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Original Research Article

Bio-efficacy of Bio-pesticides against Mealybug *Ferrisia virgata* Infesting Custard Apple

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A B S T R A C T

A field experiment was conducted to determine bio-efficacy of bio-pesticides against mealybug, *Ferrisia virgata* on Balanagar variety of custard apple at Horticulture Research Farm, College of Horticulture, AAU, Anand. The result revealed that minimum mealybug population was recorded in treatment of *Lecanicillium lecanii* 1% oil which was at par with *Metarhizium anisopliae* 1% oil, *Lecanicillium lecanii* 1.15% WP and *Metarhizium anisopliae* 1.15% WP. Tobacco decoction 2% and *Beauveria bassiana* 1% oil were found moderately effective in reducing mealybug population while, treatments of neem seed kernel extract 5% and *Beauveria bassiana* 5% WP were found less effective in reducing mealybug population.

Keywords

Bio-efficacy, *Ferrisia virgata*, Custard apple

Introduction

The custard apple (*Annona squamosa* Linneus, Family: Annonaceae), native of South America, is very hardy tropical fruit crop, tolerant to drought, salinity and saline irrigation water to a certain extent. The area under custard apple cultivation in India was 40,000 ha with a total production of 3,38,000 MT during the year 2018 (Anon., 2019). The mealybugs were observed infesting custard apple from fruit setting during August and heavy fruit damage up to 40-80 per cent during October-November in Vanthli (Junagadh) and Sanosara/Sinhor (Bhavnagar) areas of Saurashtra, Gujarat. Custard apple mealybug, *F. virgata* has been identified as predominant species in this area (Kapadia *et al*., 2009). The mealybug, *F. virgata* was first recorded and described in 1893 in Jamaica (Cockerell, 1893). Under middle Gujarat condition mealybug on custard apple was reported and identified as *Ferrisia virgata* (Cockerell) (Barad *et al.*, 2020), which caused severe yield loss in custard apple orchards. The mealybug *F. virgata* found infesting on fruits of custard apple and as custard apple is table purpose fruit use of insecticides against mealybug leads to accumulation of insecticide residue which may act as slow poison. In view of this, the present investigation on bioefficacy of biopesticides against mealybug *F. virgata* infesting custard apple under field condition was conducted in middle Gujarat conditions at Horticulture Research Farm, Anand Agricultural University, Anand.

Materials and Methods

In order to study the bioefficacy of biopesticides against mealybug *F. virgata*

infesting custard apple observations were recorded on the basis of mealybug population on custard apple fruits randomly selected from the custard apple orchard. Four branches from four directions (East, West, North and South) and five fruits from each direction were selected and tagged. The observations on nymph and female population of mealybug were recorded with the help of magnifying lens. Completely randomized design with nine treatments and three repetitions was used. Two sprays of bio-pesticides were carried out at an interval of 10 days. Effectiveness of bio-pesticides spray treatment was judged on the basis of level of mealybug incidence on randomly selected fruits from treatment plant. The count on nymph and adult of mealybug were recorded on day prior and 3, 5, 7 and 10 days after each spray.

Results and Discussions

First spray

The data shown in Table 1 that before spray there was uniform population of nymph and adult mealybug in all the treatments which were found non-significant. The average population ranged from 28.02 to 33.26 mealybug per fruit. Third day after spray, the minimum mealybug population were recorded from treatment of *L. lecanii* 1% oil (24.30 mealybug per fruit). Fifth day after spray the treatments *L. Lecanii* 1% oil and *M. anisopliae* 1% oil proved to be most effective treatments and recorded the lowest population (17.48 mealybug per fruit). However, it was at par with *L. Lecanii* 1.15% WP (17.90 mealybug per fruit) and *M. anisopliae* 1.15% WP (19.30 mealybug per fruit). Seventh day after spray, the data on mealybug population per fruit revealed that the treatment of *L. Lecanii* 1% oil maintained its superiority by recording lowest population (13.19 mealybug per fruit). However, it was at par with *M. anisopliae* 1% oil (14.63 mealybug per fruit), *L. Lecanii* 1.15% WP (14.94 mealybug per fruit), and *M. anisopliae* 1.15% WP (15.18 mealybug per fruit).Tenth day after spray, the data on mealybug population revealed that all the bio-pesticides treatments were found significantly superior over control. The treatment of *M. anisopliae* 1% oil showed the lowest population (11.20 mealybug per fruit).

Second spray

The data shown in Table 2 that third day after spray all the treatments were significantly superior over control. *L. Lecanii* 1% oil maintained its superiority by recording the lowest population (9.80 mealybug per fruit). The next best treatments were *L. Lecanii* 1.15% WP (10.06 mealybug per fruit), *M. anisopliae* 1% oil (10.19 mealybug per fruit), and *M. anisopliae* 1.15% WP (10.66 mealybug per fruit) and all were at par with each other.

Fifth day after spray, the data revealed that the treatment of *L. Lecanii* 1% oil recorded the lowest mealybug population (7.85 mealybug per fruit) and it was at par with *M. anisopliae* 1% oil (8.32 mealybug per fruit), *L. Lecanii* 1.15% WP (9.36 mealybug per fruit) and *M. anisopliae* 1.15% WP (9.42 mealybug per fruit). Seventh day after spray, the treatment of *L. Lecanii* 1% oil recorded the lowest population (7.01 mealybug per fruit), However, it was at par with *M. anisopliae* 1% oil (7.45 mealybug per fruit), *L. Lecanii* 1.15% WP (7.85 mealybug per fruit) and *M. anisopliae* 1.15% WP (8.20 mealybug per fruit). Tenth day after spray, the treatment of *L. Lecanii* 1% oil recorded the lowest population (6.42 mealybug per fruit) and it was at par with *L. Lecanii* 1.15% WP (6.79 mealybug per fruit), *M. anisopliae* 1% oil (7.01 mealybug per fruit), and *M. anisopliae* 1.15% WP (7.40 mealybug per fruit).

Table.1 Bio-efficacy of bio-pesticides against mealybug infesting custard apple after first spray

Tr. No	Treatments	No. of nymph and adult mealybug/fruit at indicated days after spray					
		Before	**3**	**5**	**7**	**10**	**Pooled**
T1	Neem seed kernel extract %	5.67 (31.65)	5.37 (28.34)	5.22c (26.75)	4.96c (24.10)	4.85cd (23.02)	5.10bc (25.51)
T2	Tobacco decoction 2%	5.34 (28.02)	5.10 (25.51)	5.03bc (24.80)	4.79cb (22.44)	4.45bc (19.30)	4.84b (22.93)
T3	*Beauveria bassiana* 1% oil (2 x 10^8 cfu/g)	5.58 (30.64)	5.38 (28.44)	5.19bc (26.44)	4.92c (23.71)	4.57c (20.38)	5.01b (24.60)
T4	*Lecanicillium lecanii* 1% oil (2 x 10^8 cfu/g)	5.49 (29.64)	4.98 (24.30)	4.24a (17.48)	3.70a (13.19)	3.46a (11.47)	4.09a (16.23)
T5	*Metarhizium anisopliae* 1% oil (2 x 10^8 cfu/g)	5.56 (30.41)	5.08 (25.31)	4.24a (17.48)	3.89a (14.63)	3.42a (11.20)	4.16a (16.81)
T6	*Beauveria bassiana* 5% WP (1 x 10^9 cfu/g)	5.81 (33.26)	5.39 (28.55)	5.27c (27.27)	5.05c (25.00)	4.82cd (22.73)	5.13bc (25.82)
T7	*Lecanicillium lecanii* 1.15% WP (1 x 10^9 cfu/g)	5.53 (30.08)	5.02 (24.70)	4.29a (17.90)	3.93a (14.94)	3.68ab (13.04)	4.23a (17.39)
T8	*Metarhizium anisopliae* 1.15% WP (1 x 10^9 cfu/g)	5.55 (30.30)	5.15 (26.02)	4.45ba (19.30)	3.96ab (15.18)	3.55a (12.10)	4.28a (17.82)
T9	Control	5.49 (29.64)	5.46 (29.31)	5.52c (29.97)	5.46c (29.31)	5.40d (28.66)	5.45c (29.20)
S. Em. ±	Treatment (T)	0.34	0.27	0.22	0.26	0.24	0.12
	Period (P)	-	-	-	-	-	0.08
	T x P	-	-	-	-	-	0.25
F Test (T)		NS	NS	Sig.	Sig.	Sig.	Sig.
C.V.%		10.89	8.96	8.01	10.05	9.82	9.20

Note: 1. Figures in parentheses are retransformed values and those outside are $\sqrt{x}$ + 0.5 transformed values 2. Treatment mean(s) with letter(s) in common are not significant by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance 3. Significant parameters and its interaction: T, P, and T x P

Table.2 Bio-efficacy of bio-pesticides against mealybug infesting custard apple after second spray

Tr. No.	Treatments	No. of nymph and adult mealybug /fruit at indicated days after spray				
		3	**5**	**7**	**10**	**Pooled**
T1	Neem seed kernel extract 5%	4.67cd (21.31)	4.47b (19.48)	4.32c (18.16)	4.12c (16.47)	4.39c (18.77)
T2	Tobacco decoction 2%	4.04bc (15.82)	3.97b (15.26)	3.63bc (12.68)	3.49b (11.68)	3.78b (13.79)
T3	*Beauveria bassiana* 1% oil (2 x 10^8 cfu/g)	4.19c (17.06)	4.08b (16.15)	3.77c (13.71)	3.55bc (12.10)	3.89b (14.63)
T4	*Lecanicillium lecanii* 1% oil (2 x 10^8 cfu/g)	3.21a (9.80)	2.89a (7.85)	2.74a (7.01)	2.63a (6.42)	2.86a (7.68)
T5	*Metarhizium anisopliae* 1% oil (2 x 10^8 cfu/g)	3.27ab (10.19)	2.97a (8.32)	2.82a (7.45)	2.74a (7.01)	2.95a (8.20)
T6	*Beauveria bassiana* 5% WP (1 x 10^9 cfu/g)	4.60c (20.66)	4.39b (18.77)	4.24c (17.48)	4.08bc (16.15)	4.33c (18.25)
T7	*Lecanicillium lecanii* 1.15% WP (1 x 10^9 cfu/g)	3.25ab (10.06)	3.14a (9.36)	2.89a (7.85)	2.70a (6.79)	2.99a (8.44)
T8	*Metarhizium anisopliae* 1.15% WP (1 x 10^9 cfu/g)	3.34ab (10.66)	3.15a (9.42)	2.95ab (8.20)	2.81a (7.40)	3.06a (8.86)
T9	Control	5.46d (29.31)	5.57c (30.52)	5.45d (29.20)	5.38d (28.44)	5.46d (29.31)
S. Em. ± Treatment (T)		0.24	0.21	0.21	0.18	0.10
Period (P)		-	-	-		0.07
T x P		-	-	-	-	0.21
F Test (T)		Sig.	Sig.	Sig.	Sig.	Sig.
C.V.%		10.57	9.51	10.00	8.96	9.84

Note: 1. Figures in parentheses are retransformed values and those outside are $\sqrt{x}$ + 0.5 transformed values 2. Treatment mean(s) with letter(s) in common are not significant by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance 3. Significant parameters and its interaction: T, P, and T x P

Table.3 Bio-efficacy of bio-pesticides against mealybug infesting custard apple (Pooled over sprays)

Tr. No.	Treatments	No. of nymph and adult mealybug/fruit indicated after sprays		
		First	Second	Pooled
T1	Neem seed kernel extract 5%	5.10bc (25.51)	4.39c (18.77)	4.74c (21.97)
T2	Tobacco decoction 2%	4.84b (22.93)	3.78b (13.79)	4.31b (18.08)
T3	*Beauveria bassiana* 1% oil (2 x 10^8 cfu/g)	5.01b (24.60)	3.89b (14.63)	4.45b (19.30)
T4	*Lecanicillium lecanii* 1% oil (2 x 10^8 cfu/g)	4.09a (16.23)	2.86a (7.68)	3.48a (11.61)
T5	*Metarhizium anisopliae* 1% oil (2 x 10^8 cfu/g)	4.16a (16.81)	2.95a (8.20)	3.55a (12.10)
T6	*Beauveria bassiana* 5% WP (1 x 10^9 cfu/g)	5.13bc (25.82)	4.33c (18.25)	4.73c (21.87)
T7	*Lecanicillium lecanii* 1.15% WP (1 x 10^9 cfu/g)	4.23a (17.39)	2.99a (8.44)	3.61a (12.53)
T8	*Metarhizium anisopliae* 1.15% WP (1 x 10^9 cfu/g)	4.28a (17.82)	3.06a (8.86)	3.67a (12.97)
T9	Control	5.45c (29.20)	5.46d (29.31)	5.45d (29.20)
S. Em. ± Treatment (T)		0.12	0.10	0.08
	Period (P)	0.08	0.07	0.05
	Spray (S)	-	-	0.03
	T x P	0.25	0.21	0.16
	T x S	-	-	0.11
	P x S	-	-	0.076
	T x P x S	-	-	0.23
F Test (T)		Sig.	Sig.	Sig.
C.V.%		9.20	9.84	9.51

Note: 1. Figures in parentheses are retransformed values and those outside are $\sqrt{x + 0.5}$ transformed values 2. Treatment mean(s) with letter(s) in common are not significant by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance 3. Significant parameters and its interaction: T, P, S, S x P and T x P

Over all pooled

The data of pooled over periods and sprays presented in Table 3 revealed that minimum mealybug population was recorded in treatment of *L. Lecanii* 1% oil (11.61 mealybug per fruit) which was at par with *M. anisopliae* 1% oil (12.10 mealybug per fruit), *L. Lecanii* 1.15% WP (12.53 mealybug per fruit) and *M. anisopliae* 1.15% WP (12.97 mealybug per fruit). Tobacco decoction 2% (18.08 mealybug per

fruit) and *B. bassiana* 1% oil (19.30 mealybug per fruit) were found moderately effective in reducing mealybug population while, treatments of neem seed kernel extract 5% (21.97 mealybug per fruit) and *B. bassiana* 5% WP (21.87 mealybug per fruit) were found least effective in reducing mealybug population.

The present findings were in close conformity with the reports of Makadia *et al.*, (2009), where they recorded that *V. Lecanii* @ 2gm/lit combined with Rapipal 1ml/lit. of water was effective against mealybug, *M. hirsutus*. According to Kumar *et al.*, (2012) recorded *M. anisopliae* and *V. Lecanii* were found effective against mealybug. Ujjan *et al.*, (2015) reported that *M. anisopliae* was effective against mealybug. Bhadani (2017) and Kumar *et al*., (2017) recorded *L. lecanii* as very effective to control mealybug population.

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