



Table of contents

Content	Pages
Dedication	ix
Acknowledgements	xi
Abbreviations	xiii
List of publications from the PhD project	xiv
Chapter 1 General Introduction	1
1.1 Wheat	1
1.2 Stem rust of wheat	3
1.2.1 Life cycle and symptoms of <i>Puccinia graminis</i> f. sp. <i>tritici</i>	5
1.2.2 Ug99 and its distribution	6
1.3 Stem rust resistance genes in wheat	8
1.4 The application of molecular markers in wheat improvement.	8
1.5 Genetic diversity in wheat	10
1.5.1 Wheat genetic resources in Ethiopia	10
1.6 Objectives	13
Chapter 2 QTL mapping of resistance to race Ug99 of <i>Puccinia graminis</i> f. sp. <i>tritici</i> in durum wheat (<i>Triticum durum</i> Desf.)	14
2.1 Abstract	14
2.2 Introduction	15
2.3 Materials and methods	17
2.3.1 Plant material and phenotyping	17
2.3.2 Statistical analysis of the phenotypic assessments	18
2.3.3 Molecular marker analysis	19
2.3.4 Genetic map construction	19
2.3.5 QTL analysis	20
2.4 Results	21
2.4.1 Evaluation of field data	21
2.4.2 Linkage analysis	23
2.4.3 QTL analysis	23
2.4.4 Epistatic QTL analysis	26
2.5 Discussion	26
2.5.1 Phenotypic analysis	26



2.5.2	QTL mapping	27
2.5.3	Comparison of the detected QTL with other reported QTL for resistance to stem rust races of <i>Pgt</i> including Ug99 in wheat	27
2.5.4	Epistatic QTL	31
Chapter 3	Haplotype analysis of molecular markers linked to stem rust resistance genes in Ethiopian improved durum wheat varieties and tetraploid wheat landraces	32
3.1	Abstract	32
3.2	Introduction	33
3.3	Materials and methods	35
3.3.1	Plant materials	35
3.3.2	Phenotyping	35
3.3.3	Marker analyses	35
3.4	Results	36
3.4.1	Phenotyping	36
3.4.2	Identification of stem rust resistance genes using molecular markers	36
3.5	Discussion	40
3.6	Conclusion	44
Chapter 4	Genetic diversity assessments of Ethiopian tetraploid wheat landraces and improved durum wheat varieties using microsatellites and markers linked with stem rust resistance	46
4.1	Abstract	46
4.2	Introduction	47
4.3	Materials and methods	50
4.3.1	Plant material	50
4.3.2	Phenotyping	50
4.3.3	Marker analyses	50
4.3.4	Data analysis	51
4.4	Results	53
4.4.1	Analysis of allelic diversity	53
4.4.2	Cluster and ordination analysis	56
4.5	Discussion	60
4.5.1	Allelic diversity	60
4.5.2	Relationships among accessions	62
4.6	Conclusion	63



Chapter 5	General discussion	65
5.1	Stem rust resistance QTL/genes for durum wheat	65
5.2	Molecular markers and Marker Assisted Selection	68
5.3	Genetic diversity assessments in Ethiopian tetraploid wheat genotypes	69
5.4	General conclusion	72
References		74
Summary		91
Zusammenfassung		95
Appendices		99
Curriculum Vitae		115
Declaration		118