

Table of Content

Table of Content	I
List of Figures.....	V
List of Tables	VI
Abbreviations	VII
1 Abstract	1
2 General Introduction.....	2
2.1 Origin, breeding, cultivation and use of oilseed rape (<i>Brassica napus</i> L.)	2
2.2 <i>Plasmodiophora brassicae</i> Woronin	4
2.3 Clubroot occurrence and importance for European oilseed rape production	7
2.4 Control of clubroot spread	8
2.5 Plant resistance against clubroot present in oilseed rape cultivars	9
2.6 Pathotypes overcoming the race-specific clubroot resistance present in oilseed rape.....	10
2.7 Molecular markers and their relevance for plant breeding	10
2.8 Major goals of the present thesis.....	11
3 A classification survey of <i>Plasmodiophora brassicae</i> pathotypes in the main regions of oilseed rape cultivation in Europe	12
3.1 Introduction	12
3.1.1 Identification of genetic variation within <i>P. brassicae</i> samples by differential sets	12
3.1.2 The relevance of pathogen classifications as a prerequisite for resistance breeding.....	15
3.2 Material and Methods.....	15
3.2.1 Origin and sampling of the pathogen	15

3.2.2 Preparation of pathogen inoculum	18
3.2.3 Plant material of differential hosts.....	19
3.2.4 Greenhouse tests for differential virulence	20
3.2.5 Field test for clubroot resistance.....	24
3.2.5.1 Locations of field trials	25
3.2.5.2 Preparation of plant material for field experiments	26
3.2.5.3 Planting, incubation and scoring of field trials	26
3.3 Results	26
3.3.1 Pathogenicity tests under controlled conditions	26
3.3.1.1 Virulence of <i>P. brassicae</i> populations under controlled conditions.....	26
3.3.1.2 Pathotype classification on differential sets	27
3.3.2 Pathogenicity tests under field conditions.....	31
3.3.2.1 Pathogenicity of <i>P. brassicae</i> populations	31
3.3.2.2 Cross checking of pathotype classification under greenhouse versus field conditions.....	31
3.4 Discussion	33
3.4.1 Distribution of virulence patterns of <i>P. brassicae</i> pathotypes found in Europe is different to samples from the Canadian prairies in accordance with earlier findings	33
3.4.2 Different thresholds used to discriminate susceptible vs. resistant reactions have no significant effect on the discovery of genetic variation within <i>P. brassicae</i> populations	35
3.4.3 Pathotype classifications of <i>P. brassicae</i> populations give hint for differential host genotypes to be used as donors for clubroot resistance	36
3.4.4 Differences in environmental conditions affect the clubroot disease reaction depending on the host genotype	36

3.4.5 Further efforts for an improvement of differential sets to define <i>P. brassicae</i> pathotypes	39
3.4.6 Status and prospects of the present clubroot resistance derived from cv. 'Mendel'	39
3.5 Summary of the <i>Plasmodiophora brassicae</i> classification survey.....	39
4 Phenotypic characterisation and genetic mapping of clubroot resistance in rapeseed (<i>Brassica napus</i> L.)	42
4.1 Breeding for clubroot resistance and genetic resources.....	42
4.2 Material and Methods.....	43
4.2.1 Plant material and pathogen isolates	43
4.2.2 Preparation and supply of inoculum of <i>P. brassicae</i>	45
4.2.3 Resistance phenotyping of DH populations and parental lines	45
4.2.4 SNP marker origin and selection.....	45
4.2.5 DNA extraction and SNP genotyping	45
4.2.6 Genetic map construction	46
4.2.7 QTL mapping	47
4.2.8 Statistical analyses	47
4.3. Results	47
4.3.1 Phenotypic variation of disease reaction	47
4.3.2 Discovery of genetic loci for clubroot resistance	50
4.3.2.1 Genetic linkage maps	50
4.3.2.2 Mapping of genetic loci for clubroot resistance	52
4.4 Discussion	53
4.4.1 Genes and QTL known from mapping studies on clubroot resistance in <i>B. napus</i>	53
4.4.2 Results on clubroot resistance of cv. 'Mendel'	55

4.4.3 Clubroot Resistance in DH population 'R103' with the donor 'Invitation'	56
4.4.4 Clubroot resistance in DH population 'R106' and the donor 'Wilhelmsburger'	57
4.4.5 Comparison of the resistance loci of 'Invitation', 'Wilhelmsburger' and 'Mendel'	59
4.4.6 Genetic core regions for clubroot resistance in <i>B. napus</i>	60
4.4.7 Outlook on breeding for clubroot resistance in <i>B. napus</i> rapeseed	61
4.5 Summary for characterisation and genetic mapping of clubroot resistance in rapeseed	62
5 Final Conclusions	64
6 References	66
7 Acknowledgements	76
8 Supplementary Data	78
Erklärung	83