

## Original Research Article

<https://doi.org/10.20546/ijcmas.2020.908.265>

## Efficacy of Different Entomopathogenic Fungi against Mango Hoppers in Middle Gujarat

B. L. Raghunandan, T. B. Kapadiya, N. B. Patel\*, N. M. Patel and D. M. Mehta

AICRP on Biological Control of Crop Pests, Anand Agricultural University,  
Anand (Gujarat), India

\*Corresponding author

### ABSTRACT

#### Keywords

Mango hopper,  
Efficacy,  
Entomopathogenic  
fungi

#### Article Info

Accepted:  
20 July 2020  
Available Online:  
10 August 2020

Mango hopper is one of the most destructive pests of mango globally which causes considerable monetary loss. An attempt was made to evaluate different entomopathogenic fungi against mango hoppers at Horticulture farm, Anand Agricultural University, Anand (Gujarat) during the year 2011-2012, 2012-13 and 2013-14. Among seven treatments imposed for the management of mango hoppers, the treatment with *Verticillium lecanii* (*Lecanicillium lecanii*) 1.15% WP ( $2 \times 10^8$  cfu/g) on tree trunk during off-season + at flowering period recorded lower number of mango hoppers, which was found at par with *Metarhizium anisopliae* 1.15% WP ( $2 \times 10^8$  cfu/g) on tree trunk during off-season + at flowering period.

### Introduction

Mango (*Mangifera indica* Linn.) is native of Indo-Burma region and most ancient among the tropical fruits. Mango is considered as the “King of fruits” due to its attractive fragrance, delicious taste, excellent flavour, nutritional richness (Vitamin A and C) and health promoting qualities. Among the pests that infest mango, the cicadellids (jassids) popularly known as ‘Mango hoppers’ are economically important (Gangolly *et al.*, 1957). Mango hopper, *Amritodus atkinsoni* (Lethierry) mainly inhabits the trunk region and new vegetative flush, while two

*Idioscopus* species, viz., *Idioscopus clypealis* (Lethierry) and *Idioscopus nitidulus* (Walker) infest during flowering season, which cause yield loss up to 50-60% in case of severe infestation (Tandon and Verghese, 1985 and Gundappa, *et al.*, 2014). Both the nymphs and adults of the hopper mainly suck the sap from tender shoots, leaves and inflorescence, which causes panicles shrivel, turn brown and finally fall off (Das, *et al.*, 1969). Hoppers also excrete honey dew which causes sooty mould on leaf surface, interferes with the photosynthetic activity of the plant and finally affect the quality of fruit production.

As regard control, using of numbers of broad-spectrum insecticides is harmful to natural enemies on the crop. In addition to this, it creates environmental pollution and leaves pesticides residue on fruits. Pesticidal residues on mangoes affect export there by leading to financial losses. To overcome these problems, there is a need to develop the management techniques which are eco-friendly and safer to natural enemies. An important mechanism for mango hopper control should be the use of fungal entomopathogens. Therefore, the present study on evaluation of biological control agents against mango hoppers was carried out.

### **Materials and Methods**

A study one valuation of entomopathogenic fungi against mango hoppers was carried out at Horticulture farm, AAU, Anand during 2011-12, 2012-13 and 2013-14. The experiment was laid out with cultivar, Langra in Completely Randomized Design (CRD) was followed with three repetitions. The experiment consists of 7 treatments (Table 1) and each tree was considered as one repetition. One off-season spray was given on tree trunk during the month of November and three sprays were given on foliage during flowering stage at fortnightly interval with the initiation of pest. Observations on number of mango hoppers were recorded before imposing the treatment as well as 7 and 14 days after treatment. Ten twigs-panicles (approx. 15 cm length) from each tree were observed and number of hoppers per twig was recorded.

The data obtained from the experiments were subjected to square root transformation and subjected to ANOVA analysis. Significant differences among the means of different treatments were tested using Duncan's new multiple range test (DNMRT)

### **Results and Discussion**

The year wise data on bio-efficacy of different biocontrol agents against hoppers infesting mango are presented hereunder:

#### **Year 2011-12**

The data (Table 2) on population of mango hopper recorded before spray showed non-significant difference among different treatments indicated that the hoppers population was uniformly distributed in all the experimental trees.

The data of pooled over periods and sprays for the first year (*rabi*, 2011-12) revealed significant reduction in hoppers population in all the treated trees compared to untreated control. The reduction in hoppers population was significantly higher in treatment of imidacloprid 17.8 SL applied on tree trunk during off-season + one spray of the same applied at flowering stage (4.56 hoppers/twig) than rest of the treatments. However, in case of bio-pesticidal treatments, trees sprayed with either *V. lecanii* (5.90 hoppers/twig) or *M. anisopliae* (6.16 hoppers/twig) on tree trunk during off-season + at flowering stage also proved effective treatment and stood next to the chemical treatment. Whereas, application of entomopathogenic fungi only on the tree trunk during off-season proved inferior against mango hoppers.

#### **Year 2012-13**

Data on hoppers population recorded prior and 7 and 14 days after each spray in different treatments during *rabi*, 2012-13 are presented in Table 3. Data indicated that the hoppers population was uniformly distributed in all the experimental trees as it evident from the observations recorded before imposing of spray.

**Table.1** Details of entomopathogenic fungi used against mango hoppers

Treatments		Concentration	Quantity (ml or g)/ 10 litre water
T <sub>1</sub>	Application of <i>Metarhiziumanisopliae</i> 1.15% WP on tree trunk during off-season + at flowering period	2x10 <sup>8</sup> cfu/g	40
T <sub>2</sub>	Application of <i>M. anisopliae</i> 1.15% WP on tree trunk during off-season	2x10 <sup>8</sup> cfu/g	40
T <sub>3</sub>	Application of <i>Verticilliumlecanii</i> 1.15% WP ( <i>Lecanicilliumlecanii</i> ) on tree trunk during off-season + at flowering period	2x10 <sup>8</sup> cfu/g	40
T <sub>4</sub>	Application of <i>V.lecanii</i> 1.15% WP ( <i>L. Lecanii</i> ) on tree trunk during off-season	2x10 <sup>8</sup> cfu/g	40
T <sub>5</sub>	One spray of imidacloprid 17.8SL (26.7 ga.i/ha) on tree trunk during off-season	0.005%	3
T <sub>6</sub>	One spray of imidacloprid 17.8SL (26.7 ga.i/ha) on tree trunk during off-season + at flowering period	0.005%	3
T <sub>7</sub>	Untreated control	-	-

**Table.2** Effectiveness of different entomopathogenic fungi against mango hoppers (2011-12)

Treatments	No. of mango hoppers/twig							
	Before spray	1 <sup>st</sup> Spray		2 <sup>nd</sup> Spray		3 <sup>rd</sup> Spray		Pooled over periods over sprays
		7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS	
T <sub>1</sub>	3.44* (11.33)	2.85 (7.62)	3.07 (8.92)	2.38 (5.16)	2.70 (6.79)	2.18 (4.25)	2.30 (4.80)	2.58 (6.16)
T <sub>2</sub>	3.31 (10.46)	3.58 (12.32)	3.75 (13.56)	3.84 (14.25)	3.80 (13.94)	3.80 (13.94)	3.91 (14.79)	3.79 (13.86)
T <sub>3</sub>	3.42 (11.20)	2.91 (7.97)	2.95 (8.20)	2.53 (5.90)	2.56 (6.05)	2.55 (6.00)	2.15 (4.12)	2.53 (5.90)
T <sub>4</sub>	3.51 (11.82)	3.53 (11.96)	3.61 (12.53)	3.58 (12.32)	3.71 (13.26)	3.71 (13.26)	3.83 (14.17)	3.67 (12.97)
T <sub>5</sub>	3.17 (9.55)	3.39 (10.99)	3.69 (13.12)	3.72 (13.34)	3.63 (12.68)	3.63 (12.68)	3.75 (13.56)	3.64 (12.75)
T <sub>6</sub>	3.24 (10.00)	2.61 (6.31)	2.85 (7.62)	2.10 (3.91)	2.33 (4.93)	2.33 (4.93)	1.87 (3.00)	2.25 (4.56)
T <sub>7</sub>	3.65 (12.82)	3.81 (14.02)	3.91 (14.79)	3.82 (14.09)	3.94 (15.02)	3.94 (15.02)	4.08 (16.15)	3.93 (14.94)
S. Em± T	0.28	0.22	0.24	0.21	0.22	0.17	0.22	0.10
Y x T	-	-	-	-	-	-	-	0.21
C.D. at 5% T	NS	0.66	0.71	0.63	0.66	0.52	0.66	0.27
Y x T	-	-	-	-	-	-	-	NS
C. V. (%)	14.21	11.71	11.95	11.47	11.55	9.79	12.11	11.49
* Figures in parentheses are retransformed values; those outside are transformed values NS = Non –significant DAS = Days After Spray								

**Table.3** Effectiveness of different entomopathogenic fungi against mango hoppers (2012-13)

Treatments	No. of mango hoppers/twig							
	Before spray	1 <sup>st</sup> Spray		2 <sup>nd</sup> Spray		3 <sup>rd</sup> Spray		Pooled over period over sprays
		7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS	
T <sub>1</sub>	3.70*	3.12	3.43	2.78	2.98	2.66	2.69	2.94
	(13.19)	(9.23)	(11.26)	(7.23)	(8.38)	(6.58)	(6.74)	(8.14)
T <sub>2</sub>	3.66	3.82	3.98	4.15	4.07	4.16	4.18	4.06
	(12.90)	(14.09)	(15.34)	(16.72)	(16.06)	(16.81)	(16.97)	(15.98)
T <sub>3</sub>	3.70	3.24	3.33	2.90	2.88	2.67	2.62	2.94
	(13.19)	(10.00)	(10.59)	(7.91)	(7.79)	(6.63)	(6.36)	(8.14)
T <sub>4</sub>	3.79	3.84	3.87	3.90	3.98	4.05	4.16	3.97
	(13.86)	(14.25)	(14.48)	(14.71)	(15.34)	(15.90)	(16.81)	(15.26)
T <sub>5</sub>	3.56	3.71	3.93	4.06	3.92	3.97	4.09	3.95
	(12.17)	(13.26)	(14.94)	(15.98)	(14.87)	(15.26)	(16.23)	(15.10)
T <sub>6</sub>	3.58	2.95	3.08	2.44	2.69	2.19	2.36	2.62
	(12.32)	(8.20)	(8.99)	(5.45)	(6.74)	(4.30)	(5.07)	(6.36)
T <sub>7</sub>	3.93	4.37	4.27	4.14	4.24	4.25	4.39	4.28
	(14.94)	(18.60)	(17.73)	(16.64)	(17.48)	(17.56)	(18.77)	(17.82)
S. Em ± T	0.22	0.18	0.19	0.19	0.18	0.13	0.17	0.08
Y x T	-	-	-	-	-	-	-	0.18
C.D. at 5% T	NS	0.56	0.59	0.60	0.56	0.42	0.53	0.23
Y x T	-	-	-	-	-	-	-	NS
C. V. (%)	10.64	8.91	9.14	9.90	9.06	7.00	8.76	8.86

\* Figures in parentheses are retransformed values; those outside are transformed values  
 NS = Non –significant DAS = Days After Spray

**Table.4** Effectiveness of different entomopathogenic fungi against mango hoppers (2013-14)

Treatments	No. of mango hoppers/twig							
	Before spray	1 <sup>st</sup> Spray		2 <sup>nd</sup> Spray		3 <sup>rd</sup> Spray		Pooled over period over sprays
		7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS	
T <sub>1</sub>	3.71	3.32	2.79	3.08	3.08	2.73	2.87	2.98
	(13.26)	(10.52)	(7.28)	(8.99)	(8.99)	(6.95)	(7.74)	(8.38)
T <sub>2</sub>	3.84	3.77	3.86	3.77	3.84	3.93	3.94	3.85
	(14.25)	(13.71)	(14.40)	(13.71)	(14.25)	(14.94)	(15.02)	(14.32)
T <sub>3</sub>	3.72	3.33	2.80	3.08	3.07	2.75	2.85	2.98
	(13.34)	(10.59)	(7.34)	(8.99)	(8.92)	(7.06)	(7.62)	(8.38)
T <sub>4</sub>	3.92	3.80	3.82	3.72	3.72	3.94	3.83	3.81
	(14.87)	(13.94)	(14.09)	(13.34)	(13.34)	(15.02)	(14.17)	(14.02)
T <sub>5</sub>	3.80	3.68	3.82	3.69	3.86	3.96	3.95	3.83
	(13.94)	(13.04)	(14.09)	(13.12)	(14.40)	(15.18)	(15.10)	(14.17)
T <sub>6</sub>	3.70	2.32	2.02	2.13	2.18	2.08	2.05	2.13
	(13.19)	(4.88)	(3.58)	(4.04)	(4.25)	(3.83)	(3.70)	(4.04)
T <sub>7</sub>	3.95	4.36	4.35	4.13	4.26	4.22	4.38	4.29
	(15.10)	(18.51)	(18.42)	(16.56)	(17.65)	(17.31)	(18.68)	(17.90)

S. Em ± T	0.27	0.25	0.25	0.22	0.23	0.20	0.26	0.10
Y x T	-	-	-	-	-	-	-	0.18
C.D. at 5% T	NS	0.77	0.76	0.65	0.71	0.63	0.80	0.29
Y x T	-	-	-	-	-	-	-	NS
C. V. (%)	12.50	12.46	12.90	11.09	11.88	10.75	13.40	12.61
* Figures in parentheses are retransformed values; those outside are transformed values NS = Non –significant DAS = Days After Spray								

**Table.5** Effectiveness of different entomopathogenic fungi against mango hoppers (Pooled over years)

Treatments	No. of mango hoppers/ twig							
	2011-12		2012-13		2013-14		Pooled	
T <sub>1</sub>	2.58 <sup>b</sup> (6.18)		2.94 <sup>b</sup> (8.14)		2.98 <sup>b</sup> (8.38)		2.83 <sup>b</sup> (7.51)	
T <sub>2</sub>	3.79 <sup>c</sup> (13.86)		4.06 <sup>cd</sup> (15.98)		3.85 <sup>c</sup> (14.32)		3.90 <sup>c</sup> (14.71)	
T <sub>3</sub>	2.53 <sup>ab</sup> (5.90)		2.94 <sup>b</sup> (8.14)		2.98 <sup>b</sup> (8.38)		2.82 <sup>b</sup> (7.45)	
T <sub>4</sub>	3.67 <sup>c</sup> (12.97)		3.97 <sup>c</sup> (15.26)		3.81 <sup>c</sup> (14.02)		3.82 <sup>c</sup> (14.09)	
T <sub>5</sub>	3.64 <sup>c</sup> (12.75)		3.95 <sup>c</sup> (15.10)		3.83 <sup>c</sup> (14.17)		3.81 <sup>c</sup> (14.02)	
T <sub>6</sub>	2.25 <sup>a</sup> (4.56)		2.62 <sup>a</sup> (6.36)		2.13 <sup>a</sup> (4.04)		2.33 <sup>a</sup> (4.93)	
T <sub>7</sub>	3.93 <sup>c</sup> (14.94)		4.28 <sup>d</sup> (17.82)		4.29 <sup>d</sup> (17.90)		4.16 <sup>d</sup> (16.81)	
	S. Em.±	C. D. at 5%	S. Em.±	C. D. at 5%	S. Em.±	C. D. at 5%	S. Em.±	C. D. at 5%
Treatments (T)	0.10	0.27	0.08	0.23	0.09	0.26	0.05	0.14
Years (Y)	-	-	-	-	-	-	0.03	0.09
Sprays (S)	0.03	0.10	0.03	0.08	0.05	NS	0.03	0.09
Periods (P)	0.03	0.08	0.02	0.07	0.04	NS	0.03	NS
T x Y	-	-	-	-	-	-	0.09	NS
T x S	0.05	0.14	0.04	0.11	0.06	NS	0.09	0.24
T x P	0.09	NS	0.08	NS	0.12	NS	0.07	NS
Y x S	-	-	-	-	-	-	0.06	NS
Y x P	-	-	-	-	-	-	0.05	NS
S x P	0.07	NS	0.06	NS	0.10	NS	0.05	NS
T x Y x S	-	-	-	-	-	-	0.15	NS
T x Y x P	-	-	-	-	-	-	0.12	NS
Y x S x P	-	-	-	-	-	-	0.08	NS
T x S x P	0.13	NS	0.11	NS	0.17	NS	0.12	NS
T x Y x S x P	-	-	-	-	-	-	0.21	NS
C.V.%	11.49		8.86		12.13		10.86	
Figures in parentheses are retransformed values; those outside are transformed values Figures in Letter(s) in common are statistically at par as per DNMRT NS = Non –significant								

Pooled over periods and sprays data for *rabi*, 2012-13 indicated that the treatment of imidacloprid 17.8 SL registered significantly least (6.36 hoppers/ twig) number of hoppers compared to rest of the treatments. While among the bio-pesticides treatments, mango trees sprayed either with *V. lecanii* or *M. anisopliae* on tree trunk during off-season + at flowering stage registered lowest (8.14 hoppers/ twig) numbers of hoppers than rest of the treatments. The treatment of alone application of *V. lecanii* or *M. anisopliae* only during off-season on tree trunk proved inferior in reducing hoppers population but registered lower hoppers than untreated control (17.82 hoppers/ twig).

### **Year 2013-14**

Pooled over periods and sprays data computed for *rabi*, 2013-14 (Table 4) indicated that all the treatments proved significantly effective when compared with control after 7 and 14 days of spray as well as in pooled. The results indicated that the lowest (4.04 hoppers/ twig) numbers of hoppers were registered in the treatment of imidacloprid 17.8 SL applied on tree trunk during off-season + one spray of the same applied at flowering stage. Both the treatments of entomopathogenic fungi *i.e.* *V. lecanii* and *M. anisopliae* registered equal numbers of hoppers *i.e.* 8.38 hoppers/ twig when applied on tree trunk during off-season + during flowering stage and found effective next to chemical insecticide treatment. While, the treatment of application of *V. lecanii* or *M. anisopliae* only on the tree trunk during off-season proved inferior against mango hoppers

### **Pooled over periods and years**

Among the different entomopathogenic fungi evaluated for their bio efficacy against mango hopper during 2011-12, 2012-13 and 2013-14 (Table 5), the data of pooled over periods

over years depicted that significantly lowest number of mango hopper/twig was recorded in the treatment T<sub>3</sub> *i.e.* application of *V. lecanii* (*Lecanicillium lecanii*) on tree trunk during off-season + at flowering period @ 5 g/ litre (7.45 hoppers/twig), which was found at par with the treatment of T<sub>1</sub> *i.e.* application of *M. anisopliae* on tree trunk during off-season + at flowering period (7.51 hoppers/twig). While, application of *V. lecanii* (*L. Lecanii*) only on tree trunk during off-season @ 5 g/ litre registered lower (14.09 hoppers/twig) numbers of hoppers and it was followed by treatment of T<sub>2</sub> *i.e.* application of *M. anisopliae* on tree trunk during only during off-season @ 5 g/ litre (14.71 hoppers/twig).

The efficacy entomopathogenic fungi against mango hoppers also get support from Valvi *et al.*, (2018), who reported that mixed application of *Leccanicillium leccanii* + *Metarhizium anisopliae* and sole application of *Metarhizium anisopliae* found effective against mango hopper. The entomopathogenic fungi *V. leccanii* effectiveness in warding off the mango hopper attack stated by Trivedi and Singh (2007) and Singh (2008). The above reports render support to the present observation of superior efficacy of fungal formulation against mango hoppers.

### **References**

- Das, G., Chavan, P. D., Sawant, B. N. 1969. The mango hoppers mainly suck the sap from tender shoots, leaves and inflorescence, *Indian Journal of Plant Protection*, 33:46-49.
- Gangolly, S. R., Singh, R., Katyal, S. L., Singh, D. Mango, ICAR, New Delhi, 1957. 492.
- Gundappa, Kamala Jayanthi P. D. and Verghese, A. 2014. Migratory behaviour of mango hopper, *Idioscopus* spp. in relation to host plant flowering phenology: A synchronous shift. An *Int*

- J Life Sci., The Bioscan*,9(2): 639-641.
- Singh, R. 2008. Evaluation of some biopesticides against Mango hoppers (*Idioscopus clypealis* and *Amritodus atkinsoni*) and flower visitors of mango. *Indian journal of Plant Protection*, 36(1):24-27.
- Tandon, P. L. andVerghese, A. 1985. World list of insect, mite and other pests of mango. Technical Document No. 5, IIHR, Bangalore.
- Trivedi, T. P. and Singh, A. 2007. Validation and Promotion of IPM in public Private Partnership. *Crop Care.*, 32:7-17.
- Valvi, A. S., Mohite, P. B. and Tarate, S. P. 2018. Efficacy of various entomopathogenic fungi against mangohopper (*Amritodus atkinsoni* Leth.). *Journal of Pharmacognosy and Phytochemistry*, 7(5): 1847-1851.

**How to cite this article:**

Raghunandan, B. L., T. B. Kapadiya, N. B. Patel, N. M. Patel and Mehta, D. M. 2020. Efficacy of Different Entomopathogenic Fungi against Mango Hoppers in Middle Gujarat. *Int.J.Curr.Microbiol.App.Sci.* 9(08): 2310-2316. doi: <https://doi.org/10.20546/ijcmas.2020.908.265>