Diagnosis and Management of Sweet Potato Leaf Curl Disease in India

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Abstract

Sweet potato leaf curl disease, caused by the sweet potato leaf curl virus (SPLCV), poses a significant threat to sweet potato production in India. This paper examines the diagnostic methods for SPLCV, including visual symptom assessment, serological tests, and molecular techniques such as ELISA, PCR. The management strategies employed in India, such as the use of virus-free planting material, resistant varieties, and integrated pest management practices to control the whitefly vector. Effective diagnosis and management are crucial for mitigating yield losses and ensuring sustainable sweet potato cultivation in India.

Introduction

Sweet potato (*Ipomoea batatas*) is a versatile and nutritious root crop that is cultivated globally. Sweet potatoes are valued for their high nutritional content, particularly their rich supply of dietary fiber, vitamin A and C, and potassium. Sweet potatoes play a critical role in food security due to their high yield potential. Sweet potato disease is reviewed by several workers in the recent years (Valverde *et al.* 2007). Leaf curl caused by the sweet potato leaf curl virus, this disease results in various symptoms such as leaf curling, yellowing, vein thickening, and stunted plant growth. The primary vector responsible for transmitting SPLCV is the whitefly, *Bemisia tabaci* (Horowitz A.R. *et al.*2011). The presence of leaf curl disease not only impacts the yield but also affects the overall health of the sweet potato plant, making it more susceptible to other pathogens and environmental stresses. The occurrence of leaf curl disease on sweet potato was first reported in 1979 from Taiwan (Liao *et al*. 1979).

Managing sweet potato leaf curl virus requires an integrated approach that combines the use of virus-free planting material, cultivation of resistant varieties, and effective control of the whitefly vector, *B. tabaci*. This integrated strategy helps to minimize the spread of the virus and protect sweet potato crops from significant yield losses. Implementing cultural practices such as crop rotation, sanitation, and optimal plant spacing, along with regular monitoring and early detection, further enhances the effectiveness of management efforts. Sustainable and informed management practices are crucial for maintaining healthy sweet potato production and ensuring food security.

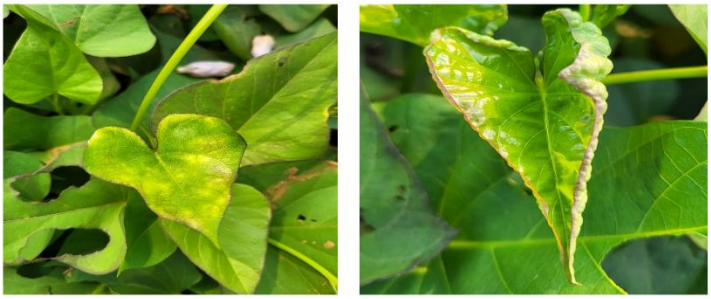

Fig. 1. Sweet potato leaf curl virus disease

Diagnosis of SPLCV

Diagnosing sweet potato leaf curl virus (SPLCV) involves several techniques to accurately identify the presence of the virus in sweet potato plants.

Here are some common diagnostic methods

1. Visual symptomatology: Observing the plant for characteristic symptoms such as leaf curling, yellowing, vein thickening, and stunted growth. While this method is straightforward, it is not always definitive as symptoms can vary and overlap with other diseases.
2. Serological assays: Using techniques like ELISA to detect viral proteins in plant tissues.
3. Molecular techniques: Polymerase chain reaction (PCR) is a widely used method for detecting SPLCV. It amplifies specific DNA sequences of the virus, making it easier to identify even in low concentration.
4. Next-Generation Sequencing: Advanced sequencing technologies can provide comprehensive information about the viral genome, helping in accurate identification and understanding of the virus.

Characterization of SPLCV

Taxonomy: SPLCV belongs to the Geminiviridae family, which consists of plant

pathogenic viruses with small, twin-shaped particles and a single-stranded DNA genome.

Table1: Taxonomy and morphology of SPLCV

Kingdom	:	Virus
Family	:	Geminiviridae
Genus	:	Begomovirus
Species	:	Sweet potato leaf curl virus
Genome	:	single-stranded DNA
Size	:	Approximately 2.8 to 3.0 kilobases
Shape	:	SPLCV particles are geminate in shape, composed of two incomplete icosahedra joined together

TEM (Transmission Electron Microscopy)

Under TEM, SPLCV particles appear as short, rod shaped entities with a diameter of 15-22nm and a length of 38nm. The nucleocapsid consists of 22 capsomers and is composed of two incomplete icosahedra joined together.

Vector-whitefly (*B. tabaci*)

- ✓ *Bemisia tabaci*, commonly known as the silverleaf whitefly or sweet potato whitefly, is a small hemipteran insect that belongs to the family Aleyrodidae. Adult *B. tabaci* are small with yellowish bodies and white wings covered with a powdery wax.
- ✓ *Life cycle:* Family lay eggs on the underside of leaves. Eggs hatch in about 5-10 days. The insect passes through four nymphal stages before reaching adulthood. Adults live for about 2-4 weeks, during which they reproduce prolifically.
- ✓ *Role as a vector: B. tabaci* transmits several important plant viruses, including Begomoviruses like SPLCV.
- ✓ *Feeding damage*- Besides virus transmission, whiteflies cause direct damage through feeding on plant sap.

Management

A. Cultural management

1. Use of virus-free planting material- Ensure that planting material, such as cutting or slips, is free from SPLCV.
2. Crop rotation- Rotate sweet potato crops with non-host crops to break the virus transmission cycle and reduce the whitefly vector population.
3. Sanitation practices- Remove and destroy infected plants to prevent the spread of SPLCV.
4. Optimal plant spacing- Maintain appropriate plant spacing to improve air circulation and reduce the humidity levels that favor whitefly proliferation.
5. Reflective mulches- Use reflective mulches to repel whiteflies and reduce their landing on sweet potato plants.
6. Intercropping- Intercrop sweet potatoes with non-host plants that can act as barriers or trap crops to divert whiteflies away from the main crop.
7. Timely planting- Adjust planting times to avoid peak whitefly population periods, reducing the likelihood of virus transmission.
8. Nutrient management- Provide balanced fertilization to maintain healthy plants, which are more resistant to diseases and pests.
9. Water management- Ensure proper irrigation practices to avoid water stress, which can make plants more susceptible to infections and reduce overall plant vigor (Gibson *et al.* 1998).
10. Monitoring and early detection- Regularly inspect crops for early signs of SPLCV and whitefly presence.

B. Vector management

1. Biological control- Introduce natural predators like lady beefless, lacewings, and parasitic wasps that feed on whiteflies.
2. Cultural practices- Rotate sweet potatoes with non-host crops to disrupt the whitefly life cycle.
3. Chemical control- Apply insecticides judiciously, rotating different classes to present resistance.
4. Resistant varieties- Cultivate sweet potato varieties that are resistant to SPLCV and less attractive to whiteflies.
5. Monitoring and early detection- Conduct regular inspections of crops for early signs of whitefly infestation and SPLCV symptoms.

6. Integrated pest management (IPM)- Combine biological, cultural, and chemical methods to manage whiteflies effectively and sustainable.

C. Virus disease management

1. Use of virus-free planting material- Ensure that the planting material is certified virus free to prevent initial infection.
2. Resistant varieties- Develop and use sweet potato varieties that are resistant to SPLCV.
3. Cross-protection- Inoculate plants with a mild strain of the virus to provide protection against more severe strains.
4. Sanitation and hygiene- Regularly remove and destroy infected plants and plant debris to reduce source of the virus.

Conclusion

Sweet potato leaf curl disease (SPLCD) presents a significant challenge to sweet potato cultivation in India, impacting both yield and quality. Effective management of SPLCD requires a comprehensive approach that includes accurate diagnosis using visual, serological, and molecular techniques. Implementing virus-free planting material, cultivating resistant varieties, and employing integrated pest management (IPM) strategies to control the whitefly vector, *B.tabaci*, are crucial components of disease management. Additionally, cultural practices such as crop rotation, sanitation, and timely planting can further reduce the incidence of the disease in the sweet potato.

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