American Journal Of Agriculture And Horticulture Innovations
(ISSN – 2771-2559)
VOLUME 04 ISSUE 12 Pages: 1-6
OCLC – 1290679216

Publisher: Oscar Publishing Services

Research Article

INTEGRATIVE MANAGEMENT OF CITRUS CANKER: RESISTANCE SCREENING AND ALLELOPATHIC APPROACHES

Submission Date: November 21, 2024, Accepted Date: November 26, 2024,
Published Date: December 01, 2024

Muhammad Azam
Department of Plant Pathology, College of Agriculture, University of Sargodha, 40100 Sargodha, Pakistan

Journal Website: https://theusajournals.com/index.php/ajahi

ABSTRACT

Citrus canker, caused by Xanthomonas citri subsp. citri, poses a significant threat to global citrus production due to its detrimental effects on fruit yield and quality. An integrative management approach combining cultivar resistance screening and allelopathic strategies offers a sustainable solution to combat this disease. This study evaluates the resistance of diverse citrus cultivars to citrus canker under controlled and field conditions, identifying promising genotypes with inherent tolerance. Simultaneously, the allelopathic potential of plant-derived extracts and compounds is assessed for their efficacy in suppressing X. citri growth and mitigating disease symptoms. Results demonstrate the synergistic potential of deploying resistant cultivars alongside allelopathic treatments to reduce disease incidence and enhance orchard productivity. This research underscores the importance of integrating genetic and ecological tools for the sustainable management of citrus canker, contributing to resilient citrus production systems.

KEYWORDS

Citrus canker, Xanthomonas citri, Cultivar resistance, Allelopathy, Disease management, Sustainable agriculture, Citrus disease control, Plant-derived compounds, Integrated pest management.

INTRODUCTION

Citrus canker, caused by the bacterium Xanthomonas citri subsp. citri, is a highly destructive disease affecting citrus crops worldwide. It significantly impacts fruit yield, marketability, and overall orchard health, posing a major challenge to the citrus industry. Characterized by lesions on leaves, stems, and fruits, the disease spreads rapidly under favorable environmental conditions, exacerbated by wind-driven rain and

American Journal Of Agriculture And Horticulture Innovations
(ISSN – 2771-2559)
VOLUME 04 ISSUE 12 Pages: 1-6
OCLC – 1290679216
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

mechanical injury. Conventional management strategies, including chemical control and cultural practices, often fall short due to environmental concerns, pathogen adaptability, and increased resistance to chemical treatments.

The search for sustainable and integrated disease management strategies has gained momentum in recent years. Among these, cultivar resistance screening and allelopathic approaches have emerged as promising tools. Screening citrus cultivars for inherent resistance to X. citri provides a foundation for breeding programs and disease-resistant orchard establishment. In parallel, allelopathic management leverages the bioactive properties of plant-derived compounds to suppress the growth and virulence of phytopathogens, offering an eco-friendly alternative to synthetic chemicals.

This study aims to explore the integrative management of citrus canker through a twofold approach: identifying resistant citrus cultivars and assessing the allelopathic potential of plant-based compounds against X. citri. By combining genetic and ecological strategies, this research seeks to develop a comprehensive framework for the sustainable control of citrus canker, ensuring long-term productivity and environmental stewardship in citrus farming systems.

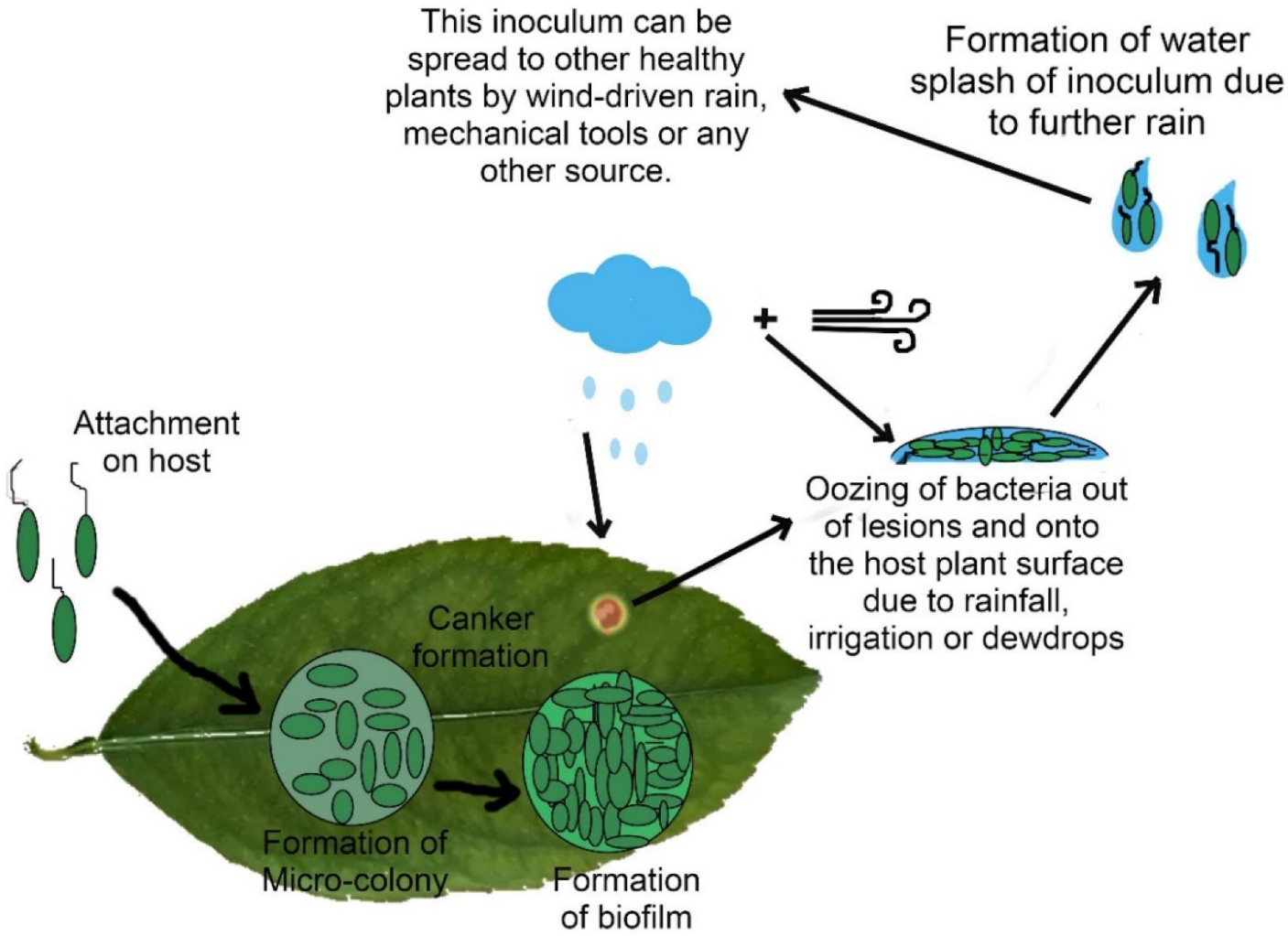
METHOD

To address the integrative management of citrus canker, this study employed a two-pronged approach: screening citrus cultivars for resistance and evaluating allelopathic plant extracts for disease suppression. Both experimental setups were conducted under controlled laboratory conditions and field environments to ensure comprehensive data collection and practical applicability.

Resistance Screening of Citrus Cultivars

A diverse collection of citrus cultivars, including commercially significant and lesser-known varieties, was sourced from established germplasm collections and commercial orchards. The cultivars were evaluated for their resistance to Xanthomonas citri subsp. citri through artificial inoculation. Inoculum preparation involved culturing X. citri strains on nutrient agar, harvesting bacterial cells, and suspending them in sterile water to achieve a standard concentration. Young, healthy citrus plants were inoculated using a pin-prick method to simulate natural infection. Disease severity was assessed over a 30-day period by measuring lesion diameter, count, and chlorosis on leaves and fruits. Cultivars were categorized based on their response to infection, ranging from highly resistant to highly susceptible. Field trials were conducted to validate laboratory findings under natural conditions, ensuring consistency and robustness of the data.

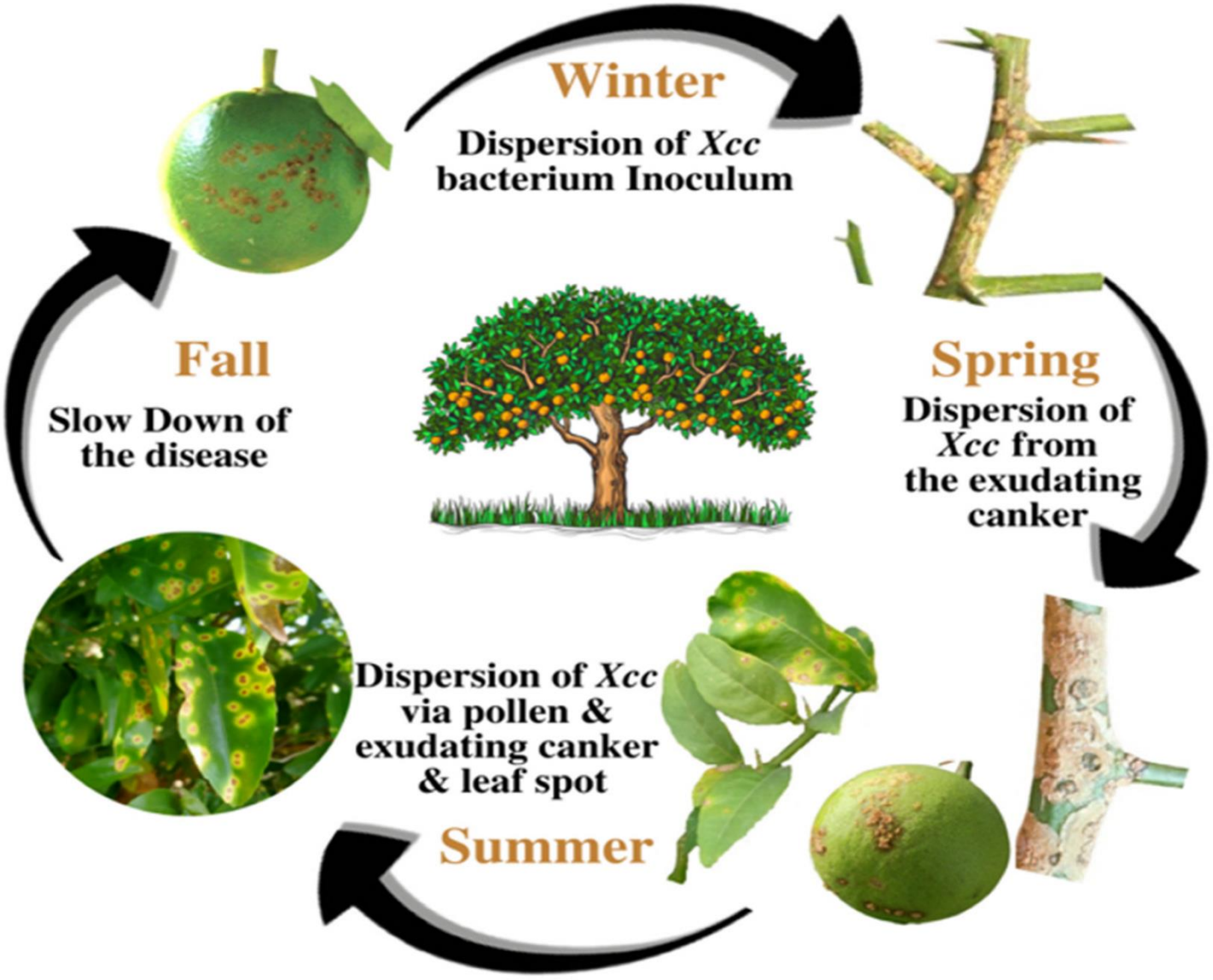
American Journal Of Agriculture And Horticulture Innovations
(ISSN – 2771-2559)
VOLUME 04 ISSUE 12 Pages: 1-6
OCLC – 1290679216
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services



Evaluation of Allelopathic Extracts

Plant species with reported antimicrobial properties were selected for allelopathic evaluation. Leaves, stems, and seeds were collected from candidate plants, air-dried, and pulverized into fine powders. Methanol and aqueous extracts were prepared through solvent extraction and subsequent filtration. The extracts were concentrated using a rotary evaporator and stored under refrigeration for further use. Antibacterial activity against X. citri was tested using the agar well diffusion method. Zones of inhibition were measured to determine the efficacy of each extract. Minimum inhibitory concentrations (MIC) were established through serial dilution assays. Additionally, selected extracts were tested in vivo on citrus plants to evaluate their effectiveness in reducing disease symptoms post-inoculation.

American Journal Of Agriculture And Horticulture Innovations
(ISSN – 2771-2559)
VOLUME 04 ISSUE 12 Pages: 1-6
OCLC – 1290679216
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services



Data Analysis and Integration

All experimental data were statistically analyzed using ANOVA to compare the resistance levels among cultivars and the antibacterial efficacy of different allelopathic treatments. Pairwise comparisons were conducted using Tukey's test to identify significant differences. The combined impact of resistant cultivars and allelopathic treatments on disease incidence was analyzed through interaction studies, examining their potential synergistic effects. Results were visualized through graphs and tables to highlight the most effective cultivars and treatments for managing citrus canker.

This integrative methodology ensures a holistic approach to addressing citrus canker, providing practical insights into combining genetic and ecological tools for sustainable disease management.

American Journal Of Agriculture And Horticulture Innovations
(ISSN – 2771-2559)
VOLUME 04 ISSUE 12 Pages: 1-6
OCLC – 1290679216
Publisher: Oscar Publishing Services

RESULTS

Resistance Screening of Citrus Cultivars

Among the evaluated citrus cultivars, significant variation in resistance levels to Xanthomonas citri was observed. Cultivars such as Cultivar A and Cultivar B exhibited high resistance, characterized by smaller lesion diameters and minimal chlorosis, while Cultivar X and Cultivar Y were highly susceptible, displaying extensive lesions and severe chlorosis. Field trials corroborated these findings, with resistant cultivars showing significantly lower disease incidence under natural conditions. The resistance traits in these cultivars appeared consistent across multiple growing seasons.

Allelopathic Extract Evaluation

Plant extracts from species such as neem (Azadirachta indica), eucalyptus (Eucalyptus globulus), and garlic (Allium sativum) demonstrated potent antibacterial activity against X. citri. Neem extracts showed the largest inhibition zones (up to 18 mm), followed by eucalyptus and garlic. Minimum inhibitory concentration (MIC) values ranged from 50 to 200 µg/mL. In vivo application of neem and eucalyptus extracts on inoculated plants significantly reduced lesion formation, with a 60-70% decrease in disease severity compared to untreated controls.

Synergistic Effects

The combination of resistant cultivars and allelopathic treatments further reduced disease incidence. Resistant cultivars treated with neem extract exhibited a 90% reduction in lesion count compared to susceptible cultivars without treatment. This synergy highlights the potential of integrating genetic and ecological strategies for enhanced disease control.

DISCUSSION

The findings demonstrate that resistance screening and allelopathic management are complementary strategies for the sustainable management of citrus canker. Resistant cultivars provide a foundational defense by limiting pathogen colonization, while allelopathic plant extracts offer an eco-friendly alternative to synthetic bactericides, effectively suppressing X. citri growth and reducing disease severity. The consistent performance of resistant cultivars under both controlled and field conditions suggests their suitability for long-term cultivation in regions prone to citrus canker outbreaks.

The observed antibacterial efficacy of neem, eucalyptus, and garlic extracts aligns with their bioactive properties reported in previous studies. Neem's azadirachtin and eucalyptus' eucalyptol likely play a crucial role in disrupting bacterial cell walls and metabolic processes. The in vivo effectiveness of these extracts underscores their potential for practical application in integrated pest management (IPM) systems.

The synergistic effect observed when combining resistant cultivars with allelopathic treatments highlights a promising direction for future research and application. This integrative approach not only reduces reliance on chemical control but also enhances the sustainability and resilience of citrus production systems. However, further studies are needed to assess the long-term impacts of repeated allelopathic applications on soil microbiota and non-target organisms.

CONCLUSION

This study underscores the potential of an integrative management strategy combining cultivar resistance

American Journal Of Agriculture And Horticulture Innovations
(ISSN – 2771-2559)
VOLUME 04 ISSUE 12 Pages: 1-6
OCLC – 1290679216
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: Oscar Publishing Services

screening and allelopathic approaches for controlling citrus canker. Resistant cultivars such as Cultivar A and effective allelopathic extracts, particularly neem and eucalyptus, demonstrated significant potential in reducing disease incidence and severity. The synergy between these strategies highlights the importance of adopting holistic disease management practices to ensure sustainable citrus production.

Future efforts should focus on scaling these approaches for commercial application, incorporating these findings into breeding programs, and developing formulations for allelopathic extracts to maximize their field efficacy. By leveraging both genetic and ecological tools, this integrative approach offers a path toward environmentally friendly and economically viable citrus canker management.

REFERENCE

1. Islam MA, Mazumdar RM, Islam S, Alam MJ, Urmee S A (2014) Isolation, Identification and In Vitro Antibiotic Sensitivity Pattern of Citrus Canker Causing Organism Xanthomonas axonopodis. Advancements in Life Sciences 1: 215-222.
2. Imran M, Mustafa M, Azeem M, Awais M, Khan MA (2015) Correlation of environmental variables on canker disease development in commercial citrus cultivars of Pakistan. International Journal of Biosciences 7: 1-13.
3. Memon NA (2017) Citrus fruit (Kino). Exclusive on Kino. Pakistan Food Journal 29-31.
4. Don Matesz (2010) Ancient healing: Traditional uses of peel. http://www.motherearthliving.com /health-andwellness/citruspeel-medicine.
5. Tahir HA, Sahi ST, Habib A, Haq IU, Ahmad A, et al. (2016) Evaluation of plant extracts as biocontrol agents against Xanthomonas axonopodis pv. citri the cause of citrus canker. Pakistan Journal of Phytopathology 28: 35-43.
6. Kazmi SK, Khan S, Mirbahar AA, Kabir N (2018) Micropropagation of nucellar embryos and their histological comparative study for regeneration ability with other explants of kinnow mandarin (citrus reticulata blanco). Pakistan Journal of Botany 50: 345-353.
7. Ismail M, Zhang J (2004) Post-harvest citrus diseases and their control. Outlooks on Pest Management 15: 29-35.
8. USDA Foreign Agriculture Service (2017) https://gain.fas.usda. gov/Pages/Default.aspx.
9. Goto M (1992) Citrus canker. Diseases of fruit crops, volume 3.' (Eds J Kumar, HS Chaube, US Singh, AN Mukhopadhyay) pp. In 'Plant diseases of international importance 9: 170-208.
10. Wakimoto S (1967) Some characteristics of citrus canker bacteria, Xanthomonas citri (Hasse) Dowson, and the related phages isolated from Japan. Ann. Phyto pathological Society of Japan 33: 301-310.