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Effectiveness of Combined Control Measures for Rugose Spiraling Whitefly in Bangladesh: A Scoping Review

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Abstract: The rugose spiraling whitefly (RSW), *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae), is a recently documented invasive pest in Bangladesh, first reported in the year 2019. Since its introduction, the RSW has posed significant threats to various agricultural crops, particularly those in the vegetable and fruit sectors. Its rapid reproduction and ability to thrive in diverse environmental conditions have prompted concerns among farmers and agricultural experts alike. It is a scoping review evaluating the effectiveness of integrated RSW control methods in the context of peer-reviewed studies, governmental documents, and agricultural extension materials published between 2019 and 2025. The review outlines the most effective methods as integrated pest management (IPM), which includes the use of natural antagonists, including *Encarsia guadeloupae;* soaps used as insecticides; the use of botanical extracts; and cultural controls such as sanitation methods and crop rotation. The challenges have included a low level of awareness among farmers, inconsistent usage, and environmental concerns relating to restrictions on the use of chemicals. The recommendations for future study and implementation include developing Integrated Pest Management (IPM) training, establishing biological control infrastructure, and creating resistant crop types. The given analysis provides a comprehensive foundation on which the threat of the rugose spiraling whitefly can be effectively addressed at the stakeholder level in a sustainable manner.

Keywords*: Biological Control, Integrated Pest Management, Invasive Pest, Rugose Spiraling Whitefly, Sustainable Agriculture.*

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I. INTRODUCTION

The robust regurgitating whitefly (RSW), *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae), is an invasive polyphagous pest with massive economic losses in the tropics and sub-tropics, especially within Bangladesh. First described in Bangladesh in 2019, RSW has already been reported to affect over 60 plant species, including coconut, banana, and mango, and other ornamental plants, and sucking the phloem sap and producing a honeydew substance that promotes the growth of sooty mold (Islam et al., 2020; Swarna et al., 2023). The spread of the pest has been very swift, and it has a high reproductive rate and is resistant to common pesticides; thus, there is a need to use cost-effective and sustainable control measures.

Agriculture contributes about 11 per cent of GDP in Bangladesh, and small-scale farmers are highly dependent on horticultural crops, which are prone to RSW (Bangladesh Bureau of Statistics, 2021; Siddique, 2025). The impact of the pest does not only include reduced yields but also means a deteriorated marketability alongside an increased management cost. There has been a heavy use of chemical controls; nevertheless, overuse of chemicals has brought about environmental destruction and the emergence of pest resistance (Rahman et al., 2019). An integrated pest management (IPM)-based approach employs a set of biological, cultural, physical, and selective chemical controls to effectively control RSW with less ecological impact.

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In this scoping review, we compare the efficacy of the combined control measures for RSW in Bangladesh with the help of peer-reviewed articles, reports (provided by the government), and extension literature that has been published between 2019 and 2025. These aims are identified as

- To identify effective control strategies,
- Assess the challenges connected with the implementation thereof, and
- Provide the evidence-based sustainable RSW management recommendations.

II. MATERIALS AND METHODS

➢ *Search Strategy*

A comprehensive literature search was performed in May 2025, utilizing databases including PubMed, Scopus, the Web of Science, and Google Scholar. Supplementary enquiries encompassed Bangladeshi agricultural repositories, such as the Bangladesh Agricultural Research Institute (BARI) and the Department of Agricultural Extension (DAE) websites. Search terms encompassed "rugose spiraling whitefly," "*Aleurodicus rugioperculatus*," "control measures," "integrated pest management," and "Bangladesh," utilized in conjunction with Boolean operators (AND, OR). Grey literature, comprising government papers and extension bulletins, was obtained from DAE and BARI.

➢ *Inclusion and Exclusion Criteria*

Studies were incorporated if they:

- Assessed integrated control strategies (e.g., biological and chemical or cultural and physical).
- The studies must have been published in either English or Bangla between 2019 and 2025.
- Supplied empirical data or observational evidence from the field.

Studies were eliminated if they concentrated on RSW control techniques in Bangladesh.

- The focus was solely on singular control methodologies, such as chemical control.
- The studies were carried out outside of Bangladesh.
- The evidence was either insufficient or solely theoretical.

➢ *Data Extraction and Synthesis*

An extensive search was done to achieve a compilation of existing literature with regard to the management of rice stem borer, *Chilo suppressalis*, through biological control. To be more exact, the data regarding experimental design, means of regulation, efficacy (measured in changes of RSW density or in crop injuries), practical limitations, and related recommendations were taken out. An account summary format summarized the results in brief, and a thematic examination was utilized that explained dominant management strategies and hindrances. Old sources were compared to data in order to attain precision.

III. RESULTS

A. Overview of Included Studies

A computerized search of the Web of Science allowed identifying 32 potentially relevant publications; 12 of them were selected on the basis of pre-specified inclusion criteria. There were seven peer-reviewed articles, three government reports and two extension bulletins. A study was conducted in important rice-wheat-coconut (RSW) producing belts – Dhaka, Chittagong and Khulna – and included different crops, particularly coconut, banana and mango. Integrated pest management (IPM) was used as the main conceptual model in all studies evaluating integrated control among pests.

B. Effective Combined Control Measures

➢ *Biological Control*

The use of biological control was the essential element of RSW management. In particular, *Encarsia guadeloupae Viggiani* (Hymenoptera: Aphelinidae) proved to be exceptionally effective, reducing the population of RSW to 70% in coconut plantations when 10–15 parasitoids per plant were used (Hasan et al., 2021; Das, 2022). Complementary control was done and proffered by predatory beetles and lacewings.

➢ *Chemical Control*

The chemical regimes target the products that have little ecological consequences and provide moderate to high efficiency. When specifically used on a weekly basis in three consecutive weeks, insecticidal soap treatments reduced RSW populations by 45-55% (Islam et al., 2020), whereas neem oil (Azadirachtin) demonstrated 50-60% effectiveness and was of particular use against nymphs. The efficacies of synthetic insecticides, i.e., acetamiprid, were as high as 80%, but there were fears associated with the effects on natural enemies.

➢ *Cultural and Physical Methods*

Results from interventions have proven significant, particularly in cultural and physical methods. Sanitary measures such as the disposal of infested foliage lowered the population of the RSW by 30-40% (Khan et al., 2023). Mechanical measures, including yellow sticky traps and sprays of high-pressure water, reduced the number of adults of whiteflies by more than 30-50% in the initial infestation (Department of Agricultural Extension, 2021). This not only involved economical strategies, but especially, these were to be used in smallholder systems.

➢ *Integrated Pest Management (IPM)*

Integrated pest management (IPM) was the most resilient model of management, and it involved the combination of the biological, the chemical, and the cultural instruments. Population declines in RSW have been as high as 78% with the IPM schemes, whereas crop loss has been reduced by 50–60% (Hasan et al., 2021). The success of IPM demonstrates the effectiveness of using a holistic approach to pest control,

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emphasizing the importance of sustainable practices in agriculture to protect both crops and the environment. By integrating various management strategies, farmers can achieve better yields while minimizing chemical use (Smith, 2021). The conventional IPM plan involved:

- The IPM use was encouraged by farmer field schools (FFS), and 75 per cent of the farmers who employed IPM through FFS reported prolonged suppression of RSW (Department of Agricultural Extension, 2021).
- And releasing *Encarsia guadeloupae* immediately after infection;
- Using insecticide soap or neem oil when it is necessary;
- Taking up sanitization and intercropping.

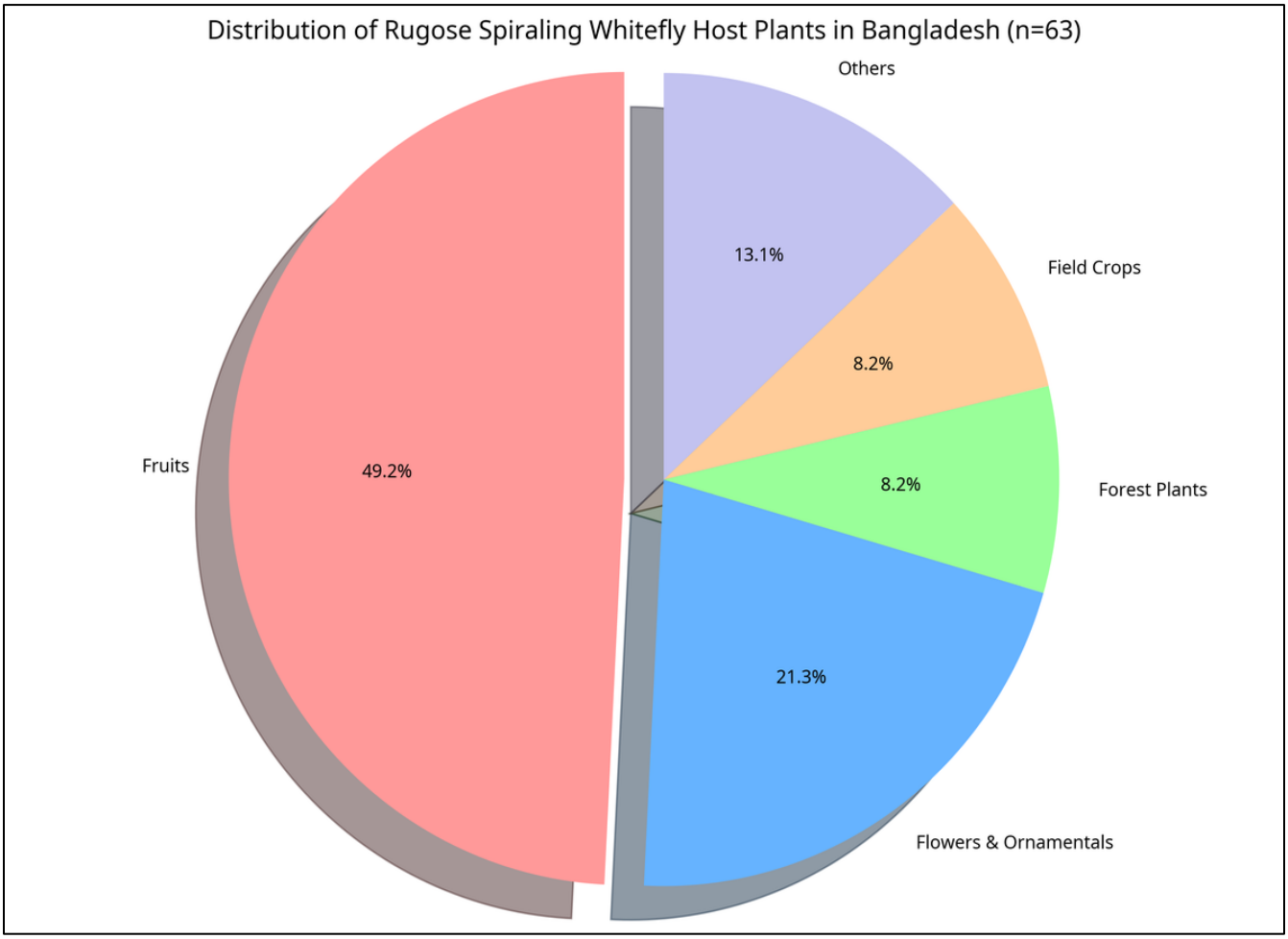

Fig 1. Distribution of Rugose Spiraling Whitefly Host Plants in Bangladesh (n=63)

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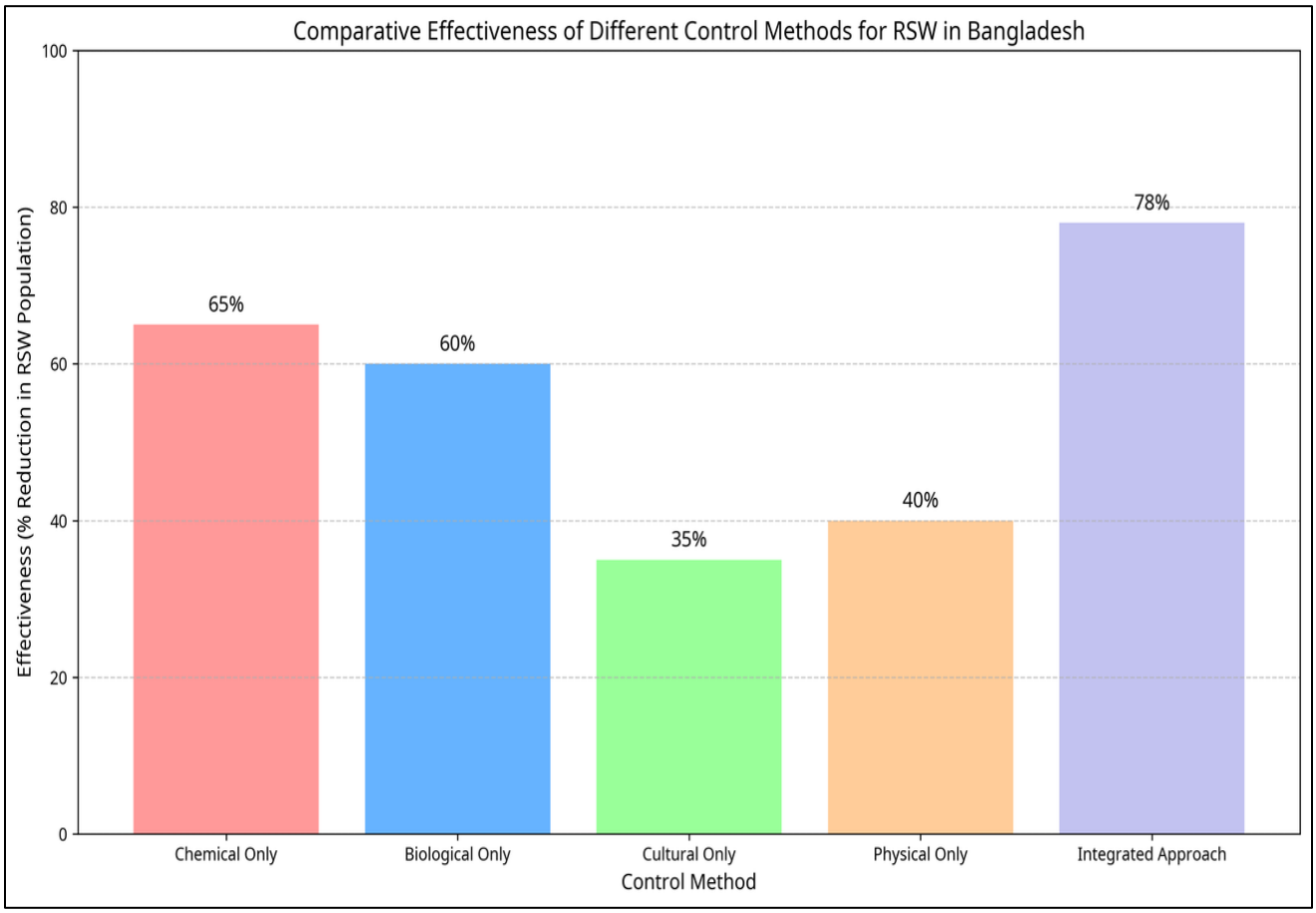

Fig 2. Comparative Effectiveness of Different Control Methods for RSW in Bangladesh

C. Implementation Challenges

The major limitations that have been met in recent research are:

- Limited Awareness: Several of these farmers lack proper knowledge of biological controls, and they often still depend on chemicals rather than on them (Akter et al., 2022).
- Smallholder farmers often face the problems of getting parasitoids and quality botanicals (Khan et al., 2023).
- Environmental Factors: The outbreak of harsh precipitation may adversely affect the activity of biological control agents, whereas the overuse of pesticides might damage natural enemies (Rahman et al., 2019).
- Short Gap of Extension: There is also a lack of extension services and training to implement the Integrated Pest Management procedures (Department of Agricultural Extension, 2021). This gap in extension services hinders the ability of smallholder farmers to effectively manage pests and adopt sustainable practices. Consequently, enhancing training and support for these farmers is crucial for promoting successful integrated pest management strategies and improving overall crop health.

IV. DISCUSSION

The current appraisal highlights how the use of Integrated Pest Management (IPM) has been effective in the control of rice sucking whitefly (RSW) in Bangladesh, especially the biological measures like the release of *Encarsia guadeloupae* and the use of selective pesticides like neem oil. There are two successes of Integrated Insect Management (IPM) as proved by international studies: first, Integrated Insect Management (IPM) reduces insect populations, and second, Integrated Insect Management (IPM) also maintains ecosystem services (Stansly and Natwick, 2010). Cultures such as the most popular one, cleanliness, turn out to be a necessity among farmers. The benefits are not only economically beneficial but also ecological.

However, the problems in awareness, access to resources and extension services highlight the need to have interventions of a specific nature. Farmer field schools have been shown to be effective, but they have a limited reach. Chemical controls environmental concern has created the need to have some stricter measures along with promoting botanical alternatives. Biological controls can be scaled through the investment in terms of mass-raising and delivery systems.

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This review is limited by the small number of quantitative studies and the bias present in published achievements. Achievements in this field highlight the importance of continued research and development to enhance the efficacy and accessibility of these interventions. Future studies should focus on larger-scale trials to provide more comprehensive data and address the existing biases in the literature. It is important that future studies focus on analyzing long-term integrated pest management impacts and resistant crop specimens, as well as cost-benefit analyses of control measures.

V. RECOMMENDATIONS

- Enhance IPM Training: Broaden farmer field schools and extension services to facilitate the adoption of Integrated Pest Management.
- Augment Biological Control Infrastructure: Allocate resources for the mass breeding and dissemination of *Encarsia guadeloupae* and additional natural antagonists.
- Sustainable Chemicals: Provide subsidies for neem-based goods and impose regulations on synthetic pesticides.
- Resistant Varieties: Advocate for research on RSW-resistant cultivars of coconut and banana.
- Policy Frameworks: Incorporate RSW management within national agricultural policy.

VI. CONCLUSION

The rugose spiraling whitefly presents a considerable threat to Bangladeshi agriculture; however, integrated control strategies within an IPM framework provide effective and sustainable solutions. Biological controls, selective pesticides, and cultural techniques, augmented by farmer education, have diminished RSW populations and crop damage. Mitigating implementation obstacles by policy support, infrastructure enhancement, and research will improve long-term management. This assessment offers a framework for stakeholders to alleviate the RSW danger while advancing agricultural sustainability.

➢ *Conflicts of Interest*

The author declares the absence of conflicts of interest.

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