
Contents

List of figures	viii
List of tables	ix
Abbreviations	x
Summary	xiii
Zusammenfassung	xv
1. Introduction	1
1.1. Molecular basis of plant-pathogen interaction	1
1.1.1. PAMP-triggered immunity	1
1.1.2. Bacterial countermeasures and effector-triggered immunity	2
1.1.3. Examples of <i>R</i> gene evolution	3
1.2. Recognition of bacterial PAMPs	4
1.2.1. Bacterial flagellin	4
1.2.2. FLS2-mediated perception of flagellin	5
1.2.3. Comparison of flagellin perception in plants and mammals	5
1.2.4. EFR-mediated perception of EF-Tu	6
1.3. The evolutionary ecology of immunity	6
1.3.1. Specificity in host-pathogen interactions	7
1.3.2. Costs of immunity	7
1.3.3. Impact of immune responses on growth and development	7
1.3.4. Ecological relevance of ETI and PTI	8
1.4. Population genetic signatures of selection	8
1.4.1. Frequency analysis of allelic variance	9

Contents

1.4.2. McDonald-Kreitman tests	9
1.4.3. Linkage disequilibrium and haplotype structure	9
1.4.4. Population differentiation	10
1.4.5. Genome-wide association mapping	10
1.5. Aim of the thesis	11
2. Materials and methods	13
2.1. Materials	13
2.1.1. Plant materials	13
2.1.2. Pathogen (<i>Pseudomonas syringae</i> pv. <i>tomato</i> DC3000)	13
2.1.3. Suppliers and manufacturers	14
2.1.4. Oligonucleotides	14
2.1.5. Antibiotics	14
2.1.6. Peptides	14
2.1.7. Media	15
2.1.8. Antibodies	16
2.1.9. Buffers and Solutions	16
2.2. Methods	16
2.2.1. Maintenance and cultivation of <i>A. thaliana</i>	16
2.2.2. Seed surface sterilization	16
2.2.3. Transformation of <i>AlFLS2</i> into <i>A. thaliana</i>	17
2.2.4. Maintenance of <i>Pseudomonas syringae</i>	17
2.2.5. Pathogen infection assay and quantification	17
2.2.6. Molecular biological methods	18
2.2.7. Biochemical Methods	19
2.2.8. Bioassays to monitor PAMP responses	20
2.2.9. Quantitative trait locus analysis	21
2.2.10. DNA sequence assembly and analysis	22
2.2.11. Control for population structure	22
2.2.12. Analysis of population differentiation	22
3. Results	25
3.1. Sequence diversity at the <i>FLS2</i> locus	25
3.2. Functional and phenotypic analysis of <i>FLS2</i> in a world wide set of <i>A. thaliana</i> .	30
3.2.1. Responsiveness to various flg22 peptide variants	30
3.2.2. Functional analysis of flg22 perception	34

3.2.3. Molecular causes of flg22 binding variation	36
3.2.4. Natural variation in PAMP-induced phenotypic responses	43
3.2.5. Correlation of flg22 binding and flowering time in <i>A. thaliana</i>	50
3.2.6. Correlation of flg22 binding and bacteria growth	52
3.2.7. Impact of FLS2-mediated immune responses on reproductive fitness . .	53
3.2.8. AIFLS2-mediated inhibition of seedling growth in <i>A. thaliana</i>	55
3.3. Characterization of immunity in local populations of <i>A. thaliana</i>	57
3.3.1. Sequence variation and genetic differentiation at the <i>FLS2</i> locus in local populations of <i>A. thaliana</i>	57
3.3.2. Natural variation and quantitative differentiation of immune responses in local populations of <i>A. thaliana</i>	58
4. Discussion	63
4.1. <i>FLS2</i> sequence diversity	63
4.2. Molecular causes of flg22 binding variation	64
4.3. Correlation of flg22 binding variation and flg22-induced immune responses .	65
4.4. Genetic basis of flg22-induced inhibition of seedling growth	66
4.5. Genetic differentiation of <i>FLS2</i> and quantitative differentiation of flg22-induced immune responses	68
4.6. The economics of immunity	69
5. Conclusion	73
References	75
A. Supplementary tables	I
A.1. Table of <i>A. thaliana</i> accessions	I
A.2. Table of Brassicaceae species	III
A.3. Table of mutant and transgenic <i>A. thaliana</i> lines	IV
A.4. Phenotypic characterization of <i>fls2</i> non-functional mutants	IV
A.5. List of suppliers and manufacturers.	V
Acknowledgments	VII
Erklärung	IX