

How temperature and water potential affect the growth of *Fusarium* and *Rhizoctonia* pathogens of wheat



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ABSTRACT

Climate change is projected to shift the temperature regimes and type of winter precipitation in the Pacific Northwest region of the United States. Temperature and moisture are two major factors influencing the activity of soil-borne pathogens like *Fusarium culmorum*, *F. pseudograminearum*, *Rhizoctonia solani* AG-8 and *R. oryzae*, causing crown and root rots of wheat respectively, in the dryland wheat production area. This study has been undertaken to decipher the influence of temperature and water potential on the biological activities of these wheat pathogens. These pathogens were grown on potato dextrose agar, potato dextrose broth, and wheat straw or toothpicks adjusted to different osmotic and matric potentials (-0.13 to -10 MPa) with sodium chloride, potassium chloride, and polyethylene glycol (PEG-8000), and incubated at temperatures ranging from 4 to 35°C. *Fusarium* spp. grew optimally at 20 - 25°C and -1 to -3 MPa. A decline in growth rate was observed at lower water potentials, but growth rates were 0.07 - 3.34 mm/day even at -9 MPa. *Rhizoctonia solani* AG-8 was more restricted for optimal growth at 20-25°C and -0.13 MPa. The optimal growth of *R. oryzae* occurred at 30°C and -0.13 MPa, but the growth rate declined less compared to AG-8 with lower water potential and temperature. *R. oryzae* was the only pathogen to grow at 35°C where the optimum water potential was -2 MPa, compared to -0.13 MPa at temperatures lower than 35°C. The effect of water potential was independent of salt composition. This study contributes to the knowledge of the biology and epidemiology of these pathogens, and will be used in predicting their potential distribution under future climate scenarios.

INTRODUCTION

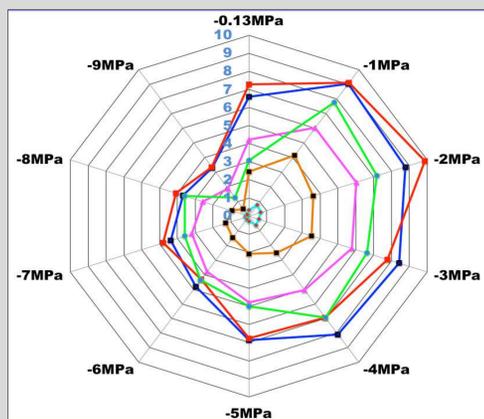
Every microorganism has optimal and minimal water potentials for growth (1). Water potentials for optimal growth may differ with temperature (2). The objective of this research was to study the effect of a full range of temperatures and water potentials on the biology, development, life cycle and pathogenicity of the above-mentioned soil-borne pathogens of wheat.

METHODS

Pathogens were grown on full strength PDA modified with salts (NaCl/KCl) to give osmotic potentials in the range of -0.13 to -10 MPa. The petri plates were incubated in the temperature range of 4 to 35°C. Linear growth of mycelium was recorded at periodic intervals up to 3 months.

RESULTS

Fusarium culmorum

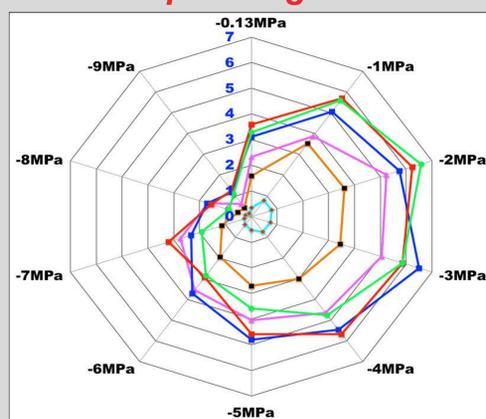


Growth rate (mm/day)

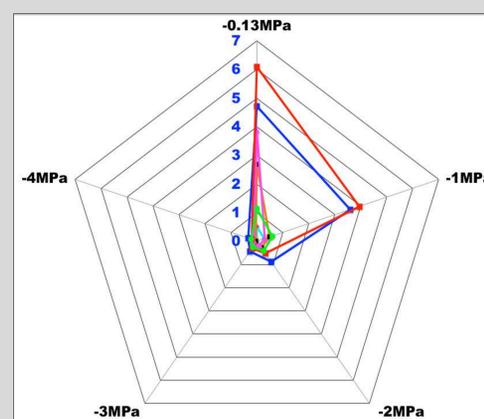
> *Fusarium* spp.

- Sharp rise in growth rate from -0.13 to -1 MPa
- At -10 MPa, growth rate was still more than 36 and 20% of that observed at optimal temperature and WP with *F. culmorum* and *F. pseudograminearum* respectively

Fusarium pseudograminearum



Rhizoctonia solani AG-8



Growth rate (mm/day)

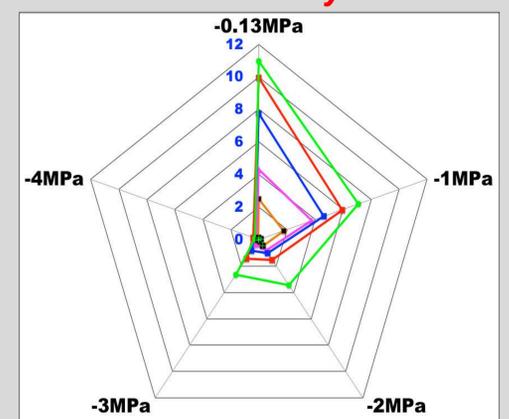
> *Rhizoctonia solani* AG-8

31 and 81% reduction in growth rate from -0.13 to -1 and -1 to -2 MPa respectively, at optimal temperature of 20-25°C

> *Rhizoctonia oryzae*

38 and 61% reduction in growth rate from -0.13 to -1 and -1 to -2 MPa respectively, at optimal temperature of 25-30°C

Rhizoctonia oryzae



DISCUSSION

- > *Fusarium* spp. are capable of growing across all wet and drier water potentials at all temperatures, except at 35°C
- > *R. solani* AG-8 is more restricted in temperature and water potential range compared to *R. oryzae*
- > Both *Rhizoctonia* spp. cease growth after -5 MPa
- > *R. oryzae* - only pathogen growing at 35°C with inclination towards drier WP

NEXT STEP

- ✓ Interpretation of response of different life-cycle stages of these soil-borne pathogens of wheat to full range of soil temperature and moisture
- ✓ Predicting the response of these soil-borne pathogens of wheat to a variable climate and other environmental conditions

REFERENCES

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