



## EVALUATION OF DIFFERENT BIO-PESTICIDES AGAINST RUGOSE SPIRALING WHITEFLY INFESTING COCONUT CROP UNDER FIELD CONDITION

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### ABSTRACT

Coconut is an important cash crop in Bangladesh, particularly for coastal livelihoods, contributing significantly to safeguard economic stability, nutritional security, and environmental protection. But being invasive sap-sucking insect pest, the rugose spiraling whitefly (RSW) (*Aleurodicus rugioperculatus*) has recently been recognized as a serious threat to coconut cultivation all over Bangladesh. Studies were carried out in two locations viz. Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Jashore and RARS, BARI, Barishal to document the comparative efficacy of five biopesticides against rugose spiraling whitefly (RSW) infesting coconut during 2023-24. The results revealed that biopesticide Bioclean 5% SL (d-limonene) provided highest efficacy with 66.51-70.56% reduction of nymph/adult population of RSW over control. Whereas, application of Fizimite (10% sodium lauryl ether sulfate) offered the second highest efficacy with 60.05-61.38% reduction of nymph/adult population of RSW over control. The highest natural parasitism (17.01-18.34%) and parasitoid adult emergence (12.35-13.59%) was recorded from Fytoclean (potassium salt of fatty acid) followed by Biotrin (5% matrine). The best performing biopesticides viz. Bioclean 5% SL and Fizimite could be utilized in a well designed IPM program against rugose spiraling whitefly in coconut.

**Keywords:** Biotrin, Fizimite, Fytoclean, *Aleurodicus rugioperculatus*, IPM

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## INTRODUCTION

Bangladesh being a tropical country with a warm and humid climate and free of trade and movement of agricultural commodities has always been vulnerable to threats of invasive pests. The rugose spiraling whitefly (RSW), *Aleurodicus rugioperculatus* Martin (Aleyrodidae: Hemiptera), a new invasive insect pest in Bangladesh, was first identified in May 2019 on coconut plants in Jashore (Dutta *et al.* 2019). RSW attack and cause damage about 250 other plants but coconut is the most preferred host (TNAU 2025). Recent survey study showed that the whole Bangladesh has been invaded by this invasive insect pest infesting 61 host plants with highest damage severity in coconut plants (Das *et al.* 2023).

Coconut is an important fruit crop in Bangladesh, which generates income for the growers continuously and contributes a lot to increase the total homestead income. It provides livelihood to coconut farmers through its versatile uses. At present, coconut cultivation in Bangladesh is being seriously impeded by RSW. This pest feeds on leaf sap, causing a severe stress to the host plant. The sticky honeydew excreted by the whiteflies drops on the lower fronds provides a substrate for sooty mould to grow producing black, dusty patches on leaves and other surfaces. The honeydew can be a nuisance, attracting ants and wasps, and the sooty mould can disrupt photosynthesis.

In severe cases, the whitefly infestation can lead to drying of leaves and leaflets (Moyem *et al.* 2023; Puvvala *et al.* 2024). The RSW have the great potential to spread and reproduce throughout the year with multiple and overlapping generations. It has now become one of the most important pests of coconut and many other economically important crop plants, warranting control measures to avoid crop losses. Until 2020, the pest infestation was limited to only the southwestern districts of Bangladesh, but by this time the pest has been reported from all other districts causing havoc to coconut cultivation in the country (Dutta *et al.* 2025). Chemical control is the only weapon of our farmers to control this pest. Spraying of chemical insecticides would highly suppress the population buildup of all the natural enemies in coconut ecosystem. Biopesticides are the most feasible, efficient, eco-friendly alternatives to chemical insecticides. Bio-pesticides offer an ecologically sound and effective solution to pest problems (Gupta and Dikshit,

2010). Although chemical pesticides may be sometimes more effective on crop pests than biopesticides, their long-term usage affects the natural enemy population, resistance development in pests, environmental pollution and human health hazards. Moreover, the biopesticides could play a vital role as component of sustainable IPM approaches against RSW. With the above perspectives, attempts were made to find out the comparative effectiveness of certain biopesticides against RSW in coconut under field conditions in Bangladesh.

## MATERIALS AND METHODS

Field experiments were carried out in two locations viz. Regional Agricultural Research Station (RARS), Jashore and RARS, Barishal to select the best biopesticide(s) against rugose spiraling whitefly infesting coconut. The same methodology was followed in both the locations. Experiment was conducted in a randomized block design with three replicates consisting of single palm each. There were six treatments including the control. Treatments were assigned as follows: T<sub>1</sub>: Spraying Bio-chamak 1% EW (*Celastrus angulatas*) @ 2.5 ml/litre of water; T<sub>2</sub>: Spraying Biotrin (Matrine) @ 1.5 ml/ litre of water; T<sub>3</sub>: Spraying Fizimite 10% (Sodium lauryl ether sulfate) @1 ml/ litre of water; T<sub>4</sub>: Spraying Bioclean (d-limonene) @ 1 ml/ litre of water; T<sub>5</sub>: Spraying Fytoclean (Potassium salt of fatty acid) @ 6 ml/ litre of water; T<sub>6</sub>: Untreated control (Water spray only).

Three sprays of each insecticide were done using high volume foot pump sprayer/ power sprayer at one month interval. Details of insecticides evaluated in the study are given in Table 1. Nymph and adult whitefly population on coconut leaflets were counted at 1 day before spraying and 7 days after each spraying (Fig. 1a, 1b). From each plant 20 leaflets were collected randomly, kept in polythene bags, brought to lab, and observed under stereo zoom microscope/10x hand lens for counting nymph and adult whitefly population.

Parasitism (%) and adult emergence (%) of nymphal parasitoids were also recorded.

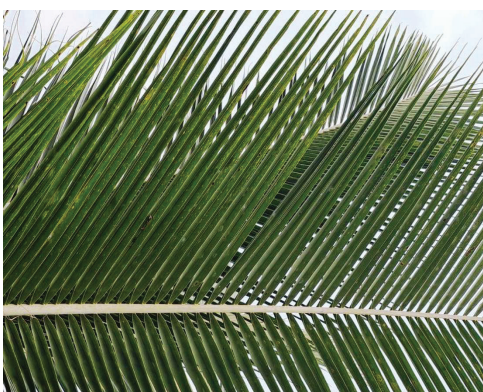
Natural parasitization by parasitoids was calculated using the following formula.

$$\text{Per cent parasitization} = \frac{\text{Number of parasitized whitefly nymphs}}{\text{Total number of whitefly nymphs}} \times 100$$

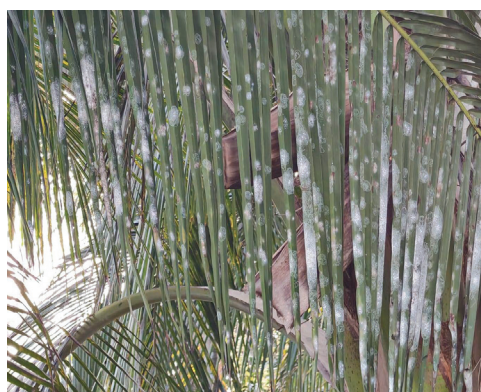
The number of parasitoids that emerged from the whitefly nymph was recorded based on the emergence hole in the nymph and the per cent emergence was worked out using the following formula:

$$\text{Per cent adult emergence} = \frac{\text{Number of nymphs having emergence hole}}{\text{Total number of parasitized nymphs}} \times 100$$

All recorded data were subjected to analysis of variance (ANOVA) using Statistix 10 analytical software to determine the statistical significance of experimental results (Analytical software, 2013) and means were separated by LSD.



**Fig. 1 A. Healthy coconut leaf**



**Fig. 1 B. RSW infested coconut leaf**

**Table 1.** Details of the biopesticides used in the experiment

| Trade name | Common name                | Group/Class                                                                                                                                                                                                                                                                    |
|------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bio-chamak | <i>Celastrus angulatus</i> | Natural bio-pesticide derived from <i>Celastrus angulatus</i> - a type of perennial herb. Destroys the function of the insect's stomach, causing the insect to die quickly due to starvation.                                                                                  |
| Biotrin    | Matrine                    | Broad-spectrum botanical biopesticide extracted from plants like <i>Sophora flavescens</i> . Control a variety of pests viz. aphids, caterpillars, and thrips etc. It acts as a contact and stomach poison, paralyzing insects' nervous systems. It has also repellent action. |

| Trade name | Common name                  | Group/Class                                                                                                                                                                                                                    |
|------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fizimite   | Sodium lauryl ether sulfate  | Fizimite is a versatile, toxin-free bio-insecticide / fungicide. Control relies on direct contact with the target pests. It was washes plant for a clear and shiny appearance.                                                 |
| Bioclean   | d- limonene                  | d-Limonene (Found mostly in citrus and also other plants and is a major constituent of essential oil. It is generally used as a component of flavorings and fragrances, as a chemical intermediate and as an insect repellent) |
| Fytoclean  | Potassium salt of fatty acid | Horticultural soap (causes cellular dehydration due to ingestion by larva. The formulation also disrupts the cuticle of soft-bodied insects resulting death).                                                                  |

## RESULTS AND DISCUSSION

***Effectiveness of biopesticides in reducing RSW nymphs and adults:*** Results of the field study conducted at RARS, Rahmatpur, Barishal, for evaluating are presented in Table 2. As shown in Table 2, at 7 days after spray (DAS), the lowest mean number of nymphs/leaflet (5.50) was noticed in Bioclean 5% SL treated plants followed by Fizimite 10% treated plants (6.85). The control treatment recorded the highest number of nymphs/leaflet (17.69). Among the bio-pesticides evaluated, significantly the highest per cent reduction of whitefly nymphs over the control was recorded in Bioclean 5% SL (68.91%), followed by Fizimite 10% (61.28%) and Biotrin 0.5% (47.54%).

At 7 days after spray (DAS), the lowest mean number of adults/leaflet (5.77) was noticed in Bioclean 5% SL treated plants followed by Fizimite 10% treated plants (7.83). The control treatment recorded the highest number of whitefly /leaflet (19.60). Among the evaluated bio-pesticides, significantly the highest per cent reduction of whitefly adult population over the control was recorded in Bioclean 5% SL (70.56%) followed by Fizimite 10% (60.05%) and Biotrin 0.5% (48.72%).

Results of the study conducted at RARS, Jashore, are presented in Table 3. As shown in Table 3, at 7 days after spray (DAS), the lowest mean number of nymphs / leaflet (6.59) was noticed in Bioclean 5% SL treated plants followed by Fizimite 10% treated plants (7.60). The control treatment recorded the highest number of nymphs /leaflet (19.68). Among the bio-pesticides evaluated, significantly the highest per cent reduction of whitefly nymphs over the control was recorded in Bioclean 5% SL (66.51%), followed by Fizimite 10% (61.38%) and Biotrin 0.5% (49.24%).

**Table 2.** Effect of different biopesticides on the reduction of RSW nymphs and adults during 2023-24 at RARS, Rahmatpur, Barishal (Pooled data of three sprays)

| Treatments                           | Mean RSW nymph population/ leaflet |         | Reduction (%) of RSW nymph population over control | Mean RSW adult population/ leaflet |         | Reduction (%) of RSW adult population over control |
|--------------------------------------|------------------------------------|---------|----------------------------------------------------|------------------------------------|---------|----------------------------------------------------|
|                                      | 1 DBS                              | 7 DAS   |                                                    | 1 DBS                              | 7 DAS   |                                                    |
| Bio-chamak 1% EW                     | 18.03                              | 11.04 b | 37.59                                              | 20.03                              | 11.77b  | 39.95                                              |
| Biotrin 0.5%                         | 18.36                              | 9.28 b  | 47.54                                              | 20.36                              | 10.05bc | 48.72                                              |
| Fizimite 10%                         | 18.07                              | 6.85 c  | 61.28                                              | 19.82                              | 7.83cd  | 60.05                                              |
| Bioclean 5% SL                       | 17.91                              | 5.50 c  | 68.91                                              | 19.98                              | 5.77d   | 70.56                                              |
| Fytoclean                            | 18.34                              | 9.38 b  | 46.98                                              | 20.47                              | 10.27b  | 47.60                                              |
| Untreated control (water spray only) | 18.56                              | 17.69 a | -                                                  | 20.41                              | 19.60a  | -                                                  |
| CV (%)                               | 5.71                               | 12.95   | -                                                  | 6.50                               | 12.04   | -                                                  |

Means having the same letter(s) in a column did not differ significantly by LSD ( $P < 0.05$ ).

At 7 days after spray (DAS), the lowest mean number of adults/leaflet (7.0) was noticed in Bioclean 5% SL treated plants followed by Fizimite 10% treated plants (8.07). The control treatment recorded the highest number of whitefly / leaflet (20.61). Among the bio-pesticides evaluated, significantly the highest per cent reduction of whitefly adults over the control was recorded in Bioclean 5% SL (66.04%) followed by Fizimite 10% (60.84%) and Biotrin 0.5% (50.85%).

**Impact of biopesticides on natural parasitism of RSW and parasitoid adult emergence:** During the study, two species of parasitoids were found associated with *A. rugioperculatus* and parasitizing RSW nymph and identified as *Encarsia guadeloupae* Viggiani and *Encarsia dispersa* Polasze. Parasitization (%) of nymph and adult emergence (%) varied significantly among the treatments in different locations (Table 4). It was observed that, in both the locations lowest parasitization (%) was obtained from Bio-chamak 1% EW (13.02% and 14.21% in Barishal and Jashore, respectively) which was followed by Bioclean 5% SL (14.58% and 15.68%, in Barishal and Jashore, respectively). In contrast, significantly the highest parasitization (%) was obtained from the untreated control (22.02% and 23.35%, in Barishal and Jashore, respectively).

**Table 3.** Effect of different biopesticides on the reduction of RSW nymphs and adults during 2023-24 at RARS, Jashore (Pooled data of three sprays)

| Treatments                           | Mean RSW nymph population/ leaflet |         | Reduction (%) of RSW nymphs over control | Mean RSW adult population/ leaflet |         | Reduction (%) of RSW adults over control |
|--------------------------------------|------------------------------------|---------|------------------------------------------|------------------------------------|---------|------------------------------------------|
|                                      | 1 DBS                              | 7 DAS   |                                          | 1 DBS                              | 7 DAS   |                                          |
| Bio-chamak 1% EW                     | 20.23                              | 12.12 b | 38.41                                    | 21.38                              | 12.48b  | 39.45                                    |
| Biotrin 0.5%                         | 20.38                              | 9.99 bc | 49.24                                    | 21.45                              | 10.13bc | 50.85                                    |
| Fizimite 10%                         | 20.12                              | 7.60 de | 61.38                                    | 21.19                              | 8.07cd  | 60.84                                    |
| Bioclean 5% SL                       | 20.27                              | 6.59 e  | 66.51                                    | 21.34                              | 7.0d    | 66.04                                    |
| Fytoclean                            | 20.14                              | 9.08 cd | 53.86                                    | 20.89                              | 9.85c   | 52.21                                    |
| Untreated control (water spray only) | 20.21                              | 19.68 a | -                                        | 21.51                              | 20.61a  | -                                        |
| CV (%)                               | 9.27                               | 10.89   | -                                        | 7.77                               | 12.61   | -                                        |

Means having the same letter(s) in a column did not differ significantly by LSD ( $P < 0.05$ ).

Similar results were also observed in case of adult emergence. Percent Parasitoid adult emergence was the lowest in Bio-chamak 1% EW (9.32% and 9.42% in Barishal and Jashore, respectively) which was followed by Bioclean 5% SL (10.28% and 11.32%, in Barishal and Jashore, respectively). In both the locations, significantly the highest adult emergence was noticed (17.23 and 18.67% Barishal and Jashore, respectively) from the untreated plants followed by biopesticide treated plants (Table 4).

The invasive rugose spiraling whitefly at present is hindering coconut production in coconut growing regions of the world. Recent invasion of this pest in Bangladesh has led to substantial economic losses, highlighting the urgent need for bio-intensive management. Since the first occurrence of this pest in the country, attempts have been made by several researchers to develop effective management options, but those previous studies mostly concentrated on the efficacy of chemical pesticides, less focusing on biopesticides. Results of the two locations study revealed that biopesticide Bioclean 5% SL (66-70% efficacy) was promising against RSW. Whereas, application of Fizimite offered the second highest efficacy with 60-62% reduction of nymph/adult populations of RSW over the control. These biopesticide could be utilized in a well designed IPM program for RSW. In Bangladesh, Dutta *et al.* (2022) advocated sanitation plus alternate spraying on biopesticide d-limonene 5% SL and acetamiprid 20 SP as sustainable management options against RSW,

**Table 4.** Parasitization (%) and adult emergence (%) of nymphal parasitoids of rugose spiraling whitefly in biopesticide treatments during 2023-24 at RARS, Jashore and RARS, Barishal

| Treatments                           | RARS, Rahmatpur, Barishal               |                                                     | RARS, Jashore                           |                                                     |
|--------------------------------------|-----------------------------------------|-----------------------------------------------------|-----------------------------------------|-----------------------------------------------------|
|                                      | *Percent parasitization (Mean $\pm$ SE) | *Percent Parasitoid adult emergence (Mean $\pm$ SE) | *Percent parasitization (Mean $\pm$ SE) | *Percent Parasitoid adult emergence (Mean $\pm$ SE) |
| Bio-chamak 1% EW                     | 13.02d                                  | 9.32d                                               | 14.21d                                  | 9.42c                                               |
| Biotrin 0.5%                         | 16.23bc                                 | 12.28b                                              | 16.85bc                                 | 12.42bc                                             |
| Fizimite 10%                         | 15.38bc                                 | 11.22bc                                             | 16.20b-d                                | 12.85bc                                             |
| Bioclean 5% SL                       | 14.58cd                                 | 10.28cd                                             | 15.68cd                                 | 11.32bc                                             |
| Fytoclean                            | 17.01b                                  | 12.35b                                              | 18.34b                                  | 13.59b                                              |
| Untreated control (water spray only) | 22.02a                                  | 17.23a                                              | 23.35a                                  | 18.67a                                              |
| CV (%)                               | 7.35                                    | 6.00                                                | 7.80                                    | 15.05                                               |

Means having the same letter(s) in a column did not differ significantly by LSD ( $P < 0.05$ ).

which are aligned with the results of Rahman *et al.* (2025) who also observed that alternating applications of acetamiprid and d-limonene were highly effective in managing RSW infestations and may also reduce the risk of pest invasions. Dutta *et al.* (2025) put emphasis on developing capacity among farmers, extension agents, and researchers to implement bio-intensive strategies effectively and reduce reliance on chemical pesticides.

The present study also revealed that natural parasitism in biopesticide treated plots ranged 13-18%. Dutta *et al.* (2026) similarly observed 15-17% natural parasitism with different biopesticides (Bioclean and Fytoclean) spraying against RSW in coconut. However, Dutta *et al.* (2025) observed about 8-12% natural parasitism from different reduced-risk insecticides treatments against RSW in coconut. So, parasitism efficiency of different parasitoids was found to be enhanced with biopesticides.

Outside Bangladesh, Chin *et al.* (2023) in their studies on the efficacy of biopesticides against RSW reported that Fizimite or Bioclean @ 1ml/L at 15 days interval, Neemtach @ 30ml + oil 2 ml/L water and Natrasoap @ 20ml + Oil @

2ml /L water at three days interval can be used to effectively control the rugose spiraling whitefly infestation. It has been reported by Alagar *et al.* (2022) that spraying three rounds of 0.5% neem oil at 15 days interval on the under surface of leaves, three rounds of jet water spray at 10 days interval about 15 days after spraying of neem oil can reduce the rugose spiraling whitefly infestation to a great extent. Mohitha Reddy *et al.* (2022) studied the efficacy of several biopesticides in Andhra Pradesh, India, and observed entomopathogen '*Iceria fumosorosea* NBAIR-Pfu-5' to be more promising in reducing the population of nymphs and adults of RSW. Working with different biopesticides against RSW, Raghuteza *et al.* (2022) also reported that *I. fumosorosea* was more effective in managing the invasive *A. rugipericulatus* adults than that of *Beauveria bassiana*, *Metarhizium anisopliae*, *Lecanicillium lecanii*, azadirachtin and soapnut powder. However, they observed that, azadirachtin 10,000 ppm significantly reduced the nymphal population of RSW and found superior among the different treatments tested. Studies on eco-friendly approaches for the management of coconut rugose spiraling whitefly by Wankhede *et al.* (2023) revealed that, IPM package consisting of neem oil application followed by water spray coupled with yellow sticky traps was found effective in reducing RSW incidence.

## CONCLUSION

Considering the damage potential of RSW and present trend of its countrywide spread in Bangladesh, there is an urgent need for sustainable, biorational based pest management options tailored to the tropical climates, needs of coconut growers and diverse agricultural systems of Bangladesh. The biopesticides selected from this study would play a vital role as component of sustainable IPM approaches against this invasive pest.

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