

ROOT PATHOGENS DETECTED IN IRRIGATION WATER OF THE ORD RIVER IRRIGATION AREA

R.E. Zappia^A, D. Hüberli^{B,C}, G.E. St.J. Hardy^{A,C} and K.L. Bayliss^A

^A Cooperative Research Centre for National Plant Biosecurity, Bruce, ACT and School of Biological Sciences and Biotechnology, Murdoch University, 90 South Street, Murdoch, WA, 6150, Australia. Email: R.Zappia@murdoch.edu.au

^B Department of Agriculture and Food Western Australia, 3 Baron-Hay Court, South Perth, WA, 6151, Australia.

^C Centre for *Phytophthora* Science and Management, School of Biological Sciences and Biotechnology, Murdoch University, Murdoch, WA, 6150, Australia.

ABSTRACT. Expansion of the Ord River Irrigation Area in Kununurra, Western Australia is currently in progress, and subject to various environmental controls, including the implementation of irrigation tailwater management (recycling) systems. The aim of this research was to determine the presence of plant pathogens in the irrigation water in the irrigation area; and to ascertain what impact they could have if tailwater is recycled. Surveys were conducted during the 2010 and 2011 dry seasons to determine the presence of *Phytophthora* and *Pythium* species in the irrigation water and the pathogenicity of isolated species was assessed against two commercial crops – butternut pumpkin and chia. Several pathogenic isolates caused damping-off or distorted primary and lateral root growth. These preliminary findings demonstrate the presence of plant pathogens in the irrigation water, and the need for further investigation to assist with their management in the tailwater.

INTRODUCTION

The existence of plant pathogens in irrigation water has been reported from irrigation systems worldwide in both supply and tailwater (drains) (1). The Environmental Risk Management Plan (ERMP) for the Ord River Irrigation Area (ORIA) expansion proposes a tailwater management system that will require tailwater to be captured on-site and returned to the farm for application to the crop. Some *Phytophthora* species, notorious root and collar rot pathogens, have been previously isolated in the ORIA. The aim of this research was to determine the presence of *Phytophthora* and *Pythium* species in the irrigation water of the ORIA; and to ascertain what impact they could have on biosecurity in the region if tailwater is recycled.

MATERIALS AND METHODS

Surveys were conducted during the 2010 and 2011 dry season in Kununurra, Western Australia. Triplicate, 1 L surface water irrigation samples (<50 cm) were collected and filtered through a 5.0 µm membrane (Durapore, Merck Millipore, USA). Membranes were inverted on to selective media (2), incubated and isolates purified and identified by DNA sequencing.

Chia (*Salvia hispanica* L.) and butternut pumpkin (*Cucurbita moschata* ‘Sunset QHI’) seedlings were inoculated with *Phytophthora* and *Pythium* isolates *in vitro* to determine pathogenicity. Surface sterilised seeds were grown for 48 h under aseptic conditions, and then inoculated with an agar plug of a 3 d old culture. Plates were incubated for 48 h, then roots assessed for the presence of lesions. The bioassay was repeated twice. To confirm pathogenicity in a soil environment, representative isolates were assessed on 5 d old chia and pumpkin seedlings in punnets containing pasteurised soil. The punnets were inoculated with infected seed, prepared in the same manner as the bioassay. The punnets were incubated for a period of 14 d and 10 d respectively, and seedlings were assessed daily for symptoms. This trial was repeated twice. Seedlings were assessed for pathogen colonisation at the conclusion of each trial.

RESULTS AND DISCUSSION

Of the 197 isolates screened in the bioassay, 68 caused the formation of brown lesions on both the pumpkin and chia. Distortion of their root systems was also observed (Table 1).

Further screening of representative isolates against chia grown in soil found that only *P. helicoides* was pathogenic. Damping-off was observed 3 d post-inoculation, with the

proportion of disease development in the punnet averaging 9.7mm/day. This is the first report of *P. helicoides* being pathogenic on chia. The only other known pathogen of chia is *Macrophomina phaseolina* (3).

Table 1. Mean (±SD) of root length and percent (%) of primary root infection of chia and pumpkin, 48 h post-inoculation with representative isolate of *Pythium helicoides*, *Phytophthora cinnamomi* var. *parvispora*, and *Pythium* sp. in aseptic conditions. Column values followed by the same letter are not significantly ($P=0.05$) different.

Species	Chia		Pumpkin	
	Root Length (mm)	Percent Root Infected (%)	Root Length (mm)	Percent Root Infected (%)
<i>P. helicoides</i>	3±2.0 ^a	100±0 ^a	23±13.5 ^c	93±15.9 ^b
<i>P. cinnamomi</i> var. <i>parvispora</i>	8±3.8 ^a	86±34 ^a	51±22.9 ^{ab}	62±30.1 ^{ab}
<i>Pythium</i> sp.	9±3.4 ^a	100±0 ^a	38±12.4 ^{bc}	23±39.1 ^{ac}
Negative Control	10±6.7 ^a	0 ^b	68±15.5 ^a	0 ^c

CONCLUSION

This study has demonstrated that plant pathogens are present in the irrigation water of the ORIA. Further work is required to ascertain how recycling of tailwater for irrigation may exacerbate the spread of pathogens and disease, as found with *Phytophthora capsici* (4).

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REFERENCES

- Hong, C.W. and Moorman, G.W. (2005). Critical Reviews in Plant Sciences 24: 189-208.
- Hüberli, D. (2001). PhD Thesis, Murdoch University.
- Phillips, T. (2012). Pers. comm. University of Kentucky.
- Roberts, P.D. *et al.*, (2005). Annals of Applied Biology 146:351-359.