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Evaluation of some fungal based biopesticides against blister beetle in okra under mid altitude hills of Meghalaya

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ABSTRACT

The field trials were carried out at ICAR RC for North Eastern Hill Region, Umiam, Meghalaya to assess some fungal based biopesticides against blister beetle in okra during *kharif* seasons of two consecutive years (2019 and 2020). The experimental trails were laid out in randomized block design. The okra seeds (Var: Nishita) were sown in 5 m × 3 m plot with 60 cm x 50 cm spacing and each plot was replicated thrice. Two sprays of commercial products (except vermiwash) of neem oil 0.03% (3ml/l), *Metarhizium anisoplae* (5g/l), *Beauveria bassiana* (5g/l), *Lecanicillium lecanii* (5g/l), *Bacillus thuringiensis* (2g/l), vermiwash (100 ml/l) were applied along with control (water spray) at 14 days intervals with initiation of blister beetle on okra. Pooled results of the two years data showed that neem oil recorded minimum number of blister beetle (0.38 beetles/plant) that was closely at par with *Beauveria bassiana* (0.39 beetle/plant) with 52.28 and 49.68% reduction of beetle population respectively over untreated control (0.78 beetles/plant). Next best treatment was *Metarhizium anisoplae* (0.47 beetle/plant). Lowest percentage of flower damage (8.22%) was recorded in the plots treated with *Beauveria bassiana* with 53.46% reduction followed by neem oil (8.49% flower infestation) and *Metarhizium anisoplae* (9.52% flower infestation) with 52.15 and 46.03% reduction respectively over untreated control (17.68%). Highest pooled yield of marketable okra (104.6q/ha) was recorded in *Beauveria bassiana* treated plots followed by neem oil (103.6q/ha) and *Metarhizium anisoplae* (98.9q/ha).

1. Introduction

Okra, *Abelmoschus esculentus* L. Moench is a common vegetable crop cultivated all over the country. It is also called as bhendi or lady's finger. Boswell and Reed (1962) reported that okra is a native crop of South East Asia, Africa and North Australia to the pacific. It is also most popular in India (Sarkar *et al.*, 2016).It has diverse uses of different plant parts such as fresh leaves, flower, buds, stem and seeds (Mihretu *et al.*, 2014). Young fruits are commonly used as vegetables and it also used in soups, stews and salads, fried or boiled and dried or fresh (Ndunguru & Rajabu, 2004). Calisir and Yildiz (2005) reported that roasted okra seeds are used to form a caffeine-free substitute for coffee. In India, okra occupied 509 thousand hectares area and production was 6095 thousand MT with a productivity of 11.97 MT/ha while in Meghalaya it covered 0.51 thousand hectares and produced 3.97 thousand MT with a productivity of 7.78 MT/ha (Anonymous, 2018). Low productivity of okra in Meghalaya is associated with many factors but insect pest infestation on okra is one of the major reasons. It is reported that okra is attacked by blister beetle, *Mylabris pustulata* (Thunb); flea beetle, *Nodostoma* spp.; red cotton bug, *Dysdercus koenigii* Fabr.; aphids, *Aphis gossypii* (Glover); shoot weevil, *Alcidodes affaber* Auriv and cotton jassid, *Amrasca biguttula biguttula* (Ishida) (Boopathi *et al.*, 2011). In Meghalaya, blister beetle attacks on okra in every year and causing considerable yield loss in okra. It feed voraciously on flower buds, flower petals, anthers, stigma and ovary and thereby causing huge yield loss in okra (Shende, 2013). The flower infestation varies from 28 to 60 % in different host plant by blister beetle (Anandita *et al.*, 2018). Flower infestation in okra by *Mylabris* spp. varies from 4.45 to 24.05% (Badiyala, 2010). *M. pustulata* is considered as a flower feeder of many crops such as bhindi, groundnut,

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cowpea, cucurbits, black gram and red gram (Panwar, 1995). Garg (1985) and Prasad *et al.* (1991) also reported that these beetles as a serious pest on sorghum, red gram, bajra, maize, rice, groundnut, cotton and rose. Sometimes management of this insect becomes difficult due its high mobility and enormous host range. Generally, farmers are relying on synthetic chemical pesticides for management of this polyphagous insect. Extensive use of synthetic pesticides creates several adverse effects on environment. Hence, it is necessary to develop an alternative safe and eco-friendly management practices against this pest. Considering the above points, the experiments were carried out to assess some fungal based biopesticides against blister beetle in okra.

2. Materials and Methods

The field trials were carried out conducted at ICAR RC for North Eastern Hill Region, Umiam, Meghalaya to assess some fungal based biopesticides against blister beetle during kharif seasons of 2019 and 2020 under organic condition. The experimental trails were laid out in randomized block design. The okra seeds (Var: Nishita) were sown in 5 m × 3 m plot with 60 cm x 50 cm spacing and each plot was replicated thrice. The commercial products (except vermiwash) of neem oil 0.03% (3ml/l), *Metarhizium anisoplae* (5g/l), *Beauveria bassiana* (5g/l), *Bacillus thuringiensis* (2g/l), *Lecanicillium lecanii* (5g/l), vermiwash (100 ml/l) were applied along with control (water spray). Two sprays were given at 14 days intervals with initiation of blister beetle on okra. Number of blister beetle population/plant was recorded before spray and after each spraying of treatments from five randomly selected tagged plants from each replication. Total number of flowers/flower buds and damaged flowers/flower buds were recorded before spray and after each spray for estimation of flower damage. Weight of okra from each replication was recorded separately after each picking of fruits for yield. The data on blister beetle population and percent of flower damage were subjected to square root and angular transformation respectively for analysis of critical difference at five percent level of significance.

3. Results

Efficacy of different biopesticides against blister beetle population in okra

The efficacy of different biopesticides against blister beetle during 2019 and 2020 is illustrated in Table 1. In 2019, the pre-treatment count of blister beetle ranged from 0.11 to 0.22 beetles/plant and it was non-significant in all the treatments. Post treatment observations showed that there was significant variation among the treatments. The lowest mean population of blister beetle (0.30 beetles/plant) was noticed in the plots treated with neem oil followed by *B.bassiana* (0.36 beetle/plant) and *M. anisoplae* (0.41 beetles/plant) with 57.81, 50.00 and 42.19% reduction over untreated control plots (0.71 beetles/plant), respectively. During 2020, it was observed that infestation of blister beetles on okra was relatively higher as compared to previous year. Pre-treatment population varied from 0.16 to 0.29 beetles/plant and it was statistically nonsignificant. However, there were significant differences among all the treatments after each spray. Mean beetle population after two sprays was minimum in *B.bassiana* treated plots (0.43 beetles/plant) followed by neem oil (0.46 beetles/plant) and *M. anisoplae* (0.52 beetles/plant) with 49.35, 46.75 and 38.96% reduction over untreated control plots (0.86 beetles/plant), respectively. Pooled data (Figure 1) revealed that lowest blister beetle was noted in the plots treated with neem oil (0.38 beetles/plant) which was closely at par with *B. bassiana* treated plots (0.39 beetles/plant) with 52.28 and 49.68% reduction respectively over untreated control plots (0.78 beetles/plant). During both the years, it was found that *B. thuringiensis* (*Bt*) was least effective among all the treatments followed by *L. lecanii* against this pest.

Effect of different biopesticides on flower infestation caused by blister beetle in okra

The effect of various biopesticides on flower infestation by blister beetles in okra is depicted in Table 2. During 2019, flower infestation by blister beetle was varied from 3.01 to 4.32% before spray and it was found statistically nonsignificant among the treatments. After two sprays, the lowest mean flower infestation was recorded in neem oil treated plots (7.46%) that was at par with *B. bassiana* (7.77%) and *M. anisoplae* (9.08%) with 54.49, 52.60 and 44.64% reduction respectively over untreated control plots (16.40% flower infestation). During second season (2020), highest efficacy was found in *B. bassiana* treated plots with 8.66% mean flower infestation and 54.31% reduction over control and it was at par with neem oil (9.51%) and *M. anisoplae* (9.97%) with 49.80 and 47.42% reduction over control plots (18.95% flower infestation), respectively. Though, all the biopesticides were effective over untreated control. Pooled of two years experiments (Figure 2) showed that the *B. bassiana* was effective treatment with minimum flower infestation (8.22%) which was statistically at par with neem oil (8.49%) and *M. anisoplae* (9.08%) with 53.46, 52.15 and 46.03% reduction over untreated control plots (17.68% flower infestation) respectively. During both the years, it was observed that *B. thuringiensis* (*Bt*), *L. lecanii* and vermiwash were comparatively less effective but all these were superior over control.

Effect of treatments on yield of okra

The effect of treatments on okra yield during 2019 and 2020 is presented in Figure 3. During 2019, the maximum fruit yield was recorded in the plots treated with *B. bassiana* (107.6 q/ha). The next best treatments were neem oil (106.8 q/ha) and *M. anisoplae* (102.1 q/ha). The minimum fruit yield was noticed in control plots (78.0 q/ha). In 2020, the trend of marketable yield of okra was similar to the previous year. Pooled of two years data also showed that all the treatments having biopesticides recorded higher yield as compared to untreated control plots (75.0 q/ha). The highest marketable yield of okra was found in *B. bassiana* treated plots (104.6 q/ha) followed by neem oil (103.6 q/ha) and *M. anisoplae* (98.9 q/ha).

4. Discussion

The present experiments revealed that all the biopesticides were effective treatments against blister beetle in okra over untreated control. Among the biopesticides, *B. bassiana*, neem oil and *M. anisoplae* showed the higher efficacy as compared to other treatments. The results of *B. bassiana* and *M. anisoplae* against blister beetle are in the line of Miranpuri and Khachatourians (1994) who reported that some strains of *B. bassiana* were highly pathogenic to Nuttall blister beetle than *L. lecanii*. The fungi *B. bassiana* and *L. lecanii* (Viegas) may be useful for management of *M. pustulata* in field conditions (Sahayaraj and Borgio, 2010). Furuie *et al.* (2022) reported that *B. bassiana* is a potential biocontrol agent against *Lema bilineata* Germar (Coleoptera: Chrysomelidae). Tuncer *et al.* (2019) reported that *B. bassiana* (TR-217) and *M. anisopliae* (TR-106) may be effective biological control agents against the invasive ambrosia beetle.Wakil *et al.* (2015) indicated the good efficacy of *M. anisopliae* against *Sitophilus oryzae* in the laboratory. The results of neem oil are in the agreement of many researchers against various coleopteran insect pests. At the higher concentrations of azadirachtin inhibited acetylcholinesterase activity by 59% in *M. pustulata* (Tahir *et al.*, 1992). Neem based pesticide was very effective against epilachna beetles on eggplant (Ghosh and Senapati, 2002). Anandita *et al.* (2018) revealed the moderate efficacy of azadiractin against blister beetle in okra under Himachal Pradesh condition. Neem oil may be effective treatment for managing insect pests in okra for higher productivity (Mochiah *et al.*, 2020). Azadirachtin acts as anti-feedant and blocks the formation of hormone ecdysteroid in insects (Berxolli & Shahini, 2017). Campos *et al.* (2016) reported that the compounds (salannin and meliantrol) in neem discourage feeding behaviour on the pests. Neem extracts show growth inhibitory activity, decrease in fertility and high rate of mortality on more than 400 insect species from different orders (Ragsdale *et al.*, 2004and Liu *et al.*, 2004). Obeng-Ofori and Sackey (2003) reported that use of commercial formulation of *B. thurigiensis* against *M. temporalis* and *M. trifasciata* provided higher marketable fruit yield of okra.

5. Conclusion

From the present experiment it was observed that *B. bassiana*, neem oil and *M. anisoplae* showed the higher efficacy in reducing the blister beetle population and provides higher marketable fruit yield of okra. Therefore, these three biopesticides may be incorporated in the pest management schedule of okra.

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Table 1. Effect of different biopesticides on blister beetle population in okra during 2019-2020

Treatment	**Dose**	**2019**					**2020**				
		No. of blister beetle before spray	No. of blister beetle after spray			Percent reduction over control	No. of blister beetle before spray	No. of blister beetle after spray			Percent reduction over control
			First spray	Second spray	Mean			First spray	Second spray	Mean	
Neem oil 0.03%	3ml/l	0.16 (0.81)	0.22 (0.85)	0.38 (0.94)	0.30 (0.89)	57.81	0.18 (0.82)	0.31 (0.90)	0.60 (1.05)	0.46 (0.98)	46.75
Metarhizium anisoplae	5g/l	0.11 (0.78)	0.33 (0.91)	0.49 (0.99)	0.41 (0.95)	42.19	0.22 (0.85)	0.42 (0.96)	0.62 (1.06)	0.52 (1.01)	38.96
Beauveria bassiana	5g/l	0.20 (0.84)	0.29 (0.89)	0.42 (0.96)	0.36 (0.92)	50.00	0.24 (0.86)	0.40 (0.95)	0.47 (0.98)	0.43 (0.97)	49.35
Bacillus thuringiensis	2g/l	0.13 (0.80)	0.53 (1.01)	0.73 (1.10)	0.62 (1.06)	12.25	0.16 (0.81)	0.64 (1.07)	0.82 (1.15)	0.73 (1.11)	14.29
Lecanicillium lecanii	5g/l	0.22 (0.84)	0.44 (0.97)	0.62 (1.06)	0.53 (1.02)	25.00	0.18 (0.82)	0.56 (1.03)	0.80 (1.14)	0.68 (1.08)	20.78
Vermiwash	100ml/l	0.20 (0.83)	0.33 (0.91)	0.76 (1.12)	0.54 (1.02)	23.44	0.29 (0.89)	0.49 (0.99)	0.78 (1.13)	0.63 (1.06)	25.97
Control	-	0.13 (0.80)	0.56 (1.03)	0.87 (1.17)	0.71 (1.10)	-	0.20 (0.84)	0.62 (1.06)	1.09 (1.26)	0.86 (1.16)	-
SEm (±)	-	-	0.04	0.03	0.02	-	-	0.03	0.03	0.02	-
CD at 5%	-	NS	0.11	0.08	0.07	-	NS	0.10	0.08	0.06	-

Data in the parentheses are square root transformed values

Table 2. Effect of different biopesticides on flower infestation caused by blister beetle in okra during 2019-2020

Treatment	**Dose**	**2019**					**2020**				
		Flower infestation (%) before spray	Percent flower infestation after spray			Percent reduction over control	Flower infestation (%) before spray	Percent flower infestation after spray			Percent reduction over control
			First spray	Second spray	Mean			First spray	Second spray	Mean	
Neem oil	3ml/l	3.07 (10.04)	5.48 (13.45)	9.45 (17.77)	7.46 (15.83)	54.49	4.40 (12.11)	7.97 (16.32)	11.06 (19.41)	9.51 (17.96)	49.80
Metarhizium anisoplae	5g/l	4.08 (11.64)	7.46 (15.85)	10.70 (19.04)	9.08 (17.52)	44.64	5.42 (13.45)	8.29 (16.67)	11.64 (19.92)	9.97 (18.37)	47.42
Beauveria bassiana	5g/l	3.43 (10.55)	5.91 (13.98)	9.63 (18.02)	7.77 (16.13)	52.60	5.35 (13.34)	7.68 (16.04)	9.64 (18.05)	8.66 (17.07)	54.31
Bacillus thuringiensis	2g/l	3.32 (10.33)	10.80 (19.17)	16.18 (23.71)	13.49 (21.54)	17.75	4.42 (12.10)	10.85 (19.19)	18.89 (25.75)	14.87 (22.66)	21.56
Lecanicillium lecanii	5g/l	4.20 (11.79)	10.08 (18.45)	14.65 (22.46)	12.37 (20.58)	24.60	4.87 (12.74)	9.84 (18.25)	17.12 (24.42)	13.48 (21.52)	28.86
Vermiwash	100ml/l	4.32 (11.93)	7.82 (16.07)	13.39 (21.45)	10.60 (18.98)	35.34	5.32 (13.30)	9.66 (18.05)	18.20 (25.25)	13.93 (21.91)	26.50
Control	-	3.01 (9.95)	13.55 (21.52)	19.25 (25.98)	16.40 (23.89)	-	4.69 (12.48)	15.69 (23.32)	22.22 (28.07)	18.95 (25.80)	-
SEm (±)	-	-	1.11	1.16	0.70	-	-	0.85	0.97	0.47	-
CD at 5%	-	NS	3.42	3.59	2.17	-	NS	2.60	3.00	1.44	-

Data in the parentheses are angular transformed values

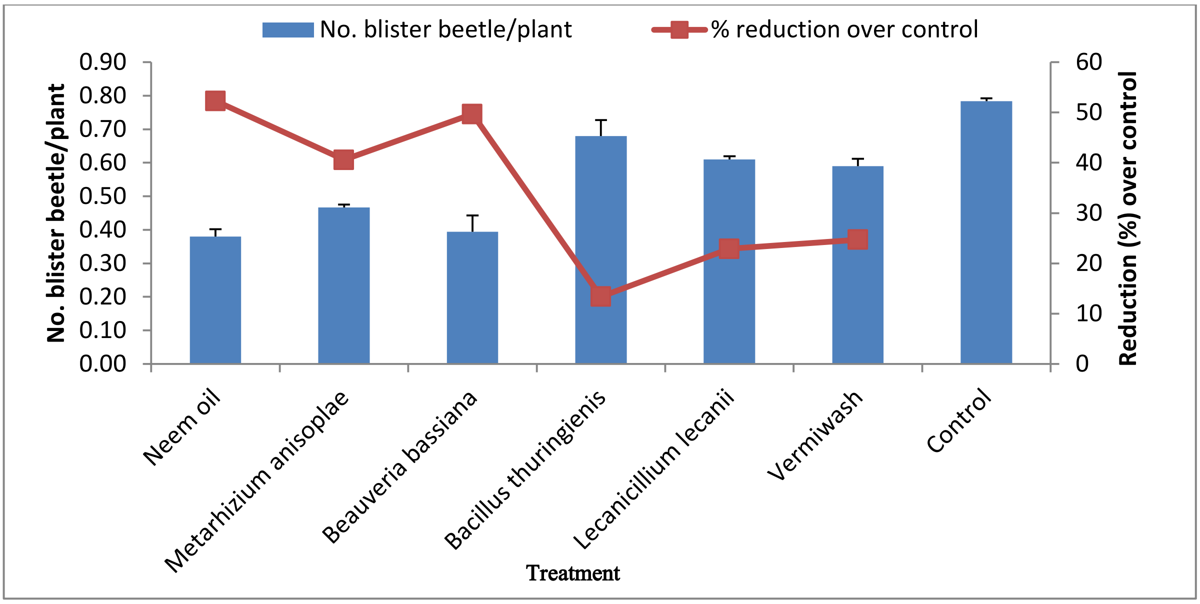

Figure 1. Pooled effect of different biopesticides on blister beetle in okra

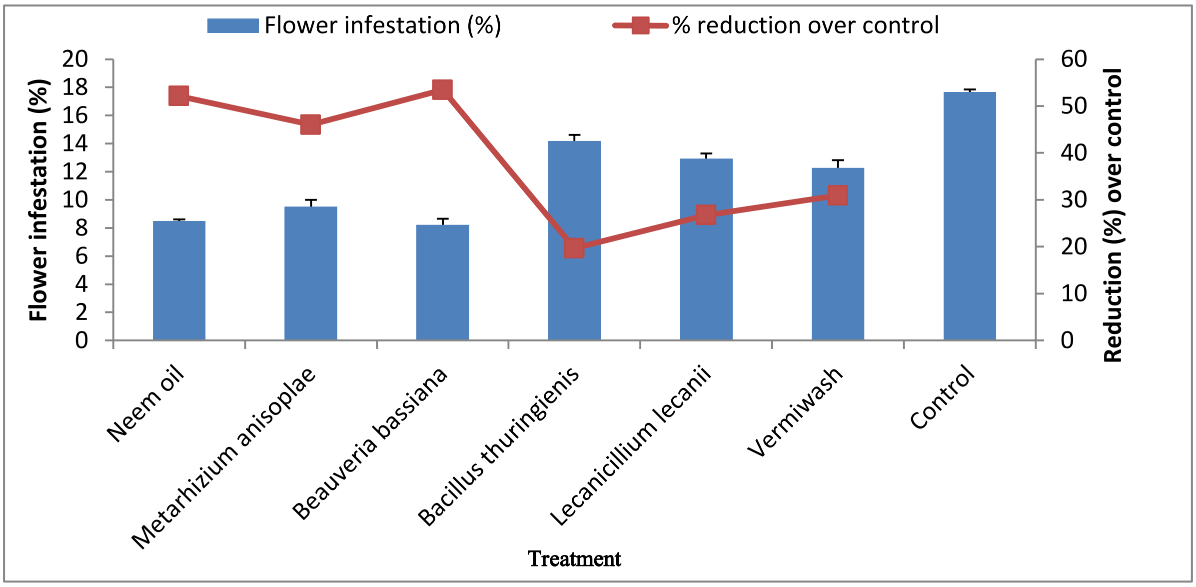

Figure 2. Pooled effect of different biopesticides on flower infestation in okra

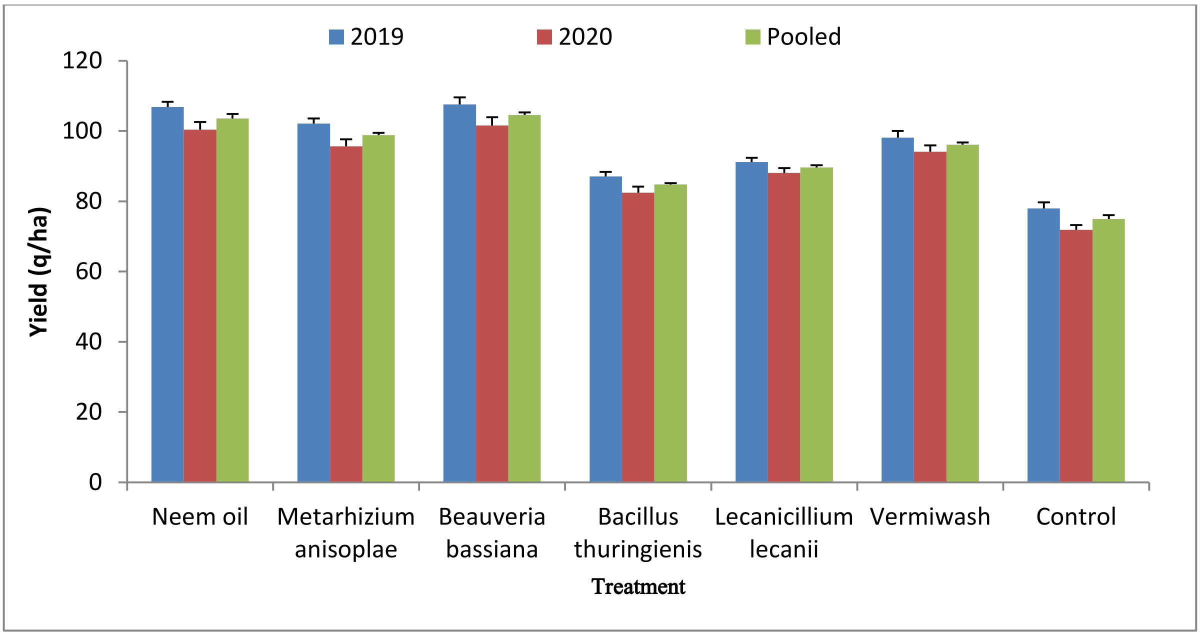

Figure 3. Effect of different biopesticides on yield of okra