Indian Journal of Entomology, 77(1): 51-55 (2015) DOI No. 10.5958/0974-8172.2015.00010.3

BIORATIONAL MANAGEMENT OF MAJOR PESTS OF BRINJAL

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ABSTRACT

Field experiments were carried out in brinjal during summer and *kharif*, 2013 to evaluate the efficacy of *Metarhizium anisopliae* and *Beauveria bassiana* (talc formulation @ 5 gm/L), *M. anisopliae* and *B. bassiana* (potato dextrose broth @10^7 spores/ml), *Bt* formulation @ 1 ml/L, spinosad 45 SC @ 0.4 ml/L, Azadirachtin 1% @ 2 ml/L and Malathion 50 EC @ 2 ml/L against *Leucinodes orbonalis*, *Epilachna vigintioctopunctata*, *Antoba olivacea* and *Selepa docilis*. Spinosad 45 SC was found to be effective in reducing shoot and fruit infestation by *L. orbonalis*. Azadirachtin 1% was found to be most effective in controlling leaf infestation by *E. vigintioctopunctata*. *Bt* formulation was highly effective for early larval instars of *A. olivacea*. However, for later instars, malathion 50 EC was found to be effective. Azadirachtin 1% was found to be highly effective against *S. docilis* during summer and *kharif*.

Key words: Spinosad 45 SC, azadirachtin 1%, *Bt* formulation, malathion 50 EC, Brinjal.

The brinjal crop is subjected to attack by number of insect pests right from nursery stage till harvesting (Regupathy *et al.*, 1997). Among these, the most important and destructive ones are the shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyraustidae); epilachna beetle, *Epilachna vigintioctopunctata* (F.) (Coleoptera: Coccinellidae); leaf roller, *Antoba olivacea* Wlk. (Lepidoptera: Noctuidae) and hairy caterpillar, *Selepa docilis* Butler (Lepidoptera: Noctuidae). For management of these pests, the conventional pest management practices often provide unsatisfactory results. Further, the use of chemical pesticide results in insecticide resistance, pest resurgence and pesticide residue. Therefore, an attempt was made to study the efficacy of microbial preparations, biorational and neem based insecticides against major pests of brinjal.

MATERIALS AND METHODS

The experiment was carried out in the Instructional farm, Kerala Agricultural University, College of Agriculture, Padanakkad during summer and *kharif* (2013). A bacterial wilt resistant variety "*Surya*" was used following randomized block design, comprising of 9 treatments *viz.*, T_1: *Metarhizium anisopliae* (talc formulation @ 5 gm/L), T_2: *Metarhizium anisopliae* (potato dextrose broth @10^7 spores/ml), T_3: *Beauveria bassiana* (talc formulation @ 5 gm/L), T_4: *Beauveria bassiana* (potato dextrose broth @10^7 spores/ml), T_5: *Bt* formulation @ 1ml/L, T_6: Spinosad 45 SC @ 0.4 ml/L, T_7: Azadirachtin 1% @ 2 ml/L, T_8: Malathion 50 EC @ 2 ml/L – standard check, T_9: Absolute control. The treatments were replicated thrice. The spray applications of the treatments were done once in 15 days after transplantation, as soon as the pests build up were noticed in the field.

The infestation on the basis of damaged shoot, fruits and leaves were recorded from five randomly selected plants from each plot. Observations were made at 15 days after application of each treatments. Per cent shoot/fruit/leaf infestation was calculated as follows:

$$\text{Per cent shoot/fruit/leaf infestation} = \frac{\text{Number of shoot/fruit/leaf infested}}{\text{Total number of shoot/fruit/leaf}} \times 100$$

The data were subjected to transformation ($\sqrt{x+1}$) wherever necessary, and statistically analyzed.

RESULTS AND DISCUSSION

From the experiment it was observed that, among the treatments, T_6 recorded minimum shoot infestation by *L. orbonalis* during summer at 15 days after first spray (DAFS), 15 days after second spray (DASS), 15 days after third spray (DATS) and 15 days after fourth spray (DAFRS). During *kharif* season, per cent incidence was 8.26, 6.81, 2.93 and 1.97 in the

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respective treatments (Table 1). This finding is in agreement with Pareet and Basavanagoud (2012) who reported that spinosad 45 EC was the most effective. Malathion 50 EC @ 2 ml/L was found to be the next best, while *M. anisopliae* talk formulation @ 5 g/L was found to be the least effective. These results agree with those of Yadav and Sharma (2005) who observed that malathion was found to be effective.

The data on fruit infestation presented in Table 2 indicate that during summer the minimum infestation was recorded in T_6 at 15 DAFS, 15 DASS, 15 DATS and 15 DAFRS; and during *kharif* also with same trend Adiroubane and Raghuraman (2008) who observed that spinosad 45 SC was effective.

The results on the leaf infestation by *E. vigintioctopunctata* is presented in Table 3. During summer T_8 (malathion 50 EC @ 2 ml/L) recorded least infestation at 15 days interval spraying four times, and during *kharif*. Azadirachtin 1% @ 2 ml/L also recorded minimum infestation. This is in accordance with Amitava-Konar *et al.* (2005) and Mane and Kulkarni (2010) who reported that azadirachtin 1000 ppm and neem oil 3% gave better results in controlling *E. vigintioctopunctata* than microbial insecticides. In the present study T_8 (standard check-malathion 50 EC) was found to be effective.

The damage caused by *A. olivacea* revealed that T_5 (*Bt* formulation) recorded minimum infestation during summer and during *kharif* season also the same trend was observed (Table 4). The next best treatment was malathion 50 EC @ 2 ml/L. The present findings corroborates with earlier report by Baskaran and Kumar (1980) that the mixture of dipel at 0.1% with sublethal doses of carbaryl (0.04%) were found to be the most effective.

As regards *S. docilis* it was observed that minimum infestation was found in T_8 (malathion 50 EC @ 2 ml/L) during summer and during *kharif* (Table 5). Even though malathion 50 EC showed slight variation in

Table 1. Shoot infestation by *L. orbonalis* and efficacy of treatments (summer, *kharif*)

Treatments*	Shoot infestation %							
	Summer season				*kharif* season			
	15 DAFS	15 DASS	15 DATS	15 DAFRS	15 DAFS	15 DASS	15 DATS	15 DAFRS
T_1	17.92	20.48	24.55	27.66	19.95	23.04	23.76 (4.97)	25.72 (5.16)
T_2	15.87	19.23	23.71	25.35	18.66	20.26	21.95 (4.79)	23.62 (4.96)
T_3	12.42	16.38	19.32	22.47	17.66	19.65	20.75 (4.66)	21.77 (4.77)
T_4	12.82	14.01	17.16	20.31	16.27	17.71	19.45 (4.52)	20.27 (4.61)
T_5	9.90	10.66	11.86	11.58	13.96	13.47	13.35 (3.78)	12.62 (3.69)
T_6	6.82	5.88	4.50	3.77	8.26	6.81	2.93 (1.98)	1.97 (1.72)
T_7	11.92	12.59	13.36	15.07	13.96	13.32	15.14 (4.01)	15.74 (4.09)
T_8	8.84	8.03	7.64	6.55	10.35	10.27	9.96 (3.31)	9.71 (3.27)
T_9	26.70	35.44 (s)	49.72 (s)	57.70 (s)	29.56	39.83 (s)	44.17 (6.72)	45.69 (6.83)
CD at 0.05%	4.79	2.41	3.60	1.55	5.92	2.66	0.98	1.01

Figures in parenthesis denote $\sqrt{x+1}$ transformed values: (s) - Highly significant; DAFS- Days after first spray; DASS- Days after second spray: DATS- Days after third spray: DAFRS- Days after fourth spray.

*T_1: *M. anisopliae* (talc formulation @ 5 gm/L of water); T_2: *M. anisopliae* (potato dextrose broth @10^7 spores/ml); T_3: *B. bassiana* (talc formulation @ 5 gm/L of water); T_4: *B. bassiana* (potato dextrose broth @10^7 spores/ml);T_5: *Bt* formulation @ 1ml/L of water; T_6: Spinosad 45 SC @ 0.4 ml/L of water; T_7: Azadirachtin 1% @ 2 ml/L of water: T_8: Malathion 50 EC @ 2 ml/L of water; T_9: Absolute control.

Table 2. Fruit infestation by *L. orbonalis* and efficacy of treatments (summer, *kharif*)

Treatments	Fruit infestation %							
	Summer season				*Kharif* season			
	15 DAFS	15 DASS	15 DATS	15 DAFRS	15 DAFS	15 DASS	15 DATS	15 DAFRS
T_1	29.91 (5.56)	43.32 (6.65)	56.62 (7.59)	66.62 (8.22)	41.11	54.16	62.22	69.06 (8.37)
T_2	30.15 (5.58)	44.99 (6.78)	54.24 (7.43)	62.56 (7.97)	42.85	50.00	54.29	60.63 (7.85)
T_3	25.94 (5.19)	33.33 (5.85)	37.09 (6.17)	52.46 (7.31)	33.96	37.73	42.34	47.31 (6.95)
T_4	28.60 (5.44)	39.58 (6.37)	47.16 (6.93)	51.18 (7.22)	35.55	42.37	46.15	54.92 (7.47)
T_5	19.58 (4.53)	23.35 (4.93)	24.89 (5.08)	26.23 (5.21)	30.35	29.47	29.10	28.17 (5.40)
T_6	11.58 (3.54)	10.34 (3.36)	8.77 (3.12)	4.60 (2.36)	20.13	16.15	13.09	8.03 (3.00)
T_7	24.42 (5.04)	28.87 (5.46)	33.54 (5.87)	38.20 (6.26)	29.20	33.27	36.51	40.42 (6.43)
T_8	16.47 (4.18)	15.75 (4.09)	13.07 (3.75)	12.92 (3.73)	25.26	18.10	15.95	11.84 (3.58)
T_9	40.59 (6.44)	58.66 (7.72)	73.42 (8.62)	86.21 (9.33)	53.33	73.14 (s)	82.73	85.38 (9.29)
CD at 0.05%	0.72	1.20	1.16	1.34	13.08	7.07	10.66	1.38

Figures in parenthesis denote $\sqrt{x+1}$ transformed values (s) - Highly significant

DAFS- Days after first spray; DASS- Days after second spray; DATS- Days after third spray; DAFRS- Days after fourth spray.

*T_1: *M. anisopliae* (talc formulation @ 5 gm/L of water); T_2: *M. anisopliae* (potato dextrose broth @10^7 spores/ml); T_3: *B. bassiana* (talc formulation @ 5 gm/L of water); T_4: *B. bassiana* (potato dextrose broth @10^7 spores/ml);T_5: *Bt* formulation @ 1ml/L of water; T_6: Spinosad 45 SC @ 0.4 ml/L of water; T_7: Azadirachtin 1% @ 2 ml/L of water; T_8: Malathion 50 EC @ 2 ml/L of water; T_9: Absolute control.

Table 3. Infestation by *E. vigintioctopunctata* and efficacy of treatments (summer, *kharif*)

Treatments*	Leaf infestation %							
	Summer season				*Kharif* season			
	15 DAFS	15 DASS	15 DATS	15 DAFRS	15 DAFS	15 DASS	15 DATS	15 DAFRS
T_1	32.72	35.30	37.69	39.16	32.13	34.12	38.52	40.73
T_2	33.39	37.29	41.12	44.58	35.35	36.81	39.37	41.73
T_3	35.73	42.58	48.83	52.91	37.23	40.68	49.07	51.17
T_4	37.98	49.35	51.09	57.46	38.92	43.21	50.14	54.44
T_5	35.67	41.69	45.32	48.50	36.78	39.81	44.54	46.89
T_6	28.70	30.81	32.44	34.25	31.24	28.24	23.79	21.80
T_7	27.40	26.29	25.73	24.69	26.82	23.93	18.92	16.50
T_8	26.07	20.76	18.50	14.43	21.33	18.03	13.05	12.43
T_9	42.00 (s)	52.04 (s)	70.59 (s)	80.34 (s)	47.60	61.68 (s)	78.28 (s)	88.80 (s)
CD at 0.05%	4.80	6.75	5.01	6.84	6.26	1.58	2.54	5.97

(s) – Highly significant; DAFS- Days after first spray; DASS- Days after second spray; DATS- Days after third spray; DAFRS- Days after fourth spray.

*T_1: *M. anisopliae* (talc formulation @ 5 gm/L of water); T_2: *M. anisopliae* (potato dextrose broth @10^7 spores/ml); T_3: *B. bassiana* (talc formulation @ 5 gm/L of water); T_4: *B. bassiana* (potato dextrose broth @10^7 spores/ml);T_5: *Bt* formulation @ 1ml/L of water; T_6: Spinosad 45 SC @ 0.4 ml/L of water; T_7: Azadirachtin 1% @ 2 ml/L of water; T_8: Malathion 50 EC @ 2 ml/L of water; T_9: Absolute control.

Table 4. Infestation by *A. olivacea* and efficacy of treatments (summer, *kharif*)

Treatment*	Leaf infestation %							
	Summer season				*Kharif* season			
	15 DAFS	15 DASS	15 DATS	15 DAFRS	15 DAFS	15 DASS	15 DATS	15 DAFRS
T_1	10.06	12.63	13.01	14.57	7.28	8.21	10.91	12.12
T_2	10.57	11.72	12.39	13.98	7.90	9.37	14.10	16.12
T_3	10.04	12.19	15.05	17.23	7.21	8.13	10.13	11.26
T_4	11.29	13.55	15.96	17.33	7.84	9.15	12.36	14.57
T_5	7.07	5.06	3.92	2.39	4.08	3.24	2.08	1.81
T_6	8.87	7.05	6.13	5.18	4.93	4.55	4.57	4.29
T_7	8.01	8.51	7.76	7.08	5.00	5.11	5.26	6.27
T_8	7.15	6.00	4.04	3.32	4.06	3.28	3.08	2.79
T_9	12.60	16.43	21.02	25.37	10.97	13.96	16.13	20.01
CD at 0.05%	1.75	2.18	1.12	1.33	1.38	0.76	0.88	1.58

DAFS- Days after first spray; DASS- Days after second spray; DATS- Days after third spray; DAFRS- Days after fourth spray.

*T_1: *M. anisopliae* (talc formulation @ 5 gm/L of water): T_2: *M. anisopliae* (potato dextrose broth @10^7 spores/ml): T_3: *B. bassiana* (talc formulation @ 5 gm/L of water); T_4: *B. bassiana* (potato dextrose broth @10^7 spores/ml);T_5: *Bt* formulation @ 1ml/L of water; T_6: Spinosad 45 SC @ 0.4 ml/L of water; T_7: Azadirachtin 1% @ 2 ml/L of water: T_8: Malathion 50 EC @ 2 ml/L of water; T_9: Absolute control.

Table 5. Leaf infestation by *S. docilis* and efficacy of treatments (summer, *kharif*)

Treatment*	Leaf infestation %							
	Summer season				*Kharif* season			
	15 DAFS	15 DASS	15 DATS	15 DAFRS	15 DAFS	15 DASS	15 DATS	15 DAFRS
T_1	8.37	9.05	9.98	10.21	7.93	9.32	12.35	14.01
T_2	8.42	9.19	10.37	11.95	8.10	10.07	13.46	15.69
T_3	7.26	7.71	8.00	8.14	7.04	8.14	9.51	11.97
T_4	7.89	8.04	8.25	9.38	7.55	9.37	12.09	13.99
T_5	7.17	5.06	4.12	2.07	5.71	3.96	2.47	0.74
T_6	7.08	6.24	5.24	4.13	5.48	4.18	2.82	1.09
T_7	6.06	4.04	2.97	1.47	4.55	3.46	2.25	0.50
T_8	5.06	3.00	1.68	0.91	4.04	3.13	2.01	0.37
T_9	11.83	13.63	15.28	18.06	11.95	14.98	16.83	18.89
CD at 0.05%	1.69	2.29	1.36	0.93	1.64	0.97	0.53	1.11

DAFS- Days after first spray; DASS- Days after second spray; DATS- Days after third spray; DAFRS- Days after fourth spray

*T_1: *M. anisopliae* (talc formulation @ 5 gm/L of water): T_2: *M. anisopliae* (potato dextrose broth @10^7 spores/ml): T_3: *B. bassiana* (talc formulation @ 5 gm/L of water); T_4: *B. bassiana* (potato dextrose broth @10^7 spores/ml):T_5: *Bt* formulation @ 1ml/L of water; T_6: Spinosad 45 SC @ 0.4 ml/L of water; T_7: Azadirachtin 1% @ 2 ml/L of water: T_8: Malathion 50 EC @ 2 ml/L of water; T_9: Absolute control.

reducing the infestation, it was on par with azadirachtin 1%. Considering the toxicity and residual effect of malathion 50 EC on brinjal fruits, azadirachtin 1% is found to be the best . Afren-Nuaman (1996), Dreyer (1986) and Jacob and Sheila (1994) reported that neem extract was highly effective against *S. docilis*.

ACKNOWLEDGEMENT

This forms part of M. Sc (Ag.) thesis submitted to the Kerala Agricultural University by the senior author. The senior author gratefully acknowledges the Kerala Agricultural University for financial assistance.

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(Manuscript Received: May, 2014)