ScienceDirect

Scientia Horticulturae
Volume 288, 15 October 2021, 110344

A rapid leaf-disc vacuum-infiltration screening for assessing resistance to bacterial leaf spot disease in anthurium

Annelle W.B. Holder-John, Winston Elibox, Pathmanathan Umaharan

Show more

Share Cite

https://doi.org/10.1016/j.scienta.2021.110344
Get rights and content

Highlights

- Non-destructive method was used to assess resistance to A. anthurii in anthurium.
- Stage-4 leaf lamina discs (2.52 cm diameter) were better than mid-rib discs.
- Vacuum-infiltration (15 psi, 10 s) with 9.7 x 107 CFU/ ml of A. anthurii optimal.
- Method differentiated levels of resistance at 5 days post-inoculation.

- Plant ages between 2 and 5 years of age did not influence resistance levels to BLS.

Abstract

Resistance to *Acidovorax anthurii*, the causal agent of bacterial leaf spot disease (BLS) of anthurium was investigated using leaf-disc vacuum-infiltration inoculation towards developing a rapid non-destructive method of screening for resistance to BLS in segregating populations. The effect of age of the plant, developmental stage of the leaf used, inoculum concentration and type of leaf disc employed (midrib disc vs. lamina disc) were investigated to optimize the leaf-disc infiltration method of inoculation that best differentiates between levels of resistance to BLS. A screening method based on vacuum-infiltration (vacuum=15 psi, 10 s) of leaf lamina discs (2.52 cm diameter obtained away from the midrib of stage-4 leaves) with an inoculum concentration of 9.7×10^7 CFU per ml was best able to effectively and quantitatively differentiate levels of resistance of 13 anthurium cultivars to BLS, as early as 5 days post-inoculation on a repeatable basis. On the other hand, plant ages between 2 and 5 years of age did not influence resistance levels to BLS. The lesion sizes elicited in response to inoculation using the optimized method showed a strong association (Pearson's r=0.84; P < 0.05) with cumulative number of diseased leaves of cultivars obtained under natural epiphytotics (Holder et al., 2017) and also a strong correlation (r=-0.72, 0.77 to 0.91, P < 0.01) with resistance to BLS identified from a destructive screening study using the same 13 anthurium cultivars (Holder et al., 2021). The implications of the findings of this study are discussed.

Introduction

Bacterial leaf spot disease (BLS) of anthurium (*Anthurium andraeanum* L.), caused by *Acidovorax anthurii* (Gardan et al., 2000), was first reported in the French West Indies (Prior et al., 1985; Prior and Sunder, 1987; Prior and Rott, 1989) and later in Trinidad and Tobago (Dilbar, 1992; Saddler et al., 1995; Holder et al., 2015). It is regarded as one of the major contributors to the demise of anthurium industries in the Caribbean (Saddler et al., 1995; Holder et al., 2015).

Infection occurs by the BLS pathogen entering the vascular system of anthurium leaves via natural openings (stomata and hydathodes) or wounds (Prioretal., 1985). Early foliar symptoms are characterized by small, angular, greasy spots on the lower surface of leaves near veins and leaf margins (Prioretal., 1985), which develop rapidly into large, black necrotic spots with characteristic greasy margins and narrow, bright chlorotic halos (Prioretal., 1985; Dilbarand Gosine,2003). Lesions usually become grey-black on older infected leaves causing the diseased leaves to become deformed (Prioretal., 1985). Foliar infections may progress into veins resulting in a soft rot, which causes the petioles to abscise. In susceptible anthurium cultivars, infections can become systemic, resulting in the general yellowing of the entire leaf lamina and typical black, necrotic lesions progressing from the leaf petioles into the major veins (Priorand Rott,1989). Systemic infections in susceptible cultivars lead to eventual plant death (Prioretal., 1985). In moderately resistant cultivars, although plant death doesn't occur, the unmarketability of infected leaves and cut-flowers results in significant losses to the producer (Holderetal., 2018). Although cultural methods can reduce the incidence of the disease, development of BLS resistant cultivars through breeding is seen as the most sustainable means of revitalizing the Caribbean anthurium industry (Holderetal., 2021).

Holderetal.(2021) was able to effectively and quantitatively distinguish between levels of resistance of anthurium cultivars to BLS using an optimized, destructive screening method. The study also showed that there were two mechanisms of resistance, one at the level of infection establishment and the other at the level of symptom severity. Anthurium cultivars that were highly resistant to BLS showed only localized lesions on the inoculated leaf with minimal symptoms, those that were moderately resistant permitted systemic spread of the disease but to a limited number of leaves, while the highly susceptible ones resulted in systemic infection affecting a greater proportion of leaves and eventual plant death. That study also showed that in addition to a cultivar dependent mechanism of resistance, there was present a general mechanism of mature plant resistance.

Although the screening method of Holderetal.(2021) was effective at discriminating BLS resistance levels in anthurium, it required anthurium plants of at least five years of age, was destructive in nature and required a period of 70 days post-inoculation to effectively discriminate between the levels of cultivar resistance to BLS. As such, the method is time-consuming, laborious, costly, and requires considerable space to accommodate the plants both pre- and post-inoculation. The development of a rapid screening method will not only reduce cost and time, but will be more amenable to assessing BLS resistance levels in large, segregating populations of anthurium as would be the case in breeding programmes. Eliboxand Umaharan(2008) developed an optimized, rapid leaf-disc vacuum-infiltration method to screen for foliar resistance to *X. axonopodis* pv. *dieffenbachiae* in anthurium and the method was used to elucidate the genetic basis of foliar resistance to the pathogen (Eliboxand Umaharan,2010). The objective of this study was to develop a rapid, reliable, non-destructive screening method to evaluate resistance to BLS in anthurium.

Section snippets

Anthurium cultivars, plant culture and leaf preparation

Unless otherwise stated experiments were conducted on two-year-old plants of 14 anthurium cultivars (Acropolis, Cuba, Fantasia, Gloria, Honduras, Lambada, Local Pink 4, Local Pink 15, Mirjam, Pistache, President, Safari, Sonate, Tropical) derived from tissue culture. The plants were maintained in a shade house covered with 75% saran netting (Holderetal., 2021).

Freshly harvested leaves from each anthurium cultivar containing no blemishes were used for experimentation. The leaves were placed…

Effect of leaf developmental stage

The effect of leaf stage, cultivar and leaf stage x cultivar interactions were significant ($P < 0.05$) for lesion size elicited at both 5 and 7 DAI using the leaf-disc vacuum-infiltration method at the inoculum concentration of 3.4×10^8 CFU per ml. The leaf disc inoculation method was able to significantly ($P < 0.05$) differentiate between the levels of resistance of 'Cuba' (resistant to BLS) and 'Gloria' (susceptible to BLS) at stages 4 and 5, but not at stages 2 and 3, resulting in the…

Discussion

This study is the first attempt at developing a non-destructive rapid screening method for identifying resistance to BLS in anthurium. Although Holderetal.(2021) developed an optimized, quantitative, whole plant screening method for evaluating BLS resistance in anthurium, it was destructive, required five-year-old plants and a prolonged period of data collection of up to 70 days post-inoculation to assess resistance. Therefore, the screening method of Holderetal.(2021) is not only costly…

Credit author statement

Path Umaharan: Conceptualisation (lead); data analysis, review and editing (equal);

Annelle Holder: writing – Conducting Experiment; Data analysis (equal); original draft (lead); formal analysis (lead); writing – review and editing (equal)

Winston Elibox – Analysis, writing –review and editing (equal)…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

Acknowledgments

The authors wish to thank the staff of the Department of Life Sciences of the University of the West Indies at St. Augustine for their assistance in executing this study. We also thank the management and staff of Kairi Blooms Farm for their assistance.…

References (19)

A. Dilbar

MSc Thesis.
(1992)

A. Dilbar *et al.*
Evaluation of susceptibility of anthurium hybrids to pseudomonas blight (*Acidovorax anthurii* sp.) and anthurium bacterial blight (*Xanthomonas campestris* pv. *dieffenbachiae*).
CARAPHIN, IICA (2003)

COLR programme, version 1
(1974)

W. Elibox *et al.*
A quantitative screening method for the detection of foliar resistance to *Xanthomonas axonopodis* pv. *dieffenbachiae* in anthurium
Eur. J. Plant Pathol. (2008)

W. Elibox *et al.*
Inheritance of resistance to foliar infection by *Xanthomonas axonopodis* pv. *dieffenbachiae* in *Anthurium*
Plant Dis (2010)

R. Fukui *et al.*
Effect of temperature on the incubation period and leaf colonization in bacterial blight of anthurium
Phytopathology (1999)

L. Gardan *et al.*
Acidovorax anthurii sp., a new phytopathogenic bacterium which causes bacterial leaf-spot of anthurium
Int. J. Syst. Evol. Microbiol. (2000)

P.A. Gay *et al.*
Oxidative burst associated with resistance to Xanthomonas campestris pv. campestris (XCC)
Phytopathology (1996)

A.W.B. Holder *et al.*
Status of bacterial leaf spot disease of Anthurium in Trinidad and characterization of native isolates of the causal organism, Acidovorax anthurii
HortScience (2015)
There are more references available in the full text version of this article.

Cited by (2)

Antibacterial mechanism of the novel antimicrobial peptide Jelleine-Ic and its efficacy in controlling Pseudomonas syringae pv. actinidiae in kiwifruit ↗
2023, Pest Management Science

Breeding Disease-Resistant Horticultural Crops ↗
2023, Breeding Disease-Resistant Horticultural Crops

View full text