

Effect of root diseases and drought on water use efficiency of wheat

By

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Dedication

This thesis is dedicated to my lovely parents, sisters and brothers. I would like to thank all of them, particularly my mother, who provided me with support, love and encouragement to enable me to achieve my goals. I also thank all of them for the financial support which enabled me to complete my study.

Abstract

In arid and semi-arid areas, wheat production is limited by drought mainly at the post-anthesis stage. Root diseases also affect the productivity of wheat. This work reports an examination of the response of wheat plants to the interaction of drought and root diseases. The major hypothesis was that root diseases reduce water use efficiency (WUE) under drought conditions.

The preliminary experiment compared two cultivars, two root diseases and drought at two plant growth stages. There were no differences between the two root diseases, *Pythium* and *Rhizoctonia*, however, there was reduced transpiration in diseased plants of cv. Janz following tillering drought, and of cv. Mulgara following anthesis drought. WUE was not affected by diseases.

In experiments with deeper pots and post-anthesis drought treatment, *Pythium* reduced transpiration prior to anthesis. When plants were regularly rewatered to field capacity before the post-anthesis drought, *Pythium* had no effect on grain yield and WUE_{grain}. When both infected and control plants were given the same total volume of water at high inoculum densities, infected plants had higher WUE_{grain} than controls. Water uptake by infected roots was reduced during early plant growth due to root damage, but was higher than controls during post-anthesis drought due to higher remaining soil water availability, when compared with non-infected plants. However, diseased plants were not able to access all of the additional water and grain yields were not different from controls.

Hydroponic experiments compared the effects of *Pythium* and root pruning on plant water relations. *Pythium*, polyethyleneglycol-induced drought and root pruning reduced

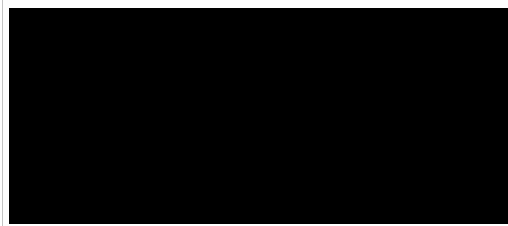
transpiration to a similar extent, but only *Pythium* reduced shoot dry weight. *Pythium* had no effect on total or instantaneous WUE. This experiment suggested that the effect of *Pythium* was more than just in reducing the effective size of the root system. Root pruning at a late stage of vegetative growth in pots reduced WUE, demonstrating the importance of the stage at which root damage occurs on how it affects total WUE.

Overall, root diseases did not reduce WUE. Reduction in growth was due to reduced transpiration. This did, however, lead to more water being available in soil during a post-anthesis drought.

Declaration

I certify that the substance of this thesis has not already been submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.



Abdallah Aldahadha

Table of Contents

Acknowledgements	i
Dedication.....	ii
Abstract.....	iii
Declaration.....	v
Table of Contents	vi
List of Tables	x
List of Figures.....	xi
Chapter 1: General introduction	1
1.1 Background.....	1
1.2 Research objectives	3
Chapter 2: Literature review	4
2.1 Introduction	4
2.2 Wheat.....	4
2.3 Drought effects on plant physiology	7
2.3.1 Yield and biomass production.....	8
2.3.2 Effect of drought on yield components	9
2.3.3 Yield and water use (evapotranspiration).....	11
2.3.4 Water use efficiency	14
2.3.5 Plant water relations	19
2.3.6 Water uptake by roots	20
2.3.7 Other physiological effects.....	22
2.4 Root diseases effects.....	25
2.4.1 <i>Pythium</i> disease of wheat	25
2.4.2 <i>Rhizoctonia</i> disease of wheat	28
2.4.3 Root damage by fungal diseases	29
2.4.4 Yield losses from root diseases in wheat	30
2.4.5 Disease and water relations	31
2.4.6 Effect of diseases on physiological parameters in wheat.....	33
2.5 Drought X pathogen interaction in other plants	34
2.6 Conclusion	36

Chapter 3: Interactive effects of drought and fungal root diseases on water use efficiency of wheat	37
3.1 Introduction	37
3.2 Materials and methods.....	39
3.2.1 Inoculum preparation	39
3.2.2 Soil preparation	39
3.2.3 Inoculation of wheat plants	40
3.2.4 Growth conditions and treatments.....	40
3.2.5 Measurements.....	41
3.3 Results	44
3.3.1 Variation of growth stages	44
3.3.2 Water Use (Transpiration).....	46
3.3.3 Plant water relations	54
3.3.4 Yield components.....	58
3.3.5 Water Use efficiency (WUE)	60
3.3.6 Lesion percentage.....	64
3.3.7 Qualitative effects of disease on root systems	66
3.4 Discussion.....	68
Chapter 4: Effect of <i>Pythium</i> on water use efficiency and gas-exchange rates of wheat under drought	74
4.1 Introduction	74
4.2 Material and Methods	76
Experiment 1: Effect of different inoculum density of <i>Pythium</i> on water-use efficiency and yield components of wheat	76
4.2.1 Preparation of inoculum	76
4.2.2 Soil preparation and soil inoculation with <i>Pythium</i>	76
4.2.3 Water regime	77
Experiment 2: Effect of <i>Pythium</i> on water relations and other physiological parameters	78
4.2.4 Soil preparation and treatments.....	78
4.2.5 Measurements.....	79
4.3 Results	80

Experiment 1: Effect of different inoculum density of <i>Pythium</i> on yield and water use efficiency	80
4.3.1 Cumulative transpiration	80
4.3.2 Transpiration per week.....	81
4.3.3 Yield components.....	82
4.3.4 Water use efficiency	83
Experiment 2: Effect of <i>Pythium</i> on water relations and other photosynthetic parameters	84
4.3.5 Cumulative transpiration	84
4.3.6 Transpiration per week.....	86
4.3.7 Yield components.....	86
4.3.8 Water use efficiency (WUE)	87
4.3.9 Plant water relations	88
4.3.10 Physiological measurements	91
4.4 Discussion.....	100
Chapter 5: Effects of <i>Pythium</i> and root pruning on water use efficiency of hydroponically grown wheat under PEG-induced drought	108
5.1 Introduction	108
5.2 Materials and methods.....	110
5.2.1 Plant material and growth conditions.....	110
5.2.2 Root inoculation by <i>Pythium</i>	112
5.2.3 Root pruning and Polyethylenglycol (PEG)	114
5.2.4 Measurements.....	115
5.3 Results	117
5.3.1 Transpiration per day	117
5.3.2 Transpiration per week.....	119
5.3.3 Plant Growth	122
5.3.4 Water use efficiency	124
5.3.5 Plant water relations	126
5.3.6 Physiological measurments	128
5.4 Discussion.....	131
Chapter 6: Effect of Root Pruning on Water Use Efficiency of Wheat.....	137

6.1 Introduction	137
6.2 Materials and Methods	139
6.3 Results and Discussion	141
6.3.1 Transpiration	141
6.3.2 Grain yield and biomass components.....	144
6.3.3 Water Use Efficiency	147
Chapter 7: General Discussion and Future Directions	149
References	162
Appendix	185

List of Tables

Table 3.1 Number of tillers per pot (TN/pot), number of heads per pot (HN/pot), grain weight (GW), dry matter weight (DMW), number of grains (GN), 1000-grain weight (1000-GW) and harvest index (HI) for well watered (WW), tillering drought (D1) and anthesis drought (D2) of two wheat cultivars under combined disease conditions.	60
Table 4.1 Number of tillers per pot (TN/pot), number of heads per pot (HN/pot), grain weight (GW), dry matter weight (DMW), and harvest index (HI) of wheat cv. Janz wheat following inoculation with different levels of inoculum of <i>Pythium</i> (g/pot) (ID). Values are means of 6 replicates.	83
Table 4.2 Cumulative transpiration of wheat cv. Janz for controls and <i>Pythium</i> at three growth stages.	84
Table 4.3 The number of heads per pot (HN/pot), grain weight (GW), dry matter weight (DMW), and harvest index (HI) for wheat cv. Janz after inoculation with 10 g of <i>Pythium</i> per pot.	87
Table 5.1 Dates of activities for hydroponic experiments 1 and 2.....	112
Table 5.2 Effect of root pruning and <i>Pythium</i> in the presence (+PEG) and absence (-PEG) of polyethylene glycol on transpiration of wheat cv. Janz during 7 days in which PEG and root pruning treatments were imposed. Each value represents the mean of eight plants per treatment.	120
Table 5.3 Effect of root pruning and <i>Pythium</i> in presence (+) and absence (-) of PEG on root and shoot dry weights, and root: shoot ratio of cv. Janz in first experiment. Each value represents the mean \pm SE of eight plants per treatment.	123
Table 5.4 Effect of root pruning and <i>Pythium</i> in presence (+) and absence (-) of PEG on root and shoot dry weights, and root/ shoot ratio of cv. Janz in second experiment.....	124
Table 6.1 Number of heads per pot (HN/pot), grain weight (GW), number of grains (GN), shoot dry weight (SDW), root dry weight (RDW), root/shoot ratio (R:S ratio) , harvest index (HI) and 1000-grain weight (1000-GWt) for controls, infected and root pruned plants of cv. Janz.....	146

List of Figures

Figure 2.1 The several means of water use efficiency. Source, Tambussi <i>et al.</i> (2007)	15
Figure 3.1 Effect of drought at tillering (D1) and disease on growth stage one week after drought treatment for <i>Triticum aestivum</i> cvs. Mulgara (M) and Janz (J). WW: well watered, C: controls, P: <i>Pythium</i> and R: <i>Rhizoctonia</i>	45
Figure 3.2 Effect of anthesis drought (D2) and diseases on growth stages one week after drought treatment for <i>Triticum aestivum</i> cvs. Mulgara and Janz . WW: well watered, C: controls, P: <i>Pythium</i> and R: <i>Rhizoctonia</i>	46
Figure 3.3 Cumulative transpiration (mm) from 9 April (tillering) to 23 July (harvest) for cvs. Mulgara (left) and Janz (right) under diseases treatments: <i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C) and drought treatments at tillering (D1) and anthesis (D2) Upper: well water, Middle: D1 and Lower:D2.	48
Figure 3.4 Transpiration per week (mm.week ⁻¹) from 9 April (tillering) to 23 July (harvest) for cvs. Mulgara (left) and Janz (right) under disease treatments (<i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C)) and drought treatments at tillering (D1) and anthesis (D2). Upper: well watered, Middle: D1 and Lower:D2.....	50
Figure 3.5A Cumulative transpiration (mm) of well watered (WW) and droughted at tillering (D1) of plants of cv. Mulgara under different disease conditions (<i>Pythium</i> P; <i>Rhizoctonia</i> R; control c) during 7 days of water stress.	52
Figure 3.5B Cumulative transpiration (mm) of well watered (WW) and droughted at tillering (D1) of plants of cv. Janz under different disease conditions (<i>Pythium</i> P; <i>Rhizoctonia</i> R; control c) during 7 days of water stress.	52
Figure 3.5C Cumulative transpiration (mm) of well watered (WW) and droughted at anthesis (D2) of plants of cv. Mulgara under different disease conditions (<i>Pythium</i> P; <i>Rhizoctonia</i> R; control c) during 7 days of water stress.	53
Figure 3.5D Cumulative transpiration (mm) of well watered (WW) and droughted at anthesis (D2) of plants of cv. Janz under different disease conditions (<i>Pythium</i> P; <i>Rhizoctonia</i> R; control c) during 7 days of water stress.	53
Figure 3.6A Water potential (left), osmotic potential (mid) and pressure potential (right) in cv. Mulgara (M) infected with <i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C). The measurements were taken at the beginning and end of 7 days of withholding water from plants droughted at tillering (D1) and equivalent time for well watered (WW) plants. .	55
Figure 3.6B Water potential (left), osmotic potential (mid) and pressure potential (right) in cv. Janz (J) infected with <i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C). The measurements were taken at the beginning and end of 7 days of withholding water from plants droughted at tillering (D1) and equivalent time for well watered (WW) plants.....	55
Figure 3.6C Relative water content (%) for WW (0) and D1 (7) after 7 days of withholding water for cvs. Mulgara (left) and Janz (right) infected with <i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C). The measurements were taken at the beginning and end of 7 days of	

withholding water from plants droughted at tillering (D1) and equivalent time for well watered (WW) plants.	56
Figure 3.7A Water potential (left), osmotic potential (mid) and pressure potential (right) in cv. Mulgara (M) infected with <i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C). The measurements were taken at the beginning and end of 7 days of withholding water from plants droughted at anthesis (D2) and equivalent time for well watered (WW) plants. .	57
Figure 3.7B Water potential (left), osmotic potential (mid) and pressure potential (right) in cv. Janz (J) infected with <i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C). The measurements were taken at the beginning and end of 7 days of withholding water from plants droughted at anthesis (D2) and equivalent time for well watered (WW) plants.....	57
Figure 3.7C Relative water content (%) for WW (0) and D2 (7) after 7 days of withholding water for cvs. Mulgara (left) and Janz (right) infected with <i>Pythium</i> (P), <i>Rhizoctonia</i> (R) and control (C). The measurements were taken at the beginning and end of 7 days of withholding water from plants droughted at anthesis (D2) and equivalent time for well watered (WW) plants.	58
Figure 3.8A Water use efficiency based on grain yield (g/l) for cvs. Mulgara and Janz infected by <i>Pythium</i> at either tillering (D1) or anthesis (D2) droughts compared with well watered (WW) plants.	61
Figure 3.8B Water use efficiency based on grain yield (g/l) for cvs. Mulgara and Janz infected by <i>Rhizoctonia</i> at either tillering (D1) or anthesis (D2) droughts compared with well watered (WW) plants.	61
Figure 3.8C Water use efficiency based on grain yield (g/l) for uninfected cvs. Mulgara and Janz at either tillering (D1) or anthesis (D2) droughts compared with well watered (WW) plants.....	62
Figure 3.9A Water use efficiency based on shoot dry weight (g/l) for cvs. Mulgara and Janz infected by <i>Pythium</i> at either tillering (D1) or anthesis (D2) droughts compared with well watered (WW) plants.	63
Figure 3.9B Water use efficiency based on shoot dry weight (g/l) for cvs. Mulgara and Janz infected by <i>Rhizoctonia</i> at either tillering (D1) or anthesis (D2) droughts compared with well watered (WW) plants.	63
Figure 3.9C Water use efficiency based on shoot dry weight (g/l) for cvs. Mulgara and Janz controls at either tillering (D1) or anthesis (D2) droughts compared with well watered (WW) plants.....	64
Figure 3.10A Effect of diseases (<i>Pythium</i> and <i>Rhizoctonia</i>) on lesion % of Mulgara and Janz. The diseases were compared with controls.....	65
Figure 3.10B Effect of droughts on lesion % of Mulgara and Janz. Root lesions for 1 st drought (D1) at tillering and 2 nd drought (D2) at anthesis were compared with well watered (WW) plants.....	65
Figure 3.11A Roots of Janz (left) and Mulgara (right) at anthesis drought (D2). Roots were infected by <i>Pythium</i> (right side), <i>Rhizoctonia</i> (mid) and control (left).	67

Figure 3.11B Roots of Janz (left) and Mulgara (right) at tillering drought (D1). Roots were infected by <i>Pythium</i> (right side, <i>Rhizoctonia</i> (mid) and control (left).	67
Figure 3.11C Roots of Janz (left) and Mulgara (right) at well water (WW). Roots were infected by <i>Pythium</i> (right side, <i>Rhizoctonia</i> (mid) and control (left).	67
Figure 4.1 Effect of inoculum density of <i>Pythium</i> on cumulative transpiration for wheat cv. Janz from tillering (11 January) until harvest (15 March). Values are means of 6 replicates.	80
Figure 4.2 Effect of inoculum density of <i>Pythium</i> on weekly transpiration rate of wheat cv. Janz from tillering (11 January) until harvest (15 March).	82
Figure 4.3 Effect of inoculum density of <i>Pythium</i> on WUE _{grain} and WUE _{DM}	83
Figure 4.4 Effect of 10 g/pot of <i>Pythium</i> on cumulative transpiration of wheat cv. Janz from three-leaf stage (17 May) until harvest (14 August). Anthesis started on 25 June. Water was withheld at late anthesis from 7 July 2010. Values are means of 12 replicates.	85
Figure 4.5 Effect of a 10 g/pot inoculum density of <i>Pythium</i> on transpiration per week of wheat cv. Janz from the three-leaf stage (17 May) until harvest (14 August). Values are means of 12 replicates.	86
Figure 4.6 Effect of 10g/ pot of <i>Pythium</i> on water use efficiency of cv. Janz based on both grain yield (WUE _{grain}) and shoot dry matter (WUE _{DM}). Values are means \pm s.e., n=12.	88
Figure 4.7 Predawn water potential (Ψ) for wheat cv. Janz for both controls and <i>Pythium</i> at 0, 7, 14 and 21 days after withholding water. Values are means \pm s.e., n=3.	89
Figure 4.8 Midday water potential (MPa) for cv. Janz for both controls and <i>Pythium</i> at 0, 7, 14 and 21 days after withholding water. Values are means \pm s.e., n=3.	90
Figure 4.9 Relationships between predawn and midday water potentials for (a) uninoculated and (b) inoculated plants during 21 days of withholding water.	91
Figure 4.10 Photosynthetic rate ($\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) of controls and <i>Pythium</i> of cv. Janz after 0, 7, 14 and 21 days of withholding water. Values are means \pm s.e., n=6.	92
Figure 4.11 Stomatal conductance ($\text{mol H}_2\text{O m}^{-2} \text{ s}^{-1}$) of controls and <i>Pythium</i> of wheat cv. Janz after 0, 7, 14 and 21 days of withholding water. Values are means \pm s.e., n = 6.	93
Figure 4.12 Intercellular CO ₂ concentration ($\mu\text{mol CO}_2 \text{ mol}^{-1}$) of controls and <i>Pythium</i> of cv. Janz after 0, 7, 14 and 21 days of water withholding. Values are means \pm s.e., n = 6.	94
Figure 4.13 Transpiration rate ($\text{mmol H}_2\text{O m}^{-2} \text{ s}^{-1}$) of controls and <i>Pythium</i> of cv. Janz after 0, 7, 14 and 21 days of withholding water. Values are mean \pm s.e., n = 6.	95
Figure 4.14 Instantaneous water use efficiency ($\text{mmol CO}_2/\text{mol H}_2\text{O}$) of controls and <i>Pythium</i> of cv. Janz after 0, 7, 14 and 21 days of withholding water. Values are mean \pm s.e., n = 6.	96
Figure 4.15 The relationship between photosynthesis ($\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) and transpiration rate ($\text{mmol H}_2\text{O m}^{-2} \text{ s}^{-1}$) as affected by <i>Pythium</i> inoculation for wheat cv. Janz during the 21 day water withholding period after anthesis. R ² are significant at $P < 0.01$	97

Figure 4.16 The relationship between photosynthesis ($\mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$) and stomatal conductance ($\text{mol H}_2\text{O m}^{-2} \text{ s}^{-1}$) as affected by <i>Pythium</i> inoculation for cv. Janz during the 21 day water withholding period after anthesis. R^2 are significant at $P < 0.01$	97
Figure 4.17 Stomatal conductance ($\text{mol H}_2\text{O m}^{-2} \text{ s}^{-1}$) for uninoculated and inoculated plants in relation to midday leaf water potential (MPa) during the 21 day water withholding period after anthesis.	98
Figure 4.18 The relationship between water use efficiency <i>intrinsic</i> (A/g_s) and stomatal conductance (g_s) for uninoculated and inoculated plants during the 21 day water withholding period after anthesis	99
Figure 4.19 The relationship between water use efficiency <i>instantaneous</i> (A/E) and stomatal conductance (g_s) for uninoculated and inoculated plants during the 21 day water withholding period after anthesis	99
Figure 5.1 Growth of <i>Pythium</i> on roots and root lesion (arrows) of wheat inoculated by <i>Pythium</i> in hydroponic solution	114
Figure 5.2 Root pruning (Rp) and <i>Pythium</i> (P) effects on transpiration per day of cv. Janz at 4 days before inoculation and 10 days after inoculation in absence of Polyethyleneglycol (-PEG) and presence of PEG-induced drought (+PEG) (1 st experiment). Arrow shows when PEG and root pruning treatments started.....	118
Figure 5.3 Root pruning (Rp) and <i>Pythium</i> (P) effects on transpiration per day of cv. Janz at 5 days before inoculation and 14 days after inoculation in absence of Polyethyleneglycol (-PEG) and presence of PEG-induced drought (+PEG) (2 nd experiment). Arrow shows when PEG and root pruning treatments started.....	119
Figure 5.4 Comparison of transpiration per week (TPW) between all treatments on 7 and 14 August (1 st experiment). Rp= root pruning, P= <i>Pythium</i> and D=PEG.....	121
Figure 5.5 Comparison of transpiration per week (TPW) between all treatments on 2 and 9 October (2 nd experiment). Rp= root pruning, P= <i>Pythium</i> and D=PEG.	122
Figure 5.6 Root pruning and <i>Pythium</i> effects on (A) WUE _(shoot + root) and (B) WUE _(shoot) of cv. Janz in absence of Polyethyleneglycol (-PEG) and presence of PEG-induced drought (+PEG) in first experiment. WUE was measured in g/l. Each column represents the mean \pm s.e for eight plants.	125
Figure 5.7 Root pruning and <i>Pythium</i> effects on (A) WUE _(shoot + root) and (B) WUE _(shoot) of cv. Janz in absence of polyethyleneglycol (-PEG) and presence of PEG-induced drought (+PEG) in second experiment. Each data represents the mean \pm s.e for eight plants....	126
Figure 5.8 Root pruning and <i>Pythium</i> effects on (A) Predawn and (B) Midday water potential of cv. Janz in absence of polyethyleneglycol (-PEG) and presence of PEG-induced drought (+PEG). Each column represents the mean \pm s.e for four plants.....	127
Figure 5.9 Root pruning and <i>Pythium</i> effects (A) osmotic potential (B) pressure potential and (C) Relative water content of cv. Janz in absence of polyethyleneglycol (-PEG) and presence of PEG-induced drought (+PEG). Each column represents the mean \pm s.e for four plants.	128

Figure 5.10 Root pruning and <i>Pythium</i> effects on (A) carbon assimilation (B) stomatal conductance (C) carbon internal (D) transpiration rate and (E) instantaneous water use efficiency of cv. Janz in absence of polyethyleneglycol (-PEG) and presence of PEG-induced drought (+PEG). Each column represents the mean \pm s.e for four plants	130
Figure 6.1 Effect of root pruning and <i>Pythium</i> on cumulative transpiration (mm) from 3-leaf stage (11-September) until harvest (23-November) in cv. Janz. Root-pruned plants matured 2 weeks after the other treatments.....	142
Figure 6.2 Effect of root pruning and <i>Pythium</i> on transpiration per week (mm) from 3-leaf stage (11-September) until harvest (23-November) in cv. Janz. Root-pruned plants matured 2 weeks after the other treatments.....	143
Figure 6.3 Effect of root pruning and <i>Pythium</i> on water use efficiency based on grain yield and total dry matter (g/l) in cv. Janz	147