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Mohitha Reddy J
PG Scholar Department of Entomology, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

Chalapathirao NBV
Principal scientist, Department of Entomology, HRS, Ambajipeta, East Godavari, Andhra Pradesh, India

Viji CP
Associate Professor, Department of Entomology, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

Narasimha Rao S
Associate Professor, Department of pathology, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

Venugopalan
Principal Scientist, Department of statistics, ICAR-IIHR, Bangalore, Karnataka, India

Corresponding Author:
Mohitha Reddy J
PG Scholar Department of Entomology, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari, Andhra Pradesh, India

Evaluation of biopesticides against rugose spiraling whitefly *Aleurodicus rugioperculatus* Martin Martin on coconut (*Cocos nucifera* L.)

Mohitha Reddy J, Chalapathirao NBV, Viji CP, Narasimha Rao S and Venugopalan

Abstract
The efficacy to test of four bio-pesticides *I. fumosorosea* NBAIR pfu-5, *L. lecanii*, *B. bassiana*, *M. anisopliae* were evaluated against nymphs and adults of Rugose spiraling whitefly, *A. rugioperculatus* (Homoptera: Aleyrodidae) on coconut palms at HRS, Ambajipeta. Results showed that *I. fumosorosea* NBAIR pfu-5was found to be superior in reducing the population of nymphs and adults of RSW among the tested biopesticides. *M. anisopliae* was found to be least effective on reducing the population of both adults and nymphs of RSW.

Keywords: Efficacy, *A. rugioperculatus*

Introduction
Coconut (*Cocos nucifera* L.) is one of the most valuable gifts of nature to mankind. It is cultivated for its multiple utilities mainly for its nutritional, medicinal, cosmetic value (Ahuja *et al.* 2014) [1] and various by- products of coconut are tender coconut water, copra, coconut oil and coir pith. It's all parts are used in some way are another in the daily life of people in coconut growing areas therefore coconut palm is eulogised as "Kalpavriksha" The coconut palm is affected by a number of diseases and insect pests, some of which are fatal while others reduce its vigour resulting in economic loss. In the recent years, coconut crop in India have experienced many new invasive pests, particularly whiteflies. Invasion of rugose spiraling whitefly (RSW), *Aleurodicus rugioperculatus* Martin has been first reported from India in Tamil Nadu (Sundararaj and Selvaraj, 2016) [8], Andhra Pradesh (Chalapathirao *et al.* 2018) [4] which caused significant damage and still it continues to be major threat.
Alaramed by the invasion of whitefly species in coconut which causes reduction in yield due to honeydew excretion and sooty mould formation, farmers resorted to spraying of chemicals pesticides to control the pest. But their efforts were in vain as the chemicals turned out to be temporary fix and more over ill effects like environmental pollution, killing of natural enemies and health risks to the people and mostly it is uneconomical.
Biological control may offer an essential alternative to the indiscriminate use of synthetic pesticides through naturally occurring insect predators, parasitoids and Entomopathogens which are economically feasible, ecologically compatible and environmentally benign. The potential of the entomophagous predators to contribute to the biological control of arthropod pests has received increased interest in the recent years.
Biopesticides are generally less toxic than conventional pesticides and therefore considered safer for human health some of the biopesticides used for pest control are *Beauveria bassiana, Metarhizium anisopliae, Lecanicillium lecanii and Isaria fumosorosea*. They can be used as alternatives to the synthetic pesticides as they are environmentally friendly and also, their use does not lead to resistance build-up in target pests.

Materials and Methods
The present study entitled evaluation of various bio-pesticides against RSW on coconut palms was carried out with a view to manage the RSW with the help of conventional biopesticides. Field experiment was conducted during 2021-22 at HRS, Ambajipeta. The experiment was performed following randomized block design having five treatments including control with three replications of each treatment. Each palm was considered as one replication.

The required quantity of spray solution was prepared at the time of application. The quantity of spray fluid required per tree was approximately 20-25 liters. Jet water spray was applied as the same quantity and high jet sprayer was used for spraying. The sprayings were taken up three times at 15 days interval

Statistical Analysis

The statistical analysis of the data was done by using OPSTAT software. The data was transformed by square root before the data subjecting for analysis. After the analysis the data was tabulated for interpretation of results.

Results and Discussions

Overall results revealed that entomopathogens *I. fumosorosea* NBAIR pfu-5 @ 5 ml/L (T1) was found to be effective in reducing the nymphs and adult population of RSW with 82.00 and 91.97 percent reduction after 2 sprays at 15 days interval followed by *L. lecanii* with reduction percent of 63.93 (nymphs) and 72.67(adults) respectively. *M. anisopliae* has least effect on both nymph and adult population with 51.54% and 72.67% reduction after 28 days. The T9 treatment (control) was recorded with highest population of nymphs and adults 50.67 and 42.10 respectively after 28 days.

The present study showed that foliar spray of EPF resulted in reducing the pest population of nymphs and adults of RSW. Throughout the infection process, entomopathogenic fungi produce enzymes such as proteases, Chitinases and lipases, which tear down the host cuticle and enhance the attachment of fungal conidia to it. The results suggest that *I. fumosorosea* was more effective in managing the invasive *A. rugioperculatus* nymphs and adults of RSW in the field than that of *B. bassiana*, *M. anisopliae*, *L. lecanii*. These findings are in accordance with those of Boopathi *et al.* (2013 and 2015) [2, 3] and Chalapathirao *et al.* (2020) [5] who reported that *I. fumosorosea* NBAIR Pfu-5 reduced the early nymphal instars of RSW by 52-68 per cent and 35-40 per cent in Godavari Ganga hybrid and Gauthami Ganga variety of coconut. Selvaraj *et al.* (2020) [6] identified *I. fumosorosea* NBAIR Pfu-5 as promising strain in reducing population of RSW in Karnataka and Andhra Pradesh with two sprays at 15 days interval in coconut and oil palm. Visalakshi *et al.* (2021) [9] observed a 58.1 to 97.03 per cent reduction in RSW intensity in coconut farms sprayed with *I. fumosorosea* fungus (NBAIR- Pfu-5) @ 2 x 108 spores/ ml (5 g/l of water).

Table 1: Treatment details of different bio- pesticides used in the trial

Treatments	Concentration	Dosage
T_1 *Isaria fumosorosea*NBAIR *pfu-5*	1 X 10^8 CFU	5 ml/L
T_2 *Lecanicillium lecanii* commercial	1 X 10^8 CFU	5 ml/L
T_3 *Beauveria bassiana* commercial	1 X 10^8 CFU	5 ml/L
T_4 *Metarhizium anisopliae* commercial	1 X 10^8 CFU	5 ml/L
T_5 Control (no spraying)	-	-

Table 2: Evaluation of different biopesticides against RSW adults in coconut palms.

Treatment	PTC	7 DAS	14 DAS	21 DAS	28 DAS	Reduction % Over PTC
I. fumosorosea NBAIR PFU- 5 @ 5 ml/L	13.46 (3.91)	6.24 (2.76)	4.04 (2.20)	1.77 (1.69)	1.08 (1.46)	91.97
L. lecani Commercial @ 5 ml/L	13.94 (3.97)	8.15 (3.11)	5.97 (2.71)	3.34 (2.13)	2.39 (1.88)	82.92
B. bassiana Commercial @ 5 ml/L	15.23 (4.14)	9.55 (3.34)	7.43 (2.98)	4.43 (2.39)	3.32 (2.13)	78.23
M. anisopliae Commercial @ 5 ml/L	13.48 (3.91)	9.03 (3.25)	7.28 (2.95)	4.64 (2.43)	3.69 (2.12)	72.67
Control	14.23 (4.01)	20.15 (4.73)	26.79 (5.43)	35.15 (6.19)	42.10 (6.76)	-
C.D at 5%	NS	0.11	0.18	0.27	0.32	-
SE (m)	0.01	0.03	0.05	0.08	0.09	-

Days after spraying, Figures in the parenthesis are √x + 0.5 transformed value

Table 3: Evaluation of different biopesticides against RSW nymphs under low incidence palms.

Treatment	PTC	7 DAS	14 DAS	21 DAS	28 DAS	Reduction % Over PTC
I. fumosorosea NBAIR PFU- 5 @ 5 ml/L	34.12 (6.10)	17.87 (4.47)	14.99 (4.11)	7.06 (2.91)	6.21 (2.75)	82.00
L. lecani Commercial @ 5 ml/L	34.57 (6.14)	22.88 (5.03)	21.40 (4.87)	13.12 (3.86)	12.47 (3.77)	63.93
B. bassiana Commercial @ 5 ml/L	35.11 (6.19)	24.56 (5.20)	23.40 (5.08)	15.30 (4.15)	14.83 (4.09)	57.72
M. anisopliae Commercial @ 5 ml/L	33.25 (6.02)	24.37 (5.18)	23.54 (5.10)	16.47 (4.30)	16.11 (4.25)	51.54
Control	34.42 (6.13)	37.78 (6.41)	42.26 (6.77)	46.02 (7.06)	50.67 (7.40)	-
C.D at 5%	NS	0.10	0.14	0.22	0.25	-
SE (m)	0.003	0.03	0.04	0.06	0.07	-

Days after spraying, Figures in the parenthesis are √x + 0.5 transformed value

Conclusion

Based on the overall results, Among the biopesticides evaluated entomopathogens *I. fumosorosea* NBAIR- Pfu-5 was found to be more promising in reducing the population of nymphs and adults of RSW. *M. anisopliae* was found to have least effect on reducing the population of nymphs and adults of RSW.

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