4.52 (2.24) * | 4.94 (2.33) * |
| T7- Neem Oil @ 2% | 6.01 (2.55) * | 5.74 (2.50) * | 4.63 (2.26) * | 4.56 (2.25) * | 4.97 (2.34) * |
| T8- Control (Untreated) | 6.67 (2.68) * | 7.88 (2.89) * | 8.88 (3.06) * | 9.95 (3.23) * | 8.90 (3.07) * |
| SEM ± (P=0.05) | 0.084 | 0.082 | 0.073 | 0.060 | 0.055 |

*Figures in parentheses are square root values; DAS = Days after spraying; ** Mean of three sprays; NS = Non- significant; *** adding 0.2% Edible oil + 0.01% Sticker
The observations on *S. litura* larval population was also recorded and it is found that the most effective treatment was spinosad 45 SC against followed by *N. rileyi* and both were significantly superior over the remaining treatments. The maximum overall mean larval population was recorded in plots treated with neem oil @ 2% after untreated plots. The present findings are in conformity with several workers such as Harish (2008) who found that spinosad was effective against *S. litura*, while Jat and Ameta (2013) observed spinosad 45% SC at 200 ml/ha with 74.67 per cent mean reduction in fruit borer. Gadhiya *et al.* (2014) also found spinosad (0.018%) effective in protecting the groundnut crop from the infestation of *S. litura*.

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