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# Evaluation of entomopathogenic fungi against the mealy bug on custard apple

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ABSTRACT

Different entophathogenic fungi were evaluated in field trials at the instructional farm of Krishi Vigyan Kendra (KVK) Dhule provided by Department of Entomology, College of Agriculture, Dhule for the management of mealy bug on custard apple in *Kharif* season of 2014-15. All the treatments were observed to be effective in reducing mealy bug infestation on custard apple. Among the evaluated insecticide and biopesticides the treatment with *Verticillium lecanii* 7.5 g/lit. was recorded significantly lowest mealy bug population and was was at par with *Verticillium lecanii* 5 g/lit. (12.74). The next best treatments protection included Trizophos 40 EC 3 ml/lit. (14.26) and it was at par with *Verticillium lecanii* 2.5 g/lit. (14.40). The next treatments in this respect were *Metarhizium anisopliae* 7.5 g/lit. (15.68), *Metarhizium anisopliae* 5 g/lit. (16.33), *Beauveria bassiana* 7.5 g/lit. (17.37), *Metarhizium anisopliae* 2.5 g/lit. (18.13), *Beauveria bassiana* 5 g/lit. (20.54) and *Beauveria bassiana* 2.5 g/lit. (22.25). There was an increase in mealy bug population in untreated check to the extent of 35.52 numbers of colonies as compared to treated plots.

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## INTRODUCTION

In India, custard apple is grown over a vast area in the states of Andhra Pradesh, Maharashtra, Tamil Nadu, Assam and Orissa. The custard apple is infested by 20 species of insect pests (Butani, 1979), of which the mealy bug is the most important one. Three species of mealy bugs *viz.*, *Maconellicocus hirsutus*, *Planococcus citri* and *Ferrisia virgata* are serious pests of this crop. Mealy bugs live in protective areas such as cracks and crevices of the bark, at the base of petioles, on the underside of leaves and between the fruit eyes. Eggs of mealy bugs protected by waxy filamentous secretion of ovisac are almost impossible to reach with insecticide. Hence, it is very difficult to manage mealy bug.

Control of mealy bugs with chemical pesticide has certain limitations of which one is the problem of hazardous levels of residue. Insecticidal sprays have adverse effect on the natural enemy population of pests, result in resurgence of the pest and pollution hazards in environment. Some mealy bugs are able to develop

resistance to insecticides (Mc Kenzie, 1967).

## MATERIAL AND METHODS

A field experiment was conducted at the Instructional Farm of Krishi Vigyan Kendra (KVK) Dhule provided by Department of Entomology, College of Agriculture, Dhule under University of M.P.K.V., Rahuri, Maharashtra during August, 2014 to December, 2014. The experiment was conducted in a Randomized Block Design with three replications. Four branches on one tree were selected from each treatment for observations and marked with paraffin coated paper tag. On each plant, four fruits on four directions were tagged and observations were recorded. As regards the efficacy of different treatments against mealy bug the observations were recorded on the basis of survival population of mealy bug *i.e.* nymphs and adults. The pre count was recorded one day before first spray and post-treatment count was recorded at 5th and 10th day after each spraying. There were eleven treatments *viz.,* $T_1$ *Verticillium lecanii* 2.5 g/lit, $T_2$ *Metarhizium anisopliae* 2.5 g/lit, $T_3$ *Metarhizium anisopliae* 2.5 g/lit, $T_4$ *Verticillium lecanii* 5 g/lit, $T_5$ *Metarhizium anisopliae* 5 g/lit, $T_6$ *Beauveria bassiana* 5 g/lit, $T_7$ *Verticillium lecanii* 5 g/lit, $T_8$ *Metarhizium anisopliae* 7.5 g/lit, $T_9$ *Beauveria bassiana* 7.5 g/lit, $T_{10}$ Trizophos 40 EC 3 ml/lit and $T_{11}$ untreated control.

## RESULTS AND DISCUSSION

Each treatment was consisted of three sprays applied at an interval of 10 days by initiating first spray with the appearance of mealy bug incidence. Effectiveness of entomopathogenic fungi was judged on the basis of level of mealy bug incidence on selected fruits. The pre-count of nymphs and adults of mealy bugs was recorded on a day prior to application and post-counts at 5 and 10 days after each spray. The generated data on survival of mealy bug was transformed into $\sqrt{x+0.5}$ values and subjected for statistical analysis. The yield per plant was recorded and economics of spray treatment was also worked out. The data on the effect of biopesticide on mealy bugs are presented in Table 1. The mealy bug population was in the range of 12.68 to 19.91/fruit on a day before spray treatment and it was statistically non-significant.

**After first spray :**

All the treatments were significantly superior over untreated control in minimizing the incidence of mealy bug on 5th and 10th DAS. The infestation of mealy bugs was slightly reduced in all the treatments except control on 5th days after first spray. On 10th days after first spray the population of mealy bug recorded in treatments was ranged between 10.00 to 20.5 mealy bug/fruit. *Verticillium lecanii* 7.5 g/lit. was found to be most effective in minimizing the mealy bug population and recorded 10.00 mealy bug/fruit and was at par with *Verticillium lecanii* 5 g/lit (10.81), Trizophos 40 EC 3 ml/lit (11.41), *Verticillium lecanii* 2.5 g/lit (11.73), *Beauveria bassiana* 7.5 g/lit (13.20), *Metarhizium anisopliae* 7.5 g/lit (13.66), *Metarhizium anisopliae* 5 g/lit (14.33), *Metarhizium anisopliae* 2.5 g/lit (15.00) and *Beauveria bassiana* 5 g/lit (17.05).

**After second spray :**

The data on post- treatment average number of mealy bug per fruit are presented in Table revealed that all the treatments were statistically significant over untreated control at five days after second spraying. Significantly lowest numbers of colonies (11.01) were recorded in the treatment with *Verticillium lecanii* 7.5 g/lit and it was at par with *Verticillium lecanii* 5 g/lit (12.40), Trizophos 40 EC 3 ml/lit (13.00), *Metarhizium anisopliae* 7.5 g/lit (13.90), *Verticillium lecanii* 2.5 g/lit (14.00), *Metarhizium anisopliae* 5 g/lit (14.43), *Beauveria bassiana* 7.5 g/lit (16.50). Whereas untreated control registered significantly highest (33.55) number of colonies per fruit.

The numbers of colonies per fruit were significantly less in various treatments as compared to untreated check at ten days after second spray. The best treatments with less number of mealy bug colonies per fruit included *Verticillium lecanii* 7.5 g/lit (12.4) and was at par with, *Verticillium lecanii* 5 g/lit (13.63), Trizophos 40 EC 3 ml/lit (15.00), *Verticillium lecanii* 2.5 g/lit (15.46), *Metarhizium anisopliae* 7.5 g/lit (16.76), *Metarhizium anisopliae* 5 g/lit (17.00). Whereas, the untreated check recorded highest number of colonies (35.73).

**After third spray :**

The data regarding the number of mealy bug colonies per fruit at five days after third spray indicate that, all the treatments were statistically superior to

**Table 1 : Efficacy of different entomopathogenic fungi against mealy bugs on custard apple**

| Sr. No. | Name of the treatment | Average no. of mealy bug per fruit | | | | | | | Cumulative mean of three spary | Yield (kg/plant) | ICBR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I spary | | II spary | | III Spary | | | | |
| | | Pre-count | 5 DAS | 10 DAS | 5 DAS | 10 DAS | 5 DAS | 10 DAS | | | |
| 1. | *Verticillium lecanii* | 12.68 | 11.91 | 11.73 | 14.00 | 15.46 | 16.70 | 16.60 | 14.40 | 10.89 | 16.84 |
| | WP (1x $10^8$CFU/ml) 2.5 g/lit | (3.63) | (3.52) | (3.49) | (3.80) | (3.99) | (4.14) | (4.13) | (3.85) | | |
| 2. | *Metarhizium anisopliae* | 17.75 | 14.58 | 15.00 | 16.81 | 20.00 | 21.10 | 21.26 | 18.13 | 10.55 | 12.95 |
| | WP (1x $10^8$CFU/ml) 2.5 g/lit | (4.24) | (3.86) | (3.92) | (4.15) | (4.52) | (4.64) | (4.66) | (4.30) | | |
| 3. | *Beauveria bassiana* | 19.91 | 21.5 | 20.5 | 19.39 | 21.76 | 23.90 | 26.43 | 22.25 | 10.26 | 9.62 |
| | WP (1x $10^8$CFU/ml) 2.5 g/lit | (4.45) | (4.59) | (4.50) | (4.46) | (4.68) | (4.91) | (5.18) | (4.76) | | |
| 4. | *Verticillium lecanii* | 12.91 | 10.58 | 10.81 | 12.40 | 13.63 | 14.03 | 15.00 | 12.74 | 11.74 | 17.91 |
| | WP (1x $10^8$CFU/ml) *5* g/lit | (3.64) | (3.31) | (3.35) | (3.59) | (3.76) | (3.81) | (3.94) | (3.63) | | |
| 5. | *Metarhizium anisopliae* | 15.5 | 14.33 | 14.33 | 14.43 | 17.00 | 18.96 | 19.70 | 16.33 | 10.66 | 9.57 |
| | WP (1x $10^8$CFU/ml) 5 g/lit | (3.97) | (3.83) | (3.83) | (3.93) | (4.16) | (4.40) | (4.49) | (4.09) | | |
| 6. | *Beauveria bassiana* | 15.16 | 17.66 | 17.05 | 19.16 | 20.23 | 23.36 | 25.76 | 20.54 | 10.31 | 6.87 |
| | WP (1x $10^8$CFU/ml) 5 g/lit | (3.79) | (4.16) | (4.04) | (4.34) | (4.50) | (4.85) | (5.10) | (4.57) | | |
| 7. | *Verticillium lecanii* | 19.91 | 10.33 | 10.00 | 11.01 | 12.40 | 13.43 | 13.96 | 11.86 | 12.05 | 15.31 |
| | WP (1x $10^8$CFU/ml) *7.5* g/lit | (4.45) | (3.27) | (3.22) | (3.39) | (3.59) | (3.73) | (3.80) | (3.51) | | |
| 8. | *Metarhizium anisopliae* | 19.83 | 13.33 | 13.66 | 13.90 | 16.76 | 17.10 | 18.56 | 15.68 | 10.72 | 7.57 |
| | WP (1x $10^8$CFU/ml) 7.5 g/lit | (4.44) | (3.68) | (3.74) | (3.78) | (4.15) | (4.19) | (4.37) | (4.02) | | |
| 9. | *Beauveria bassiana* | 12.91 | 13.83 | 13.20 | 16.50 | 19.10 | 20.13 | 21.46 | 17.37 | 10.41 | 5.76 |
| | WP (1x $10^8$CFU/ml) 7.5 g/lit | (3.64) | (3.74) | (3.67) | (4.07) | (4.42) | (4.53) | (4.68) | (4.21) | | |
| 10. | Trizophos 40 EC 3 ml/lit | 16.08 | 12.00 | 11.41 | 13.00 | 15.00 | 16.03 | 17.50 | 14.26 | 11.68 | 11.27 |
| | | (4.04) | (3.53) | (3.45) | (3.67) | (3.94) | (4.06) | (4.24) | (3.83) | | |
| 11. | Untreated control | 15.11 | 26.83 | 29.76 | 33.55 | 35.73 | 41.06 | 46.16 | 35.52 | 9.42 | - |
| | | (3.81) | (5.22) | (5.49) | (5.83) | (6.01) | (6.45) | (6.83) | (5.98) | | |
| | S.E.± | 0.5136 | 0.3531 | 0.3488 | 0.2424 | 0.220 | 0.198 | 0.171 | 0.054 | 0.5013 | - |
| | C.D. (P=0.05) | NS | 1.041 | 1.029 | 0.7152 | 0.650 | 0.584 | 0.504 | 0.154 | 1.4791 | - |

Figures in the parenthesis indicate $\sqrt{x + 0.5}$ transformed values NS=Non-significant

untreated check (41.06). The treatments with *Verticillium lecanii* 7.5 g/lit recorded least number of colonies per fruit (13.43) and were at par with *Verticillium lecanii* 5 g/lit (14.03), Trizophos 40 EC 3 ml/lit (16.03), *Verticillium lecanii* 2.5 g/lit (16.70), *Metarhizium anisopliae* 7.5 g/lit (17.10). The next best performing treatments was *Metarhizium anisopliae* 5 g/lit with 18.96 colonies per fruit followed by *Beauveria bassiana* 7.5 g/lit (20.13), *Metarhizium anisopliae* 2.5 g/lit (21.10), *Beauveria bassiana* 5 g/lit (23.36) and *Beauveria bassiana* 2.5 g/lit (23.90).

Ten days after third spray, the minimum number of mealy bug colonies were observed in the treatment having *Verticillium lecanii* 7.5 g/lit (13.96) and it was at par with *Verticillium lecanii* 5 g/lit (15.00), *Verticillium lecanii* 2.5 g/lit (16.60), Trizophos 40 EC 3 ml/lit (17.50). The next best treatments in this respect included *Metarhizium anisopliae* 7.5 g/lit (18.56), *Metarhizium anisopliae* 5 g/lit (19.70), *Metarhizium anisopliae* 2.5 g/lit (21.26), *Beauveria bassiana* 7.5 g/lit (21.46), *Beauveria bassiana* 5 g/lit (25.76) and *Beauveria bassiana* 2.5 g/lit (26.43) colonies per fruit and were significantly superior over untreated check with 46.16 colonies per fruit. All the treatments were statistically significant over untreated control.

The general trend of field efficacy of the treatment under study against average mealy bug per fruit indicated as *Verticillium lecanii* 7.5 g/lit > *Verticillium lecanii* 5 g/lit > Trizophos 40 EC 3 ml/lit > *Verticillium lecanii* 2.5 g/lit > *Metarhizium anisopliae* 7.5 g/lit > *Metarhizium anisopliae* 5 g/lit > *Beauveria bassiana* 7.5 g/lit.

All the biopesticide treatments significantly increased fruit yield over control. The highest yield (12.05kg/plant) was recorded in *Verticillium lecanii* 7.5 g/lit and was at par with *Verticillium lecanii* 5 g/lit (11.74kg/plant), Trizophos 40 EC 3 ml/lit (11.68kg/plant), *Verticillium lecanii* 2.5 g/lit (10.89kg/plant), *Metarhizium anisopliae* 7.5 g/lit (11.74kg/plant), *Metarhizium anisopliae* 5 g/lit (11.74kg/plant).

The incremental benefit cost ratio (IBCR) ranged

from 5.76 to 17.91 in different treatments. The most economical treatment was *Verticillium lecanii* 5 g/lit (17.91) followed by *Verticillium lecanii* 2.5 g/lit (16.84), *Verticillium lecanii* 7.5 g/lit (15.31), *Metarhizium anisopliae* 2.5 g/lit (12.95), Trizophos 40 EC 3 ml/lit (11.27), *Beauveria bassiana* 2.5 g/lit (9.62), *Metarhizium anisopliae* 5 g/lit (9.57), *Metarhizium anisopliae* 7.5 g/lit (7.57), *Beauveria bassiana* 5 g/lit (6.87), *Beauveria bassiana* 7.5 g/lit (5.76). Our study clearly indicates that *Verticillium lecanii* 5 g/lit is effective and economical thus, proving to be a potential alternative to insecticides.

The satisfactory control of pest by *V. lecanii* in present study is in agreement with that reported by Kulkarni *et al.* (2003) and Jayachakravarthy (2001) on *Ferrisia virgata* and *M. hirsutus*, respectively. Gonzalez *et al.* (1995) reported that, the *V. lecanii* conidia as well as filtrates gave very good mortality (84.81%) against *P. citri* on 10$^{th}$ day. Eswaramoorthy and Jayaraj (1987) reported that, the *V. lecanii* was highly effective for the control of *C. viridis* under field conditions in Tamil Nadu, with fortnightly application of 1.6 x 10$^{6}$ spores/ml. Shelke (2001) observed that, *V. lecanii* (0.4%) or *C. montrouzieri* was the safest and most suitable treatment against grapevine mealy bug, *M. hirsutus*. According to Koli (2003), *V. lecanii* WP @ 0.3% was found to be best against nymphs and adults of grape mealy bug. The results of the present study are in line with the above orders.

Kulkarni and Patil (2013) reported that the incremental benefit cost ratio (IBCR) ranged from 1.17 to 13.40 in different treatments. The most economical treatment was *V. lecanii* (1.15%) WP and recorded (13.40) followed by *V. lecanii* (3%) WP (7.60) and buprofezin (0.02%) (6.81) and clearly indicates that *V. lecanii* is effective and economical thus proving to be a potential alternative to insecticides.

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