RHIZOCTONIA DISEASE ON POTATOES:

THE EFFECT OF ANASTOMOSIS GROUPS, FUNGICIDES AND ZINC ON DISEASE.

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Abstract

Rhizoctonia solani causes disease on potato crops world-wide. Previous research showed that various anastomosis groups (AGs) caused disease on potato plants in two regions that supply the fresh washed industry in South Australia. However, the AGs of this pathogen and their impact on other potato growing regions of Australia, particularly those that supply the processing industry, was unknown. *R. solani* was isolated from commercial crops and volunteer potato plants in south-eastern South Australia, Kangaroo Island and Tasmania between 2005 and 2007. Both microscopy and AG-specific polymerase chain reaction assays were used to assign the resulting *R. solani* isolates to AGs.

The main AGs found in potato fields, in all three Australian regions, were AG 2-1, AG 2-2 and AG 3. Isolates from all three AGs were associated with disease on root, stolon, stem and tuber tissues of potato plants. Isolates representative of the main AGs found in Australian fields were used in further experiments.

The pathogenicity of selected isolates to potato was investigated. Disease severity was assessed on mature plants in experiments conducted in a shade-house and on potato sprouts grown in a controlled environment. AG 3 caused more sclerotia on tubers than did the other AGs but all three AGs were associated with stem, stolon and root necrosis. Variation in the severity of symptoms was observed among isolates from the same group. For example, inoculation of potato plants with one AG 2-1 isolate resulted in deep necrotic lesions on stems, however, inoculation with two other isolates from the same group produced no or minor lesions on stems.

Current control of Rhizoctonia disease relies on fungicides applied to seed tubers and/or soil at planting. With the aim of optimising fungicide use, the sensitivity of selected Australian isolates to one new and six commercially available fungicides was tested *in vitro* and *in vivo*. At the highest concentration tested most fungicides inhibited mycelial growth of the majority of isolates by over 80%. However, some isolates exhibited fungicide insensitivity. For example, two AG 2-1 isolates were insensitive to an iprodione fungicide *in vitro*. The control of disease symptoms on potato plants by fungicides also differed. The azoxystrobin fungicide significantly reduced stem necrosis caused by AG 2-1 and tuber sclerotia caused by AG 3 *in planta*, however, the other fungicides tested were less effective.

These findings indicate that fungicide application may be tailored to manage specific AGs and disease symptoms.

In other crops, such as medic and wheat, disease severity caused by *R. solani* is increased in micronutrient-deficient conditions. The influence of micronutrients, specifically zinc, on the susceptibility of potato plants to Rhizoctonia disease was investigated. This was explored in a shade-house and a glass-house experiment by growing potato plants in soil in which zinc had been incorporated at four different rates. In both a preliminary shade-house and subsequent glass-house experiment, the concentration of zinc in the stem tissue increased with increasing soil concentration of zinc. Assessment of disease severity was not possible in the preliminary experiment due to early senescence of plants. During a secondary experiment the increased tissue concentrations of zinc were associated with decreased stem necrosis of AG 2-1-inoculated plants after 30 days, however, this was not reflected in AG 3-inoculated plants. At harvest, disease severity could not be linked with zinc concentration due to variation in tissue content of other nutrients.

Effective management of Rhizoctonia disease is essential to produce optimum yield in terms of both quantity and quality of potato tubers. Advances in AG-specific detection of inoculum, prior to planting, provide the opportunity to refine management practices for Rhizoctonia disease, based on observations that AGs may respond differently to some management strategies, such as chemical treatments. The association of AG with Rhizoctonia disease symptoms will allow further investigation of environmental factors that influence symptom severity, including the influence of micronutrients on tolerance of potato plants to Rhizoctonia disease.

Declaration

This thesis contains no material which has been accepted for the award of another degree or diploma in any University and, to the best of my knowledge an belief, contains no other material previously published or written by another person, except where due reference is given. I give consent to this thesis being made available for photocopying and loan from the University Library.

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Abbreviations

AG	anastomosis group
ITS	internal transcribed spacer
IGS	intergenic spacer
SB	sodium borate
TAE	Tris acetate EDTA
PCR	polymerase chain reaction
nt	nucleotide
PDA	potato dextrose agar
WA	water agar
ppm	parts per million
cv.	Cultivar
a.i.	active ingredient